Fiscal sustainability in Africa: Accelerating the post-COVID-19 recovery through improved public finances

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Abstract
The article examines the impact of the COVID-19 pandemic on economies in Africa through the application of a novel Debt, Investment and Growth model with a segmented Labor market (DIG-Labor). The pandemic is modeled via supply shock that disrupts economic activities in countries in Africa, followed by effects on household consumption behavior and welfare, and business investment decisions. The DIG-Labor model is calibrated to account for informality, which is a key characteristic of economies in Africa. We find that, in the absence of appropriate remedial measures, the COVID-19 pandemic reduces employment in the formal and informal sectors and scales back consumption for savers and non-savers, with the reduction in consumption being more pronounced for savers. These contractions lead to an economic recession in Africa and widen the fiscal and current account deficits, among others. The effects of fiscal stimulus packages in response to the COVID-19 pandemic and various financing mechanisms are also examined. A key finding is that various policy responses to the emerging COVID-19 induced macroeconomic imbalances have diverse implications, which should be carefully examined to mitigate the negative consequences while maximizing the opportunities for a swift, stronger and more inclusive economic recovery.

KEYWORDS
debt, investment and growth; fiscal policy; national government expenditures and related policies

1 | INTRODUCTION

COVID-19 triggered an unprecedented collapse in economic activity globally. While Africa might have been spared the extreme health effects, the socioeconomic fallout from the pandemic has been significant. Africa enjoyed relatively resilient growth during the period 2009–2019 (Figure 1a), despite shocks like the global financial crisis and commodity price fluctuations (Figure 1b). COVID-19 is expected to hold back Africa's progress. The African Development Bank (AfDB, 2021) reported that the continent witnessed a decline in GDP growth of 1.5% in 2020, its lowest in the past two decades. The continent’s GDP fell by US$165 billion relative to the pre-COVID-19 estimated GDP for 2020 of US$2.59 trillion. These losses persisted in 2021, albeit at a lower level, reflecting the partial recovery. The estimated GDP losses
in 2021 could range between US$27.6 billion and US$47 billion from the projected GDP of US$2.76 trillion in the absence of COVID-19. Africa’s real GDP growth is projected at 4.2% in 2022, above the pre-COVID-19 levels (Figure 1a).

The pandemic has affected Africa’s economic outlook through several channels including commodity prices and trade, travel and tourism, and financial flows. The most affected countries are those characterized by weak health systems and those reliant on service sectors like tourism, international trade, and commodity exports (AfDB, 2020). Economies with high debt burdens and those dependent on international financial flows have also been adversely affected (AfDB, 2021).

Expansionary fiscal spending is projected to double the continent’s high fiscal deficits. Despite Africa’s fiscal consolidation policy stance, fiscal deficits persist owing to weaknesses in public revenue mobilization (PRM) (Figure 1c). COVID-19-induced spending on healthcare, social safety nets and measures to preserve productivity1 amidst depressed public revenues has further aggravated Africa’s already high fiscal deficits. Fiscal deficits almost doubled from 4.3% and 4.7% of GDP in 2018 and 2019, respectively, to 7.2% in 2020 before moderating to 5.3% in 2021 and projected to ease further to 4.7% and 4.0% in 2022 and 2023, respectively (Figure 1d). This confirms that African countries experienced diminished fiscal space to undertake the required policy responses to the COVID-19 crisis.

COVID-19 will worsen Africa’s sovereign debt burdens. Whereas the debt-to-GDP ratio for African countries averaged under 60%2 prior to the COVID-19 crisis, this ratio increased to over 70% in 2020 (AfDB, 2021). Debt vulnerabilities are particularly high in seven countries, namely Angola, Cabo Verde, Republic of Congo, Eritrea, Mozambique, Sudan and Zambia, whose debt-to-GDP ratios exceed 100% (International Monetary Fund, 2020a). In addition, Africa’s gross government debt more than doubled in 2020 from a low of 32% of GDP in 2008 (following Heavily Indebted Poor Countries/Multilateral Debt Relief Initiative, HIPC/MDRI), in part owing to increased access to international credit markets and diversification of creditors (Organisation for Economic Co-operation and

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FIGURE 1  (a) Real gross domestic product (GDP) growth (%); (b) commodity prices—annual indices (real, US$, 2010 = 100); (c) government revenue and expenditure (% GDP); (d) fiscal balance (including grants, % GDP). Source: African Development Bank Statistics Department.
Development, 2020). Similar trends were illustrated across diverse creditor (Figure 2a) and debtor (Figure 2b) types. Debt-to-GDP ratios were projected to increase by up to 10 percentage points between 2020 and 2021 (AfDB, 2020). The number of African countries at either high risk of debt distress or in distress has increased from 8 in 2015 to 16 and 17 in 2019 and 2020, respectively (International Monetary Fund, 2020b).

The pandemic’s impact on Africa’s sovereign debt is a key concern considering the evolving risk structure. Following the continent’s inaugural Eurobond issue by South Africa in 1995, 21 African sovereigns had issued over 125 Eurobond instruments by 2020 valued at US$155 billion (about 6% of Africa’s GDP). Public and publicly guaranteed external debt owed by African sovereigns to private creditors (bondholders and commercial banks, among others) increased by more than twofold from 3.4% of GDP in 2010 to 8.8% in 2019 (Figure 2a). The median amount of foreign currency denominated public debt increased from 22% of GDP in 2013 to 29% of GDP in 2018 with a corresponding negative impact of reduced international reserves, which reached 14% of GDP in 2018 from a high of 22% in 2009 (Organisation for Economic Co-operation and Development, 2020). Less than half (49%) of the continent’s public external debt during 2012 and 2017 was concessional, down from 58% over the period 2002–2007 (Calderon & Zeufack, 2020). A higher share of external debt is owed to non-Paris Club governments and private creditors (Organisation for Economic Co-operation and Development, 2020). This reconfiguration in the structure and higher risk profile of public

![Figure 2](https://example.com/figure2.png)

**Figure 2** (a) Long-term external debt by creditor type (% GDP); (b) long-term external debt by debtor type (% GDP); (c) debt servicing (% central government spending); and (d) debt outstanding and debt servicing (% GDP). Source: African Development Bank Statistics Department.
Net oil-exporting countries and previous HIPC/MDRI beneficiaries have led the recent pick-up in debt accumulation in Africa. Debt-to-GDP ratios for several net oil exporters like Angola, Cameroon, Chad, Gabon and Equatorial Guinea more than doubled between 2010 and 2019, as fiscal deficits widened following the end of the commodity price boom in 2014 (Organisation for Economic Co-operation and Development, 2020). Oil exporters are projected to suffer the highest increases in debt burdens because of COVID-19 and reduced oil prices. Public debt-to-GDP ratios for oil exporters are now estimated to increase by 18 percentage points to 68.5% of GDP in 2020 relative to the pre-COVID-19 projections compared with an increase of 9 percentage points (to 65.6% of GDP) for sub-Saharan Africa (International Monetary Fund, 2020b).

Regarding the trade channel, more than 85% of Africa’s trade is with the rest of the world, with Europe, China, and the USA accounting for 56% of Africa’s total trade in 2018. For net oil-exporting countries such Nigeria, Angola and Algeria, the falling oil prices3 induced by COVID-19 will significantly reduce their export revenues and weaken their trade balances, while net importers will experience a relative improvement of their trade balance. On tourism, Africa has the second-fastest-growing tourism sector in the world, representing 8.5% of the continent’s GDP and employing 24.3 million Africans or around 6.7% of total employment. Between 2017 and 2018, Africa’s travel and tourism sectors grew by 5.6%, compared with the global average of 3.9% and contributed about US$194.2 billion to Africa’s GDP in 2018. COVID-19 has created a sudden stop of the sector and the associated economic activities around hospitality, entertainment and logistics.

Africa is particularly vulnerable to the COVID-19 crisis owing to its heavy dependence on external flows, with remittances projected to contract. Remittances are the largest source of external financing inflow for the continent and amounted to US$86.2 billion in 2019, up from US$82.8 billion in 2017 and surpassed official development assistance (ODA) at US$55 billion. This pick-up in remittances reflects the improved global economic conditions and the upsurge in migration during this period. Remittances, which account for between 5% and 10% of GDP in several African countries, are expected to contract owing to weaknesses in global economic conditions and the subsequent negative impacts on migrant jobs and incomes (AfDB, 2020). Migrants’ financial resources have been affected by job losses, salary cuts, increased household expenditures and healthcare costs.

Foreign direct investment (FDI) and ODA are also projected to decrease. Foreign direct investment increased by 10.9% to US$45.9 billion in 2018, the fastest growth in the world, and further to US$49 billion in 2019 on the back of the continent’s improved economic outlook. However, investors are likely to defer or even cancel their investment plans owing to COVID-19-related uncertainties, thereby reducing FDI inflows. Net ODA, which increased by 4.2% to US$55 billion in 2019, relative to US$52.8 billion in 2017, will probably be held back as donor countries focus on addressing the health and socioeconomic effects of COVID-19 in their own countries. Portfolio flows, which experienced a steady decline since 2017 and were estimated at US$27.1 billion in 2019, have also been affected by COVID-19-induced sudden stops in emerging market capital flows. The African Development Bank (AfDB, 2020) projects that portfolio flows could decrease by 50% in 2020 on the back of weak global growth and heightened risk aversion on the part of investors. Planned portfolio investments, especially from China, in key sectors such as construction, transportation (roads, railroads, airports, and harbors) and energy, could also be affected if global uncertainty continues because of COVID-19. The Institute of International Finance (2020) reported that the first quarter of 2020 experienced the largest capital flight for emerging markets, exceeding the global financial crisis.

Constrained fiscal space and reduced external financial inflows will lead to substantial funding shortages, thereby diminishing the scope for COVID-19 policy responses. The International Monetary Fund (2020b) estimated sub-Saharan Africa’s external financing needs at US$890 billion (55% of 2020 GDP) for the period 2020–2023, with a financing gap of about US$130 billion. In the absence of international financial support, several countries across the continent will probably implement stringent austerity measures, which could further hold back inclusive growth and negatively affect social stability.

Development partners have swiftly responded to Africa’s COVID-19 responses with diverse instruments. These include the African Development Bank’s COVID-19 US$10 billion Crisis Response Facility and support from other international financial institutions like the World Bank Group and International Monetary Fund (IMF), the European Union, and bilateral partners. A few African countries have also benefitted from debt moratoria and forbearance initiatives such as the G20’s Debt Service Suspension Initiative (DSSI). However, these initiatives are currently only short-term and private creditors are yet to contribute on equal terms.4

Consequently, deeper governance reforms are necessary to strengthen public finances and promote growth-enhancing reforms. Robust debt management practices are critical. However, Africa’s policy toolkit should be expanded through a
gradual transition from debt management to balance-sheet management of the public sector, and policies to improve efficiency in public investment (Calderon & Zeufack, 2020). Cohen et al. (2020) reported that the COVID-19-induced macroeconomic imbalances and uncertainties will reduce sovereigns’ ability to service debt, making creditors less willing to accept permanently reduced claims. This will subsequently reduce the likelihood of orderly and timely debt restructuring, depriving countries of much needed financing for prolonged time periods, holding back pro-poor and growth-enhancing spending, thereby affecting countries’ abilities to finance their debt.

This article seeks to contribute to policy discussions and reforms to accelerate Africa’s post-COVID-19 recovery, with emphasis on improving public finances. The article focuses on examining: (i) the impact of COVID-19-induced shocks on public finances, debt sustainability and other outcomes like productivity and employment; (ii) the impact of inefficiencies in public spending on debt sustainability and growth; (iii) the fiscal space and associated reforms like digitalization to improve tax administration, tax compliance, public financial management, and public investment management; and (iv) how reforms in public financial management can mitigate future debt burdens. Simulations seek to quantify the additivity of proposed policy responses to close budget financing gaps, ensure debt sustainability and preserve spending on pro-poor sectors and investments necessary to expand the economy. The policy responses include improvements in PRM, strengthening public expenditure efficiency and short-term measures like debt service payment forbearance.

The rest of this article is organized as follows. The second section reviews pertinent literature and the third section presents the methodology and assumptions. The fourth section discusses the simulation results and the fifth section concludes and highlights the key policy recommendations.

## SUMMARY OF RELEVANT LITERATURE

Faria-e-Castro (2020) studied the macroeconomic effects of the COVID-19 outbreak in the USA using a non-linear DSGE macroeconomic model. The effects of the pandemic are examined as a sudden stop of a contact-intensive services sector, with aggregate demand externalities transmitting the shock to the non-services sector. Balance sheet linkage transmits the shocks to the financial sector. The model assumes endogenous entry and exit in the affected services sector, implying that the fluctuations in demand can have persistent effects on the sector’s productivity and the economy does not recover immediately following the conclusion of the pandemic. The framework examined diverse types of discretionary fiscal policy including increases in non-service government purchases, reductions in income tax, expansion of unemployment insurance, unconditional transfer and payment of wages by the government to service sector firms. The article found significant variation in the distribution effects of various policy measures. Unemployment insurance benefits are most effective in stabilizing incomes for hardest hit borrowers whereas unconditional transfers are most suitable for savers. The study also found that liquidity assistance programs work best if the policy objective is to stabilize employment in an affected sector. However, the study did not consider the impact of COVID-19-related fatalities on the labor force.

Drautzburg and Uhlig (2015) and Taylor (2018) studied fiscal stimulus packages implemented during 2007–2009 global financial crisis and great recession using DSGE models. Drautzburg and Uhlig (2015) reported that policy intervention could reduce the welfare of economic agents. Taylor (2018) found that fiscal actions were not very effective in stimulating the economy, but such actions increased the fiscal deficits, necessitating fiscal consolidation. Faria-e-Castro (2018) applied a non-linear quantitative model to examine the macroeconomic effects of the US fiscal policy response to the great recession. The authors considered standard measures like government purchases and transfers as well as financial sector interventions such as bank recapitalizations and credit guarantees. This study concluded that aggregate consumption would have reduced by 50% in the absence of fiscal policy responses, with transfers and bank capitalizations generating the largest fiscal multipliers owing to linkages between household and bank balance sheets.

Fornaro and Wolf (2020) studied the macroeconomic implications of COVID-19 and found that monetary stimulus is useful in mitigating the impact of the pandemic on employment and output. However, monetary policy might not be adequate to maintain the economy at full employment following the COVID-19 outbreak and aggressive fiscal policy, notably policies that sustain investment, is necessary to elevate the global economy out of stagnation. Eichenbaum et al. (2020) examined the equilibrium interaction between economic decisions and epidemics via a canonical epidemiology model. They reported that people’s decisions to scale back on consumption and work reduces fatalities owing to the epidemic, although such decisions aggravate the magnitude of the recession caused by the epidemic. The authors found that supply and demand effects reinforce each other to generate a large and persistent recession. However, since each person takes the economy-wide infection rates as given, large-scale containment measures—that
result in sharp and sustained reductions in aggregate output—are necessary to ensure a Pareto-optimal competitive equilibrium.

Guerrieri et al. (2022) argued that Keynesian supply shocks could be generated in a multiple-sector, incomplete-markets economy under certain conditions. For instance, firm exit and loss of jobs can escalate the initial effects, thereby intensifying the recession. Regarding policy responses, the authors argued that standard fiscal stimulus (spending or non-targeted transfers) could be less potent than usual as the closure of some sectors reduces the impact of the Keynesian multiplier. However, monetary policy, especially if not impeded by the zero-lower bound, can generate notable results, including preventing firm exits and incentivizing labor retention. Guerrieri et al. (2022) confirmed that lockdown of contact-intensive sectors coupled with the provision of full insurance payments to affected workers is the optimal policy.

Bayer et al. (2020) used a HANK model to analyze the quantitative impact of transfers under the US Coronavirus Aid, Relief, and Economic Security (CARES) Act and the extent to which these transfers mitigate the economic effects of COVID-19. The article’s benchmark scenario captures a quarantine shock that affects the amount of labor and capital in aggregate production and reduces the consumption of goods. This shock also raises the income risk at household level. The authors found that the effects of the transfer payments implemented under the CARES Act differed fundamentally depending on whether the transfers were conditional on the recipient being unemployed or not. Conditional transfers (conditional on the income loss during the quarantine shock) are seen to be very effective in stabilizing the economy since they mitigate the income risk ex ante. Furthermore, these transfers target households with a high marginal propensity to consume. The authors obtained short-run multipliers of 1.5 and 0.25 for the conditional and unconditional transfers, respectively. Elenev et al. (2020) studied the equilibrium dynamics of macroeconomic quantities and prices and how these variables are influenced by government interventions in the corporate debt markets. The authors made the point that fiscal policies are effective in preventing a deeper crisis by mitigating corporate bankruptcies by about 50%, although the fiscal costs are quite steep and lead to increased interest rates on government debt.

Several studies have examined the impact of COVID-19 on Africa. Gondwe (2020) applied a macroeconomic model of Africa to project and simulate the COVID-19 impacts on African economies, notably through the collapse of fuel prices and global recession. The author found that COVID-19 would lead to a 1.4% drop in Africa’s GDP, with smaller economies experiencing a contraction of up to 7.8%. The contraction is mainly attributed to export adjustment facing primary commodity exporters and the associated losses in tax revenue. Hanan et al. (2021) adopted a DSGE model to study the effects of the COVID-19 pandemic on African economies. The authors reported that COVID-19 could diminish employment in the formal and informal sectors and reduce consumption, particularly for non-savers. These effects lead to economic recession, wider fiscal and current account deficits, and higher extreme poverty. Cilliers et al. (2020) used the international futures assessment model to examine the impact of COVID-19 in Africa, looking ahead to 2030 in terms of income, debt, poverty and the Sustainable Development Goals. The authors found that the pandemic could erase most of the progress made in the fight against poverty in recent years, setting back the realization of the 2030 SDGs and Agenda 2030. Boukar et al. (2021), using a CGE model, assessed the impacts of COVID-19 on diverse economic sectors in Cameroon, accounting for the informal sector. The authors reported that economic sectors such as construction, education, hotels and restaurants and commerce experienced the most severe employment losses owing to the pandemic. Djoumessi (2021) used a logistic model to study the effects of the COVID-19 pandemic on employment in Cameroon. The findings showed that a large share of workers suffered wage cuts and job losses, with private sector and middle-aged workers being most affected. Strauss et al. (2021) applied a Bayesian hierarchical model to examine the effects of shocks to GDP on employment in the Southern Africa Development Community (SADC) during COVID-19. The authors found that most SADC countries will experience loss of wage income more than 10% of GDP through job losses and/or reductions in wages and working hours.

### 3 Macromodeling of COVID-19 Shocks on Public Finances

This study applies a Debt-Investment-Growth model with a segmented labor market (DIG-Labor) to examine the COVID-19 effects and additionality of selected policy responses. This model is better suited to the analysis of COVID-19 shocks because it accounts for important features of African economies, namely the existence of a large informal sector, which employs non-saving households and low-skilled workers who live hand-to-mouth and consume all of their disposable income each period. In the modeling exercise, trade, financial flows and tourism are considered as the main
channels through which the COVID-19 crisis affects African economies. This model is superior to standard Computable General Equilibrium models where most of the transmission channels of COVID-19 are not captured. The model is summarized below and presented in detail in the Appendix.

### 3.1 Model description

#### 3.1.1 Supply side

The model is a perfect foresight deterministic general equilibrium model\(^9\) 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-skilled 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-skilled labor depends on work effort vs. 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 reduction in work effort.

The production technologies of the different sectors \(x, n, j\) are represented via Cobb–Douglas production functions.\(^{10}\) All sectors utilize private capital, low-skilled labor, high-skilled labor and government-supplied infrastructure. Infrastructure is a public good that enhances productivity in all sectors, and land or some natural resource is a sector-specific input in sector \(x\). The quantity and quality of primary education are linked to the human capital of low-skilled labor. In the formal sector, where efficiency wage considerations apply, the productivity of low-skilled labor also depends on work effort.

#### 3.1.2 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 the formal and informal sectors, and from imported traded goods. The non-saving class comprises unemployed individuals and low-skilled workers in the informal sector. They consume all of their income in each period, 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-skilled labor in the formal sector. They maximize an intertemporal utility function subject to a budget constraint. Unlike the non-savers, the savers have access to capital and financial assets and/or liabilities and can therefore 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 taxes on capital income, land rent and 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.\(^ {11}\) The spending side of non-savers budget constraint is similar except that this class is exempted from payment of user fees on infrastructure services. Moreover, they do not accumulate capital and debt.

#### 3.1.3 The public sector

The public sector collects revenues from different sources and spends on investment in education, infrastructure and transfers. The model allows for different government financing options including grants, concessional and commercial loans, FDI and other financial flows. Oil revenues are exogenously determined, as are public investments in infrastructure and human capital. In the absence of 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 bridge the financing gap, with taxes and transfers responding to stabilize debt levels over time. Withdrawals from oil funds and earnings on investments made by such funds constitute additional sources of revenues for the government.
3.1.4 | Closure rule

The model is closed through the accounting identity that the country's net foreign debt equals the current account deficit, which provides 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 of oil revenues as applicable. Claims on the government include interest costs on external commercial debt, domestic debt and concessional debt, plus principal payments. The interest rate on external commercial debt is a function of risk-free interest (US 10-year Treasury Bill rate) plus an endogenously determined risk premium (modeled as a function of a country's debt level). The private sector pays an exogenously determined risk premium in addition to what the government incurs. The interest rate (paid on the external commercial debt) is determined through the uncovered interest rate parity, that is, the interest differential between domestic bonds and foreign loans. When the capital account is perfectly open, the interest rate on domestic debt is equal to that on foreign loans. In a closed capital account, the differential is determined by portfolio adjustment costs.

3.1.5 | Base case calibration of the model

The calibration of the model requires data on the structure of the economies, elasticities of substitution, depreciation rates, tax rates, debt stocks and the returns on infrastructure and education capital at the benchmark equilibrium. Once values are set for these parameters, all other model variables can be derived from the budget constraints, first-order conditions associated with the solution to the private agents’ optimization problems, and various adding-up constraints. The model is calibrated to generate a steady state in the reference case against which counterfactual cases will be compared.

The Appendix (Table A1) provides the values of key model parameters. These parameter values have been calibrated to the average African economies and the data reflect the structure of the economies prior to the COVID-19 crisis. Most of the parameter values used for the baseline (pre-COVID-19) calibration of the DIG-Labor model are drawn from the existing literature. Moreover, the calibration of cost and factor shares builds on data from the Global Trade Analysis Project (GTAP), International Food Policy Research Institute and World Bank databases.

3.1.6 | Modeling the COVID-19 shocks

The supply-side shock is modeled as a sudden loss of productivity of unwell workers as well as in terms of a decline of their work effort or increase in leisure. The falling productivity along with the loss of work effort leads to a contraction of sector output and employment which depresses real wages. If other components of household income remain unchanged, households will face a loss of their income with some attendant effects on consumption. Beside the shocks originating from direct human cost and preventive measures, African economies are also hit by global trends. As discussed earlier, the slowdown in global economic activity and disruption of global supply and value chains are affecting these economies through a contraction of trade, tourism and financial flows. The resulting effects from these adjustments will contract domestic demand and economic activity. The degree of Africa's exposure and vulnerability to global trends will depend on the extent of the continent's integration into the rest of the world and the effect of each of the above-mentioned transmission channels on the individual economies.

We model these global trends as exogenous external shocks along with the health (or productivity) shock and assess their impact on African economies. However, although high-frequency data provide some indicators, the uncertainty surrounding the depth and breadth of the pandemic in African countries makes it difficult to assess with certainty the macroeconomic impacts of COVID-19. We therefore consider two possible scenarios regarding the depth and duration of the shocks to these variables: the ‘pre-COVID-19’ and ‘after-COVID-19’ scenarios summarized in Table 1. Cognizant of these challenges, the results reported in this article should be regarded as scenario analyses or simulations as opposed to projections.

3.1.7 | Macromodeling of improved public finances

Following Faria-e-Castro (2020), we also study the impact of different fiscal policy adjustment instruments to alleviate the impacts of COVID-19 on households and businesses, and to stabilize the economy. One of the most obvious
channels through which governments can cushion the impact of the COVID-19 crisis on the most affected households and businesses is through the provision of tax relief and public transfers. Tax relief in the form of the exemption (or reduction, deferment) of consumption and income taxes and/or public transfers will attenuate household income losses while exemption of taxes on profit will stabilize business balance sheets and mitigate business closures. However, in a fiscally constrained situation, the policy response package will further deteriorate the fiscal deficit. Overall, we adopt the following fiscal policy adjustments to cover the funding needs arising from the increased COVID-19 related public spending: (i) reducing non-productive public spending and thus improving allocation efficiency; (ii) temporarily running higher fiscal deficits; (iii) improving tax collection through innovations like digitalization; and (iv) using grants and concessional loans, and the G20 DSSI.

4 | FINDINGS

4.1 | Macroeconomic impacts of COVID-19 in Africa

Figure 3 illustrates the adjustments in key macroeconomic variables to the COVID-19 shocks derived from the DIG-Labor model under the scenario assumptions in Table 1.

4.1.1 | Impact on output and consumption

Under the “After-COVID-19” scenario, the combined COVID-19 shocks (loss of productivity, trade, tourism and financial flows) are estimated to cause in 2020 drops of 6.3, 6.4 and 9.2% in output in the informal, formal service and formal tradable sectors, respectively, under the “After-COVID-19” scenario. The reduction in output affects non-savers, whose consumption falls by almost 8.3% owing to the pandemic. There is a more pronounced reduction in consumption for savers. Since savers are assumed to have a rational and forward-looking behavior, they would prefer to save more and postpone consumption out of precautionary motives, leading to the observed more pronounced drop in their consumption level (−11.1%). Private investment decisions of businesses follow suit, dropping by 8.4%. These combined effects would lead to a contraction in real GDP, with Africa’s real GDP growth

| Scenario                  | Duration and spread of COVID-19 outbreak | Scenario assumptions                                                                 |
|---------------------------|------------------------------------------|----------------------------------------------------------------------------------------|
| Pre-COVID-19 scenario     | End of 2019 until the end of 2021         | • Oil and commodity prices increase by 40% from their level in the second half of 2020  |
|                           |                                          | • Financial flows (FDI, loans, portfolio investments, and remittances) to Africa        |
|                           |                                          | represented 8.53% of GDP in 2019. We maintain this level until the end of 2021          |
|                           |                                          | • Africa’s tourism revenues would increase by 20%, from their level in 2019             |
|                           |                                          | • Capacity utilization and total factor productivity would increase by 20% from its     |
|                           |                                          | level in 2019                                                                           |
| After-COVID-19 scenario   | Until the middle of 2022                  | • Oil and commodity prices drop by 60% from their level in the second half of 2020      |
|                           |                                          | following a fall in global demand and excess supply                                   |
|                           |                                          | • Financial flows (FDI, loans, portfolio investments and diaspora remittances) to     |
|                           |                                          | Africa would decline by 60%, because of investor flight to safety and constrained      |
|                           |                                          | liquidity                                                                              |
|                           |                                          | • Tourism to Africa would halt completely because of the total ban on travels and      |
|                           |                                          | social separation                                                                       |
|                           |                                          | • Capacity utilization and total factor productivity would decline by 60% owing to the |
|                           |                                          | lockdown of cities, absenteeism from the outbreak, postponement of construction        |
|                           |                                          | activities, and disruption in supply chains                                             |

Abbreviations: FDI, foreign direct investment; GDP, gross domestic product.

Source: Authors.
rate dropping by 1.9% in 2020. These projections are consistent with the outturns for 2020. For instance, the African Development Bank’s 2021 African Economic Outlook (AfDB, 2021) estimated that the continent’s real GDP contracted by 1.8% in 2020.

4.1.2 | Impact on fiscal balances

The combined COVID-19 shocks reduce the fiscal space as fiscal deficits are estimated at 8 and 9% of GDP in 2020, which is also consistent with findings from the 2021 African Economic Outlook. Indeed, the contraction of real GDP reduces tax revenues and the contraction in government revenues is aggravated by lower foreign exchange receipts, especially for commodity exporters. On the expenditure side, governments faced increased pressure to spend to improve health infrastructure and protect and provide for vulnerable segments of the society. Therefore, governments increased health-related spending while setting up fiscal policy response packages for vulnerable households and businesses.

4.1.3 | Effects on external balances

External balances are adversely affected, with the current account deficit estimated at 7.9% of GDP owing to COVID-19 shocks in 2020. Weakening of Africa’s terms of trade with the rest of the world and loss of competitiveness of Africa’s exports are key drivers of these current account deficits. Other drivers include the low demand for exports, the expected reductions in remittances and reduced domestic demand.

4.1.4 | Post-COVID-19 economic recovery

A recovery is projected in 2021 for the selected variables, although the recovery speed varies across variables. In fact, the recovery is expected to be faster in informal low-skilled employment, followed by employment in service sectors, but slow for...
employment in the tradable sector. Accordingly, consumption and investment behavior adjust, with a gradual recovery in consumption of both classes of households (savers and non-savers) and private investment post 2020.

4.2 | Fiscal policy responses to the pandemic

In the previous sections, the DIG-Labor model exercise did not account for the effects of the different policy responses implemented by African countries in response to COVID-19 crisis. This section simulates the impact of activating the following fiscal policy response packages to mitigate the pandemic shock:

- increases in public transfers;
- consumption tax cut; and
- wage income tax cut for low- and high-skilled labor.

The immediate implication of the response package is a further deterioration of the fiscal deficit observed through the COVID-19 shock analyzed earlier. The legitimate question that arises is how the government will finance the fiscal gap. There are different ways through which governments do this: (i) the reduction of non-productive public spending, thus improving allocation efficiency; (ii) temporarily running higher fiscal deficits or accumulating more debt; (iii) improving tax collection efficiency through innovations like digitalization; (iv) using grants and concessional loans; and (v) G20 DSSI.

4.3 | Increases in public transfers

This simulation takes the form of direct transfer payments handed out by governments to the two classes of households during 2020–2021. We calibrate the share of non-savers such that this category of household is entitled to 60% of the transfers while their counterpart savers receive the remaining 40%. The intervention consists of a one-time 4.6 percentage points of 2020 GDP increase in public transfers, which is equivalent to the percentage point increase of fiscal deficit in Africa under the “after-COVID-19” scenario (compared with the “pre-COVID-19” scenario). The key finding is that public transfer increases of this magnitude alleviate the impacts of the pandemic on households’ consumption. We find that the contraction of consumption of non-savers in the ‘after-COVID-19’ scenario is reduced by 6.1 percentage points in 2020 from the 8.3% reduction in the absence of the transfers (Figure 4). For savers, the intervention lessens the contraction in consumption by 9.2 percentage points from the 11.2% reduction in the absence of transfers.

4.3.1 | Economic impact of public transfers

The overall economic impact of this instrument depends on how the resulting fiscal gap will be closed. First, we assume that governments will close the deficit by reducing infrastructure spending by a corresponding amount. This substitution of productive spending with consumption expenditure (public transfers) has some benefits for the overall economy. Indeed, this is so given the short time horizon of only 2 years during which the transfers are implemented.
Within this time horizon, the overall impact on the economy is measured in terms of Keynesian spending effects, with attendant demand-related pressures and accordingly, a small pressure on prices. Our results show that the increased public spending on public transfers cushions the pandemic’s effects on household consumption. Finally, we assume that governments can secure grants and concessional loans to finance the fiscal deficit. Our findings show that grant and concessional financing does not create any unintended effects on the economy in the short term. However, under this adjustment, private consumption is higher by 0.24 percentage points for non-savers and 0.11 percentage point for savers compared with the spending re-allocation scenario.

4.4 | Consumption tax cut

This simulation consists of a one-off reduction in the consumption tax rate by 20%. The effects of the consumption tax cut are found to be progressive among both classes of households, but more beneficial to the non-savers in terms of mitigating the contraction of consumption compared with the ‘after-COVID-19’ scenario. For instance, a 20% reduction in the consumption tax rate lessens the contraction in consumption for non-savers and savers by 6.9 and 9 percentage points for non-savers and savers (Figure 5). This finding is in line with the general belief that cutting consumption taxes tends to be progressive in countries where the poor spend a large share of their income on consumption goods compared with high-income households. The quantitative results remain unchanged, irrespective of the strategies used to close the fiscal gap.

4.5 | Low-skilled and high-skilled wage income tax reductions

This simulation comprises a one-off cut in the low-skilled income tax by 20% and high-skilled income tax by 10%, to ensure progressivity of the fiscal policy response. The tax cuts help sustain household income, which increases consumption. The 20% reduction in low-skilled income tax lessens the drop in the level of consumption observed by 6.6 percentage points for non-savers (Figure 6). Likewise, a 10% cut of high-skilled income tax reduces the drop in the level of consumption.
consumption of savers by 9.7 percentage points. The overall economic impacts, including on GDP growth and employment are mild given the shorter time horizon.

4.6 | Financing mechanisms of the stimulus package

4.6.1 | Financing through indirect taxes

Domestic resource mobilization in Africa often relies on consumption taxes. Tax evasion and the lack of tax compliance undermine resource mobilization. We assume that the surge in digital technology will improve government’s capacity to mobilize revenue, especially indirect taxes. While mobilizing indirect taxes is viable from the debt sustainability perspective, it may also have important distributional consequences. To understand the forces at play, we analyze the impact of an increase in consumption tax rate from 17% in 2019 to 19.5% in 2024 used to finance the cash transfer program explored in the previous section (Figure 7). It is assumed that 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 finding is robust through the transition path where the non-savers’ consumption lies below that of the savers (see consumption).

The implications from a macroeconomic perspective are captured through a crowding out of private investment over the short and medium term, coinciding with the increase in indirect tax revenues. As a result, sectoral output gaps are negative. However, the long-run productivity gains from the big-push investment in part offsets the short- and medium-run crowding out effect, leading to a surge in private investment in the long run. Consequently, sectoral outputs increase, leading to a higher real GDP growth rate.

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

The distributional consequences of cutting other expenditures to finance the cash transfer program are more worrisome, with increased consumption inequality between saver and non-saver households. In fact, it is assumed that...
4.6.3 | Financing through grants and concessional debt

To preserve long-term fiscal sustainability and avoid fiscal adjustments that sacrifice welfare for long-term objectives, we assume that the financing needs for the cash transfer program would be covered mainly through grants and highly concessional loans. The grant element of the borrowing is expected to remain above 1.3% of GDP in the first 5 years (2020–2025) of the investment scaling up phase. Concessional debt GDP ratio increases and peaks in 2025 before gradually declining.

The short-run macroeconomic consequences of grant- and concessional debt-financed public investment scaling-up are relatively standard (Figure 9). An appreciation of the real exchange rate (i.e. the relative price of non-traded goods) and of other prices (e.g. real wages) is a central part of the transmission mechanism in the grant- and concessional debt-financed investment scaling-up scenario. In the short run, public investment in infrastructure and human capital creates demand pressure. It follows a sectoral competition over labor, which is in scarce supply in the short run, especially skilled labor. Indeed, it is assumed that investment in basic education increases the supply of skilled labor with a 6 year lag, while upper-level education increases the supply of skilled labor with an 8 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 in real wages for skilled labor. From a distributional perspective, the sectoral competition over labor and the hike in 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 for debt sustainability is straightforward. Concessional debt is relatively cheap. The interest rate on concessional debt is calibrated at zero, consistent with the financing terms for such debt, which implies that debt follows a sustainable path.
4.6.4 | Financing through improved efficiency of spending and tax revenue mobilization

The macroeconomic and fiscal impacts of the public investment program can be significant if the government institutes reforms to enhance investment efficiency and the return on investment. This simulation assumes that the government undertakes reforms to remove bottlenecks that reduce inefficiencies in public spending. Inefficiencies can lead to mismanagement and leakages in the cash transfer program and undermine the intended outcomes of the program.

The dynamic implications of reforms that improve the efficiency of government spending are examined and conditions that represent an optimistic scenario are compared with the base case scenario. In the “optimistic scenario”, we assume that public spending is more efficient (no leakages) with 100% of transfers reaching the recipients (households); we set the efficiency parameter at 100% vs. 60% according to our estimate. This scenario also simulates improvements in the efficiency of domestic revenue mobilization. Improvement in the efficiency of revenue mobilization is justified by the current surge in digital technology in many African countries because of COVID-19-related measures. Digital technology can be leveraged by African governments to modernize tax administrations and information technology infrastructure and capacitate human resources in charge of revenue mobilization. The improvement in tax revenue mobilization is achieved through the broadening of the consumption and income tax bases. Expansion of the tax base is captured by the following parameters (in Equation (A8) Appendix A1) in the government budget constraint: \( g, g_m, f_q, f_wq, f_h \). Enhanced efficiency of public spending and tax revenue mobilization improves fiscal and debt sustainability. In addition, the fiscal adjustment is not punitive as private consumption and private investment are not negatively impacted (Figure 10).

Figure 10 displays the results associated with the “optimistic scenario” compared with the base case (After COVID-19 shock). As would be expected, with improved efficiency, the fiscal adjustment (revenue side) is less punitive, with certainly some implications for inequality. The paths are notably better in the medium to long run for private investment...
with stronger crowding-in effect. Private investment is more than 8 percentage points higher by 2025. The ratio of total public debt is much lower at peak level and real GDP growth rate reaches a much higher level like the pre-COVID-19 situation with improved efficiency in public spending.

4.6.5 | Accommodating the DSSI

The suspension of concessional debt repayments is modeled for up to 2 years and compared with a ‘no-DSSI’ scenario, following which, the implications for debt sustainability and the impact on the overall economy are examined. The DSSI scenario is modeled as a suspension of concessional debt (both principal and interest payment). Concessional borrowing is exogenous in the model, that is, it is not market determined unlike commercial debt. Findings confirm that the DSSI is a welcome relief. Indeed, the fiscal deficit is much lower with the DSSI, and total public debt is on a sustainable path compared with the “no-DSSI” scenario (Figure 11). The impact of the DSSI on the overall economy is positive. Output and consumption are higher with the DSSI. The positive impact on the real economy is because the DSSI makes fiscal adjustment growth friendly and therefore stimulates production, consumption and investment.

5 | CONCLUSION AND POLICY RECOMMENDATIONS

The article examines the impact of the COVID-19 pandemic on economies in Africa through the application of a novel Debt, Investment and Growth model with a segmented Labor market. The pandemic is modeled via supply shock that disrupts economic activities in countries in Africa, followed by effects on household consumption behavior and welfare, and business investment decisions. The DIG-Labor model is calibrated to account for informality, which is a key characteristic of economies in Africa. We find that in the absence of appropriate remedial measures, the COVID-19 pandemic reduces employment in the formal and informal sectors and scales back consumption for savers and non-savers, with the reduction in consumption being more pronounced for savers. These contractions lead to an economic recession in Africa and widen the fiscal and current account deficits, among others. The effects of fiscal stimulus packages in response to the COVID-19 pandemic and various financing mechanisms are also examined. A key finding is that various policy responses to the emerging COVID-19-induced macroeconomic imbalances have diverse

FIGURE 10  Improving efficiency of spending and tax revenue mobilization. The y-axis measures the growth of the variable, unless otherwise indicated. The x-axis denotes the years. The charts illustrate the transition paths following improvements in efficiency of public spending and domestic revenue mobilization. Variables are expressed as percentage deviations from the initial steady state, unless otherwise noted. Source: Authors’ calculations.
implications, which should be carefully examined to mitigate the negative consequences while maximizing the opportunities for a swift, stronger and more inclusive economic recovery.

Five key policy recommendations are proposed to support Africa’s post-COVID-19 economic recovery, namely: (i) reform actions should be sequenced to maximize developmental impact; (ii) the diverse effects of deficit and public debt financing should be scrutinized to mitigate any unintended effects; (iii) economic governance and structural reforms are necessary to create the enabling conditions for economic recovery; (iv) strengthening public investment management (PIM) maximizes returns on public and private investment; and (v) enhancements in domestic resources mobilization (DRM) augment PIM.

5.1 | Policy reforms should be sequenced to maximize developmental impact

In the near-term, emphasis should be placed on harnessing grants and concessional financing and using non-concessional resources for projects with the highest returns and impact on the post-COVID-19 recovery. Furthermore, PRM and PIM provide low-hanging fruits in terms of supporting fiscal sustainability. For the medium to longer term, policy reforms should prioritize improvements in the business, enabling environment to catalyze private investment and finance.

5.2 | Diverse effects of deficit and public debt financing should be scrutinized to mitigate any unintended effects

Consequently, closer attention should be given to the interrelationships between fiscal policy and economic activity to maximize the developmental impact of reforms while mitigating any negative effects. Fiscal policy reforms to create fiscal space through PRM and fiscal consolidation generate varied effects on household welfare including through

FIGURE 11  Effects of the DSSI. The y-axis measures the growth of the variable, unless otherwise indicated. The x-axis denotes the years. The charts illustrate the transition paths following DSSI for eligible countries. Variables are expressed as percentage deviations from the initial steady state, unless otherwise noted. Source: Authors’ calculations.
private consumption and unemployment, private investment and returns to factors of production. In this context, a careful assessment of proffered reforms and their effects on economic activity and households is critical in identifying the most optimal responses and their prioritization.

5.3 | Economic governance and structural reforms are necessary to create the enabling conditions for economic recovery

Enhancement of institutional capacities and strengthening of business regulatory rubrics to bolster competition in growth poles, notably finance, telecommunications, and logistics, among others, have the potential to boost investment and finance from the private sector while maximizing returns from these investments. Economic governance and structural reforms create enablers for non-traditional financing like public–private partnerships and privatization of capital-intensive public assets, which reduces dependence on expensive borrowing. Nonetheless, the contingent liabilities associated with alternative financing windows like public–private partnerships need to be quantified and mitigated. Other considerations include fiscal rules to minimize fiscal discretion and improve fiscal policy effectiveness, and state-dependent debt instruments like GDP- and commodity price-indexed debt, among others, to lessen the debt burden during economic downturns.

5.4 | Strengthening PIM maximizes returns on public and private investment

The specific actions to improve PIM include selecting projects based on rigorous technical and financial feasibility studies, improving the delivery of infrastructure by ensuring robust project designs and the selection/management of contractors. Other measures include maximizing the effectiveness of existing infrastructure, for instance through efficient project monitoring, sufficient maintenance and the application of cost-reflective infrastructure tariffs. Enhanced multiyear budgeting and infrastructure governance and technical capabilities are equally important. Periodic assessments like Public Investment Management Assessments and Public Expenditure Reviews are necessary to inform policy responses. Capacity strengthening in project cycle activities will enable countries to harness the developmental impact of public investments.

5.5 | Enhancements in DRM augment PIM

PRM reforms should prioritize improvements in tax compliance while strengthening measures to reduce tax avoidance and evasion. Strengthening PRM requires a transition from commodity taxation toward more broad-based value-added or sales taxes and personal income tax to expand and diversify the tax base while enhancing the progressivity of the tax system. Measures to improve compliance while also expanding the tax base comprise simplifying taxpayer registration processes, harnessing digitalization to improve tax collection systems, and consolidating regional economic cooperation and tax coordination. Support from development partners will contribute to boosting PRM, notably in the design of new tax legislation and digitalization of tax systems to, among other things, build capacity to tax online transactions. Complementary actions to bolster domestic savings will be necessary and include strengthening the monetary frameworks, diversifying financial products to crowd-in longer-term savings, and reducing monetization of the fiscal deficits to preserve macroeconomic stability.

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ENDNOTES

1 African countries have implemented various safety nets like unemployment benefits, targeted wage subsidies and direct transfers and measures to preserve productivity including tax cuts and deferrals for affected businesses.

2 The IMF and African Monetary Cooperation Program consider a debt-to-GDP of 55 and 60%, respectively, as the threshold for prudent debt levels.
3 The IMF’s 2020 October Regional Economic Outlook reported that oil prices have settled at US$41.5 per barrel, which is 32% down from 2019.

4 G20 bilateral official creditors agreed to extend the initial debt service suspension by six months to the end of June 2021 and the International Institute of Finance issued in May 2020 Terms of Reference to foster private creditors’ voluntary participation in debt payment suspension on similar terms. https://www.imf.org/en/About/FAQ/sovereign-debt#s2q3

5 Especially where monetary policy is impeded by the zero-lower bound.

6 The supply effects derive from the fact the epidemic exposes the workforce to the virus and workers react to this risk by scaling back their labor supply. The demand effect emerges because the epidemic exposes consumers to the pandemic and they respond to this risk by reducing their consumption.

7 Supply shocks that trigger changes in aggregate demand larger than the shocks themselves. The authors argue that the economic shocks associated with the COVID-19 crisis including shutdowns, layoffs and firm exits could be considered Keynesian supply shocks.

8 Heterogeneous Agent New Keynesian.

9 This model is largely for public investment purposes, and thus governments have a public investment plan for the next 3–5 years, for instance based on a National Development Plan, and will know with some level of certainty the public investment implementation plan.

10 See Appendix A1 for more details.

11 The adjustment costs in capital accumulation and accumulation of debt refer to real frictions such as borrowing constraints and difficult access to credit in domestic and international markets.

12 These scenarios were defined during the COVID-19 pandemic (2020–2021) but are subject to revision given the current developments, including the Russia–Ukraine conflict. Therefore, the results should be interpreted considering these assumptions.

13 Keynesian demand effects refer to the short-run impacts of government spending. Increased spending creates demand pressures in the short run because the supply side can only adjust in the long term. Without any price rigidities, demand pressures lead to price increases.

14 Here, we focus on exploring various financing options to close the fiscal deficit created by the provision of public transfers. The effects for the other stimuli (consumption tax cut, and reductions in taxes on low- and high-skilled labor) are similar and not discussed here.

15 The efficiency parameter is estimated using Data Envelopment Analysis method (see Barhoumi et al. (2018) for more details).

16 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.

17 See this link for more details: https://www.gtap.agecon.purdue.edu/databases/Africa/v2/default.asp

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**APPENDIX A1: TECHNICAL APPENDIX**

See Box 1

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**BOX 1: Essential pieces and blocks of the model**

How does the model capture the investment-growth nexus? The model is an open-economy perfect foresight general equilibrium model with three private sectors: tradable agriculture, non-tradable formal and non-agriculture informal sectors. Each sector is represented by a neoclassical production function where output is produced by combining public capital, private capital, low-skilled labor, high-skilled 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. As well as the rate of return to public capital, the model captures public investment inefficiencies and absorptive capacity constraints.

![Diagram of model components](image)

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

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

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**APPENDIX A1: TECHNICAL APPENDIX**

See Box 1
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-skilled 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-skilled labor depends on work effort vs. 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 as:

$$q_{x,t} = a_{x} z_{t-1}^{\psi_{x}} k_{x,t-1}^{\alpha_{x}} S_{x,t-1}^{\delta_{x}} H^{x} (e_{h,t} L_{n,t})^{(1-\alpha_{x}-\delta_{x})},$$  \hspace{1cm} (A1)

$$q_{n,t} = a_{n} z_{t-1}^{\psi_{n}} k_{n,t-1}^{\alpha_{n}} S_{n,t-1}^{\delta_{n}} (e_{n,t} e_{h,t} L_{n,t})^{(1-\alpha_{n}-\delta_{n})},$$ \hspace{1cm} (A2)

$$q_{j,t} = a_{j} z_{t-1}^{\psi_{j}} k_{j,t-1}^{\alpha_{j}} S_{j,t-1}^{\delta_{j}} (e_{h,t} L_{j,t})^{(1-\gamma_{j}-\delta_{j})}.$$ \hspace{1cm} (A3)

All sectors utilize private capital $k$, low-skilled labor $L$, high-skilled 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 $e_{n}$ links the quantity and quality of primary education to human capital of low-skilled labor. In the formal sector, where efficiency wage considerations apply, the productivity of low-skilled 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 the formal sector, the informal sector and imported traded goods.
The non-saving class comprises unemployed individuals and low-skilled workers in the informal sector. They live hand-to-mouth and consume all of their income each period and receive transfers from the government; their earnings in agriculture may include a share of land rents. The saving class comprises skilled workers and low-skilled labor in the formal sector. They maximize an intertemporal utility function subject to a budget constraint. Unlike the non-savers, this class of households has access to capital and financial assets and liabilities and therefore has 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 the 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:

$$P_{c,t}c_{1,t} = (1 - f_{wx}) (w_{x,t}L_{x,t} + \sigma r_t)H + (1 - f_{wj})w_{j,t}L_{j,t} + a_1 T_t$$  \hspace{0.5cm} (A4)

where $L_{x,t}$ and $L_{j,t}$ are the supply of low-skilled 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-skilled wage income; and $c_1$ is consumption of this class of households; $T_t$ represents public transfers and the coefficient $a_1$ measures the share of transfers going to this class, with $(1 - a_1)$ the share of transfer going to the counterpart savers.

The savers maximize the following intertemporal utility function:

$$V = \sum_{t=0}^{\infty} \beta^t c_{2,t} \frac{(1-1/\tau)}{1 - 1/\tau}.$$  \hspace{0.5cm} (A5)

Subject to the following budget constraints:

$$P_{b,t} - b_{f,t} = (1 - f_w)(w_{n,t}L_{n,t} + w_{x,t}S_{t-1}) + \sum_{q=j,n,x} \left[ r_{q,t} - f_q (r_{q,t} - \delta P_{q,t}) \right] k_{q,t-1} + (1 - f_n)(1 - \delta)n_{t}H$$

$$+ (1 - a_1) T_t - \frac{1 + \eta}{1 + g} b_{f,t-1} + \frac{1 + \eta}{1 + g} P_{b,t-1} - P_{k,t} \sum_{q=j,n,x} (i_{q,t} + AC_{q,t}) - \frac{n}{2} (b_{f,t} - \bar{b}_f)^2$$  \hspace{0.5cm} (A6)

$$- P_{c,t}c_{2,t} - \mu_i z_{t-1}.$$

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

$$(1 + g)k_{q,t} = i_{q,t} + (1 - \delta)k_{q,t-1}.$$  \hspace{0.5cm} (A7)

The term $AC_{q,t}$ in the budget constraint captures costs incurred in changing the capital stock in sector $q$ and expressed as

$$AC_{q,t} = \frac{\nu}{2} \left( \frac{i_{q,t}}{k_{q,t-1}} - \delta - g \right)^2.$$  

The term $\frac{n}{2} (b_{f,t} - \bar{b}_f)^2$ measures portfolio adjustment costs associated with the deviations of foreign loans from their steady-state level.

The public sector

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 follows:

\[ R_t \Delta b_t + \Delta d_{c,t} + \Delta d_t = \frac{r_d - g_d}{1 + g} d_{c,t-1} + \frac{r_{dc} - g_d}{1 + g} d_{c,t-1} + \frac{r_t - g}{1 + g} P_t b_{t-1} + P_t (I_{t-1} + m_t, T_t + P_t i_{t-1} - \mu_t z_{t-1} - h_t)

\]

\[ (P_t i_{t-1} \gamma_{ct}, + g_t P_t \gamma_{ct, t} + g_x \gamma_{xt, t} + g_m \gamma_{mt, t}) - \sum_{q=j,n,x} \left[ f_q (r_q, t - \delta P_q) k_{q, t-1} + f_{q, t} w_{q, t} L_{q, t} \right] - f_{q, t} w_{q, t} S_t \]  

(A8)

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 \( d_{c} \), respectively.

The term \( P_t i_{t-1} \gamma_{ct, t} \), where \( I_{t-1} = \mathcal{M}_C(i_{t-1} - i_{z,0}) + i_{z,0} \), 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 costs on external commercial debt, on domestic debt and on concessional debt, plus the principal. The 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. The interest rate is determined through the uncovered interest rate parity, that is, the interest differential between domestic and foreign loans.

**B. Base case calibration of the model**

The calibration of the model requires data on the structure of the economies, elasticities of substitution, depreciation rates, tax rates, debt stocks and the returns on infrastructure and education capital at the benchmark equilibrium. Once values are set for these parameters, all other variables that enter the model can be deduced by order conditions associated with the solution to the private agents’ optimization problems and various adding-up constraints.

Table A1 gives the value of key parameters of the model. These parameter values have been calibrated to the average African economies; the data reflect the structure of the economies prior to the pandemic crisis. Below we discuss the values assigned to the key parameters.

- The consumption shares for the formal non-traded good (\( \gamma_{ct} \)), the informal good (\( \gamma_{ct} \)), the imported consumer good (\( \gamma_{cm} \)), and the traded good (\( \gamma_c \)): the data on consumption shares for these categories of goods are taken from the GTAP Africa social accounting matrix.\(^{17}\) Formal non-traded goods imported goods and traded goods account for 40, 10 and 30% of total household consumption, respectively. By deduction we get the consumption share for the informal goods, which represent 20%. These consumption shares and the values assigned to other parameters imply GDP shares of 31.8, 25.5 and 42.7% for the formal non-tradable sector, the informal sector and the tradable sector.
- Intertemporal elasticity of substitution (\( \tau \)): according to estimates in Agénor and Montiel (2015), the value of this parameter for less-developed countries lies between 0.15 and 0.75. For the base case calibration, we choose the value of 0.40, which is close to the average estimate for low income countries (LICs) in Ogaki et al. (1996).
- Elasticity of substitution in consumption between traded goods and other goods (\( \gamma_t \)): this parameter is calibrated to 0.5, in line with Lluch et al. (1977), Deaton and Muellbauer (1980), Blundell (1988), and Blundell et al. (1993), who
find that estimates of compensated elasticities of demand tend to be small at high levels of aggregation, especially when food claims a large share of total consumption.

- Elasticity of substitution in consumption between the composite formal non-traded good and the informal good ($\varepsilon_2$): most of the estimates of demand systems do not distinguish between goods produced by formal and informal firms. The right value for $\varepsilon_2$ depends on whether firms in the formal and informal sectors sell in similar or distinct product markets. The sectoral overlap between formal and informal firms seems to suggest that both high and low values of $\varepsilon_2$ are plausible. For the base case calibration, we set $\varepsilon_2 = 0.5$ to reflect the fact that, in LICs, informal firms operate in services and commerce while formal firms dominate in manufacturing. Alternatively, a higher value can be assigned to $\varepsilon_2$ to reflect the fact that both types of firms sell in similar product markets.
- Wages in the formal and informal sectors ($w_s, w_n, w_j$): the wage for skilled labor ($w_s = 3$) agrees with data on wages for workers with high vs. low levels of education in Latin America (Joumard & Velez, 2013) and with empirical estimates that each additional year of upper-level education raises earnings by 11–13% (Peet et al., 2015). Data on the wage differential between formal low-skilled labor and informal labor is highly country specific and rare. For the base case we choose a 40% wage differential between the two types of labor, that is, $w_n = 1$ and $w_j = 0.60$.

### TABLE A1 Calibration of the model

| Parameter/variable                                                                 | Value in base case |
|-----------------------------------------------------------------------------------|--------------------|
| Consumption shares of the imported consumer good and the formal and informal goods ($\gamma_m$, $\gamma_n$, $\gamma_j$) | $\gamma_n = 0.40$, $\gamma_m = 0.10$, $\gamma_j = 0.20$, $\gamma_s = 1 - \gamma_n - \gamma_m - \gamma_j = 0.30$ |
| Intertemporal elasticity of substitution ($\tau$)                                 | 0.40               |
| Elasticity of substitution between good $x$ and goods $n$, $j$ and $m$ ($\varepsilon_1$) | 0.5                |
| Elasticity of substitution between the formal and informal traded goods ($\varepsilon_2$) | 0.5                |
| Elasticity of substitution between the imported consumer good and the formal good ($\varepsilon_3$) | 0.5                |
| Wages in the formal and informal sectors ($w_s$, $w_n$, $w_j$)                    | $w_s = 3$, $w_n = 1$, $w_j = 0.6$ |
| Factor shares in the formal sector ($\alpha_n$, $\delta_n$)                      | $\alpha_n = 0.50$, $\delta_n = 0.30$ |
| Factor shares in the informal sector ($\alpha_j$, $\delta_j$)                    | $\alpha_j = 0.20$, $\delta_j = 0.20$ |
| Factor shares in agriculture ($\chi$, $\alpha_x$, $\delta_x$)                   | $\chi = 0.30$, $\alpha_x = 0.20$, $\delta_x = 0.05$ |
| Depreciation rates ($\delta$, $\delta_x$, $\delta_m$, $\delta_j$)              | $\delta = \delta_x = \delta_m = \delta_j = 0.05$ |
| Real interest rate on concessional + semiconcessional loans ($r_{d+}$)           | 0.013              |
| Real interest rate on external commercial debt ($r_{dc}$)                        | 0.06               |
| Trend growth rate ($g$)                                                          | 0.023              |
| Ratio of user fees to recurrent costs ($f$)                                       | 0.5                |
| Consumption VAT rates ($h$, $g_n$, $g_x$)                                        | $h = 0.20$, $g_n = 0.30$, $g_x = 0.10$ |
| Taxes on profits, wages, and land rents ($f_n$, $f_j$, $f_x$, $f_w$, $f_wj$, $f_wx$) | $f_n = 0.15$, $f_j = 0.03$, $f_x = 0.02$, $f_w = 0.12$, $f_wj = f_wx = f_w = 0.01$ |
| Efficiency of public investment ($s$)                                             | 1                  |
| Absorptive capacity constraint ($\phi$)                                           | 0                  |
| Return on infrastructure ($R_z$)                                                  | 0.20               |
| Real interest rate on domestic bonds ($r_d$)                                      | 0.10               |
| Real interest rate on foreign loans held by the private sector ($r_f$)            | 0.10               |
| Parameter/variable                                                              | Value in base case |
| Interest elasticity of private capital flows ($\Gamma$)                           | 1                  |
| Ratio of maintenance spending to GDP ($P_{zm}/GDP$)                              | 0.01644            |
| Ratio of infrastructure investment to GDP ($P_{zi}/GDP$)                         | 0.06               |
| Ratios of investment in education to GDP ($P_{jz}/GDP$, $P_{iz}/GDP$)            | $P_{jz}/GDP = 0.028$, $P_{iz}/GDP = 0.012$ |
• Factor shares in the formal non-tradable sector (\(\alpha_n\) and \(\theta_n\)): data on factor shares are found in World Bank Enterprise Surveys and in social accounting matrices assembled by GTAP and the International Food Policy Research Institute. These sources suggest a capital share of 40–60% in LICs. The data in Thurlow and Wobst (2004) and Perrault et al. (2010) suggest similar numbers. Accordingly, we set \(\alpha_n = 0.50\).

There is no hard data on factor shares by skill or education level. Therefore, we set the cost share for high-skilled labor to be consistent with data on the share of high-education (secondary+) workers in the formal sector. The values assigned to \(\theta_n\) (0.30) and the wage rates \(w_k = 3\) and \(w_n = 1\) give an employment share of 33.3% for high-skilled labor. By way of comparison, the employment share for high-skilled labor is 35.6% in Côte d'Ivoire (Gunther & Launov, 2012) and 32.9% in Egypt (Harati, 2013).

• Factor shares in the informal sector (\(\alpha_j\) and \(\theta_j\)): good, sensible data are not readily available for factor shares in the informal sector. We chose cost shares to match data on the share of high-education workers in the informal sector and the share of the informal sector in total non-agricultural employment. High-education workers account for 6.2% of informal sector employment in Côte d'Ivoire (Gunther & Launov, 2012) and 7% in Egypt (Harati, 2013). The informal sector share in non-agricultural employment equals 75% in sub-Saharan Africa and 70% in South Asia and Southeast Asia (Jütting & de Laiglesia, 2009). For the base case values \(\alpha_j = 0.20\) and \(\theta_j = 0.20\), the high-skilled employment share in the informal sector is 6.3% and the sector's share in non-agricultural employment is 74.1%.

• Factor shares in formal tradable sector (\(\chi, \alpha_s, \text{ and } \theta_s\)): in the GTAP database, the cost share for land in less-developed countries ranges from 12 to 51%, while Fuglie (2010) cites studies that place the cost share between 22 and 29% in India, Indonesia, China, Mexico and sub-Saharan Africa; the common 50–50 split in sharecropping contracts (Otsuka, 2007) suggests a cost share of 50% for labor and 30–35% for land (the landowner usually provides equipment and structures in addition to land). Therefore, we set the cost shares for land, capital and high-skilled as \(\chi = 0.30, \alpha_s = 0.20\) and \(\theta_s = 0.05\), respectively.