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## Article

# Does financial sector transparencies tame government debts in Africa: exploring for complementarities and nonlinear threshold effects

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# Does financial sector transparencies tame government debts in Africa: exploring for complementarities and nonlinear threshold effects

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## ABSTRACT

Despite evidence that improving financial sector transparency (FST) can help tame clientele (households, businesses and corporate) debts, the empirical literature fails to explore how improving FST can lower/tame the unsustainable soaring government or (regulator) debts, particularly in Africa where alternative government debt management is inevitable. Hence, this study examines the complementarity and nonlinear threshold effects of private and public sector-led financial transparencies on government debts in Africa for the first time. Using a dynamic GMM panel data strategy covering periods between 2004 and 2020, the results show that the joint term of public and private sector-led financial sector transparency has complementary-synergetic effects on long-term debts and interest on debts while having substitutive effects on gross and short-term government debts, implying that private and public sector-led financial transparencies are substitutes to each other or can be used to complement gross and short-term government debts but complementary on long-term debt and interest on debts. Similarly, it is reported that there is a nonlinear inverted U-shaped threshold effect of financial sector transparencies on government debts, implying that financial sector transparencies must reach a minimum threshold/level to induce the desirable reducing effect of financial sector transparencies on government debts in Africa. These results create awareness of how financial regulators can employ FST as a debt-reducing tool and require policymakers to expand and deepen FST information to hasten it and reinforce the reducing effect of financial sector transparencies on government debts.

## IMPACT STATEMENT

This study provides novel evidence on how transparency in the financial market can serve a tool for taming governments debts when is it well-developed to certain levels/thresholds. Especially in the context of Africa where governments debts have reached unsustainable thresholds and both country and international level financial bodies are seeking to have alternative mechanisms for lowering government debts, this study employs data on 23 African countries between the periods of 2004 and 2020 to show that (i) while the two forms of financial sector transparencies have substitutive effect on government debt, it could have either complementary or substitutive effect depending on the type of government debt (short-term, long-term, privately and publicly guaranteed debts), (ii) the reducing effect of financial sector transparency can only be attained when financial sector transparency is well-developed over a certain threshold. Hence, the impact of this study is its novel revelation that regulators can rely on improved financial sector transparency to lower government debts, particularly in Africa.

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## Introduction

Debts can be an important financing source, especially when it is used to create assets that are can finance itself, however, the sustainability of government debts in Africa has become a critical/topical issue of concern given the possible adverse economic effects of excessive borrowing and the nature of

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poor debt sustainability of African governments (Flandreau & Ugolini, 2011; Lane, 2012; Schumacher & di Mauro, 2015). For instance, the World Bank (2020)<sup>1</sup> notes that the external debts of African countries have increased by over 158.33% between 2010 and 2020, representing an increase from \$300 billion in 2010 to \$775 billion in 2020. Coupled with this, six African countries (including Angola, Cabo Verde, Mauritius, Mozambique, Tunisia, and Zambia) are reported to have over 100 percent debt to GDP ratio, which has serious economic and financial crises implications. In the same light, fourteen African countries (Angola, Cabo Verde, Djibouti, Mauritania, Mauritius, Mozambique, Rwanda, Sao Tome and Principe, Senegal, Somalia, Sudan, Tunisia, Zambia, and Zimbabwe) have crossed debt to GDP threshold of 60 and 55% which flouts the International Monetary Fund (IMF) and African Monetary Cooperation Programme (AMCP) debt sustainability respectively while thirteen African economies (Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Djibouti, Ethiopia, The Gambia, Ghana, Guinea Bissau, Kenya, South Sudan, and Zambia) are categorized as debt distress economies<sup>2</sup>. Thus, the soaring government debts in Africa are alarming which has attracted the attention of international monetary/financial institutions such as International Monetary Fund (IMF) and World Bank to propose/suggest a number of debt sustainability strategies (which include debt relief, debt forgiveness, debt restructuring, increasing domestic tax revenues and reducing government expenditure) to help tame government debt levels in Africa (Easterly, 2001; Minow, 2015; Ndikumana, 2004; Neumayer, 2002; Sanford, 1994).

In light of the excessive government debt levels in Africa and following the information asymmetry and information sharing theory literature that advances that sharing information of economic agents among lenders can lower excessive indebtedness of economic agents (see Bennardo et al., 2015; Jappelli et al., 2013; Kusi et al., 2021), it is surprising to observe that the empirical literature is yet to document how reducing information asymmetry through improvements in financial sector transparency (FST) can impact government debts, especially when the government is a key financial market participant and government debts are rapidly soaring and poses risk to the African economy. Put differently, there are no empirical studies that document the effect of financial sector transparency systems on government debts particularly in Africa. Additionally, with the government being a regulator and implementer of transparency in the financial market, there are doubts about whether FST (particularly public sector-led FST) can effectively and efficiently tame government debts in Africa. Thus, intuitively, one is tempted to argue that since the government is a regulator and implementer and FST is low in Africa, African governments may have a way to induce FST to help them access debts. However, when FST increases beyond some thresholds, there will be clear and full disclosure of African governments' indebtedness, which leads to reduced government access to debts. Hence, there is a possibility of nonlinear threshold effects of FST on government debts. However, such arguments and empirical evidence do not exist in the literature.

Furthermore, learning from prior empirical literature that FST is low in Africa and can be implemented through the private and or public sectors (Kusi et al., 2016, 2020, 2021), it is intuitively important to empirically document for policy purposes; (i) whether these two financial sector-led transparency systems is more effective in taming government debts, (ii) whether the coexistence of the two FST types (FST led by private sector or FST led by public sector) induce complementary-synergetic or substitutive effects on government debts and (iii) the level/threshold point at which these two financial sector-led transparencies can tame government debts. Arguably, the empirical literature is silent and yet to document (i) comparative taming/reducing effects of private sector-led and public sector-led FST in taming government debts in Africa, (ii) complementary-synergetic and or substitutive effects of FST types on government debts in Africa and (iii) possible nonlinear threshold effects of FST types on government debts in Africa. Thus, this study aims at uncovering the reducing threshold effect of FST on government debts in Africa. By achieving this aim, this study contributes to the literature as follows: (i) extending the use of FST as a debt management tool for households and corporate entities to using FST as a debt management tool for government, (ii) exploring the complementary-synergetic or otherwise effects of FST types on government debts and (iii) presenting first-time empirical evidence on the nonlinear threshold nexus between FST types and government debts from an African perspective. The rest of the paper is organized into an overview, literature review, method and data, empirical results and discussions and conclusion, policy implications and recommendations.

## Overview of government debts and financial sector transparency in Africa

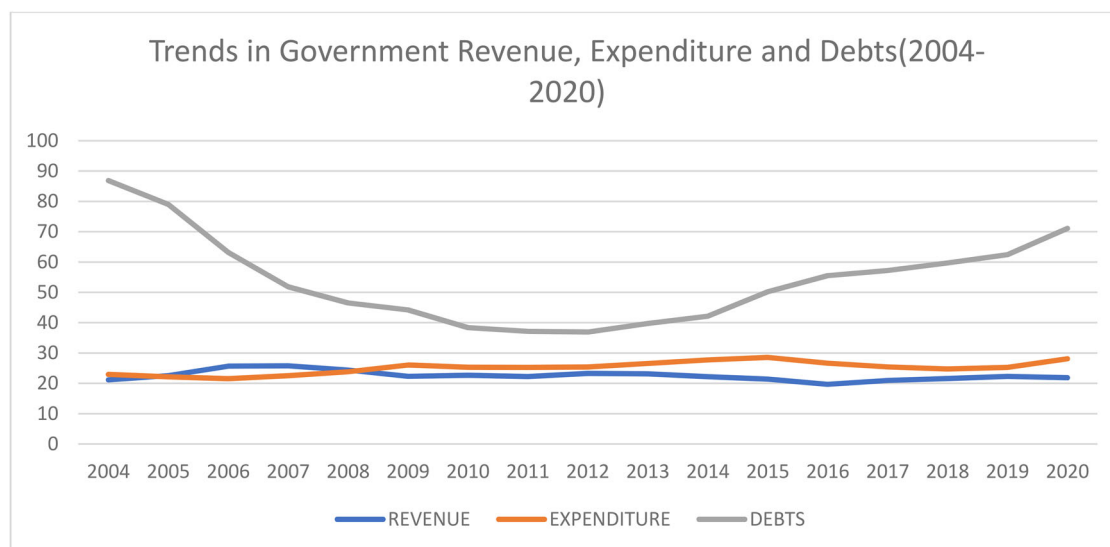
Over the last few years, African economies' debt levels/indebtedness have notably increased and have attracted the attention of international policymakers and analysts because of their potential adverse effects (World Bank, 2020). Arguably, declining levels of grants, aid and official assistance from donors coupled with low tax revenues have necessitated African governments' use of debt financing strategies. The World Bank reports that between 2010 and 2020, the external debt of African economies rose from \$300 billion to \$775 billion, representing over 150%. As of 2010, about 80% of Africa's debt was attributed to only 15 of 54 African economies, and South Africa and Egypt were the main contributors, accounting for over \$100 billion each. Nigeria, Morocco and Angola reported total debts of \$70 billion while 35 African economies reported \$20 billion. At the time, Burundi, Comoros, Eswatini, Gambia, Lesotho and Sao Tome and Principe were reported to be the African economies with the lowest joint debts of about 1 billion (World Bank, 2020).

Currently, in 2020, six African economies (Angola, Cabo Verde, Mauritius, Mozambique, Tunisia, and Zambia) have crossed a 100% debt-to-GDP ratio, while fourteen African economies (Angola, Cabo Verde, Djibouti, Mauritania, Mauritius, Mozambique, Rwanda, Sao Tome and Principe, Senegal, Somalia, Sudan, Tunisia, Zambia, and Zimbabwe) have exceeded the 60 and 55% debt-to-GDP thresholds for prudent debt levels for IMF and AMCP, respectively (Qobo et al., 2022). Despite the increasing trends in debt-to-GDP in Africa, the majority of African economies have a debt-to-GDP lower than 50%, with 6 African economies (Algeria, Botswana, Burundi, the Democratic Republic of Congo (DRC), Eswatini, and Nigeria) having a debt-to-GDP lower than 20%. The IMF debt sustainability framework in 2021 shows that nineteen African economies have been classified as debt distress or at a high-risk debt distress status. Specifically, thirteen (Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Djibouti, Ethiopia, The Gambia, Ghana, Guinea Bissau, Kenya, South Sudan, and Zambia) have been classified as high-risk debt economies while the other six (Congo Republic, Mozambique, Sao Tome, and Principe, Somalia, Sudan, and Zimbabwe) have been classified as debt distress. The increasing debt vulnerability of these African countries stems from high levels of government debt and a substantial rise in debt servicing costs. Data from IMF plotted by authors show that gross government debt in Africa in the last few years since 2014 has increased steadily between 2004 and 2019 (see Table 1 and Figure 2). However, between 2004 and 2014, the gross debt of African countries declined, and this reduction can be attributed to the debt relief and forgiveness experienced by some African countries (Coulibaly et al., 2019; Hernandez & Katada, 1996; Nuemayer, 2002).

In the light of financial sector transparency, transparency in the financial market over the last few decades has been increasing in Africa and has attracted the attention of policymakers and academics (Kusi, 2021; Kusi et al., 2016, 2017, 2020). Arguably, financial sector transparency is argued to reduce debt and enhance the indebtedness of households and corporate entities (Doblas-Madrid & Minetti, 2013; Kusi et al., 2021). On the one hand, while improved transparency improves lender decisions (lowers adverse selection), which lowers the amount and volumes of debts advanced by lenders, it is also

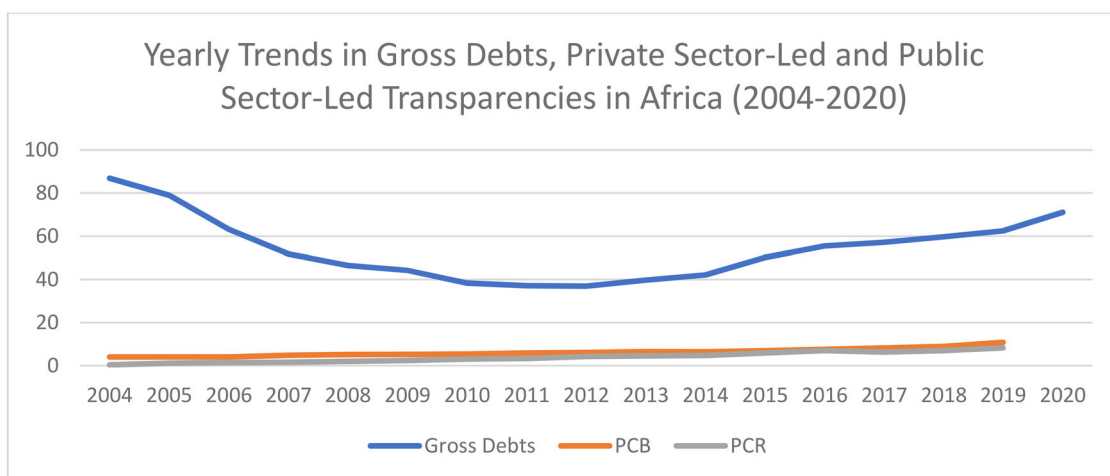
**Table 1.** Trends in gross government debts and financial sector transparencies in Africa (2004–2020).

Years	Gross Debts	PCB	PCR
2004	86.87	4.02	0.4
2005	78.99	4.07	1.12
2006	63.16	4.03	1.46
2007	51.84	4.81	1.57
2008	46.51	5.17	2.01
2009	44.23	5.25	2.42
2010	38.35	5.35	3.06
2011	37.14	5.86	3.37
2012	36.91	6.08	4.26
2013	39.74	6.5	4.51
2014	42.13	6.43	4.72
2015	50.21	6.97	5.9
2016	55.51	7.6	7.04
2017	57.18	8.2	6.27
2018	59.68	8.93	7.01
2019	62.45	10.9	8.3
2020	71.09	–	–



**Figure 1.** Trends in government revenue, expenditure and debts (2004–2020).

Sources: Plotted by authors based on data from International Debt Statistics.



**Figure 2.** Yearly trends in gross government debt and financial sector transparencies in Africa (2004–2020).

Sources: Plotted by authors based on data from International Debt Statistics.

argued that improved transparency boosts the confidence of lenders, lowers cost of finance and capital and hence induces more debt financing deals. Interestingly, the implementation quest to reinforce transparency in the African financial markets and institutions became visible around 2004 by the introduction of private credit bureaus and public credit registries (Kusi, 2021; Kusi et al., 2016). While private credit bureaus (PCB) and public credit registries (PCR) had long existed in Europe and America and helped improve the transparency of their financial market, they emerged as financial sector transparency enhancers in Africa a few decades ago. The role of these financial sector transparency systems is to collect, process, store and share credit information among lenders to determine the creditworthiness of economic agents that participate in financial sector activities.

These roles tend to lower the risk of adverse selection and default and improve the confidence and trust of financial market participants. Data from the World Bank plotted by authors show that private and public sector-led transparencies increased steadily between 2004 and 2019 (see Table 1, Figures 1 and 2). In practice, private credit bureaus are owned and managed by the private sector and established purposely to improve transparency for profit-making, while public credit registries are owned and managed by central banks and set up to complement the regulatory activities of central banks (Ghosal & Miller, 2003; Kusi et al., 2017, 2022). While in theory, PCB and PCR are argued to be substitutive because one can be employed in place of the other, in practice, however, the effects of PCB are reported to be



more effective on household and corporate entities activities/operations in most instance (see Kusi et al., 2018, 2017, 2016).

### Literature review: theoretical, empirical and hypothesis development

In the public debt literature, the classical theory of public debts argues that full employment and the obvious unproductive nature of public expenditure justify governments not acquiring debts. Several theories explain government debts and borrowing behavior (Buchanan, 1997; Buchanan & Roback, 1987; Sharp, 1959). The classical theory of public debts or the traditional view of public debts, argues that continuous unbalanced budgets leading to a rapid increase in public debts imperil the financial stability of economies and a dislike for accumulating government debts by classical economists. The classical public debt economists argued that government debt financing strategies were invariably wasteful, ruinous to prosperity, and even morally unjust (Salsman, 2017). In the wake of the great depression of the 1930s, the modern theory of public debts emerged (Churchman, 2001; Harris, 1949; Sharp, 1959). Contrary to the classical theory of public debt view, the modern theory of public debt proponents argued that once economists assume a more realistic mood and allow for unemployment to exist, monetary policy has elastic effects on other macroeconomic variables and that government expenditure could be productive and not always wasteful, the case for public/government debt financing becomes desirable and strengthened.

Moving from the public debt theories, the pure theory of country risk highlights the presence of information asymmetry in lending to sovereign economies/countries (Eaton et al., 1986; Hellwig, 1986). Thus, information asymmetry in the credit market induces over-indebted economic agents, which can harm the financial and economic systems (Stiglitz, 2000; Stiglitz & Weiss, 1992). Specifically, information asymmetry in the credit market can trigger character defects such as nonpayment of debt obligations and excessive debt financing/borrowing. Following the concept of 'lemons' (bad borrowers) and 'diamonds' (good borrowers) in the credit market (see Akerlof, 1978), the quest for lenders to share credit information/history of their client have become an integral part of financial market/sector mechanisms for lowering the debt financing problem associated with information asymmetry. Thus, the information sharing theory advance that sharing client information/credit history improves the predictive power of lenders (to enable them to avoid adverse selection) and increases the pressure on borrowers to fulfil/honor the debt obligations (to lower moral hazard) of borrowers (Kusi et al., 2017, 2016). Luoto et al. (2007) argue that the ability of credit information sharing to lower lender's adverse selection is termed the 'screening effect' while the ability of credit information sharing to discipline borrowers to honor their debt obligations is termed the 'incentive/motivation effect'. Intuitively, sharing credit information on financial market participants, of which the government is an integral player, can serve as a tool that can help to lower the indebtedness of governments, particularly in Africa, where government/public debts have reached unsustainable levels. Yet, empirical studies employing FST as a tool for taming government debts are scanty, particularly in Africa, where government debts are soaring.

Regarding empirics, the effect of various forms of transparencies on household, firm and government debt outcomes has been widely studied. For instance, how fiscal/budget transparency affects debts (Alt & Lassen, 2006, 2003; Bastida et al., 2017; Benito et al., 2016; Cormier, 2023; Jarmuzek, 2006), corporate/accounting transparency affects debt (Armstrong et al., 2010; Copelovitch et al., 2018; DeBoskey et al., 2021; Raimo et al., 2021; Wang et al., 2011; Zhu et al., 2023) and financial sector transparency affects debts (Asongu, 2017; Asongu & Nwachukwu, 2018; Doblas-Madrid & Minetti, 2013; Kusi et al., 2021; Kusi & Opoku-Mensah, 2018; Sutherland, 2018) have been documented. While it is worth noting that FST has empirically been examined on variables such as risk, crisis, profits/return, market power and economic performance, this current empirical review focuses solely studies that report on the link between financial sector transparencies (FSTs) and debts. Interestingly, other studies (such as Cifuentes-Faura, 2023a, 2023b; Seiferling & Tareq, 2023; Cifuentes-Faura et al., 2023) have extensively document the effects of other forms/types of transparencies. Hence, the review focuses solely on financial sector transparency and debts.

### Effect of financial sector transparency on users of debts

Focusing on FST, it is observed that the effect of FST on debts has been studied from the perspectives of the suppliers of debt funds (lenders) and demanders/users of debt funds (borrowers). Starting with the effect of FST on debts from the perspective of users of debt financing (borrowers), Kusi et al. (2021) studied how FST affect the debt financing of nonfinancial listed firms on the Ghana stock exchange market. Using various estimation models in a panel framework of 20 firms between 2003 and 2013, the results show that FST tends to promote using short-term debts while lowering the use of long-term debts. Similarly, Sutherland (2018) investigated the effect of FST on access to credit/debts and how FST affects lender debt contracts for firms. The study employed firm-time and lender-time tests to show that FST encouraged debt usage by firms by lowering relationship-switching costs for small, young and non-defaulting firms. From the lender perspective, FST changed the lenders' debt contracts from relationship-based lending contracts to contract maturities lending, which were shorter for non-defaulting borrowers.

Likewise, Doblas-Madrid and Minetti (2013) and Dierkes et al. (2013) examined how FST helps improve debt market and utilization by US and German firms, respectively. Employing 3,815 and 25,344 US and German bank-borrowing firms by Doblas-Madrid and Minetti (2013) and Dierkes et al. (2013), respectively, both show that FST promotes the bank-debt markets and utilization by reducing debt defaults through the motivational effect of FST. Triki and Gajigo (2012) examined how FST affects access to bank credit by firms in Africa. The study employs 17,240 firms from 42 African economies between 2006 and 2009 in regression models. Their result shows that FST improves access to debt funds utilization by lowering bank financing costs. Brown et al. (2009) explored how FST affected debt/credit availability in European economies. Employing 5717 firms from 24 transition economies in Europe between 2002 and 2005, their result shows that FST improves banks' debt fund availability and lowers the cost of debt funds to firms, which encourages debt utilization by firms.

### Effect of financial sector transparency on suppliers of debts

Moving to how FST affects debts from the perspective of lenders (suppliers of debts), Kusi and Opoku-Mensah (2018) studied how FST reduced the debt funding cost of banks in Africa using 233 banks from 17 African economies between 2006 and 2012. Using dynamic GMM models, their results show that FST can lower the cost of funds banks seek to advance credit/debts to their borrowers, implying that FST is a useful tool for reducing banks' debt funding costs. Similarly, Tchamyou and Asongu (2017) examined how FST affects the development of debt credit market development in 53 African economies. Using OLS and dynamic GMM covering periods between 2004 and 2011, it was reported that FST promotes/encourages the use of debt financing in the form of formal bank credit and loans. Likewise, Asongu (2017) used data on 162 banks from 39 African economies between 2001 and 2011 to investigate how FST affects access to debt financing through bank loans. Employing instrumental variable fixed effect models with overlapping and/or non-overlapping bank size thresholds to control for the quiet life hypothesis, the study shows that FST reduced the cost of debt financing through banks and increased the volumes of debt financing banks advanced/granted. However, private sector-led FST was more effective. This suggests that FST promote the use of debt financing. Again, Asongu (2017) investigated how the FST systems coexist to affect formal and informal debt finance access in 53 African economies. Using quantile regression models covering 2004 and 2011, the results show that while a positive association is reported between FST and formal debt/credit access, a negative association is reported between FST and informal debt/credit access. This suggests that the effect of FST on debt financing through banks can vary depending on whether the debt financing is formal or informal.

Following the theoretical and empirical review, while it is clear that an obvious link exists between debts and types of transparencies (corporate/accounting, fiscal/budgetary, financial sector transparencies) and the effect of transparencies on debts have been examined by the suppliers (lenders) and demanders (borrowers) perspectives, there is limited understanding and evidence in the empirical literature on whether specifically the two types of FSTs can be used as a tool for taming government debts Africa. Furthermore, learning from the FST literature that FST can be implemented or led by the private



sector or public sector and the private sector-led FST being more effective, there is a knowledge gap as to which of the two FST types (FST led by private sector or FST led by public sector) will be more effective in taming government debts and whether the existence of the two FST types yield 'complementary-synergetic' or 'substitutive' effects in Africa. Additionally, with FST being low in Africa and the government being a regulator and implementer of FST, it is intuitive to argue that initial levels of FST would promote government debts. Still, as FST increases beyond a certain threshold (which is yet to be determined by this study), FST would be able to reduce government debts.

Given the above arguments and empirical evidence, three key hypotheses are discussed and argued. Following the literature on how effective the types of FST can be on debts, this present study hypothesizes following prior studies (see Asongu, 2017; Kusi et al., 2017, 2020; Miller, 2003a) that private sector-led FST will be more effective compared to public sector-led FST and states the null hypothesis as:

H<sub>1</sub>: There is no significant difference in the effectiveness of Private and Public Sector-Led FSTs on government debts

Similarly, while in theory, private sector-led FST and public sector-led FST are substituted in nature, Miller (2003a) argues that private and public sector-led FSTs are complementary largely because the private sector-led FST which provide more detailed client information, better capitalized and resourced complement the public sector-led FST which have limited resources and cannot cover wide and more detailed information on clients. Following these, it is unclear how the types of FST coexist to affect government debts. However, following Asongu (2017), who empirically shows that the coexistence of the types of FST provides complementary-synergetic effects on bank debt financing in Africa, this study hypothesizes that there is a complementary-synergetic effect of the coexistence of public sector-led FST and private sector-led FST on government debts. Hence, the study states the second null hypothesis as:

H<sub>2</sub>: There is no significant complementary-synergetic or substitutive effect of Private and Public Sector-Led FSTs on government debts

Furthermore, with the FST literature reporting that FST is low in Africa (Kusi et al., 2020, 2017) and the government being a regulator and implementer of FST and extremely powerful, it is intuitive to argue that FST must reach a certain threshold before it can have the ability to tame government debts. Thus, initially, FST may induce debt usage by governments. However, beyond a certain level/threshold, FST can dampen government debts because FST would induce a disciplinary/motivational effect that ensures the government is limited/stopped from receiving additional debt assistance if the current ones are not paid. Based on this assertion from the literature, this present study hypothesizes that there is a nonlinear threshold effect of FST on government debts.

H<sub>3</sub>: There is a linear effect of Private and Public Sector-Led FSTs on government debts

## Methodology and data

The study employs data covering 23 African economies between 2004 and 2020. The selection criteria are purely based on data availability for the period under study and countries that have at least 10 years of continuous data on government debts between the periods under study. Hence, the data structure used for this study is a panel data structure where the variables change across entities and time. The general panel data is expressed in Equation (1), where  $Y$  is the dependent variable,  $\alpha$  and  $\gamma$  are the country-fixed and time-specific effects.  $X$  is a vector of control variables and  $\beta$  is the sensitivity of the vector of independent variables. Data for this study is obtained from two (2) different sources, including World Development Indicators (WDI) and International Debt Statistics. Prior econometric literature advances that the panel data produces more accurate, reliable and robust results than the traditional time series or cross-sectional data (see Baltagi et al., 2015; Baltagi & Baltagi, 2008). Moreover, Imbens and Wooldridge (2009) show that the panel data structure can overcome omitted variable biases, such as the ability to compromise the authenticity of the results.

$$Y_{it} = \alpha_i + \gamma_t + \beta X_{it} + \varepsilon_{it}, \quad (1)$$

To explore the usage of FST types as a tool/strategy for reducing/taming government debts (gross debts, total debts, long-term, short-term and private and publicly guaranteed debts) in Africa, dynamic regression GMM models are employed for a number of reasons. First, prior studies show that high persistence (correlation above 0.8) in the dependent variable and its lags requires the use of GMM (see Asongu & Tchamyou, 2016; Kusi, 2021), and given that government debts are cumulative and are reported to be highly correlated with its past values (see Appendix A), this study employs the dynamic GMM model accommodate the persistence in the dependent variable. Again, following the GMM-centric literature (Asongu et al., 2019; Tchamyou, 2020), it is argued that when the number of entities (23) is more than the time of time series (16), the GMM presents more reliable and accurate results and hence the use of the dynamic GMM. Furthermore, literature shows that macroeconomic variables such as government debts, inflation, and gross domestic product are endogenous, leading to potential endogeneity problems and knowing that the GMM can control for endogeneity (see Ahmed et al., 2024; Zakari et al., 2022), this study employs the dynamic GMM to cater for the possible endogeneity that may emerge. The dynamic GMM framework is expressed as:

$$Y_{it} = \alpha Y_{it-1} + \gamma Z_{it} + \beta U_{it} + \phi X_{it} + \varepsilon_{it}, \quad (2)$$

where  $Y_{it}$  is the dependent variable (government debts),  $Y_{it-1}$  represents the past values of government debts,  $Z_{it}$  and  $U_{it}$  are the variables of interest (private and public sector-led FST) and  $X$  represents a vector of control variables determined to influence government debts (expenditure, revenue, GDP growth, trade and exchange rate) in the empirical literature (see Nikolaidou & Okwoche, 2023; Thornton & Vasilakis, 2019). Thus, following prior studies (see Nikolaidou & Okwoche, 2023; Thornton & Vasilakis, 2019), the study contextualizes the government model in Equations (3)–(5), where Equation (3) examines the complementary-synergetic or substitutive effects of FST types on government debts and Equations (4) and (5) examine the nonlinear threshold effects of private and public sector-led FSTs on government debts, respectively.

In determining the complementary-synergetic or substitutive effects of FST types (hypothesis 2) and which transparency in more effective (hypothesis 1), the study follows prior studies (Asongu & Odhiambo, 2020) that use the sign in front of the coefficient ( $\beta_4$ ) of the joint/interactive term of the types of FST. Suppose the coefficient of the joint term is positive. In that case, it signifies complementary-synergetic effects (meaning the existence of the two types of FST reinforces each other to promote debts). In contrast, if it is negative, it signifies substitutive effects (meaning one of the two FST types can be used instead of the other). Likewise, in determining the nonlinear threshold point (hypothesis 3), the approach of Lind and Mehlum (2010) is employed where partial derivatives of Equations (4) and (5) are taken for FST and set to zero to obtain Equations (6) and (7) respectively. The resulting value of computing Equations (6) and (7) signifies the threshold/level of FST beyond/below which FST reduces government debts.

$$GOVDEBT_{it} = \mu_1 GOVDEBT_{it-1} + \mu_2 PCB_{it} + \mu_3 PCR_{it} + \mu_4 [PCB * PCR]_{it} + \sum_{j=5} \mu_5 X_{it} + \varepsilon_{it} \quad (3)$$

$$GOVDEBT_{it} = \beta_1 GOVDEBT_{it-1} + \beta_2 PCB_{it} + \beta_3 PCR_{it} + \beta_4 [PCB * PCB]_{it} + \sum_{j=5} \beta_5 X_{it} + \varepsilon_{it} \quad (4)$$

$$GOVDEBT_{it} = \varphi_1 GOVDEBT_{it-1} + \varphi_2 PCB_{it} + \varphi_3 PCR_{it} + \varphi_4 [PCR * PCR]_{it} + \sum_{j=5} \varphi_5 X_{it} + \varepsilon_{it} \quad (5)$$

$$\frac{\partial GOVDEBT}{\partial PCB} = 0 = -\beta_2/2 * \beta_4 \quad (6)$$

$$\frac{\partial GOVDEBT}{\partial PCR} = 0 = -\varphi_3/2 * \varphi_4 \quad (7)$$

In terms of modeling government debts, the study follows prior studies (see Nikolaidou & Okwoche, 2023; Thornton & Vasilakis, 2019) who studies government debt determinants in Africa. The dependent variable is represented by 6 different government debt indicators, including gross government debts to GDP and the natural log of total debts, long-term debts, short-term debts, privately and publicly guaranteed debts, and interest payments in order to ensure consistency, reliability and robustness of the results. The International Debt Statistics World Bank database contains these government debt indicators. The variables of interest, private and public sector-led financial sector transparencies, are obtained from the World Development Indicators database. It captures the percentage of adult population of

financial market participants whose credit information is captured, stored and shared by credit information-sharing systems in a country. The expectation is that FST would have an inverted U-shaped threshold on government debts, and following (Miller, 2003b), a substitutive effect of the FST types is expected on governments.

Regarding control variables, GDP growth is measured as year-on-year changes in GDP. It is expected to lower government debts because income signifies an income improvement and the economy's expansion. It reflects less government borrowing because it places less demand on government expenditures and revenues. Trade openness is computed as the sum of imports and exports scaled over GDP. It reflects how an economy is integrated into the global chain/trade. The effect of trade could be positive or negative depending on whether trade terms are favorable or not. However, because most African economies are import-driven, this study anticipates a negative nexus between government debts and trade openness. The exchange rate is measured as a log of local currency to the dollar and reflects weakened/depreciated local currency.

Given that external debts are soaring and depreciated, local currency increases the value of government debts, and a positive relationship is expected. Government revenue and expenditure are the ratio of government revenue and expenditure to GDP, respectively. The expectation is that government revenue would lower the government's quest to borrow while expenditure would increase the quest for the government to borrow.

## Empirical results and discussions

The main results of this study are reported in Tables 4–6 and Figures 3–8. However, Tables 2 and 3 report the summary statistics and correlation matrix to check for outliers and multicollinearity. Following the literature on outliers, which advances that outliers can distort the accuracy and reliability of regression results (Chio, 2009; Osborne & Overbay, 2004; Yuan & Bentler, 2001), the study finds no evidence of outliers using the mean, minimum, maximum and standard deviation values. Also, using natural logs and ratios has helped lower the presence of outliers. In the context of multicollinearity, the study uses a

**Table 2.** Summary statistics.

Variable	Obs	Mean	Std. Dev	Min	Max
Grossdebtogdp	849	54.03	50.252	.488	544.341
shorttermdebtoftot ~ t	833	9.95	10.568	0	62.519
Lnextdebt	833	22.031	1.465	18.683	25.97
Lnextdebtlt	833	21.811	1.479	18.421	25.734
Lnextdebtppg	833	21.68	1.397	18.421	25.328
lnInterest	816	17.339	1.939	10.385	22.313
privatecreditburea ~ u	817	6.347	15.299	0	67.3
publiccreditregist ~ d	817	4.089	11.851	0	100
gdpgrowthannual	862	3.993	7.109	−62.076	123.14
tradeofgdp	1249	68.078	37.028	.785	347.997
Lnexch	409	4.738	4.048	2.051	32.821
Revenueofgdp	881	22.526	12.658	1.983	164.054
Expenditureofgdp	873	25.186	13.35	3.787	151.462

**Table 3.** Pairwise correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) grossdebtogdp	1.000												
(2) shorttermdebto ~ l	0.207	1.000											
(3) lnextdebt	0.002	0.290	1.000										
(4) lnextdebtlt	−0.015	0.190	0.991	1.000									
(5) lnextdebtppg	0.003	0.167	0.965	0.976	1.000								
(6) lnInterest	−0.132	0.122	0.880	0.893	0.898	1.000							
(7) privatecreditb ~ o	−0.142	0.243	0.238	0.229	0.211	0.262	1.000						
(8) publiccredit ~ e	0.047	0.172	0.131	0.126	0.024	0.077	−0.122	1.000					
(9) gdpgrowthannual	−0.103	−0.068	−0.010	0.000	0.007	0.031	−0.059	−0.052	1.000				
(10) tradeofgdp	−0.092	0.000	−0.112	−0.129	−0.110	−0.069	−0.012	−0.053	0.029	1.000			
(11) lnexch	−0.350	0.330	0.056	0.028	0.037	0.193	0.000	−0.013	−0.016	−0.103	1.000		
(12) revenueofgdp	0.041	−0.054	−0.170	−0.163	−0.166	−0.053	0.150	0.021	0.010	0.006	−0.262	1.000	
(13) expenditureof ~ p	0.139	−0.022	−0.103	−0.104	−0.108	−0.008	0.168	0.024	−0.197	0.035	−0.312	0.758	1.000

**Table 4.** Complementarity effects of public and private sector-led financial transparencies on government borrowings/debts.

VARIABLES	(1) GROSS	(2) SHORT	(3) TOTAL	(4) LONG	(5) PPG	(6) Interest
L.grossdebtofgdp	0.835*** (0.0921)					
L.shorttermdebt		0.306* (0.171)				
L.lnextdebtlt			0.720*** (0.163)			
L.lnextdebtlt				0.654*** (0.1000)		
L.lnextdebtppg					0.858*** (0.0792)	
L.lnInterest						0.504*** (0.135)
c.PCB#c.PCR	−0.0519* (0.0268)	−0.0746** (0.0335)	0.00418 (0.00367)	0.00626** (0.00257)	0.00138 (0.00219)	0.0154*** (0.00340)
PCB	0.112 (0.122)	0.194* (0.103)	0.0200* (0.0110)	0.0261*** (0.00796)	0.00979** (0.00400)	0.0395*** (0.0126)
PCR	0.134** (0.0549)	0.101 (0.251)	0.0116 (0.00826)	0.0118** (0.00451)	0.00714* (0.00414)	0.0235** (0.00929)
gdpgrowthannua	−0.646** (0.246)	0.0326 (0.0616)	0.00196 (0.00332)	−0.000853 (0.00535)	0.000135 (0.00218)	0.0217 (0.0135)
tradeofgdp	0.0193 (0.0240)	0.0219 (0.0191)	0.000913 (0.00101)	0.000554 (0.00132)	0.000774 (0.000672)	0.000412 (0.00196)
Lnexch	12.46 (10.15)	1.664 (3.832)	0.153** (0.0710)	0.129 (0.0957)	0.0713 (0.0530)	0.329** (0.140)
revenueofgdp	−0.608* (0.345)	0.0517 (0.193)	−0.0182*** (0.00503)	−0.0179*** (0.00565)	−0.0217** (0.00773)	0.00689 (0.0139)
expenditure	0.958** (0.345)	0.0164 (0.311)	0.0141* (0.00729)	0.0101 (0.00690)	0.0170** (0.00685)	−0.00787 (0.0138)
Constant	−717.9 (474.1)	231.1 (494.4)	−3.711 (15.81)	2.998 (16.08)	−13.40 (8.965)	−37.15 (28.24)
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	278	270	270	270	270	270
Number of ccode	23	22	22	22	22	22
AR(1)	−2.63(0.009)	−1.60(0.109)	−2.60(0.009)	−2.75(0.006)	−3.04(0.002)	−1.82(0.069)
AR(2)	−0.21(0.831)	1.29(0.198)	−0.83(0.409)	0.13(0.898)	0.35(0.727)	0.98(0.525)
Sargan	21.18(0.00)	29.95(0.000)	1.88(0.597)	1.57(0.666)	15.13(0.087)	0.40(0.941)
Hansen	2.48(0.480)	11.39(0.250)	1.94(0.585)	1.67(0.643)	11.96(0.215)	0.44(0.932)

Note: Standard errors in parentheses.

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

VIF threshold of 5 to justify the inclusion of the variables. There is no evidence of multicollinearity, given that the VIF value of all the variables was below the VIF threshold of 5 (see [Appendix B](#)). Autocorrelation and validity of instruments have been reported in [Tables 4–6](#) and the results present no presence of autocorrelation and valid instruments. Moreover, different dependent variables are employed to check for consistency and robustness in the results obtained in [Tables 4–6](#). Hence, the results obtained are reliable, accurate and consistent. The main results are reported as follows:

### Complementary, synergetic and substitutive effects of financial sector transparencies on government debts

Following the results on the complementary-synergetic effects of private and public sector-led financial sector transparencies ([Table 4](#)), it is observed that having both private and public sector-led financial sector transparencies operating together in an economy have varying complementary-synergetic and substitutive effects on different government debts. Thus, the joint term (coexistence) of private and public sector-led financial sector transparency has significant complementary-synergetic effects on long-term government debts and interest payment of government debts while substituting effects on gross and short-term government debts. Clearly, having either private or public is conducive for government gross and short-term debts, both private and public sector transparency systems are required for an effective effect on government interest payment and long-term debts. Hence, the importance of joint existence and implementation of financial sector transparencies through the private and public institutions to tame government debts is evident and supports the results of prior studies (see Kusi & Opoku-Mensah,

**Table 5.** Nonlinear effects of private sector-led financial transparencies on government borrowings/debts.

Variables	(1) Gross	(2) Short	(3) Total	(4) Long	(5) PPG	(6) Interest
L.grossdebt	0.509*** (0.0937)					
L.shortterm		0.544*** (0.150)				
L.inextdebt			0.853*** (0.0619)			
L.inextdebtlt				0.832*** (0.0545)		
L.inextdebtpp					0.789*** (0.0551)	
L.lnInterest						0.490*** (0.138)
PCB	0.710* (0.349)	−0.125 (0.148)	0.0230** (0.0102)	0.0309*** (0.0108)	0.0312*** (0.00992)	0.0806** (0.0339)
PCB#c.PCB	−0.0135** (0.00607)	0.00486* (0.00263)	−0.000230 (0.000140)	−0.000344** (0.000149)	−0.000346** (0.000151)	−0.000831* (0.000473)
PCR	0.254** (0.105)	0.0270 (0.0892)	0.00745* (0.00402)	0.00909** (0.00354)	0.0112** (0.00440)	0.0281** (0.0120)
gdpgrowth	−0.953** (0.435)	0.0776 (0.0642)	0.00371 (0.00221)	0.000824 (0.00310)	−0.000889 (0.00271)	0.0218 (0.0140)
tradeofgdp	−0.0250 (0.0225)	0.0159 (0.00971)	0.000640 (0.000728)	0.000680 (0.000708)	0.000686 (0.000730)	0.000108 (0.00200)
lnexch	−5.142 (4.970)	1.227 (1.408)	0.0802 (0.0622)	0.0565 (0.0625)	0.0796 (0.0582)	0.311** (0.128)
revenueofgdp	−1.245*** (0.372)	0.0661 (0.101)	−0.0177*** (0.00434)	−0.0184*** (0.00579)	−0.0227*** (0.00621)	0.00819 (0.0147)
expenditure	1.261** (0.505)	−0.0273 (0.109)	0.0149** (0.00558)	0.0135* (0.00664)	0.0168** (0.00661)	−0.00916 (0.0140)
Constant	1.460 (1.101)	−30.40 (259.9)	1.476 (12.79)	10.45 (12.26)	5.259 (11.79)	−10.01 (32.97)
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	278	270	270	270	270	270
Number of ccode	23	22	22	22	22	22
AR(1)	−2.58(0.010)	−2.38(0.017)	−3.15(0.002)	−3.02(0.003)	−3.19(0.001)	−1.85(0.064)
AR(2)	−0.41(0.682)	1.59(0.113)	−0.61(0.540)	0.30(0.766)	0.48(0.634)	1.06(0.290)
Sargan	42.97(0.000)	10.41(0.001)	7.37(0.288)	7.51(0.276)	5.84(0.442)	0.25(0.969)
Hansen	12.6(0.399)	1.62(0.203)	5.56(0.474)	6.94(0.326)	6.45(0.375)	0.23(0.973)

Note: Standard errors in parentheses.

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

2018; Kusi et al., 2020) that show the coexistence of complementary-synergetic effects of private and public sector-led financial sector transparencies. On the contrary, the substitutive effect results confirm the results of Miller (2003b) who suggests that the two transparency systems are substitutes and should be used alternatively.

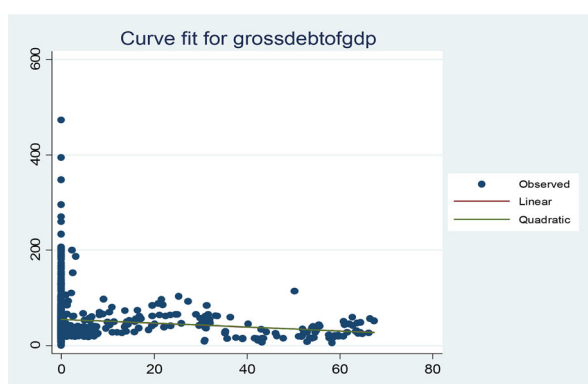
### Nonlinear threshold effects of financial sector transparencies on government debts

Following the results on the nonlinear threshold effects of private and public sector-led financial sector transparencies on government debts in Tables 5 and 6, it is observed that initial levels of financial sector transparency through private and public sector institutions promote government debts while further increases of both private and public sector-led financial sector transparencies in an economy lower government debt. Specifically, while private sector-led financial sector transparency has nonlinear inverted U-shape on gross debts (see Figure 3), long-term debts (see Figure 4), privately and publicly guaranteed debts (see Figure 5) and interest on debts (see Figure 6), public sector-led financial sector transparency have nonlinear inverted U-shape on only privately and publicly guaranteed debts (see Figure 7) and interest on debts (see Figure 8). Thus, private FST can achieve its target of lowering government debts when it attains some minimum threshold. Using the approach of Lind and Mehlum (2010), as indicated in Equations (6) and (7), it is evident that government debts are reduced only at a certain threshold of financial sector transparency. That is, government gross debt, long-term debts, private and publicly

**Table 6.** Nonlinear effects of public sector-led financial transparencies on government borrowings/debts.

Variables	(1) Gross	(2) Short	(3) Total	(4) Long	(5) PPG	(6) Interest
L.grossdebtogdp	0.516*** (0.104)					
L.shorttermdebt		0.538*** (0.148)				
L.inextdebt			0.881*** (0.0678)			
L.inextdebtlt				0.873*** (0.0568)		
L.inextdebtppg					0.823*** (0.0600)	
L.lnInterest						0.415** (0.172)
PCB	0.00636 (0.0925)	0.127** (0.0556)	0.0108** (0.00438)	0.0119*** (0.00343)	0.0135*** (0.00337)	0.0497*** (0.0161)
PCR	0.173 (0.343)	0.345 (0.209)	0.0161 (0.0103)	0.0173* (0.00916)	0.0233** (0.00957)	0.0850*** (0.0267)
c.PCR#c.PCR	−4.67e−05 (0.00663)	−0.00663* (0.00352)	−0.000241 (0.000176)	−0.000252 (0.000156)	−0.000354** (0.000167)	−0.00129*** (0.000429)
gdpgrowthannual	−0.969** (0.439)	0.0925 (0.0699)	0.00452** (0.00177)	0.00216 (0.00251)	0.000542 (0.00219)	0.0249* (0.0144)
Tradeofgdp	−0.0161 (0.0199)	0.0134 (0.00891)	0.000598 (0.000627)	0.000599 (0.000671)	0.000623 (0.000769)	−0.000165 (0.00201)
Lnexch	−4.452 (4.862)	0.960 (1.403)	0.0639 (0.0611)	0.0422 (0.0619)	0.0743 (0.0578)	0.368** (0.168)
revenueofgdp	−1.231*** (0.351)	0.0709 (0.102)	−0.0178*** (0.00474)	−0.0184*** (0.00619)	−0.0234*** (0.00697)	0.00664 (0.0147)
expenditureofgdp	1.281** (0.455)	−0.0353 (0.112)	0.0150** (0.00562)	0.0138** (0.00651)	0.0178** (0.00683)	−0.00919 (0.0141)
Year	−0.314 (0.402)	−0.118 (0.117)	0.00411 (0.00538)	0.00252 (0.00536)	0.00583 (0.00444)	0.0196 (0.0158)
Constant	672.7 (827.7)	234.7 (236.0)	−6.019 (11.30)	−2.520 (11.11)	−8.265 (8.897)	−31.04 (31.58)
Year Effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	278	270	270	270	270	270
Number of ccode	23	22	22	22	22	22
AR(1)	−2.50(0.012)	−2.36(0.018)	−3.12(0.022)	−3.02(0.003)	−3.09(0.002)	−1.60(0.111)
AR(2)	−0.40(0.687)	1.44(0.150)	−0.98(0.328)	0.09(0.931)	0.30(0.764)	0.82(0.415)
Sargan	42.17(0.000)	9.85(0.002)	9.36(0.154)	9.22(0.162)	7.21(0.302)	0.79(0.852)
Hansen	10.33(0.587)	1.53(0.215)	6.71(0.348)	8.70(0.191)	8.60(0.197)	1.14(0.767)

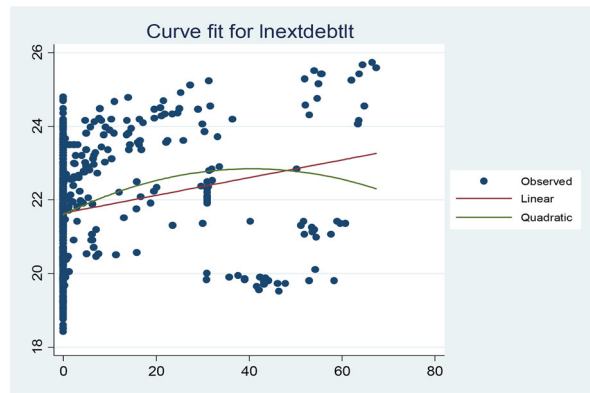
Note: Standard errors in parentheses.

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .**Figure 3.** Model 1- gross debt.

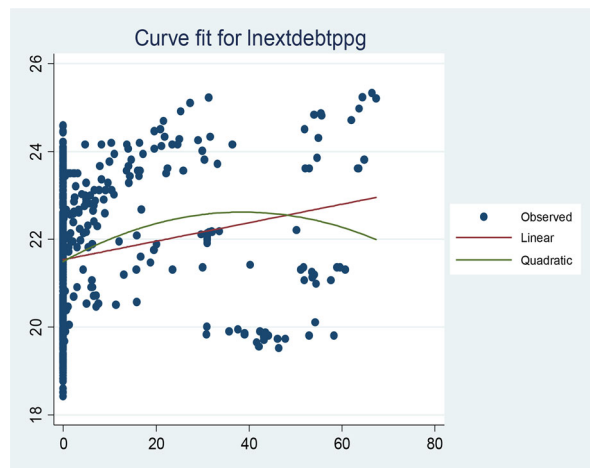
guaranteed debts and interest on debt payments would significantly reduce when private sector-led financial sector transparency reaches 26.30, 44.91, 45.09, and 48.50%, respectively.

Similarly, private and publicly guaranteed debts and interest on debt payments would significantly reduce when public sector-led financial sector transparency reaches 9.03 and 32.95%, respectively. Clearly, the study presents a new and insightful finding that until financial sector transparency (FST) in

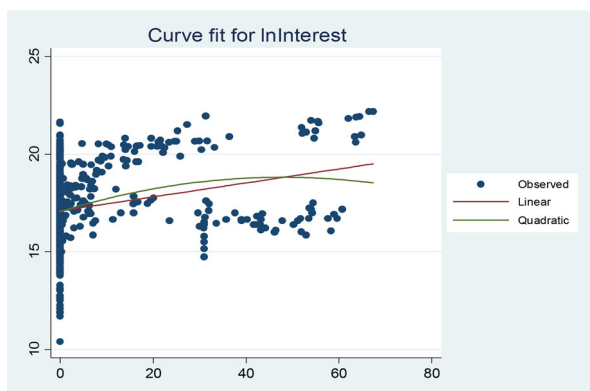




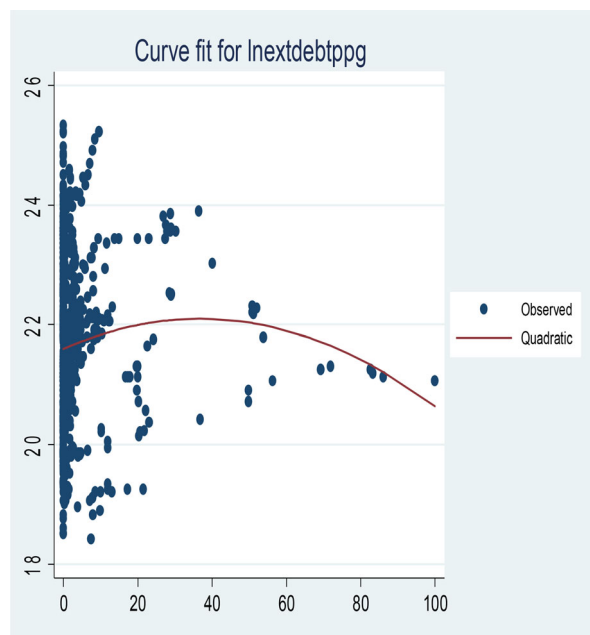
**Figure 4.** Model 4- long-term debt.



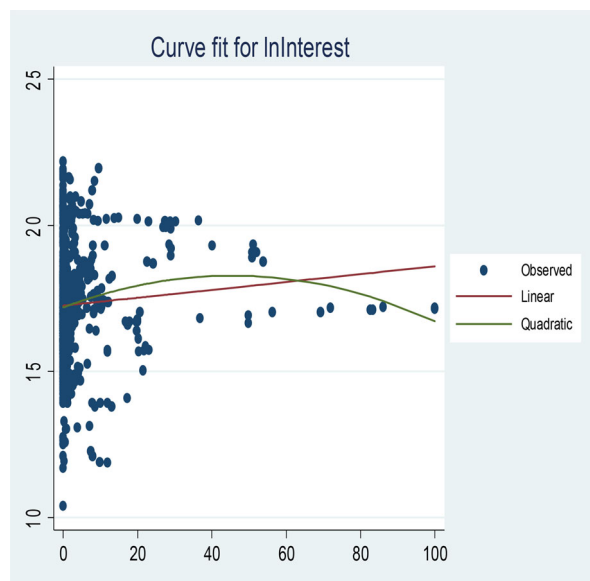
**Figure 5.** Model 5- public and publicly guaranteed debt.



**Figure 6.** Model 6- interest payment on debt.



**Figure 7.** Model 5 - public and publicly guaranteed debt.



**Figure 8.** Model 6- interest payment on debt.

the financial market attains/reaches a certain threshold/level, its (FST) desirable debt-reducing effect cannot be achieved. From the results, it is clear that comparing the thresholds/levels of private and public sector-led financial sector transparency, lower levels/thresholds of public sector-led financial sector transparency are required to tame government debts, implying that public sector-led financial sector transparency may be more effective in reducing government debts.

In terms of the control variables, it is consistently observed that GDP growth and government revenue lower government debts across the models estimated. In contrast, exchange rate and government expenditure increase government debts across the models estimated. These results on the control variables are largely consistent with the theoretical and empirical evidence in the literature, as indicated in the methodology and data section.

## Conclusions, policy implications and recommendations

Recently, the debts of African economies have increased drastically and attracted the attention of local and international policymakers largely because of how government over-indebtedness has induced some crisis in the past (see Kusi et al., 2022). As a result of the adverse effects of government indebtedness, international institutions and agencies like the IMF and World Bank have employed bailouts, debt restructuring, debt reliefs and debt forgiveness as possible solutions. At the same time, local policymakers have relied on rebasing economies and increasing domestic revenue mobilization as local alternative strategies to lower the effects of government over-indebtedness. Learning from the information asymmetry literature, sharing credit information among lenders on financial market participants can help tame the over-indebtedness of financial markets, and surprisingly, existing empirical literature fails to examine the debt-reducing effect of financial sector transparency on government debts. Again, knowing that financial sector transparency can be implemented through public sector and private sector institutions and taking advantage of the rising debt levels of governments in Africa, this study is motivated to investigate how private and public sector-led transparencies coexist to influence government debts and the nonlinear threshold effects of these transparencies on government debts in Africa.

The study employs panel data from 23 African economies between 2004 and 2020 to examine the complementary and nonlinear threshold effects of financial sector transparencies on government debts using a dynamic GMM estimation strategy. From the results, the study finds that while the coexistence/implementation of both private and public sector-led financial transparencies induce complementary synergies to increase long-term debts and interest on debt payments, there was also a substitutive effect of the coexistence/implementation of both private and public sector-led transparencies to lower gross and short-term government debts. Furthermore, the study shows an inverted nonlinear threshold effect of financial sector transparencies on government debts, implying that financial sector transparencies must reach a minimum threshold/level to induce the desirably reduced effect on government debts in Africa. On the threshold level of financial sector transparency that has a reducing effect on government debts, it is observed that public sector-led financial sector transparency achieves the desirable government debt-reducing effect at lower thresholds compared to private sector-led financial sector transparency.

The results of this study have policy implications and recommendations for governments, economic policymakers, financial regulators and international institutions interested in taming government indebtedness. First, this study makes African financial regulators aware of how financial sector transparency can influence government debts and hence, the need to improve transparency in the financial market. Thus, financial regulators can rely on financial sector transparency to reduce government debts. Second, given that financial sector transparency can reduce government debts only when they attain a minimum threshold, policymakers need to expand and strengthen the coverage of private and public sector information-sharing institutions to increase the quality and depth of information covered and shared by information-sharing institutions in order to improve transparency in financial sector. This can help hasten the attainment of the minimum threshold required for financial sector transparency to lower government debts in Africa. Again, since the study covered on 23 African economies, researcher can replicate this study and use more African economies in order to test the consistency of this result. Furthermore, it would be interesting for future research to document how IMF policy arrangements influence African government debts across the different debt-burden groupings to offer insights into effectiveness and efficiency of IMF debt-reducing policies.

## Notes

1. [https://openknowledge.worldbank.org/server/api/core/bitstreams/2d6b3d72-a763-5db8-bd8b-209a6a7fb384/content?International Debt Statistics 2022 \(worldbank.org\)\(doi:10.1596/978-1-4648-1800-4\).](https://openknowledge.worldbank.org/server/api/core/bitstreams/2d6b3d72-a763-5db8-bd8b-209a6a7fb384/content?International%20Debt%20Statistics%202022%20(worldbank.org)(doi:10.1596/978-1-4648-1800-4).)
2. <https://www.imf.org/-/media/Files/Publications/PP/2020/English/PPEA2020003.ashx>

## Author contributions statement

Baah Aye Kusi was involved in the conceptionalization and designing, analysis and interpretation of the data. He was also involved the drafting of the paper, revising the manuscript critically for intellectual content and the final

approval of the version to be published. Edward Daniels was also involved in the drafting of the paper and revising of the manuscript critically for intellectual content. Blessing Akumah was involved in the conceptualization, writing and designing of the manuscript. Authors have agreed to be accountable for all aspects of the manuscript submitted.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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## Availability of data and materials

Data will be made available on request.

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## Appendices

### Appendix A: Correlation between government debts and the past values

Variables	grossdebtogdp	lnextdebt	lnextdebtlt	lnextdebtst	lnextdebtppg	lnInterest
L.grossdebtogdp	0.945*					
L.lnextdebt		0.988*				
L.lnextdebtlt			0.987*			
L.lnextdebtst				0.911*		
L.lnextdebtppg					0.983*	
L.lnInterest						0.941*

\*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

## Appendix B: Variance inflation factor

	VIF	1/VIF
revenueofgdp	4.849	.206
expenditureofgdp	4.769	.21
incomeg	1.876	.533
publiccreditregist ~ d	1.473	.679
privatecreditburea ~ u	1.449	.69
lnexch	1.223	.817
year	1.173	.852
gdpgrowthannual	1.093	.915
tradeofgdp	1.054	.949
Mean VIF	2.107	.

## Appendix C: Summary of empirical review papers

Year	Authors	Methods	Financial Market Agent	Results	Sample/Context
2021	Kusi, Dzeha, Gyan & Turkson	GMM panel between 2003–2013; linear effect	Users of debt funds - Businesses/firms	FST encourages short-term debts but detracts long-term debts	20 listed firms in Ghana
2018	Sutherland	firm-time and lender-time tests; linear Effect	Users of debt funds - Businesses/firms	FST boosts debt usage by lowering switching cost	firms in Asia
2013	Doblas and Minetti	panel regression; linear Effect	Users of debt funds - businesses/firms	reinforce bank-debt utilization	3,815 US bank-borrowing firms
2013	Vierkes, Erner, Langer and Norden	panel regression; linear Effect	Users of debt funds - banks as borrowing firms	encourages debt lending by banks	25,344 German bank-borrowing firms
2012	Triki and Gajigo	Panel regression between 2006–2009; linear Effect	Users of debt funds - businesses/firms	FST improves access to debt utilization	17240 firms in Africa
2009	Brown, Jappelli and Pagano	Panel regression between 2002–2005; linear Effect	Users of debt funds - businesses/firms	FST improves debt fund availability and lowers cost of debt funds	5717 firms from 24 European economies
2018	Kusi and Opoku-Mensah	GMM panel between 2006–2012; linear Effect	Supplier of debt funds - banks	FST lowers the cost funds banks seek to advance credit	233 banks from 17 African economies
2017	Tchamyu and Asongu	OLS/GMM panel data between 2004 and 2011; linear Effect	Supplier of debt funds - banks	FST promotes the utilization of bank debt financing	53 African economies
2017	Asongu	instrumental variable fixed effect panel between 2004 and 2011; linear Effect	Supplier of debt funds - banks	FST reduces cost of debt financing and increase volumes of debt financing administer by banks	162 banks from 39 African economies
2017	Asongu	quantile regression between 2004 and 2011; linear Effect	Supplier of debt funds - banks and nonbanks	FST ecourages and discourages formal and infromal bank debt utilizations, respectively.	53 African economies

## Appendix D: Cross sectional dependence

Residuals calculated using predict, residuals.  
 (1,234 missing values generated)  
 Unbalanced panel detected, test adjusted.  
 Missing values imputed for CD\*.  
 Testing for weak cross-sectional dependence (CSD)  
 H0: weak cross-section dependence  
 H1: strong cross-section dependence

	+	CD	CDw	CDw+	CD*
residuals		6.70 (0.000)	−1.88 (0.060)	127.62 (0.000)	−0.18 (0.857)

*p*-values in parenthesis.

References.

CD: Pesaran (2015, 2021).

CDw: Juodis and Reese (2021).

CDw+: CDw with power enhancement from Fan et al. (2015).

CD\*: Pesaran and Xie (2021) with 4 PC(s).

## Appendix E: Fisher-type unit-root test for gross debt of GDP

Based on Phillips-Perron tests

Ho: All panels contain unit roots      Number of panels = 51

Ha: At least one panel is stationary      Avg. number of periods = 16.65

AR parameter: Panel-specific      Asymptotics: T → Infinity

Panel means: Included

Time trend: Included

Newey-West lags: 2 lags

		Statistic	<i>p</i> -value
Inverse chi-squared(102)	<i>P</i>	226.8962	0.0000
Inverse normal	<i>Z</i>	−0.8186	0.2065
Inverse logit t(254)	<i>L</i> *	−3.1666	0.0009
Modified inv. chi-squared	<i>P</i> m	8.7445	0.0000

*P* statistic requires number of panels to be finite.

Other statistics are suitable for finite or infinite number of panels.