AFRICAN DEVELOPMENT BANK GROUP

Fiscal and debt sustainability in Africa[1]

August 2020

[1] Prepared by George Kararach, Jacob Oduor, Edward Sennoga, Walter Odero, Peter Rasmussen and Lacina Balma. The views expressed here are those of the authors and do not represent official policy of the Africa Development Bank.

Abstract:

Fiscal sustainability concerns in Africa have increased recently following heightened fiscal vulnerabilities attributed to external factors including falling commodity prices particularly for commodity-exporting countries and emerging health challenges like COVID-19 and the Ebola pandemics that weakened fiscal revenues and growth as well as domestic factors such as elevated government spending on the back of big-push investment expenditures to close infrastructure gap, increased security expenditures in response to conflict and social unrest in some countries. To entrench fiscal sustainability, countries need to strengthen domestic resource mobilization and improve public investment management. Consequently, measures to increase tax revenue collections, savings mobilization and efficiency of public spending are critical. It is prudent for development partners to support debt reporting, data harmonisation, tax compliance, combating illicit financial flows and developing effective debt resolution frameworks.

1. Introduction

Fiscal policy is an important macroeconomic policy tool for allocating government revenues to different public expenditure needs. It is also important in stabilizing the economy during periods of sluggish growth or overheating. While fiscal policy has the potential to drive a country's development, it can also lead to undesirable outcomes if not well managed. Following the recent fall in commodity prices and the associated decline in fiscal revenues, fiscal sustainability concerns are rising in Africa. On the other hand, rapid rise in public debt accumulation in some African countries is fuelling concerns about the possibility of a new debt crisis. This situation has been worsened by the onset of COVID-19 pandemic since December 2019.

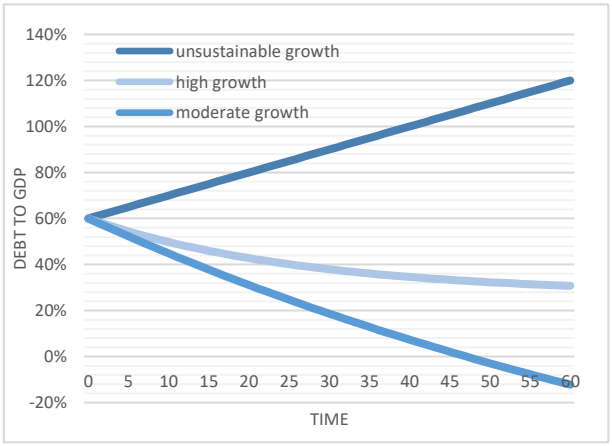
A commonly used approach in assessing fiscal sustainability applies non-increasing public debt to distinguish between sustainable and unsustainable fiscal policies. More recently, focus in literature has shifted towards assessing whether fiscal policies can follow the same trajectory without threatening government solvency. Therefore, fiscal policy can be sustainable even where public debt does not follow a non-increasing path.

The analytical starting point in assessing fiscal sustainability begins with the government's intertemporal budget constraint

$$d_t = \left(\frac{1+r_t}{1+g_t}\right) d_{t-1} - p_t \qquad (1)$$

where d_{t-1} is the previous period relative stock of government debt to GDP, r is the real rate of interest on debt, g is the real rate of economic growth, and p is the primary balance. Sustainability of fiscal policy requires that the present value budget constraint[2] holds true. In other words, fiscal sustainability requires that the present value of today's government debt, d_0, is less than or equal to the difference between future primary surpluses and primary deficit in present value terms.

Figure 1: debt dynamics, with different growth rates, real interest rates and primary balance.



In practice, testing for fiscal sustainability involves a determination of whether the historical process that generates fiscal data are likely to result in the preservation of the present value budget constraint. Statistically, fiscal policy is sustainable when debt, primary fiscal surpluses and the real interest rate move together in the long run (are co-integrated). Figure 1, provides an example assuming a starting point of debt to GDP ratio of 60%. Three scenarios are calculated, high debt growth path (g = 9%, r = 5% and p = –1%), moderate debt growth path (g = 3%, r = 2% and p = 1%) and unsustainable debt growth path (g = 5%, r = 5% and p = –1%). Noteworthy from this example is that even a small fiscal deficit of 1% can quickly increase debt over time if economic growth is not strong.

[2] $d_0 \leq \sum_{j=1}^{\infty} (1+r)^{-j} \quad p_j$

This paper assesses the fiscal and debt sustainability in Africa under different shocks including the COVID-19 shock. The rest of this paper is organized as follows. Chapter 2 highlights relevant literature and Chapter 3 summarizes recent trends in the main fiscal and debt variables in Africa. Chapter 4 assesses fiscal and debt sustainability under different fiscal shocks, whereas Chapter 5 concludes with policy recommendations on improving fiscal and debt sustainability.

2. Summary of relevant literature

The literature has many definitions of fiscal sustainability. Equally, different conditions for sustainability are proposed – from a non-ever-rising tax rate to an intertemporal discounted budget constraint (see Balassone and Monacelli, 2000; Krejdl, 2006; and Sarvi, 2011 for a survey). The requirement that the tax rate should not rise forever is one major condition for sustainable fiscal policy. That in turn is based on another necessary condition for sustainability: an ever-growing tax ratio cannot be sustainable. The economy must also grow to allow the tax ratio to fall without constraining the fiscal space (ibid.). David Hume argued that public debt was likely to lead to injurious tax increases in the short term and possibly to default in the long term. Adam Smith also cautioned that debt financing would lead to default (Chibi et al., 2019). The consensus was that debt financing need be used only under exceptional circumstances, such as wars (Alfonso, 2005).

Fiscal sustainability generally refers to limits on government debt or debt accumulation. A common notion of fiscal sustainability is based on the idea that government cannot engage in Ponzi schemes - borrowing just to meet interest payments, resulting into the ballooning of debt. Fiscal sustainability requires that government entities stay solvent. Buiter (1985) and Blanchard et al. (1990) show that an intertemporal fiscal solvency criterion requires the present discounted value of all future primary surpluses equal the initial level of public debt (or some target level). However, such intertemporal solvency criteria should allow a government to run persistent deficits for a prolonged period as long as there are surpluses at some time in the future and as long as the debt issuance does not rise faster than the real interest rate on debt (this is the transversality condition). These criteria, while insightful theoretically, are loose and offer little by way of policy guidance as to specific limits on debt accumulation and ways to avoid it (Chibi et al., 2019).

Blanchard et al. (1990) argued that sustainability is about whether, based on current fiscal policy, a government risks excessive debt accumulation. To operationalise this general statement operational, they define sustainable fiscal policy as a policy that ensures that the ratio of debt to GDP converges back towards its initial favourable baseline level. Buiter (1985) adopts a similar premise and notes a fiscal policy is sustainable if it maintains the ratio of government net worth to GDP at the present level. These authors differ in their approaches only empirically. By focusing on net worth, Buiter (ibid) explicitly notes the government may temporarily keep its gross debt from rising by using its assets to finance the deficits. But the fact that gross debt does not rise immediately by no means signifies sustainability, since the government will sooner or later deplete its assets and the debt will start growing again (Balassone and Monacelli, 2000; Krejdl, 2006). Blanchard (1985) was conscious of the complexities involved in measuring the asset/liability position of the government

Rajan et al. (2014) argue that in operational terms fiscal sustainability broadly encapsulates how public debt evolves over time and where debt stabilises as a share of GDP. Based on this definition, the debt ratio

will continue to rise indefinitely if the real interest rate exceeds real GDP growth and the primary budget is not in enough surplus. For the government is expected to run a primary deficit (thus adding to the stock of debt), then the economic growth rate must exceed (real) interest rates for the debt-to-GDP ratio to fall. There are deficiencies with this framework such as: it being partial equilibrium by nature, if primary balance, interest rates, and economic growth are exogenous variables; and not incorporating uncertainty. The strength of this approach, however, is that allows for a measure of sustainability of debt in the long run.

Krejdl (2006) highlights main problem with defining sustainable fiscal policy in terms of circumstances whereby the debt-to-GDP ratio converges back towards the initial level is the apparent arbitrariness of such a definition. The arbitrariness exists in at least two ways: (a) there is no theoretical reason why the debt ratio should return to its initial level and not to any other stable level, be it lower or higher; and (b) a policy condition may exist under which the debt ratio initially rises to levels that are likely to be perceived as excessive by market participants and for debt to later come down 'safer' levels.

The strand of criticism under item (a) above was resolved by making the definition of sustainability more general. In that case, any convergence of the debt ratio towards its initial favourable level is only a special case of a more general definition where fiscal policy is sustainable provided the present value of future primary surpluses is equal to the current level of debt. This definition is derived from the intertemporal government budget constraint given in equation 1. The second strand of criticism highlighted under (b), led some authors to distinguish between solvency and sustainability (see for examples, Artis and Marcellino, 2000; IMF, 2002, Ruobini, 2001; Mendoza and Oviedo, 2003). The government is solvent when, over an infinite time horizon, it pays given public debts via future primary surpluses (Krejdl, 2006). the government is solvent if the intertemporal budget constraint is fulfilled. The distinction between finite and infinite horizon is important when defining the various sustainability indicators (ibid).

Equation 1 forms a strong for deriving of indicators of fiscal sustainability. Omitting stock-flow adjustment, a simple relationship between deficit and debt will hold. The debt at current period is the sum of the debt in the previous period and the current deficit. The current deficit in turn is made up of the primary deficit and interest payments. The primary deficit may be inclusive of seigniorage (Artis and Marcellino, 2000). Moreover, the interest payments are a function of the interest rate (r) and the previous period debt level. If all the variables are expressed in real terms, r implicitly is the real interest rate. The primary deficit (surplus) is a positive (negative) value. It is important to accommodate growth dynamics to accurately assess fiscal sustainability because as economies grow over time, the government's capacity to repay its debt increases. Fiscal sustainability policy prioritises the evolution of the debt to GDP ratio rather than the debt in absolute terms. The deficit is expressed thus:

$$d_t = \left(\frac{1 + r_t}{1 + g_t}\right) d_{t-1} - \ p_t \qquad (2)$$

Equation (2) solved backwards to an initial period 0 and the debt ratio at time T (d_T), provides the sum of the present value of the initial debt and the present value of all past primary deficits. Discounting by the factor d back to the initial period 0 and assuming an infinite time horizon (T→∞) we obtain:

$$\lim_{T\to\infty}\left[d_T\left(\frac{1 + r_t}{1 + g_t}\right)^{-T}\right] = d_0 + \lim_{T\to\infty}\left[\sum_{t=1}^{T} p_t\left(\frac{1 + r_t}{1 + g_t}\right)^{-t}\right] \qquad (3)$$

And if the present discounted value of the debt from a very distant time in the future is equal to zero, the equation (3) becomes:

$$\lim_{T\to\infty}\left[\sum_{t=1}^{T} p_t \left(\frac{1+r_t}{1+g_t}\right)^{-t}\right] = -d_0 \qquad (4)$$

Equation (4) provides a condition for fiscal sustainability. The present discounted value of future primary surpluses must be equal to the initial value of debt. There is convergence of the discounted value of the debt at infinity towards zero. Dividing a finite value of debt by an infinitely large discounting factor satisfies the condition under equation (4). Fiscal sustainability is thus characterised by the debt ratio converging towards its initial level or to any other finite level. However, sustainability requires that even if the debt ratio diverges, its growth rate must be lower than the difference between the real interest rate and the real GDP growth rate (r-g). Without economic growth, the government engage in fiscal expansion and increase its indebtedness forever. It must also to be noted that deficit and debt have an impact on other macroeconomic variables such as the levels of savings and investments, of which the interest rate and the growth rate of GDP are of utmost interest for sustainability. In that regard, attention needs to be paid to the interaction between the fiscal space and the rest of the economy.

Finally, equation (4) suggests that sustainability is a forward-looking concept. Therefore, when conducting any measurement exercise, historical fiscal data may provide one with a basis for assessing and measuring levels of fiscal sustainability, however crudely this may be. Many papers (e.g. Hamilton and Flavin, 1985; Banca d'Italia, 2000) over the years have tested econometrically the sustainability of fiscal policy. These papers used an operational definition of fiscal sustainability based on tests to ascertain the univariate statistical properties of individual public finance variables (Hamilton and Flavin 1986; Trehan and Walsh 1991). This extant literature tests the stationarity of public debt and the primary balance relative to GDP, with non-stationarity interpreted as an unsustainable policy. However, such time series approaches are "backward looking" and do not factor in estimates of future revenue and expenditures and also do not offer any guidance about the "fiscal reaction" of governments needed to ensure debt sustainability (Bohn 1998). Assessment of the long-term sustainability of public finances implore us to be able to project the future path of revenues, expenditures and deficits – especially in conditions shocks that many African countries seems to be historically prone to. We return to some of these discussions in Section 4.

3. Recent trends in the main fiscal and debt variables in Africa

This section explores recent trends in the main fiscal variables as contained in equation 1, namely the primary fiscal deficit (expenditures and revenues), interest payments and public debt.

3.1 Fiscal deficits in Africa

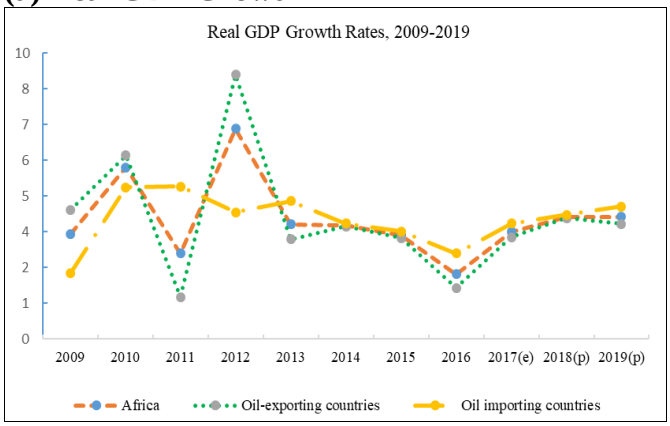
Fiscal deficits in many countries have deteriorated in the recent past following sustained reductions in commodity prices since 2014 (**see Figure 2**). While commodity prices decreased across the board, reduction in oil prices were most rapid and adverse. Consequently, and as shown in **Figure 2,** real GDP growth decreased consistently during 2012-2016 and slowdown was more severe in oil-exporting, African

countries. Net oil exporters[3] recorded a growth of 1.7 percent in 2016 compared to 2.9 percent for net oil importers in the same year[4].

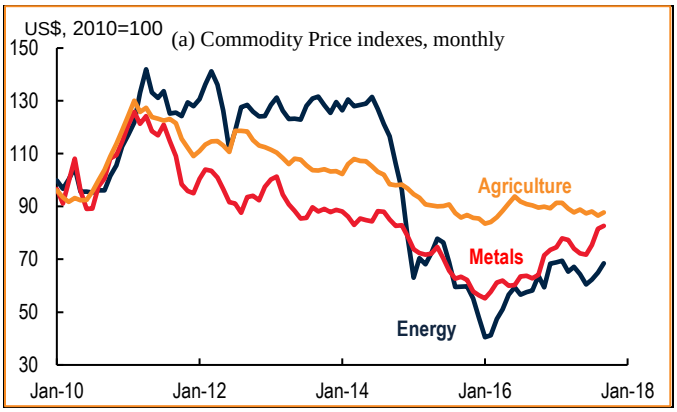
The decline in GDP growth and commodity prices put pressure on government revenues in many African countries leading to higher fiscal deficits. At the aggregate level the large primary deficits are mostly due to lower than expected revenue performance across the continent and generally increasing trend in public spending[5], which has also increased the underlying contingent liabilities. **Figure 2** shows the recent trends in Africa's real GDP growth rates, commodity prices, government revenues and expenditure and fiscal balances.

Figure 2: Fiscal deficit and related drivers in Africa

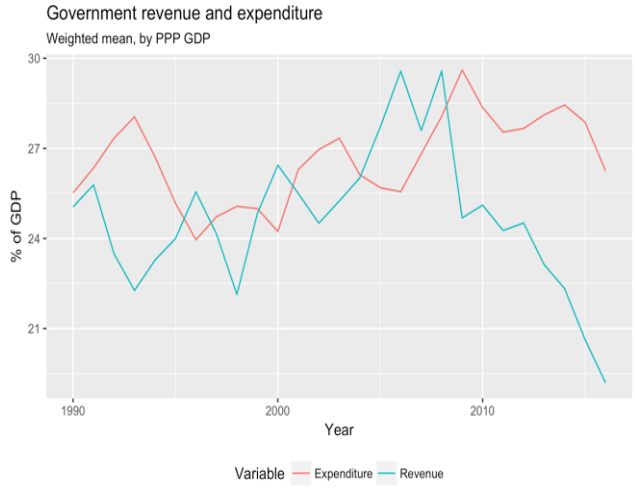
(a) Real GDP Growth



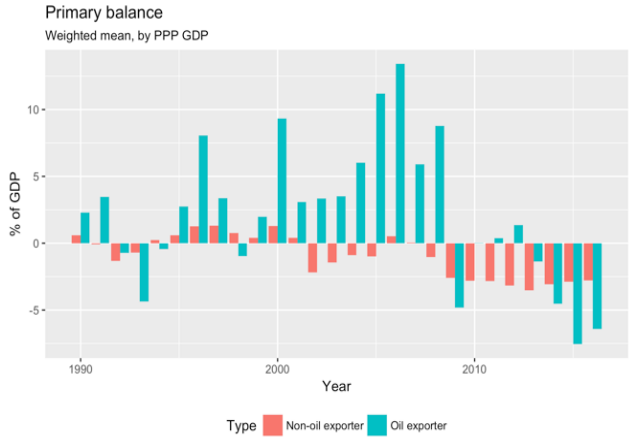
(b) Commodity prices



(c) Government revenue and expenditure



(d) Primary fiscal balance



Source: AfDB Statistics Department

[3] The group of oil exporting countries include, Algeria, Angola, Cameroon, Chad, Congo, Democratic Republic of the, Congo, Republic of, Côte d'Ivoire, Egypt, Equatorial Guinea, Gabon, Libya, Nigeria, South Sudan, Sudan

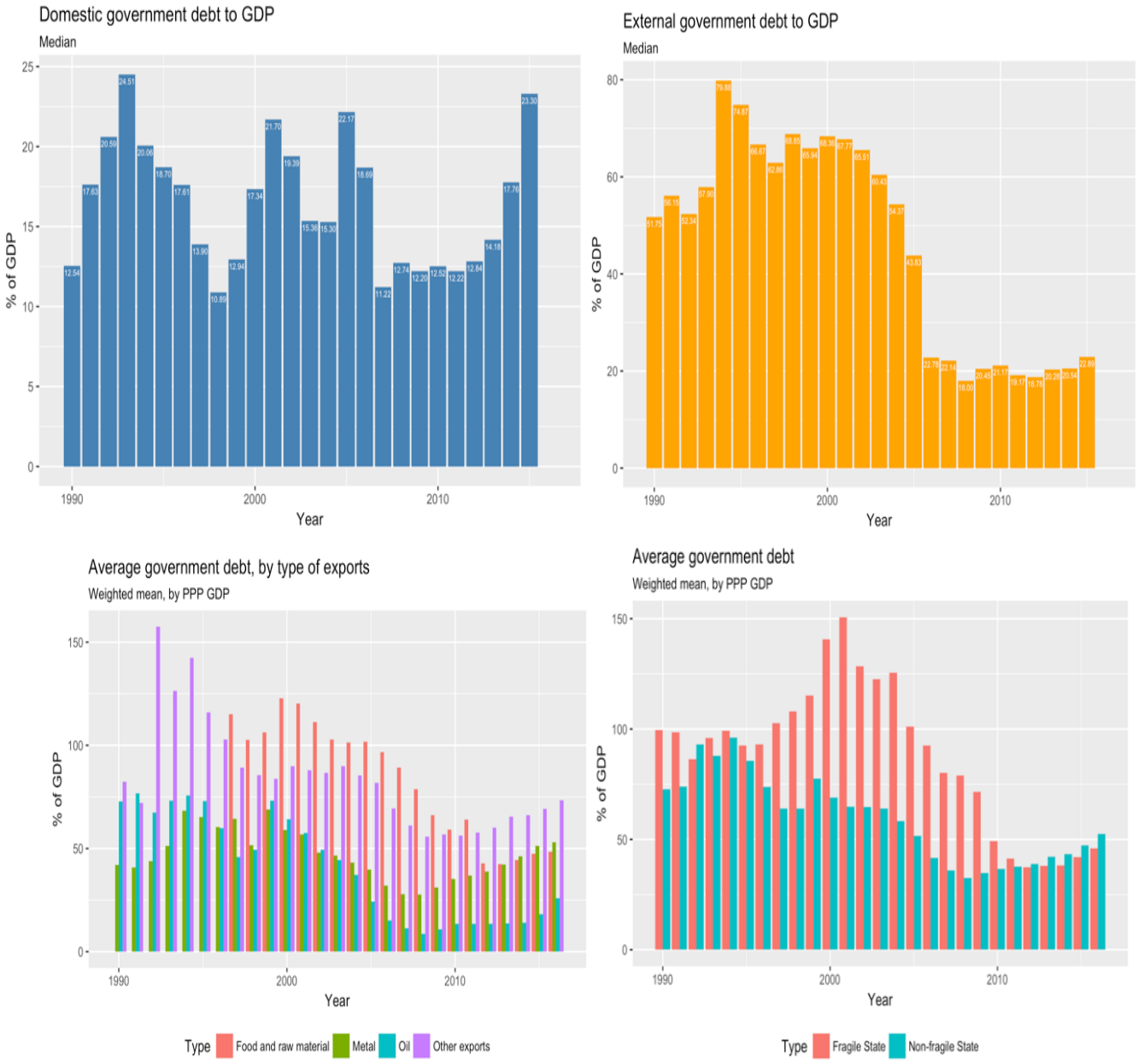
[4] Between 2015 and 2017, growth in real GDP in Nigeria for instance (one of the major oil exporters in Africa) averaged only 0.7 percent compared to an average growth of 6.3% recorded during the 2010-2014 period. Falling oil prices led to sharp fall in fiscal revenues since revenues from oil exports account for an average of 75% percent of the Nigeria's total government revenues.

[5] In some areas, this was compounded by security threats and political instability (Sahel, Arab spring, Boko Haram) which put an additional financing burden on African governments.

3.2 Increased debt accumulation in Africa

Weak growth, in part due to falling commodity prices, poor performance of fiscal revenues and consequent increased access to international commercial capital markets to address public financing shortfalls, and more recently due to COVID-19 lockdown, have driven a rapid rise in Africa's public debt. Following debt cancellation for many countries in the early naught's, growth in public debt started after the global financial crisis (when measured in weighted averages) and accelerating from 2013. External pressures on prices for major exports and weak fiscal balances triggered a rise in the debt burdens (see **Figure 2**).

Figure 2: Public debt accumulation in Africa



Source: AfDB Research Department

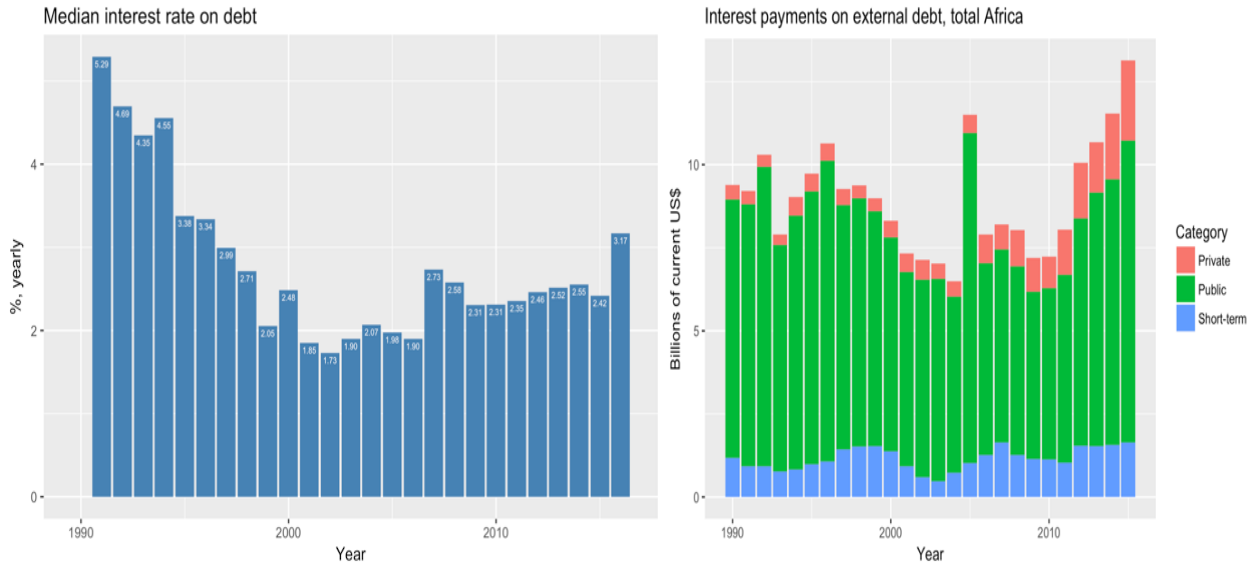
Average debt to GDP ratios among oil exporters increased from 20 to 30% of GDP between 2013 and 2016, while they increased by only a fifth (from 55 to 66%) among non-oil exporters (see **Figure 2 panel c**). However, the increase in debt to GDP ratios was slower when compared to other oil-exporting developing countries whose debt to GDP rose from 20 to 35%. Public debt decreased at a faster rate throughout the 2000s for commodity exporters, due to positive terms-of-trade and strong growth in Asia, leading to large reductions in foreign debt. However, while average debt levels for commodity exporters are lower due to the past accumulation of external surpluses, the severity of the vulnerabilities experienced between 2013 and 2016 is a key driver of the recent acceleration in debt burdens. Fragile states in Africa (**Figure 2 panel d)** recorded less rapid increases in public debt compared to the non-fragile states reflecting the limited access to external debt for fragile states.

3.2 Interest payments

Africa's increased reliance on external commercial financing has increased the cost of debt servicing. As illustrated by **Figure 3**, interest payments have rapidly risen as a share of government revenues. The increase in interest costs has been faster for public debt compared to private debt contracted over the same period (see Figure 3 panel b), showing an increasingly tighter financing environment for African sovereigns compared to the private sector.

Figure 3: Interest rates on Africa's debt

(a) Median interest rate on debt (b) Interest payments on external debt



Source: AfDB research department

4. Assessing fiscal and debt sustainability in Africa

The preceding sections have outlined the increased fiscal vulnerabilities in some African countries in the recent past. The impact of these vulnerabilities in long-term fiscal and debt sustainability is a matter of great concern for policy makers. In this section we assess fiscal and debt sustainability in Africa using standard tools including trend and co-integration analysis as well as results from other published research.

4.1 Assessing debt sustainability in Africa

In this section we use a simple panel cointegration analysis to assess fiscal sustainability in Africa. Using a panel of 53 African countries (excluding Somalia due to data limitations) and with data spanning from 1991-2016, the results show that the present value budget constraint holds for Africa over the period, implying that Africa's fiscal position is sustainable given the historical trend. This is true for the whole African sample as well as oil exporters and fragile countries. However, the results show that oil exporters have the most vulnerable fiscal position. This can be seen from the magnitude of their t-statistics in the **Table 1** below. A small t-statistic shows reduced level of statistical significance (a t-statistic lower than 2 would mean that we do not reject the null hypothesis of no cointegration or put simply, we would conclude that the fiscal position is not sustainable). Fragile countries also face vulnerable fiscal positions but not as much as oil exporters. Given the long period of the data in our assessment, it is safe to conclude that a similar trend will obtain in future in Africa with the smoothing of business cycles, particularly coming from commodity price booms and busts.

Table 1: Test of cointegration between primary fiscal balances and public debt in Africa

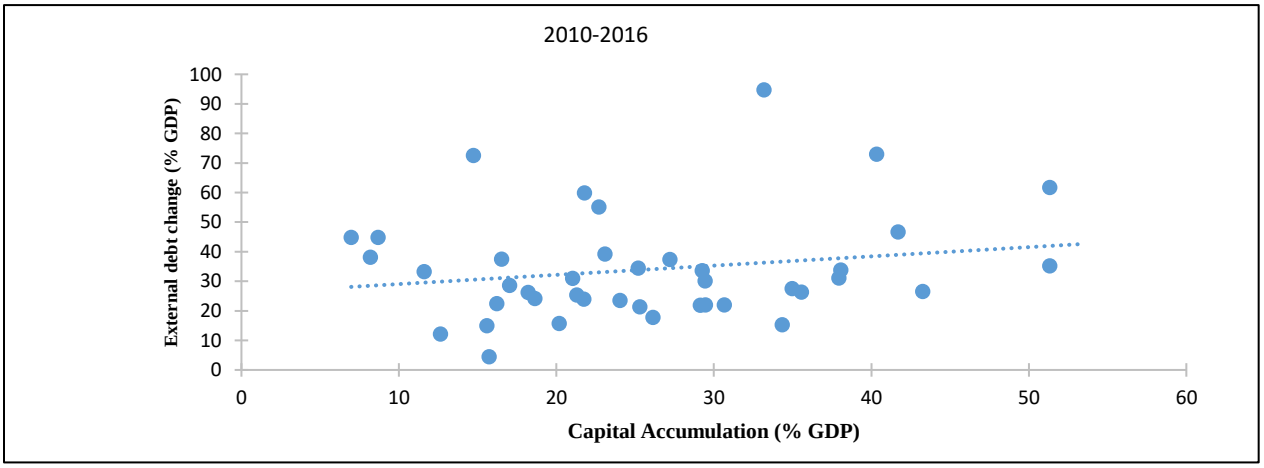
	Modified Phillips-Perron	Phillips-Perron	Augmented Dickey-Fuller t
Africa	-11.63**	-11.28**	-10.61**
Oil exporters	-4.87**	-5.04**	-5.37**
Fragile countries	-6.71**	-5.91**	-6.50**

Source: Author's computations, ***reject the null of no cointegration at 5% significance level.

4.2 Use of debt for productive investments in Africa

The assessment of debt sustainability in Africa requires an understanding of how the debt has been used. The correlation between external debt and investment presented in **Figure 4** shows a positive correlation between external debt and capital accumulation, an indication that an increasing share of public debt has been used for investments. African countries that accumulated the largest volumes of external debt as a percentage of GDP between 2010 and 2016 also recorded the fastest rates of capital accumulation during the same period. The positive co-movement across the two variables generally suggests that debt provided resources to implement ambitious infrastructure and other development projects thereby expanding productive capacities in the public and private sectors. This confirms the functional nature of fiscal policy (Kararach et al., 2017).

Figure 4: Debt is associated with increased public investments in Africa

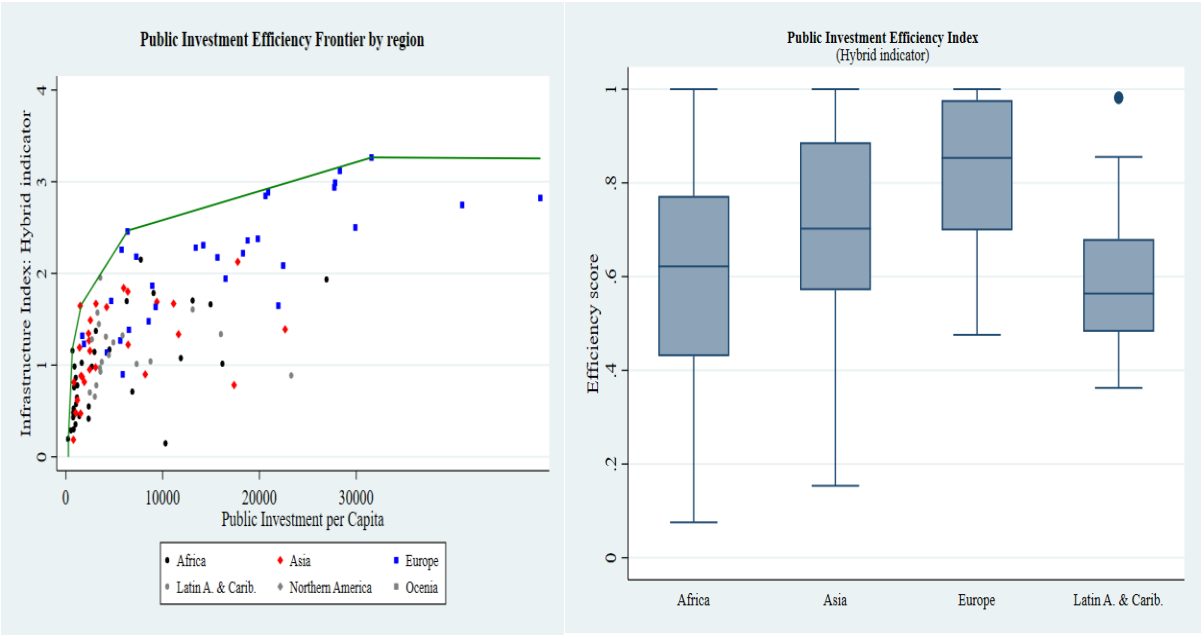


Source: AfDB Research Department

Despite evidence that debt has been used for investment purposes in Africa, the standardized IMF-WB debt sustainability framework does not take sufficiently into account the relationship between public investment and growth and the growth-promoting properties of well-executed investment programs. That is, the projections of the debt sustainability indicators—such as debt-to-GDP ratios—are generally not linked with the public investment that the proposed non-concessional borrowing is meant to finance. As a result, the future growth dividends are omitted, and this could inflate debt indicators such as debt-GDP ratio.

Nevertheless, the long run growth dividends of big-push investment programs are not straightforward. Indeed, there is evidence that the link between debt financing and the growth-enhancing role of public investment is weakened by low efficiency. The main challenge facing African governments in using debt to finance big-push investment programs is that spending on public investment does not always imply an equivalent increase in capital stock. This is so because some of the spending may be wasted or spent in poor investment projects with low economic and social returns. Based on a sample of 32 African countries, our estimates show that Africa has an average efficiency gap of 39%, which means that close to 39% of debt financing is wasted or spent on poor projects (Figure 5). This is higher compared efficiency gaps of 17% in Europe and 29% in Asia. Our results are close to Barhoumi, Vu, Towfighian and Maino (2018) who analysed the relative efficiency of sub-Saharan African (SSA) countries in translating public investment into infrastructure. The authors found that SSA countries compared unfavourably in terms of public investment efficiency relative to other regions, with an efficiency gap of up to 36% for the hybrid indicator (combined quality and physical indicator) and 54% for the physical indicator only.

Figure 5: Public infrastructure investment efficiency: Hybrid indicator



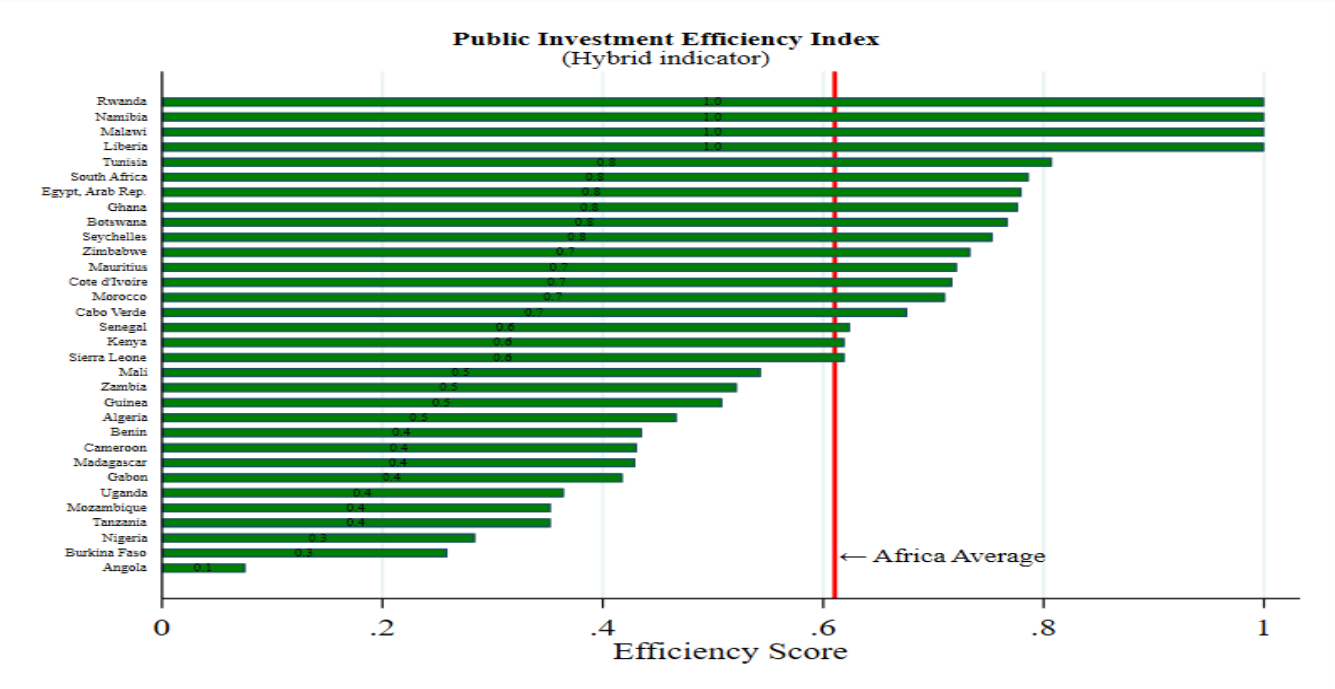
Source: Authors' estimates
Note: The hybrid indicator of efficiency accounts for both quality and physical indicator

However, the estimated efficiency gap of 39% masks important heterogeneity across the 32 African countries in the sample (see Figure 6). For instance, Rwanda, Namibia and Liberia have an efficiency score of close to 100%, meaning that these countries are the best-performers in the sample. Other countries with an efficiency score above the average of 61%, that is, with an efficiency gap below 39% against the best-performers include South Africa, Egypt, Ghana, Botswana, Zimbabwe, Seychelles and Mauritius. Countries such as Angola, Burkina Faso and Nigeria lag, with an efficiency gap of more than 70%.

The root cause of failing to translate debt financing into productive public investment is poor public investment management (PIM) and the institutions committed to it. Strengthening these institutions could close the average Africa public investment efficiency gap of 39% and enable SSA countries to improve infrastructure quality while ensuring sustainable fiscal positions. In particular, the quality of institutions is the most important determinant of public investment efficiency. In addition, emphasis on growth enhancing expenditures, revenue mobilization and improved public investment efficiency will expand the fiscal space for SSA countries. Overall, well-executed high-yielding public investment programs can substantially raise output and consumption and be self-financing in the long run, thereby maximizing the growth and revenue dividends associated with productive public investment. Future investment programs would pay for themselves and higher growth dividends would in turn put debt on a sustainable path and pave the way for further access to new external debt by reducing rollover risk. Other impediments include to maximizing public expenditure efficiency comprise delays in the implementation of projects (Balma and Gurara, 2019) due to weaknesses in coordination across level of government and low absorptive capacity resulting from weak planning and oversight, among others.

Consequently, SSA countries could strengthen the efficiency of public investments by improving planning, project selection, appraisal and corresponding financing modalities, ensuring credible multiyear budgeting, and monitoring of implementation. Strengthening infrastructure governance and capabilities, through improvements in technical capabilities and providing performance incentives for project staff.

Figure 6: Efficiency gap by countries



Source: Authors' estimates

4.3 Assessing the debt-investment-growth linkages

We analyze the interplay between public investment, growth and debt sustainability with a special focus on quantitative and qualitative issues. In particular, the paper goes beyond consideration of the *level* of public investment in infrastructure to provide an understanding of how aspects such as closing the efficiency gap influence the investment-growth nexus and debt sustainability. The model is calibrated to the average for Africa and used for public investment and financing scenarios. A short description of the general structure of the model and transmission mechanisms is presented in Box 1.

Policy scenarios

The simulations focus on the impact of scaling up public investment in infrastructure, mix of infrastructure spending and investment in education, and different financing options including debt-financing. A *base case or business-as usual scenario* is contrasted with a more *optimistic scenario*, assuming that reforms are undertaken to close the efficiency gap. The base case will be informed by our estimates of the efficiency of public investment in infrastructure, which are derived from the Data Envelopment Analysis and Stochastic Frontier Analysis. World Bank's estimates for SSA are used to quantify the return on infrastructure and education investments. According to Foster and Briceno-Garmendia, 2010, the return on the World Bank's infrastructure projects in SSA is 27%. Psacharopoulos and Patrinos (2004) found a higher return on education investment (35%) compared to the return on infrastructure investment. The model is calibrated in 2019 for the average Africa. The overall calibration of the model is provided in Appendix and summarized in Box 1.

Box 1: General structure of the model

How does the model capture the investment-growth nexus?
The model is an open-economy perfect foresight general equilibrium model with three private sectors: tradable agriculture, non-tradable formal and non-agriculture informal sectors. Each sector is represented by a neoclassical production function where output is produced by combining public capital, private capital; low-skill labor, high-skill labor and land in the agriculture sector. Then, because public capital is productive, government spending can raise output directly; this, however, depends on the marginal productivity (return) of public capital which in the model is calibrated in line with existing empirical evidence. Furthermore, through raising the marginal productivity of private capital, public capital can crowd in private investment and ultimately stimulate growth. Beside the rate of return to public capital, the model captures public investment inefficiencies and absorptive capacity constraints.

Public Investment in Human Capital
Public investment in human capital plays three fundamental roles. First, it raises the productivity of low skill labor in the different sectors, including in the informal sector. Second, it increases the supply of high skill labor into the different sectors of the economy. Finally, educational capital has a complementarity effect on physical capital by providing skilled labor to the different sectors of the economy and loosening absorptive capacity constraints. When skilled labor is in scarce supply, higher demand for skilled labor when public investment is scaled up will shift labor from one sector to another, put pressure on real wages and create a situation which is not pareto optimal for the economy.

Labor market
The labor market is segmented and comprises formal sector (non-tradable), non-agricultural informal sector and agricultural sector. Firms in the formal sector pay efficiency wage, while firms in the informal sector and agriculture are populated by own-account workers, and therefore form an integrated labor market with flexible wages. There is open involuntary unemployment so aggregate labor productivity increases when labor moves from the informal to the formal sector or from agriculture to either non-agricultural sector. New skill labor enters the labor market thanks to public investment in educational capital.

Efficiency wage and unemployment
A wage curve relates the efficiency wage *log(wn/P)* to unemployment rate *log(unemployment)* in a way that a decline in the unemployment rate increases the efficiency *wn/P* more, as the unemployment rate declines and the labor market tightens.

Fiscal Adjustment and the Public Sector Budget Constraint
Regarding the fiscal adjustment, the model considers different government financing options. When revenues fall short of expenditures, the resulting deficit is financed through domestic borrowing, external commercial borrowing, or concessional

borrowing. The revenue side of the government budget constraint is well detailed with many tax instruments which the government can also adjust in order to ensure debt sustainability. On the other hand, expenditures correspond to interest payments on the three types of debt, public investment in infrastructure, in primary education and upper education, and other non-capital and non-educational expenditures.

The response of the private sector

The private sector (firms and households) response is the key in the transmission and the ultimate impact of the government investment surges on the overall economy. The private sector response is related to crowding in (long term, supply-side effect) and crowding out effects on private demand. In the model, fiscal adjustment and domestic borrowing can crowd out private consumption and investment. This is because of two reasons: First, tax increases, which are distortionary, lower private consumption. And second, when the government uses domestic resources to invest, these resources are no longer available for private investment and consumption. On the other hand, firms in the model maximize profits. They use their production functions to produce goods and services, where increases in public capital—physical and human capital—raise the marginal productivity of private capital, and therefore, can crowd in private investment. In the end, the balance between crowding in and crowding out depends on factors such as the return to capital and efficiency of public investment. But in the long run, there is always crowding in if the projects are good, while in the short to medium run, crowding out may dominate, especially if there is not enough foreign financing.

Regarding the financing mechanisms, the viability of programs with substantial investment in infrastructure and education depends on: (i) success in broadening the tax base; (iii) rationalizing expenditures; and (iv) access to external borrowing over an extended period. Different financing mechanisms are explored including broadening the income tax base, mobilizing user fees for all recurrent costs, reducing unproductive expenditures (expenditures other than physical and human capital expenditures) and access to external commercial, concessional and domestic borrowing. Furthermore, the optimistic scenario assumes gradually narrowing of the efficiency gap as structural reforms are undertaken to close the efficiency gap. This scenario also assumes further broadening of the tax base and improvements in the collection of user fees.

A. Long-run outcome

Before studying the transition dynamics of the model's variables in the short and medium run, it will prove helpful to understand how the model operates in the long run. The long-run corresponds to the model's deterministic steady state, that is, the state where all the model's variables are assumed to be constant. The short and medium run correspond to the dynamics of variables around the steady. For the simulation below, we assume between 2 and 10 for the short run and up to 30 years for the medium run.

Table 2 presents the results of three public investment programs. First, the government increases infrastructure by 4% of initial GDP without any change in maintenance spending (Program 1). Second, the government increase infrastructure and maintenance each by 2% of initial GDP (Program 2). Third, the government undertakes and mixed program where investment in infrastructure, upper-level education, and basic education increase 2%, 1% and 1% of initial GDP respectively (Program 3). We show how these programs affect real output, the aggregate private capital stock ($k = kx + kn + kj$), sectoral output and employment, the unemployment rate, real wages, the relative prices of the formal and informal goods and the associated fiscal adjustments. CIC is the crowding-in coefficient, the ratio of the increase in real private investment to the increase in real public investment.

The VAT and all other taxes are held constant, so the change in the other types of expenditure (other than public investment in infrastructure and human capital) measures the net fiscal gain/loss. In what follows, we discuss the key findings of the simulations.

First, investing in infrastructure alone where the government increase investment spending by 4% of initial GDP results in real GDP increase by 7.8%. Second, when infrastructure investment includes maintenance,

the impact on GDP is greater. Real GDP increases by an additional 4.5 percentage points beyond the initial 7.8% with a crowding-in coefficient of 0.94 compared to 0.7 for infrastructure investment alone. Third, mixed investment programs are highly beneficial, as they reduce the large gaps in partial equilibrium returns that emerge when investment is directed solely to one type of public capital. The resulting efficiency gains are not trivial: GDP increases by 11.6 percentage points over and above the gains in GDP from investment in infrastructure alone.

The long run fiscal gain is greatest for the program that involves investment in both infrastructure and human capital. However, investment in infrastructure requires the government to scale up the mobilization of public revenue, while spending on maintenance increases investment costs, which could generate fiscal losses. Big-push investment like Program 3 entails a fiscal gain of 2.2% of initial GDP. Investment in infrastructure alone and infrastructure investment combined with maintenance yields a fiscal loss of a modest 0.6% and 0.3% of initial GDP respectively. Therefore, the mixed program may improve the government's capacity for revenue mobilization and hence contribute to debt sustainability. Variations in fiscal adjustment are due to the magnitude of reductions in the relative price of formal non-tradable sector output. Since the non-tradable sector provides the bulk of VAT and income tax revenue, a large decrease in its relative price may erode the tax base.

Table 2: Long run effects of different public investment programs

	Program 1	Program 2	Program 3
Real GDP	7.8	12.3	19.4
CIC: $\Delta(k_n + k_x + k_j)/\Delta z^e$	0.70	0.94	1.36
Private capital: $k_n + k_x + k_j$	14.2	21.5	47.8
Traded output : q_x	4.1	6.7	10.9
Formal output : q_n	2.7	3.9	9.9
Informal output : q_j	2.7	4.5	7.4
Private consumption : ctotal	7.4	12.1	23.9
Relative price, nontradable: P_n	-9.8	-7.2	-5.9
Relative price, informal : P_j	-0.4	-0.7	-11.1
Low-skill emplymt traded : L_x	-0.1	-0.3	-0.2
Low-skill emplymt formal : L_n	0.0	-0.1	0.4
Low-skill emplymt informal : L_j	0.1	0.3	-1.9
Unemployment rate: u	12.15	12.2	11.76
Real wage, formal : w_n/P	3.85	6.12	8.25
Real wage, informal : w_j/P	9.68	15.86	25.22
Real wage, skilled : w_s/P	6.60	9.97	-19.92
Fiscal adjustment: $\Delta T/GDP_o$	-0.6	-0.3	2.2

Note: CIC for crowding-in coefficient. The effects are measured as the percentage change between the steady states, except for taxes and the CIC. Fiscal adjustment is assumed to fall exclusively on unproductive spending, so taxes are kept constant.
Program 1: Infrastructure investment increases 4% of initial GDP with no change in maintenance spending
Program 2: Investment in infrastructure and maintenance spending increase each 2% of initial GDP
Program 3: Investment in infrastructure, upper-level education, and basic education increase 2%, 1% and 1% of initial GDP

B. Short-and medium-run dynamics

This section presents track the short and medium-run paths of the key macroeconomic and fiscal variables following a range of simulations of public investment scaling ups and financing mechanisms. The growth, distributional and debt sustainability impacts are also assessed. To achieve this, we consider a big-push investment program where the government combines infrastructure and human capital investment. We also consider improving the efficiency of public investment.

I. Mixed investment programs and financing mechanisms

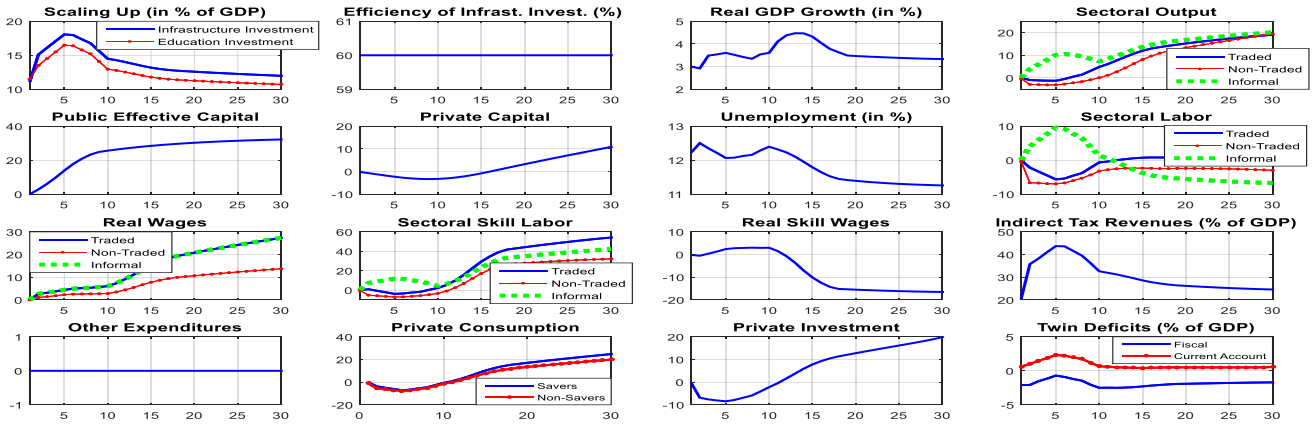
We simulate an investment program where the government combines pari passu infrastructure and human capital investment. Public investments have important macroeconomic consequences, which strongly depend on the way governments adjust fiscal policy to finance such investments. Diverse financing options are used to assess the macroeconomic and fiscal impacts. Moreover, the efficiency of public investment are important factors that come at play and the framework used here includes an efficiency parameter which takes its values between 0 and 1. The baseline calibration of this parameter is informed by our estimate of the efficiency score discussed in previous sections.

Financing through indirect taxes

Domestic resource mobilization in Africa often relies on consumption taxes, which are generally regressive. While mobilizing indirect taxes is viable from debt sustainability perspective, it may have important distributional consequences. To understand the forces at play, we analyze the impact of an increase in consumption tax rate from 20% in 2019 to 22.5% in 2024 used to finance a predetermined investment plan for the next 30 years (Figure 7). There is no adjustment in the spending (other than spending on infrastructure and human capital) and the government does not resort to borrowing.

From a distributional perspective, we find that a protracted fiscal deficit and the fiscal adjustment through indirect taxes to finance the investment program increases inequality. Since the poor (hereafter non-savers) live hand to mouth and spend a larger share of income on consumption goods compared with better-off households (hereafter savers), an increase in the indirect taxes tends to widen consumption inequality. This is robust through the transition path where the non-savers' consumption lies below that of the savers (see private consumption).

Figure 7: Base Case: Combined infrastructure and human capital investment



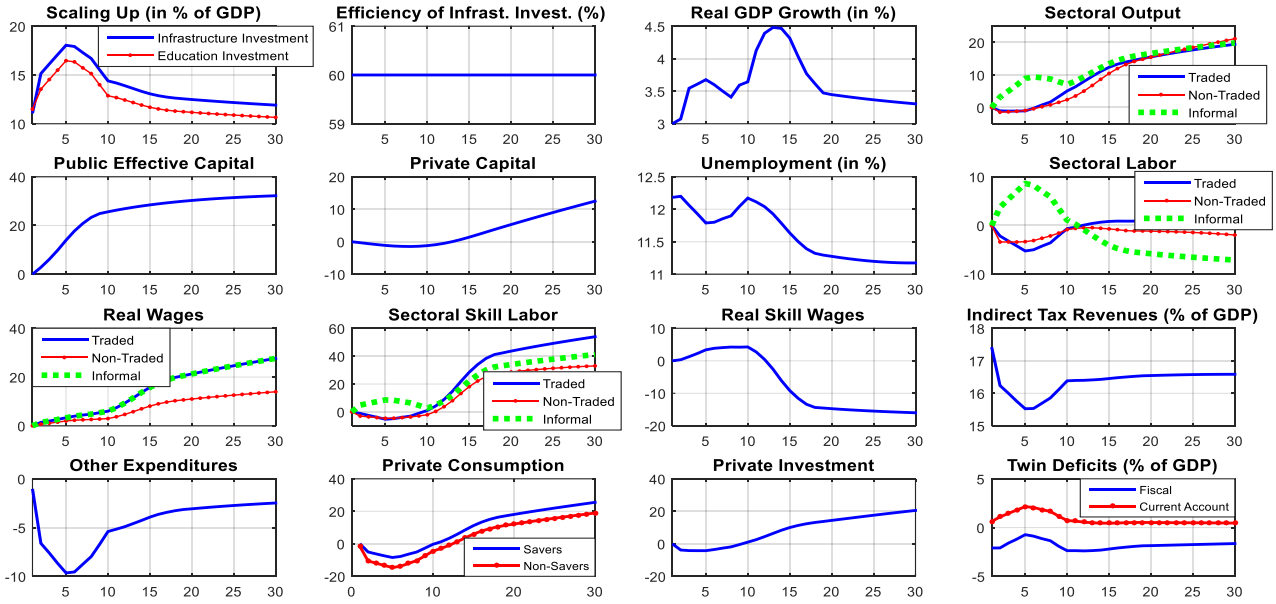
Source: Authors' calculations
Note: The Y axis measure the growth of the variable, unless otherwise indicated. The X axis denotes the years. The transition paths when the government increase indirect taxes to finance the investment program.

The implications from macro perspective are captured through a crowding out of private investment over the short and medium run, coinciding with the increase in indirect tax revenues. As a result, sectoral output gaps, especially in the formal sectors are negative, except in the informal sector. However, the long run productivity gain from the big-push investment somehow offset the short and medium run crowding out effect leading to a surge in private investment in the long run. Consequently, sectoral outputs are higher and growth rate follows suit.

Financing through cuts in expenditures other than infrastructure and human capital investment spending

The distributional consequences of cutting other expenditures (including transfers) to finance the investment program are more worrisome, with increased consumption inequality between savers and non-savers households. In fact, it is assumed that non-savers live hand to mouth, and that part of their income is driven by government transfers. Figure 8 shows that the consumption of non-savers is expected to evolve below that of savers. Compared with the previous fiscal adjustment on the revenue side (financing through indirect taxes), inequality is higher when government cuts other expenditures (including transfers) to close the financing gap. Nonetheless, the macroeconomic consequences under this expenditure-side adjustment are like the previous revenue-side adjustment.

Figure 8: Base Case with fiscal adjustment on the spending side



Source: Authors' calculations
Note: The Y axis measure the growth of the variable, unless otherwise indicated. The X axis denotes the years. The transition paths when the government increase indirect taxes to finance the investment program.

Financing through grants and concessional debt

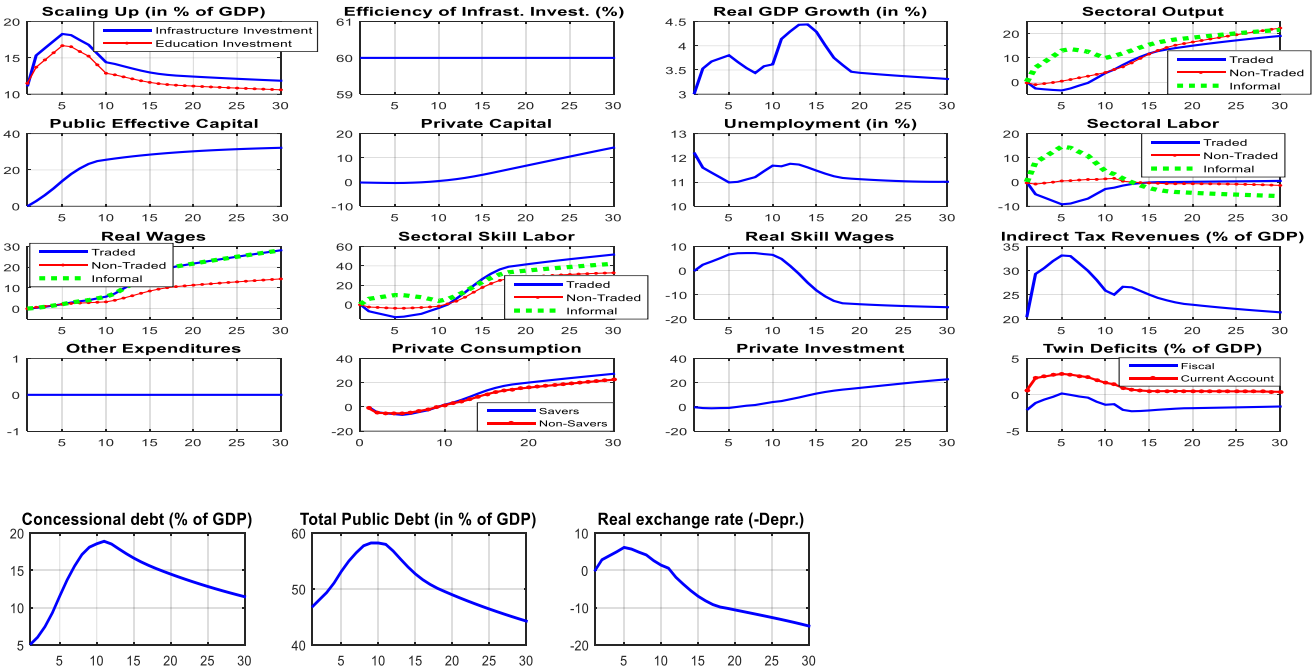
In order to preserve long-term fiscal sustainability and avoid fiscal adjustments that sacrifice welfare for long-term objectives, we assume that the financing needs for much-needed public investments would be covered mainly through grants and highly concessional loans. The grant element of the borrowing is expected to remain above 1.3 percent of GDP in the first-five years of the investment scaling ups phase. Concessional debt increases above 5% and reaches 18% in year 11 before gradually declining.

The short-run macroeconomic consequences of grant-and concessional debt-financed public investment scaling-ups are relatively standard (Figure 9). An appreciation of the real exchange rate (i.e., the relative price of non-traded goods) and of other prices (e.g., real wages) are a central part of the transmission mechanism in the grant-and concessional debt-financed investment scaling-ups scenario. In the short run public investment in infrastructure and human capital creates a demand pressure. It follows a sectoral

competition over labor, which is in scarce supply in the short run, especially the skilled one. Indeed, it is assumed that investment in basic education increases the supply of skilled labor with six-year lag, while upper-level education increases the supply of skilled labor with an eight-year lag. In the interim, the sectoral competition is over low-skilled labor, resulting in an increase in real wages for this category of workers. The shortage of skilled labor in the short and medium run also results in a corresponding hike of the skilled real wages. From distributional perspectives, the sectoral competition over labor and the hike of the low-skilled and skilled wages (in real terms) in the short run can reduce income inequality and improve the purchasing power of low-income individuals.

The implication on debt sustainability is straightforward. Concessional debt is exogenously determined. It increases during the investment scaling up phase until it reaches a peak around year 10. Thereafter it is expected to quickly decline. Total debt path follows that of concessional debt. As a result, the fiscal adjustment needed to ensure debt sustainability is more realistic compared to the base case (see variable indirect tax revenues).

Figure 9: Base case with financing through concessional borrowing



Source: Authors' calculations
Note: The Y axis measure the growth of the variable, unless otherwise indicated. The X axis denotes the years. The transition paths when the government increase indirect taxes to finance the investment program.

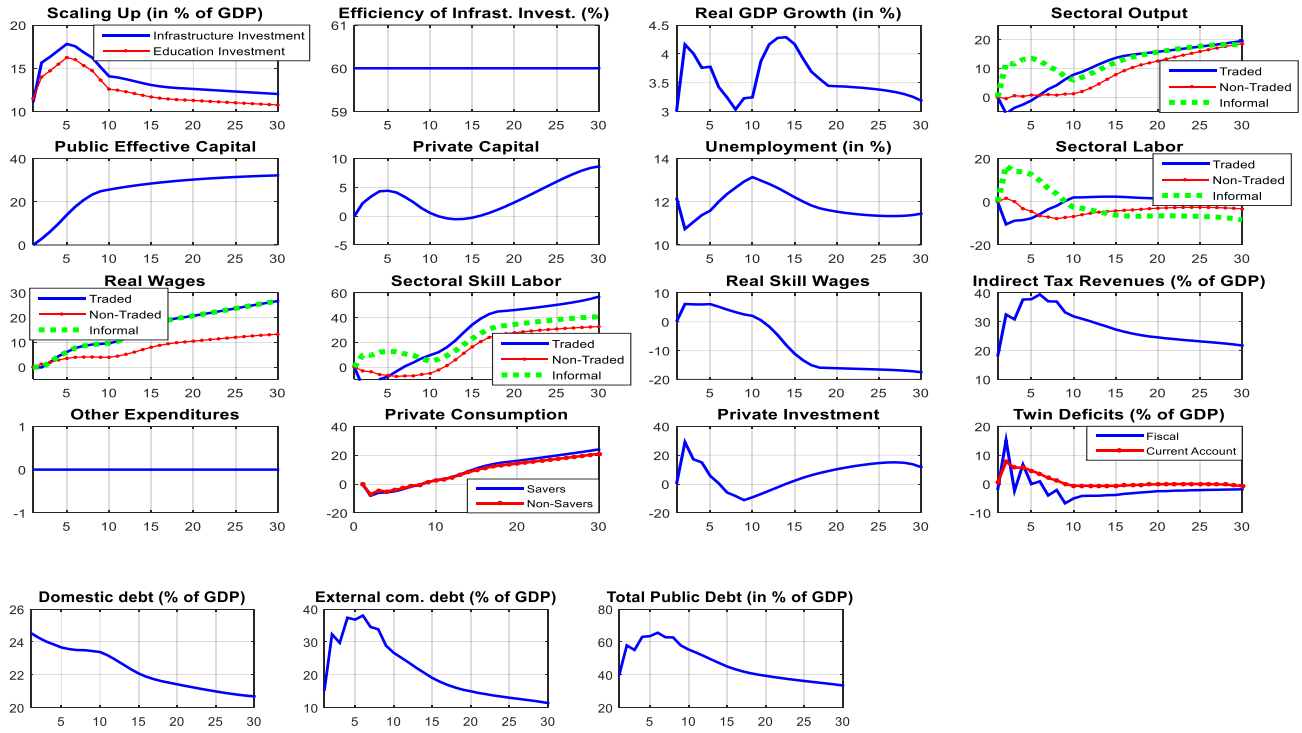
Financing through external commercial debt

Under this scenario, we assume that given the base case scenario, the government accesses additional resources in the form of external commercial borrowing to fill the financing gap (Figure 10). Given the access to additional resources, the fiscal adjustment is made easier in the initial years but become untenable in the medium run during the repayment phase. Accordingly, securing external commercial borrowing can ease fiscal adjustment with attendant distributional consequences. Indeed, there is a

reduction in the gap between the consumption profiles for the two types of household. Meanwhile, we find that external commercial borrowing creates a volatility in private investment. This volatility reflects the private sector sentiment vis-à-vis the government regarding the accumulation of external debt. Nonetheless, the upside of the long run fiscal adjustment is a debt dynamic that is shown to be sustainable; in fact, commercial public debt and total public debt as a share of GDP gradually decrease after 5 year and eventually return to their initial level or below. This reflect the incidence of the revenue and growth dividends that come with the public investment surge.

In summary, this alternative financing source goes a long way toward making the investment program fiscally viable. It indicates that in the short run policymakers can enjoy both higher growth (demand effect) and welfare improvement (less painful fiscal adjustment). However, in the long run, policymakers may face a trade-off between fiscal sustainability and social-friendly goals, especially when strong growth is not materialized.

Figure 10: Base case with financing through external commercial borrowing



Source: Authors' calculations
Note: The Y axis measure the growth of the variable, unless otherwise indicated. The X axis denotes the years. The transition paths when the government increase indirect taxes to finance the investment program.

II. Improving the efficiency and the rate of return to investment

The macroeconomic and fiscal impacts of public investment program can be significant if the government institutes reforms to enhance investment efficiency and the return to investment. Below we assume that the government undertakes reforms in view to remove bottlenecks that reduce the efficiency and public investment. In this regard, Collier et al. (2010) suggest if there are concerns about the efficiency, then the government could temporarily postpone investment and invest in capital that improves the country's

capacity to invest, or what is dubbed as "investing in investment". For instance, absent reforms that increase efficiency of infrastructure investment, it is optimal to invest only in human capital.

Economies' specific characteristics or initial conditions can alter the positive impacts of the government investment program. For instance, public investments can pay for themselves in the long run; the long run growth and revenue dividends can help avoid any unrealistic fiscal adjustment that hurt households purchasing power. The revenue dividends can also help contain vulnerability to debt distress. Meanwhile, the extent of the growth and revenue benefits depends on the efficiency of the public investment.

We study the dynamic implications of reforms that improve the efficiency and the return to public investment. We consider conditions that represent an optimistic scenario and compare with the base case scenario.

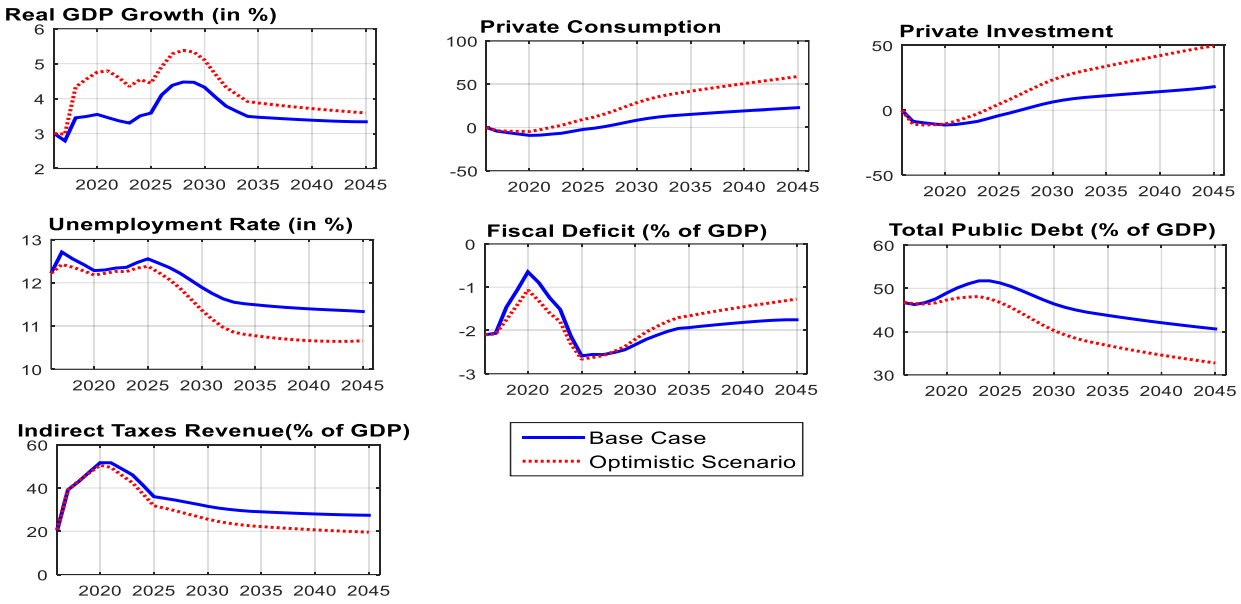
In the "optimistic scenario", the return on infrastructure investment is set at 40% versus 27% in the base case. The return on investment in education is set at 50% versus 35% in the base case. We assume that public investment is more efficient with 100% of investment expenditure being transformed into capital; we set efficiency parameter at 100% versus 60% according to our estimate (Table 2). In addition, the size of the scaling-up of public investment, the financing mode and fiscal adjustment are like those in the base case.

Table 3: Changing the structural conditions of the economy

	Return on infrastructure (***Rz***)	Return on basic education (***Rb***)	Return on upper-level education (***Ru***)	Efficiency of public investment (***s***)
Base case	27%	35%	35%	60%
Optimistic	40%	50%	50%	100%

Figure 5 displays the results associated with the "optimistic scenario" compared with the base case. Not surprisingly, the transition paths under the optimistic scenarios are encouraging compared to the base case. Specifically, the effective public capital as well as growth rate reach a much higher level and total public debt is at a lower level. Fiscal adjustment (revenue side) is less painful, with certainly some implication on inequality. The paths are notably better in the long run. Total private consumption is 35 percentage points higher by 2040 and private investment is more than 40 percentage points higher by the same year. The ratio total public debt is much lower during transition path and real GDP growth rate reaches a much higher level.

Figure 5: Base case with changing the structural conditions of the economy



Source: Authors' calculations
Note: The transition paths when the government increase indirect taxes to finance the investment program. Variables are expressed as percentage deviations from the initial steady state, unless otherwise noted.

We conclude that good institutional factors interfere significantly in the process of translating investment into capital stock and hence affecting growth and debt sustainability. It is critical that governments strive to improve the efficiency of the public investment, through structural reforms aimed at improving the institutional and regulatory frameworks of project selection and monitoring. Such reforms should include "investing in investing" or investment in capacities that foster new investments and institutional capacities (Collier, 2010).

Despite aid and Foreign Direct Investment, Africa is a net creditor to the rest of the world of valuable development finance once Illicit Financial Flows (IFFs)[6] are taken into account. Between 1980 and 2009, illicit transfers increased within a range of US $1.22 to $1.35 trillion, amounting to 6% of Africa's GDP.[7] IFFs end up weakening financial systems and reducing legitimacy of the state in the eyes of their citizens.[8]

In recent times, there have been pressures for public debt to rise. Figure 5 shows more than half of African countries saw a rise in the commitment of government. These have resulted in the in public debt – with a large component contracted from commercial space through multilateral agencies (see Figure 6). Bonds

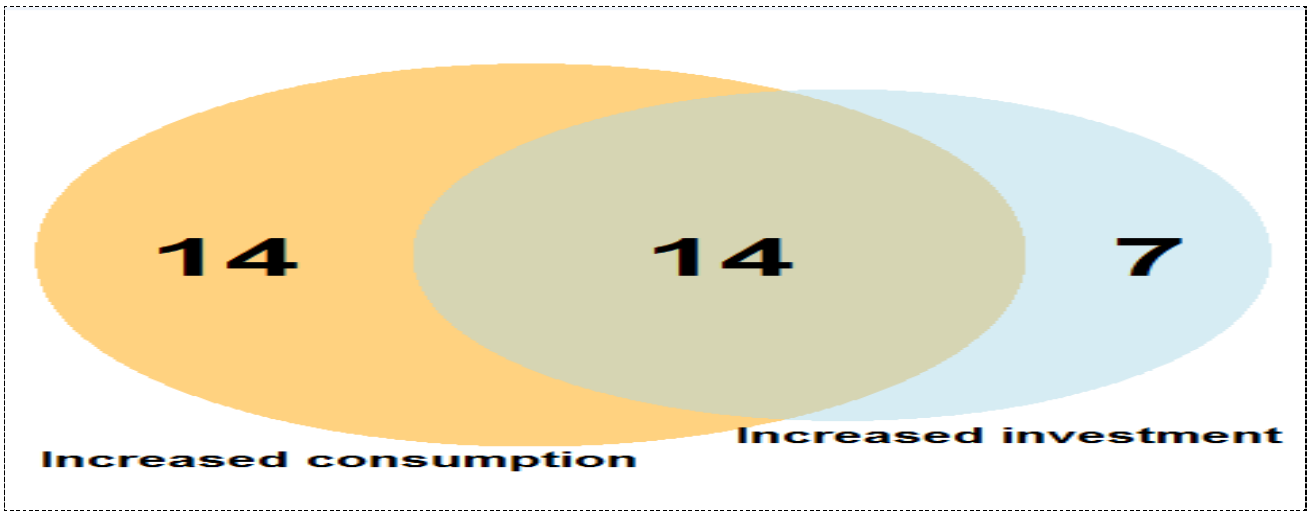
[6] Defined as "money that is illegally earned, transferred, or utilized, whereby somewhere at its origin, movement, or use, the money broke laws and hence it is considered illicit" Global Financial Integrity

[7] African Development Bank and Global Financial Integrity (2013):"Africa's Illicit Financial Flows: What do They Tell us?"

[8] The relevance of countering IFFs has been recognized by the international community: with a global commitment through the Sustainable Development Goals and the Addis Ababa Action Agenda, have committed to "redouble efforts to substantially reduce IFFs by 2030."

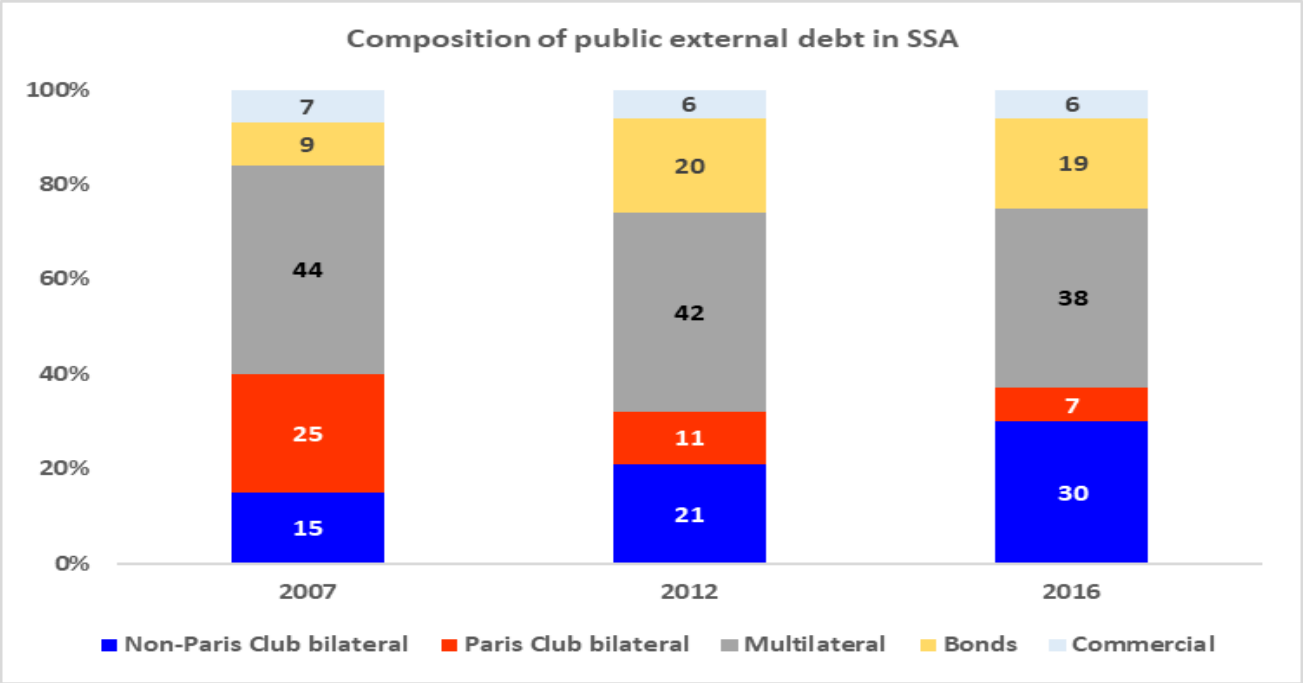
issuance have also been on the rise.

Figure 5: Number of countries with increases in government consumption, public investment, or both between 2013 and 2016



Source: Author's calculation. Sample excludes São Tomé and Príncipe, South Sudan, and Gambia due to data availability

Figure 6: Composition of public external debt



Source: AfDB Statistics Department

5. Policy recommendations

5.1 Policies for fiscal sustainability: what African countries and development partners should do.

- Strengthening **public investment management** through key measures; namely fact-based project selection using standardized technical and financial feasibility diagnostics; streamlining delivery of infrastructure by improving the rigor of project designs, contractor selection and management; and more effective use of existing infrastructure, via effective project monitoring, adequate maintenance, and cost-reflective infrastructure tariffs. Others include strengthening multiyear budgeting and infrastructure governance and technical capabilities. Diagnostics, such as public investment management assessments and public expenditure reviews should be undertaken periodically to inform requisite remedial reform measures. G20/DP countries can support African countries through building and strengthening technical capacity for project appraisals, as well as strengthening public sector capacity to oversee or implement large-scale infrastructure projects.

- Increasing **domestic revenue mobilization**, by shifting from commodity taxation towards more neutral, broad-based value-added or sales taxes and personal income tax. Simplifying the registration process for businesses, leveraging new technologies to modernize the tax collection system, deepening regional integration and tax coordination, are necessary elements of a broad-based strategy to broaden the tax base. G20 countries can support African countries to strengthen capacity for tax revenue mobilisation; e.g., design of new tax codes, digitisation of tax systems, including capacity to levy taxes on e-commerce and related transactions.

- **Increasing domestic savings** by improving monetary frameworks, supporting the development of long-term savings instruments, aligning exchange rates on their long-term sustainable level, and reducing monetary financing to tame inflation.

- **Developing and implementing fiscal rules** to reduce fiscal discretion and allow for more effective fiscal policy. Fiscal rules, if well designed and implemented, can help reduce the pro-cyclicality of government spending, encouraging savings accumulation during hay days.

5.2 Policy measures for debt sustainability

Recommendations to the G20 & other DPs on fiscal and debt sustainability

- Accelerate the projects on ***debt data reporting and standardization***. Support countries to establish publicly available debt registers; set up Debt Management offices, or strengthen capacity where the offices already exist; and ensure linkages between the debt management functions and other public finance management functions. Support development of medium term public investment programs that are linked to the raising of public debt.

- Support efforts by African countries to ***enforce compliance with taxation*** in face of domestic revenues

lost to profits shifting, and support DRM capacity development more broadly. This would require technical assistance in formulating revenue mobilization policies, attendant legislation and regulations. It would also require support with procurement of software for revenue recording and collection.

- Step up efforts to ***combat illicit capital outflows from Africa***, including helping track and repatriating illicit funds back to African countries. Support should be provided to assessing key risks relating to money laundering and illicit financial flows, and defining mitigation measures; building human and institutional capacity to uphold relevant laws, investigate suspicious activity and recover stolen assets; and providing the infrastructure necessary to track and report cash movements across borders.

- Ensuring ***that multilateral development institutions are adequately capitalized*** and can use their own resources - and the leverage their credibility affords - to offer countries alternative meaningful solutions to expensive or risky foreign-currency borrowing in international capital markets. Given their development mandate, political neutrality and strong technical expertise and due diligence capacity, multilateral financing is more likely to yield development benefits and have a catalytic role.

- ***Support countries to improve long-term debt management capacity, governance, and transparency including: Reviewing debt sustainability assessment methodologies*** to capture new realities, notably security-related expenditures and the quality of public investment, and take into account unique features of African economies, institutions and operations of various markets, including the financial and labour markets.

- ***Develop innovative tools to finance development.*** Support the development of African domestic capital markets, potentially through the introduction of African-wide safe assets, with senior tranches potentially guaranteed by the MDBs and marketed to international investors as a mezzanine, investment-grade exposure to frontier market debt.

- Put in place a ***framework for an orderly debt resolution mechanism*** in the context of more diffuse creditor base and other new features of the debt.

What African countries should do to improve debt sustainability

Emphasis should be placed on more effective and efficient use of debt, including through institutional and governance reforms to strengthen debt management and data transparency. The specific measures include:

- **Reduce reliance on risky and volatile debt sources.** Developing innovative and alternative mechanisms of development financing such as Public Private Partnerships, securitization of

infrastructure assets, privatization as recently demonstrated by Ethiopia. In addition, creation of an asset class for public projects, using the leverage afforded by safe capital from multilateral institutions is equally important. However, it is important to adequately quantify and mitigate the underlying fiscal risks from PPPs and government guarantees.

- **Increasing the maturity of external debt** when possible at reasonable costs, possibly making use of guarantees provided by multilateral institutions to tap liquidity at the long-end of the yield curve (20 to 30 year's bonds), on the model of Kenya's recent issue of a 30-year bond in February 2018.

- Using **more flexible, counter-cyclical and state-contingent debt instruments** to relieve the debt burden during recessions, through commodity hedging or GDP-indexed instruments. Key implementation challenges should be mitigated, notably the high liquidity and novelty premium charged at first issuance and the increased risk of moral hazard, especially when the borrower assumes excessive risks in the knowledge that relief will be provided.. Fiscal rules may also be considered in the management of windfalls.

- Developing **domestic safe assets** through enhanced credibility and independence of monetary and debt management authorities, with the support of the MDBs' debt management initiatives and technical assistance.

- **Greater transparency** in debt management, including commitment by governments to release in real-time all data on old and new debt from all sources. This will require efforts to standardize data gathering practices, develop data collection systems, address data gaps, notably in the accounting of SOE-related liabilities and contingent liabilities arising from sovereign guarantees to individual projects, and consolidate government accounts, across regional levels, agencies, ministries and institutions.

- **Designing standard terms and assisting African countries in negotiations over innovative sources of funding** that limit the need for foreign currency borrowing and exploit mutually advantageous exchanges, such as "Natural resources for infrastructure" bargains with traditional or new bilateral lenders. Attention should be paid to **crowding-in private capital through risk mitigation instruments** to unlock resources that can substitute debt. Multilateral lenders can provide benchmarks and guidelines, as well as low-risk financing tranches for long-term projects.

References

Afonso, A. (2005) “Fiscal Sustainability: The Unpleasant European Case”, FinanzArchiv / Public Finance Analysis, 2005, Vol. 61, No. 1 (2005), pp. 19-44

Balassone F, and Monacelli D (2000) “EMU fscal rules: is there a Gap?.” Banca d’Italia, Rome

Balma, L., and Gurara, D. “Public investment, time-tobuild, and fiscal stimulus”, Working Paper Series, 324, African Development Bank.

Barhoumi, K., Ha Vu, Shirin Nikaein Towfighian, and Rodolfo Maino. (2018). “Public Investment Efficiency in Sub-Saharan African Countries: What Lies Ahead?” IMF African Department Series No. 18/09, International Monetary Fund, Washington DC.

Berensmann. K. (2018). “The global debt governance system for developing countries: deficiencies and reform proposals”, in Third World Thematic: TWQ Journal.

Blanchard OJ (1990) Can severe fscal contractions be expansionary? tales of two small european countries: comment. NBER Macroecon Ann 5:111–116

Blanchard, O., J. C. Chouraqui, R. P. Hagemann, and N. Sartor (1990): “The Sustainability of Fiscal Policy: New Answers to an Old Question”, OECD Economic Studies, No. 15, pp. 7–36.

Bohn H (1998) “The behavior of US public debt and defcits”. Quarterly Journal of Economics 113(3):949–963

Buiter WH (1985) “A guide to public sector debt and deficits”, Economic Policy 1(1):13–61

Chibi, A., Chekouri, S.M and Benbouziane, M. (2019) “The dynamics of fiscal policy in Algeria: sustainability and structural change”, Journal of Economic Structures vol. 8(28). Available at: https://link.springer.com/content/pdf/10.1186/s40008-019-0161-3.pdf

Foster, V. and C. Briceño-Garmendia, 2010, Africa’s Infrastructure: A Time for Transformation, forthcoming (Agence Francaise de Developpement and the World Bank).

Hamilton, J. D. and M.A. Flavin. 1986. "On the Limitation of Government Borrowing: A Framework for Empirical Testing." The American Economic Review 76: 808-819.

Kararach, G., Kedir, A., Ajambo, E. and Souminen, H. (2017). “Fiscal Policy, Long-Term Growth and Structural Transformation in Africa”, in Lopes, Carlos, Hamdok, Abdalla, Elhiraika, Adam (Eds.), Macroeconomic Policy Framework for Africa's Structural Transformation, Palgrave Macmillan.

Krejdl A (2006) Fiscal sustainability: defnition, indicators and assessment of czech public fnance sustainability. Czech National Bank, Economic Research Department, Na Příkopě

Mendoza EG, and Oviedo PM (2003). Public debt, fiscal Solvency and macroeconomic uncertainty in emerging markets. Research Paper, Iowa University.

Mustapha, S., and A. Prizzon. (2018). “Africa’s Rising debt: How to Avoid a New Crisis.” ODI Briefing Papers.

Psacharopoulos, G. and H. Patrinos, 2004, “Returns to Investment in Education: A Further Update”. Education Economics 12, 111-134.

Rajan R.S., Giap T.K., Yam T.K. (2014) Fiscal Sustainability and Competitiveness: Definitions, Issues, and Measures. In: Fiscal Sustainability and Competitiveness in Europe and Asia. Palgrave Macmillan, London.

Roubini N (2001). Debt Sustainability: How to assess whether a country is insolvent. Stern Business School, Research Papers Series, New York University

Sarvi T (2011) Some approaches for assessing the sustainability of public finances. Master’s thesis. Aalto University School of Economics

Trehan, B., and C.E. Walsh. 1988. "Common Trends, The Government Budget Constraint And Revenue Smoothing." Journal of Economic Dynamics and Control. 425-444.

World Bank Group. 2018. Africa's Pulse, volume 18. Washington, DC: World Bank.

Appendix

Table A.1. Calibration of the Model

Parameter/Variable	Value in Base Case
Consumption shares of the imported consumer good and the formal and informal goods (γ_m,γ_n, γ_j)	$\gamma_n = .40$, $\gamma_m = .10$, $\gamma_j = .20$, $\gamma_x = 1 - \gamma_n - \gamma_m - \gamma_j = .30$
Intertemporal elasticity of substitution (τ)	.40
Elasticity of substitution between good x and goods n, j, and m (ε_1)	.5
Elasticity of substitution between the formal and informal traded goods (ε_2)	.5
Elasticity of substitution between the imported consumer good and the formal good (ε_3)	.5
Wages in the formal and informal sectors (w_s, w_n, w_j)	$w_s = 3$, $w_n = 1$, $w_j = .6$
Factor shares in the formal sector (α_n, θ_n)	$\alpha_n = .50$, $\theta_n = .30$
Factor shares in the informal sector (α_j, θ_j)	$\alpha_j = .20$, $\theta_j = .20$
Factor shares in agriculture (χ, α_x, θ_x)	$\chi = .30$, $\alpha_x = .20$, $\theta_x = .05$
Depreciation rates (δ, δ_z, δ_b, δ_u)	$\delta = \delta_z = \delta_b = \delta_u = .05$
Real interest rate on concessional + semi-concessional loans (r_d)	.013
Real interest rate on external commercial debt (r_{dc})	.06
Trend growth rate (g)	.023
Ratio of user fees to recurrent costs (f)	.5
Consumption VAT rates (h, g_j, g_x)[1]	$h = .20$, $g_j = .30$, $g_x = .10$
Taxes on profits, wages, and land rents (f_n, f_j, f_x, f_w, f_{wj}, f_{wx}, f_h)	$f_n = .15$, $f_j = .03$, $f_x = .02$ $f_w = .12$, $f_{wj} = f_{wx} = f_h = .01$
Efficiency of public investment (s)	1
Absorptive capacity constraint (ϕ)	0
Return on infrastructure (R_z)	.20
Real interest rate on domestic bonds (r)	.10
Real interest rate on foreign loans held by the private sector (r_f)	.10
Parameter/Variable	Value in Base Case
Interest elasticity of private capital flows (Γ)	1

Ratio of maintenance spending to GDP ($P_z m/GDP$)	.01644
Ratio of infrastructure investment to GDP ($P_z i_z/GDP$)	.06
Ratios of investment in education to GDP ($P_s i_b/GDP$, $P_s i_u/GDP$)	$P_s i_b/GDP$ = .028, $P_s i_u/GDP$ = .012
Ratio of domestic public debt to GDP (b/GDP)	.15
Ratio of private foreign loans and concessional and non-concessional public external debt (b_f, d, dc) to initial GDP	b_f/GDP = 0, d/GDP = .32, dc/GDP = .06,
q-elasticity of investment spending (Ω)	2.5
Return on maintenance relative to new investment in infrastructure (R_{mz})	R_{mz} = 1
Share of new high-skill workers drawn from the pool of low-skill workers in sector x-j (Δ_{xj}) and the fraction of newly created/vacant formal sector jobs filled by workers from sector x-j (ξ)	Δ_{xj} = .80, ξ = .5
Unemployment rate (u)	u = .06
Elasticity of the real wage in the formal sector with respect to the unemployment rate (g_3) and the real informal sector wage (g_2)	g_2 = .1, g_3 = .5
Cost shares of nontraded inputs in the production of capital goods (α_{ij}, α_{in}, i =s, z, k)	$\alpha_{kj} = \alpha_{zj}$ =.35, $\alpha_{kn} = \alpha_{zn}$ = .15 α_{sj} =.60, α_{sn} = .20
Returns to education (R_u, R_b)[2]	R_u = .30, R_b = .30
Ratio of elasticities of sectoral output with respect to the stock of infrastructure (ψ_n/ψ_x, ψ_j/ψ_x)	1
Long-run targets for domestic debt (b_{target}) and external commercial debt (dc_{target})	$b_{target} = b_o$, $dc_{target} = dc_o$
Division of fiscal adjustment between expenditure cuts and tax increases (λ)	.5
Residual financing of the fiscal gap (λ_{dc})	.30

Source: Authors