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Public Investment Efficiency, Economic Growth and Debt Sustainability in Africa

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Abstract

Investment is an important driver of economic growth with important implications for debt sustainability. Investment efficiency gaps adversely impact debt sustainability in Africa. The current heightened fiscal vulnerabilities can be attributed to external factors including volatile commodity prices particularly for commodity-exporting countries and health challenges like COVID-19 pandemic that weakened fiscal revenues and growth. In addition are 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. Using a dynamic stochastic general equilibrium (DSGE) framework, we estimate the role of debt in the provision of productive investments, driving economic growth and subsequent debt sustainability. To entrench fiscal sustainability, countries need to strengthen domestic resource mobilization and improve public investment management for greater efficiency. Measures to increase tax revenue collections, savings mobilization and efficiency of public spending are therefore 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.

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Public Investment Efficiency, Economic Growth and Debt Sustainability in Africa

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1. Introduction

The role of public investments in economic growth is rather well known in the economic literature. However, increased public investment may result to reduced output gains if efficiency in the investment process is not enhanced. Public investment efficiency gains can contribute to achieving stated development aspirations — particularly in developing countries characterized by limited resources. According to a 2013 McKinsey report, there is ample room to improve the effectiveness and efficiency of infrastructure investment. For example, up to 38 percent of global infrastructure investment is not spent productively because of inefficiencies. The efficient provision of public infrastructure can reduce spending by more than $1 trillion a year for the same amount of infrastructure delivered — and the savings can help in closing the SDG financing gap (McKinsey, 2013).

The link between efficiency[2] and public investment is critical in the context of poor governance and rudimentary public investment systems. Public sector corruption put unnecessary strain on resources and efficiencies. Corruption alters decision making processes connected with public investment projects (Anyanwu, 2020). Tanzi and Davoodi (2000) assert that corruption can affect investment in at least two ways; (a) through the size of public investment, and (b) the quality of investment decisions and investment projects. An investor needs to exercise careful judgement on the risks and constraints likely to affect the project before choosing the relevant entry points.

Unsustainable debt burdens are of great concern to developing countries and moreover, debt crises due to fiscal inefficiencies are a recurrent phenomenon. Jalles (2011) examined the role of corruption in the association of public debt with economic growth for a panel of developing countries over the 1970- 2005 period. The results showed that countries with lower corruption are able to use and manage their debt better. Melecky (2012) points out that good public debt management can reduce borrowing costs and curb financial risks - but largely appear in countries with good quality institutions. Megersa and Cassimon (2015) studied some 57 developing countries and found that debt is detrimental for growth, however, harm is reduced with quality public sector management. Cooray et al. (2017) examined the relationship between corruption and public debt in

[2] Investment efficiency is a function of the risk, return and total cost of an investment management structure, subject to the fiduciary and other constraints defining the investor's operational limits. Investment efficiency should be considered as a combination of financial efficiency and non-financial efficiency.

106 countries over 1996-2012 and found that increased corruption leads to an increase in public debt by speeding up misallocation of resources and enhancing other leakages such as illicit financial flows that force government to increase its spending, divert resources, and create or widen the deficit.

Unfortunately, less focus has been paid to possible interactions between government spending efficiency, public investment and public debt. This is important because public investment will continue to be fundamental in financing development goals which has the tendency to raise debt ratios. Addressing spending inefficiencies is critical— countries need to spend not only more, but better. It is generally accepted by most commentators that countries could make significant savings through efficiency improvements. In several countries, increased public investment does not lead to productive capital (Pritchett 1996).

Following on from the above, 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 managed well. 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 March 2020.

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.

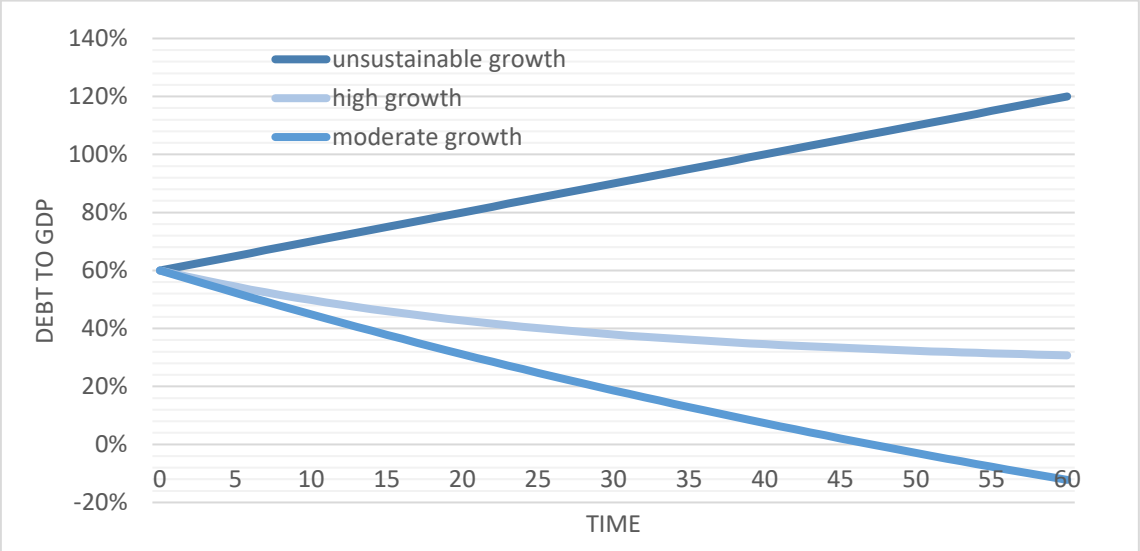
The analytical starting point in assessing fiscal sustainability begins with the government's intertemporal budget constraint:

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

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[3] 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.

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 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 small fiscal deficit of 1% can quickly increase debt over time given sluggish economic growth.

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



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

Over the years the IMF and World Bank (IMF-WB) have perfected the debt sustainability analysis framework (DSA) to identify excessive borrowing that undermines macroeconomic stability. The DSA has helped countries to monitor their risks of debt distress, though it has been criticized for various reasons (Buffie et al., 2012). For example, the existing joint World Bank (WB)-IMF Debt Sustainability Framework (DSF) does not distinguish debt directed to productive investments. Wyplosz (2007) argued that the IMF-WB DSA analysis does not adequately consider the link between public investment and growth; it does not capture some key factors concerning the structure of a country's economy, such as the absorptive capacity of the country, efficiency of public investment, and the return on infrastructure which have enormous impact on the outcome of public investments. The DSA also assesses the evolution of a number of economic variables without paying much attention to the non-stationarity inherent in such time series. This paper contributes to the debate by examining the effects of investment efficiency gaps on economic growth and the evolution of debt and its possible sustainability.

Consequently, the purpose of this paper is to empirically investigate the following hypothesis: the interaction of public investment and government spending efficiency tends to decrease debt ratios. This paper assesses the fiscal and debt sustainability in Africa under different shocks regimes including the COVID-19 shock and implications for investment efficiencies. The rest of this paper is organized as follows. Section 2 highlights relevant literature and Section 3 summarizes recent trends in the main fiscal and debt variables in Africa. Section 4 assesses fiscal and debt sustainability under different fiscal shocks, whereas Section 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, they define sustainable fiscal policy as one through which 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 the 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 above. 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 case 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:

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

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:

$$\lim_{T\to\infty}\left[d_T\left(\frac{1 + r_t}{1 + g_t}\right)^{-T}\right] = d_0 + \lim_{T\to\infty}\left[\sum_{t=1}^{T} p_t\left(\frac{1 + r_t}{1 + g_t}\right)^{-t}\right] \quad (2)$$

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:

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

Equation (3) 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 (3). 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 (3) 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 are prone to. We return to some of these discussions in Section 4.

Moreover, there is a burgeoning literature on the interplay between debt, investment and economic growth in the context of debt sustainability analysis. Melina et al (2016) show how scaling up public investment in resource-rich developing countries generates the possibilities of debt sustainability. Their study captures pervasive problems of these countries that may be aggravated during scaling-ups, including investment inefficiency and limited absorptive capacity. Critically, investment can be jointly financed by resource revenues and debt; a resource fund may be used as a buffer; and distorting fiscal adjustments are subject to feasibility constraints, Buffie et al. (2012) identify the various transition problems and adjustments paths countries go through as they step up public investments and at the same time seeking debt sustainability.

Delong and Summers (2012) and Abiad et al. (2015), present a slightly different theoretical framework for understanding the effect of public investment on output growth and public debt and how public investments can raise output and be self-financing in the long run. An increase in public investment boosts aggregate demand through the short-term fiscal multiplier, and the magnitude varies with the state of the economy (Auerbach and Gorodnichenko, 2013). This, in turn, affects the debt-to-GDP ratio, which could increase or decrease depending on the magnitude of the fiscal multiplier and the elasticity of revenue with respect to output. As demonstrated in Abiad et al.

(2015) and Delong and Summers (2012); in the short term, an increase in public investment as a share of potential GDP (ΔI) (leads to a change in the debt-to- potential GDP ratio (Δd_{t-1}) given by:

$$\Delta d_{t-1}=(1-\mu\tau)\Delta I. \quad (4)$$

In which μ is the fiscal multiplier and τ is the marginal tax rate

The efficiency of public investment is central to determining the size of the fiscal multiplier and the elasticity of revenue with respect to output. Inefficiencies in the public investment process, such as poor project selection, implementation, and monitoring, can result in a fraction of public investment turning into productive infrastructure, undermining the long-term output gains (Pritchett 2000). Public investment efficiency contributes to higher output by increasing the stock of capital. The extent to which increases in public capital can raise output is a key factor in determining the sequence of public debt-to-GDP ratio. Over time, the increase in public capital will affect the debt-to-GDP ratio by affecting annual debt-financing burden, which is equal to the difference between the real government borrowing rate (r) and the real GDP growth rate (g) multiply by the initial change in the debt-to-GDP ratio:

$$(r - g)\,\Delta d_{t-1} = (r - g)\,(1 - \mu\tau)\Delta i \quad (5)$$

How the financing burden will affect the debt-to-GDP ratio in the long term depends on the parameters of equation (6) and the elasticity of output to public capital, ε. In the long term, an increase in public investment may lead to an increase in output (Y), which will generate long-term future revenues:

$$\tau\Delta Y = \tau\varepsilon yo\Delta I \quad (6)$$

Where ε is the long-term elasticity of output to public capital and is the initial output-to-public capital ratio. Equations (5) and (6) jointly imply that if the returns to public capital (short-term multipliers and the elasticity of output to public capital) are e large enough, such that:

$$(r - g)\,(1 - \mu\tau) - \tau\varepsilon yo\Delta I \leq 0, \quad (7)$$

Then an increase in public investment will be self-financing – implying debt is becoming more sustainable.

Some innovations have been made to the above formulations by authors such as Jakab and Kumhof (2015) using the stock-flow-cash framework. In their formulation multiplier result from bank money creation and subsequent lending behaviours. They argue that the key function of banks is the provision of financing, or the creation of new monetary purchasing power through loans, for a single agent that is both borrower and depositor. The bank therefore creates its own funding, deposits, in the act of lending, in a transaction that involves no intermediation whatsoever. Third parties are only involved in that the borrower/depositor needs to be sure that others will accept his new deposit in payment for goods, services or assets. This is never in question, because bank deposits are any modern economy's dominant medium of exchange. Furthermore, if the loan is for physical investment purposes, this new lending and money is what triggers investment and therefore, by the national accounts identity of saving and investment (for closed economies), saving. Saving is therefore a consequence, not a cause, of such lending. Saving does not finance investment, financing does. McLeay et al. (2014) note that the SFC approach to investment dynamics provides a realistic approach to a modern financial system. Our concern here is the influence of investment multiplier resultant of any efficiency and how that interact with economic growth and debt sustainability.

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 deficit (expenditures and revenues), interest payments and public debt.

3.1 Fiscal deficit in Africa

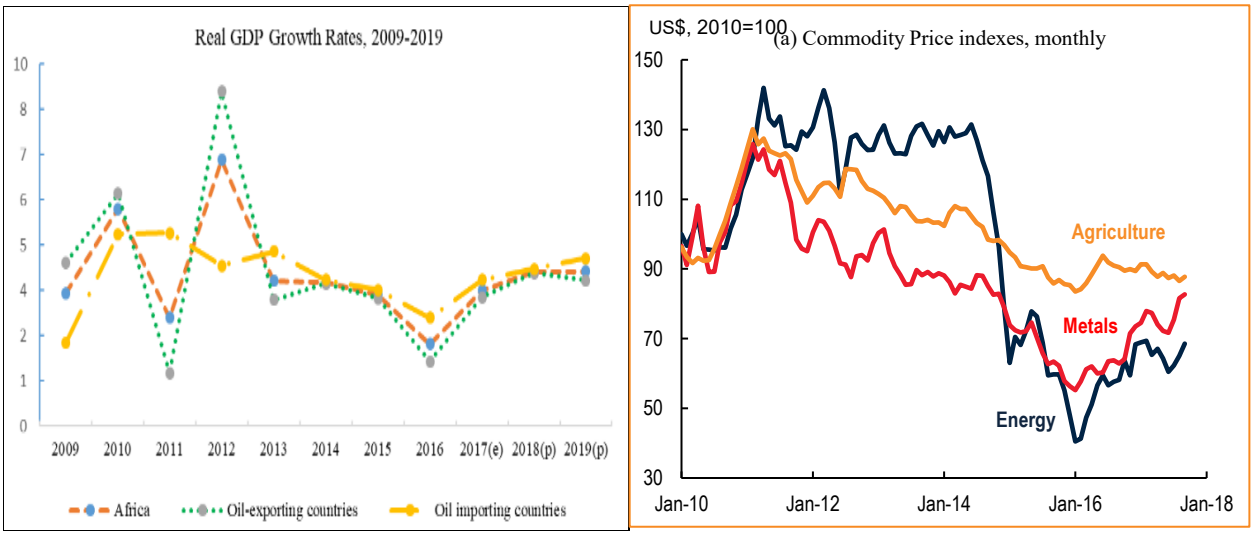
Fiscal deficits in many countries have deteriorated in the recent past following sustained reductions in commodity prices since 2014 (see Figure 2). While commodity prices decreased across the board, reduction in oil prices were most rapid and adverse. Consequently, and as shown in Figure 2, real GDP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

exporting, African countries. Net oil exporters[4] recorded a growth of 1.7 percent in 2016 compared to 2.9 percent for net oil importers in the same year[5].

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[6], 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 primary balances. As real GDP growth slowed down after 2010, the deficit widened (panel c) – and the fall in the primary balance was steeper for oil-exporters (panel d). The impact of commodity price improvements of 2011/12 (panel b) on real growth (panel a) was not long-lasting even for oil-exporting countries.

Figure 2: Fiscal deficit and related drivers in Africa

(a) Real GDP Growth **(b) Commodity prices**

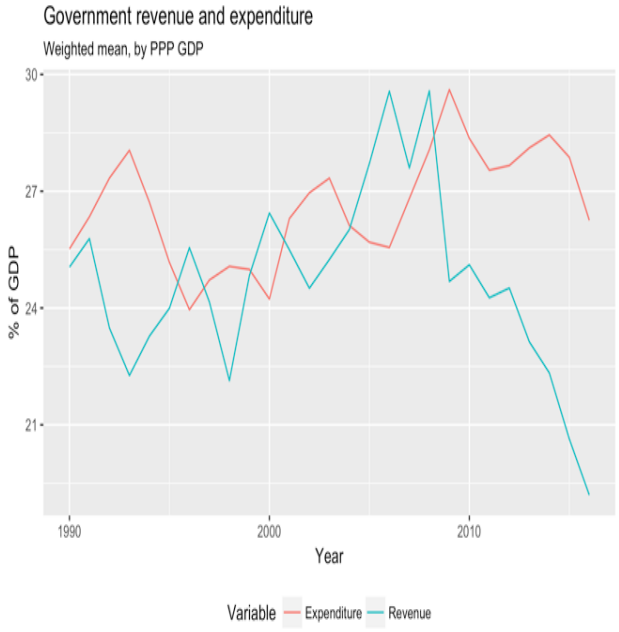


[4] The group of oil exporting countries include, Algeria, Angola, Cameroon, Chad, Congo, Democratic Republic of the, Congo, Republic of, Côte d'Ivoire, Egypt, Equatorial Guinea, Gabon, Libya, Nigeria, South Sudan, Sudan.

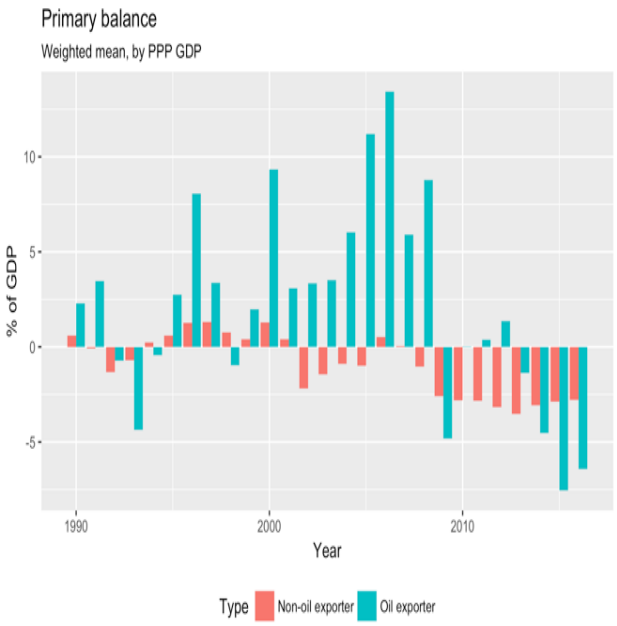
[5] Between 2015 and 2017, growth in real GDP in Nigeria for instance (one of the major oil exporters in Africa) averaged only 0.7 percent compared to an average growth of 6.3% recorded during the 2010-2014 period. Falling oil prices led to sharp fall in fiscal revenues since revenues from oil exports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

[6] 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.

(c) Government revenue and expenditure



(d) Primary fiscal balance



Source: AfDB Statistics Department

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 1990's, growth in public debt started after the 2008 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 3).

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 3 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. Since 2010, fragile states in Africa (Figure 3 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.

Figure 3: Public debt accumulation in Africa

Source: AfDB Research Department

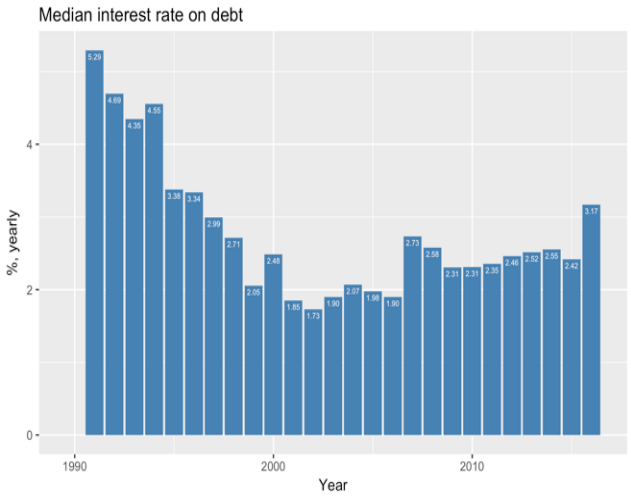
3.3 Interest payments

Africa's increased reliance on external commercial financing has raised the cost of debt servicing. As illustrated by Figure 4, interest payments have rapidly risen in recent years. The rise in interest costs has been faster for public debt compared to private debt contracted over the same period (see

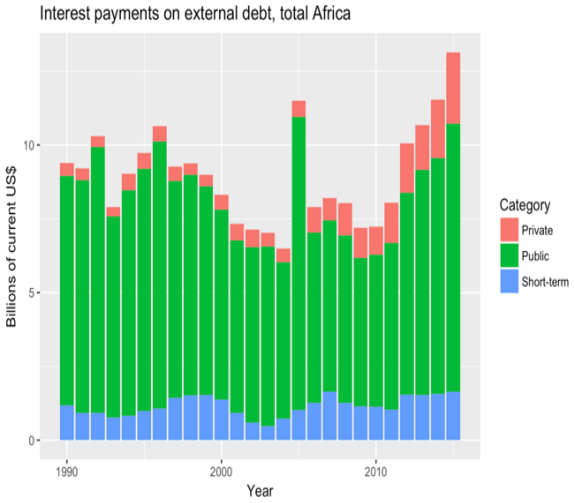
Figure 4 panel b), showing an increasingly tighter financing environment for African sovereigns compared to the private sector.

Figure 4: 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

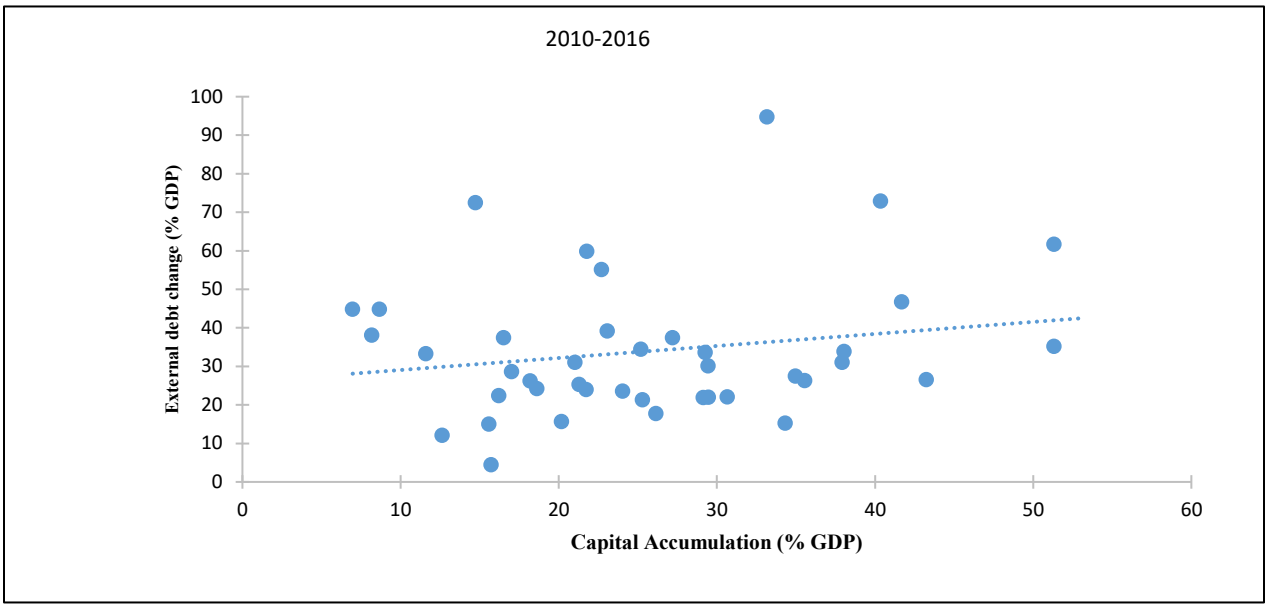
	Modified Phillips-Perron	Phillips-Perron	Augmented Dickey-Fuller t
Africa	-11.63**	-11.28**	-10.61**
Oil exporters	-4.87**	-5.04**	-5.37**
Fragile countries	-6.71**	-5.91**	-6.50**

Source: Authors' 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 5 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 5: Debt is associated with increased public investments in Africa



Source: AfDB Research Department

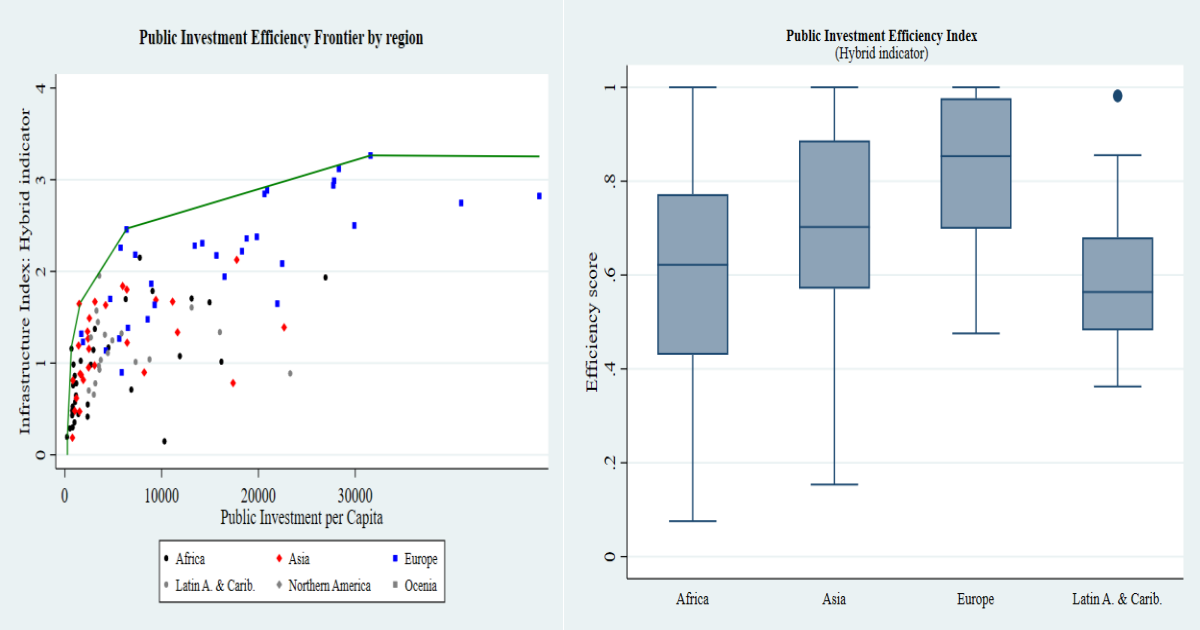
Despite evidence that debt has been used for investment purposes in Africa, the standardized IMF-WB debt sustainability framework does not take sufficiently into account the relationship between public investment and growth and the growth-promoting properties of well-executed investment programs. That 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 6). This is higher compared to 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.

However, the estimated efficiency gap of 39% masks important heterogeneity across the 32 African countries in the sample (see Figure 7). 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%.

Figure 6: Public infrastructure investment efficiency: Hybrid indicator



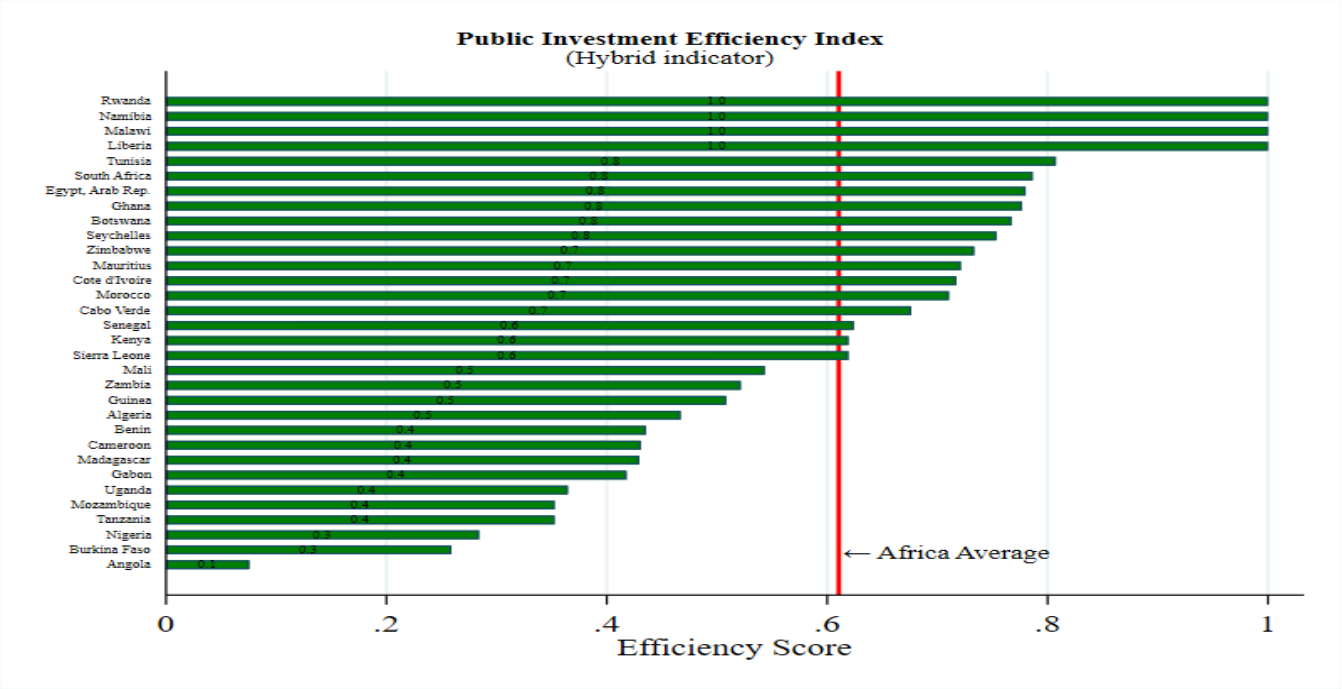
Source: Authors' estimates
Note: The hybrid indicator of efficiency accounts for both quality and physical indicator

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 delays in the implementation of projects, which create inefficiencies in public expenditure (Balma and Gurara, 2019). These delays are often due to weaknesses in coordination across different levels of government and low absorptive capacity resulting from weak planning and oversight, among others. In short, state capabilities play an important role in maximizing public expenditure efficiencies and mobilizing further investments.

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 7: 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 using a dynamic stochastic general equilibrium (DSGE) framework. The model is calibrated to the average for Africa and used for public investment and financing scenarios. A key advantage of DSGE models is that they share core assumptions on the behaviour of households and firms, which makes them easily scalable to include details that are relevant to address the question at hand. A short description of the general structure of the model and transmission mechanisms is presented in Box 1.

4.3.1 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 dynamic stochastic general equilibrium 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 labour in the different sectors, including in the informal sector. Second, it increases the supply of high skill labour into the different sectors of the economy. Finally, educational capital has a complementarity effect on physical capital by providing skilled labour to the different sectors of the economy and loosening absorptive capacity constraints. When skilled labour is in scarce supply, higher demand for skilled labor when public investment is scaled up will shift labour from one sector to another, put pressure on real wages and create a situation which is not pareto optimal for the economy.

Labour market

The labour 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 labour 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 labour enters the labour 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 labour 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; (ii) rationalizing expenditures; and (iii) 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.

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 a mixed program where investment in

infrastructure, upper-level education, and basic education increase by 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 of 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: $\Delta T/GDP_0$	-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

Short-and medium-run dynamics

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.

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

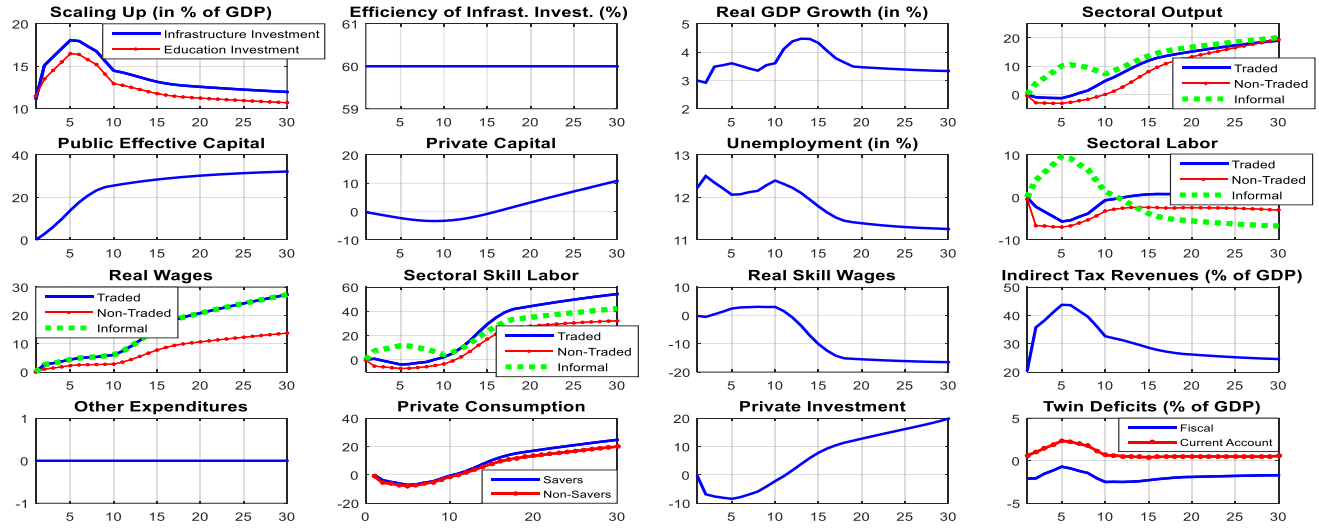
includes an efficiency parameter which takes its values between 0 and 1. The baseline calibration of this parameter is informed by our estimate of the efficiency score discussed in previous sections.

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 8: Base Case: Combined infrastructure and human capital investment



Source: Authors' calculations

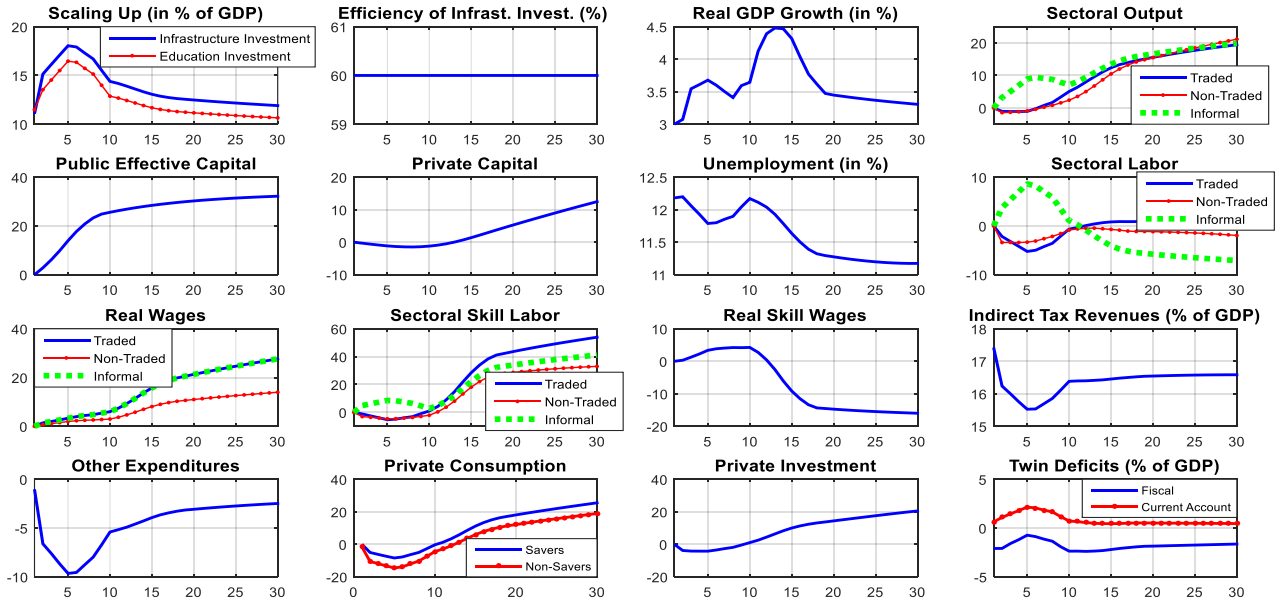
Note: The Y axis measure the growth of the variable, unless otherwise indicated. The X axis denotes the years. The transition paths when the government increase indirect taxes to finance the investment program.

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 9 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 9: 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

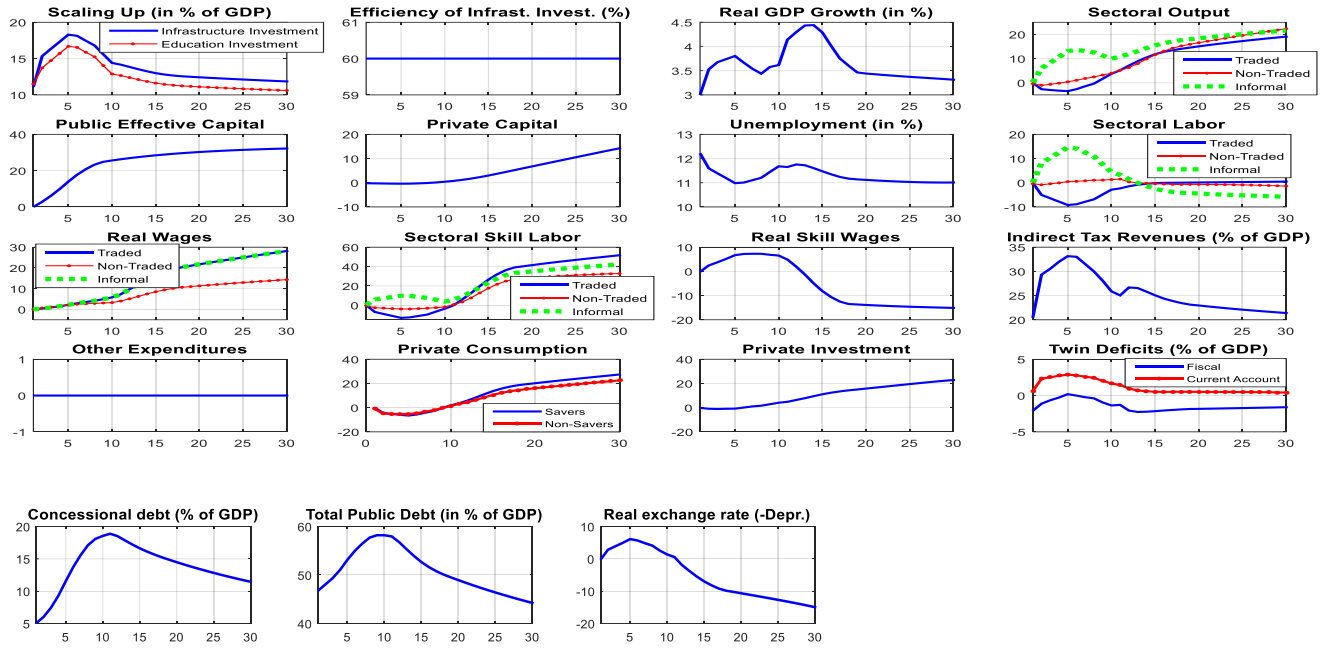
Financing through grants and concessional debt

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 10). 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 10: 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.

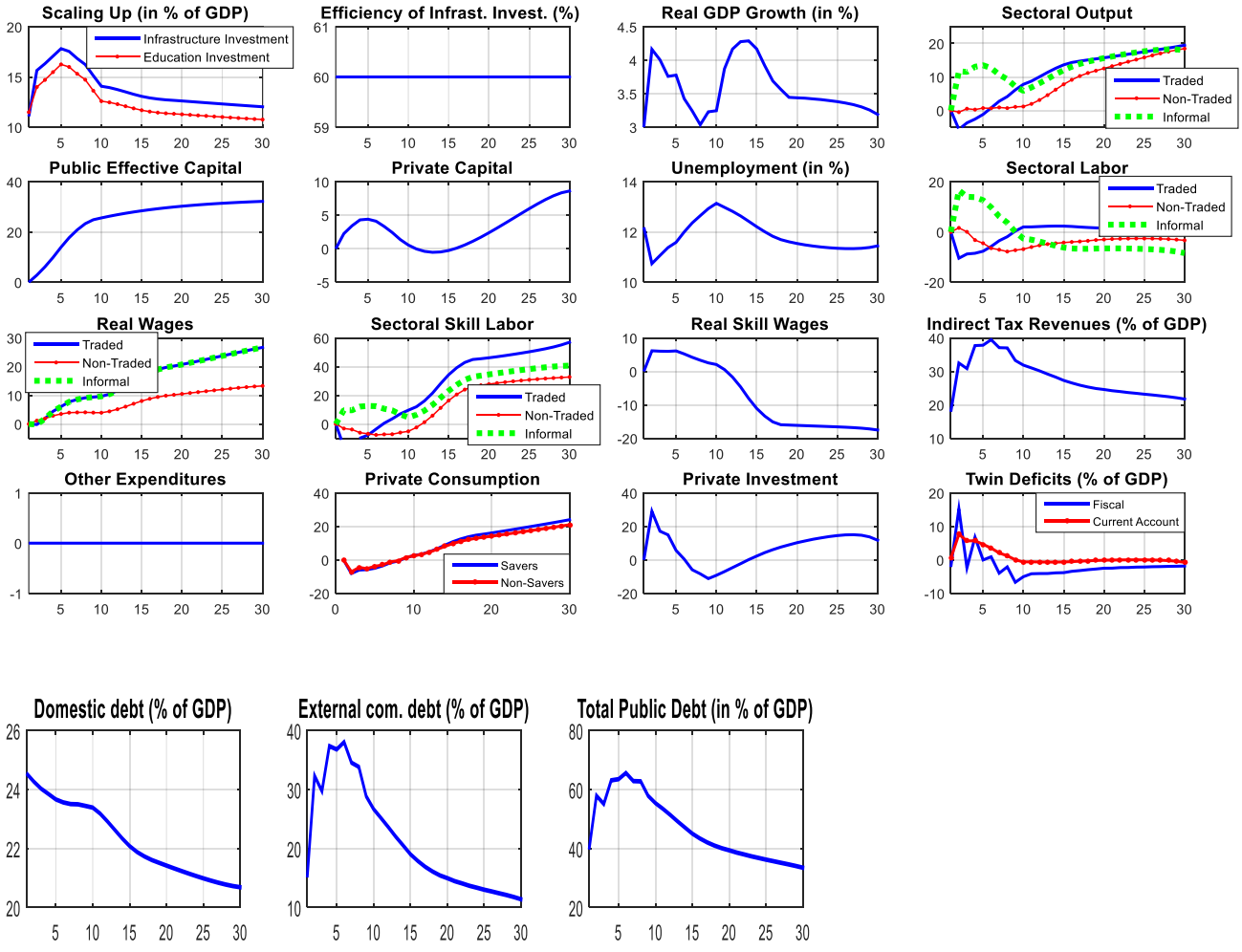
Financing through external commercial debt

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 11). 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. For example, real skilled wages decline in about 20 years and real GDP growth eventually slows down.

Figure 11: 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.

Specific characteristics or initial conditions of an economy 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.

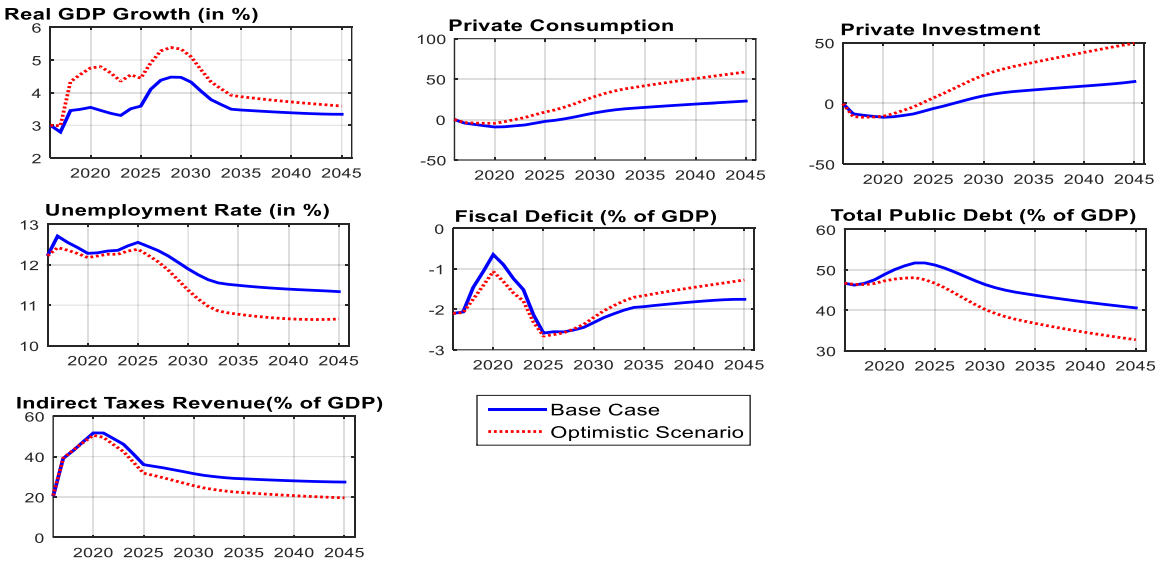
In the "optimistic scenario", the return on infrastructure investment is set at 40% versus 27% in the base case. The return on investment in education is set at 50% versus 35% in the base case. We assume that public investment is more efficient with 100% of investment expenditure being transformed into 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 12 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 12: Base case with changing the structural conditions of the economy



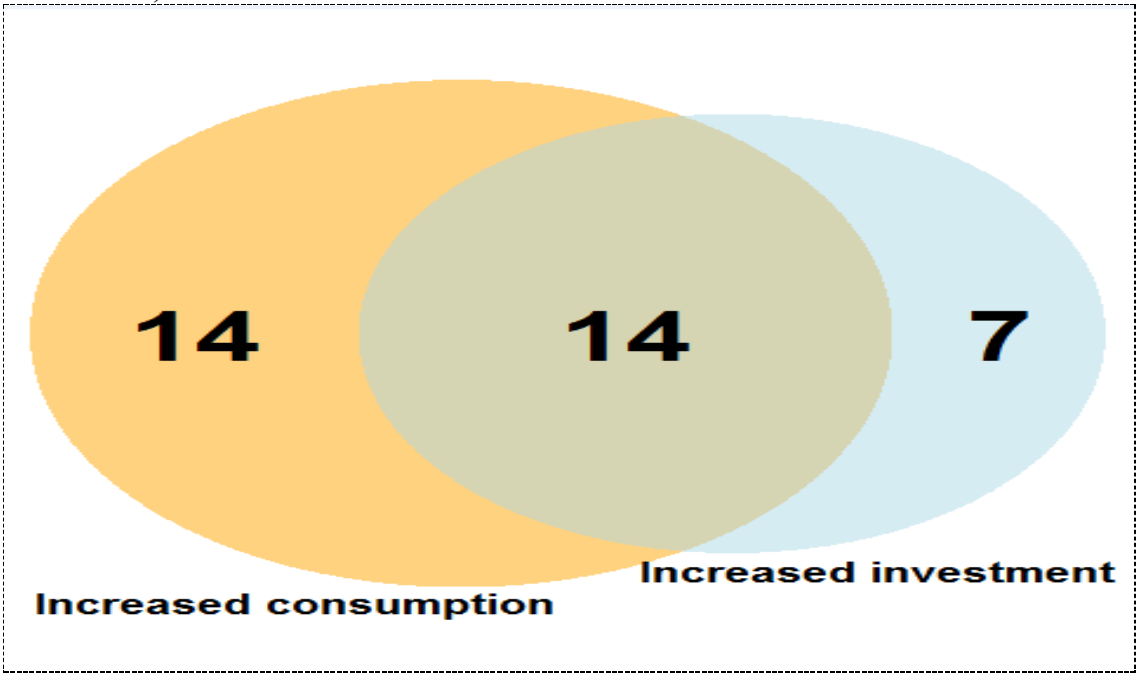
Source: Authors' calculations
Note: The transition paths when the government increase indirect taxes to finance the investment program. Variables are expressed as percentage deviations from the initial steady state, unless otherwise noted.

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)[7] are considered. 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.[8] IFFs end up weakening financial systems and reducing legitimacy of the state in the eyes of their citizens.[9]

In recent times, there have been pressures for public debt to rise. Figure 12 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 13). Bonds issuance have also been on the rise.

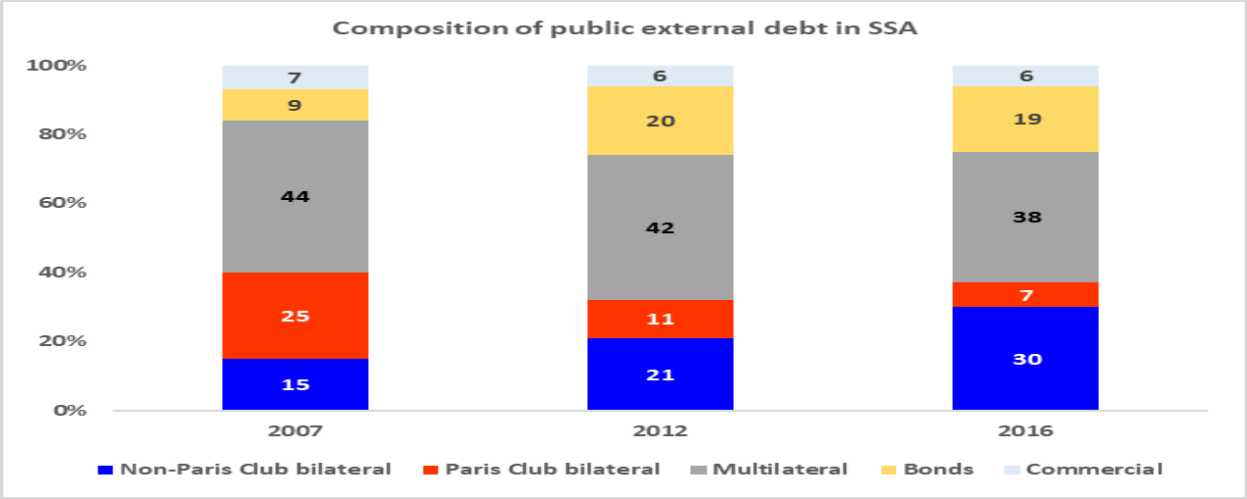
Figure 13: Number of countries with increases in government consumption, public investment, or both between 2013 and 2016



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

[7] 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
[8] African Development Bank and Global Financial Integrity (2013):" Africa's Illicit Financial Flows: What do They Tell us?"
[9] 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."

Figure 14: Composition of public external debt



Source: AfDB Statistics Department

5. Policy recommendations

The policy recommendations are clustered around five key actions, namely, deficit and public debt financing mechanism have implications and these should be considered, prioritization of actions is critical, governance and structural reforms are equally important, public investment management (PIM) increases returns on investment; domestic resources mobilization (DRM) is complementary to PIM and development partners have a role to play in supporting countries to improve fiscal and debt sustainability.

Financing, including deficit and public debt, mechanisms have implications, which calls for paying attention to the fiscal space-rest of the economy nexus for optimal policy responses. Measures to expand the fiscal space either through public revenue mobilization or scaling back on public spending have diverse implications on welfare e.g. through private consumption and unemployment; private investment and returns to factors of production. Consequently, thorough analyses of proposed actions and their impact on the economy are necessary to inform the choice and prioritization of reform actions.

Prioritization is important and policy reforms should be sequenced for maximum development impact. In the short-term, the proposal is to use concessional financing and earmark non-concessional borrowing for high-return transformative projects. In addition, DRM and PIM offer immediate opportunities for fiscal and debt sustainability. In the medium- to longer-term, reforms

to improve the business regulatory environment and investment climate are necessary to crowd-in private investment and finance.

Governance and structural reforms, with emphasis on strengthening institutions and improving regulatory frameworks to improve competition in key economic sectors like finance, telecommunications, logistics and others will catalyze private investment and finance and increase the returns on investment. Governance reforms can also trigger the development of innovative and alternative mechanisms of development financing such as Public Private Partnerships, securitization of infrastructure assets, privatization will reduce reliance on risky and volatile debt sources. However, it is important to adequately quantify and mitigate the underlying fiscal risks from PPPs and government guarantees. 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 and bolster savings accumulation. Adopting more flexible, counter-cyclical and state-contingent debt instruments to relieve the debt burden during recessions, through commodity hedging or GDP-indexed instruments is an imperative. Greater transparency in debt management, notably in the accounting of SOE-related liabilities and contingent liabilities is equally important.

Improvements in public investment management, ranging from fact-based project selection to streamlined delivery and infrastructure governance are key imperatives. The action actions include 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.

Domestic resources mobilization is complementary to PIM. Reforms on the public revenue side should focus on making it harder to avoid/ evade taxes but easier to comply. Increasing **domestic revenue mobilization**, by shifting from commodity taxation towards more neutral, broad-based value-added or sales taxes and personal income tax will diversify the revenue base and support progressivity of the tax system. 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. In addition, **domestic savings** can be bolstered by improving monetary frameworks, supporting the development of long-term savings instruments, aligning exchange rates to their long-term sustainable level, and reducing monetary financing to tame inflation. Creation of an asset class for public projects, using the leverage afforded by safe capital from multilateral institutions is equally important. Indeed, there is an emergent literature on tax cut versus government spending as policy tools to complement domestic resource mobilisation. The business cycle literature in this context seems to suggest that tax-cuts are more effective in stimulating economic activity. In this line of literature, economists and policymakers have been debating the relative importance of tax cuts versus higher government spending. This line of thought can also be used to extend the current debate especially on fiscal deficit-investment-growth linkages.

Development partners have a significant role to play, including supporting reforms to the international debt architecture, supporting governance reforms, combatting illicit financial flows and contributing to the development of innovative financial instruments. The specific actions are listed below:

- **Support reforms to improve the debt architecture**, including 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. MDBs should also champion a *framework for*

an orderly debt resolution mechanism in the context of more diffuse creditor base and other new features of the debt.

- Accompany African countries to ***enforce tax compliance*** in face of domestic revenues lost to profit 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 to assess key risks relating to money laundering and illicit financial flows, building human and institutional capacity to enforce relevant laws, investigate suspicious activity is critical and will help to inform mitigation measures. Assistance to recover stolen assets and providing the infrastructure to track and report cash movements across borders is equally important.
- ***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 multilateral development banks (MDBs) and marketed to international investors as a mezzanine, investment-grade exposure to frontier market debt. Multilateral lenders can provide benchmarks and guidelines, as well as low-risk financing tranches for long-term projects.

References

Abiad, A., Furceri, D. and Topalova, P. (2015). "The Macroeconomic Effects of Public Investment: Evidence from Advanced Economies." IMF Working Paper 15/95. International Monetary Fund.

Auerbach, A. and Gorodnichenko, Y. (2013). "Measuring the Output Responses to Fiscal Policy." American Economic Journal: Economic Policy 4 (2): 1–27

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

Anyanwu, A.A. (2020). "Debt-financed public investment in developing countries: Does the efficiency of public investment matter?", Mimeo, United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, Thailand.

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-to build, 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.

Beqiraj, E., Fedeli, S.; and Forte, F. (2018). "Public debt sustainability: An empirical study on OECD countries", Journal of Macroeconomics, volume 58: 238-248,

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):949–9

Buffie, E.E, Berg, A., Pattillo,C., Portillo, R. and Zanna, L.F. (2012). 'Public Investment, Growth, and Debt Sustainability: Putting Together the Pieces", IMF Working Paper WP/12/144

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

Cooray, A., Dzhumashev, R. and Schneider, F. (2017). "How Does Corruption Affect Public Debt? An Empirical Analysis." World Development 90: 115–127.

DeLong, J. B., and Summers, L.H. (2012), "Fiscal Policy in a Depressed Economy", Brookings Papers on Economic Activity, 233–297.

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.

Jakab, Z. and Kumhof, M. (2015). "Banks are not intermediaries of loanable funds — and why this matters", Bank of England Working Paper No. 529.

Jalles, J.T. (2011). "The impact of democracy and corruption on the debt-growth relationship in developing countries", Journal of Economic Development 36: 41–72.

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.

Knutsson, A. (2021). "Analyzing The Sustainability of Swedish Fiscal Policy Johansen cointegration approach", Magister thesis, 15 hp Master program in Economics, 120 hp Spring term, UMEA University.

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

Llorca, M. (2017). External Debt Sustainability and Vulnerabilities: Evidence from a Panel of 24 Asian Countries and Prospective Analysis. ADBI Working Paper 692. Tokyo: Asian Development Bank Institute

Magazzino, C.; Brady, G.L. and Forte, F. (2019). "A panel data analysis of the fiscal sustainability of G-7 countries", The Journal of Economic Asymmetries, volume 20.McKinsey Global Institute (2013). Infrastructure productivity: How to save $1 trillion a year, The McKinsey Infrastructure Practice Report, January.

McLeay, M., Radia, A. and Thomas, R. (2014), "Money in the Modern Economy: An Introduction", Bank of England Quarterly Bulletin, 54(1), 4-13.

Megersa, K. and Cassimon, D. (2015). "Public debt, economic growth and public sector management in developing countries: Is there a link?", Public Administration and Development 35: 329–4

Melecky, M. (2012). "Formulation of public debt management strategies: An empirical study of possible drivers", Economic System 36: 218– 34.Melina, G., Yang, S.S. and Zanna,L.F (2016). "Debt sustainability, public investment, and natural resources in developing countries: The DIGNAR model", Economic Modelling,Volume 52, Part B.

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.

Pritchett, L. (1996). “Where Has All the Education Gone?” World Bank Policy Research Working Paper No. 1581.

Pritchett, L. (2000). “The Tyranny of Concepts: CUDIE (Cumulated, Depreciated, Investment Effort) Is Not Capital.” Journal of Economic Growth5 (4): 361–84

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 fnances. Master’s thesis. Aalto University School of Economics.

Tanzi, V. and Davoodi, H.R. (2000). “Corruption, Growth and Public Finances”, IMF (International Monetary Fund) Working Paper, 182: 1-26.

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.

Wyplosz, C. (2007). “Debt sustainability Assessment: The IMF Approach and Alternatives,” IHEID Working Paper 03-2007, Economic Sector, The Graduate Institute of International Studies.

Appendix

A. Model description

Supply Side

The model is a perfect foresight deterministic general equilibrium model that features the informal economy (Colombo et al, 2019). The supply side features three private sectors: tradable agriculture x, non-tradable formal sector n and non-agriculture informal sector j. Each sector utilizes private capital, low- and high-skill labor, government-supplied infrastructure which increases the productivity of all sectors, and land, which is specific to agriculture.

Furthermore, the model assumes that the productivity of low-skill labor depends on work effort versus leisure. This allows us to assume that with the COVID-19 crisis and the resulting confinement measures, workers' leisure is increasing relative to their work effort. The death toll on human capital is captured indirectly through a loss of productivity while the lockdowns and confinement of workers at home are captured through increased leisure or decline in work effort.

The production technologies q of the different sectors x, n and j in period t are given:

$$q_{x,t} = a_x z_{t-1}^{\psi_x} k_{x,t-1}^{\alpha_x} S_{x,t-1}^{\theta_x} H^{\chi} \left(e_{b,t} L_{x,t}\right)^{(1-\alpha_x-\theta_x-\chi)} \quad (1)$$

$$q_{n,t} = a_n z_{t-1}^{\psi_n} k_{n,t-1}^{\alpha_n} S_{n,t-1}^{\theta_n} \left(e_{n,t} e_{b,t} L_{n,t}\right)^{(1-\alpha_n-\theta_n)} \quad (2)$$

$$q_{j,t} = a_j z_{t-1}^{\psi_j} k_{j,t-1}^{\alpha_j} S_{j,t-1}^{\theta_j} \left(e_{b,t} L_{j,t}\right)^{(1-\alpha_j-\theta_j)} \quad (3)$$

All sectors utilize private capital k, low-skill labor L, high-skill labor S, and government-supplied infrastructure z. Infrastructure is a public good that enhances productivity in all sectors, and land or some natural resource H is a sector-specific input in sector x. The variable e_b links the quantity and quality of primary education to human capital of low-skill labor. In the formal sector, where efficiency wage considerations apply, the productivity of low-skill labor also depends on work effort e_n.

Demand Side

The demand-side of the model has two representative households: non-savers and savers who derive their utility from consumer goods produced domestically from formal sector, informal sector, and from imported traded goods.

The non-saving class comprises unemployed individuals and low-skill workers in the informal sector. They live hand-to-mouth and consume all their income each period and receive transfers from the government and their earnings in agriculture may include a share of land rents. The saving class comprises skilled workers and low-skill labor in the formal sector. They maximize an intertemporal utility function subject to a budget

constraint. Unlike the non-savers, this class of households have access to capital and financial assets and or liabilities and have therefore the possibility to smooth their consumption subject to a discount factor which measures their preference for the future or the present.

On the spending side of their budget constraint, savers pay tax on capital income, on land rent and on wage income in the formal sector. In addition, they pay user fees charged on infrastructure services. Furthermore, they face adjustment costs in accumulating capital, and portfolio adjustment costs in accumulating debt. The spending side of non-savers budget constraint is similar except that this class is exonerated from payment of user fees on infrastructure services. Moreover, they do not accumulate capital and debt.

The budget constraint of the representative non-saver is given by:

$$P_{c,t}c_{1,t} = (1 - f_{wx})\left(w_{x,t}L_{x,t} + \sigma r_h H\right) + \left(1 - f_{wj}\right)w_{j,t}L_{j,t} + a_t T_t \quad (4)$$

where $L_{x,t}$ and $L_{j,t}$ are the supply of low-skill labor in the formal tradable and informal sectors, respectively; $L_{j,t}$; $w_{x,t}$ and $w_{j,t}$ are the corresponding real wages; f_{wx} and f_{wj} are ad valorem taxes on low-skill wage income; and c_1 is consumption of this class of households; T_t represents public transfers and the coefficient a_t measures the share of transfers going to this class, with $(1 - a_t)$ the share of transfer going to the counterpart savers.

The savers maximize the following intertemporal utility function:

$$V = \sum_{t=0}^{\infty} \beta^t \frac{{c_{2,t}}^{(1-1/\tau)}}{1-1/\tau} \quad (5)$$

Subject to the following budget constraints:

$$P_t b_t - b_{f,t} = (1 - f_w)\left(w_{n,t}L_{n,t} + w_{s,t}S_{t-1}\right) + \sum_{q=j,n,x}\left[r_{q,t} - f_q\left(r_{q,t} - \delta P_{q,t}\right)\right]k_{q,t-1} + (1 - f_h)(1 - \delta)r_{h,t}H + (1 - a_t)T_t - \frac{1+r_f}{1+g}b_{f,t-1} + \frac{1+r_{t-1}}{1+g}P_t b_{f,t-1} - P_{k,t}\sum_{q=j,n,x}\left(i_{q,t} + A\mathbb{C}_{q,t}\right) - \frac{\eta}{2}\left(b_{f,t} - \bar{b}_f\right)^2 - P_{c,t}c_{2,t} - \mu_t z_{t-1} \quad (6)$$

And for each sector q with $q = j, n, x$:

$$(1 + g)k_{q,t} = i_{q,t} + (1 - \delta)k_{q,t-1} \quad (7)$$

The term $A\mathbb{C}_{q,t}$ in the budget constraint captures costs incurred in changing the capital stock in sector q and expressed as $A\mathbb{C}_{q,t} = \frac{\upsilon}{2}\left(\frac{i_{q,t}}{k_{q,t-1}} - \delta - g\right)^2$. The term $\frac{\eta}{2}\left(b_{f,t} - \bar{b}_f\right)^2$ measures portfolio adjustment costs associated with the deviations of foreign loans from their steady state level.

The public sector

Public Investment in Infrastructure

Casual observation and indirect empirical evidence suggest that all too often high returns on infrastructure capital do not translate into equally high returns on public investment either because of inadequate expenditure on maintenance or because a large fraction of public investment *spending* does not increase the stock of productive infrastructure (Hulten, 1996; Pritchett, 2000). The DIG-Labor models allow for both types of inefficiency. Public investment i_z increases the stock of physical infrastructure $\tilde{z}$:

$$(1 + \mathfrak{g})\tilde{z}_t = i_{z,t} + (1 - \delta_{z,t})\tilde{z}_{t-1}. \tag{8}$$

Some of the newly built infrastructure, however, may not be economically valuable, productive infrastructure:

$$z_t = z_0 + s(\tilde{z}_t - \tilde{z}_0), \tag{9}$$

with $s \in [0,1]$ denoting the efficiency of public investment.[10]

Spending on maintenance $\mathfrak{m}$ extends the service life of infrastructure by reducing the depreciation rate:

$$\delta_{z,t} = \delta_o e^{-\Lambda \mathfrak{m}_t/\tilde{z}_{t-1}}, \tag{10}$$

where $\Lambda > 1/\delta_o$. Maintenance is underfunded relative to new investment when $\Lambda > 1/\delta_z$. In too many countries this condition holds with margin to spare.

Public Investment in Human Capital

Investment in human capital takes much longer to pay off than investment in infrastructure. The time lag is six years for investment in basic education i_b and eight years for investment in upper-level education i_u, which implies:

$$S_{b,t} = i_{b,t-6} + (1 - \delta_b)S_{b,t-1} \quad \text{and} \quad S_{u,t} = i_{u.t-8} + (1 - \delta_u)S_{u,t-1}. \tag{11}$$

Fixed input-output coefficients connect increases in education capital to the supply of high-skill labor S and the productivity of low-skill labor e_b:

$$S_t = S_0 + \phi_1(S_{u,t-1} - S_{u,0}) \quad \text{and} \quad e_{b,t} = 1 + \phi_2(S_{b,t-1} - S_{b,0}). \tag{12}$$

[10] The return on public investment is *not* necessarily lower in countries with a history of low efficiency of public investment. Low values of s in equation (35) are counterbalanced by lower values of z_0 and a higher marginal product of infrastructure. In an apple-to-apple comparison of otherwise structurally identical countries, the return to investment may be *higher* in the low-efficiency country (Berg et al., 2019).

The public sector collects revenues from different sources and spends them on investment in education, infrastructure, and transfers. The model allows for different government financing options. Grants, aid, FDI, concessional borrowing and other financial flows and oil revenues are exogenously given as well as public investment in infrastructure and human capital.

Absent additional financing sources, the government adjusts taxes and/or transfers to finance the fiscal gap. Moreover, the model considers external commercial borrowing and domestic borrowing to help meet the financing gap, with taxes and transfers responding to stabilize debt levels over time. Withdrawals from oil funds and earnings on investments made by the fund constitute additional sources of revenues for the government.

The public sector budget constraint is expressed as follow:

$$P_t \Delta b_t + \Delta d_{c,t} + \Delta d_t = \frac{r_d - g}{1+g} d_{t-1} + \frac{r_{dc} - g}{1+g} d_{c,t-1} + \frac{r_{t-1} - g}{1+g} P_t b_{t-1} + P_{z,t}\left(I_{z,t} + m_t\right) + T_t + P_{s,t} i_{s,t} - \mu_t z_{t-1} - h_t\left(P_{n,t} c_{n,t} + g_j P_{j,t} c_{j,t} + g_x c_{x,t} + g_m c_{m,t}\right) - \sum_{q=j,n,x}\left[f_q\left(r_{q,t} - \delta P_{q,t}\right) k_{q,t-1} + f_{wq,t} w_{q,t} L_{q,t}\right] - f_{wq,t} w_{s,t} S_t - f_{h,t} r_{h,t} H \quad (13)$$

where $\Delta b_t = b_t - b_{t-1}$, $\Delta d_{c,t} = d_{c,t} - d_{c,t-1}$, $\Delta d_t = d_t - d_{t-1}$, and r_d and r_{dc} are interest rates (in dollar) on concessional debt d and commercial debt dc, respectively.

The term $P_{z,t} I_{z,t}$, where $I_{z,t} = \mathcal{H}_t\left(i_{z,t} - i_{z,0}\right) + i_{z,0}$, determines absorptive capacity constraint in the public sector.

Closure rule

The model is closed by the accounting identity that the country's net foreign debt equals the current account deficit. This gives the possibility of a twin deficit. On the external financing of the fiscal gap, the government sector borrows on concessional and non-concessional terms and accumulates assets from investment in oil revenues. Claims on the government include interest cost on external commercial debt, on domestic debt and on concessional debt, plus principal. Interest rate on external commercial debt is a function of risk-free interest plus an endogenously determined risk premium. The private sector pays an exogenously determined risk premium in addition to what the government incurs. Interest rate is determined through the uncovered interest rate parity, i.e., the interest differential between domestic bonds and foreign loans. When the capital account is perfectly open, the interest rate on domestic debt is equal that of foreign loans. In a closed capital account, the differential is determined by portfolio adjustment costs.

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