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# A two-edged sword: The impact of public debt on economic growth-the case of Ethiopia

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# A two-edged sword: the impact of public debt on economic growth—the case of Ethiopia

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#### ABSTRACT

This study investigates the dynamic effects of public debt on economic growth in Ethiopia using annual data from 1980 to 2021. The results from the Autoregressive Distributed Lag (ARDL) modeling approach reveal that while public debt boosts investment and enhances growth in the short term, it hinders long-term growth. Additionally, debt servicing negatively impacts growth in both the short and long term by diverting vital resources from investment. Thus, public debt acts as a two-edged sword for Ethiopia's economic growth. On one side, it finances infrastructure and other growth-stimulating projects; on the other, high debt levels can impede growth. To mitigate the adverse impacts of public debt, Ethiopia should implement prudent fiscal discipline, mobilize domestic revenue, manage debt efficiently, address its structural trade deficit, and prioritize needs to prevent misuse and corruption. This approach should also prioritize social spending and public investment while strategically transitioning from debt dependence.

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Debt is a two-edged sword. Used wisely and in moderation, it clearly improves welfare. But, when it is used imprudently and in excess, the result can be disaster. For a country, too much debt impairs the government's ability to deliver essential services to its citizens.

Cecchetti et al. (2011)

# 1. Introduction

Public debt can have both positive and negative effects on economic growth, depending on how it is used and managed. On the positive side, public debt can be used to finance investments in infrastructure, education, and healthcare, which can contribute to longterm economic growth. For example, investments in transportation infrastructure can enhance the productivity of businesses and reduce transportation costs, while

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investments in education and healthcare can improve the quality of the workforce and lower healthcare costs.

However, public debt can also burden the economy, as it requires a significant portion of the government's revenue to be allocated towards interest payments. This, in turn, can diminish the amount of funding available for other crucial sectors, such as education, healthcare, and infrastructure. Thus, if public debt is not managed properly, it can have negative effects on economic growth. For instance, studies have found that public debt negatively impacts growth by crowding out private investments (see, e.g., Panizza & Presbitero, 2013; Reinhart & Rogoff, 2010; Woo & Kumar, 2015). It can also lead to an increase in the cost of borrowing for private businesses (see, e.g., Cecchetti et al., 2011; Clements et al., 2003; Pattillo et al., 2006; Woo & Kumar, 2015). In addition, high levels of public debt can lead to inflation, currency depreciation (devaluation), and other macroeconomic vulnerabilities, which can have a negative impact on the economy (see, e.g., Woo & Kumar, 2015). Private investment could also be adversely affected by the "debt overhang" problem if economic agents expect high public debt to mean future high taxes (Pattillo et al., 2006).

In the case of Ethiopia, the country's public debt is accumulating in large amounts due to increasing financing needs, both domestic and external shocks, and structural macroeconomic imbalances. In recent years, the debt-to-GDP ratio has reached 50.7% in 2021. This reached as high as 60% in 2018. While some of this debt has been used to finance infrastructure and other vital projects, there are concerns about the sustainability of the debt and its potential negative impact on economic growth. Bad governance, natural disasters, and emergencies such as conflicts, the climate crisis, and the COVID-19 pandemic further exacerbate the increasing public debt and the challenge of servicing it. The growing accumulation of debt could become unsustainable, resulting in difficulties with debt repayment and hindering growth, as well as impeding the achievement of other development goals.

Understanding the pathways and nature of the relationship between public debt and economic growth in Ethiopia is more crucial than ever. This is particularly true as the government intensifies its efforts to transform the country into a middle-income nation by 2030. This transformation requires a sustainable method of financing its ambitions. This is because the causal relationship between sovereign debt variables and economic growth has direct policy implications, particularly on tax and investment choices – and consequently on economic growth (see Gómez-Puig & Sosvilla-Rivero, 2015, 2018).

Therefore, it is important for policymakers to carefully analyze the relationship between debt and economic growth and take measures to manage the debt in a sustainable manner. This may include implementing fiscal reforms, increasing revenue generation, and improving debt management practices. By doing so, Ethiopia can ensure that public debt is effectively utilized to promote long-term economic growth and development.

While numerous studies have examined the impact of public debt on economic growth in general (see, e.g., D'Andrea, 2022; de Soyres et al., 2022; Donayre & Taivan, 2017; Ewaida, 2017; Gómez-Puig et al., 2022; Huang et al., 2018; Mohsin et al., 2021), little has been done, however, to investigate this relationship in Ethiopia. This is consistent with the paucity of literature on the subject in Africa in general. In addition, the relationship between debt and economic growth is specific to each country and time

period. Therefore, it is crucial to analyze the specific impact of public debt on economic growth in every country, including Ethiopia. While the few available country-case studies on Ethiopia provide valuable insights into the relationship between debt and growth in the country, their primary focus is on determining whether debt impacts growth in Ethiopia. However, they fail to address the policy-relevant question of how debt affects growth in the country, specifically the mechanisms through which debt affects growth. They also predominantly focused on the growth impact of the external component of public debt, disregarding the fact that domestic (or internal) debt constitutes approximately half of the total public debt. Furthermore, they also suffer from methodological and data-related problems (see, e.g., Alani, 2020; Gebrekidan, 2023; Getinet & Ersumo, 2020).

Thus, this study complements previous research on Ethiopia and aims to address some of the gaps in the existing literature by conducting a comprehensive analysis of the relationship between debt and economic growth. The study examines the short- and long-term impacts of public debt on economic growth using a combination of theoretical approaches. Specifically, it focuses on analyzing the "crowding out" and "debt overhang" hypotheses. Based on this approach, the study aims to answer the following research questions: a) Does Ethiopia's public debt have any effect on the country's economic growth? b) If so, is the investment channel important? and c) How does this influence vary in the short run and the long run? Using annual data from 1980 to 2021, the study employs the autoregressive distributive lag (ARDL) modeling approach to address these questions.

This study makes three major contributions to the literature on the debtgrowth nexus. First, it comprehensively investigates the dynamic effects of public debt on economic growth in Ethiopia from 1980 to 2021 using the Autoregressive Distributed Lag (ARDL) modeling approach. Unlike previous studies, this research distinguishes between the short-term and long-term impacts of public debt on economic growth, showing that public debt can enhance growth in the short term while hindering it in the long term. Additionally, this study integrates the effects of debt servicing on economic growth, offering a holistic view of public debt dynamics and revealing how debt servicing exacerbates negative growth impacts by diverting resources from critical investment areas. Second, the study contributes a novel policy-oriented analysis, offering tailored recommendations for Ethiopia's economic framework. Researchers, policymakers, and economic analysts can benefit from these results: researchers gain a detailed case study for comparative analyses with other developing countries, policymakers can use the insights to design better fiscal and debt management policies, and economic analysts can forecast economic trends and advise on sustainable debt practices. For example, the findings highlight the dual role of public debt as both a catalyst for short-term investment-driven growth and a hindrance to long-term economic stability due to debt servicing burdens. By emphasizing the importance of prudent fiscal discipline, domestic revenue mobilization, efficient debt management to prevent misuse and corruption, and improved prioritization of investment needs, along with the critical importance of addressing the country's structural trade deficit, this research provides actionable insights specifically designed to address Ethiopia's unique economic challenges. Lastly, the study's single-country focus on Ethiopia allows for an in-depth analysis of local factors influencing public debt and economic growth. This detailed case study is valuable for other researchers as it can be contrasted with results from other nations, helping to build a broader understanding of debt dynamics in emerging economies. This focus enhances the specialized literature by offering a detailed, context-specific study that can inform more generalized theories and models of public debt and economic growth in developing regions.

The remainder of the study is organized as follows: Section 2 briefly discusses the general outlook of public debt and economic growth in Ethiopia. Section 3 presents a review of the relevant literature. Section 4 discusses the methodology and data used. Section 5 presents the findings and discusses the results. Section 6concludes the study.

# 2. The outlook of public debt and economic growth in Ethiopia

This section provides a brief overview of the general patterns and evolution of public debt and economic growth in Ethiopia from 1980 to 2021. However, it should be emphasized at the outset that the evolution of public debt and economic performance are closely connected to the dynamics of the political-economic landscape of the period being examined. For instance, political instability, as well as drastic policy changes and reversals, have characterized Ethiopia's long political history (Geda & Degefe, 2005). Such political processes have a significant impact on the behavior of economic agents, macroeconomic balance and performance, domestic borrowing, and external financial flows to the country (Geda, 2008; Geda & Degefe, 2005).

The analysis in this study focuses on two of the most recent regimes that the country has witnessed: the "Derg" (the military regime) and the Ethiopian People's Revolutionary Democratic Front (EPRDF) regime. The period 1974–1991 corresponds to the Derg (military) regime. The Derg experimented with socialism, in which a centralized command system controlled all spheres of decision-making in the country (Geda, 2008). This period is characterized by the prolonged civil war between the Derg and the then-opposition parties, mainly the EPRDF and Eritrean People's Liberation Front (EPLF), the war with Somalia, deliberate market and private sector repression policies, nationalization policies, and drought. These factors contributed to highly erratic economic performance during this period (Geda & Yimer, 2016).

The second period, from 1991 to the present, began with the Tigray People's Liberation Front (TPLF)-led Ethiopian People's Revolutionary Democratic Front (EPRDF) taking power in 1991, militarily ousting the Derg. The regime supported free market policies and implemented market liberalization, as well as various reform programs (Geda, 2008; Geda & Yimer, 2016). However, this period has also been marked by numerous episodes of conflict. These include the war with Eritrea (1998–2000), the countrywide political unrest (2015–2018), sporadic ethnic-based conflicts in various parts of the country (mainly in the post-2018 period), and the Tigray war (November 2020–November 2022). Thus, the analysis in this study needs to be understood in the context of these two regimes and the events that characterize each period (see Yimer, 2024; Geda & Yimer, 2023 for details).



**Figure 1.** Public debt outlook in Ethiopia (% of GDP), 1980–2021. Source: Authors' computation based on the Ministry of Finance and Economic Development (MOFED) various years' annual reports.

# 2.1. Public debt outlook in Ethiopia

Figure 1 depicts the evolution of public debt (the sum of external and domestic debt) as a percentage of GDP in Ethiopia over the last four decades.

As shown in Figure 1, the country has a high dependency on public debt. During the TPLF-led EPRDF period, there were some of the highest peaks, with an average of 69% of the domestic output. This is a significant increase from the 57% during the Derg regime (Figure 1). As of 2021, the public debt stood at 51% of the country's GDP. In some years of the TPLF-led EPRDF regime, this rate has reached as high as 110 to 121% of GDP (Figure 1).



**Figure 2.** Real per capita GDP growth in Ethiopia (1980–2021). Source: Authors' computation based on National Bank of Ethiopia's (NBE) various years' annual reports.

#### 2.2. Economic growth outlook in Ethiopia

Figure 2 depicts the pattern of growth, as measured by real per capita GDP growth, over the last four decades. During the study period, i.e., 1980–2021, economic growth in Ethiopia had two distinct features, depending on the regime considered (Figure 2).

During the Dreg regime, economic growth was very erratic (see Figure 2). Growth decelerated in 1981 before reaching a negative rate in 1982. The instability induced by the emerging new policies of the Derg, such as the nationalization policy, along with drought, the war with Somalia, and internal civil war, explain a significant portion of this decelerating and negative growth performance. Partly due to relative political stability and favorable weather conditions, a positive growth rate of 5.3% was recorded in 1983. In 1984 and 1985, growth decelerated quickly and reached – 5.2% and – 13.5%, respectively, primarily due to a devastating drought. Growth became positive again in 1986 and 1987, reaching 10.1% in the latter year. Following the intensified civil war and adverse weather conditions, economic growth turned negative again for each of the years between 1988 and 1991. Overall, growth during this period was very erratic and had a negative average of – 0.2%.

In May 1991, the TPLF-led EPRDF came into power. Following a period of low economic activity and political uncertainty, growth remained negative in 1992 (-12.3%). Growth regained momentum and increased to 9.4% in 1993. Except for the three years, namely 1997, 1998, and 2003, where growth was negative (primarily due to drought in those years), the growth was hailed as impressive for most of the remaining period under the EPRDF. Other notable episodes of real GDP growth in the country include the deceleration of growth in 2006 and 2009, which occurred as a result of the contested election in 2005 and the global financial crisis in 2008/09. Partly due to the fall in commodity prices in 2011 and thereafter, growth decelerated in the successive years of 2011 and 2012. The political unrest in the country from 2015 through 2018 has also contributed to the slowdown of economic growth during the same period. In 2020, amidst the COVID-19 pandemic and the war in Tigray, economic growth slowed down but remained positive. Overall, growth during the post-Derg period has been quite good, with real GDP per capita growing by an average of 4.5% per year (Figure 2). The availability of internal and external debt financing explains a significant portion of this growth. Notwithstanding the strong economic growth and Ethiopia's status as one of the fastest-growing economies in Africa, it still remains one of the poorest countries in the world, with a per capita income of US\$ 835 in 2021 (World Bank, 2023b).

Overall, during the study period, there seems to be a general negative correlation between public debt and economic growth, with a limited episode of positive association (Figure 3). This will be further examined econometrically in Section 3.

# 3. Review of literature

There is no consensus on the effects of public debt on economic growth. The literature has identified various channels through which debt affects economic growth. The discussion in this section focuses on highlighting the theoretical and empirical literature that has broadly shaped the debt-growth literature and the relevant studies that have guided this study.



**Figure 3.** Total public debt (% of GDP) and real per capita GDP growth in Ethiopia (1980–2021). Source: Authors' computation based on growth data from NBE and debt data from MOFED's various years' annual reports.

# 3.1. The theory

The effects of public debt on economic growth can be broadly examined using three different theoretical growth models: classical and neoclassical growth theories, Keynesian and post-Keynesian growth theories, and endogenous (new) growth theories.

Public debt is considered detrimental to long-term growth and economic development by the mainstream classical school (see, e.g., Mill, 1848; Ricardo, 1817; Smith, 1776). Under the principle of "laissez-faire," in the neoclassical version of classical economics, proponents argue for limiting the role of the state to ensuring the proper operation of economic relations, such as maintaining the rule of law, national security, and diplomatic relations. According to this principle, the government is not permitted to interfere in the economy. They argue that economic resources are managed more inefficiently in the public sector compared to the private sector. Additionally, public debt diverts private capital from its productive function to non-productive uses, which has a negative impact on capital accumulation. This diversion of investment undermines long-term growth (Ricardo, 1817; Smith, 1776). Ricardo (1817), in his concept of Ricardian Equivalence, noted that government borrowing in the present requires future tax rates to be raised above the normal rate in order to repay the borrowed amount (see also Roberts, 1942; Shoup, 1957). This means that efforts to stimulate the economy by increasing public spending through debt financing will be ineffective. Taxpayers are aware that the repayment of the debt will ultimately have to be funded through future taxes. Because taxpayers save in order to pay the anticipated future taxes that will be imposed to finance the repayment of debt, this will offset the macroeconomic benefits of increased aggregate demand resulting from increased public spending (Barro, 1974, 1979, 1989; Churchman, 2001). Thus, in the classical school, public debt is regarded as a societal burden (Elmendorf & Mankiw, 1999; Kumar & Woo, 2010; Woo & Kumar, 2015).

Similarly, in neoclassical growth theories, public debt is viewed as harmful to longterm economic growth due to its crowding-out effect on physical capital formation (investment) (see, e.g., Blanchard, 1985; Diamond, 1965; Dombi & Dedák, 2019; Modigliani, 1961; Saint-Paul, 1992; Solow, 1956, 1957). In the Solow (1956, 1957) model, fiscal policy (and, by extension, public debt) could potentially have a positive impact on the per capita output level. Such a policy, however, has no impact on longterm economic growth, implying that debt is growth-neutral (Solow, 1956, 1957). Modigliani (1961) also argued that public debt can crowd out private investment by reducing credit availability or by raising long-term interest rates on public borrowing, both of which have a negative impact on long-term growth. In the Diamond/ Overlapping Generation models, public debt has two effects in the long run, both stemming from the taxes required to fund debt repayments. An increased level of taxation reduces the available lifetime consumption of the individual taxpayer (Diamond, 1965; Dombi & Dedák, 2019). Furthermore, taxes have the effect of reducing an individual taxpayer's disposable income, which in turn reduces their ability to save and contribute to capital formation. This negative impact on long-term growth has been discussed in various studies (see, e.g., Blanchard, 1985; Diamond, 1965; Dombi & Dedák, 2019; Saint-Paul, 1992). In line with this, the monetarist school emphasized the issue of the crowding-out effect caused by public sector debt. They argue that a high level of indebtedness crowds out private investment through higher interest rates, negatively affecting growth (see, e.g., Barik & Sahu, 2022; Elmendorf & Mankiw, 1999).

While classical and neoclassical theories emphasize the long-run negative or zero effects of debt on growth, the Keynesian paradigm is concerned with the short run (Akram, 2015). According to the Keynesians, the market cannot always achieve full employment on its own. Thus, the government must intervene to overcome such market failures (including low effective demand), reduce economic fluctuations, and promote balanced growth. In this process, public debt is viewed as one of the important policy tools (Barik & Sahu, 2022) and a key source of financing the domestic saving-investment gap, which is required for output growth, especially through the expenditure multiplier effect (Eisner, 1989; Todaro & Smith, 2006). This view takes an extreme form in the recent development of what is called modern monetary theory (MMT), which was also previously noted by Kalecki (1954). Given their emphasis on endogenous money, the post-Keynesian view of debt is closer to MMT, although they emphasize the importance of its prudent management and its distributional implications (Davidson, 1996; Lavoie, 2006).

In endogenous growth models (the new growth models), public debt, like that of the classical and neoclassical schools, is viewed as potentially harmful to long-term growth (see, e.g., Aizenmana et al., 2007; Barro, 1990; Jafarov et al., 2020; Josten, 2000; Lo & Rogoff, 2015; Saint-Paul, 1992; Villanueva, 1972). This is due to the fact that the repayments must be financed by future cuts in government spending to reduce primary deficits (i.e., the difference between government revenues and spending, excluding interest payments) or by distortionary taxation, both of which harm growth (Lo & Rogoff, 2015). Moreover, high debt may signal future financial repression (Abiad & Mody, 2005; Jafarov et al., 2020), raise real interest rates, and reduce private investment (Engen & Hubbard, 2005; Spiro, 1988), adversely affecting growth.

In addition, a significant number of studies that are difficult to classify in a particular school have analyzed and argued that the debt-growth nexus varies across countries depending on a number of country-specific characteristics related to debt composition, past and current macroeconomic outlook, governance, and institutional framework (see, e.g., Dell'erba et al., 2013; Eberhardt & Presbitero, 2015; Kraay & Nehru, 2006; Manassea & Roubinib, 2009; Reinhart et al., 2003, 2012).

Aside from the previously mentioned theoretical arguments, there is another theory and a substantial body of empirical literature on the non-linear (asymmetric or threshold) effects of public debt on economic growth (see, e.g., Aguiar et al., 2009; Augustine & Rafi, 2023; Eberhardt & Presbitero, 2015; Krugman, 1988; Makun, 2021; Pattillo et al., 2006; Perotti, 1999; Reinhart & Rogoff, 2010; Sutherland, 1997). Debt's non-linear effect implies that moderate and low levels of debt boost growth, while excessive and unsustainable levels of debt stifle it (Chudik et al., 2017; Clements et al., 2003; Krugman, 1988; Pattillo et al., 2006). The theoretical literature on the non-linear effects of debt primarily focuses on the concept of "debt overhang." Debt overhang is a scenario in which "the expected present value of future country transfers is less than the current face value of its debt" (Krugman, 1988). This is a situation where a country's debt service burden is so heavy that a significant portion of its output goes to foreign lenders, which in turn creates disincentives for investment (Krugman, 1988; Sachs, 1989, 2002). Excessive borrowing leads to high levels of indebtedness and debt traps. The need to repay the accumulated debt and the costs associated with servicing it hinder economic growth by discouraging private investment (Krugman, 1988; Sachs, 1989, 2002). This will happen because the debt overhang creates a perception among investors that any new investment returns will be subject to higher taxes to pay off the debt, which reduces their willingness to invest (see, e.g., Aguiar et al., 2009; Deshpande, 1990; Gordon & Cosimo, 2018; Krugman, 1988; Sachs, 1989). In this sense, the idea is also similar to what is called "Ricardian Equivalence". Furthermore, the debt overhang harms growth by reducing the availability of public funds for private investment (financing crowding-out) and altering the allocation of government spending (Coccia, 2017; Krugman, 1988; Obstfeld & Rogoff, 1996). High indebtedness also signals creditors to charge higher interest rates due to the increased risk of default (Obstfeld & Rogoff, 1996). The latter will increase financing costs, decrease domestic investment, and consequently hinder economic growth.

We note in passing here that this literature ignores the other important costs of such debt to developing countries, such as exerting pressure on them for the geopolitical interests of the lender or donor. This is because the theory is typically based on the experiences of developed countries. For developing countries, the aforementioned costs are just as crucial, if not more so, than the investment and financial costs (see Geda & Yimer, 2023).

In summary, the relationship between public debt and economic growth is complex, and there are several theories that attempt to explain this relationship. The most frequently cited channels are the financial crowding out of private investments, the effect on macroeconomic vulnerability, and the debt-overhang hypothesis. The traditional view is that high levels of public debt can crowd out private investment and reduce economic growth. This is because when the government borrows a large amount of money, it increases the demand for loanable funds, which, in turn, drives up interest rates. Higher interest rates can discourage private investment as it becomes more expensive for firms to 10 🕒 A. YIMER AND A. GEDA

borrow money. This can then lead to a reduction in economic growth. However, some economists argue that public debt can actually stimulate economic growth in certain circumstances. For example, during an economic recession, the government can use public debt to finance fiscal stimulus measures such as infrastructure spending. These measures can subsequently stimulate economic growth. Thus, empirical scrutiny of such theories in the context of each country is important.

# 3.2. The empirical regularity

Although there is a scarcity of country-specific empirical studies on the debt-growth relationship in Ethiopia, there is a substantial body of empirical literature on this topic. This literature primarily focuses on the external debt component of public debt and includes studies conducted in developed countries (see, e.g., Herndon et al., 2014; Kumar & Woo, 2010; Lim, 2019; Reinhart & Rogoff, 2010) as well as other developing countries (see, e.g., Elbadawi et al., 1997; Siddique et al., 2016; Zouhaier & Fatma, 2014). This section summarizes the results from some of the most important and recent studies on developing countries in general, with a particular focus on Africa. For a more comprehensive list of studies, please refer to Table A1 in Appendix A.

Based on studies conducted in both cross-country<sup>1</sup> and single-country<sup>2</sup> contexts, there have been mixed results reported on the effects of public debt on economic growth. Some studies have found a negative relationship between public debt and economic growth (see, e.g., Asteriou et al., 2021; Calderón & Fuentes, 2013; Fosu, 1999; Heimberger, 2022; Mohamed, 2013; Sandow et al., 2022; Siddique et al., 2016), while others have found no significant relationship (see, e.g., Schclarek, 2004; Tchereni et al., 2013)<sup>3</sup> or even a positive relationship (Amin & Audu, 2006; Owusu-Nantwi & Erickson, 2016).<sup>4</sup> Some other studies found a non-linear (positive, negative, or insignificant) effect of public debt on economic growth (see, e.g., Baum et al., 2013; Eberhardt & Presbitero, 2015).<sup>5</sup> However, the findings from the majority of the empirical studies reviewed suggest a negative relationship between public debt and economic growth (see, e.g., Adamu & Rasiah, 2016; Baldacci & Kumar, 2010; Clements et al., 2003; Doğan & Bilgili, 2014; Table A1 in Appendix A; Maitra, 2019; Pattillo et al., 2006; Sandow et al., 2022).

<sup>&</sup>lt;sup>1</sup>See, for example, Asteriou et al. (2021), Siddique et al. (2016), and Fosu (1999).

<sup>&</sup>lt;sup>2</sup>See, for example, Hilton (2021) and Owusu-Nantwi and Erickson (2016) for Ghana; Sharaf (2021) for Egypt; Adamu and Rasiah (2016) for Nigeria; Mohamed (2013) for Tunisia; Tchereni et al. (2013) for Malawi; Akram (2011) for Pakistan; and Were (2001) for Kenya.

<sup>&</sup>lt;sup>3</sup>Tchereni et al. (2013) analyzed the effect of foreign debt on Malawi's economic growth from 1975 to 2003 and found a statistically insignificant negative relationship between foreign debt and economic growth. Schclarek (2004) assessed the impact of gross external debt (both private and public) on economic growth for a panel of 59 developing and 24 industrial countries. The data was averaged across each of the seven 5-year periods between 1970 and 2002. For industrialized countries, no robust relationship between debt and growth is found. On the other hand, in developing countries, lower levels of total external debt are found to be associated with higher growth rates. This negative relationship is driven by the incidence of public external debt.

<sup>&</sup>lt;sup>4</sup>Owusu-Nantwi and Erickson (2016) examined the long-term and causal relationship between public debt and economic growth in Ghana from 1970 to 2012. They found a positive and statistically significant long-term relationship between public debt and economic growth. Additionally, in the short run, a bidirectional Granger causality between public debt and growth is found. Amin and Audu (2006) also reported a positive effect of external debt on economic growth in Nigeria during the period 1990–2004.

<sup>&</sup>lt;sup>5</sup>Baum et al. (2013) investigated the relationship between public debt and growth in 12 European countries from 1990 to 2012. The empirical results suggest that the short-run impact of debt on growth is positive and significant, but it decreases to around zero and loses significance beyond public debt-to-GDP ratios of 67%. On the other hand, when the debt-to-GDP ratios are high (above 95%), additional debt has a negative impact on growth.

Several studies have also examined the non-linear effect of public debt, with a particular focus on the external debt component, on economic growth. According to the debt-overhang hypothesis, debt only has a damaging effect on growth once it surpasses a certain threshold level (see Imbs & Romain, 2005; Pattillo et al., 2006). Several of these studies agree that "debt overhang" is a major reason for slowing economic growth in indebted countries. They argue that heavy debt burdens prevent countries from investing in their productive capacity, which is necessary to spur economic growth. Disincentives to investment also arise for reasons largely related to investors' expectations about the economic policies required to service debts (see, e.g., Baum et al., 2013; Cecchetti et al., 2011). For example, Presbitero (2012) analysed the link between debt and economic growth in developing countries using a panel of low- and middle-income countries. The study found a threshold effect for debt-to-GDP ratios above 90%. This finding is consistent with influential studies conducted on advanced and emerging economies, such as Woo and Kumar (2015), Cecchetti et al. (2011), and Reinhart and Rogoff (2010).<sup>6</sup> In contrast, Mohamed (2013) examined the effects of external debt on the economic growth of Tunisia and found evidence of debt overhang even at relatively low levels of debt. He found that although the ratio of public external debt to GDP is relatively low in his country of study, the levels of external debt achieved are detrimental to economic growth. He estimated that the threshold for the phenomenon known as "debt overhang" is around 30% of GDP (see also Clements et al., 2003).

In summary, the existing empirical literature offers relatively strong evidence on how public debt could have a negative impact on medium- and long-term growth through various channels. The crowding out of private investments, caused by excessive public debt, can have a negative impact on capital accumulation and growth due to higher interest rates. This can also create macroeconomic vulnerability, leading to increased future discretionary taxation and inflation. The empirical evidence for a nonlinear effect of public debt on growth suggests that, although thresholds may exist, there may not be a universal threshold level, and they may largely depend on other factors, such as a country's level of development.

While the findings presented in previous studies broadly support the debt overhang hypothesis, most available studies are based on panel data analysis, focusing on either mixed samples of countries or samples of advanced countries. While such studies are useful in identifying the general nature of the relationship between public debt and growth, they have little relevance for country-specific debt management policies. This is

<sup>&</sup>lt;sup>6</sup>The work of Reinhart and Rogoff (2010) was among the first empirical studies to investigate and discover the threshold effect of public debt on economic growth in advanced economies. Reinhart and Rogoff (2010) investigated the nonlinear effect of public debt on economic growth in 20 advanced economies over the period 1946–2009. The study found that government debt becomes detrimental to economic growth when the debt-to-GDP ratio reaches the 90% threshold. However, this study has been subject to criticism as it contained errors in its data and methodology (see, e.g., Herndon et al., 2014). Herndon et al. (2014) corrected several methodological flaws in the same dataset used by Reinhart and Rogoff (2010) and found that the effect of public debt on economic growth varies significantly across countries and over time. Herndon et al. (2014) found that a debt threshold of 30% hinders economic growth in these advanced economies. Woo and Kumar (2015) explore the impact of high public debt on long-term economic growth, including the presence of threshold effects, nonlinearities, and variations between advanced and emerging market economies. Woo and Kumar (2015) found a negative effect of public debt on economic growth. They also found evidence of nonlinearity, with only high (above 90% of GDP) levels of debt having a significant negative effect on growth. A study by Cecchetti et al. (2011) found that high levels of public debt convented bt threshold level of 85% of GDP) have a negative impact on economic growth, but only in advanced economies. In developing economies, it was found that public debt to an economies. In developing economies, it was found that public debt to an economic growth.

because the relationship between debt and economic growth is influenced by specific dynamics that can vary significantly from country to country. In addition, most of the existing studies entirely neglect domestic debt, overlooking the fact that domestic (or internal) debt also constitutes a significant portion of the public debt. Furthermore, most available studies do not seek to explore the channels through which public debt may hinder economic growth, such as the investment channel. This omission prevents a more rigorous explanation for the various mechanisms through which debt may adversely affect growth.

Thus, to fill some of the gaps in the literature noted above, this study revisits the debtgrowth relationship in Ethiopia and explores the short- and long-run effects of public debt on economic growth along the lines of the "crowding out" and "debt overhang" hypotheses. In that regard, the study aims to answer the following research questions: a) Does Ethiopia's public debt have any effect on the country's economic growth? b) If so, is the investment channel important? c) How does this influence vary in the short run and the long run? Using annual data from 1980 to 2021, the study employs the autoregressive distributive lag (ARDL) modelling approach to address these questions.

# 4. The empirical approach

This section presents the study's basic theoretical growth and investment model, as well as the econometric technique used to estimate the empirical models.

# 4.1. The growth equation: the theoretical model and description of variables

This study employs an augmented and modified version of Mankiw et al. (1992) neoclassical theoretical growth model,<sup>7</sup> as well as the specifications in the debt-growth studies of Fosu (1999) and Pattillo et al. (2006), to investigate the effects of public debt on economic growth in Ethiopia during 1980–2021. Furthermore, both linear and nonlinear effects are investigated. The details of the empirical approach used in the study are discussed in the next section.

Assume a production function given in per capita terms, wherein public debt is explicitly incorporated as a determinant of growth given as follows:

$$y_t = \alpha + \sum_{j=1}^k \beta_j Z_{tj} + \sum_{m=1}^p \phi_m p d_{tm} + \varepsilon_t$$
(1)

where *y* represents the natural logarithm of real GDP per capita, *Z* is a vector of control variables, and *pd* represents the natural logarithm of the public debt variables. In this study, we use two indicators for the public debt variable: total public debt as a percentage of GDP (including external and domestic debt), and public debt service as a percentage of exports (all in their natural logarithm transformation). The subscript "*t*" refers to years, and  $\varepsilon_t$  represents the usual error term.

Several studies have examined the effects of various potential determinants on economic growth. Most have questioned the robustness of the parameter

<sup>&</sup>lt;sup>7</sup>See also Yimer (2024, 2023b), Sala-I-Martin et al. (2004), Islam (1995), and Romer (1994).

estimates, as they are often sensitive to many other conditional variables (Levine & Renelt, 1992; Sala-I-Martin, 1997). In light of this, several authors recommend using a core set of factors that have consistently and robustly impacted growth. They also suggest assessing the significance of other variables conditional on the inclusion of the core set (see, e.g., Bosworth & Collins, 2003). This is the method that we used in this study.

Against this background, the selection of variables in the control vector  $(Z_t)$  is informed by theoretical and empirical literature on growth analysis in general, and specifically on the relationship between debt and growth.  $Z_{i,t}$  contains the natural logarithm of population growth (popg), the natural logarithm of domestic investment (k), the natural logarithm of trade openness (op), and the natural logarithm of government consumption (gc). The reasons for including these variables are provided below. The definitions of variables in the empirical model and the sources of data are provided in Table B1 in Appendix B.

The choice of the time period is solely based on the availability of data. The dependent variable is the real per capita GDP level (see, e.g., Chowdhury, 2001; Mohamed, 2013; Yimer, 2023a, 2023b). For the public debt variable, the sum of the stock of external public debt and domestic public debt is used (see, e.g., Akram, 2015; Mohamed, 2013; Woo & Kumar, 2015). In addition, in an alternative specification of the growth model, the analysis replaces total public debt with the disaggregated components of public debt, namely external and domestic public debt.

Labor force growth is included to account for the potential negative effects of high labor force growth on steady-state per capita output. This is because when the labor force grows, each worker has less capital to work with, which can impact output (Iamsiraroj, 2016; Yimer, 2023a, 2023b). Domestic investment is included because it is consistently found to be a robust determinant of economic growth in the literature. It also theoretically shows the rate of capital accumulation, which is crucial for growth (see, e.g., Iamsiraroj, 2016; Kalecki, 1954; Yimer, 2023a).

Several studies have also reported a consistent and robust relationship between economic growth, trade openness, and government consumption (see, e.g., Yimer, 2023a, 2023b). Trade openness allows for a more efficient allocation of resources and also facilitates the transfer of skills, know-how, and technology, all of which impact efficiency and productivity (Barro & Sala-I-Martin, 1997). Government consumption could have both positive and negative effects on growth. It positively affects growth through its expansionary effect on output or aggregate demand (Barro, 1990; Blanchard & Perotti, 2002). On the other hand, it has a negative impact on growth by increasing the fiscal deficit (and resulting in inflation in a supply-constrained economy) and crowding out the private sector (Yimer, 2023b). Given that the Ethiopian economy has a significant state presence, it is important to consider the size of the government in the analysis.

Thus, by substituting the control variables in Equation 1, we can investigate the growth effects of debt using Equation 2, as shown below:

$$y_t = \alpha + \beta_1 popg + \beta_2 k_t + \beta_3 op_t + \beta_4 gc_t + \beta_5 pd_t + \beta_6 pds_t + \varepsilon_t$$
(2)

where all the variables are as defined before and are in their natural logarithm form.

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#### 4.2. The investment equation: the theoretical model and description of variables

Taking into account the crucial role of investment in growth, many studies (see, e.g., Akram, 2015) suggest that it is important to analyse the relationship between public debt and investment as well. To do so, we will also estimate the following reduced-form equation of investment.

$$k_t = \gamma + \sum_{j=1}^k \delta_j w_{tj} + \sum_{m=1}^p \theta_m p d_{tm} + \xi_t$$
(3)

where  $\gamma$  denotes the intercept,  $k_t$  represents investment at t time  $w_{tj}$  is a vector of control variables,  $\delta_j$  is a vector of the coefficients of control variables. The vector  $pd_{tm}$  represents various public debt indicators,  $\theta_m$  represents the vector of the coefficients of public debt indicators, and  $\xi_t$  is the usual error term. To analyze the impacts of public debt on investment in Ethiopia, we used time series data from 1980 to 2021 (see Table B1 in Appendix B for the list of variables, their measurement, and the sources of data).

Following the literature on the determinants of investment in general and the relationship between public debt and economic growth in particular, the investment equation in this study includes the following variables as regressors: the natural logarithm of per capita real GDP (y), the natural logarithm of trade openness (op), the natural logarithm of interest rate (ir), the natural logarithm of inflation (inf) and two public debt indicators, the natural logarithm of total public debt (pd) and the natural logarithm of public debt service. Thus, by substituting the control variables in Equation (3), we can investigate the investment effects of debt using Equation (4) as shown below:

$$k_t = \alpha + \beta_1 y_t + \beta_2 op_t + \beta_3 ir_t + \beta_4 inf_t + \beta_5 pd_t + \beta_6 pds_t + \xi_t \tag{4}$$

# **4.3.** The econometric technique: the autoregressive distributed lag (ARDL) approach

A number of cointegration techniques exist in the literature, including the Engle and Granger (1987), Johansen (1988), Johansen and Juselius (1990), Phillips and Hansen (1990), Gregory and Hansen (1996), Saikkonen and Lütkepohl (2000), Pesaran and Shin (1999), Pesaran et al. (1996), and Pesaran et al. (2001) ARDL approach. This study employs the ARDL approach advanced by Pesaran et al. (2001) to empirically examine the effects of debt on economic growth in Ethiopia for the period 1980–2021.

The ARDL approach has several advantages over other cointegration techniques. First, it can be used regardless of whether the variables are integrated of order 0 (I(0)) or all integrated of order 1 (I(1)), or have a combination of these integration orders. Traditional approaches require that all series have identical orders of integration (Engle & Granger, 1987; Johansen & Juselius, 1990; Phillips & Hansen, 1990). The ARDL approach, however, will be inefficient in the presence of I(2) or higher-order series. Second, unlike other multivariate cointegration techniques (see, e.g., Johansen & Juselius, 1990), this method is relatively simple and allows for estimating a cointegration relationship using the ordinary least squares (OLS) method. Third, it is comparatively more robust and efficient in small samples comprising 30 to 80 observations (Pesaran et al., 2001).

In addition, traditional cointegration techniques may also encounter issues of endogeneity, whereas the ARDL technique typically yields unbiased estimates of the long-run model and valid t-statistics, even when the regressors are endogenous (Narayan & Smyth, 2005; Harris & Sollis, 2003; Pattichis, 1999; H. Pesaran & Shin, 1999; Pesaran et al., 1996, 2001). Furthermore, the appropriateness of using an ARDL model lies in the fact that it is based on a single-equation framework. ARDL cointegration estimates short- and longrun relationships simultaneously and provides unbiased and efficient estimates (H. Pesaran & Shin, 1999). An error correction model (ECM) can also be derived from an ARDL model through a simple linear transformation (H. Pesaran & Shin, 1999). As noted by H. Pesaran and Shin (1999), ECM combines short-term adjustments with longterm equilibrium while retaining long-term information. These advantages of the ARDL technique over other standard cointegration techniques justify its application in this study.

The estimation procedure in the ARDL framework involves two steps. First, the existence of a long-run relationship between the variables of the model is tested by considering F-statistics, referred to as a "bound test." If evidence of a long-run relationship is found, the ARDL method is used at the second stage to estimate the short-run and long-run parameters. Following M. Pesaran et al. (2001), the ARDL model in this study can be written as follows:

$$y_{t} = \alpha \sum_{i=1}^{p} \gamma_{i} y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_{j}} X'_{j,t-i} \beta_{j,i} + \varepsilon_{t}$$
(5)

An ARDL is a least squares regression that includes the lags of both the dependent variable (y) and the explanatory variables (the X's) in Equation 5. ARDL models are typically represented as ARDL  $(p, q_1, \ldots, q_h)$ , where p represents the number of lags of the dependent variable,  $q_1$  represents the number of lags of the first explanatory variable, and  $q_h$  represents the number of lags of the k-th explanatory variable. For an ARDL model written as Equation (5), some of the explanatory variables,  $X_j$ , may have no lagged terms in the model  $(q_j = 0)$ . These variables are referred to as static or fixed regressors. Explanatory variables with at least one lagged term are called dynamic regressors.

To specify an ARDL model, we must first determine the number of lags for each variable to be included (*i.e.*, specify ,  $q_1, \ldots, q_h$ ) in the models. In this study, the optimal lag order of the ARDL is determined using the Schwarz Information Criterion (SIC). The SIC is particularly suitable for small sample sizes and offers a more concise specification compared to other information criteria in the literature (H. Pesaran & Pesaran, 2009).

#### 4.3.1. Long-run relationships

Since an ARDL model estimates the dynamic relationship between a dependent variable and explanatory variables, it is possible to transform the model into a long-run representation. This representation shows the long-run impact of changes in the explanatory variables, including public debt indicators, on the dependent variable in our models. The calculation of these estimated long-run coefficients, once the estimation is complete, is given by Equation (6) as:

$$\theta_j = \frac{\alpha \sum_{i=1}^{q_j} \hat{\beta}_{j,i}}{1 - \sum_{i=1}^{p} \gamma_i} \tag{6}$$

#### 4.3.2. Cointegrating relationships

The cointegrating regression from an ARDL model is obtained by transforming Equation (5) into differences and substituting the long-run coefficients from Equation (6) into the resulting equation, resulting in (7):

$$\Delta y_{t} = -\sum_{i=1}^{p-1} \gamma_{i}^{*} \Delta y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_{j}-1} \Delta X_{j,t-i}^{'} \beta_{j,i}^{*} - \hat{\phi} E C_{t-1} + \varepsilon_{t}$$
(7)

where  $EC_t = y_t - \alpha - \sum_{j=1}^k X'_{j,t} \hat{\theta}_j; \hat{\phi} = 1 - \sum_{i=1}^p \hat{\gamma}_i; \beta^*_{j,i} = \sum_{j=1}^{q_j} \beta_{j,m}$ 

# 4.3.3. Bounds testing

Using the cointegrating relationship form in Equation (7), Pesaran et al. (2001) provided a methodology for testing whether the ARDL model contains a level (or long-run) relationship between the dependent variable and the regressors. The Bounds test procedure transforms Equation (7) into the following representation:

$$\Delta y_{t} = -\sum_{i=1}^{p-1} \gamma_{i}^{*} \Delta y_{t-i} + \sum_{j=1}^{k} \sum_{i=0}^{q_{j}-1} \Delta X_{j,t-i}^{'} \beta_{j,i}^{*} - \rho y_{t-1} - \alpha - \sum_{j=1}^{k} X_{j,t-1}^{'} \delta_{j} + \varepsilon_{t}$$
(8)

The test for the existence of level relationships is then simply a test of

$$\rho = 0$$
  
$$\delta_1 = \delta_2 = \ldots = \delta_k = 0 \tag{9}$$

The coefficient estimates used in the test can be obtained from a regression using Equation (5) or can be estimated directly from a regression using Equation (8).

The test statistic, based on Equation (9), has a distinct distribution under the null hypothesis (which assumes no level relationships). This distribution varies depending on whether the regressors are all I(0) or all I(1). Further, in both cases, the distribution is non-standard. M. Pesaran et al. (2001) provide critical values for cases where all regressors are I(0) and cases where all regressors are I(1). They suggest using these critical values as upper and lower bounds for the more typical cases where the regressors are a mixture of I(0) and I(1).

At this stage, the order of integration of each variable should be determined before any inferences can be made. When the order of integration of all the variables is found to be I (1), the decision is made based on the upper critical bound. On the other hand, if all the series are I(0), then the decision is made based on the lower critical bound. If the F-statistic is higher than the upper bound critical value, we reject the null hypothesis (H\_0) of no cointegration and conclude in favor of a long-run relationship. In contrast, if the F-statistic is below the lower critical bound, then we cannot reject the null hypothesis of no cointegration, indicating that there is no long-run relationship. However, if the F-statistic falls between the upper-bound and lower-bound critical values, the inference would be inconclusive.

The standard ordinary least squares (OLS) model calculates the coefficient covariance matrix assuming that there are no issues of autocorrelation or hetero-skedasticity in the error terms (Geda & Yimer, 2016; White, 1980). If these assumptions do not hold, inferences based on the resulting error-correction model (ECM) will be invalid (Roecker, 1991; White, 1980; Wooldridge, 2000). However, heteroskedasticity and autocorrelation are common issues encountered in time series analysis. Thus, in such studies, it is important to estimate the coefficient covariance matrix under the assumption that errors are conditionally heteroskedastic and serially correlated (Newey & West, 1987). The resulting estimator for the coefficient covariance is the Heteroskedasticity and Autocorrelation Consistent Covariance (HAC) or Newey-West estimator. This procedure will only modify the standard errors of the estimated coefficients without altering the coefficients (Newey & West, 1987). This study has followed the procedure.

Finally, a series of diagnostic tests are conducted to assess the robustness and reliability of the ARDL model. These tests include assessing the normality of the error term, checking for serial correlation and heteroscedasticity, and verifying the functional form of the empirical model. All of the models that have been reported have passed these tests. The models reported here are, thus, the best models that we came up with after experimenting by estimating various models with different specifications, data points, and a battery of diagnostic tests.

In this study, two versions of the growth and investment equations are estimated. The first model uses the total public debt stock variable, while the second model disaggregates the total public debt stock variable into external public debt and domestic public debt in both the growth and investment equations. The ARDL specification of the models used to investigate the effects of public debt on economic growth and the public debt-investment nexus can be written as follows:

$$\Delta y_{t} = \alpha + \beta_{1} y_{t-1} + \beta_{2} popg_{t-1} + \beta_{3} k_{t-1} + \beta_{4} op_{t-1} + \beta_{5} gc_{t-1} + \beta_{6} pd_{t-1} + \beta_{7} pd_{t-1} + \sum_{i=0}^{p_{1}} \gamma_{1i} \Delta popg_{t-i} + \sum_{i=0}^{p_{2}} \gamma_{2i} \Delta k_{t-i} + \sum_{i=0}^{p_{3}} \gamma_{3i} \Delta op_{t-1} + \sum_{i=0}^{p_{4}} \gamma_{4i} \Delta gc_{t-i} + \sum_{i=0}^{p_{5}} \gamma_{5i} \Delta pd_{t-i} + \sum_{i=0}^{p_{6}} \gamma_{6i} \Delta pd_{t-i} + \varepsilon_{t}$$

$$(10)$$

$$\Delta y_{t} = \alpha + \beta_{1} y_{t-1} + \beta_{2} popg_{t-1} + \beta_{3} k_{t-1} + \beta_{4} op_{t-1} + \beta_{5} gc_{t-1} + \beta_{6} epd_{t-1} + \beta_{7} dpd_{t-1} \beta_{8} pds_{t-1} + \sum_{i=0}^{p_{1}} \gamma_{1i} \Delta popg_{t-i} + \sum_{i=0}^{p_{2}} \gamma_{2i} \Delta k_{t-i} + \sum_{i=0}^{p_{3}} \gamma_{3i} \Delta op_{t-1} + \sum_{i=0}^{p_{4}} \gamma_{4i} \Delta gc_{t-i} + \sum_{i=0}^{p_{5}} \gamma_{5i} \Delta epd_{t-i} \sum_{i=0}^{p_{6}} \gamma_{6i} \Delta dpd_{t-i} + \sum_{i=0}^{p_{7}} \gamma_{7i} \Delta pds_{t-i} + \varepsilon_{t}$$
(11)

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$$\Delta k_{t} = \alpha + \beta_{1}k_{t-1} + \beta_{2}y_{t-1} + \beta_{3}op_{t-1} + \beta_{4}ir_{t-1} + \beta_{5}inf_{t-1} + \beta_{6}pd_{t-1} + \beta_{7}pds_{t-1}\sum_{i=0}^{p_{1}}\gamma_{1i}\Delta y_{t-i}$$

$$+ \sum_{i=0}^{p_{2}}\gamma_{2i}\Delta op_{t-1} + \sum_{i=0}^{p_{3}}\gamma_{3i}\Delta ir_{t-i} + \sum_{i=0}^{p_{4}}\gamma_{4i}\Delta inf_{t-i} + \sum_{i=0}^{p_{5}}\gamma_{5i}\Delta pd_{t-i}$$

$$+ \sum_{i=0}^{p_{6}}\gamma_{6i}\Delta pds_{t-i} + \xi_{t}$$
(12)

$$\Delta k_{t} = \alpha + \beta_{1}k_{t-1} + \beta_{2}y_{t-1} + \beta_{3}op_{t-1} + \beta_{4}ir_{t-1} + \beta_{5}inf_{t-1} + \beta_{6}epd_{t-1} + \beta_{7}dpd_{t-1} + \beta_{8}pds_{t-1}\sum_{i=0}^{p_{1}}\gamma_{1i}\Delta y_{t-i} + \sum_{i=0}^{p_{2}}\gamma_{2i}\Delta op_{t-1} + \sum_{i=0}^{p_{3}}\gamma_{3i}\Delta ir_{t-i} + \sum_{i=0}^{p_{4}}\gamma_{4i}\Delta inf_{t-i} + \sum_{i=0}^{p_{5}}\gamma_{5i}\Delta epd_{t-i} + \sum_{i=0}^{p_{6}}\gamma_{6i}\Delta dpd_{t-i} + \sum_{i=0}^{p_{7}}\gamma_{7i}\Delta pds_{t-i} + \xi_{t}$$
(13)

# 5. Discussion of results

In this section, we will begin by presenting the pre-estimation tests that were conducted. The estimated model results are then presented, along with a test to assess the robustness of these results.

# 5.1. The econometric results

Before conducting econometric estimation, a test for the stationarity of the variables is performed (Table 1, with reported p-values). The results indicate that most of the variables are I(1), while others are I(0) (Tables 1).

		Level	Firs	st difference	
Variable	Intercept	Intercept & trend	Intercept	Intercept & trend	Inference
у	0.99	0.92	0.00	0.00	l(1)
k	0.38	0.14	0.00	0.00	l(1)
popg	0.00	0.00	0.00	0.00	I(0)
h	0.82	0.13	0.04	0.08	l(1)
ор	0.53	0.12	0.00	0.00	l(1)
gc	0.47	0.31	0.00	0.00	l(1)
ir	0.22	0.46	0.00	0.00	l(1)
inf	0.00	0.00	0.00	0.00	I(0)
pd	0.10	0.17	0.00	0.00	l(1)
epd	0.30	0.30	0.00	0.00	l(1)
dpd	0.11	0.17	0.00	0.00	l(1)
pds	0.66	0.91	0.06	0.00	I(1)

Table 1. ADF unit-root test results.

Note: All the variables are as defined previously (see also for Table B1 in the Appendix).

After determining the order of integration in the variables of our empirical model, as given in Equations (10)–(13), the bounds test for cointegration is conducted using the appropriate lag length. One of the most important issues in applying the ARDL approach is choosing the order of the distributed lag functions.<sup>8</sup>

The results from the bounds test for the four models estimated in this study (i.e., two for the growth and two for the investment models) are presented in Tables 2. Based on the bounds test for cointegration shown in Table 2, the null hypothesis of no long-run relationship among the variables in the respective models (i.e., the growth and investment models) is rejected. This is because the computed F-statistic for the test equation is greater than the upper-bound critical value even at the one-percent level of significance for both the growth and the investment models.

	5			
Method: Al Sample: 19	RDL Bounds Test 80–2021 basis: Na Jang rup relationshing exist			
пип пурог				
		Test Statistic	Value	k
Model 1	The growth model			
(Eq. 10)	(Total public debt variable used as a regressor)			
•		F-statistic	6.37	7
		Significance	10	1
		-	Bound	Bound
		10%	2.12	3.23
		5%	2.45	3.61
		1%	3.15	4.43
Model 2	The growth model			
(Eq. 11)	(External public debt and domestic public debt replace total public	F-statistic	7.84	7
-	debt as regressors.)	Significance	10	1
	-	-	Bound	Bound
		10%	2.38	3.45
		5%	2.69	3.83
		1%	3.31	4.63
Model 3	The investment model			
(Eq. 12)	(Total public debt variable used as a regressor)	F-statistic	5.16	6
		Significance	10	11
			Bound	Bound
		10%	2.12	3.23
		5%	2.45	3.61
		1%	3.15	4.43
Model 4	The investment model			
(Eq. 13)	(External public debt and domestic public debt replace total public	F-statistic	6.12	7
	debt as regressors.)	Significance	10	11
			Bound	Bound
		10%	2.38	3.45
		5%	2.69	3.83
		1%	3.31	4.63

 Table 2. The bound-test to cointegration.

Note: In Model 1, the cointegration test equation includes the dependent variable (y) and the following regressors: pd, pds, popg, k, op, and gc. In Model 2, pd is replaced by its components, epd and dpd, while keeping all other variables in Model 1 unchanged. In Model 3, the cointegration test equation includes the dependent variable (k) and the following regressors: pd, pds, ir, inf, and op. In Model 4, pd is replaced by its components, epd and dpd, while keeping all other variables in Model 3 unchanged. All the variables are as defined previously and also in Table B1 in Appendix B. Pesaran et al. (2001) critical values for the bounds test are used and reported.

<sup>8</sup>Since we have a small data sample (42 annual observations), SIC is the criterion used for choosing lag lengths. M. Pesaran et al. (2001) showed that SIC is preferable to other lag-length selection criteria because it is suitable for small sample sizes.

# 5.1.1. The growth effect: the long-run and short-run models results

This section aims to answer the question, "Does public debt affect economic growth in Ethiopia?", and presents the results of the estimated models for this exercise. Specifically, the estimation results for Equations (10) and (11) are discussed (see Tables 3 and 4).

Table 3 presents the estimated results of the growth model specified in Eq. (10), in which total public debt and public debt service are used as indicators of the debt variable. The results show that public debt has a significant negative effect on real output per capita in the long run. However, its short-run effect can be both negative and positive, depending on the time lag.

Model: ARDL Cointegrating and Long Run Form			
Sample: 1980 2021			
The short run model (Error Correction Model (ECM)) res	sult		
Dependent variable: $\Delta$ in real GDP per capita			
Selected Model: ARDI (3, 1, 1, 2, 2, 2, 2)			
Variable	Coefficient	Standard error	Prob.
$\Lambda$ (In real GDP per capita(-1))	_0 20**	0.06	0.01
$\Delta(\ln \text{real GDP per capita(-1)})$ $\Delta(\ln \text{real GDP per capita(-2)})$	-0.20	0.00	0.01
A(In population growth)	_0.02	0.04	0.00
A(In gross capital formation as % of GDP)	0.15	0.04	0.00
A(In government consumption as % of GDP)	0.10	0.04	0.00
$\Delta(\ln \text{government consumption as % of GDP(-1)})$	-0.07***	0.04	0.00
$\Lambda(\ln \text{ openness})$	0.09*	0.04	0.07
$\Delta(\ln \text{ openness})$	-0.08**	0.03	0.03
$\Delta$ (In total public debt as % of GDP)	-0.14***	0.04	0.00
$\Delta$ (ln total public debt as % of GDP(-1))	0.14**	0.05	0.03
$\Delta(\ln \text{ public debt service as }\% \text{ of exports})$	-0.02***	0.03	0.08
$\Delta(\ln \text{ public debt service as }\% \text{ of exports}(-1))$	-0.02***	0.02	0.00
$\Delta$ (Regime dummy)	-0.08***	0.01	0.00
EC(-1)	-0.25***	0.05	0.00
The long run model result			
Dependent Variable: In real GDP per capita			
In population growth	-1.72**	0.64	0.02
In gross capital formation as % of GDP	0.88**	0.28	0.01
In government consumption as % of GDP	-0.08	0.15	0.58
In trade openness	0.69***	0.14	0.00
In total public debt as % of GDP	-0.93***	0.19	0.00
In public debt service as % of exports	-0.17***	0.02	0.00
Regime dummy	-0.30***	0.06	0.00
Constant	6.81***	0.62	0.00
@trend	0.0004	0.0013	0.77
Model diagnostic tests			
Test statistic	Value		
R-squared	0.99		
Adjusted R-squared	0.99		
F-statistic	28.11		
Jarque - Berra	2.55		
Prob(Jarque - Berra)	0.28		
Breusch-Godfrey Serial Correlation LM Test	0.23		
Heteroskedasticity Test: ARCH	0.82		
Ramsey RESET Test 👕	0.71		

 Table 3. The short run and long run model result: the growth model (Equation 10.)

Note: △ denotes change and \*\*\*, \*\*, \* indicates 1 %, 5% and 10% level of significance respectively. EC is the adjustment coefficient (the error correction term). • in the diagnostic tests indicates that the P-value for the F-Statistics is reported.

#### Table 4. The short run and long run model result: the growth model (Equation 11.)

Method: ARDL Cointegrating And Long Run Form Sample: 1980 2021 The short run model (Error Correction Model (ECM)) result Dependent Variable:  $\Delta$  In real GDP per capita Selected Model: ARDL(3, 2, 1, 1, 2, 0, 2, 2)

Variable	Coefficient	Standard error	Prob.
$\Delta(\ln \text{ real GDP per capita}(-1))$	-0.02	0.07	0.82
$\Delta$ (In real GDP per capita(-2))	-0.80***	0.11	0.00
$\Delta$ (In population growth)	-0.25***	0.04	0.00
$\Delta(\ln \text{ population growth } (-1))$	0.16**	0.05	0.01
$\Delta$ (In gross capital formation as % of GDP)	0.20***	0.01	0.00
$\Delta$ (In government consumption as % of GDP)	0.04*	0.02	0.06
Δ(In openness)	0.02	0.01	0.30
Δ(In openness(-1))	-0.09***	0.01	0.00
$\Delta$ (In external public debt as % of GDP)	-0.13***	0.01	0.00
$\Delta$ (In domestic public debt as % of GDP)	0.05***	0.01	0.00
$\Delta$ (In domestic public debt as % of GDP (-1))	0.20***	0.02	0.00
$\Delta(\ln \text{ public debt service as }\% \text{ of exports})$	0.01	0.03	0.74
$\Delta(\ln \text{ public debt service as }\% \text{ of exports } (-1))$	-0.07***	0.02	0.00
Δ(Regime dummy)	-0.05***	0.01	0.00
EC(-1)	-0.31***	0.02	0.00
The long run model result			
Dependent Variable: In real GDP per capita			
In population growth	-2.30***	0.32	0.00
In gross capital formation as % of GDP	0.79***	0.06	0.00
In government consumption as % of GDP	-0.40***	0.06	0.00
In openness	0.44***	0.10	0.00
In external public debt as % of GDP	-0.42***	0.02	0.00
In domestic public debt as % of GDP	-0.33**	0.12	0.02
In public debt service as % of exports	-0.25***	0.01	0.00
Regime dummy	-0.17***	0.03	0.00
Constant	6.18***	0.34	0.00
@trend	0.007	0.005	0.17
Model diagnostic tests			
Test statistic	Value		
R-squared	0.99		
Adjusted R-squared	0.99		
F-statistic	46.22		
Prob(F-statistic)	0.39		
Jarque - Berra	0.39		
Prob(Jarque - Berra)	0.82		
Breusch-Godfrey Serial Correlation LM Test *	0.24		
Heteroskedasticity Test: ARCH	0.11		
Ramsey RESET Test 🕈	0.72		

Note:  $\Delta$  denotes change and \*\*\*, \*\*, \* indicates 1 %, 5% and 10% level of significance respectively. EC is the adjustment coefficient (the error correction term). • in the diagnostic tests indicates that the P-value for the F-Statistics is reported.

Debt service is found to have a significant negative effect in both the long run and the short run. However, when compared to the short run, the magnitude of the effect is found to be stronger in the long run (Table 3). In Ethiopia, high public debt service payments can have a negative effect on economic growth in both the short run and the long run, especially when the government's fiscal space is limited. As a result of high debt service payments, the government has less room to maneuver when dealing with economic downturns, which can result in reduced public investment, lower productivity, and slower economic growth. Moreover, the government may sometimes rely on

increased taxation to service its debt, which can reduce consumer and business confidence, thereby lowering economic growth in both the short run and the long run. Finally, in Ethiopia, high public debt service payments often lead to inflationary pressures. If the government prints more currency to finance its domestic debt service obligations, this can lead to inflation, which can further reduce economic growth in the long run.

Table 4 presents the estimated results of the growth model given in Eq. (11), specifically the growth model with a disaggregated public debt variable. The results show that public debt can have both negative and positive effects, depending on the sources of borrowing and the time period considered.

As shown in Table 4, the analysis reveals that external debt has a detrimental impact on the real per capita output of the country, both in the short and long run, while domestic debt is found to have a positive effect on economic growth in the short run, but its long-run effect is negative. Similar to our earlier finding in the previous model (Table 3), we find that debt servicing has a significant negative effect on the real per capita output of the country, both in the short run and the long run (Table 4).

Based on the results presented in Tables 3 and 4, the estimated coefficient for the error-correction term (EC) is significant in both specifications. This finding suggests that, as noted by Banerjee et al. (1998), a significant negative coefficient for the error-correction term provides additional evidence of a stable long-term relationship among the variables used in the model.

With regard to the control variables, the results of both models are generally consistent with the findings of previous studies on economic growth. For instance, in the long run, population growth and government consumption have a negative impact on real per capita output. On the other hand, gross capital formation and trade openness have a significant positive impact on the country's per capita output. These findings on the control variables align with the results of existing literature and are consistent with expectations, as they have extensive empirical support (see, for example, Yimer, 2023a, 2024).

In summary, the short-run negative effects of public debt on real per capita output may be due to the necessity of diverting resources away from productive activities in order to service the debt. While the positive results on public debt flows suggest that public debt can help stimulate economic growth through capital formation. A similar result has been found in other studies conducted in different countries (see, e.g., Akram, 2015; Mohamed, 2013). The long-run negative effect of public debt on per capita GDP aligns with the widely held view that public debt has a detrimental impact on economic growth (see, e.g., Table A1 in Appendix A for further details).

A battery of model diagnostic tests was applied to assess the robustness of the estimated models. The tests indicate that the estimated models have the desired statistical properties (see Tables 3 and 4). Both models have a good fit. In addition, the models successfully passed a battery of tests, including tests for normality, heteroskedasticity, serial correlation, model specification, and stability. The Jarque-Bera statistic confirms the normality of the residuals, as the null hypothesis that "errors are normally distributed" is not rejected in each of the specifications of the growth model. Based on the results of the Breusch-Godfrey Lagrange Multiplier (LM) test and the Autoregressive Conditional Heteroskedasticity (ARCH) test, we do not have enough evidence to reject



Figure 4. Parameter stability tests: the growth model reported in Table 3.

the null hypotheses of no serial correlation and no heteroscedasticity of the residuals, respectively. Thus, there are no issues of serial correlation or heteroskedasticity in the estimated models. The Ramsey Regression Equation Specification Error Test (RESET) supports the null hypothesis of the correct functional form (Tables 3 and 4).

Model parameter stability is one of the requirements for a well-specified and performing ARDL model (Murthy & Okunade, 2016). The stability of the regression coefficients is evaluated through stability tests, which can determine whether the regression equation remains stable over time (H. Pesaran & Pesaran, 2009). To assess the stability of the estimated coefficients, we conducted cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests on the recursive residuals derived from the estimated ARDL models for each specification of the growth equation, i.e., Equations 10 and 11. As depicted in Figures 4 and 5, the plots of the CUSUM and CUSUMSQ statistics both fall within the critical bounds at the 5% significance level and do not cross the lower and upper critical limits in any of the estimated models. This indicates that the estimated coefficients exhibit the desired characteristics of parameter stability throughout the entire sample period of the estimated model.

With regard to the robustness check, the estimated baseline growth models were examined to assess the robustness of the results. Although the results from such exercises are not reported here, alternative specifications using different sets of control variables of the estimated models have shown that the findings are robust across different



Figure 5. Parameter stability tests: the growth model reported in Table 4.

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specifications. The general finding is that the coefficients of the public debt variables are consistently estimated.<sup>9</sup>

# 5.1.2. The investment effect: the long-run and short-run models results

The finding that public debt variables have a strong negative association with real per capita growth, either in the long run or both in the short run and long run, raises an important policy-relevant question: "How does public debt affect the country's growth?". The following section aims to provide insights by examining the relationship between public debt and investment in the country. Similar to the estimation of the growth model, we have estimated two versions of the investment equation. The first version uses the total public debt variable (Equation 12), while the second one uses a disaggregated public debt variable (Equation 13), where the total public debt variable is replaced by its disaggregated component of external public debt and domestic public debt.

As shown in Tables 5 and 6, public debt, both domestic and external, is found to have a positive impact on short-term gross capital formation. Public debt, particularly external public debt, can serve as a source of foreign currency that can be used to finance imports and other forms of capital, thereby stimulating the economy. This can be particularly useful in countries like Ethiopia, where access to foreign currency is limited, making it difficult to finance investments through domestic sources. In addition, public debt can also help stabilize the economy during periods of volatility. A government can issue debt to finance programs and initiatives that can mitigate the negative impact of a crisis and enable businesses and individuals to continue investing in the economy.

On the other hand, it has been found that public debt, both domestic and external, has a negative impact on long-term gross capital formation. One major way in which domestic public debt can negatively impact long-term capital formation in the country is by crowding out private investment. When a government borrows heavily from creditconstrained domestic markets, such as Ethiopia, to finance its spending, it can crowd out private investors from accessing the same pool of funds. This can reduce private investment in the economy, which, in turn, can slow down the rate of capital formation. In the long run, this can result in reduced investment in infrastructure, research and development, and other key drivers of economic growth. Additionally, in countries like Ethiopia, high levels of domestic public debt can further constrict an already limited fiscal space of the government, which refers to its capacity to respond to future economic shocks or crises. If a significant portion of the government's income is already committed to servicing debt payments, it may be more challenging to allocate funds to crucial investments that could stimulate long-term development.

Debt service payments are found to negatively impact gross capital formation both in the short run and the long run. In the short run, in countries like Ethiopia, debt service payments can reduce the amount of funds available for investment in the economy. When a government is required to make large debt payments, it may need to reduce spending in other areas, such as investment in infrastructure, education, and research and development. This can slow down the rate of capital formation and reduce economic growth in the short term. In the long run, the negative impact of debt service payments

<sup>&</sup>lt;sup>9</sup>Interested readers are advised to refer to the working paper version of this study for a detailed presentation of the alternative robustness check estimation cited in the reference section as Yimer and Geda (2023).

#### Table 5. The short run and long run model result: the investment model (Eq. 12.)

Method: ARDL Cointegrating and Long Run Form Sample: 1980 2021 The short run model (Error Correction Model (ECM)) result Dependent Variable:  $\Delta$  In gross capital formation as % of GDP Selected Model: ARDL(2, 1, 0, 1, 0, 1, 1)

Variable	Coefficient	Standard errors	Prob.
$\Lambda(\ln \operatorname{gross} \operatorname{capital} \operatorname{formation} \operatorname{as} \% \operatorname{of} \operatorname{GDP}(-1))$	-0.33***	0.05	0.00
$\Delta$ (In real GDP per capita)	2.36***	0.13	0.00
$\Delta(\ln \text{ trade openness})$	0.19***	0.06	0.00
$\Delta$ (In public debt as % of GDP)	0.28***	0.08	0.00
$\Delta$ (In total public debt service as % of exports)	-0.02***	0.01	0.00
$\Delta(\ln \text{ interest rate})$	0.25	0.23	0.29
$\Delta(\ln inflation)$	-0.06***	0.01	0.00
Δ(Regime dummy)	0.10	0.12	0.43
EC(-1)	-0.33***	0.08	0.00
The long run model result			
Dependent Variable: In gross capital formation as	% of GDP		
In real GDP per capita	0.03	0.04	0.51
In trade openness	0.60***	0.04	0.00
In total public debt as % of GDP	-0.32***	0.04	0.00
In public debt service as % of exports	-0.07***	0.00	0.00
In interest rate	-0.07	0.64	0.91
In inflation	-0.56***	0.09	0.00
Regime dummy	0.29	0.29	0.33
Constant	3.98***	1.37	0.01
Model diagnostic tests:			
Tests statistic	Value		
R-squared	0.954		
Adjusted R-squared	0.929		
F-statistic	38.76		
Prob(F-statistic)	0.00		
Jarque - Berra	2.65		
Prob(Jarque - Berra)	0.27		
Breusch-Godfrey Serial Correlation LM Test +	0.57		
Heteroskedasticity Test: ARCH *	0.72		
Ramsey RESET Test <sup>®</sup>	0.89		

Note:  $\Delta$  denotes change; \*\*\* indicates 1 % level of significance. EC is the adjustment coefficient (the error correction term).  $\clubsuit$  in the diagnostic tests indicates that the P-value for the F-Statistics is reported.

on gross capital formation can be even more significant. If a government is consistently required to make large debt payments over a long period of time, it can limit its ability to invest in sectors that are crucial for long-term economic growth. Additionally, high levels of debt can increase the risk of a financial crisis, as investors may become concerned about the government's ability to service its debt. The resulting economic instability can further reduce investment in the economy and lead to a long-term slowdown in growth.

Overall, Tables 5 and 6 reveal that in the long run, there is a negative and significant relationship between both external total public debt as a percentage of GDP and external debt servicing as a percentage of exports with investment in Ethiopia. However, changes in the public debt stock (i.e., debt-creating flows, as can be seen from the variable measured in changes) are found to have a positive relationship with investment, while debt servicing has a negative relationship with investment in the short run. This aligns with the widely accepted belief that, in the short term, debt-creating flows have a positive impact on growth by increasing domestic investment in a country. On the other hand,

#### Table 6. The short run and long run model result: the investment model (Equation 13.)

Method: ARDL Cointegrating and Long Run Form Sample: 1980 2021 The short run model (Error Correction Model (ECM)) result Dependent Variable:  $\Delta$  In gross capital formation as % of GDP Selected Model: ARDL(2, 1, 0, 1, 1, 0, 1, 1)

Variable	Coefficient	Standard errors	Prob.
$\Delta(\ln \text{ gross capital formation as }\% \text{ of GDP } (-1))$	-0.52***	0.01	0.00
$\Delta$ (In real GDP per capita)	2.95***	0.03	0.00
Δ(In trade openness)	0.19***	0.01	0.00
$\Delta$ (In external public debt as % of GDP)	0.07***	0.00	0.00
$\Delta$ (In domestic public debt as % of GDP)	0.34***	0.00	0.00
$\Delta(\ln \text{ public debt service as }\% \text{ of exports})$	-0.01**	0.00	0.01
$\Delta(\ln \text{ interest rate})$	0.18***	0.01	0.00
Δ(In inflation)	-0.08***	0.00	0.00
Δ(Regime dummy)	0.31***	0.00	0.00
EC(-1)	-0.17***	0.01	0.00
The long run model result			
Dependent Variable: In gross capital formation as	% of GDP		
In real GDP per capita	1.01***	0.14	0.00
In trade openness	1.09***	0.03	0.00
In external public debt as % of GDP	-0.26***	0.01	0.00
In domestic public debt as % of GDP	-0.06**	0.02	0.02
In public debt service as % of exports	-0.03**	0.01	0.02
In interest rate	-0.68***	0.04	0.00
In inflation	-1.22***	0.09	0.00
Regime dummy	1.78***	0.15	0.00
Constant	-0.57	0.47	0.24
Model diagnostic tests			
Test statistic	Value		
R-squared	0.982		
Adjusted R-squared	0.965		
F-statistic	60.44		
Prob(F-statistic)	0.00		
Jarque - Berra	3.09		
Prob(Jarque - Berra)	0.21		
Breusch-Godfrey Serial Correlation LM Test 🕈	0.71		
Heteroskedasticity Test: ARCH *	0.25		
Ramsey RESET Test	0.52		

Δ denotes change; \*\*\* indicates 1 % level of significance. EC is the adjustment coefficient (the error correction term). + in the diagnostic tests indicates that the P-value for the F-Statistics is reported.

debt service payments invariably indicate a reduction in the amount of financial resources available for productive investments. This is especially true when the payments are made in foreign currency. This finding has extensive empirical support in previous studies (see, e.g., Akram, 2015; Fosu, 1999).

In summary, the cumulative effects of public debt and external debt servicing indicate that "debt overhang" and "crowding out" are the primary mechanisms that hinder investment and impede real per capita income growth.

A battery of model diagnostic tests was also applied to check the robustness of the estimated investment model. The tests indicate that the estimated models possess the desired statistical properties (see the diagnostic test results reported in Tables 5 and 6).

Model parameter stability tests have also confirmed that the estimated investment equation remains stable over time (Pesaran & Pesaran, 2009). Figures 6 and 7 present the results of these tests for the model results presented in Tables 5 and 6. The plots of CUSUM and CUSUMSQ statistics both fall within the critical bounds at the 5 percent



Figure 6. Parameter stability tests: the investment model reported in Table 5.



Figure 7. Parameter stability tests: the investment model reported in Table 6.

significance level and do not cross the lower and upper critical limits in the estimated investment models (Figures 6 and 7). This indicates that the estimated coefficients exhibit the desired characteristics of parameter stability over the sample period for both specifications of the investment model as well.

With regard to the robustness check of the estimated baseline investment models (reported in Tables 5 and 6), alternative specifications using different sets of control variables of the estimated model have shown that the findings are robust across different specifications (see the working paper version of this study for a more in-depth presentation of the alternative robustness check estimation, which is referenced as Yimer and Geda (2023).

# 6. Conclusion

This study modestly attempts to contribute to the literature on economic growth and debt by revisiting the relationship between debt and growth in Ethiopia. The study examines the effects of public debt on economic growth in Ethiopia, both in the short run and the long run. In addition, it also examines the principal channel through which the impact of public debt is transmitted to economic growth, which is the investment channel. Using the ARDL modeling approach on annual data from 1980 to 2021, it was found that the levels of external debt in this country have a detrimental effect on economic growth, particularly in the long run. We have found that the short-term negative impact of public debt on economic growth is primarily caused by the debt servicing associated with the accumulated debt. In addition, while debt-creating flows are found to have a positive impact on investment in the short run, their long-term impact is found to be negative and significant.

Our results may also have some interesting policy implications. Firstly, it is necessary to examine why increases in the public debt-to-GDP ratio have a negative effect on longterm growth in Ethiopia. Is the increase in public debt due to financing projects of little value to future economic growth? Or is it because the increase in public debt has benefited a few elites at the expense of burdening the rest of the population with more debt? The answer may be that a combination of all the elements comes into play. Secondly, the country should consider implementing institutional improvements and control mechanisms that ensure fiscal discipline on the part of the government and its agencies.

To prevent the growth-damaging effects of debt, the country needs to implement prudent policy changes that will reduce its fiscal deficit, address its structural trade deficit, and enhance its institutional capacity to manage debt (see Geda & Yimer, 2023). Nonetheless, reducing fiscal and trade deficits may not be an easy task, nor will it be sufficient to address the external component of the debt. It is crucial to seriously consider implementing additional public policies and strategies to effectively address the significant external debt problem that the country is currently facing.

Furthermore, achieving this may not be easy in the short term due to the current political and economic context of the country. The economy is being negatively affected by significant macroeconomic imbalances, which in turn are impacting the social and economic conditions of the population. These conditions are characterized by high levels of unemployment and poverty. These challenges, in turn, require significant social spending and increased public investment, which will inevitably exacerbate the budget deficit and indebtedness (see Geda & Alemu, 2023; Geda & Yimer, 2023). That is why a strategic approach to transitioning from debt or aid dependence needs to be pursued.

This study, however, is not without limitations. It relies on annual data from 1980 to 2021, which may not capture more frequent fluctuations in economic variables observable with quarterly or monthly data. Additionally, the availability and reliability of data, particularly in earlier years, may affect the robustness of the results. While the Autoregressive Distributed Lag (ARDL) modeling approach is suitable for analyzing long-term and short-term effects, it assumes a linear relationship between variables and a single cointegrating vector. This assumption might oversimplify complex economic dynamics, especially in settings with multiple long-term relationships. Despite this, the ARDL model's practicality and empirical success in capturing essential long-term relationships justify its use. The study also focuses on Ethiopia's internal dynamics of public debt and economic growth, excluding external factors like global economic conditions, international trade, and foreign aid, which could influence outcomes. Policy recommendations are based on theoretical and empirical findings but may face political, social, and institutional barriers not fully explored

in this study. While the findings offer valuable insights for Ethiopia, their applicability to other countries may be limited. Future research could benefit from comparative studies involving multiple countries, addressing transitional dynamics between shortand long-term effects, and distinguishing between different types of debt for deeper insights.

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# Availability of data and materials

All data analyzed in this study are available on request from the authors.

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				Effec	t on growth
Author	Scope	Debt type	Method	Linear	Von-linear (Threshold effect)
Developing countrie	8				
Sandow et al. (2022)	31 sub-Sahara African (SSA) countries (2005–2017)	External debt	System generalized method of moments (SGMM) and panel smooth transition regression (PSTR)	Negative	45% of GDP
Mohsin et al. (2021)	South Asian countries, (Afghanistan, Bangladesh, Bhutan, India, Pakistan, Sri Lanka, Maldives, and Nepal) (2000–2018)	External debt	Panel ordinary least square, fixed effect, Quantile regression, and robust output regression were used to analyze the World Bank data from 2000 to 2018. South Asian countries,	Negative	
Maitra (2019) Adamu and Rasiah	Sri Lanka (1977–2016) Nigeria (1970–2013)	External debt External debt	ARDL ARDL	Negative Negative	
(2016)	1			I	
Owusu-Nantwi and Erickson (2016)	Ghana (1970–2012)	External debt t	Johansen cointegration and Vector Error Correction Model (VECM)	Positive	
Siddique et al. (2016)	40 heavily indebted poor countries (HIPCs) (1970-2007)	External debt	ARDL	Negative	
Doğan and Bilgili (2014)	Turkey (1974–2009)	External debt	Markov Regime-switching approach	Negative	
Zouhaier and Fatma (2014)	19 developing countries (1990-2011)	External debt	Dynamic panel regression (Arellano-Bond estimator)	Negative	
Mohamed (2013)	Tunisia (1 <i>97</i> 0–2010)	External debt	Engel and Granger error correction model (ECM)	Negative	>30% of GDP
Tchereni et al. (2013)	Malawi (1975–2003)	External debt		zero	
Adegbite et al. (2008)	Nigeria (1975–2005) 03 Aevelonina (1960–1908)	External debt	OLS and generalized least squares (GLS) OLS: Instrumental variables (IVV: EE: and SGMM	Negative	35_10% of GDD
Clements et al. (2003)	55 low-income countries (1970–1999)	External debt	Fixed effects (FE) & SGMM	Negative	>35% of GDP
Fosu (1999)	35 sub-Saharan Africa (SSA) (1980– 1990)	External debt	OLS	Negative	
					(Continued)

Appendix A. An overview of empirical literature on the effects of public debt on economic growth

Appendices

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Table A1. (Continue	ed).				
				Eff	ect on growth
Author	Scope	Debt type	Method	Linear	Non-linear (Threshold effect)
Elbadawi et al. (1997)	99 developing countries spanning SSA, Latin America, Asia, and the Middle East	External debt	Cross-section Regression (Fixed and random effect)	Negative	
<b>Developed countrie</b> Liaqat (2019)	s 39 high income countries 7120 2017)	Domestic debt	Panel VAR	Negative	
Pegkas (2019)	Greece (1970–2016)	Domestic debt	Regression model with multiple thresholds		21%—50% & >90%
De Vita et al., (2018)	10 EMU, US, UK and Japan	Domestic debt	Granger causality & ARDL cointegration	Negative	סו פרער
Esteve and Tamarit	Spain (1851–2013)	Domestic debt	Dynamic Ordinary Least Square (DOLS)		No threshold
Gómez-Puig and Sosvilla-Rivero	Euro area countries (1961–2015)	Domestic debt	Panel ARDL	Positive	
(2018) Shahor (2018)	Israel (1983–2013)	Domestic debt	Undefined		
Pegkas (2018) Amann and Middleditch (2020)	Greece (1970–2016) United Kingdom (1995–2013)	Domestic debt Domestic debt	ARDL & VAR Granger causality & cointegration tests	Negative	>90% of GDP
Kempa and Khan (2017)	11 major Euro zone countries (1991–2014)	Domestic debt	Panel VAR	zero	
Lee et al. (2017)	Advanced economies (1946–2009)	Domestic debt	Median regression		21%—50% of GDP
Panizzaa and Presbitero (2014)	17 developed OECD countries	Public debt (Domestic	2	zero	No threshold
Docod base toolaiod		aept ه external debt)			
кеплагт апо кодоп (2010)					

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(Continued)

	-m-				
				Effec	t on growth
Author	Scope	Debt type	Method	l Linear	Non-linear (Threshold effect)
<b>Mixed countries (De</b> Asteriou et al. (2021)	veloping and Developed) 14 countries in Asia (1980–2012)	Public debt (Domestic debt &	Pooled mean group (PMG), mean group (MG), dynamic fixed effects (DFE) allowing for common correlated, and asymmetric panel Autoregressive Distributed Lag Model (ARDL)	Negative	
Lim (2019)	41 advanced & emerging economies (1952–2016)	external debt) Total Debt (private & nublic debt)	metnod Panel VAR	Negative	
Intartaglia et al. (2018)	48 developing & developed countries (1961–2015)	Domestic debt	Panel VAR	Negative	
Arčabić et al. (2018)	OECD & non-OECD countries (1960–2009)	Domestic debt	Panel VAR, FE, FE with IV, SGMM	zero	No threshold
Butkus and Seputiene (2018)	152 countries (1996–2016)	Domestic debt	SGMM, Pooled OLS (POLS) & LSDV	v	<20% & >90% of GDP
Karadam (2018)	135 countries (1970–2012)	Domestic debt	PSTR		71%—90% & >90% of GDP
Ramos-Herrera and Sosvilla-Rivero (2017)	115 developed & developing economies (1970–2013)	Public debt (Domestic & external debt)	Mean, median, winsorized mean & trimmed mean	Negative	
Chudik et al. (2017) Ewaida (2017)	40 countries (1965–2010) Highly indebted countries in Euro & non-Furo zone (1993–2013)	Domestic debt Domestic debt	Panel ARDL POLS	Negative Negative	
Kim et al. (2017) Chiu and Lee (2017)	77 countries (1990–2014) 61 countries (1985–2009)	Domestic debt Domestic debt	POLS, FE & SGMM PSTR	Positive & Negative	No threshold
Brida et al. (2017)	16 countries in Euro & non-Euro (1977–2015)	Domestic debt	Minimal spanning tree & hierarchical tree		71%—90% of GDP
Ahlborn & Schweickert (2018)	111 developing & developed economies (1971–2010)	Domestic debt	FE & 2SLS		51%—70% of GDP
Chen et al. (2017)	65 developing & developed economies (1991–2014)	Domestic debt	PSTR		21%—50% of GDP
					(Continued)

Table A1. (Continued).

fect on growth	Non-linear (Threshold effect)	>90% of GDP		>90% of GDP	90% of GDP
Ef	Linear	Negative	Negative	Negative	
	Method	POLS, robust regression, between estimator (BE), fixed effects (FE) panel regression and system GMM (SGMM) dynamic panel regression	Time series, cross-country growth regressions	Between estimators (BE); Pooled OLS; FE; SGMM	Descriptive data analysis
	Debt type	Public debt (Domestic debt & external debt)	Public debt (Domestic debt & external debt)	Public debt (Domestic debt & external debt)	Public debt (Domestic debt & external debt)
	Scope	38 advanced and emerging economies (1970–2008)	136 developed and developing countries (1970-2010)	38 advanced & emerging economies (1970–2007)	44 advanced & emerging economies (1946-2009)
	Author	Woo and Kumar (2015)	Calderón and Fuentes (2013)	Kumar and Woo (2010)	Reinhart and Rogoff (2010)

Table A1. (Continued).

# Appendix B Definition, measurement and data sources of the variables

Variable	Definition and measurement	Source
y <sub>t</sub>	The natural log of real GDP per capita at 2017 US\$ constant prices	NBE various years annual reports
k	The natural log of gross capital formation as a percentage of GDP	NBE various years annual reports
pd	The natural log of total public debt as a percentage of GDP	MOFED various years annual reports
pd	The natural log of external public debt as a percentage of GDP	MOFED various years annual reports
pd	The natural log of domestic public debt as a percentage of GDP	MOFED various years annual reports
pds	The natural log of public debt service as a percentage of exports	World Bank (2023a)
рорд	The natural log of population growth rates	World Bank (2023b)
ор	The natural log of trade openness (TO) where $TO = \left(\frac{(exports + imports)/2}{GDP}\right) * 100$	Calculated based on NBE various years annual reports
gc	The natural log of government consumption expenditure as a percentage of GDP	NBE various years annual reports
inf	The natural log of inflation calculated as In (1+inflation)	
ir	Nominal lending interest rate	NBE various years annual reports

Table B1. Definition, measurement and data sources of the variables.

*y* represents the natural logarithm of real GDP per capita. *k* represents the natural logarithm of gross capital formation as a percentage of GDP. *popg* represents the natural logarithm of population growth rates. *h* represents the natural logarithm of the human capital index. *op* represents the natural logarithm of trade openness. *gc* represents the natural logarithm of government consumption as a percentage of GDP. *ir* represents the natural logarithm of the lending interest rate. *pd* represents the natural logarithm of the total public debt as a percentage of GDP. *epd* represents the natural logarithm of the external public debt as a percentage of GDP. *dpd* represents the natural logarithm of the atural logarithm of the atural logarithm of the apercentage of GDP. *pds* represents the natural logarithm of the total public debt as a percentage of exports.

# Appendix C. Summary statistics and correlation matrix

	у	рорд	k	gc	ор	pd	pds
Mean	5.87	1.06	3.01	2.49	2.95	4.11	2.64
Median	5.70	1.10	3.12	2.54	3.02	4.12	2.85
Maximum	6.73	1.14	3.65	3.04	3.66	4.80	3.80
Minimum	5.37	0.33	2.18	2.07	2.07	3.11	1.03
Std. Dev.	0.41	0.12	0.44	0.25	0.36	0.39	0.75
Skewness	0.91	-5.57	-0.17	0.08	-0.28	-0.32	-0.45
Kurtosis	2.40	34.55	1.80	2.03	2.79	2.80	2.30
Observations	42.00	42.00	42.00	42.00	42.00	42.00	42.00

Table C1. Summary statistics: the growth model in Eq. (10).

Table C2. Correlation matrix: the growth model in Eq. (10).

	у	рорд	k	gc	ор	pd	pds
у	1.00						
popg	0.24	1.00					
k	0.74	0.19	1.00				
gc	-0.68	-0.02	-0.56	1.00			
ор	0.67	0.10	0.84	-0.49	1.00		
pd	-0.47	-0.22	-0.14	0.35	-0.12	1.00	
pds	-0.04	-0.10	-0.40	0.24	-0.41	0.31	1.00

Table C3. Summary statistics: the growth model in Eq. (11).

	у	рорд	k	gc	ор	epd	dpd	pds
Mean	5.87	1.06	3.01	2.49	2.95	-0.83	4.11	2.64
Median	5.70	1.10	3.12	2.54	3.02	-0.72	4.11	2.85
Maximum	6.73	1.14	3.65	3.04	3.66	0.32	4.78	3.80
Minimum	5.37	0.33	2.18	2.07	2.07	-2.28	3.10	1.03
Std. Dev.	0.41	0.12	0.44	0.25	0.36	0.71	0.39	0.75
Skewness	0.91	-5.57	-0.17	0.08	-0.28	-0.27	-0.31	-0.45
Kurtosis	2.40	34.55	1.80	2.03	2.79	2.14	2.81	2.30
Observations	42	42	42	42	42	42	42	42

Table C4. Correlation matrix: the growth model in Eq. (11).

	у	рорд	k	gc	ор	epd	dpd	pds
у	1.00							
popg	0.24	1.00						
k	0.74	0.19	1.00					
gc	-0.68	-0.02	-0.56	1.00				
ор	0.67	0.10	0.84	-0.49	1.00			
epd	-0.60	-0.31	-0.44	0.38	-0.41	1.00		
dpd	-0.47	-0.21	-0.13	0.35	-0.12	0.81	1.00	
pds	-0.04	-0.10	-0.40	0.24	-0.41	0.52	0.31	1.00

Table C5. Summary statistics: the investment model in Eq. (12).

	k	у	ор	pd	ds	ir	inf
Mean	3.01	5.87	2.95	4.11	2.64	2.33	2.91
Median	3.12	5.70	3.02	4.12	2.85	2.38	3.01
Maximum	3.65	6.73	3.66	4.80	3.80	2.74	4.22
Minimum	2.18	5.37	2.07	3.11	1.03	1.92	0.00
Std. Dev.	0.44	0.41	0.36	0.39	0.75	0.23	0.77
Skewness	-0.17	0.91	-0.28	-0.32	-0.45	-0.40	-1.83
Kurtosis	1.80	2.40	2.79	2.80	2.30	2.70	7.68
Observations	42	42	42	42	42	42	42

	k	у	ор	pd	ds	ir	inf
k	1.00						
у	0.74	1.00					
ор	0.84	0.67	1.00				
pd	-0.14	-0.47	-0.12	1.00			
ds	-0.40	-0.04	-0.41	0.31	1.00		
ir	0.46	0.13	0.59	0.17	-0.37	1.00	
inf	0.17	0.29	0.11	-0.33	-0.15	0.08	1.00

Table C6. Correlation matrix: the investment model in Eq. (12).

Table C7. Summary statistics: the investment model in Eq. (13).

	k	у	ор	epd	dpd	ds	ir	inf
Mean	3.01	5.87	2.95	-0.83	4.11	2.64	2.33	2.91
Median	3.12	5.70	3.02	-0.72	4.11	2.85	2.38	3.01
Maximum	3.65	6.73	3.66	0.32	4.78	3.80	2.74	4.22
Minimum	2.18	5.37	2.07	-2.28	3.10	1.03	1.92	0.00
Std. Dev.	0.44	0.41	0.36	0.71	0.39	0.75	0.23	0.77
Skewness	-0.17	0.91	-0.28	-0.27	-0.31	-0.45	-0.40	-1.83
Kurtosis	1.80	2.40	2.79	2.14	2.81	2.30	2.70	7.68
Observations	42	42	42	42	42	42	42	42

Table C8. Correlation matrix: the investment model in Eq. (13).

	k	у	ор	epd	dpd	ds	ir	inf
k	1.00							
y	0.74	1.00						
ор	0.84	0.67	1.00					
epd	-0.44	-0.60	-0.41	1.00				
dpd	-0.13	-0.47	-0.12	0.81	1.00			
ds	-0.40	-0.04	-0.41	0.52	0.31	1.00		
ir	0.46	0.13	0.59	0.05	0.17	-0.37	1.00	
inf	0.17	0.29	0.11	-0.42	-0.33	-0.15	0.08	1.00