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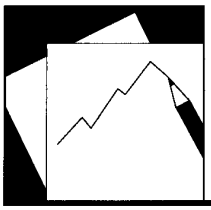

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The Investment-Financing-Growth Nexus: The Case of Liberia

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The Investment-Financing-Growth Nexus: The Case of Liberia

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Abstract

Liberia is facing large infrastructure gaps and developmental needs that constrain the country's growth potential. The government has set an ambitious agenda to transform the economy and to reach middle-income country status by 2030 by scaling up investment in infrastructure and human capital. Fiscal space remains constrained by rigidities in current spending and the government will need to resort to borrowing to close some of the gaps. This paper presents an estimate of the nexus between public investment, financing, and growth in Liberia using an inter-temporal macroeconomic model. The model has been calibrated as much as possible to Liberian economic data and assumes that public investment has a high economic and social rate of return and is highly complementary toward private sector investment. The objective of the paper is to contribute to the debate on how fast public investment should be scaled up to address the country's developmental needs. The paper also highlights the trade-offs and potential risks associated with different financing options and the required changes in fiscal policy to ensure macroeconomic stability.

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I. INTRODUCTION

In 2003, political stability was restored in Liberia after a protracted civil war that destroyed the economy and the country's stock of human capital. Today, Liberia faces a severe infrastructure shortage and large developmental needs. In response to these challenges, the government has set the ambitious goal of tranforming the economy and achieving middle-income country status (income per capita of just over $1000) by 2030. Achieving this goal will require a significant increase in public investment and human capital, which given Liberia's limited resources, will require debt financing. Debt forgiveness granted in 2010, together with the strong macroeconomic performance of the last seven years provides a new opportunity to access foreign creditors. Even if Liberia does not reach middle income status by 2030, scaling-up public investment is critical to boost the country's growth potential and foster social and economic development.

The structural macroeconomic model developed by Buffie, et al. (2012) was used to evaluate several public investment strategies for Liberia. The model acts as a complement to the traditional IMF-World Bank debt sustainability framework. It offers a complete and coherent economic story for evaluating the government's plans to scale up public investment. It is particularly useful for evaluating the trade-offs and potential risks associated with different investment strategies. Several features of the model have been designed with low-income countries like Liberia in mind. Inefficiencies in the public investment process, absorptive capacity constraints, and limited household access to capital markets specifically reflect the challenges facing the Liberian economy.

The model assumes that public capital is highly productive and complementary towards private capital. All else being equal, a higher public capital stock leads to increased private capital investment and can serve as a catalyst to boost long-term growth. There is no free lunch, however; the borrowing to invest will increase the stock of debt which— if not managed properly—may become unsustainable, thus curtailing the positive effects of public investment and increasing the country's exposure to external shocks.

The model helps to assess the macroeconomic impact of scaling up public investment in Liberia, including the path of debt for different types of borrowing (concessional, external commercial, domestic, or a mix). It also allows the government to assess fiscal policy changes (higher taxes or lower spending) to increase investment. The main issue facing policymakers, which the model helps to analyze, is whether the long-run growth dividend (i.e., increase in per capita GDP growth terms relative to the steady state) that comes from increased investment accrues fast enough to sustain the short and medium-run increase in debt.

The model evaluates four scenarios: i) the public investment program agreed under the ECF arrangement (baseline scenario); ii) the authorities' more ambitious program (aggressive scenario) in which debt becomes unsustainable, reaching nearly 200 percent of GDP by year nine; iii) an intermediate case with more sustainable debt paths and less painful fiscal

adjustments; and iv) a simulation showing how some structural changes in the economy could increase growth and while limiting the increase in the level of public debt.

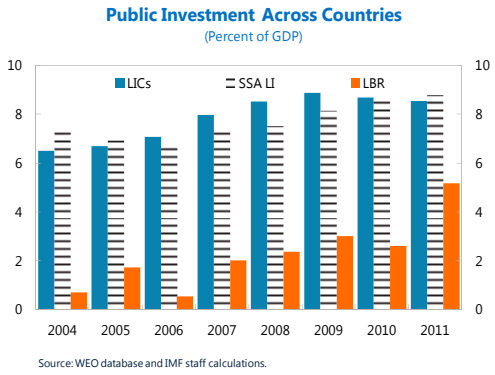
This paper is organized as follows. Section II describes the evolution of the Liberian economy and the need for a public investment boom. Section III describes the structure of the model and its calibration to Liberia. Section IV explains the model simulations of different investment strategies, and Section V concludes.

II. THE LIBERIAN EXPERIENCE AND THE NEED FOR PUBLIC INVESTMENT

Liberia's infrastructure suffered major damage during its recent civil war (1989–2003). The country's hydropower plant was destroyed, leaving most of the country in the dark. Transportation infrastructure was completely neglected, cutting off access to limited public services and completely isolating the country to both domestic and international trade. Schools and hospitals were damaged or destroyed, public institutions were abandoned and social indicators deteriorated sharply. Along with a deteriorated infrastructure, Liberia's managerial capacity to execute infrastructure projects was completely undermined as qualified staff fled the country.

Since the Peace Accords, signed in 2003, the Liberian economy has grown at a healthy rate of over 7 percent per year. While this may reflect an initial boost associated with the recovery after the massive losses during the civil war, real economic growth has still averaged a solid 7 percent over the last four years, driven both by mining and non-mining activities. Going forward, the mining sector is expected to be an important source of strong growth, but expanding the non-mining sector will be crucial to achieve broad-based and sustainable growth. Scaling up public investment will play a critical role in this process.

While public investment in Liberia reached 4.2 percent of GDP in FY 2011/12, it has been low—around 3 percent of GDP on average in the previous five years—and below that of other low income countries (LICs). Liberia also has a weak track record of project implementation with an execution rate of around 60–65 percent of budgeted capital expenditures, reflecting legal, institutional, and managerial bottlenecks which hamper the efficient selection and effective implementation of public investment projects.



Box 1. Liberia: Key Social Indicators

Liberia is a fragile state with massive infrastructure gaps and developmental needs as demonstrated by some key social indicators. The 2010 Heavily Indebted Poor Countries (HIPC) initiative opens the door for Liberia to address some these major constraints.

- Per capita income is very low, with 84 percent of the population as of 2007 living in poverty ($1.25 per day in PPP terms);
- Employment creation has been low; according to the 2010 Liberia Labor Force Survey, 68 percent of employed Liberians are in the informal sector;
- Child mortality rate (children under five) is 103 per 1,000, while the maternal mortality rate is high at 770 per 100,000 births, both of which are high compared to neighboring countries;
- Pipe-borne water—the main source of drinking water—is low and water deficiency affects about 61 percent of the population. Reasonable sanitation (percent of population with access) is very low at only 17 percent;
- Years of war affected the education system which needs to be rebuilt to deliver quality practical and vocational training; the adult literacy rate (literate adults over age 15) is 59 percent;
- Liberia ranks at the bottom of the UN's Human Development Index (174 out of 186 countries in 2013);
- Infrastructure is weak. The country currently produces 23 megawatts of electricity covering just 2–3 percent of the population at a cost of 50 cents per kilowatt hour, putting it among the most expensive in the world;
- Access to electricity is also a constraint to small-scale manufacturing and industrial enterprises; poor roads are an impediment to trade (both domestic and cross-border) and a constraint to access public services such as education and health, especially during the rainy season;

Liberia reached the completion point under the Heavily Indebted Poor Countries (HIPC) initiative in June 2010, helping the country bring down its external debt from close to 150 percent of GDP to less than 9 percent. The government's tax collections have increased substantially over the last six years (from 11 percent of GDP in FY 2005/06 to 22 percent of GDP in 2011/12). Aid inflows total around 39 percent of GDP, including some 2 percent of GDP for budget support. Current spending, however, has progressed as fast as the rise in tax intake. The government is making efforts to contain current spending, which together with the fiscal space created by the 2010 debt relief provides an opportunity to increase public investment.

The government has laid out a five-year development plan (the Agenda for Transformation, or AfT) in support of the country's goal to promote broad-based economic growth and to achieve middle income status by 2030. The plan focuses on five strategic pillars—at an estimated cost of $3.2 billion in 2012 present value terms over FY 2012/13 to FY 2016/17—to increase productivity, boost economic growth, and improve social inclusion, particularly by creating jobs, especially for its young population. The pillars are:

- *Economic transformation through investing in infrastructure*. In particular, rehabilitation of the hydropower plant and related transmission and distribution networks destroyed

during the civil war, improvement of trunk roads, rehabilitation and expansion of ports, and improvement in information and communications technology. Total infrastructure investment needed is estimated at $2.2 billion in 2012 present value terms, including $1.4 billion for roads and $0.5 billion in the energy sector, of which $0.2 billion is needed for the hydropower plant. The government has already secured some $0.2 billion in loans and grants for this project as well as some $0.1 billion for roads and ports.

- *Human development.* The strategy aims to increase access and improve the quality of education and health, provide social protection for vulnerable persons, and rehabilitate and expand the infrastructure in water and sanitation. The estimated cost is $0.5 billion.

- *Peace, security, and the rule of law*. The government intends to invest in the security sector to absorb some of the functions currently performed by the UN security forces in order to maintain a stable and peaceful environment as the UN begins its gradual drawdown (50 percent in a three-year period). The expected cost is $0.4 billion.

- *Governance and public institutions*. The government plans to invest US$0.1 billion on the public sector modernization and reform agenda, focusing on decentralization and local governance and enhanced transparency and accountability.

- *Cross-cutting issues*. The government intends to invest some $0.1 billion to develop youth skills and increase empowerment, child protection, gender equality, and human rights.

The government expects to finance its medium-term investment program by combining different financing sources. It is estimated that the government will contribute between 10–12 percent of the financing required to implement the investment program. Projected disbursement of existing and new loans account for about 18 percent of the AfT financing needs; estimated budget support grants and recently approved grants for the hydropower plant account for close to 11 percent of the total financing. The remaining 60 percent is still unfunded. The government is working to secure external resources (both loans and grants) from multilateral and bilateral sources and are also reaching to non traditional lenders (nonconcessional loans) to fully execute its development strategy.

Given the size of the government's investment plan, the government may need to assess potential changes to the current fiscal policies. The model below can be used to assess the trade-offs of alternative financing options for the government's Agenda for Transformation and their impact on the economy.

Table 1. Agenda for Transformation Cost Summary
(percent of GDP)

	FY 12/13	FY 13/14	FY 14/15	FY 15/16	FY 16/17
Pillar 1. Economic Transformation	11.7	30.0	22.9	20.6	11.6
Pillar 2. Human Development	3.4	6.8	7.4	7.2	6.9
Pillar 3. Peace, Security, and Rule of Law	0.9	4.6	4.8	4.0	3.7
Pillar 4. Governance and Public Institutions	0.8	1.2	0.9	1.2	0.5
Pillar 5. Cross-cutting Issues	1.3	2.6	2.2	2.3	2.2
Total	18.1	45.1	38.3	35.3	25.0

Sources: Ministry of Finance, Agenda for Transformation (as of May 2, 2013) and IMF staff calculations.

III. FEATURES OF THE MODEL AND CALIBRATION TO LIBERIA

In this section, we outline the basic structure of the model and highlight some key features that apply to Liberia. A more technical explanation of the paper can be found in Buffie et al. (2012). Briefly, we use a two-sector intertemporal macroenomic model designed for long-run analysis. It therefore does not include money or any nominal rigidities.

The model alows us to look at the dynamic interactions of public investment, growth, and fiscal policy. An increase in the level of public capital will increase private investment and growth in the long term, but in the medium term, the authorities must decide how to finance investment without increasing debt to unsustainable levels and within their legal framework.

A. Features of the Model

The model economy is comprised of two sectors, one for traded goods and one for non-traded goods. There is also an imported good (a traded good produced in another country), which can be consumed or used to produce capital. In each sector i (with $i = n, x$, where n is for the non-traded sector and x is for the traded/export sector), representative firms take private capital ($k_{i,t}$), labor ($L_{i,t}$), and effective public capital (z_t) to produce output using Cobb-Douglas technology:

$$q_{i,t} = A_{i,t}(z_{t-1})^{\psi_i}\left(k_{i,t-1}\right)^{\alpha_i}\left(L_{i,t}\right)^{1-\alpha_i} \qquad (1)$$

The role of public capital in the production function is the core feature of the model. Public capital is not sector-specific and, all else being equal, an increased stock of public capital increases output and raises the return on private capital and labor. An increased flow of public investment therefore boosts growth because of this complementarity of public and private capital.

Firms maxize the following objective function, where the choice variables are the labor and capital used as production inputs:

$$\max\ p_{i,t}q_{i,t} - w_t L_{i,t} - r_{i,t}k_{i,t-1} \tag{2}$$

The price of output in each sector is denoted by $p_{i,t}$, the wage by w_t, and the rental rate of capital by $r_{i,t}$. Note that the wage—unlike the rental rate of capital—is not sector-specific, as labor is mobile across sectors.

The economy is populated by two types of consumers: savers and non-savers. Each type i consumes a constant elasticity of substitution (CES) basket of goods given by equation (3), with a price index given by equation (4):

$$c_t^i = \left[(\rho_x)^{1/\epsilon}\left(c_{x,t}^i\right)^{\epsilon-1/\epsilon} + (\rho_m)^{1/\epsilon}\left(c_{m,t}^i\right)^{\epsilon-1/\epsilon} + (\rho_n)^{1/\epsilon}\left(c_{n,t}^i\right)^{\epsilon-1/\epsilon}\right]^{\epsilon/\epsilon-1} \tag{3}$$

$$P_t = \left[\rho_x\left(P_{x,t}\right)^{1-\epsilon} + \rho_m\left(P_{m,t}\right)^{1-\epsilon} + \rho_n\left(P_{n,t}\right)^{1-\epsilon}\right]^{1/1-\epsilon} \tag{4}$$

The parameter ϵ governs the intra-temporal elasticity of substitution. The parameters ρ_x, ρ_m, and ρ_n govern the distribution of goods in the basket and sum up to one.

Non-savers are constrained by an inability to access capital markets and must therefore consume all of their earned income in the period in which it is earned. Their hand-to-mouth behavior creates non-Ricardian outcomes that we observe in a low-income country like Liberia. Non-savers are subject to the following budget constraint:

$$(1 + h_t)P_t c_t^h = w_t L_t^h + \frac{a}{1+a}(R_t + T_t) \tag{5}$$

The constraint says that consumption (c_t, and the superscript h stand for "hand-to-mouth") after taxes (a value-added tax give by h_t) must be equal to labor income plus remittances and transfers. The parameter a governs the ratio of savers to non-savers in the economy.

Savers behave like standard utility-optimizing agents. They are able to smooth consumption over time by investing in traded or non-traded capital, or by borrowing in domestic or international debt markets. Their maximization problem is given by:

$$\max \sum_{t=0}^{\infty} \beta^t \frac{(c_t^t)^{1-1/\tau}}{1-1/\tau}$$

subject to a budget constraint and two capital accumulation equations:

$$
\begin{aligned}
P_t b_t^s - b_t^{s*} = {} & r_{x,t} k_{x,t-1}^s + r_{n,t} k_{n,t-1}^s + w_t L_t^s + \frac{R_t}{1+a} + \frac{T_t}{1+a} \\
& - \frac{1+r_{t-1}^*}{1+g} b_{t-1}^{s*} + \frac{1+r_{t-1}}{1+g} P_t b_{t-1}^s \\
& - P_{k,t}\left(I_{x,t}^s + I_{n,t}^s + AC_{x,t}^s + AC_{n,t}^s\right) \\
& - P_t c_t^h (1+h_t) - \Upsilon_t^s - \Phi_t^s
\end{aligned} \tag{6}
$$

$$
(1+g) k_{x,t}^s = I_{x,t}^s + (1-\delta) k_{x,t-1}^s \tag{7}
$$

$$
(1+g) k_{n,t}^s = I_{n,t}^s + (1-\delta) k_{n,t-1}^s \tag{8}
$$

Domestic bonds are denoted by b_t^s and foreign bonds by b_t^{s*}; the interest rates on each are given by r_t and r_t^*, respectively. Capital adjustment costs are given by $AC_{i,t}$ for each sector. Portfolio adjustment costs linked to foreign liabilities are given by Y_t^s, which captures the degree of financial account openness. Profits of domesic firms are represented by Φ_t^s, and finally, the rate of depreciation of capital is given by δ.

The budget constraint simply says that income (from labor, capital, remittances, transfers, bond holdings, and firm profits) must not exceed expenses (on debt accumulation, investment, investment adjustment, and portfolio adjustment).

An important feature of the model, designed specifically to match low-income economies, is the process by which public capital is accumulated. It is best understood as a two-step process. In the first step, the government allocates money to be invested in public capital, which evolves according to a standard accumulation equation:

$$
z_t = I_{z,t} + (1-\delta) z_{t-1} \tag{9}
$$

In the second step, some of that public capital is allocated for productivity-enhancing infrastructure (z_t^e), which we have been calling effective public capital:

$$
z_t^e = \bar{s}\bar{z} + s(z_t - \bar{z}) \tag{10}
$$

The parameter s governs the efficiency of public investment; that is, the rate at which public capital is turned into productivity-enhancing infrastructure. This parameter takes a value between zero and one, implying that one dollar spent on public investment yields less than one dollar's worth of public infrastructure. Note that it is this z_t^e which enters into the representative firm's production function.

In low-income countries, as written in Hulten (1996) and Pritchett (2000), the productivity of infrastructure is high while the return on public spending is low. This feature of the model

accounts for this fact, since the return on investment can be quite low if the efficiency of that investment is also low.

The government is also subject to a budget constraint, which allows us to specify the size of the fiscal adjustment required for a given investment buildup. The budget constraint equates government financing from domestic debt, external commercial debt ($d_{c,t}$), concessional debt (d_t), and taxes with expenditures on debt service, investment, transfer spending (T_t), and grant aid (G_t), which is exogenous:

$$\begin{aligned} P_t\Delta b_t + \Delta d_{c,t} + \Delta d_t \\ = \frac{r_{t-1}-g}{1+g}P_t b_{t-1} + \frac{r_{d,t-1}-g}{1+g}d_{t-1} \\ + \frac{r_{dc,t-1}-g}{1+g}d_{c,t-1} + P_{z,t}I_{z,t} + T_t - h_t P_t c_t - G_t \end{aligned} \tag{11}$$

The path for concessional debt and public investment spending is exogenous to the model.

For a given initial level of taxes and transfer spending, the budget constraint can be re-written as a gap between spending and revenues:

$$\begin{aligned} GAP_t = \frac{1+r_{d,t}}{1+g}d_{t-1} - d_t + \frac{r_{dc,t-1}-g}{1+g}d_{c,t-1} \\ + \frac{r_{t-1}-g}{1+g}P_t b_{t-1} + P_{z,t}I_{z,t} + T_o - h_o P_t c_t - G_t \end{aligned} \tag{12}$$

$$GAP_t = P_t\Delta_{bt} + \Delta d_{c,t} + (h_t - h_{to})P_t c_t - (T_t - T_o) \tag{13}$$

In the long run, for debt to be sustainable, the gap must be covered by adjustments in taxes and transfers (current transfers). In the short and medium term, though, the gap may be closed with additional borrowing. If the fiscal adjustment occurs too slowly, however, the interest payments on accrued debt will rise faster than revenue and the path of debt explodes. This is the core dilemma facing policymakers—timing the fiscal adjustment so that it is not too painful, but not so slow that debt is unsustainable.

B. Calibration to Liberia

Three parameters govern the dynamics of debt in the model. First is the return on public investment, which is the marginal product of effective public capital net of the depreciation rate. There is no estimate of this parameter for Liberia, so we set it at 25 percent, based on estimates for Sub-Saharan Africa, though there is considerable variation across countries.

The second key parameter is the efficiency of public investment, or the rate at which public investment is converted into productivity-enhancing capital. Pritchett (2000) estimates that around half of government investment spending does not actually create capital. We use this estimate to inform our baseline, which assumes that, over the projection period, 50 percent of investment spending goes towards productive public capital formation while the remaining is

spent in non-productive projects. While this assumption maybe realistic in the early years of increasing public investment as the country faces important capacity constraints, it may not be fully accurate once a solid public investment framework is in place to ensure that projects selected are aligned to the government's priorities, they are efficiently evaluated and selected based on their value for money.

By increasing the efficiency of investment over time, it is possible to lower the debt path and increase the growth dividend for a given level of investment spending, or alternatively achieve the same growth dividend with reduced reliance on new tax revenue or commercial borrowing. In one scenario below, we increase this parameter over time to demonstrate the effect of increased investment efficiency.

Third is the absorptive capacity constraint, which captures the difficulties stemming from planning, coordination, and management problems. This can manifest itself in cost overruns or low execution ratios (i.e., inability to spend all allocated money). Constraints on absorptive capacity are currently a problem for Liberia, and we assume that cost overruns are approximately 20 percent to begin with (i.e., similar to the cost overrun estimated by the government for the rehabilitation of the hydropower plant). Reducing this constraint can have a significant effect on the path of debt, and we show in a scenario below how big this impact can be. Box 1 details strategies for how this may be achieved.

Because we are using a general equilibrium model, it is important to carefully consider how our steady state is parameterized as the simulations we show are all deviations from the model's initial equilibrium. We use the latest data and medium-term macroeconomic framework underlying the joint IMF-World Bank debt sustainability analysis (DSA) for Liberia to calibrate the level of initial debt-to-GDP ratios (commercial, domestic, and concessional), remittances, and grants. Based on the underlying data, we assume a per capita potential growth rate of 3.0 percent and an initial public investment level of 4.0 percent of GDP (steady state).

Because the model divides consumers into those who can smooth consumption across time and those who cannot, the calibrated level of savers to non-savers is very important. It controls the degree to which domestic interest rates react to fiscal policy. Because there is not a reliable estimate of this value for Liberia, we use the estimate from Buffie, et al. (2012). It is possible that the proportion of savers is higher than what we assume here due to widespread adoption of microfinance. However, it is likely that the informal nature of microfinance institutions in rural areas and the limited degree to which rural workers are able to save means that many users would still be considered non-savers.[2]

We parameterize the model to reflect the high import share of Liberia's public capital. For many of the current investment projects, labor and materials are imported rather than locally

[2] Recall that the purpose of including non-savers into the model is to break Ricardian equivalence. Poor rural workers who save a small fraction of their income in informal microfinance institution are unlikely to behave in a non-Ricardian manner.

hired. We expect that this will have implications for the exchange rate effects of large-scale public borrowing (this is the case, detailed in the simulations below). Specifically, we assume that 70 percent of public capital components are imported.

For the rest of the parameters, no data are available for Liberia-specific estimates. We use the values presented in Buffie, et al. (2012), which are estimates taken from the literature for Sub-Saharan African.

Table 2. Model Calibration for Baseline Scenarios

Parameter	Value	Definition
τ	0.34	Intertemporal elasticity of substitution
ϵ	0.90	Intratemporal elasticity of substitution across goods
α_x	0.40	Capital's share in value added – traded sector
α_n	0.55	Capital's share in value added – non-traded sector
α_k	0.50	Cost share of non-traded inputs in the production of private capital
α_z	0.41	Cost share of non-traded inputs in the production of public capital
δ_x, δ_n, δ_z	0.05	Capital depreciation rates
ρ_x	0.32	Distribution parameter – traded goods
ρ_n	0.44	Distribution parameter – non-traded goods
g	0.03	Trend per capita growth rate
r_o	0.10	Initial real interest rate on domestic debt
$r_{dc,o}$	0.06	Real interest rate on external commercial debt
$R_{z,o}$	0.25	Initial return on public investment
b_o	0.017	Initial public domestic debt to GDP ratio
d_o	0.10	Initial external concessional debt to GDP ratio
G_o	0.017	Initial grants to GDP ratio
R_o	0.05	Remittances to GDP ratio
$I_{z,o}$	0.041	Initial ratio of public investment to GDP
s	0.50	Efficiency of public investment
h_o	0.07	Initial consumption VAT rate
a	1.50	Ratio of savers to non-savers

Box 2. Improving Public Investment Execution in Liberia

Scaling up infrastructure investment is critical to achieving the AfT goals. However, legal, institutional and managerial bottlenecks continue to hamper project selection and efficient project implementation. The main issues that need to improve absorptive capacity and efficiency include:

- Legal and political constrains could be improved by properly: prioritizing project ideas; requiring pre-feasibility and feasibility studies to strengthen project design and increase execution level; submitting and approving the budget on time; and observing the public sector procurement law.
- Institutional capacity constraints could be tackled by: letting the recently established Project Management Office (PMO) evaluate and select projects in line with the AfT priorities; train key staff at line ministries in the project investment cycle; maintain a database of essential information for projects at an early stage in the project cycle; improve coordination between the MOF and implementing line ministries; and periodic meetings to report performance and delaying factors to enhance execution.
- Private sector capacity constraints could be reduced by: broadening the list of construction companies to include non-resident firms; pre-qualifying potential companies to accelerate the procurement process; limiting the number of projects allocated to a single contractor and penalizing those not meeting deadlines and quality; and pooling together similar small projects.
- Procurement constraints could be addressed by: strengthening procurement capacity for large and strategic projects which require competitive bidding; starting drafting procurement plans and bidding documents ahead of budget approval; allocating projects before the end of the rainy season to ensure execution picks up in the dry season.

IV. EVALUATION OF INVESTMENT STRATEGIES

The main issue policymakers face, which the model can help analyze, is whether the long-run growth benefit that comes from increased public investment accrues fast enough to offset the short- and medium-run increase in debt. We use the model to evaluate different scaling up public investment programs. The baseline scenario reflects the medium-term investment program agreed under the ECF arrangement. The aggressive scenario shows the tradeoffs from the authorities' more ambitious targets; under this rapidly increasing public investment, debt becomes unsustainable reaching near 200 percent of GDP by year nine. Finally, we present an intermediate scaling-up plan with more a sustainable debt path and less painful fiscal adjustments. We also run simulations to show that some structural changes in the economy can contribute to increase growth and reduce the level of debt.

A. Baseline Investment Scenario

The baseline scenario roughly corresponds to the government's current investment strategy. Public investment is rapidly scaled up from 4 percent of GDP to 12 percent of GDP. After six years, investment declines almost as quickly back to around 5 percent of GDP, where it stays permanently.

Grant aid rises modestly from its initial level of 1.7 percent of GDP to 2.1 percent of GDP and remains constant. There is no fiscal adjustment in the form of changes to tax policies or current spending, and all additional financing is assumed to come from concessional lending.

Under the baseline scenario, the increase in foreign financing (i.e., grants and concessional lending) leads to an 11 percent exchange rate appreciation by year two, returning to its original level by year ten. This is accompanied by a decline in traded output as the higher exchange rate causes the export goods sector to contract by nearly six percent by year two.

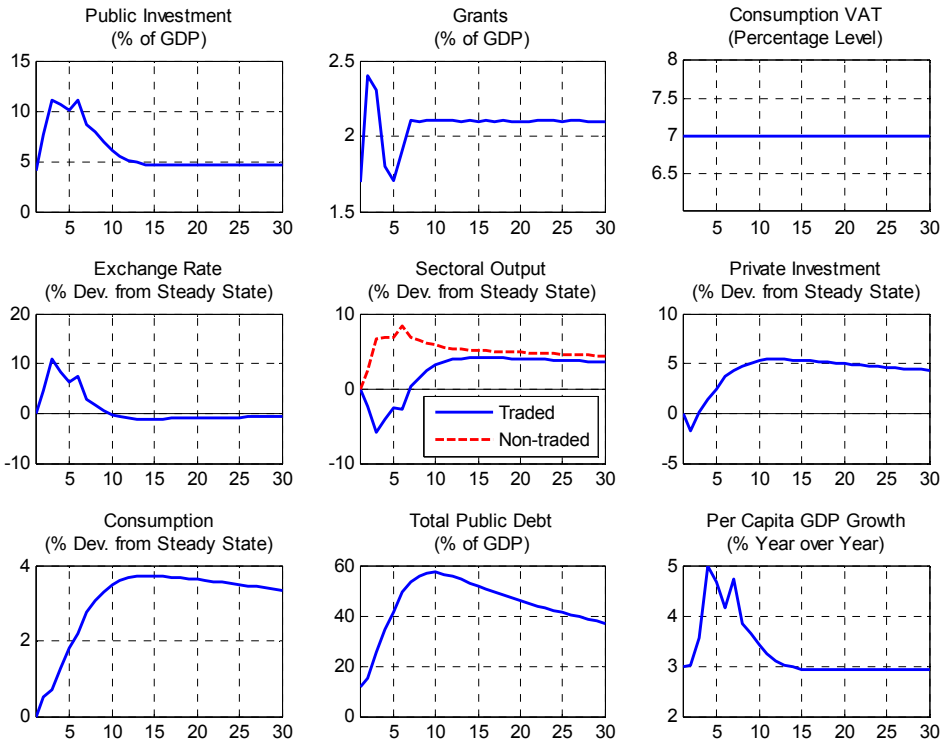
Private investment initially dips by about one percent before rising back above its initial level, caused by the sharp decline in traded output. Real per capita GDP growth is also stagnant at the 3 per cent in the steady state for years one and two before it rises above its long run level of three percent. On the plus side, private consumption increases immediately as a result of the inflow of foreign aid, though the increase is rather modest (it is nearly four percent higher by year 12 before it begins to return to its initial level).

Total public debt as a share of GDP rises to 58 percent at year ten before falling to 38 percent by year 30 (the new debt is composed entirely of concessional loans). Real per capita GDP growth stays above four percent per year from years three through seven, then gradually declines back to its long run level of three percent.

The peak debt-to-GDP ratio of 58 percent is not unreasonably high, but the composition of the growth dividend in this scenario is somewhat worrisome. Real per capita growth comes mostly from an increase in non-traded output, with other traditional measures of debt sustainability like debt-to-exports pointing out to higher risk of debt distress. Despite this result implies that Liberia is going against the pattern of export-led growth that has successfully brought other countries, notably those in Southeast Asia, out of poverty, further adaptation of the model to capture the uniqueness of Liberia's economy is still warranted.

Ultimately, the investment surge is meant to boost growth so that Liberia can reach middle-income country status by 2030, but given the relative conservative level of the scaling up of investment, it is likely that the strategy will fall short of that goal. Given the path of debt in this scenario is sustainable, it is possible the government could afford to borrow higher amounts. This suggests that a more ambitious investment strategy is needed to achieve the country's long-run growth goals. In the next section, we analyze just such a strategy as laid out by the authorities.

Figure 1. Baseline Investment Strategy



It is likely that the exchange rate path outlined in this scenario is more volatile than what would be experienced in Liberia given exports are driven by commodities will be less affected by the exchange rate. It is expected that the natural resource sector will continue to drive the projected increase in exports in Liberia. Additionally, the country's investment plan focuses in large part on developing the electricity grid and improving the country's road and transportation infrastructure which represents the two main binding constraints to growth. Currently, Liberia has the highest electricity prices in the world, and its roads coverage is among the lowest in the world.

In the model, the exchange rate appreciation is caused by increased demand for domestic goods from the influx of foreign money (in this case, concessional lending and grant aid). This domestic price pressure is likely to be mitigated in Liberia because the investment projects specifically target two industries currently contributing to high domestic prices. The model accounts only partially for this industry-specific investment, but we believe that the exchange rate story is likely to be more muted than it appears here—and so the negative impact on growth from this channel is also likely to be much smaller. This conclusion holds for the rest of the scenarios, some of which show particularly extreme exchange rate appreciations.

B. Aggressive Investment Scenario

This scenario corresponds roughly to the authorities' aspirational plans. It follows from the belief that a more aggressive investment strategy will be needed for Liberia to achieve middle income country status. Public investment, starting from 4 percent of GDP as before, quickly rises to 20 percent of GDP by year six, then falls again and is back to 5 percent, permanently, by year twelve. Additional financing is assumed by the authorities to come from grants, which increase to three percent of GDP, and from concessional lending.

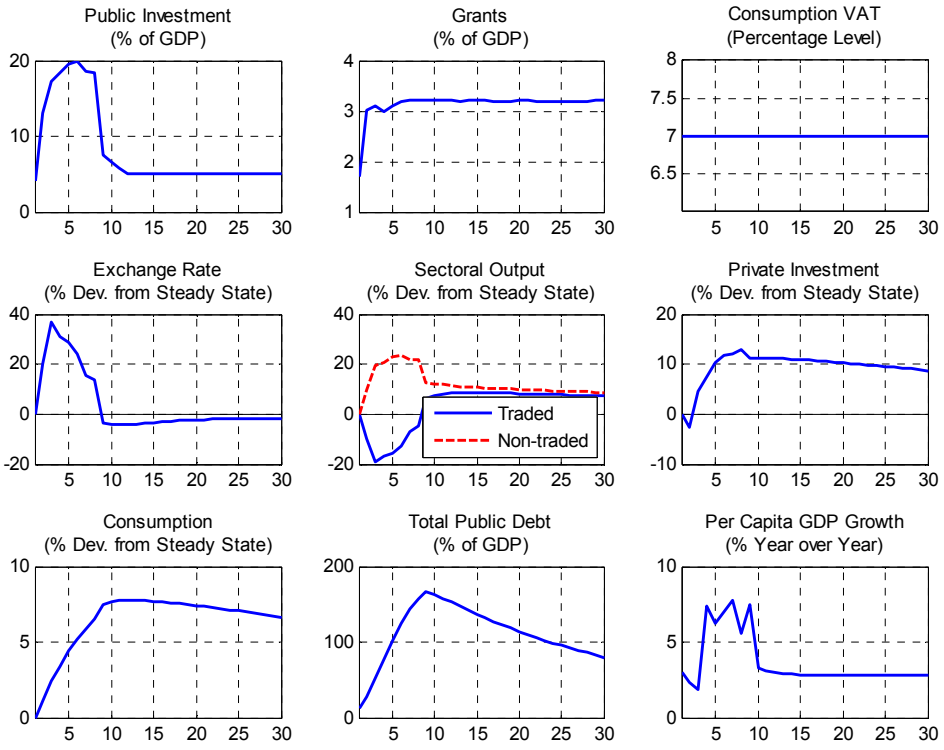
The story here is similar to that in the baseline scenario with the exchange rate appreciating. The higher grant aid and the non-concessional lending provide a massive inflow of foreign cash to the economy, and as in the baseline case, the traded goods sector is affected negatively. In this case, the exchange rate appreciates by about 37 percent from its initial level and does not fall back until year nine of the simulation.

This exchange rate appreciation by itself would likely be without precedent. Panel 4 in Figure 2 shows that the exchange rate appreciation would lead to a rapid decline in the tradable sector of about 20 percent in the short run. This presents the same challenges as the baseline case, in that it exacerbates other traditional measurements of debt risk like total debt-to-exports ratio.

On the bright side, private investment rises significantly after a short hiccup in year one of the scenario, peaking at about 12 percent above its initial level in year six before slowly declining. Consumption also rises permanently, increasing by seven percent by year ten and declining slowly as well. This suggests that debt-financed public investment can increase consumer welfare, though the costs of doing so in this case are overwhelming given the increase in consumption and investment.

Most worrisome is the rise in the total stock of debt. Panel 8 of Figure 2 shows that the debt-to-GDP ratio rises to over 150 percent of GDP in year nine of the scenario. Although the debt level appears sustainable in the strict sense that it eventually begins to decline, in no real way is it a sustainable level of debt. The working assumption is that nonconcessional loans will arise to close the fiscal gap, but nonconcessional borrowing channels are likely to close far before the nation reaches this kind of debt level. This level of debt would likely trigger a crisis by almost any conventional measure and paints this scenario as unrealistic.

Figure 2. Aggressive Investment Strategy



C. Intermediate Investment Scenario

In this section, we outline a moderate investment scenario designed to create modest and sustained real per capita GDP growth while keeping the stock of debt at manageable levels. As before, public investment is assumed to begin at 4 percent of GDP, then it rises for four years before peaking at 13 percent of GDP. Over the next seven years it falls gradually to its new permanent level of 5 percent of GDP (depicted in Figure 3).

Grant aid is assumed to increase only modesty from its initial level of 1.7 percent of GDP to 2.1 percent of GDP. There is no fiscal adjustment, so all remaining financing needs must be covered by concessional borrowing. This assumption is used to compare this scenario to the two prior scenarios.

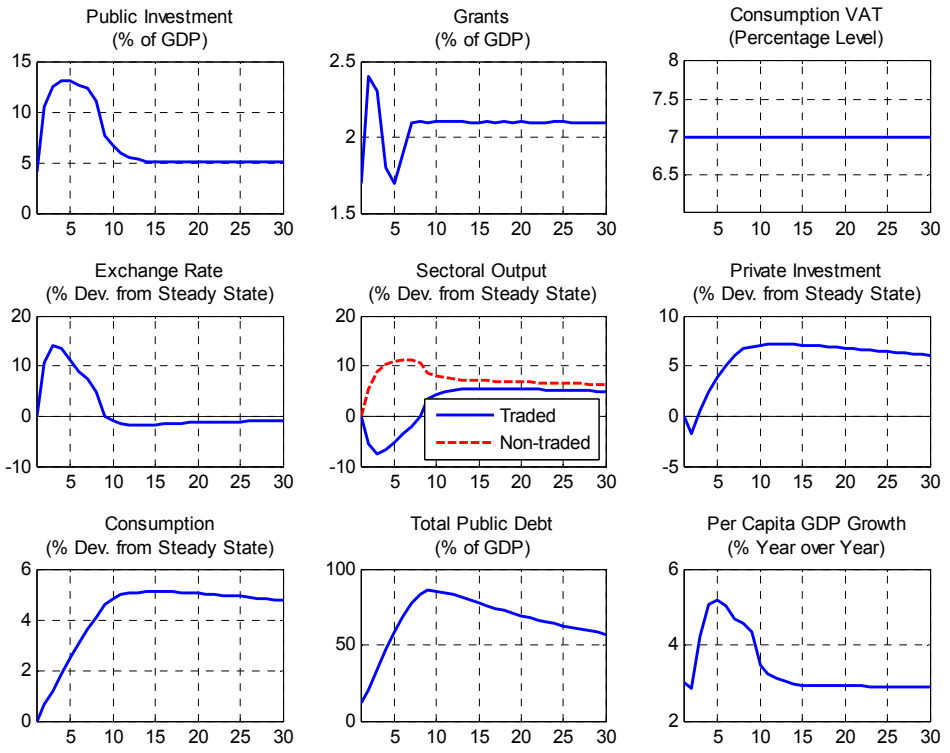
As before, the influx of borrowed money and grants lead to an exchange rate appreciation. Traded output falls and non-traded output rises. Total output initially contracts, though on balance real per capita GDP growth increases from its steady state of 3 percent to about five percent per year. Consumption rises by about five percent by the time the investment surge is over, so this strategy is welfare-enhancing.

The stock of debt, which again begins at 11 percent of GDP, shoots up to 86 percent of GDP, considerably higher than any reasonably sustainable level. The debt profile is not explosive (i.e., continues to increase permanently) in the sense that it eventually begins to decline only

because the debt is assumed to be concessional; so compounding interest payments (i.e., commercial borrowing) will not either lead to an explosive but certainly to a more unsustainable trajectory in a shorter period of time. Still, no external lender would consider providing lending to a country with high risks of debt distress, even if prospects for growth were otherwise good.

In other simulations not presented in this paper, financing with commercial lending is explored. The burden of maintaining the debt becomes overwhelming, and the debt trajectory rapidly becomes explosive. After ten years, the stock of debt is over 100 percent of GDP, and then continues to rise to nearly 200 percent of GDP after 30 years. This level of debt is not only unmanageable but will require a permanent and painful fiscal adjustment for a several years.

Figure 3. Intermediate Investment Strategy



D. Intermediate Investment Strategy with Structural Reforms

One possibility is that the authorities can explore structural reforms aimed at increasing the efficiency of the public investment process. We consider two parallel strategies: increasing the efficiency of public investment (that is, directing a higher share of investment toward productivity-enhancing projects) and reducing the level of cost overruns. In reality, these two are very tightly related concepts that are difficult to measure separately, whereas they are separate concepts in the context of the model used here.

Recall that for every dollar directed towards infrastructure investment, some fraction *s* is spent on productivity-enhancing public capital that enters into the firm production function. In the baseline calibration, we assume that this fraction is 50 percent. In this scenario (depicted in Figure 4), we gradually increase investment efficiency over 10 years, so that by the end of the investment period, 90 percent of allocated money was spent on effective public capital. Additionally, in the baseline calibration, we assume that public investment projects run over cost by about 20 percent. Here, we assume that the level of cost overruns slowly declines over the 10 year investment surge to about 10 percent.

As in the case of aggressive investment, we assume that grant aid increases to three percent of GDP. This matches the authorities' assumption that donors will be able to fill some of the government's financing needs and give more fiscal space for public infrastructure investment. Additional financing comes from concessional lending, as has been the working assumption throughout the paper. Taxes are again held constant so that the investment surge does not come at the expense of private consumption.

This scenario delivers a very productive investment surge, real per capita GDP growth rises to five and a half percent by year five, and stays above four percent per capita through the end of year ten. There is still an increase in the exchange rate that leads to a fairly sharp contraction of traded output, but private consumption and investment both increase substantially, indicating that the strategy is likely to be welfare-enhancing. Total debt-to-GDP rises, but peaks at a level of 70 percent of GDP around year nine before it begins to decline over the next two decades. This compares very favorably to the intermediate investment simulation with no reform, where debt rises to 86 percent of GDP.

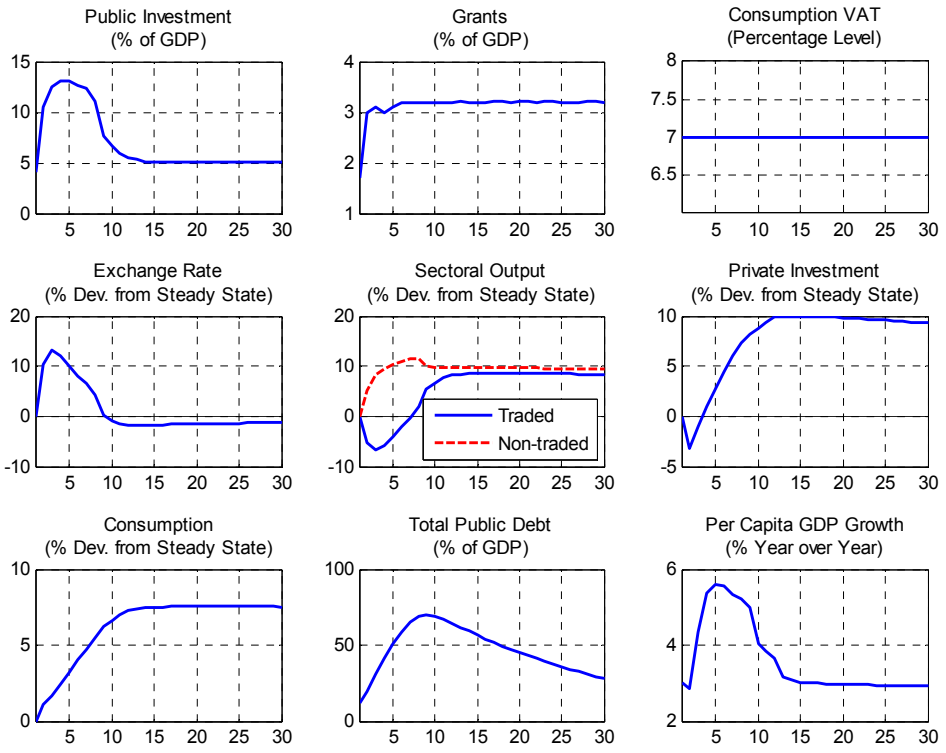
The cumulative growth dividend is calculated as the cumulate difference over 10 years of annual per capita GDP growth above and beyond the steady state baseline growth rate of 3 percent, and this intermediate scenario with structural reforms boosts growth by 16 percentage points. The table below compares the scenarios:

Table 3. Comparison of Scenarios

Scenario	Growth Dividend	Peak Debt-to-GDP
Baseline Investment	9.0	57.2
Aggressive Investment	21.8	167.1
Intermediate Investment	12.4	85.8
Intermediate Investment with Structural Reforms	16.4	70.0

This simply confirms what we learned from the simulations above: an intermediate investment strategy combined with an increase in aid and some structural reforms offer the best path forward for achieving sustained growth and manageable debt.

Figure 4. Intermediate Investment Strategy with Structural Reforms



V. CONCLUSION

The simulations presented here capture some of the costs and benefits of three potential public investment strategies. The model results provide background to support the government's objectives and expectations to scale up public investment to stimulate the economy while flagging the risks related to debt sustainability.

Some caution is required when interpreting the simulations presented here. Liberian data is limited, the model relies on some average parameters calculated for other LICs, and it abstracts away from reality in some important ways (e.g., a two-sector economy, only two types of consumers, agents with perfect foresight, etc.). Even with this in mind, the model still helps to gauge the relative costs and benefits of various investment and financing scenarios.

Further work is needed to capture some of the specific features of the Liberian economy in the structure of the model. For example, Liberia is a highly dollarized economy, so the exchange rate appreciation observed in the scenarios here are likely overstated. Besides, Liberia's growing natural resource sector can be modeled more formally in future work.

As expected, the more ambitious investment program yields the larger growth dividend over the medium term, but it comes at the risk of unsustainable debt; assessing other options is therefore warranted. The intermediate scaling up option in which the government is able to secure some 2 percentage points of GDP in new grants for budget support results in stronger growth dividends and more stable debt dynamics.

In addition to securing the ideal balance of financing options, there is a critical need to increase the efficiency of public investment in Liberia. The government needs to step up efforts to tackle bottlenecks to project implementation and even more importantly to properly prioritize and select high return projects that effectively translate investment dollars into productive capital.

Adjustments in taxes or in current spending (net transfers) may be painful policies which may have high political costs but may also be required to successfully implement the government's Agenda for Transformation. The authorities are rightly focusing on creating fiscal space to scale up public investment, but further efforts to streamlining current spending and increasing revenue collections are warranted.

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