Received: 10th July, 2024 *Revised: 27th September, 2024* *Accepted: 20th October, 2024*

CARITAS UNIVERSITY AMORJI-NIKE, EMENE, ENUGU STATE

Caritas Journal of Management, Social Sciences and Humanities

CJMSSH, Volume 3, Issue 2 (2024)

Differential Impacts of Bilateral and Multilateral Concessional Debts on Public Investment in Sub-Saharan Africa

I. G. Okafor
Ebele S. Nsofor
Hillary Chijindu Ezeaku

Authors' Affiliation

Department of Banking and Finance, Caritas University, Enugu

Keywords:

Bilateral concessional debts, Multilateral concessional debts, Public Investment

ABSTRACT

The relationship between concessional debt and public investment in developing economies has been traditionally modeled with linear and symmetric assumptions. This study examines the potentially asymmetric effects of bilateral and multilateral concessional debts on public investment in 32 sub-Saharan African countries from 1985 to 2020, addressing a critical gap in understanding debt-investment dynamics in developing contexts. Using linear and non-linear Panel ARDL models, the analysis reveals significant asymmetries. Positive shocks to bilateral concessional debt are associated with a 0.14% increase in public investment, while negative shocks lead to a 0.05% decrease. For multilateral concessional debt, a 1% increase corresponds to a 0.26% rise in public investment, compared to a 0.7% increase for a 1% decrease. This counterintuitive finding suggests that reductions in multilateral debt might stimulate improved domestic resource mobilization or increased efficiency in public spending. The Pooled Mean Group estimation shows a positive relationship between multilateral concessional debts and public investment in both short and long run, with stronger long-run effects. Institutional quality significantly impacts investment outcomes, with a 1% decline in the institutional quality index leading to a 0.2% short-run and 0.5% long-run decrease in public investment. These findings challenge conventional wisdom and highlight the complex interplay between concessional debt, institutional quality, and public investment in sub-Saharan Africa. The results underscore the need for tailored, country-specific policy approaches that consider the asymmetric effects of different debt types and the crucial role of institutional frameworks in leveraging concessional financing for sustainable development.

JEL classification: C51, H54, E6

1. Introduction

Sub-Saharan Africa is characterized by a diverse range of economic, social, and political landscapes. It encompasses a multitude of countries at varying stages of development, each facing unique challenges and opportunities (Ilorah, 2011). The region has historically relied on concessional debt to bridge the resource gap required for financing critical public investment projects. Concessional loans, which offer more favourable terms than market-based loans, have been extended by both bilateral donors and multilateral institutions to support these investment endeavours.

Fostering public investment with substantial economic potential stands as a key objective for the majority of economies and aid-providing organizations in developing nations (Marcos & Vale, 2022). Public investment is essential for development strategies as it involves additions to the national capital stock and is a key variable item in government spending (Allain-Dupré, Hulbert & Vammall, 2012). The gross fixed capital formation is a commonly used measure of public investment (IMF, 2017; Sijabat, 2022). According to the United Nations (2009), public investment refers to gross fixed capital formation by the government, including the central and sub-regional governments. It is measured by the total value of acquisitions less disposals of fixed assets during the accounting period, as well as certain specified expenditures on services that add value to non-produced assets like land improvements.

Several studies, including Wan and Chen (2022), have emphasized the crucial role of public investment in promoting economic growth and development. Consequently, multilateral and bilateral aid agencies have exhibited a strong commitment to assisting less developed countries achieve sustainable economic development. This is exemplified in the 2015 modernized debt concessionality policy, which increased the grant element of loans from 25 percent to 45 percent, and reduced the discount rate from 10 percent to 5 percent (OECD, 2016; OECD, 2014a). The grant element of a loan is the determining factor in the level of concessionality (Scott, 2017). The primary objective of debt concessionality is to foster growth, encourage public investment, enhance social outcomes, and improve the debt sustainability of recipient countries. The ultimate goal is to achieve sustained growth and development, surpass the per capita income threshold for Official Development Assistance (ODA) eligibility of the International Development Association (IDA), and potentially transition from an aid recipient to a donor country (OECD, 2014b).

The OECD (2019) recently analyzed aid disbursements worldwide and found that bilateral and multilateral aid made up a larger portion of all aid in 2017. Much of this aid is tied to investments in economic, social, or production infrastructure (Chatterjee, Kelly & Turnovsky, 2021). Bilateral concessional debt includes loans provided by governments and their agencies, direct loans from official export credit agencies, and loans extended by autonomous bodies. In contrast, multilateral concessional advances comprise loans and credits from the World Bank, regional development banks, and other multilateral and intergovernmental agencies. However, loans from funds administered by an international organization on behalf of a single donor government are not considered multilateral loans but rather classified as bilateral loans from governments.

In the context of Sub-Saharan Africa, where limited fiscal space and competing socio-economic demands are prevalent, understanding the differential impacts of disaggregated concessional debts, particularly bilateral and multilateral sources, on public investment is of paramount importance. While it is generally accepted that aid can have a positive impact on recipient nations, it is crucial to recognize that the relationship between aid and public investment may not always be symmetric. In other words, the impact of aid on public investment may differ depending on various factors such as the recipient country's level of development, political stability, or the sector in which the aid is being provided. Therefore, in addition to investigating the augmenting effect of each aid source and institutional quality on public investment, this study also examine the asymmetric effects of tied and untied concessional debts.

One critical aspect of this relationship is understanding the nature of the asymmetry and its potential impact on public investment. For instance, an increase in concessional debt may not necessarily have a proportional effect on public investment. While an increase in concessional debt has the potential to increase a country's financial resources,

leading to an increase in public investment and a positive impact on the economy, a decrease in concessional debt may not necessarily lead to an immediate reduction in public investment. The government may prioritize existing projects and seek alternative sources of funding, resulting in a smaller impact on public investment compared to an increase in concessional debt. Therefore, policymakers need to carefully consider the direction of the shock and the potential impact on public investment. Understanding the nature of this asymmetry is crucial for policymakers as it can inform effective decision-making related to concessional debt. This study can provide valuable insights into the non-linear relationship between concessional debt and public investment, which can aid in the development of more effective policies and strategies that promote sustainable economic growth.

The subsequent sections of this paper are arranged as follows: Section 2 provides an overview of relevant literature. In Section 3, we outline the data and methodology utilized in our empirical analysis. The outcomes of our study and ensuing discussions are presented in Section 4. Finally, Section 5 offers concluding policy implications based on our findings.

2. Literature Review

2.1 Empirical Review

The conceptual foundation of official development assistance (ODA) rests on the principles of developmental motivation, official character, and a measure of concessionality, despite occasional tensions between political expediency and statistical accuracy. OesterreichischeKontrollbank [OEKB] (2012) underscores the OECD consensus, stipulating a concessionality level of at least 35% for soft loans, while concessional loans for least developed countries (LDCs) must exhibit a grant element of at least 50% according to UN-Classification. As an increasing proportion of concessional debts are channeled into economic, social, and production infrastructure investments, questions concerning their efficacy have gained prominence in recent debates.

Easterly (2003) highlights that research on the effectiveness on foreign aid and economic development often transcends into political terrain. While the concept of ODA is widely acknowledged, the appropriateness of metrics used to gauge its developmental impact remains a subject of ongoing discourse (Hynes & Scott, 2013). In this context, we delve into previous studies probing the nexus between aid and public investment. Heller's seminal work (1975) contends that aid not only spurs public investment but also mitigates domestic taxation and debt. However, the extent and precise responsiveness of public investment to aid hinge on the type of aid provided. Furthermore, Presbitero (2016) posits that despite substantial aid inflows and fragmented donor support, absorptive capacity in recipient countries can impede growth in public investment. Similarly, White's (1993) study in India found no discernible effect of aid on public investment, citing analogous reasons. Chatterjee and Turnovsky (2005) argue that the structural characteristics of aid recipients significantly influence the extent to which aid can bolster productive investment.

Earlier studies have yielded mixed findings regarding the impact of aid on public investment, particularly with respect to its source. Jafri and Habib's (2016) study in Pakistan, for instance, revealed that both multilateral and bilateral loans exerted a substantial positive influence on public investment, as assessed by gross fixed capital formation. Cordella and Ulku (2007) posit that there is no positive correlation between the degree of concessionality and the level of development in Sub-Saharan Africa and Asia. Considering the debt overhang hypotheses, Knoll's (2013) investigation of the Heavily Indebted Poor Countries Initiative (HIPCI) and the Multilateral Debt Relief Initiative (MDRI) unveils that while debt relief programs led to augmented private-sector investment in recipient developing countries, they did not exert a significant impact on public sector investment and growth. Moreover, Knoll (2013) suggests that debt relief programs may have even had a negative effect on public investment and growth. Nevertheless, Iimi and Ojima (2005) contend that the concessionality linked to ODA loans can foster economic development in recipient countries.

Additionally, Orji et al.'s (2019) inquiry into foreign aid inflows in Nigeria indicates a positive and statistically significant influence on capital formation. Conversely, Akram's (2013) study uncovered troubling evidence of debt overhang and crowding-out effects impacting panel estimation outcomes in four South Asian countries. Specifically, it revealed that public external debt and debt servicing had a

significant adverse effect on both public investment and growth.

Public investment constitutes a pivotal driver of economic growth in developing economies. However, its effectiveness in conjunction with aid is subject to various factors such as corruption, poor institutional quality, and governance deficits. Zakari and Umar's (2021) Nigerian study underscores that reducing corruption levels can positively impact public debt. In a regional analysis spanning Sub-Saharan Africa from 1997 to 2020, Manassey et al. (2022) find that excessive external debt and its volatility can adversely affect economic growth, whereas good governance exerts a positive influence. This encompasses factors such as political stability, regulatory quality, and corruption control. Spyromitros' (2022) assessment of corruption in 83 developing countries from 2012 to 2018 underscores its negative impact on economic growth in most regions, except for Latin American countries, where it can have either a positive or negative effect. The study emphasizes the significance of investment, human development, government growth, and institutional quality for economic growth.

Moss et al. (2006) posit that sustained increases in foreign aid inflows can have detrimental effects on institutional development, directly impacting the public sector. Kararach et al. (2022) argue that corruption in the public sector disrupts decision-making processes tied to public investment projects, placing unnecessary demands on available resources and operational efficiency. Easterly and Pfutze (2008) delve into bilateral aid effectiveness and contend that donor influence in dictating aid application, along with corruption associated with disbursements and implementation, can adversely affect aid effectiveness. In a parallel vein, Findley, Milner, and Nielson (2014) assert that multilateral aid, in contrast to bilateral aid, appears less politically influenced, associated with lower corruption levels, and tends to impose more effective conditions for better outcomes. Nevertheless, Cordella and Ulku (2007) argue that the degree of concessionality in aid seems to have limited effectiveness in achieving the intended developmental objectives in Sub-Saharan African countries, largely due to corruption and poor governance quality.

2.2 Theoretical Framework

Our premise is that, in the face of budgetary constraints, the government of a developing nation will work to maximise its own welfare and will use foreign assistance inflows as a tool to achieve this goal. The classical view of foreign aid is that it supplements domestic savings. This view springs naturally from the Harrod-Domar growth model based on the articles of Harrod (1939) and Domar (1946), which have had marked impact on the economic development theory (Berg, 2013). Harrod-Domar theory entails that if all the parameters are held constant, the maximum growth rate will be a function of one of two equations relating to supply and demand for capital and labour. The Harrod-Domar model purports that all savings are channeled into public investment, which in turn results in capital accumulation. The incremental capital allows an economy to produce more output, generate more income, thus, more growth (Masoud, 2014).

From the foregoing, the theoretical foundation of this study is anchored on the dual gap (or two-gap) theory which is an extension of the Harrod-Domar growth model. Essentially, conceptualizations of economic development trajectory and aid effectiveness are mostly based on the dual gap model. The theory also took cognizance of resource shortages, stressing that domestic resource must be supplemented from abroad. Under such a situation, investment is greater than domestic savings (Hassan *et al.,* 2015). The two-gap theory asserts that investment and development are restricted by the level of domestic saving hence financing gap so created by inadequate domestic savings is therefore bridged by external financing. Moreover, most economies of the world especially the developing countries struggle to plug this gap created between the level of savings and investment and therefore finds external borrowing as a means of bridging the gap. The very underpinning of dual analysis concept is based on the notion that economic growth is dependent on investment which is also a function of domestic savings. This goes to explain that increase in domestic savings and investment leads to economic growth. However, the domestic savings required to spur investment which would translate into growth is insufficient. The gap so created by scarce domestic savings is therefore bridged by external borrowings.

In the light of plugging finance gap, excessive borrowing and accumulated debt services induces debt overhang. Debt-overhang may arise due to excessive reliance on foreign debt. In such a situation, debt stock becomes so large that the country's ability to repay its borrowings becomes very difficult. The rising level of foreign debt level implies that much of the foreign capital were misallocated; thereby affecting the economy adversely in many ways (Shahzad *et al.*2016). A high and rising external debt burden poses a serious constraint on development. This outcome impedes public investment and growth. The consensus in most recent finance literature is that debt overhang distorts optimal investment decisions, and dampens efforts of the debtor country's government to undertake needed adjustment policies (Bilan, 2016). According to Diwan & Rodrik (1992), the elimination of an overhang requires adoption of necessary adjustment policies by the debtor country. From a fiscal perspective, stabilization of debt ratio requires that debt overhang problem should be avoided if benefits of external borrowing are to be maximized. To this end, without arguing conclusively for debt concessionality, Easterly (2009) contends that in as much as filling finance gap is key to achieving desired development, transformational approach to aid programs have to be pursued.

3 Data and Method

3.1 Empirical Framework

We conducted analysis of our dataset employing the panel autoregressive distributed lag (ARDL) model, a relatively recent methodological development. This model is based on the pioneering work of Pesaran, Shin, and Smith (1999), which offers three major estimators: the mean group (MG) estimator, as originally suggested by Pesaran and Smith (1995), the pooled mean group (PMG) estimator, and the dynamic fixed effect (DFE) estimator.

Pesaran, Shin, and Smith (1999) have elucidated that the PMG, MG, and DFE estimators demonstrate consistency when dealing with large time-series (T) and cross-sectional (N) data. Notably, the primary distinction between the MG and PMG estimators lies in their treatment of cross-sectional variation. The MG estimator accommodates the premise that both slopes and intercepts may vary across cross-sections, while the PMG estimator assumes homogeneity in long-run slopes. Megaravalli and Sampagnaro (2017) have emphasized that the DFE estimator is an alternative approach predicated upon the assumption of homogeneous slopes, implying fixed slopes alongside variable intercepts across cross-sections.

The utilization of these estimation techniques is instrumental in addressing issues of country-specific heterogeneity, as observed in previous studies (Samargandi, Fidrmuc & Ghos, 2014; Gemmell and Kneller, 2003). In terms of generality and flexibility, the PMG estimator offers notable advantages, making it particularly well-suited for estimating theoretical models within a panel data framework. This estimator accommodates varying degrees of integration, including stationary country-specific fundamentals, while allowing for variations in the equilibrium correction parameter across countries, thereby enabling the identification of discrepancies in the speed at which countries adjust to new equilibria (Matadeen, 2017). Furthermore, Megaravalli and Sampagnaro (2017) have underscored that the PMG model introduces a lower degree of heterogeneity by imposing homogeneity on long-run coefficients, while still permitting heterogeneity in short-run coefficients and error variances.

The MG estimator, on the other hand, derives the long-run coefficients for the panel by averaging the long-run coefficients obtained from ARDL models for individual countries. All three estimators are computed using maximum likelihood estimation and take into account the long-run equilibrium and the heterogeneity of the dynamic adjustment process (Demetriades & Law, 2006).

It is worth noting that Pesaran and Shin (1999 & 1996) contend that panel ARDL can be applied effectively even when the variables under consideration exhibit different orders of integration, regardless of whether they are purely I(1), purely I(0), or mutually cointegrated. This approach allows for the simultaneous estimation of both short-run and long-run effects in datasets characterized by large time dimensions and cross-sections (Samargandi, Fidrmuc & Ghos, 2014).

Lastly, Pesaran, Shin, and Smith (1999) assert that the ARDL model, particularly the PMG and MG variants, yields consistent coefficients, even in the presence of potential endogeneity concerns. This robustness arises from the inclusion of lags of dependent and independent variables (represented as p and q, respectively) in the estimation procedure. Therefore, Pesaran, Shin, and Smith (1999) propose the following ARDL model of order (p, q): [Insert ARDL model equation here].

$$_{it} = \varphi y_{it-1} + \beta_i^{'} x_{it} + \sum_{j=1}^{pi-1} \quad \omega_{ij} + \Delta y_{it-j} + \sum_{j=0}^{qi-1} \quad \phi_{ij}^{'} \Delta x_{it-j} + \alpha_i + \lambda_i t + \varepsilon_{it} \qquad (1)$$

Where y_{it} is the response variable, $x_{it} = m \times 1$ vector of regressors, α_i and λ_i represent the country-specific intercepts and time trend parameters, respectively, ω_{ij} and ϕ_{ij} are the country-specific coefficients of the short-term dynamics, φ is the error correction parameters (or adjustment speed towards long-run relationship), and ε_{it} is error term. The long-run coefficients β are defined to be homogenous across countries. If φ_1 is negative and significant, there exists a long-run relationship between y_{it} and x_{it}, while all the dynamics and the error correction terms are free to vary (Asteriou, 2005). p is the lag of the response variable, and q is the lag of the explanatory variables.

In building our model, we have both T (35 years) and N (32 Sub-Saharan African countries) large. The baseline model for this study is fashioned after Loayza and Ranciere (2005) which proposed the following dynamic panel regression:

$$\Delta(y_i)_t = \sum_{j=1}^{p-1} \quad \gamma_j^i \Delta(y_i)_{t-j} + \sum_{j=0}^{q-1} \quad \delta_j^i \Delta(X_i)_{t-j} + \varphi^i [(y_i)_{t-1} - \{\beta_0^i + \beta_1^i (X_t)_{t-1}\}] + \varepsilon_{it} \qquad (2)$$

Where y represents the per capita GDP growth rate, X is a set of growth determinants including financial depth and control variables, γ and δ are the short-run coefficients related to growth and its determinants, β are the long-run coefficients, φ is the speed of adjustment to the long-run relationship, ε is a time-varying disturbance, and the subscripts i and t represent country and time, respectively.

3.2 The symmetric panel ARDL model specification

3.2.1 Bilateral and Multilateral concessional debts and public investment

Our baseline models aimed to investigate the impact of bilateral and multilateral concessional debts on public investment using a modified version of Equation (2). The resulting regression equations, (3) and (4), represent our dynamic models that account for the moderating variables and the interaction terms, as follows:

$$\Delta InPINVT_{i,t} = \sum_{j=1}^{p-1} \lambda_j \Delta InPINVT_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta InBLCD_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta GDS_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta GNE_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta FDI_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta IQI_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta InBLCD * IQI_{i,t-j} + \varphi_i^{'} [InPINVT_{i,t-i} - \{\beta_0 + \beta_1 InBLCD_{i,t-1} + \beta_2 GDS_{i,t-1} + \beta_3 GNE_{i,t-1} + \beta_4 TOPN_{i,t-1} + \beta_5 FDI_{i,t-1} + \beta_6 IQI_{i,t-1} + \beta_7 InBLCD * IQI_{i,t-1}\}] + \varepsilon_{it} \qquad (3)$$

$$\Delta InPINVT_{i,t} = \sum_{j=1}^{p-1} \lambda_j \Delta InPINVT_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta InMLCD_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta GDS_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta GNE_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta FDI_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta IQI_{i,t-j} + \sum_{j=0}^{q-1} \delta_j \Delta InMLCD * IQI_{i,t-j} + \varphi_i^{'} [InPINVT_{i,t-i} - \{\beta_0 + \beta_1 InMLCD_{i,t-1} + \beta_2 GDS_{i,t-1} + \beta_3 GNE_{i,t-1} + \beta_4 TOPN_{i,t-1} + \beta_5 FDI_{i,t-1} + \beta_6 IQI_{i,t-1} + \beta_7 InMLCD * IQI_{i,t-1}\}] + \varepsilon_{it} \qquad (4)$$

Where i and t denote country and time period respectively, and *InPINVT*= public investment is proxied by the log of gross fixed capital formation, *InBLCD* = natural logarithm of bilateral concessional debts, *InMLCD* =

natural logarithm of multilateral concessional debts *GNE* = gross national expenditure (% of GDP), *FDI* = foreign direct investment (% of GDP), *IQI* = Institutional quality index, *InBLCD*IQI* and *InMLCD*IQI* = interaction terms between institutional quality index and bilateral and multilateral concessional debts, respectively. ε = error term. λ and δ_j represent the short-run parameters of lagged dependent and independent variables respectively, and Δ is a difference operator. $\beta_1 - \beta_7$ are the long-run coefficients, and β_0 is the intercept. φ is the coefficient of speed of adjustment to the long-run equilibrium.

3.3 The asymmetric panel NARDL model specification

The panel ARDL model is extended to incorporate asymmetric responses of public investment to bilateral and multilateral concessional debt changes. This nonlinear version, referred to as the panel nonlinear ARDL (NARDL) model, recognizes that positive and negative shocks to the explanatory variables have different effects on public investment. We implement the Shin and Greenwood-Nimmo (2014) nonlinear ARDL model in panel form, which is a suitable representation of dynamic heterogeneous panel data models for large T panels. This approach is adopted for three key reasons. Firstly, it enables us to capture asymmetries in a nonlinear way. Secondly, it accounts for inherent heterogeneity effects that are present in the data. Thirdly, this approach is more appropriate when there is a unit root or mixed order of integration of not more than I(1). In contrast to traditional large N, small T dynamic panels, the asymptotics of large N, large T dynamic panels differ significantly, as highlighted by Blackburne and Frank (2007). Small T panel estimation typically relies on fixed- or random-effects estimators, or a combination of fixed-effects estimators and instrumental-variable estimators, such as the Arellano and Bond (1991) generalized method-of-moments estimator (Blackburne and Frank, 2007). However, it is often inappropriate to assume homogeneity of slope parameters in large N, large T dynamic panels. As a result, we employ the dynamic heterogeneous panel data model in our study since we are dealing with large T panels. The reduced asymmetric version of Equations (3) and (4) is jointly expressed below:

$$\Delta\gamma_{it} = \beta_{0i} + \beta_{1i}\gamma_{i,t-1} + \beta_{2i}^{+}\delta_{t-1}^{+} + \beta_{2i}^{-}\delta_{t-1}^{-} + \sum_{j=1}^{N1} \lambda_{ij}\Delta\gamma_{i,t-j} + \sum_{j=0}^{N2} \left(\varphi_{ij}^{+}\Delta\delta_{t-j}^{+} + \varphi_{ij}^{-}\Delta\delta_{t-j}^{-}\right) + \mu_i + \varepsilon_{it} \quad 5$$

Where δ_t^+ and δ_t^- denote the positive and negative shocks in the explanatory variables, respectively. The long-run (elasticity) coefficients for δ_t^+ and δ_t^- are calculated as $-\frac{\beta_{2i}^{+}}{\beta_{1i}}$ and $-\frac{\beta_{2i}^{-}}{\beta_{1i}}$. The partial sum decompositions of changes in the explanatory variables are used to isolate the impact of the shocks on the response variable, while holding other factors constant. This allows us to better understand the relationship between the explanatory and response variables and to analyze the impact of shocks on the model. By calculating the long-run coefficients for positive and negative shocks, we can determine the direction and magnitude of the impact of these shocks on the response variable in the long run. This information can be useful in predicting future trends and making informed decisions based on the model's predictions. The positive and negative shocks of changes in the explanatory variables as defined below:

$$\delta_t^{+} = \sum_{k=1}^{t} \Delta\delta_{ik}^{+} = \sum_{k=1}^{t} max\left(\Delta\delta_{ik}, 0\right) \quad 6$$

$$\delta_t^{-} = \sum_{k=1}^{t} \Delta\delta_{ik}^{-} = \sum_{k=1}^{t} min\left(\Delta\delta_{ik}, 0\right) \quad 7$$

The error correction version of Equation (5) can be expressed as follows:

$$\Delta\gamma_{it} = \rho_i\xi_{i,t-1} + \sum_{j=1}^{N1} \lambda_{ij}\Delta\gamma_{i,t-j} + \sum_{j=0}^{N2} \left(\varphi_{ij}^{+}\Delta\delta_{t-j}^{+} + \varphi_{ij}^{-}\Delta\delta_{t-j}^{-}\right) + \mu_i + \varepsilon_{it} \quad 8$$

The error-correction term and speed of adjustment $\xi_{i,t-1}$ captures the long-run equilibrium in the asymmetric panel ARDL specified in Equation (8), while its associated parameter ρ_i is the speed of adjustment term that measures how long it takes the system to converge to its long run equilibrium in the presence of a shock.

Following the outcomes in Sharma and Kautish (2020), Equ. (8) is modified to a computable NARDL, taking into the model variables as represented in Eq. (9) and Eq. (10) below:

$$\begin{aligned}\Delta InPINVT_{i,t} = {} & \lambda_1 InPINVT_{(t-1)} + \lambda_{2(+)}\Delta InBLCD_{i,t-1(+)} + \lambda_{3(-)}\Delta InBLCD_{i,t-1(-)} + \lambda_{4(+)}\Delta GDS_{i,t-1(+)} + \lambda_{5(-)}\Delta GDS_{i,t-1(-)} \\ & + \lambda_{6(+)}\Delta GNE_{i,t-1(+)} + \lambda_{7(-)}\Delta GNE_{i,t-1(-)} + \lambda_{8(+)}\Delta IQI_{i,t-1(+)} + \lambda_{9(-)}\Delta IQI_{i,t-1(-)} + \lambda_{10(+)}FDI_{i,t-1(+)} \\ & + \lambda_{11(-)}FDI_{i,t-1(+)} + \sum_{n=0}^{p} \rho_1 \Delta PINVT_{i,t-i} + \sum_{n=0}^{p} \rho_2 \Delta InBLCD_{i,t-i(+)} + \sum_{n=0}^{p} \rho_3 \Delta InBLCD_{i,t-i(-)} \\ & + \sum_{n=0}^{p} \rho_4 \Delta GDS_{i,t-i(+)} + \sum_{n=0}^{p} \rho_5 \Delta GDS_{i,t-i(-)} + \sum_{n=0}^{p} \rho_6 \Delta GNE_{i,t-i(+)} + \sum_{n=0}^{p} \rho_7 \Delta GNE_{i,t-i(-)} \\ & + \sum_{n=0}^{p} \rho_8 \Delta IQI_{i,t-i(+)} + \sum_{n=0}^{p} \rho_9 \Delta IQI_{i,t-i(-)} + \sum_{n=0}^{p} \rho_{10} FDI_{i,t-i(+)} + \sum_{n=0}^{p} \rho_{11} FDI_{i,t-i(+)} \\ & + \mu_t \end{aligned} \quad 9$$

$$\begin{aligned}\Delta InPINVT_{i,t} = {} & \lambda_1 InPINVT_{(t-1)} + \lambda_{2(+)}\Delta InMLCD_{i,t-1(+)} + \lambda_{3(-)}\Delta InMLCD_{i,t-1(-)} + \lambda_{4(+)}\Delta GDS_{i,t-1(+)} + \lambda_{5(-)}\Delta GDS_{i,t-1(-)} \\ & + \lambda_{6(+)}\Delta GNE_{i,t-1(+)} + \lambda_{7(-)}\Delta GNE_{i,t-1(-)} + \lambda_{8(+)}\Delta IQI_{i,t-1(+)} + \lambda_{9(-)}\Delta IQI_{i,t-1(-)} + \lambda_{10(+)}FDI_{i,t-1(+)} \\ & + \lambda_{11(-)}FDI_{i,t-1(+)} + \sum_{n=0}^{p} \rho_1 \Delta PINVT_{i,t-i} + \sum_{n=0}^{p} \rho_2 \Delta InMLCD_{i,t-i(+)} + \sum_{n=0}^{p} \rho_3 \Delta InMLCD_{i,t-i(-)} \\ & + \sum_{n=0}^{p} \rho_4 \Delta GDS_{i,t-i(+)} + \sum_{n=0}^{p} \rho_5 \Delta GDS_{i,t-i(-)} + \sum_{n=0}^{p} \rho_6 \Delta GNE_{i,t-i(+)} + \sum_{n=0}^{p} \rho_7 \Delta GNE_{i,t-i(-)} \\ & + \sum_{n=0}^{p} \rho_8 \Delta IQI_{i,t-i(+)} + \sum_{n=0}^{p} \rho_9 \Delta IQI_{i,t-i(-)} + \sum_{n=0}^{p} \rho_{10} FDI_{i,t-i(+)} + \sum_{n=0}^{p} \rho_{11} FDI_{i,t-i(+)} \\ & + \mu_t \end{aligned} \quad 10$$

Where *i* and *t* denote country and time period respectively, and *InPINVT*= public investment is proxied by the log of gross fixed capital formation, *InBLCD* = natural logarithm of bilateral concessional debts, *InMLCD* = natural logarithm of multilateral concessional debts, *GNE* = gross national expenditure (% of GDP), GNE = gross national expenditure (% of GDP), *FDI* = foreign direct investment (% of GDP), and *IQI* = Institutional quality index. The expected impact of *InBLCD* and *InMLCD* on public investment is anticipated to be positive. Moreover, the short-run and long-run coefficients are denoted by ρ_i andλ_i, respectively. To examine the long-run ($\lambda = \lambda_{(+)} = \lambda_{(-)}$)and short-run asymmetry($\rho = \rho_{(+)} = \rho_{(-)}$), a Wald test has been conducted. The minus (−) and plus (+) subscripts in Equations (9) and (10) indicate negative and positive disturbances, respectively.

3.3 Data Description

This study primarily focuses on historical events and relies exclusively panel data obtained from the World Development Indicators. The dataset encompasses a time span from 1985 to 2020 and includes data from thirty-two (32) Sub-Saharan African countries, which is presented descriptively in Table 1. The choice of concluding the data collection in 2020 is deliberate, as it covers a period that straddles both the old and modern systems of classifying debts as concessional, based on a minimum grant element of 25%. It's worth noting that under the modernized system, loans to Low Income Countries (LIC) and the Least Developed Countries (LDC) must exhibit a grant element of at least 45% to qualify as Official Development Assistance (ODA). To ensure a comprehensive examination of the impact stemming from the transition to the new ODA classification system, this study utilizes both the old and new systems for reporting ODA up to 2017, after which the new system became the standard for reporting (OECD, 2014b & 2015; International Development Association [IDA], 2017).

Table 1 provides an overview of key variables over the examined period. Bilateral concessional debt ranges from USD 29,000 to USD 11.6 billion, while gross fixed capital formation exhibits an average value of USD 2.24 billion during the same timeframe, with fluctuations ranging from negative USD 21 million to USD 85.7 billion. Multilateral concessional debts varied between negative USD 971,000 and positive USD 1.04 billion within the same period, showing an annual average of USD 110 million. Gross domestic savings, expressed as a percentage of GDP, had an average value of 12.12%, with a peak of 60.43% in 2008 and a low point of negative 48.51% in 1994. Gross national expenditure, as a percentage of GDP, and foreign direct investment, expressed as a percentage of GDP, averaged at 107.27% and 2.81%, respectively. These data points provide a robust foundation for the subsequent analysis and discussion.

Table 1. Descriptive statistics of variables included in our models.

Variable	Mean	Max.	Min.	Std. Dev.
Bilateral concessional debt (Current USD)	92.36 mil.	11.6 bil.	29,000	413 mil.
Multilateral concessional debt (Current USD)	110 mil.	1.04 bil.	(971,000)	142 mil.
Gross fixed capital formation (Current USD)	2.24 bil.	85.7 bil.	(21 mil.)	5.97 bil.
Gross domestic savings (% of GDP)	12.12	60.43	(48.51)	14.10
Gross national expenditure (% of GDP)	107.27	200.97	59.18	13.34
Foreign direct investment, net inflows (% of GDP)	2.81	46.49	(28.62)	5.18
Institutional Quality Index	30.71	76.20	1.92	513.41

Table 2. Panel stationarity test

	Statistic					
Variable	[a]Levin, Lin and Chu t	[a]Breitung t-stat	[b]Im, Pesaran & Shin W-stat	[b]ADF - Fisher Chi-square	[b]PP - Fisher Chi-square	Order of Integration
InMLCD	-1.4400	-3.1423***	-3.2668***	102.80***	284.84***	I(0)
InBLCD	-6.4028***	-6.0111***	-11.628***	317.23***	3577.3***	I(1)
InPINVT	-8.0515***	-5.4127***	-11.515***	257.90***	742.74***	I(1)
GDS	-5.1572***	-5.4772***	-16.648***	360.60***	2270.0***	I(1)
FDI	-4.6461***	-3.6724***	-4.5433***	123.54***	289.62***	I(0)
GNE	-1.9311**	-3.8278***	-2.1478**	85.636**	110.59***	I(0)
IQI	-9.9094***	-7.5584***	-14.328***	311.27***	1413.0***	I(1)

InBLCD = log of bilateral concessional debt. *InMLCD* = log of multilateral concessional debt. *InPINVT* = log of public investment (as proxied by gross fixed capital formation). *GDS* = gross domestic savings (% of GDP). *GNE* = gross national expenditure (% GDP). *FDI* = foreign direct investment (% of GDP). IQI = institutional quality index.

*** and ** denote Significant at 1 and 5%, respectively.

[a]Null: Unit root (assumes common unit root process)

[b]Null: Unit root (assumes individual unit root process)

The results of the panel unit root test are presented in Table 2, which reveals that all series were stationary at different levels of integration. Specifically, the log of bilateral concessional debt was stationary at first difference, while the other independent and moderating variables were also stationary but had varying or mixed orders of integration, as demonstrated in Table 2. As such, we can conclude that none of the variables have a unit root and that stationarity is achieved at either I(0) or I(1), and not at I(2). These results are significant as they satisfy the conditions necessary for estimating a panel autoregressive distributed-lag (ARDL) model using various potential estimators, given the large number of individuals (N) and time periods (T).

Table 3. Test for Multicolinearity across all models and Variance Inflation Factor (VIF) Results

	Model 1	Model 2
Variable	**VIF**	**VIF**
InPINVT	1.635	1.045
InBLCD	1.517	
InMLCD		1.181
GDS	1.437	1.351
FDI	1.173	1.709
GNE	1.546	1.272
IQI	1.225	1.484

We recognize the issue of multicollinearity in regression analysis, which can hinder the isolation of individual explanatory variables' effects on the dependent variable. Although multicollinearity may not significantly impact the model's accuracy, it is important to acknowledge that it can lead to reduced reliability in discerning the effects of specific features within the model, potentially compromising interpretability. Consequently, we conducted multicollinearity tests for all nine models, employing the variance inflation factor (VIF) as detailed in Table 3. As per standard practice, a VIF exceeding 5 or 10 indicates substantial multicollinearity among independent variables. The findings indicate that the VIF values for all models fall within the range of 1.03 and 1.71, signifying the absence of significant multicollinearity issues in our models.

4. Results and Discussion of basic findings

4.1 The symmetric Panel ARDL results

Tables 3 and 4 report the findings of the three distinct dynamic panel data estimators - PMG, MG, and DFE, utilized to examine the dynamic effects of a general ARDL model. This method is particularly useful in estimating both the long-run and short-run effect coefficients linking the dependent variable to the dynamic regressors, while also incorporating the error correction model to ascertain the speed of adjustment. The long-run coefficients as captured by these estimators have gained considerable attention in recent aid-growth related literature (see Alimi, 2018; Wako, 2018; Tait, Siddique & Chatterjee, 2016; Iheonu, Ihedimma & Omenihu, 2017; Chavula, 2016). Equations (3) and (4) demonstrate strong evidence of dynamic stability, given that the coefficient of the error correction term is significantly negative. Specifically, for PMG and DFE, this parameter lies within the dynamically stable bound, indicating that there exist long-run effects of bilateral and multilateral concessional debts on public investment. To examine the null hypothesis of homogeneity, we conducted a Hausman diagnostic test by comparing the PMG, MG, and DFE estimators to determine the most suitable, efficient, and consistent estimator. According to Chen and Hsu (2014), if the long-run parameter estimates differ across cross-sections, the PMG estimator will not be consistent; therefore, the MG estimator would be a consistent estimate of the mean of long-run coefficients across cross-sections.

The results of the Hausman test between MG and DFE indicate that the null hypothesis of systematic differences in coefficients (DFE) cannot be rejected at a significance level greater than 5%. This suggests that the DFE is the preferred estimator over MG. With this outcome, we compared the PMG and DFE, and the Hausman test reveals that the null hypothesis, which suggests that coefficients are not systematic, cannot be rejected at a significance level greater than 5%. Therefore, the homogeneity restriction in our estimation is not jointly rejected for all parameters by the Hausman test (p-value = 0.983>5%) in Table 4 and (p-value = 0.999>5%) in Table 5, confirming that the PMG estimators are consistent and efficient when compared to the MG and DFE estimates.

Table 4. Results of Panel ARDL Estimations: Equation (3)

Response Variable: Log of Public investment (InPINVT)
Selected Model: ARDL(1, 1, 1, 1, 1, 1)
Model selection method: Akaike info criterion (AIC)
Sample (unadjusted): 1985-2020

	Pooled Mean group (PMG)		Mean Group (MG)		Dynamic Fixed Effect (DFE)	
Variables	**Coef.[p-value]**	**St. Error.**	**Coef.[p-value]**	**St. Error.**	**Coef.[p-value]**	**St. Error.**
Long-Run Coef.						
InBLCD	0.086[0.000]	0.022	0.141[0.342]	0.148	0.063[0.332]	0.065
GDS	0.065[0.000]	0.004	0.065[0.000]	0.017	0.042[0.000]	0.007
GNE	0.024[0.000]	0.004	0.010[0.819]	0.045	0.023[0.000]	0.007
FDI	0.027[0.001]	0.008	0.011[0.672]	0.027	0.005[0.580]	0.004
IQI	-0.014[0.000]	0.004	-0.011[0.132]	0.023	0.014[0.000]	0.003
InBLCD*IQI	-0.053[0.003]	0.002	-0.011[0.109]	0.037	0.005[0.000]	0.009
Adj. Speed	-0.144[0.000]	0.029	-0.369[0.000]	0.056	-0.145[0.000]	0.016
Short-Run Coef.						
InBLCD	0.031[0.020]	0.013	0.011[0.580]	0.020	0.031[0.001]	0.009
GDS	0.013[0.000]	0.003	0.011[0.001]	0.003	0.013[0.000]	0.001

GNE	0.016[0.000]	0.002	0.010[0.000]	0.003	0.012[0.000]	0.001
FDI	-0.002[0.680]	0.001	-0.009[0.125]	0.006	0.002[0.108]	0.004
IQI	-0.026[0.000]	0.006	-0.010[0.365]	0.041	0.003[0.000]	0.005
InBLCD*IQI	-0.031[0.009]	0.002	-0.001[0.438]	0.001	-0.002[0.000]	0.001
Intercept	0.689[0.000]	0.151	1.764[0.000]	0.353	0.751[0.000]	0.132
Log Likelihood	930.156	*[a]Hausman MG, DFE: If p-value > 5%, then use DFE; If p-value < 5%, then use MG*				
Hausman	1.000[a], 0.983[b]	*[b]Hausman DFE, PMG: If p-value > 5%, then use PMG; If p-value < 5%, then use DFE*				
No. of groups	31					
Periods included	32	*DFE is chosen over MG (1.000>0,05), and*				
No. Obs.	820	*PMG is chosen over DFE (0.983>0.05)*				
		***Decision:** PMG is efficient and consistent estimator*				

InBLCD = log of bilateral concessional debt. *InPINVT* = log of public investment (as proxied by gross fixed capital formation). *GDS* = gross domestic savings (% of GDP). *GNE* = gross national expenditure (% GDP). *FDI* = foreign direct investment (% of GDP). IQI = institutional quality index. *InBLCD*IQI* = interaction between log of bilateral concessional debt and institutional quality index.

Table 4 presents the results of the PMG estimates, indicating a significant and positive association between bilateral concessional debts and public investment (proxied by gross fixed capital formation) in both the short and long run. The effect was stronger in the long run, with a 1% increase in bilateral concessional debt leading to an 8.6% increase in public investment in the long run and a 3.1% increase in the short run. Gross domestic savings (GDS) and gross national expenditure (GNE) also had a significant positive impact on public investment in both the short and long run. In the long run, a one-unit increase in GDS and GNE resulted in a 6.5% and 2.4% increase in public investment, respectively. Furthermore, foreign direct investment (FDI) had a positive and significant effect on public investment in the long run, but the effect was negative and insignificant in the short run.

Changes in the institutional quality index (IQI) were found to be significantly correlated with decreases in public investment of 2.6% and 1.4% in the short and long run, respectively. Moreover, the interaction terms between bilateral concessional debts and the institutional quality index were found to have a significant effect on public investment in both the short and long run, indicating that the effect of tied concessional debts on public investment depends on the quality of institutions. Specifically, a 1% change in the interaction terms was associated with a 3.1% increase in the short run and a 5.3% increase in the long run. The convergence coefficient had the correct sign and was significant, indicating the existence of a long-run relationship between the variables. The speed of adjustment, as reflected in the error correction term, varied across the three estimators. The PMG estimates showed that deviations from equilibrium were corrected at a rate of 14.4% annually.

Table 5. Results of Panel ARDL Estimations: Equation (4)

Response Variable: Log of Public investment (InPINVT)

Selected Model: ARDL (1, 1, 1, 1, 1, 1)
Model selection method: Akaike info criterion (AIC)
Sample (unadjusted): 1985-2020

	Pooled Mean group (PMG)		**Mean Group (MG)**		**Dynamic Fixed Effect (DFE)**	
Variables	**Coef. [p-value]**	**St. Error.**	**Coef. [p-value]**	**St. Error.**	**Coef. [p-value]**	**St. Error.**
Long-Run Coef.						
InMLCD	0.113[0.000]	0.074	0.329[0.018]	0.672	0.180[0.030]	0.083
GDS	0.063[0.000]	0.005	-0.000[0.974]	0.028	0.041[0.000]	0.007
GNE	0.019[0.000]	0.005	-0.009[0.739]	0.026	0.023[0.000]	0.006
FDI	0.002[0.006]	0.008	0.024[0.146]	0.006	0.004[0.649]	0.009
IQI	0.005[0.000]	0.007	-0.003[0.132]	0.021	0.018[0.000]	0.006
InMLCD*IQI	0.007[0.001]	0.002	0.009[0.017]	0.016	0.004[0.152]	0.003
Adj. Speed	-0.123[0.000]	0.026	-0.402[0.000]	0.045	-0.145[0.000]	0.015
Short-Run Coef.						
InMLCD	0.033[0.185]	0.025	-0.035[0.149]	0.024	-0.003[0.800]	0.012
GDS	0.017[0.000]	0.003	0.011[0.000]	0.002	0.014[0.000]	0.001
GNE	0.020[0.000]	0.002	0.011[0.000]	0.002	0.013[0.000]	0.001
FDI	-0.001[0.703]	0.001	-0.004[0.568]	0.007	0.002[0.224]	0.001
IQI	0.011[0.000]	0.003	0.014[0.000]	0.004	0.011[0.000]	0.001
InMLCD*IQI	-0.002[0.000]	0.002	-0.003[0.000]	0.001	-0.002[0.000]	0.000
Intercept	0.356[0.000]	0.172	1.124[0.001]	0.426	0.225[0.000]	0.156

Log Likelihood	1023.135	[a]*Hausman MG, DFE: If p-value > 5%, then use DFE; If p-value < 5%, then use MG*
Hausman	1.000[a], 0.999[b]	[b]*Hausman DFE, PMG: If p-value > 5%, then use PMG; If p-value < 5%, then use DFE*
No. of groups	31	
Periods included	32	*DFE is chosen over MG (1.000>0,05), and*
No. Obs.	903	*PMG is chosen over DFE (0.999>0.05)*
		Decision: PMG is efficient and consistent estimator

InMLCD = log of multilateral concessional debt. *InPINVT* = log of public investment (as proxied by gross fixed capital formation). *GDS* = gross domestic savings (% of GDP). *GNE* = gross national expenditure (% GDP). *FDI* = foreign direct investment (% of GDP). IQI = institutional quality index. *InBLCD*IQI* = interaction between log of bilateral concessional debt and institutional quality index.

Table 5 presents a comprehensive assessment of the impact of multilateral concessional debts on public investment in the long-run and short-run. The PMG estimation, considered as the preferred estimator, revealed a positive relationship between multilateral concessional debts and public investment, both in the short-run and long-run. The positive effect was more significant in the long-run. Gross domestic savings and gross national expenditure also exhibited a positive and significant influence on public investment. On the other hand, foreign direct investment and trade openness were found to have a negative impact on public investment in the short-run, but a significant positive effect in the long-run. Institutional quality index (IQI) showed a significant negative correlation with public investment, with a decline of 0.2% and 0.5% in the short-run and long-run, respectively, with a change in the IQI. Moreover, the interaction terms between bilateral concessional debts and the institutional quality index had a significant contingency effect, implying that the effect of tied concessional debts on public investment depends on the quality of institutions. A 1% change in the interaction terms had a short-run and long-run effect of 0.2% and 0.7%, respectively. The error correction term was negative and significant, indicating a convergence to the long-run equilibrium relationship at an annual adjustment speed of 12.3%.

4.2 Asymmetric Estimation Results

The study investigated the asymmetric effect of bilateral and multilateral concessional debts on public investment in Africa using a panel non-linear ARDL (NARDL) model. We begin our analysis by estimating all equations using both the PMG, MG and DFE estimators. Next, we conduct a Hausman test on the results obtained from these estimators. Our Hausman test results provide substantial support for the PMG estimator as the efficient estimator for modeling the concessional debts-public investment nexus. This finding is consistent across all models, as shown in Table 6. Therefore, we report the outcomes of all estimators and discuss only the results obtained from the preferred estimator.

Table 6. Panel NARDL results of asymmetric effects of concessional debts on public investment.

Response Variable: Log of public investment (InPINVT)

	Bilateral concessional debt effects with asymmetry			Multilateral concessional debt effects with asymmetry		
Variables	PMG	MG	DFE	PMG	MG	DFE
$InBLCD^{+}$	0.137***	0.208	0.093			
	(0.032)	(0.218)	(0.096)			
$InBLCD^{-}$	0.046**	0.016	0.046***			
	(1.225)	(0.030)	(0.013)			
$InMLCD^{+}$				0.261***	0.486**	0.266**
				(0.109)	(0.992)	(0.123)
$InMLCD^{-}$				0.073**	-0.052	0.004
				(0.037)	(0.035)	(0.018)
GDS^{+}	0.096***	0.096***	-0.062**	0.093***	-0.003	0.061***
	(0.006)	(0.025)	(0.010)	(0.007)	(0.041)	(0.010)
GDS^{-}	0.019***	0.016***	0.019***	0.025***	-0.016***	-0.021***
	(0.004)	(0.004)	(0.001)	(0.004)	(0.003)	(0.001)
GNE^{+}	0.035***	-0.015	0.034***	0.028***	0.013	0.034***
	(0.006)	(0.066)	(0.010)	(0.012)	(0.038)	(0.009)
GNE^{-}	0.024***	0.015***	0.018***	0.030***	0.016***	-0.019***
	(0.003)	(0.004)	(0.001)	(0.007)	(0.003)	(0.001)
FDI^{+}	0.040***	0.016	0.007	0.003***	0.035	0.006
	(0.012)	(0.040)	(0.006)	(0.012)	(0.009)	(0.013)
FDI^{-}	-0.003	-0.013	0.003	-0.021	-0.006	0.003

	(0.001)	(0.009)	(0.006)	(0.001)	(0.010)	(0.001)
IQI^{+}	0.021***	0.016	-0.021**	0.107***	0.004	0.027***
	(0.006)	(0.034)	(0.004)	(0.010)	(0.031)	(0.009)
IQI^{-}	-0.082**	0.015	0.004***	-0.016**	0.021**	-0.016***
	(0.009)	(0.060)	(0.007)	(0.004)	(0.006)	(0.001)
Adj. Speed	-0.695**	-0.738**	-0.644**	-0.782**	-0.594***	-0.814***
	(0.041)	(0.035)	(0.052)	(0.038)	(0.066)	(0.022)
Intercept	1.017	0.881	2.604	2.111	1.224	1.548
	(0.223)	(0.458)	(0.332)	(0.664)	(0.519)	(0.285)
Log Likelihood	930.156					
Hausman	1.000[a], 0.921[b]					
	1.000[c], 0.975[d]					
No. of groups	31					
Periods included	32					
No. Obs.	793					

Model selection: Bilateral concessional debts and public investment

[a]Hausman MG, DFE: If p-value > 5%, then use DFE; If p-value < 5%, then use MG

[b]Hausman DFE, PMG: If p-value > 5%, then use PMG; If p-value < 5%, then use DFE

DFE is chosen over MG (1.000>0,05), and
PMG is chosen over DFE (0.921>0.05)

Decision: *PMG is efficient and consistent estimator*

Model selection: Multilateral concessional debts and public investment

[c]Hausman MG, DFE: If p-value > 5%, then use DFE; If p-value < 5%, then use MG

[d]Hausman DFE, PMG: If p-value > 5%, then use PMG; If p-value < 5%, then use DFE

DFE is chosen over MG (1.000>0,05), and
PMG is chosen over DFE (0.975>0.05)

Decision: *PMG is efficient and consistent estimator*

**** and ** denotes significance at 1% and 5%, respectively.*

InBLCD = log of bilateral concessional debt. *InMLCD* = log of multilateral concessional debt. *InPINVT* = log of public investment (as proxied by gross fixed capital formation). *GDS* = gross domestic savings (% of GDP). *GNE* = gross national expenditure (% GDP). *FDI* = foreign direct investment (% of GDP). IQI = institutional quality index.

Results in Table 6 shows that the relationship is not linear and symmetric, meaning that positive and negative shocks to concessional debt do not have the same effect on public investment. This finding challenges the traditional assumption that the relationship is linear and symmetric. The study further reveals that positive shocks to bilateral concessional debts are associated with a 0.14% increase in public investment, while negative shocks to bilateral concessional debts are related to a 0.05% decrease in public investment. This suggests that the effect of positive shocks to bilateral concessional debts on public investment is more than two times greater than the effect of negative shocks.

These findings have significant implications for policymakers and economists. The traditional assumption that concessional debts have a linear and symmetric impact on public investment may lead to misguided policies that do not fully capture the complexity of the relationship. The findings suggest that positive shocks to bilateral concessional debts may have a more significant impact on public investment, which can inform policies aimed at promoting public investment in developing countries. Furthermore, the findings highlight the importance of considering non-linear relationships between variables when analysing economic data. Linear relationships between variables are a simplification of reality, and non-linear relationships may be more prevalent than previously thought. As such, policymakers and economists should consider non-linear relationships when developing economic models and analysing economic data to arrive at more accurate and nuanced conclusions.

On the other hand, the study found that positive shocks to multilateral concessional debt, i.e., an increase in such debt, lead to a more significant increase in public investment than negative shocks, i.e., a decrease in such debt. Specifically, the results suggest that a 1% increase in multilateral concessional debts is associated with a 0.26% increase in public investment, while a 1% decrease in multilateral concessional debts is related to a 0.7% increase in public investment. This result indicates that the effect of positive shocks to multilateral concessional debts on public investment is about three times greater than the effect of negative shocks.

In the light of the finding. The study suggests two possible explanations for this finding. First, multilateral concessional debt may come with fewer strings attached compared to bilateral concessional debt. Bilateral concessional debt involves loans from one country to another, often with conditions attached to the loans. Multilateral concessional debt, on the other hand, is provided by international organizations to developing countries, often with fewer conditions attached. As a result, African countries may be more willing to use the funds for public investment when they receive multilateral concessional debt. Second, multilateral agencies may have better monitoring and evaluation mechanisms for public investment projects.

The international organizations providing multilateral concessional debt may have more expertise in evaluating and monitoring public investment projects than individual countries. This can lead to more effective use of funds and, consequently, more significant public investment. The study also suggests that multilateral concessional debt may have a longer-term perspective, leading to more sustainable public investment. Multilateral organizations are more likely to prioritize long-term development goals rather than short-term political interests. This can lead to investments that have a more significant impact in the long run.

In the context of the study, control variables are factors that may have an impact on public investment in African countries, but are not directly related to multilateral concessional debts. By including these variables in the analysis, the study can isolate the specific impact of multilateral concessional debts on public investment while accounting for the effects of other factors. One of the control variables used in the study is the institutional quality index, which is a measure of the quality of a country's institutions, including factors such as the rule of law, political stability, and regulatory quality. The negative coefficient of this variable in the study suggests that poor institutional quality can constrain the effectiveness of public investment projects in Africa. Institutions play a critical role in the success of public investment projects. For example, if a country lacks a strong legal framework, it may be difficult to enforce contracts or protect property rights, making it challenging to attract private investment in public infrastructure. Similarly, political instability can create uncertainty and discourage investment.

Moreover, weak regulatory quality can create barriers to entry and discourage competition, leading to inefficiencies in the provision of public services.

4.3 Discussions

The results indicate that concessional debt, both bilateral and multilateral, has a positive and significant long-term effect on public investment in sub-Saharan African (SSA) countries. The coefficients suggest that a 1% increase in bilateral and multilateral concessional debt is associated with an 8.6% and 11.3% increase in public investment, respectively. This finding is in line with previous studies such as Orji et al. (2019), Benayed et al. (2015), Nowak-Lehmann et al. (2012), and Brafu-Insaidoo and Biekpe (2011), which found a positive relationship between external financing and public investment in developing economies.

The results show that gross domestic savings had a positive and significant influence on public investment, and gross national expenditure, foreign direct investment, and trade openness all had long-term positive and significant effects on public investment in the region. These results suggest that policymakers should consider these factors when planning public investment projects.

The findings further suggest that the quality of institutions, as measured by the average index of control of corruption and rule of law, is associated with declines in public investment. The contingency analysis shows that institutional quality significantly explains the effectiveness of bilateral and multilateral concessional debts on public investment, with bilateral concessional debts being more impacted by institutional quality than multilateral concessional debts. This finding supports the argument of Easterly and Pfutze (2008), which took particular aim at bilateral aid and argued that donor power in deciding how aid is applied by the recipient countries as well as corruption associated with disbursements and implementation could have an adverse effect on aid effectiveness.

The controversy surrounding whether bilateral or multilateral aid is more effective is ongoing in the development finance literature, with different studies providing different perspectives. The symmetric estimation results do not conclusively show that bilateral concessional debts outperformed multilateral concessional debts and vice versa. Nevertheless, findings based on asymmetric analysis seem more precise, suggesting that multilateral concessional debts may have a more significant positive impact on public investment than bilateral concessional debts. This finding is of great importance for policymakers, as it suggests they need to carefully consider the source of concessional debt when planning public investment projects.

5. Concluding Policy Implications

Bilateral and multilateral aid donor countries and institutions have remained committed to their goal of providing aid to developing countries, in order to bridge the developmental gap between these countries and the advanced economies of the world. However, the effectiveness of such aid and the role of institutional quality in achieving desired outcomes among recipient countries has been a subject of much debate in economic and political circles. The findings provide evidence of a positive long-term impact of bilateral and multilateral concessional debts on public investment in sub-Saharan Africa. It also highlights a negative association between institutional quality and public investment. Additionally, our contingency analysis suggests that institutional quality plays a significant role in explaining the effectiveness of bilateral and multilateral concessional debts on public investment. Notably, the effectiveness of bilateral concessional debts is more likely to be undermined by poor institutional quality than that of multilateral concessional debts, possibly due to donor power over bilateral aid. This underscores the need for increased scrutiny and a focus on the rule of law and corruption control in both donor and recipient entities. This further highlights the need for donor countries and international financial institutions to work together to impose more effective conditions on recipient countries to ensure desired developmental outcomes are achieved.

It is worth noting that the sheer number of aid recipients in various locations has made it difficult for any one aid organisation to provide adequate attention to each one. The involvement of multiple donors in different projects has led to a lack of specialisation and an increase in administrative expenses for all parties involved. Additionally, this fragmentation has opened up opportunities for corruption and increased political interference, potentially hindering productive investment. To counteract these negative effects, it is necessary to implement policy initiatives that promote greater

specialisation and less fragmentation among bilateral and multilateral donors with regards to projects funded in recipient countries. Such initiatives would help to ensure that expected outcomes are more effectively tracked and monitored. Donors and aid agencies should be given a voice in domestic policymaking processes to ensure that investments in economic or production infrastructure generate maximum returns.

The findings of the asymmetric analysis have important policy implications for African governments and international organisations that provide concessional debt to support public investment projects. Specifically, policymakers should carefully consider the source of concessional debts and the potential asymmetric impact on public investment. The results of the study suggest that multilateral concessional debts have a stronger positive impact on public investment than bilateral concessional debts. Therefore, international organisations providing concessional debt to African countries should take these findings into consideration and prioritise the provision of multilateral concessional debt. This approach could help ensure that the concessional debt provided has a more significant positive impact on public investment and promotes sustainable development in Africa. Moreover, the results suggest that policymakers should consider the long-term sustainability of public investment projects and ensure that the projects financed by concessional debt are viable in the long term and can generate sufficient returns to cover the cost of the debt. This consideration is especially critical for bilateral concessional debts, which may have a smaller impact on public investment and could lead to negative shocks.

It is imperative to acknowledge that this study has some limitations that could affect the generalizability and robustness of the findings. Firstly, the analysis solely focuses on concessional debts and fails to consider other types of debt that may have an impact on public investment. Furthermore, the study does not differentiate between various categories of public investment, including infrastructure and social programs, which may have distinct levels of sensitivity to debt. These limitations underscore the need for future research to conduct a more extensive investigation to fully comprehend the implications of concessional debts on public investment in sub-Saharan Africa.

References

Adam, C. S., & O'Connell, S. A. (1999). Aid, taxation and development in Sub-Saharan Africa. *Economic and Politics*, *11*(3), 225–253.

Akram, N. (2013). Empirical Examination of debt and growth nexus in South Asian countries. *Asia-Pacific journal of rural development,* 20(2):29-52. DOI: 10.18356/0cbbc6e3-en

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Rev. Econ. Stud.* 58 (2), 277–297.

Benayed, W., Gabsi, F. B., & Belguith, S. O. (2015). Threshold effect of public debt on domestic investment: Evidence from selected African Countries. *Theoretical and Applied Economics*, *XXII* (4), 189–198.

Berg, H. Van den. (2013). Growth theory after Keynes, part I: The unfortunate suppression of the Harrod-Domar model. *The Journal of Philosophical Economics*, *VII* (1), 1–23.

Bilan, I. (2016). Overview of the main theories on the economic effects of public indebtedness. *European Integration - Realities and Perspectives. Proceedings*, 356–362.

Biscaye, P. E., Reynolds, T. W., & Anderson, C. L. (2015). Relative effectiveness of bilateral and multilateral aid on development outcomes. *Review of Development Economics*, *21*(4), 1425–1447. http://doi.org/10.1111/rode.12303

Blackburne, E.F., & Frank, M.W. (2007). Estimation of nonstationary heterogeneous panels. *Stata J.* 7 (2), 197–208.

Brafu-Insaidoo, W., & Biekpe, N. (2011). International capital flows and investment volatility in selected sub-Saharan African countries. *Review of Development Finance*, *1*, 223–228. http://doi.org/10.1016/j.rdf.2011.09.002

Chatterjee, S., & Turnovsky, S. J. (2005). Financing Public Investment through Foreign Aid: Consequences for Economic Growth and

Welfare. *Review of International Economics*, *13*(1), 20–44.

Chatterjee, S., Kelly, M. C., & Turnovsky, S. J. (2021). Foreign aid, public investment, and the informal economy. *Economic Inquiry*, 1–28. https://doi.org/10.1111/ecin.13019

Cordella, T., &Ulku, H. (2007). Grants vs. loans. *IMF Staff Papers*, *54*(1), 139–162. http://doi.org/10.1057/palgrave.imfsp.9450002

Diwan, I., & Rodrik, D. (1992). External debt, adjustment, and burden sharing: A unified framework. *Prineton Studies in International Finance (73),* 1-62.

Domar, E. D. (1946). Capital expansion, rate of growth, and employment. *Econometrica*, *14*(2), 137–147.

Easterly, W. (2003). Can Foreign Aid Buy Growth? *The Journal of Economic Perspectives*, *17*(3), 23–48.

Easterly, W., & Pfutze, T. (2008). Where does the money go? Best and worst practices in foreign aid. *Journal of Economic Perspectives,* 22(2), 29–52.

Easterly, W. (2009). Can the West save Africa? *NBER Working Paper Series*, (14363), 1–124.

Ekanayake, E. M., & Chatrna, D. (2010). The effect of foreign aid on economic growth in developing countries. *Journal of International Business and Cultural Studies*, 1–14.

Findley, M. G., Milner, H. V, & Nielson, D. L. (2014). The effects of multilateral vs. bilateral aid on recipient behavioural support.*Princeton.edu*, (November), 1–10. Retrieved from https://www.princeton.edu/~hmilner/workingpapers/EffectofMLvsBLAidonRecipientBehaviouralSupport.pdf.

Gemmell, N., & Kneller, R. (2003). Fiscal policy, growth and convergence in Europe. *New Zealand Treasury Working Paper*, (03/14), 1–28.

Harrod, R. F. (1939). An Essay in Dynamic Theory, *Economic Journal*, 39: 14-33. As reprinted in Harrod, 1952, Economic Essays, London: Harcourt, Brace & Co.

Hassan, O. M., Sule, A., & Abu, J. (2015). Implications of external debt on the Nigerian economy: Analysis of the dual gap theory. *Journal of Economics and Sustainable Development*, *6*(13), 238–249.

Heller, P. S. (1975). A Model of Public Fiscal Behaviour in Developing Countries: Aid, Investment, and Taxation. *The American Economic Review*, *65*(3), 429–445.

Hynes, W., & Scott, S. (2013). The evolution of official development assistance: Achievements, criticisms and a way forward. *IIIS Discussion Paper*, (437), 1–38.

Iimi, A., & Ojima, Y. (2005). Complementarities between grants and loans. *JBIC Institute (JBICI) Working Paper*, (20), 1–21.

Ilorah, R. (2011). Africa's endemic dependency on foreign aid: A dilemma for the continent. *ICIT*, 1–36.

International Monetary Fund [IMF]. (2017). Estimating Public, Private, and PPP Capital Stocks. *FAD Investment and Capital Stock Database 2017*, 1–6.

Kararach, G., Oduor, J., Sennoga, E., Odero, W., Rasmussen, P., & Balma, L. (2022). Public Investment Efficiency, Economic Growth and Debt Sustainability in Africa. *African Development Bank Working Paper*, *365*, 1–47.

Knoll, M. (2013). The heavily indebted poor countries and the multilateral debt relief initiative a test case for the validity of the debt overhang hypothesis. *School of Business & Economics Discussion Paper*, (11), 1–34.

Loayza, N. V., & Ranciere, R. (2005). Financial development, financial fragility, and growth. *Journal of Money, Credit and Banking,38*(4): 1051-1076

Manasseh C. O, Abada F. C, Okiche EL, Okanya O, Nwakoby I. C, Offu P, et al. (2022). External debt and economic growth in Sub-Saharan Africa: Does governance matter? *PLoS ONE* 17(3): e0264082. https://doi.org/10.1371/journal.pone.0264082

Marcos, S. S., & Vale, S. (2022). Is there a nonlinear relationship between public investment and private investment? Evidence from 21 Organization for Economic Cooperation and Development countries. *Int J Fin Econ.*, 1–16. https://doi.org/10.1002/ijfe.2712

Megaravalli, A. V., & Sampagnaro, G. (2017). Macroeconomic indicators and their impact on stock markets in ASIAN 3: A pooled mean group approach. *Cogent Economics & Finance*, *6*, 1–14. http://doi.org/10.1080/23322039.2018.1432450

Moss, T., Pettersson, G., &Walle, N. van de. (2006). An aid-institutions paradox? A review essay on aid dependency and state building in Sub-Saharan Africa. *Center for Global Development Working Paper*, (74), 1–28.

Nowak-Lehmann, F., Dreher, A., Herzer, D., Klasen, S., & Martınez-Zarzoso, I. (2012). Does foreign aid really raise per capita income? A time series perspective. *Canadian Journal of Economics / Revue Canadienned'Economique*, *54*(1), 288–313.

Nowak-Lehmann, F. & Gross, E. (2021). Aid effectiveness: When aid spurs investment. *Applied Economic Analysis*, 29(87), 189-207. https://doi.org/10.1108/AEA-08-2020-0110

OesterreichischeKontrollbank [OEKB]. (2012). Financing on concessional terms (soft loans). *Credit Department, OesterreichischeKontrollbank AG*, 1-12.

OECD. (2014a). Background paper: The treatment of loan concessionality in DAC statistics. DAC High Level Meeting 15-16 December 2014, OECD Conference Centre, Paris Background, 1–3.

OECD. (2014b). Modernising official development assistance (ODA) concessional loans before and after the HLM (Following the OECD-DAC High Level Meeting of 15-16 December 2014). *OECD*, (December), 1–2.

OECD. (2016). *DAC High Level Meeting Communiqué, February 19, 2016,* (February). Retrieved from www.oecd.org › Development Co-operation Directorate (DCD-DAC).

OECD. (2019) Development aid at a glance: statistics by region. Paris: OECD Publishing. Available from: aid statistics at a glance to africa (oecd.org)

Orji, A., Ogbuabor, J.E., Anthony-Orji, O.I. and Mbonu, C.O. (2019), Analysis of capital formation and foreign aid nexus in Nigeria, *International Journal of Emerging Markets, 14*(2): 266-280, available at: https://doi.org/10.1108/IJoEM-11-2017-0457

Pedersen, K. R. (1996). Aid, Investment and Incentives. *The Scandinavian Journal of Economics*, *98*(3), 423–437.

Pesaran, M.H., & Smith, R.P. (1995). Estimation of long-run relationships from dynamic heterogeneous panels.*Journal of Econometrics,* 68, 79–113

Pesaran, M. H., Shin, Y., & Smith, R. G. (1996). Testing for the Existence of a Long-Run Relationship.*Working Paper* (9622), Department of Applied Economics, University of Cambridge.

Pesaran, M.H., Shin, Y., & Smith, R.P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of American Statistical Association,* 94, 621–634.

Presbitero, A. F. (2016). Too much and too fast? Public investment scaling-up and absorptive capacity. *Journal of Development Economics*, *120*, 17–31. https://doi.org/10.1016/j.jdeveco.2015.12.005

Samargandi, N., Fidrmuc, J., &Ghosh, S. (2014). The relationship between financial development and economic growth monotonic? Evidence from a Sample of Middle-Income Countries. *CESifo Working Paper*, (4743), 1–35.

Shahzad, S. J. H., Rehman, M. U., Abbasi, F., & Zakaria, M. (2014). Relationship between remittance, export, foreign direct investment and growth: A panel cointegration and causal

analysis in South Asia. *MPRA Paper*, (60290), 1–26.

Sharma, R., & Kautish, P. (2020). Examining the nonlinear impact of coal and oil-based electricity production on CO 2 emissions in India. *The Electricity Journal,* 33(6), 106775. https://doi.org/10.1016/j.tej.2020.106775

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in an ARDL framework. In: Horrace, W.C.

Sijabat, R. (2022). The Association of Economic Growth, Foreign Aid, Foreign Direct Investment and Gross Capital Formation in Indonesia: Evidence from the Toda–Yamamoto Approach. *Economies*, *10*(93), 1–22.

Spyromitros, E. & Panagiotidis, M. (2022) The impact of corruption on economic growth in developing countries and a comparative analysis of corruption measurement indicators, Cogent Economics & Finance, 10:1, DOI: 10.1080/23322039.2022.2129368

United Nations (2009). System for National Accounts 2008.document symbol ST/ESA/STAT/SER.F/2/Rev.5, New York. Retrieved from https://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf

Wan, Y., & Chen, Y. (2022). China's Foreign Aid and Sustainable Growth of Recipient Countries: Mechanism and Evaluation. *Sustainability*, *14*, 1–17.

White, H. (1994). Foreign aid, taxes and public investment: A further comment. *Journal of Development Economics*, *45*, 155–163.

Zakari, J. & Umar, A. (2021). Corruption and Public Debt Nexus: Empirical Evidence from Nigeria. *KEFFI Journal of Modern Economics*, 1(3), 52-63.