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A research report submitted to the Faculty of Commerce, Law, and Management, University of the Witwatersrand, partially fulfils the requirements for the degree of Master of Management in Finance & Investments.

Research tittle: **Public Debt and Government Guarantees**

By

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Abstract

The focus of this research paper is to examine the relationship between public debt and government guarantees. The analysis considers various macroeconomic indicators, including short-term and long-term interest rates, budget deficits and real GDP growth rate, as control variables. The study predominantly concentrates on 16 European countries, with South Africa being the only African country in consideration. The study employed Generalized Methods of Moments (GMM) which is a Dynamic Panel Data technique, and Fixed Effect in establishing this relationship. The study found a positive association between public debt and government guarantees, short-term real interest rate, and its lag as estimators using the Fixed Effect model. However, budget deficit, real GDP growth, and long-term interest rates exhibit a negative and significant relationship.

Keywords: Government Guarantees, Real interest rates, Budget Deficit, GDP growth rate.

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Ethical clearance

All ethical issues in this research were taken into consideration and observed. Permission to obtain the secondary data was obtained—the fundamental research adhered to all ethical requirements.

Acronyms and Abbreviations

DPDA	Dynamic Panel Data Analysis
PI	Private Investment
PS	Private Savings
GDP	Gross Domestic Products
IMF	International Monetary Fund
GMM	Generalized Method of Moments
FR	Foreign Reserve
TDSK	Total Debt Stock
FRINV	Foreign Investment
DSP	Debt Service Payment
IDC	Industrial Development Corporation

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1. Introduction

1.1. Background

This paper focuses on the impact of government guarantees on public debt, with real interest rates, budget deficit and real gross domestic product growth rate as control covariates. Determining the impact of government guarantees on the rise in public debt is the primary goal of this paper. Understanding the effect of government guarantees on government debt is important because of the increasing risk of defaults of both public and private debt holders (Leonello, 2018; Bajo and Primorac, 2011; Bredenkamp et al., 2019). Due to the significant impact, it has on the economy, public debt is a topic of constant discussion in the current global environment. It is important to consider that the size or amount of the public debt is related to the surplus or deficit in the national account, which in turn depends on the goals of the nation's policymakers (Taib and Alam, 2013). In most cases, the old debt is replaced with the new debt, so there is typically a certain amount of debt present in the portfolio of public debt (Musgrave, 1984), and (Reinhart and Rogoff, 2008, 2009).

Understanding the role of guarantees in shaping public debt is of paramount importance and has so far been overlooked by the existing literature on guarantees (Ester, 2017). Government guarantees to financial institutions are common all over the globe. They often come in different forms, ranging from standard deposit insurance schemes to the promise of an ex-post bailout in the case of a financial institution's failure, (Allen et al., 2017). The recent outbreak of Covid -19 pandemic which led to many businesses coming under severe financial distress and call for massive government guarantees, has sparked renewed interest and debate about government intervention in the financial sector. Government action has often been effective in restoring confidence and maintaining financial stability during a crisis, and it does not have a negative impact on public finances, the financial health of banks and companies, or the cost of funding.

Barro (1979) discusses how debt can be used to smooth out taxes and the associated distortions when the desired path of government spending is not straightforward. According to (Sobel et al., 2006), when an economy is not performing optimally, the government should implement an expansionary fiscal strategy and increase the budget deficit to support funding and guarantee favourable borrowing terms. For example, since 1996, the Croatian government has been issuing financial and performance guarantees in the financial market of state-owned companies. However, state guarantees are rarely included in clearly defined public debt and risk management strategies and objectives. The composition of active guarantees and how they affect Croatia's public debt is still unknown, despite the steady growth in their use. The focus of the presentation is an overview of the literature on the relationship between the national debt and government guarantees, based on several countries both in developed and developing nations, including South Africa.

State guarantees have rarely been included in clearly defined public debt and risk management strategies and objectives. However, government guarantees are considered an effective tool used to prevent the occurrence of financial crises and mitigate their negative effects. However, such provisions can distort the banks' risk-taking incentives and induce them to take excessive risks. Because of such moral hazard problems, the provision of government guarantees can result in pervasive outcomes increasing the overall instability in the banking sector and even increasing the government debt stock (Kunt and Detraigiache, 1998). According to the ESA 95 methodology, the budget deficit is automatically accounted for when a protested guarantee affects the public debt's growth, (Bajo and Primorac, 2011) . In comparison to levels that prevailed in earlier decades, real interest rates appear to have increased in virtually all industrialized countries in the 1980s and 1990s.

It is feared that this rise in interest rates may be a result of growing public debt, which will be stifling to private-sector activities Additionally, there has been a rise in the integration of the capital markets internationally, suggesting that interest rates may be sensitive to changes in the world's fiscal situation, (Ford and Laxton, 1999). With more integration, the spillover of financial distress is likely to bring systemic effects to various sectors in the economy globally. To spur production and maintain economic growth, a nation's economy needs a certain amount of capital. When government spending outpaces tax revenue, there is a budget deficit, which must be filled by borrowing money from the private sector or other governments, (Mankiw, 2013). According to (Rahman, 2012a), public debt occurs when government holdings of securities are insufficient to cover prior budget deficits. Concerns have been raised about whether borrowings could improve economic growth or whether they could become a financial burden on future generations because of the dramatically rising public debt in developing nations.

According to (Reinhart and Rogoff, 2010), having a high debt load can have a detrimental effect on economic growth. In the case of South Africa, a recent study by (Marimuthu, 2020), which examined whether government assistance to State Owned Enterprises (SOEs) influences the financial performance of state-owned enterprises, found that support by the government in the form of guarantees and subsidies has a significant negative effect on the financial performance of SOEs in South Africa. Usually, when tax revenues fall short of expenditure estimates, government guarantees analysis and public debt, and interest rate will be considered. The realization of the stimulating effect of fiscal policy on the growth of public debt led to a sharp increase in public debt worldwide, and a growing national income.

1.2. Research gap

Research paper by (Bajo and Primorac, 2011) focus only on the effect of government guarantees on public debt for selected European countries, without the inclusion of any African country. This paper tackles the same questions to provide new insights on any about the impact government guarantees have on public debts in 16 European countries and one African country (South Africa). The aim is to determine the desirability of government guarantees as a determinant of public debt controlling for other macroeconomic variables. Abraham and Schmukler (2017) focus on the assistance government credit guarantees have on state-owned enterprises and do not highlight the cost of debt advantages on state-owned enterprises in South Africa. The government gives loans and guarantees to SOEs to lower borrowing costs and relieve pressure on the domestic capital market, as borrowing money without the government's guarantee would be prohibitively expensive (Sadiki, 2015). A study highlighting the management of government guarantees, the impact of real interest rates, budget deficit and the impact of real GDP growth is needed for developing nations to influence policy decisions on whether government involvement in an economy can ensure a prolonged and sustainable growth.

Another study by (Beyhaghi, 2022) focuses on state guarantees by the American government on American corporations, American banks, and small medium type enterprises in that country without giving reference to developing African countries. Abraham and Schmukler (2017) focus on the assistance government credit guarantees have on state-owned enterprises and do not highlight the cost of debt advantages on state-owned enterprises. The study by (Zia, 2008) revealed that credit guarantees issued to financially unconstrained SOEs have no impact on state debt of public guarantees for financially constrained SOEs. The study by Prats and Moskovits 2020), also showed that the risk management of credit guarantees on total government debt does not explain the impact of government credit guarantee materialization on total government debt. In South Africa, not all studies done on state credit guarantees speak about the materialization of credit guarantees on total government debt or the reduced cost of debt to SOEs because of government guarantees. Many of these scholars have only shown negative concerns about government guarantees on fiscal risks, sovereign risks, valuing credit guarantees, disclosure of credit guarantees, and rising government debt caused by these states guarantees. Literature reviewed speaks of the positives effects of government guarantees to SOEs in South Africa.

1.3. Objectives of the study

The main objective of this study is to find out the effect of state guarantees on the state debt. The objective will be pursued considering other controls such as government guarantees, long-term and short-term interest rates, budget deficit and the real GDP growth rate. Research papers that study the relationship between public debt and government guarantees, real interest rates, budget deficits and real GDP growth in selected developing and developed countries such as South Africa, are scarce. However, there is a large body of literature on the relationship between debt and GDP growth; there is still considerable uncertainty on the relationship between government guarantees and public debt.

1.4. Research question

Financial institutions are intrinsically fragile to what their role is as liquidity providers. This often result in limited liquidity. The research question in this paper aims to investigate the impact government guarantees have on public debt in 16 selected countries; control variables such as real interest rates (both long-term and short-term), budget deficit, real GDP growth rate and government guarantees as a percentage of GDP, are also used to substantiate the investigation of the research question:

What is the effect of government guarantees on public debt?

1.5. Contribution of the study

This study makes empirical contribution to the existing literature. We estimate the effect of government guarantees on public debt using a panel data method. The national debt or government debt mainly results from the debt-financed deficit activities. Analysis of the growing size of government guarantees impact on public debt has become more crucial because of the sharp increase in state guarantees issued since the 2007 financial year of assessment (Bajo and Primorac, 2011). More and more countries are using public debt to obtain additional financing to meet government-financing needs that cannot be met through conventional taxation mechanisms. That is why the expenses of the government sector grow faster than revenues, and the surplus is mainly financed by domestic and foreign loans.

1.6. Significance of the study

Expensive government borrowing (in case of rising interest rates) can trigger inflation and bring about macroeconomic instability in the process. This trend worries policymakers because it undermines macroeconomic stability, especially in emerging and developing economies where monetary institutions are relatively weak and dependent on monetary policy formulation and implementation. Therefore, the relationship between national debt and other macroeconomic factors is important in the development process of an economy, (Reinhart and Rogoff, 2010) and (Woo and Kumar, 2015). Issued and lingering financial guarantees could endanger the expansion of the public debt.

Analysis of the growing size of government guarantees impact on public debt has become more crucial because of the sharp increase in guarantees issued since 2007, (Bajo and Primorac, 2011). Thus, unpacking the effect of government guarantees on public debt will help policymakers to make sound fiscal policy decisions.

The remainder of this research report is as follows: Section II reviews the literature, Section III presents the model specification, Section 4 presents the empirical results and discussion. Section 5 concludes the work with some recommendations.

2. Literature Review

2.1. Theoretical background

This chapter presents the literature review of public debt and government guarantees and other covariates, which determine public debt. The recent ongoing debate is whether government guarantees have a net positive effect on government debt. The bifurcation of the matter arises from the fact that continued government bailouts to poor-performing state-owned enterprises exacerbate their poor financial performance and encourage these enterprises to become too reliant on government assistance, burdening the national fiscus, (Murimuthu, 2020). A similar study by (Keister, 2012), finds that in the absence of government guarantees (bailouts) banks tend to invest in short-term instruments as a form of private insurance against a potential bank run. While gradual build-up in debt is often attributed to the "debt bias" of government, this does not explain the sudden increase in the debt spikes observed recently, (Reinhart and Rogoff, 2010). Such spikes are often caused either by the exchange rate crashes that cause the external debt burden to soar or by the government assuming responsibility for private sector debt – a contingent liability shock, (see Jaramillo et al. 2016). Of these potential debt obligations, bailouts of financial institutions, especially banks, are often the most important source.

Bredenkamp et al. (2019) provides an extensive review of the benefits and challenges; countries face in trying to navigate the nexus between government guarantees and government debt. Bova et.al. (2016) argue that the average fiscal cost of a financial sector bailout episode accounts for 9.7 percent of GDP and has historically been as high as 57% of GDP. Moreover, the bailouts (government guarantees) often take place during recession, when government debt is already on the rise. Reinhart and Rogoff (2008) argue that such financial shocks often worsen recessions and exacerbate the indirect costs of public finances. This gives more reasons for the investigation of the relationship between government guarantees and government debt. Sources of literatures have detailed the need for government guarantees in ensuring the stability of financial system during crisis (Borio, 2012). Government guarantees are an essential tool used by government to ensure that support is in place in the event of systemic risk to the financial market. Such provision has overreaching implications on government debt, (Hett and Schmidt, 2017).

Government's ability to borrow is often anchored around its ability to meet its future payment obligations, not necessary its ability to provide government guarantees assurance to lenders that in the event of financial collapse, there is a mechanism in place to mitigate such risks, (Nier and Baumann, 2006; Hryckiewicz, 2014). The assurance that debt holders will not renege on its debt obligations creates a healthy financial system, which is important for economic growth. Dell'Ariccia (2012) provides merits for having government guarantees by arguing that if there are well-designed supporting policies for government guarantees, such policies can improve financial stability and reduce risk bailouts and debt explosion risks. However, (Allen et.al., 2015) argue that provision such as government guarantees, tends to generate significant negative effects in terms of sovereign fiscal positions, banking, and firm financial health, and rise cost of funding.

Diamond and Dybvig's (1983) seminal work, pave the way for the introduction of government guarantees in academic research. Their work emphasizes the role financial institutions such as banks play in creating liquidity in the economy, hence the need for the provision of safe rails in the event of financial shocks. (Demirguc-Kunt and Detragiache, 2002; Kunt and Huizinga, 2004; Ioannidou and Penas, 2001), used cross country dataset to show that the provision of deposit insurance (guarantees) adversely affects the monitoring incentives of all investors having claims on the financial institution, therefore, increasing the probability of a banking crises. Bredenkamp et al. (2019), give further reasons why government guarantees are necessary for a well-functioning financial system. They argue that first, availability of a government bailout, tends to create credibility and solve a time inconsistency problem, where the lack of credibility of government stopping the support thus tend to ensure they safeguard the financial sector since the cost of letting it collapse outweighs the immediate benefits.

Benford et al. (2016), explains how government guarantee bond, which are linked to GDP are used to mitigate debt explosion risk. By linking debt to nominal GDP during recession the value of debt reduction - which provides automatic debt and increases fiscal space - can be used for cyclical policy. Moreover, the reduction of default risks through provision of government guarantees will decrease the likelihood that credit spread will results in contractionary monetary policy, thereby further supporting growth. Pienkowski (2017) describes the mechanism through which a GDP-linked bond (guarantees) works to raise a country's maximum sustainable debt.

In summary, presence of government guarantees, though they present a risk of moral hazard in debt management, if well designed, may play a crucial role in alleviating pressure on debt obligations and financial needs during a crisis. The next section of this paper discusses the consequences of government guarantees and contingent liabilities. Thereafter, provide a brief discussion of the literature on other covariates used as controls in this paper. Each covariate is discussed separately to give more clarity. Even though the consorted effort is put towards acknowledging most of the important findings in these areas, this literature review is not exhaustive, but note that its lacking is not because of the lack of effort, but purely due to time and space constrains.

2.2. Empirical evidence

2.2.1. Government Debt and Government Guarantees

Government guarantees can pose a threat to effective fiscal management because they are not included in fiscal policy analysis, giving a distorted picture of public finances, and posing a challenge to reliable projections on the future impact of fiscal policy, according to (Bajo and Primorac, 2011). Government guarantees, however, are not the most appropriate form of support to achieve a desired purpose (IMF, 2005). According to a study conducted by Leonelle (2018), government guarantees play a crucial role in connecting banks with sovereign stability, even if banks do not hold any sovereign bonds. The study also suggests that the effectiveness of guarantees in strengthening the bank-sovereign relationship depends on the type of economy and banking crises involved. In certain circumstances, increasing the size of guarantees can promote financial stability without jeopardizing the solvency of the sovereign.

Guarantees issued by other government agencies, such as development banks, are particularly controversial because they are difficult to monitor and control. Possible state guarantee costs positively correlate with the risk of implementing a financial project, its value and duration (Polackova, 1998). Guarantees can pose many problems because they are not monitored as part of the regular budget expenditure (Bajo and Primorac, 2011). Government credit guarantees exist where the state can predict risk, regulate risk exposure, and minimize risk cost; these credit guarantees then serve as a fiscal tool of financial support for infrastructure and public goods investments (IMF, 2005). Government credit guarantees are contingent liabilities as their repayment is contingent upon the occurrence of a particular event (Frits and Jane, 2018).

Contingent liabilities have contributed enormously to fiscal risk according to a study, (Bova, Arranz, Toscani, & Ture, 2016) . On several occasions, the inability to declare, disclose and prepare for such risks caused by these contingent liabilities has resulted in massive increases in government debt and triggered significant fiscal crises (Cebotari, 2008 and MF, 2012). The materialization of contingent liabilities losses in the short to medium term in South Africa for instance is likely to put upward pressures on government debt. Since the state is the one, which will pick up the bill from such losses, the net government debt is likely to increase, posing the risk of its sustainability (Bachmair and Bogoev, 2018).

2.2.2. The effect of the Government Guarantees on Government debt.

Government guarantees can have both beneficial and harmful consequences on government debt. They can be used to lower capital costs, secure long-term financing, and therefore, play a crucial role in lowering the cost of capital. However, in the event of financial distress government will have to bail out the firms both private and public. Doing so will result in an increase in government debt (National Planning Commission, 2010). Gozzi and Schumuckler, (2016) undertook a study to determine the effectiveness of state credit guarantees in mitigating default risks for small enterprises.

In a study by (Leonello, 2017) on government guarantees and the bank sovereign nexus, he finds that public guarantees may increase financial sustainability without discoursing sovereign solvency, which would ensure a positive response between the bank and sovereign stability depending on the status of a nation's economy. Based on his finding, one would expect that government guarantees will have a positive impact on government debt such as the increase in the availability of government guarantees will decrease the potential risk of rising government debt, contrary to Marimuthu's (2020) findings. (Murimuthu, 2020) study on whether the government supports SOEs using government guarantees in South Africa poses moral hazard behaviour among recipients of such guarantees, argued in favour, that the presences of government guarantees cause a moral hazard problem. In such an event, the government guarantees are expected to have an adverse effect on government debt. According to Mankiw (1986), the goal of a credit guarantee is to counteract inefficient credit allocation induced by knowledge asymmetry between borrowers and lenders. In the South African context, the goal specified by Mankiw (1986) is to ensure that SOEs access funding from financial institutions such as the IMF even when the quality of their assets does not permit them to provide collateral for the funding required.

An optimum credit guarantee based on the lending institution's financial strength, macroeconomic conditions, and state policy objectives needs to be established (Yoshino & Hesary, 2018). Guarantees from the government can have both beneficial and harmful consequences as stated previously. They can be used to lower capital costs and secure long-term financing (National Planning Commission, 2010). The study by Gozzi and Schumuckler, (2016) was trying to prove the effectiveness of state credit guarantees in reducing funding costs for small-medium-type enterprises. In a study by (Leonello, 2017) on government guarantees and the bank sovereign nexus, he asserts that public guarantees may increase financial sustainability without discoursing sovereign solvency, which would ensure a positive response between the bank and sovereign stability depending on the status of the nation's economy.

Credit guarantees shift risk from borrowers to the government (and, eventually, taxpayers), causing moral hazard problems and affecting resource allocation efficiency (Dong, Hou, and Ni, 2021). Furthermore, credit guarantees shift risk from borrowers to the government and, eventually, taxpayers, causing moral hazard problems and affecting resource allocation efficiency (Dong, Hou, and Ni, 2021). For example, the South African government had to honour its credit guarantee to the Land Bank of South Africa, amounting to R10 billion, as the Landbank defaulted on its bonds (2020 Budget Speech, SA). On the positive side, Government Credit Guarantees (GCGs) are expected to boost GDP growth by increasing economic additionalities such as job creation, factor productivity, technology, and knowledge spillovers (Cowling and Mitchell, 1997; Riding and Haines, 2001; Green, 2003).

As a result, GCGs can be essential in encouraging funding for SMEs in emerging economies, which have a more significant financing gap than advanced nations (Wu, Song, and Zeng, 2008; Kim, 2004). A study by (Mothibi and Mncayi, 2019) on key drivers of government debt in South Africa, shows that contingent liabilities in the form of government credit guarantees are significant contributors to the rising government debt. They further state that most governments' contingent liabilities have been chiefly accounted for by inefficient state-owned entities (Budget Review, 2018), which have posed a significant risk to the fiscus. The materialization of contingent liabilities, in combination with other factors such as exchange rate depreciation is the cause of significant unexpected increases in the debt-to-GDP ratio over the last 10 to 15 years (IMF, 2003; Cebotari , 2009; Jaramillo and Granados, 2015), with high fiscal costs. These fiscal costs, because of contingent liabilities, reached 50% of GDP during the Asian and Latin American crises (Honohan and Klingebiel, 2000); fiscal costs attributable to contingent liabilities from natural disasters have historically been as high as 10% of GDP (Freeman et al, 2003). The global financial crisis and several episodes of bank restructuring or recapitalization have taken a significant toll on government budgets, demonstrating the substantial implicit guarantees governments frequently provide to the banking sector (Amoglobeli et.al., 2015; IMF, 2015).

2.2.3. Contingent Liabilities

Calls on contingent liabilities or credit guarantees in the banking system, other sections of the public sector (state-owned companies and subnational levels of government), and the government's contracts with private sector agents contribute to fiscal risk (Cebotari, Davis, Lusinyan and, Mati, 2009). The risks inherent due to credit guarantees to SOEs have a material bearing on the sovereign balance sheet. For instance, the cost of credit guarantees to the public balance sheet in 2003 amounted to 1.6 percent of the GDP in the Dominican Republic, where the government had to save two national electricity suppliers and assumed the debt of other state-owned enterprises. In 2004, the Colombian government assumed an amount of $ 2.4 billion belonging to a Metro system of a Colombian SOE; this amounted to 2.1 percent of that country's GDP. The SOE debt amounted to 9.4% of the GDP in developing economies according to the 2020 financial period report. In developing economies, SOEs-guaranteed debt as a percentage of GDP amounted to 4.7% in 2020 (Prats and Moskovits, 2020). Against the above backdrop, government guarantees have a significant effect on government debt position around the world.

The guarantee programs can help small-medium-type enterprises grow by lowering their external funding costs (Gozzi and Schumuckler, 2016). Contradicting suggestions are that continuing government bailouts of underperforming state-owned firms exacerbates their financial problems and encourage them to become overly reliant on government aid, putting a strain on the public budget (Marimuthu, 2020). On the other hand, extensive guarantees to SOEs put the fiscus at risk, causing the country's fiscal condition to deteriorate and affecting credit ratings (Peterson, 2016). Guarantees may jeopardize the efficiency of public financial management and may even obstruct accurate forecasting of future fiscal policy consequences (Bajo and Primorac, 2011).

State-owned enterprises (SOEs) are critical to the South African economy because they are seen as key drivers of economic growth and essential vehicles for providing critical infrastructural services such as transportation, energy, and water, allowing the economy to grow while assuring equal access to high-quality services to all (Kikeri, 2018). SOEs can be categorized as commercial or non-commercial businesses depending on the reason for their establishment.

Commercial SOEs are government business companies that carry out government services commercially and are owned entirely or partially by the government (Moeti, 2013). Government contingent guarantees (GCGs) play a critical role in ensuring that state-owned enterprises provide essential services such as roads, electricity, health, and education. Because there are so many transmission channels between SOEs and the budget, shocks to SOEs are likely to influence the government's budget or balance sheet. These impacts can be automatic, such as smaller profit margins resulting in smaller payouts, or they can only occur if the government assists in improving the company's financial health. Governments require a comprehensive grasp of the channels and probable variables that explain vulnerabilities in SOEs to be able to monitor and reduce fiscal risks (Baum et al., 2020). To safeguard SOEs, government liability stock is susceptible to shocks resulting from these SOEs financial performance or lack thereof. It is imperative that the state invests in mechanisms to minimize the need for bailout for its SOEs, to rain on their unscrupulous spending and financial mismanagement.

2.2.4. Government Debt and Economic Growth

Debt and economic growth nexus are widely explored, with mixed results (see Abbas and Christensen, 2010; Pattillo et al., 2004; Kumar and Woo, 2015) Generally, the studies have set out to establish how government debt affects economic growth. Intuitively, what role does government debt play in explaining economic growth. The popular study of (Reihart & Rogoff, 2008, 2009, 2010), argues that debt has a negative correlation with economic growth. These findings are met with criticism from the likes of Herdon et al. (2014), who argues that Rogoff and Reinhart's findings are time sensitive and that such a link between them does not exist. The notable difference between previous studies and this study is the direction of relationship. While previous studies endeavour to establish how debt affects economic growth, this paper aims to establish how the economic growth affects government debt. The assumption is that improvement in economic growth will result in a decrease in government debt.

Many other different empirical approaches have been used to investigate the relationship between public debt and economic growth. Asteriou et al. (2020) argue that the study period, country selection and assessment methods can often strongly influence the results, as (Panizza and Presbitero, 2013) note that models at the theoretical level produce ambiguous results. The relationship between government debt and economic growth, so the relationship between the two is essentially an empirical question. Rogoff and Reinhart (2009, 2010) did a threshold study of debt sustainability in relation with public debt and economic growth and argued that, at a certain threshold, debt is not a problem-yet their finding is correlation not causal.

The abovementioned findings build on Barro's (1979) paper, which considers the relationship between public debt and economic growth, arguing that excess debt can reduce growth by increasing interest rates and crowding out investment. Moreover, (Panizza and Presbitero, 2013), claim that there are no empirical studies that can definitively demonstrate a causal relationship between debt and economic growth. Despite this, Pattillo and others observe a strong negative effect of high public debt in poor countries. Herdon et al. (2004) concluded that per capita growth in highly indebted countries falls by 1% when debt is doubled. Cecchetti et al. (2011) argue, based on an analysis of 18 OECD economies, that there is a threshold of 85% debt to GDP ratio, above which future economic growth declines. They conclude that a 10% increase in government debt to GDP ratio after this threshold reduces annual economic growth by 0.17-0.18% over the following five-year period.

2.2.5. Government debt and Interest rates

Higher interest rates cause the demand for government paper to rise, resulting in government debt mopping up all the liquidity in the market and therefore crowded out investment, inhibiting interest-sensitive spending on consumer durables, and reducing the value of assets held by households, indirectly dampening consumption spending through a wealth effect. Engen and Hubbard (2004) suggest that the magnitude of these potential negative consequences depends on the extent to which government debt raises interest rates. Most of the empirical evidence suggests that all else equal, a 1% increase in debt to GDP would raise the long-term real interest rate by about three basis points. Although one specification suggests a larger impact, while some find estimates that are not statistically significantly different from zero,(see Engen and Hubbard, 2004; Rogoff and Reinahrt, 2010; Soyres et al., 2022) .

Government debt is an essential mechanism for the State to finance public spending, especially when it is struggling to increase taxes and decrease public expenditure. Financing public spending has left many governments with vast debt (Yusuf and Mohd, 2021). Increasing government debt problems can limit the state's ability to pursue more effective investment programs in infrastructure, education, and public health (Johnny and Johnnywalker, 2018). The state's public finances are essential for a fiscal policy that promotes economic growth. Public balance sheets are exposed to fiscal risks and can damage the state's intention to exercise good fiscal policy. Materialization of contingent liabilities has an impact on government finances and threatens the fiscal debt of the state. Contingent liabilities in the form of government credit guarantees are an essential element of fiscal risk (Bachmair and Bogoev, 2018).

2.2.6. Government Debt and Budget Deficit

By definition, a country faces a budget deficit when government expenditure exceeds its revenue. In other words, the level of public savings is negative (Hayati and Rahman, 2012). One can consider the budget deficit as the mother of the public debt, since the occurrence of budget deficits usually leads to the creation of public debt. However, in the case of external public debt, everything remaining the same, the current account deficit and exchange rate depreciation also come into play and are significantly related to it (Alam and Taib, 2013).

Fiscal deficits are necessary for the buildup of public debt, according to (Tanzi and Blejer, 1988) since the need to finance the difference between ordinary government revenues and total expenditures typically results in the problem of government liabilities. The government will need to borrow money from either private domestic sources or foreigners to cover the increased budget deficit (Sobel et al., 2006). According to (Rao et al., 1994), a country faced with a rising current deficit must borrow money from abroad or other financial institutions to finance its current account deficit. According to Edwards (2000), a country's current account position is influenced by the rate at which foreigners are expected to amass its financial liabilities.

2.2.7. Summary

This chapter has explored various possible information regarding the area of the study. Given this exploration, it is still found that there is a need to research the model or framework that uncovers the factors that may influence the impact on the public of government guarantees, budget deficit, real interest rates, real GDP growth in South Africa and the European Union (EU) selected countries. The following chapter will discuss the Research methodology and the study's results.

3. Research methodology and data

This chapter presents the data analysis results of this study. Secondary data for the past twelve years, on government debt as a percentage of GDP, government guarantees as a percentage of GDP, percentage of long-term interest rate, and percentage of short-term interest rate. The other variable is budget deficit as a percentage of GDP, and annual real GDP growth rate were collected from the World Bank WDI, Eurostat, OECD Data, International Financial Statistics (IFS) and the South African National Treasury. The data assembled were analyzed using R (R-project.org, 2023) and Stata software.

3.1. Methodology

Bajo, and Primorac, (2011) used a simple linear regression model to establish the impact of issued government guarantees on public debt. The dependent variable in their model is public debt with only one independent variable being government guarantees. Bajo, and Primorac, (2011) do not include other impact control macroeconomic variables which influence public debt in their study. However, the structural model of Merton (1974) and Merton (1977) incorporated potential government guarantees as both calls put options which also represented government guarantees as equity element in that model and ignored the impact government guarantees has as a macroeconomic control variable. The impact of government guarantees, real interest rates (both short term and long term), budget deficit and the real GDP growth rate is extrapolated from a model by Blanchard (2008), which is stated in equation (1) below, where public debt (B_t) is a function of real interest rates (r_t); real GDP growth (g_t) and budget decifit ($G_t - T_t$).

$$\frac{B_t}{Y_t} = f\left(r_t, g_t, \frac{B_{t-1}}{Y_{t-1}}, \frac{G_t - T_t}{Y_t}\right) \quad (1)$$

3.1.1 Model specifications

The objective is to investigate how government guarantee affects public debt; therefore equation (1) can be reformulated as follow to account for it:

$$\frac{B_t}{Y_t} = f\left(r_t, R_t, g_t, \frac{B_{t-1}}{Y_{t-1}}, \frac{G_t - T_t}{Y_t}, \frac{GG_t}{Y_t}\right) \quad (2)$$

Where $\frac{GG_t}{Y_t}$ is government guarantees to GDP ratio. The econometric specification of the model in equation (2) is as follows:

$$b_t = \alpha_b b_{t-1} + \alpha_r r_t + \alpha_R R_t + \alpha_g g_t + \alpha_d pd_t + \alpha_{gg} gg_t + \varepsilon_t \quad (3)$$

The panel data specification of the model in equation (3) is presented as follows:

$$b_{it} = \alpha_b b_{it-1} + \alpha_r r_{it} + \alpha_R R_{it} + \alpha_g g_{it} + \alpha_d pd_{it} + \alpha_{gg} gg_{it} + \varepsilon_{it} \quad (4)$$

Where, b_{it} is public debt as a percentage of GDP, r_{it} is the real interest rate percentage, $\alpha_R R_{it}$ is the long term interest rate, pd_{it} is the budget deficit as a percentage of GDP, gg_{it} represents government guarantees as a percentage of GDP and ε_{it} represents error terms. The assumption made here are that the data sample is random, normally distributed and error terms exhibit white noise. The advantages of using panel data techniques are expounded extensively in Baltagi (2013).

4. Empirical results

This chapter presents the data analysis of the results for this study. Secondary data for the past twelve years on government debt as a percentage of GDP, government guarantees as a percentage of GDP, long-term interest rate in percentage form, short-term interest rate in percentages and budget deficit as a percentage of GDP. The other variable is the annual real GDP growth rate are collected from the World Bank WDI, Eurostat, OECD Data, International Financial Statistics (IFS), the South African National Treasury. The data assembled was analyzed using R (R-project.org, 2023) and Stata software's. The objective here is to investigate how public debt responds to macroeconomic variables, mainly government guarantees. Other covariates such as real interest rate, budget deficit, and real GDP growth are included as control variables. Below is the research question for this paper regarding the impact government guarantees have on public debt:

What is the relationship between public debt and government guarantees?

The next sections present the panel data that was assembled, data visualization, and regression analyses.

4.1. Descriptive statistics

Table 4.1 presents the descriptive statistics of the variables used in the study. Notable finding here, is that GDP growth, Budget deficit, Nominal long interest rates, real long-term interest rates, and nominal short-term interest rates have a standard deviation greater than a mean. This could be due to heterogeneity of policies governing these variables in different countries. Macro prudence vary across countries, and thus the averages of these macroeconomic variables are likely to be different. Short-term real interest rates and Budget deficits are negative per average across the panel. The debt variable is larger than other variables. While the other variables are positive. Table 5.5 in the appendix shows the list of countries included in this study.

Table 4.1 Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
Budget Deficit	192	-3.121	3.601	-14.6	11.4	-13.4	10.13	.176	4.863
GDPgrowth	192	1.512	3.446	-11.325	13.072	-10.1	8.4	-.913	5.458
Nominallrate	192	3.201	3.208	-.511	22.497	-.377	15.749	1.883	9.55
Reallrate	192	1.395	3.074	-4.686	20.996	-3.44	12.419	1.979	11.91
Realsrate	192	-.948	1.66	-5.652	3.536	-5.232	3.081	.239	3.048
Nominalsrate	180	.914	1.943	-.549	7.331	-.549	7.228	1.949	5.818
Inflation	192	1.805	1.735	-1.736	6.571	-1.545	6.13	.437	2.812
Debt	192	73.924	40.186	15.2	206.3	15.3	194.5	1.113	3.867
Year	192	2015.5	3.461	2010	2021	2010	2021	0	1.783

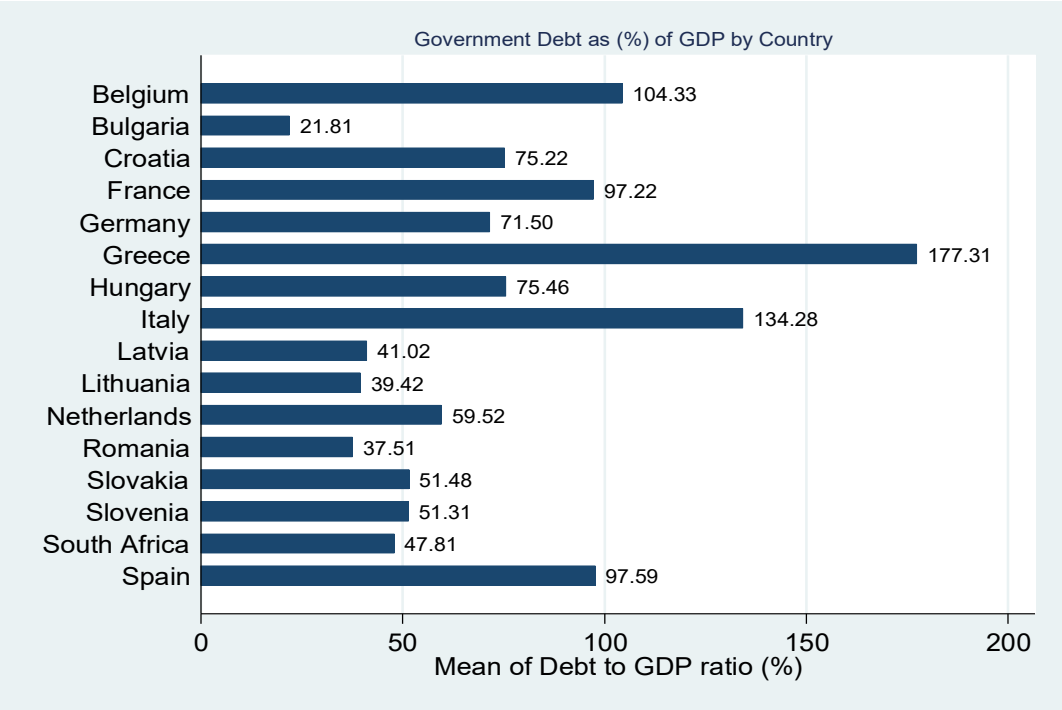
Source: Own computation based on data collected

Average % Guarantees = Average government guarantees as a percentage of GDP
Average % Debt = Average government debt as a percentage of GDP
Average % GDP Growth = Average real annual GDP growth rate in percentage
Average % Budget Def = Average budget deficit as a percentage of GDP
Average % LT Int. Rate = Average percentage of long-term interest rate
Average % ST Int. Rate = Average percentage of short-term interest rate

In the appending graphs, government debt as a percentage of GDP, government guarantees as a percentage of GDP, long-term percentage of real interest rate, short-term percentage of real interest rate, budget deficit as a percentage of real GDP, real GDP annual growth rate in percentage were plotted against the 12-year period under study for each of the countries using the same scale. Figure 4.1 shows the plots for the government debt as a percentage of GDP for all the countries in the study, including South Africa. Countries such as Belgium, France, Greece Italy, and Spain have debt to GDP ratio above 90% argued by (Rogoff and Reinhart, 2010). Thus, these countries are likely to struggle to manage their debt levels going forward and their economic growth prospect is likely to be impaired. Eastern Europe countries such as Bulgaria, Latvia, Lithuania, Romania, Slovenia, and Slovakia have debt to GDP ratio below 60%, which is appropriate for emerging economies according to (Rogoff and Reinhart, 2010).

South Africa's debt to GDP ratio is 47.81%, which is within the region of sustainability for developing countries. The variation in debt to GDP ratio across countries is likely to be affected by exogenous shocks such as financial crises, pandemics. For example, Greece and Spain were highly affected by the financial crisis of 2008-2009. Bulgaria has the lowest debt to GDP ratio in the sample, while Greece has the largest.

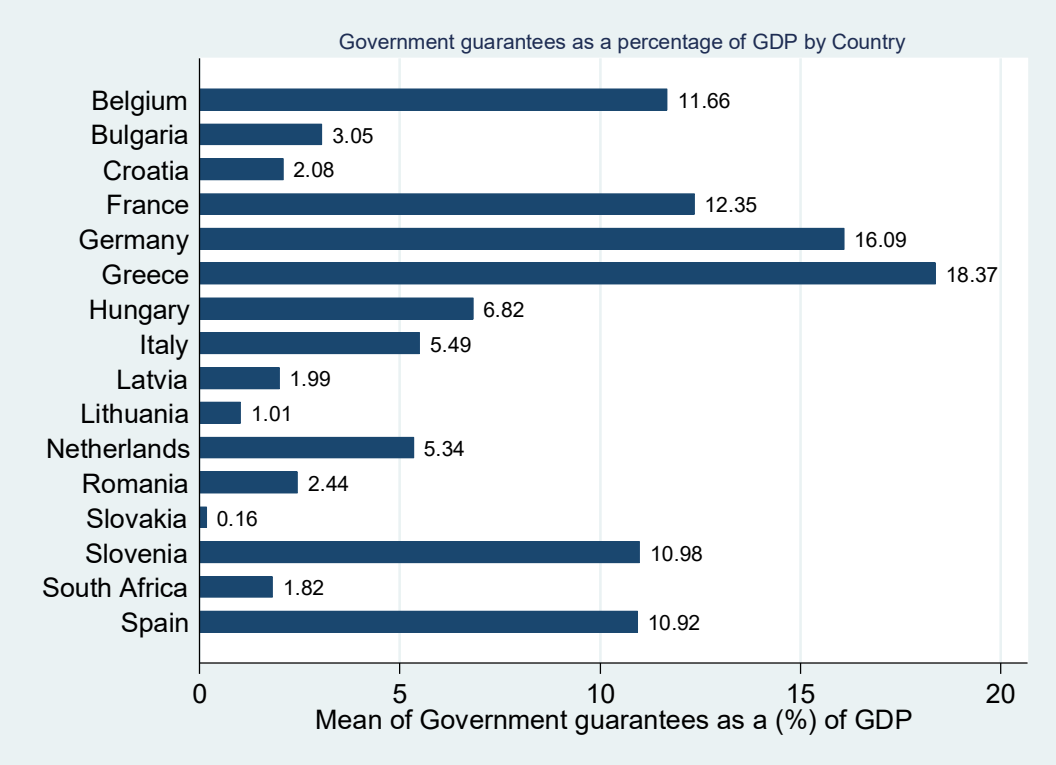
Figure 4.1: Government debt as a percentage of GDP



Source: Stata (Self computed)

Figure 4.2 shows the plot for the government guarantees as a percentage of GDP for all the countries in the study, including South Africa. Again Greece, Germany, France has the average government guarantees of 18.37%, 16.06% and 12.35%. Whereas, Belgium, Slovenia and Spain have government guarantees of 11.66%, 10.98% and 10.92% respectively. Similarly, Hungary, Italy and Netherlands have government guarantees of 6.82%, 5.49% and 5.34% respectively. All other countries have government guarantees below 5%, with Slovakia having the lowest value of the levels of government guarantees across countries. Most depends on maturity of their financial markets and the regulations in place. Slovakia has the least government guarantees average which could be due to its financial market begin thin, thus no space to use government guarantees. Furthermore, government guarantees are likely to depend on investors sentiments towards a country fiscal credibility. Countries which have a historical background of debt defaults or miss debt repayments are likely to struggle to use government guarantees in their operations.

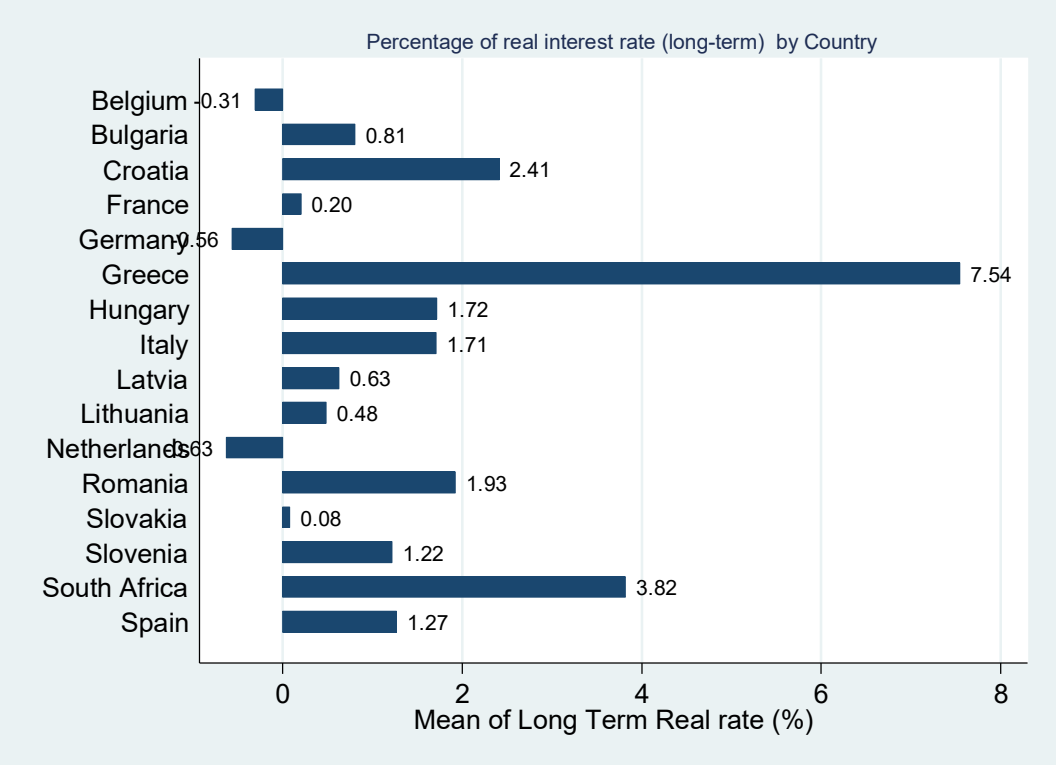
Figure 4.2: Government guarantees as a percentage of GDP



Source: Stata (Self computed)

Figure 4.3 shows, long-term real interest rate in percentage form for 16 selected countries. Greece has the largest real interest rate of 7.54%, followed by South Africa and Croatia with 3.82% and 2.41% respectively. By implication, cost of capital is higher in these countries relative to other countries. Hungary, Italy, Romania, Slovenia, and Spain all have long term interest rate below 2%. Bulgaria, France, Latvia, Lithuania, and Slovakia have real interest rate below one. While Germany, Belgium and Netherlands have lower bound real interest rates.

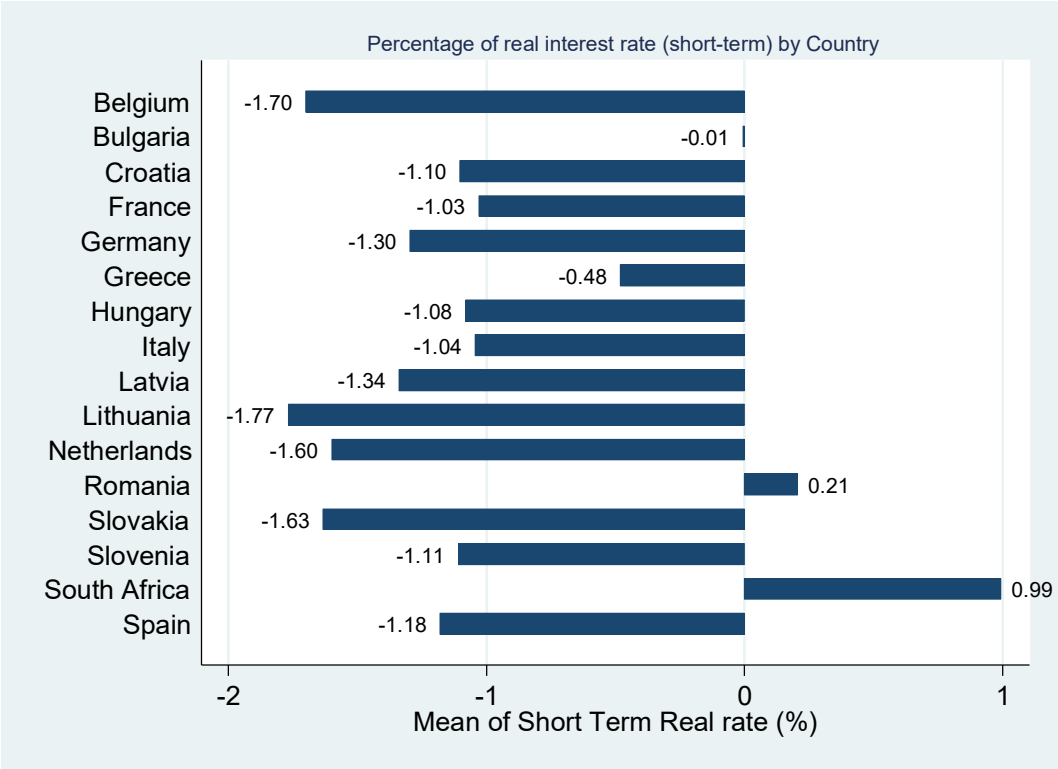
Figure 4.3: Percentage of real interest rate (long-term)



Source: Stata (Self calculated)

Figure 4.4 shows the plots for the short-term real interest rate for all the countries under study. As seen in Figure 5.4, the short-term real interest rate for all the countries under study has been unstable from 2010 to 2021. In addition, countries such as Greece, South Africa, Bulgaria, and Hungary have experienced greater short-term real interest rate instability. Similar patterns are seen in the short-term real interest rates, Lithuania has the lowest short term real interest rate (-1.77%), followed by Belgium with (-1.70%). Netherlands and Slovakia short term interest rates of (-1.60%) and (-1.63%) respectively. This means that return on real assets priced using short rates had negative returns per average for the period of the study. Positive short real rates are seen only in South Africa (0.99%) and Romania (0.21%). The strength of South African monetary policy prudence for the period and the impact of the financial crisis having mild effect on the South African financial market could explain the reason the rate is positive.

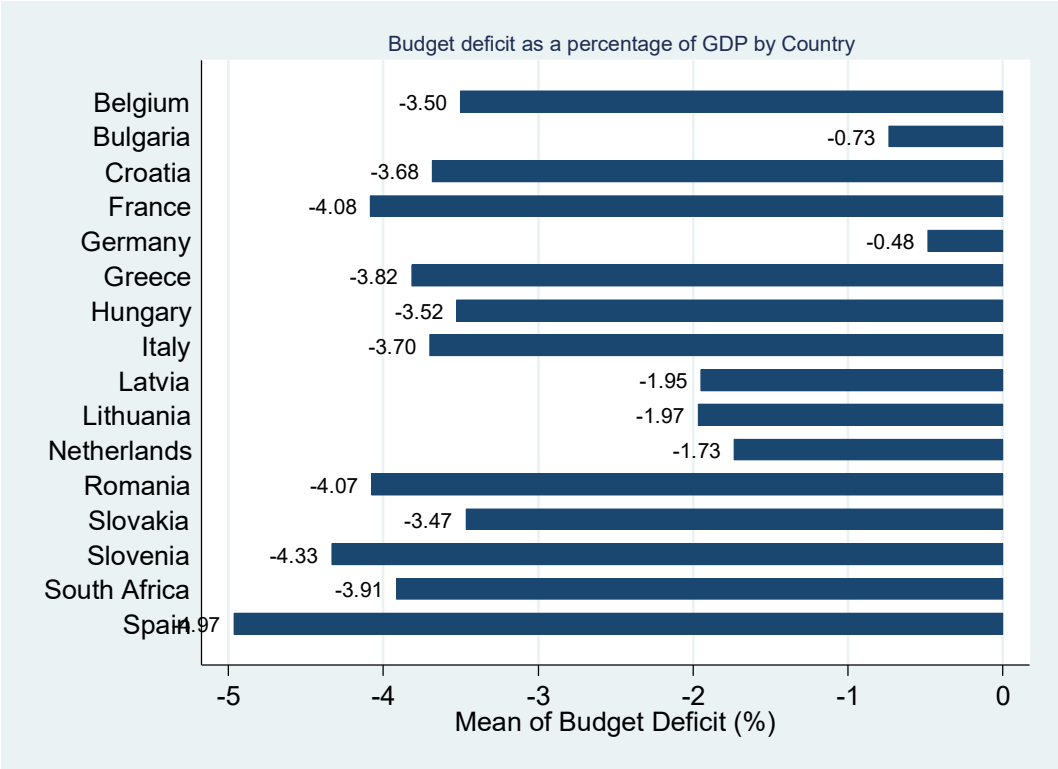
Figure 4.4: Percentage of real interest rate (short-term)



Source: Stata (Own computation)

Figure 4.5 shows the plots for the budget deficit as a percentage of GDP for all the countries in the study. As seen in Figure 5.5, the budget deficit as a percentage of GDP for all the countries under study has been stable from 2010 to 2021. However, different countries experienced peaks of budget deficit as a percentage of GDP in different years during the period of 2010 to 2021. The notable finding is that Spain Budget deficit as a % of GDP is the highest in negative terms (-4.97%) followed by Slovenia (-4.33%), France (-4.08%) and Romania (-4.07%). Deficit fluctuations highly depends on the initial state of the economy before shocks. During the period of the study, the world went through financial distress which forced countries to increase their debt issuing and therefore increasing their budget deficits. The Stronger economies such as Germany and Bulgaria have not experienced a large growth of its deficits in the last decade due to financial crises and the Covid-19 pandemic. South Africa's budget deficit averaged (-3.91%) of GDP in the last decade. The covid pandemic did force many countries to undertake borrowing and issuing debts to fight the pandemic's which is likely to increase the debt position of the countries and therefore increasing their budget deficits.

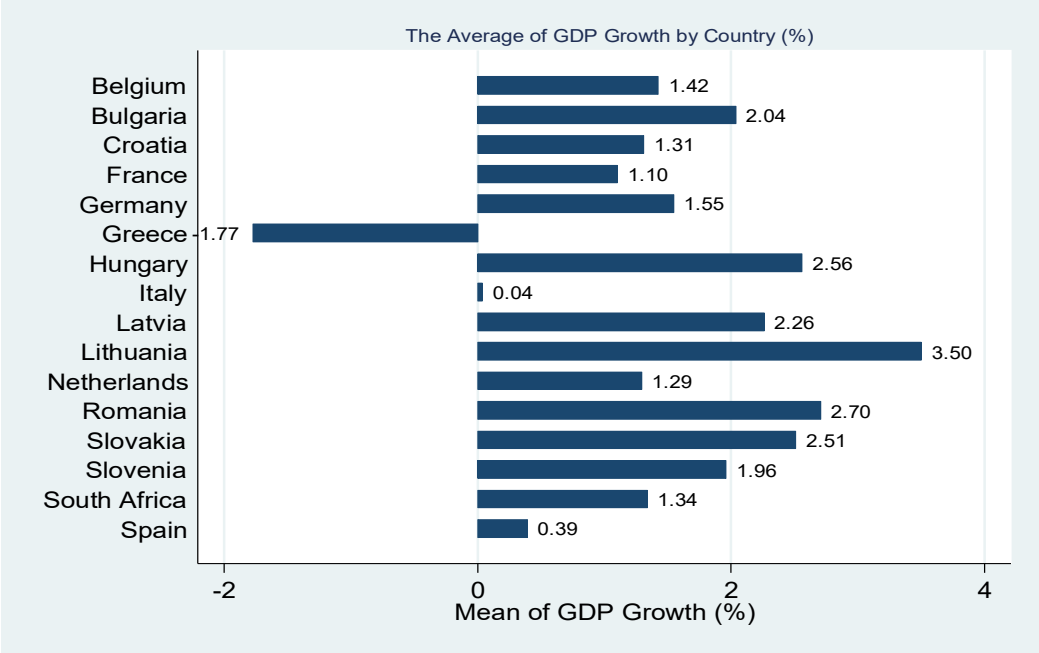
Figure 4.5: Budget deficit as a percentage of GDP



Source: Stata (Self computed)

Figure 5.6 shows the plots for the real GDP growth rate annually for all the countries in the study including South Africa., The real annual GDP growth rate for most of the countries under study has been stable from 2010 to 2021, with most countries experiencing a slump around 2020 except Spain that peaked during this time. In addition, the real annual GDP growth rate for Greece declined sharply from 2010 and then remained unstable until 2019, and thereafter declined sharply with the other countries. Most economies struggle to grow in the last decade due to continues exogenous shocks ranging from financial crisis inherited a decade before, and other exigence's, such as climate change and structural deficits such as unskilled labour force, the fall in manufacturing sectors in Europe and the initial position some countries find themselves in. Greece defaulted on its debt in the 2008-2009 financial crisis. Italy, Spain also was hugely affected by the crisis and the effect spilled over to 2010-2021 periods as seen in the table below. In general, economic growth for all countries in the study has been inimical.

Figure 4.6: Real annual GDP growth rate in percentage



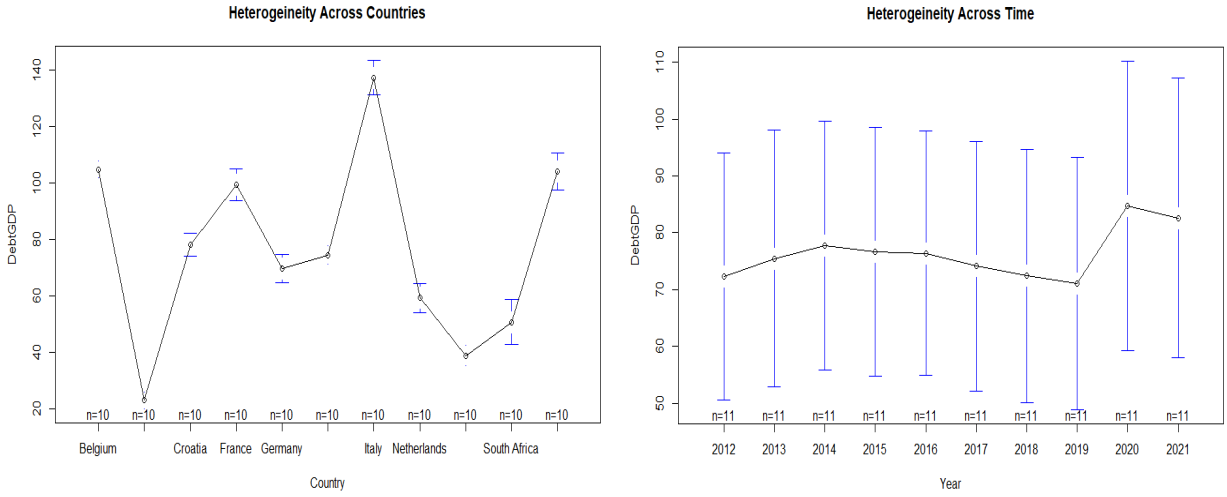
Source: Stata (Self computed)

4.2. Empirical estimates

Different dynamic panel data regression models were used to analyze the data to investigate the response of public debt to the independent variables under study. As explained in (Robert and Whited, 2013), the lag of the dependent variable is used as an explanatory variable. However, to determine the right regression model that would be most applicable to this study, the data was first tested for heterogeneity across country and heterogeneity across time. Figure 4.8 shows the results of the heterogeneity test across country and across time. As shown in Figure 5.7, the means of the government debt as a percentage of GDP (Debt GDP), which is the dependent variable, are different across country and across time. Therefore, the basic multiple regression model is not sufficient for this study. The study used the dynamic panel data regression models to adjust for the Nickell's bias and endogeneity (Nickell, 1981).

In addition, the panel regression models use instrumental variables to adjust for endogeneity and inconsistent estimators (Nickell, 1981). Further, Anderson and Hsiao (1982) explained that the earlier lag period of the model could be used as an instrumental variable (IV) and that the first difference and or level of second difference of the dependent variable is considered an instrumental variable. However, Arellano and Bond (1991) cautioned that this method may be consistent but not efficient because instrumental variables do not exploit all the available moments conditions. Therefore, they proposed the generalized method of moments (GMM) estimator (Arellano and Bond, 1991). The following subsections present the dynamic panel data regression models results including that of the system GMM.

Figure 4.7: Heterogeneity across country and across time



Source: Stata (Own computation)

The model used to show the response of government guarantees to public debt, is given below with other control variable such as real interest rate, budget deficit, and real GDP growth to public debt included. The derivation of the model is the modification of Blanchard (2016), chapter 2-budget debt specification equation, the innovation here is the introduction of government guarantees in his model. The baseline follows the work of (Kumar and Wood, 2010; Dreger and Reimers, 2013; Checchetti ,2011; Panizza et.al., 2014) research which studies the real effect of data.

$$b_{it} = \alpha_b b_{it-1} + \alpha_r r_{it} + \alpha_R R_{it} + \alpha_g g_{it} + \alpha_d pd_{it} + \alpha_{gg} gg_{it} + \varepsilon_{it} \qquad (4)$$

Where:

b_{it} = the dependent variable public debt measured for country *i* at time *t*,

α_b = the slope coefficient (short run effect) of b_{it-1},

α_r = the slope coefficient of r_{it} (the independent variable – real interest rate measured for country *i* at time *t*),

α_R = the slope coefficient of R_{it} (the independent variable – long term interest rate – measured for country *I* at time *t)*

α_g = the slope coefficient of g_{it} (the independent variable – real GDP rate measured for country *i* at time *t*),

α_d = the slope coefficient of pd_{it} (the independent variable – budget deficit measured for country *i* at time *t*),

α_{gg} = the slope coefficient of gg_{it} (the independent variable – government guarantee measured for country *i* at time *t*),

and

ε_{it} = error term for country *i* at time *t*.

However, to establish more interpretations of the data, a pooling model is used as in (Cecchetti, 2011 and Panizza et.al., 2014), by the author, to investigate the results further, the response of public debt to economic variables that include government guarantees, real interest rate, budget deficit, and real GDP growth. This is explained by the pooling model below, equation (5):

$$b_{it} = \alpha + \beta b_{it-1} + \delta X_{it} + \mu_i + \varepsilon_{it} \quad (5)$$

Where:

b_{it} = the dependent variable public debt measured for country *i* at time *t*,

α = the intercept constant of the regression line,

β = the slope coefficient (short run effect) of Y_{it-1},

δ = the slope coefficient of X_{it} (the independent variables measured for country *i* at time *t*),

μ_i = Individual-specific effects, and

ε_{it} = error term for country *i* at time *t*.

Anderson and Hsiao (1982) explained that the earlier lag period of the model could be used as an instrumental variable (IV) and that the first difference and or level of second difference of the dependent variable is considered an instrumental variable as shown in Model (5). In addition, Acemoglu, Johnson, and Robinson (2008) considered the level of the second dependent variable as an instrumental variable.

$$\Delta b_{it} = \beta\Delta (b_{it-1}) + \delta(\Delta x_{it}) + (\Delta\varepsilon_{it}) \quad (6)$$

Where:

Δ = the difference or change,

b_{it} = the dependent variable public debt measured for country *i* at time *t*,

β = the slope coefficient (short run effect) of Y_{it-1},

δ = the slope coefficient of X_{it} (the independent variables measured for country *i* at time *t*), and

ε_{it} = error term for country *i* at time *t*.

Table 4.2: Coefficients of the Pool OLS model

VARIABLES	(1) POLS	(2) POLS	(3) POLS	(4) POLS	(5) POLS	(6) POLS
L.Ddebt	-0.0875	-0.0921	-0.00915	0.0172	0.0183	0.156
	(0.169)	(0.167)	(0.132)	(0.133)	(0.134)	(0.117)
ΔGuarantees		0.173	0.166	0.172	0.170	0.141
		(0.221)	(0.205)	(0.208)	(0.211)	(0.189)
ΔReallrate			-0.834***	-1.070***	-1.075***	-1.339***
			(0.296)	(0.312)	(0.309)	(0.306)
ΔRealsrate				0.609**	0.611**	1.001***
				(0.294)	(0.291)	(0.262)
ΔBudgetDeficit					-0.0348	-0.128
					(0.141)	(0.110)
ΔGDPgrowth						-0.826***
						(0.162)
2013	0.108	0.0173	-0.392	-1.490	-1.521	-0.702
	(2.091)	(2.066)	(1.755)	(1.802)	(1.835)	(1.721)
2014	-1.508	-1.431	-1.585	-2.710	-2.711	-0.866
	(1.823)	(1.755)	(1.668)	(1.805)	(1.803)	(1.632)
2015	-4.721***	-4.838***	-5.276***	-5.790***	-5.796***	-4.215***
	(1.628)	(1.610)	(1.537)	(1.518)	(1.526)	(1.356)
2016	-3.541**	-3.478**	-3.873**	-4.053***	-4.031***	-2.616**
	(1.604)	(1.591)	(1.518)	(1.469)	(1.467)	(1.322)
2017	-5.369***	-5.492***	-6.933***	-6.678***	-6.702***	-4.208***
	(1.571)	(1.570)	(1.578)	(1.459)	(1.473)	(1.393)
2018	-6.394***	-6.508***	-6.686***	-6.971***	-6.989***	-5.541***
	(1.752)	(1.763)	(1.745)	(1.707)	(1.724)	(1.597)
2019	-3.866**	-4.062**	-4.134**	-4.661***	-4.672***	-3.349**
	(1.725)	(1.770)	(1.738)	(1.714)	(1.734)	(1.556)
2020	9.633***	9.019***	9.705***	8.981***	8.763***	2.959
	(2.253)	(2.407)	(2.324)	(2.286)	(2.593)	(2.448)
2021	-4.093	-4.310	-7.215***	-7.070***	-7.085***	2.570
	(2.896)	(2.815)	(2.393)	(2.309)	(2.318)	(2.356)
Constant	3.539**	3.727**	3.720**	4.089***	4.114***	2.715**
	(1.499)	(1.528)	(1.485)	(1.465)	(1.488)	(1.314)
Observations	160	160	160	160	160	160
R-squared	0.538	0.544	0.580	0.590	0.590	0.659

Source: Stata (Self Computed, 2023), Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

According to the pooling OLS model summary given in Table 4.2, the results show that the change in government guarantees is positively related to government debt. However, it is not significant. Other variables are significant in explaining the variation in the debt to GDP ratio of the countries in the study. Checchetti et.al. (2011), included liquidity as a share of GDP in their model to proxy for easiness of access to finance and found it to be insignificant. The change in long run real interest rate is negative and significant in explaining the change in debt to GDP ratio. For every one percent change in long run interest rate, the debt to GDP ratio decreases by 1.34%.

In terms of the short-term real interest rate, the relationship is positive and significant. Every one percent increase in short term real interest rate results in an increase and a change in debt to GDP by one percent. In terms of economic growth, the relationship is negative; an increase in economic growth by one percent will results in debt to GDP ratio to declining by 0.83 percent. This makes economic sense, since an increase in economic productivity, results in improvement in tax revenue of the state which can be used to repay the debt liability of the state. Budget deficits and government guarantees as a percent of GDP are both not significant in explaining debt to GDP ratio. As more variables are added in the model the goodness of fit increases, such as both rates, and an economic growth explain a 66% variation in change in debt to GDP ratio. In terms of time effect, the change of debt to GDP ratio is significant for the year 2015-2018, and insignificant for other years. As explained by Arellano and Bond (1991), the Pooling method may be consistent but not efficient because instrumental variables do not exploit all the available moments conditions. In the following section, Fixed Effect (FE), System GMM and Difference GMM Estimation are performed, and the results are presented in Table 4.3. But first a brief background is provided on the models' constructions. The Hausman test is used to decide between the random Effect and fixed effect model, the FE model is chosen according to the results of the test.

Next, the response of public debt to the government guarantees, real interest rate, budget deficit, and real GDP growth is by means of the following initial and transformed Difference GMM models (4), (5), and (6), respectively as proposed by Arellano and Bond (1991). The Difference GMM method transforms all the regressors through differencing and removes the fixed effects (Arellano and Bond, 1991).

Initial model: $lnb_{it} = \Phi lnb_{it-1} + \beta X'_{it} + (\eta_i + \varepsilon_{it})$ (5)
Transformed model: $\Delta lnb_{it} = \Phi \Delta lnb_{it-1} + \beta \Delta X'_{it} + \Delta\varepsilon_{it}$ (6)

Where:
Δ = the difference or change,
b_{it} = the dependent variable public debt measured for country i at time t,
Φ = the slope coefficient (short run effect) of Y_{it-1},
β = the slope coefficient of X'_{it} (the independent variables measured for country i at time t), and
ε_{it} = error term for country i at time t.

By transforming the regressors from (5) to (6) above through first differencing removes the fixed effect as it does not vary with time but the problem of endogeneity remains (Arellano & Bond, 1991).
From (6) the model becomes:

$$\Delta\mu_{it} = \Delta\eta_i + \Delta\varepsilon_{it} \quad (7)$$

or

$$\mu_{it} - \mu_{it-1} = (\eta_i - \eta_i) + (\varepsilon_{it} - \varepsilon_{it}) = \varepsilon_{it} - \varepsilon_{it-1} \quad (8)$$

Accordingly, unobserved fixed effects no longer enter the equation as they are by assumption constant between periods. Also, the first-differenced lagged dependent variable is instrumented with its past levels and now the changes in the dependent variable are assumed to be represented in Model (5) outlined earlier (Arellano and Bond, 1991). In addition, the study makes use of the fixed effect regression model as done by Bettina Bokemeier (2013), Dreiger and Reimers (2013) and uses Stata software to estimate results for comparison purposes in the selection between Difference GMM and System GMM. The results of the fixed effect model are shown in Table 4.3 below, the response of public debt to government guarantees, which is the main variable of interest and real interest rate, budget deficit, and real GDP growth are estimated using the Fixed effect model and the results are presented in Table 4.3 below in the first column.

Major criticism levelled against (Reinhart and Rogoff, 2010) works is that their research did not consider the endogeneity issue. Westphal and Rother (2012) employ various instrument techniques with 2-stage least square or GMM estimators. Their finding suggests that the two-step GMM is more favourable regarding efficiency. Furthermore, (Kumar and Woo, 2000) use a 2-step GMM dynamic pea regression approach to correct the endogeneity issue. Lastly, the response of public debt to the government guarantees, real interest rate, budget deficit, and real GDP growth was investigated by means of the System GMM as shown in the model. In addition, the model builds on a system of two equations, the original equation (5) and the transformed one (6) stated earlier, and it uses orthogonal deviations (Arellano and Bover, 1995; Blundell and Bond, 1998). The System GMM was proposed by (Arellano and Bover, 1995) and Blundell and Bond (1998). The model corrects for endogeneity by introducing more instruments to dramatically improve efficiency and transforms the instruments to make them uncorrelated with the fixed effects, (see Roodman, 2009 and Presbitero, 2012).

As seen in the Fixed Effect Model Summary in Table 4.3, lag Debt GDP coefficients is statistically significant at the 5% level. There is a positive relationship (R = 0.52) between the dependent variable public debt and other independent variables. This means that the R-square indicates that only up to 52% of public debt is explained by the independent variables. Government guarantees, which the main variable of interest in this paper is positive and significant in explaining the change in debt to GDP ratio. Intuitively, the presence of government guarantee function as a buffer for financial risks and thus increase the government's ability to borrow and thus, the positive relation between the two. Considering the estimation in column one, the lagged dependent variable is positive and significant in explaining the change of debt to GDP ratio in the sample. i.e., for every one percent change in last year's debt to GDP, current debt to GDP will increase by 0.35%.

By implication, debt is persistent over time. For every one percent increase in government guarantees, the change of debt to GDP ratio of increases by 0.25%, which is significant. Similarly, a one percent increase in long-term interest rate will result in a 1.504% decrease in the change in government debt to GDP ratio. At the same time, short-term real interest rates affect the change of government to GDP positive. i.e., a one percent increase in the change short-term interest rates will result in a 1.16 percent increase in the change of government debt as a percent of GDP. Furthermore, changes in budget deficits and economic growth are negative and significant in explaining the change in government debt to GDP ratio. A one percent increase in budget deficit and economic growth, results in a decrease of government debt ratio by 0.31% and 0.897% respectively.

According to the difference GMM model summary part in Table 4.3 column 2, the following regression coefficients are statistically significant. The lag of debt to GDP ratio, long-term real interest rate, short-term real interest rate, budget deficit and economic growth. However, the coefficient for a lag difference of GDP growth is statistically significant at the 5% level, and for everyone with one percentage increase in earlier debt ratio, current debt to GDP increases by 0.29 percent. While a one percent increase in long-term real interest rate, in 1.987 percent increase in debt to GDP ratio, at the same time short-term real interest seems to affect the debt to GDP ratio positively. A one-percentage increase in short-term real interest rate leads to a 1.724 percent increase in debt to GDP ratio. Moreover, a percentage increase in GDP growth, will lead to a 0.83 percent decrease in debt to GDP ratio. The p-value of the Sargan test is <0.05 and this means that we fail to reject the null hypothesis that the instruments are valid. In addition, the p-value of the autocorrelation test (1) is greater than 0.05 and this means that there is no autocorrelation of the error terms in order 1. Which is a necessary requirement for the application of GMM estimation. Further, the p-value of the autocorrelation test (2) is greater than 0.05 and this means that there is no autocorrelation of the error terms of order 2 of the model.

As seen in the System GMM part in Table 4.3 column 3, the lag Debt GDP, coefficients are statistically significant at the 5% level. The lag of dependent variable is positive and significant in explaining the debt to GDP ratio. Debt to GDP ratio remains persistent under the system GMM. For every one-percentage debt to GDP ratio increase in the previous year, debt to GDP ratio increases by 0.372 percent. A one-percentage increase in long real interest rate leads to a 1.976 percent decline in debt to GDP ratio. Similarly, a one percent increase in short-term interest rate, result in an increase of 1.94 percent increase in debt to GDP ratio. Lastly, a one percent increase in GDP growth results in a decrease in debt to GDP ratio by 0.86 percent. The p-value of the Sargan test is > 0.05 and this means that we fail to reject the null hypothesis that the instruments are valid. However, the p-value of the autocorrelation test (1) is less than 0.05 and this means that there is serial autocorrelation of order one in the error terms. In addition, the p-value of the autocorrelation test (2) is also less than 0.05 and this means that there is autocorrelation of the error terms of order 2 of the model.

Because of the study, the System GMM model is selected for this study to control for potential endogeneity problems. However, the results obtained for the variable of interest; government guarantees are positive but not significant under the system GMM. The main insight of our analysis is that government guarantees are welfare enhancing because they induce financial institutions to improve liquidity provision and therefore reduce the system risks, which might occur in its absences under the fixed effect (FE) model but not under system/difference GMM. The presence of government guarantees allows financial institutions to increase liquidity transformation that they perform in the economy and would not have done in its absence for fear of financial fragility.

Table 4.3: Coefficients of, Fixed Effect (FE), Difference GMM and the system GMM

	(1)	(2)	(3)
VARIABLES	FE	Difference GMM	System GMM
L.Ddebt	0.354***	0.287**	0.372**
	(0.082)	(0.115)	(0.147)
ΔGuarantees	0.247*	0.256	0.249
	(0.136)	(0.386)	(0.328)
ΔReallrate	-1.504***	-1.987***	-1.976***
	(0.296)	(0.355)	(0.291)
ΔRealsrate	1.158***	1.724***	1.936***
	(0.299)	(0.352)	(0.302)
ΔBudgetDeficit	-0.310***	-0.345*	-0.327
	(0.099)	(0.197)	(0.204)
ΔGDPgrowth	-0.897***	-0.830***	-0.858***
	(0.101)	(0.197)	(0.169)
Constant	0.745*		0.632
	(0.401)		(0.386)
Observations	160	144	160
R-squared	0.515		
Number of id	16	16	16
Countries	16	16	16
F	24.452		
No. of instruments		86	118
AR1 p-value		0.001	0.001
AR2 p-value		0.604	0.602
Sargan p-value		0.003	0.026
Hansen p-value		1.000	1.000

Source: Stata (Self Computed, 2023), Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.10

Table 4.4 Robustness check and diagnostic for Panel Data estimates

Hypothesis	Test Statistics	Decision
Test for Random effect: BP-LM Test:(RE or OLS) Ho: Variance across entities is zero, no significant differences across unit (i.e., no panel effect)	The Breusch and Pagan (LM) test for RE provide a test statistic of 0.00 with a probability of 1.000	Since probability is greater than 5%, we fail to reject the null and conclude that there is no evidence of significant differences across panel, therefore we cannot run a simple OLS
Hausman Test: Choice between RE and FE: **Ho:** Difference in coefficients not systematic	The Hausman test provides a test statistic of 4.55 with a probability of 0.6024.	We therefore fail to reject the null hypothesis and conclude that there is not a systematic difference in coefficients and therefore we use RE for estimation instead of FE
Wooldridge test for autocorrelation in Panel data Ho: No first order Autocorrelation	Wooldridge test for autocorrelation provide us with a test statistic of 26.437 with a probability of 0.0001	We reject the null hypothesis, of no first order serial correlation in panel data.
Heteroscedasticity in Panel data Ho: Homoscedasticity (constant variance)	The Modified Wald Test for groupwise heteroscedasticity in FE, gives a test statistic of 342.98 with a probability of 0.000	We reject the null of homoscedasticity in the panel and therefore heteroscedasticity is a possible problem
Cross-sectional-dependence/ contemporaneous-correlation Ho: The residuals are not correlated	Pesaran's test of cross-sectional independence provide a test statistic of 12.274 with a probability of 0.000	Since the probability is less than 5%, we reject the null that the residuals are not correlated.
Sargan test: Test of over identification restriction: Ho: The instrument set is valid, and the model is correctly specified.	The Sargan test of over identification provide a test statistic of 13.93 with a probability of 1.000	Since the computed chi2-square is less than the critical chi2-we fail to reject the null, which means that the instrument set is valid, and the model is correctly specified.

Test for inclusion of time dummies in FE model: Ho: The time dummies are jointly not significant.	The test statistic for the time dummies is 4.25 with probability of 0.002.	Since the probability is less than 5%, we reject the null hypothesis. Thus, it is appropriate to include time effect in our FE model.
Arrellano_Bond Test for zero autocorrelation in first difference **Ho: no auto correlation**	At the first order the z-statistics is -2.23 with a p-vale of 0.026 and at second order the z-statistics is -0.44 with a p-value of 0.662	Therefore, at first difference we reject the null of no autocorrelation, but at a second difference we fail to reject the null hypothesis of no autocorrelation.

4.3. Discussion of results

From the results obtained above, government guarantees are found to have a positive effect on government debts only under the Fixed effect model for example holding for all else constant, an increase in government guarantees, is likely to result in an increase in government debt which support finding of (Murimuthu, 2020) for South Africa. The results further confirm the finding of (Tabuenca and Espert, 2010) who argue that the provision of government guarantees to Spanish SMEs' results in firm profitability. However, government guarantees are positive but not significant for other estimation techniques such as difference and system GMM and POOLS. The main objective of this paper was to examine how government guarantees affect government debt. The results show that the provision of government guarantees has a positive impact on government debt as a percent of GDP. The positive relationship observed means that debt moves in the same direction as government guarantees. Thus, its presences encourage moral hazard from recipients and thus increases government liabilities. Moreover, the conclusion reached here is in line with those of Allen et al. (2015) argue that the provision of government guarantees to the banking sector encourages reckless risk-taking because of lack of accountability in case they fail.

This section discusses the results obtained above, in terms of variables included in the regression estimation as control variables, such as real interest rate, budget deficit, and real GDP growth. Recall that, the research question of this study was broken down below according to each macroeconomic variable against the independent variable, public debt, based on the Fixed effect model and system GMM model, there is a positive relationship between public debt and government guarantees as observed above across all models. Nevertheless, it is only under fixed effect (FE), government guarantees are found to be positive and significant in influencing government debt. This finding substantiates those of, (Bajo and Primorac, 2011) who argue that government guarantees can pose a threat to effective fiscal management because they are not included in fiscal policy analyzes, giving a distorted picture of public finances and posing an obstacle to reliable projections of the future influence of fiscal policy.

However, it is indisputable that the presence of government guarantees creates favourable environment in the financial market and the economy by ensuring predictability and flexibility in managing government debt. A study by (Mothibi and Mncayi, 2019) on key drivers of government debt in South Africa proved that contingent liabilities in the form of government credit guarantees are significant contributors to the rising government debt in South Africa. They further stated that most governments' contingent liabilities have been chiefly accounted for by inefficient state-owned entities (Budget Review, 2018), which have posed a significant risk to the fiscals. The argument that government guarantees enhances liquidity in the financial market and are thus necessary in explaining government debt, is still not clearly embraced in policy makers' cycles. However, the IMF (2005) report argued that government guarantees are not the most appropriate form of support to achieve the desired goal.

Guarantees issued by other government agencies, such as development banks, are particularly controversial because they are difficult to monitor. Possible government guarantee costs of the state are positively correlated with the risk of implementation of the financial project, its value and duration (Polackova, 1998). Government guarantees can cause many problems because they are not tracked as part of normal budget costs, according to (Bajo and Primorac, 2011) Government credit guarantees exist where the state can predict risk, regulate risk exposure, or minimize risk cost; these credit guarantees then serve as a fiscal tool of financial support for infrastructure and public goods investments (IMF, 2005). Government credit guarantees are contingent liabilities as their repayment is contingent upon the occurrence of a particular event. Credit guarantees as contingent liabilities by (Frits and Jane, 2018). Contingent liabilities have contributed enormously to fiscal risk (Bova et al., 2016). Despite the mixed criticism put forward against government guarantees as potential consideration in explaining government debt, there is scant research undertaken recently to find channels through which government guarantees affect government debts. This paper's results, confirm that government guarantees are positively associated with government debt. However, it is not significant for all estimation techniques, but one.

According to the dynamic panel data analysis results, there exists a relationship between public debt with the economic variables under study including government guarantees, real interest rate (both short-term and long-term rates), budget deficit, and real GDP growth. In addition, there is a very strong positive and significant relationship between the dependent variable public debt and the independent variable lag Debt GDP. Consequently, the study found that the country's public debt of the previous year affects the country's public debt in the current year. This result was captured by means of the lag of public debt (L. Debt) in the panel data analysis models. The lagged dependent variable was included in the models as a control and captured the persistence of debt over time. Thus, it reflects the possibility that the effects of changes in the independent variables are distributed over multiple time periods (Deephouse, 1999). In addition, the lagged dependent variable controls for omitted variables and they are expected to have a positive coefficient (Deephouse, 1999). In the dynamic panel data regression models above, the Lag-dependent variable (lag Debt GDP) had a positive coefficient, and the results were statistically significant at the 5% level.

Therefore, the use of the dynamic panel data analysis models has revealed that the country's public debt of the previous year influences the country's public debt in the current year. Government debt refers to the total amount of government fixed-term contractual obligations to others due on a specific date (World Bank, 2013). The long-term real interest rate is negative and significant in influencing debt to GDP ratio under all three estimations techniques. Moreover, short-term interest is observed to have a positive and significant relationship with government debt as a percent of GDP for the 16 selected countries. Lastly, economic growth is negative and statistically significantly associated with debt to GDP ratio. This means that if the economy was to grow, the country's debt to GDP will decrease as a result, holding all else constant. The appending sections present a discussion of the study results with respect to the study objectives.

The outcomes of the system GMM model show that there is a positive relationship between public debt and long-term real interest rates. However, this result is not statistically significant. The study revealed a very strong positive relationship between the dependent variable public debt and the independent variable lag Debt GDP (the lag of public debt). The study found that the country's public debt of the previous year has a more significant impact on the current year's public debt compared to the impact of the long-term real interest rate. Higher interest rates caused by growing government debt can reduce investment, inhibit interest-sensitive spending on consumer durables, and reduce the value of assets held by households, indirectly dampening consumption spending through a wealth effect. The magnitude of these potential negative consequences depends on the extent to which government debt raises interest rates (Engen and Hubbard, 2004).

Most of the empirical evidence suggests that all else being equal, a 1% of GDP increase in government debt would raise the long-term real interest rate by about three basis points (although one specification suggests a larger impact), while some estimates are not statistically significantly different from zero (Engen and Hubbard, 2004). Government debt is an essential mechanism for the State to finance public spending, especially when it struggles to increase taxes and decrease public expenditure. Financing public spending has left many governments with vast debt (Yusuf and Mohd, 2021). Increasing government debt problems can limit the state's ability to pursue more effective investment programs in infrastructure, education, and public health (Johnny and Johnnywalker, 2018).

Further, the results of the system GMM model show that there is a negative relationship between public debt and short-term real interest rates. However, this result is not statistically significant. The study revealed a very strong positive relationship between the dependent variable public debt and the independent variable lag Debt GDP (the lag of public debt). The study found that the country's public debt of the previous year has a more significant impact on the current year's public debt compared to the impact of the short-term real interest rate. The State's public finances are essential for a fiscal policy that promotes economic growth. Public balance sheets are exposed to fiscal risks and can damage the State's intention to exercise good fiscal policy. Materialization of contingent liabilities has an impact on government finances and threatens the fiscal debt of the State. Contingent liabilities in the form of government credit guarantees are an essential element of fiscal risk (Bachmair and Bogoev, 2018).

In addition, the results of the system GMM model show that there is a positive relationship between public debt and budget deficit. However, these results are not statistically significant. The study revealed a very strong positive relationship between the dependent variable public debt and the independent variable lag Debt GDP (the lag of public debt). The study found that the country's public debt of the previous year has a more significant impact on the current year's public debt compared to the impact of a budget deficit. By definition, a country faces a budget deficit when government expenditures exceed its revenues. In other words, the level of public savings is negative (Rahman, 2012). One can consider the budget deficit as the mother of public debt, since the occurrence of budget deficits usually leads to the creation of public debt.

However, in the case of external public debt, everything remains the same; the current account deficit and exchange rate depreciation also come into play and are significantly related to it (Noor, Alam, and Fauzia, 2013). Fiscal deficits are necessary for the buildup of public debt, according to (Tanzi and Blejer, 1988) since the need to finance the difference between ordinary revenues and total expenditures typically results in the problem of government liabilities. The government will need to borrow money from either private domestic sources or foreigners to cover the increased budget deficit (Sobel et al., 2006). According to (Rao et al., 1994), a country's balance of payments must be borrowed money from abroad to cover a current account deficit. According to (Edwards, 2000), a country's current account position is influenced by the rate at which foreigners are expected to amass its financial liabilities.

The results of the system GMM model show that there is a positive relationship between public debt and real GDP growth. However, this result is not statistically significant. The study revealed a very strong positive relationship between the dependent variable public debt and the independent variable lag Debt GDP (the lag of public debt). The study found that the country's public debt of the previous year has a more significant impact on the current year's public debt compared to the impact of real GDP growth. Many different empirical approaches have been used to study the relationship between public debt and economic growth. Results can be strongly influenced by the period of study, country selection, and estimation methods (Asteriou et al., 2020). As pointed out by (Panizza and Presbitero, 2013), models at the theoretical level yield ambiguous results regarding the relationship between government debt and economic growth, and thus the link between the two is fundamentally an empirical question.

They also argue that there is no empirical study that can conclusively prove a causal relationship between debt and economic growth (see Panizza and Presbitero, 2013). Nonetheless, a strong negative effect of high public debt in low-income countries is found in the study by (Pattillo et al., 2004), who conclude that per capita growth in highly indebted countries falls by 1% when debt is doubled. Cecchetti et al. (2011) argued, based on an analysis of 18 OECD economies, that there is a threshold of 85% debt to GDP ratio, above which future economic growth declines. They conclude that a 10% increase in government debt to GDP ratio after this threshold reduces annual economic growth by 0.17-0.18% over the following five-year period.

5. Conclusion and policy recommendations

Based on the results of the study, public debt has a relationship with government guarantees controlling for real interest rate, budget deficit, and real GDP growth effects. Short-term interest rates likewise promote the uptake of debt and therefore tends to drive the debt position up. The real long-term interest incentivizes debt holders to switch to long-term high interest-bearing assets than debt. The earlier sections of this chapter have presented the results of this study. The study has used the different dynamic panel data regression models (GMM) and static fixed effect model and OLS to analyze the data on the response of public debt to the independent variables under study namely government guarantees, real interest rate, budget deficit, and real GDP growth. The results of the study showed a positive relationship between public debt and the independent variables such as short-term real interest, lag of debt to GDP ratio and government guarantees under the FE estimation. While for both systems GMM and Difference GMM, only the lag of debt to GDP ratio and the short-term real rate are positive and significant in explaining the debt to GDP ratio dynamic. Other variables such as real interest rate, budget deficit, and real GDP growth are all negatively related to debt to GDP ratio. In addition, the goodness of fit and the test statistics are correctly specified for these estimations.

Consequently, the study finds that the country's public debt of the previous year, economic growth, budget deficits, and real interest rate, both long and short have effects on the country's public debt. The government guarantees are only significant under the Fixed effect model. The next chapter presents a discussion of the results based on the research objectives of the study. The previous sections of Chapter 4 presented a discussion of the results and the outcomes of this study. Where we observe a positive and significant relationship between government guarantees and government debt. In addition, there is a very strong positive relationship between the dependent variable public debt and the independent variable lag Debt to GDP, which is consistent with those of (Rogoff and Reinhart, 2010), and (Checherita, 2012). Consequently, the study found that the country's public debt of the previous year has a more significant impact on the current year's public debt compared to the impact of any of the independent variables under study, including government guarantees, real interest rate, budget deficit, and real GDP growth. Chapter 6 presents the conclusions and policy recommendations of the study.

Output growth plays an essential role in debt reduction, therefore growth functions as an antidote to remedy a growing debt. In addition, these results are statistically significant under Fixed effect for government guarantees. While short-term rates, long-term rates and economic growth have corrected signs and are statistically significant under OLS, FE, and difference GMM and system GMM estimation technique. Furthermore, there is a very strong positive relationship between the dependent variable public debt and the independent variable the lag of public debt (lag-DebtGDP). Consequently, the study found that the country's public debt from the previous year has a more significant impact on the current year's public debt compared to the impact of any of the independent variables under study including government guarantees, real interest rate, budget deficit, and real GDP growth.

The policy implication of these results is that policy makers and other stakeholders need to be cognizant of the underlying effect of government guarantees on government debt when designing and implementing policies concerning government debt. Further research could explore the extent of influence of government guarantees in the broader perspective, such as between regions or at a firm level within countries.

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Appendix

Table 4.5 List of countries included in the study

Country
Belgium
Bulgaria
Croatia
France
Germany
Greece
Hungary
Italy
Latvia
Lithuania
Netherlands
Romania
Slovakia
Slovenia
South Africa
Spain