WP/15/164

IMF Working Paper

Macroeconomic Challenges of Structural Transformation: Public Investment, Growth and Debt Sustainability in Sierra Leone

Lacina Balma and Mthuli Ncube

 WP/15/164

IMF Working Paper

Research Department and Strategy, Policy, and Review Department

Macroeconomic Challenges of Structural Transformation: Public Investment, Growth and Debt Sustainability in Sierra Leone

Prepared by Lacina Balma and Mthuli Ncube*

Authorized for distribution by Andrew Berg and Catherine Pattillo

July 2015

Abstract

This paper analyzes the link between public investment, economic growth and debt sustainability in Sierra Leone using an inter-temporal macroeconomic model. In the model, public capital improves the productive capacity of private capital, generating positive medium and long term effects to increases in public investment. The model application indicates that a large increase in public investment would have positive macroeconomic effects in the medium term. However, since there is no free lunch, rigidities in tax adjustment would entail unrealistic and unachievable adjustment in the current spending to cover recurrent costs and ensure debt sustainability. A more ambitious increase in public investment would entail more fiscal adjustment, particularly if external commercial loans are secured to complement the adjustment. The model simulations also emphasize the importance of improvements in the structural economic conditions to reap growth dividends. In addition, even if the macroeconomic implications of public investment scaling-up can be favorable in the long term under changes in certain structural conditions, downside risks such as terms of trade shifts and Ebola-induced productivity shortfall expose the country to increased risk of unsustainable debt dynamics. This underscores the need to remove bottlenecks to growth and maintain prudent borrowing policies.

JEL Classification Numbers: O43; E62; F34.

Keywords: Structural Transformation; Public Investment; Growth; Debt Sustainability.

Author's E-Mail Addresses: balmalacina20@yahoo.fr; mthuli.ncube@bsg.ox.ac.uk.

* We have benefited from comments and conversations with Ed Buffie, Felipe Zanna, Matteo Francesco, Wang Hou, Daniel Gurara, Antoine Bouet, Terrie Wamsley, Pietro Toigo, Ibrahim Bangura and participants of the 2015 CSAE conference at Oxford University. We are grateful to staffs from the Strategy, Policy and Review department for helpful comments. All errors remain ours. This paper should not be reported as representing the views of the International Monetary Fund. Lacina Balma is currently with Université de Bordeaux/LAREFi, France. Mthuli Ncube is Professor of Public Policy, and Leader of RethinkHIV, University of Oxford, Blavatnik School of Government & Fellow of St Antony's College, UK.

Table of Contents Page

I. Introduction....4

II. Public Investment and Infrastructure Needs, and Debt Policy in Sierra Leone....5

III. Features of the Model and Calibration to Sierra Leone....7
1. Features of the Model....7
A. Firms....8
B. Consumers....8
C. Government....10
2. Calibration to Sierra Leone....12

IV. Base Case Analysis....17
A. Short Run Effects....18
B. Medium to Long Run Effects....20

V. Alternative Assumptions....22
A. Closing the Financing Gap with External Commercial Borrowing....22
B. Closing the Financing Gap with Domestic Borrowing vs. External Commercial Borrowing....23
C. Alternative Case Investment Strategies....24

VI. Baseline Investment Strategy with Structural Reforms and Policy Conditions....26
A. Structural Reforms....26
B. Policy Conditions: Fiscal Limits....28
C. Time and Speed of Fiscal Adjustment....29

VII. Downside Risks....31
A. Terms-of-Trade Shocks....32
B. Total Factor Productivity Shocks....32

VIII. Concluding Remarks....33

Tables

Table 1. Sierra Leone: Debt Stock Evolution, 2007-11....7
Table 2. Calibration of Main Parameters (Base Case)....16
Table 3. Sensitivity Analysis Assumptions....27

Figures

Figure 1. Frontloaded investment scaling-up, constrained tax adjustment and increasing loans and grants....20
Figure 2. Frontloaded investment scaling-up, unconstrained tax adjustment and increasing loans and grants....20
Figure 3. External commercial versus concessional borrowing only....23
Figure 4. Domestic borrowing versus external commercial borrowing....24
Figure 5. Aggressive Public Investment scaling Up....25

Figure 6. Lower Public Investment scaling Up 26
Figure 7. Optimistic scenario: Efficiency of public investment (s, in %) 27
Figure 8. Higher efficiency of public investment and allowing for commercial public debt..28
Figure 9. Lower structural conditions and allowing for commercial public debt.....28
Figure 10. Different fiscal limits and allowing for external commercial borrowing.....29
Figure 11. Speed of tax adjustments with external commercial borrowing and different paths of the grant-financing.....30
Figure 12. Negative TOT and TFP Shocks.....32
Figure 13. Estimated GDP impact of Ebola (2014-17).....33

Boxes

Box 1. Speed of Fiscal Adjustment.....31

Appendix

Table
1. Agenda for Prosperity ESTIMATES (in Millions US$).....37

References.....35

I. Introduction

The UN High Level Panel on the Post-2015 development agenda has laid out a new roadmap driven by five big transformative shifts. One of these shifts is a profound economic transformation to improve livelihoods by harnessing innovation, technology, and the potential of businesses. Many African countries, including Ethiopia, Kenya, Rwanda, Ghana and Nigeria, have endorsed this new consensus paradigm for Africa's development and embarked accordingly on a large-scale investment program meant to transform their economy for jobs and inclusive growth in order to achieve middle-income country status. For example, Ethiopia has set an ambitious medium-term growth and transformation plan for the period 2010/11-2014/15; and Kenya has also embarked on a long-term vision for 2030, and many more countries have committed to doing so.

Sub-Saharan Africa (SSA) is a multifaceted region, however, with some countries having a long way to go to transform their economies, while others will have fewer issues implementing these transformative shifts. Fragile states and countries hurt by civil conflicts, for instance, face severe post-conflict challenges and will have to go through a significant reconstruction and rehabilitation process to pave the way for the catch up. Other countries in SSA, on the other hand, have made strides toward setting the initial conditions which include closing their large infrastructure gaps and filling their developmental needs. Even if countries do not graduate into middle income status, they still have to scale-up public investment in order to boost their growth potential and foster economic and social development.

Large public investment projects have huge financial implications which coupled with limited resources will require resorting to borrowing. For resource-intensive countries, the buildup of fiscal buffer during good times can expand the resource available to their governments. For low-income non-resource-intensive countries, debt relief and successful policy reforms have helped to offset the negative impacts of higher oil prices; grant has been the major source of financing that allowed them to bolster their capital investment, including infrastructure and human capital. However, with some industrial countries undergoing fiscal austerity measures, official aid is not keeping in line with public investment spending in many aid-dependent countries (Redifer, 2010); some countries as a result are looking for new financing sources including external commercial borrowing to supplement concessional funding.

The recent debt forgiveness granted to most SSA countries, along with better economic policies in the region, low global interest rates at time of monetary ease in many OECD countries, and debt crises in many major advanced economies, especially in Europe (e.g.: Greece, Portugal, Ireland and Italy), provide opportunities for the access to external debt markets. In recent years, Uganda, Tanzania, Senegal, Ghana, Angola, Congo DRC, Mali, Mauritania, and Rwanda have all entered into non-concessional loan agreements or issued sovereign bonds in international capital markets (Sy, 2013).

Until recently, the African Development Bank Group amended its non-concessional debt accumulation policy to provide a more flexible and streamlined approach for low-income African countries to contract and manage debt in a sustainable manner. The amendments were aligned with the changes in the IMF external debt limit policy and concessionality framework. This flexible approach is meant to align the Bank's policy with current practices in supporting LICs financing needs in support of their transformation agenda. For countries

with low risk of debt distress, flexibility was applied to accommodate their non-concessional borrowing needs consistent with the assessment of their debt management capacity (AfDB, 2014).

This paper presents an evaluation of public investment scaling-up strategies in Sierra Leone based on the debt sustainability framework constructed by Buffie and others (2012) for LICs. The model complements the standard IMF-World Bank debt sustainability framework by explicitly modeling and analyzing the links between public investment, economic growth and debt sustainability. 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 including the fiscal policy reactions to debt including non-concessional, domestic and concessional debt. It also captures the key factors concerning the structure of a country's economy, such as changes in the efficiency of public investment, the absorptive capacity of the country, and the return on infrastructure, which have a significant impact on the outcome of public investment.

The consideration of these issues is particularly important for a fragile state such as Sierra Leone, since the country is recovering from a protracted civil war—ended in 2002—that has destroyed its stock of physical and human capital. Therefore, it is clear that the country will have a long way to go before transforming its economy. Indeed, Sierra Leone is going through a rehabilitation and reconstruction process meant to put back on track what has been destroyed during a decade of conflict, and close the large infrastructure shortages and severe human capital gaps. In addition, the country will have to borrow to finance its investment needs. Borrowing to invest would certainly increase the country's stock of capital which in the long run will boost growth. However, there is no free lunch and sovereign borrowing would also increase the country's debt stock, which in case of default could create a debt crisis and thus curtail or offset the initial positive effects of public investment.

The modeling device applied in this paper helps to assess the macroeconomic impact of scaling up public investment in Sierra Leone, including the path of debt for different types of borrowing—concessional, external commercial, domestic—and associated risks. It also allows the government to assess fiscal policy changes (such as tax increases or spending cuts) to increase investment. The main issue facing policymakers, which the model helps to analyze, is whether the long-run growth pay-off that comes from increased investment accrues fast enough to sustain the short and medium-run increase in debt.

The remainder of the paper is organized as follows. Section II lays out the current investment and infrastructure needs, and debt policy in Sierra Leone. Section III presents a brief description of the model and calibration to the Sierra Leonean economy. Sections IV-VII discuss the main results of the model simulations and section VIII concludes.

II. Public Investment and Infrastructure Needs, and Debt Policy in Sierra Leone

Sierra Leone has gone through nearly a decade of civil conflict (1990-2002) that has destroyed its stock of physical and human capital. The country has made strides in consolidating peace, putting behind its troubled past and rebuilding state institutions. Over the past five years, Sierra Leone has consistently recorded double digit growth. These achievements have classified the country's success story a case worth emulating by other

nations in post conflict. Yet, many developmental and infrastructural challenges standing on its way. In addition, the current Ebola epidemic and its overwhelming repercussion on the economy is threatening to end the positive trajectory and halt the country's reform momentum.[2]

Structural issues include the country's electricity distribution capacity which is severely constrained causing frequent power shortages. Most of the manufacturing sectors (including the mining sector) primarily rely on captive generation to meet their large power needs. Non-mining customers are forced to resort to private diesel generators. In rural areas, where the bulk of the population resides, electricity access is practically non-existent; sound transportation infrastructure is non-existent which hinders the country's competiveness; skilled labor is scant with most qualified people having fled the country during the war; and schools and hospitals have been damaged.

The authorities' aspirational plan laid out in the *Agenda for prosperity (A4P)* for the next five years is underpinned by eight strategic pillars which would serve as the foundation for achieving middle income status. Through pillar 1 and 4, the authorities envision to implement a number of large-scale projects in agriculture, energy and transportation. The envisaged projects include irrigation and rice production to continue supporting agricultural supply and employment, the construction of hydroelectric plants to increase power production by an estimated 475 Mega Watts, and the construction of a new airport in the mainland. The cost of the airport project alone is estimated at US$312 million (6.6 percent of 2013 GDP). Coping with the resource implications of these reforms will be challenging given limited domestic resource mobilization and expenditure pressure. Indeed, the government will cover only 8 percent of the total estimated of the plan from own budget; estimated budget support represents 56 percent of total cost with the remaining 36 percent still unfunded ((see table 1 in appendix). In addition, the short-term non-programed fiscal impact of Ebola in Sierra Leone is U$79 million (1.8 percent of GDP) according to World Bank (2014). Thus, in pursuing its developmental strategy, the country will have to resort to external borrowing to fill the financing gap.

According to the authorities' estimates, substantial debt relief in recent years has reduced Sierra Leone's debt burden. Public and publicly guaranteed external debt amounted to 142 percent of GDP at end–2005 and declined to 26 percent of GDP in 2007. It has since remained near that level, totaling about 30 percent of GDP at end-2011. This substantial decline reflects the impact of debt forgiveness under the Heavily Indebted Poor Countries Initiative (HIPC) and the Multilateral Debt Relief Initiative (MDRI). Concessional debt accounts for the largest share of public and publicly guaranteed debt. The country's access to external commercial creditors is undermined by the repayments of huge arrears accumulated

[2]The short-term (2014) economic cost is estimated at 3.3 percentage point of GDP (reducing growth from 11.3 percent to 8 percent) (World Bank, 2014).

prior to and during the civil conflict (total external commercial debt amounted to 7.8 percent of GDP at end-2011). Domestic debt amounted to 11 percent of GDP at end-2011.[3]

Table 1: Sierra Leone: Debt Stock Evolution, 2007-11

	2007	2008	2009	2010	2011
In percent GDP					
Domestic debt	18.4	17.5	15.2	13.8	11.1
External Debt	25.9	25.8	36.9	32.3	29.9
Multilateral	12.2	13.3	23.0	21.4	18.4
Bilateral	1.8	2.0	4.4	4.1	3.6
Commercial	12.0	10.0	10.0	9.1	7.8

Source: Sierra Leone Authorities

III. Features of the Model and Calibration to Sierra Leone

1. Features of the Model

The model elaborated by Buffie and others (2012) that is applied to Sierra Leone in this paper is a two-sector open economy dynamic general equilibrium model with three types of public sector debt (external concessional, external commercial and domestic debt). The model is intended for long term analysis and therefore does not include money or nominal rigidities. An interesting feature of the model is that public capital (infrastructure) enters the production function for both tradable and non-tradable goods. Nevertheless the extent to which public investment produces additional infrastructure depends on positive changes in the parameter measuring the efficiency of investment. Another useful feature of the model is that it allows comparison of the implications of a range of financing options. Concessional loans by official creditors and grants from donors are both considered to be determined exogenously and are therefore fixed. Since they are the cheapest forms of financing, policy makers are assumed to use them as much as possible. In addition, the model can simulate governments borrowing under non-concessional terms at home and abroad.

Furthermore, governments can also modify tax policy and user fees from capital utilization in the model. The tax burden (modeled as a tax rate on consumption) is a crucial policy variable, and changes in the speed and size of the fiscal adjustment (i.e., increases in the tax burden) eventually required to pay for the investment scaling-up are important for determining whether debt will follow a sustainable path. The main lesson of the model is the need to consider the dynamic interactions of public investment, growth, recurrent costs, and fiscal policy. In addition to servicing the debt, the government needs to pay for maintenance, if it desires a sustained increase in effective public capital. Therefore, even when investment has a high rate of return, it may not fully pay for itself from the point of view of the fiscal

[3] Domestic debt as percent of GDP declined significantly over time since 2007 (it was 18.4 percent of GDP in 2007) in an effort to contain it since its maturity structure, with some 78 percent in short-term securities, highlights significant rollover and refinancing risk.

authorities if tax rates and user fees are low and the benefits initially accrue mainly to the private sector. There may also be a transitional fiscal problem if the benefits of the public investment do not fully materialize before the debt needs to be repaid.

A. Firms

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 stands for non-traded sector and x for traded sector), representative firms take private capital ($k_{i,t}$), labor ($L_{i,t}$), and effective public capital ($\mathrm{z_t}$) to produce output using Cobb-Douglas technology:

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

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.

The sectors' productivities feature "learning-by-doing" externality and "static" externality as follows:

$$A_{j,t} = a_j\left(\frac{q_{j,t-1}^{I}}{\bar{q}_j^{I}}\right)^{\sigma_j}\left(k_{j,t-1}^{I}\right)^{\xi_j}, \text{ for } j = n, x \quad (2)$$

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

$$MaxP_{i,t}q_{i,t} - w_t L_{i,t} - r_{i,t}k_{i,t-1}$$

Where $\mathrm{P_{i,t}}$denotes the price of output in each sector, $\mathrm{w_t}$ the wage, and $\mathrm{r_{i,t}}$ the rental rate of capital. Note that the wage—unlike the rental rate of capital—is not sector-specific, as labor is mobile across sectors.

B. Consumers

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 traded, imported and non-traded goods given by equation (3), with a price index given by equation (4):

$$c_t^i = \left[(\rho_x)^{1/\epsilon}\left(c_x^i\right)^{\epsilon-1/\epsilon} + (\rho_m)^{1/\epsilon}\left(c_m^i\right)^{\epsilon-1/\epsilon} + (\rho_n)^{1/\epsilon}\left(c_n^i\right)^{\epsilon-1/\epsilon}\right]^{\epsilon/\epsilon-1} \quad (3)$$

$$P_t^i = \left[\rho_x\left(P_x^i\right)^{1-\epsilon} + \rho_m\left(P_m^i\right)^{1-\epsilon} + \rho_n\left(P_n^i\right)^{1-\epsilon}\right]^{1/1-\epsilon} \quad (4)$$

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 Sierra Leone. Non-savers (where the subscript h stands for "hand-to-mouth") are subject to the following budget constraint:

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

Equation (5) says that consumption (including value-added tax, h_t) is 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. The model assumes that savers can invest in private capital in both the traded and non-traded sectors ($I_{i,t}^s$ in Equation 6 denotes investment in each of the sectors). They also pay user fees for infrastructure services (μz_t^s), can buy domestic bonds (b_t^s) and a real interest rate r_t , and can contract foreign debt (b_t^{s*}) which an exogenous real interest rate r^* .Savers solve the same utility function as the nonsavers, but subject to three constraints. The model is rescaled by a permanent component of sector-wide total factor productivity, growing at a rate (g). Their maximization problem is given by:

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

Subject to a budget constraint:

$$P_t b_t^s - b_t^{s*} = r_{x,t} k_{x,t-1}^s + r_{n,t} k_{n,t-1}^s + w_t L_t^s + \frac{Rem_t}{1+a} + \frac{T_t}{1+a}$$
$$- \frac{1+r_{t-1}^*}{1+g} b_{t-1}^{s*} + \frac{1+r_{t-1}}{1+g} P_t b_t^s \quad (6)$$
$$- P_{k,t}\left(I_{x,t}^s + I_{n,t}^s + AC_{x,t}^s + AC_{n,t}^s\right)$$
$$- P_t c_t^s (1+h_t) - \mu z_{t-1}^s - \Upsilon_t^s - \Phi_t^s,$$

and two capital accumulation equations:

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

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

Where r is the real interest rate on domestic bonds, r_t^* is the interest rate on foreign debt, δ is the depreciation rate, $\Upsilon_t^s = \frac{\eta}{2}\left(b_t^{s*} - \bar{b}^{s*}\right)^2$ is portfolio adjustment costs linked to foreign liabilities capturing the degree of financial account openness, Φ_t^s is profits for domestic firms, g is the trend growth rate of GDP per capita, $AC_{i,t}^s = \frac{\nu}{2}\left(\frac{I_{j,t}^s}{k_{j,t}^s} - \delta - g\right)^2 k_{j,t-1}^s$with $\nu > 0$ are adjustment costs incurred in changing the capital stock in each of the sectors.

The portfolio adjustment costs capture the degree of integration of the private sector into world capital markets. In log linearized form, equation (9) implicitly defines a private demand for foreign debt, which can be explicitly expressed as:

$$r_t - r_t^* \cong \eta(b_t^{s*} - \bar{b}^{s*}) \quad (9)$$

In this equation, the value of η governs the degree of capital mobility. For some emerging market economies, a low η may be appropriate reflecting an open capital account. Elastic capital flows then keep the domestic rate close to the foreign rate. In LICs, where η is comparatively big, the capital account is fairly closed, and the private sector has limited capacity to borrow from abroad.[4]

C. The Government

Public capital in the model evolves as follows

$$(1+g)z_t^e = (1-\delta)z_{t-1}^e + s\left(I_{z,t} - \bar{I}_z\right) + \bar{s}\bar{I}_z \quad (10)$$

Where $\bar{I}_z$ is public investment in the steady state; $\bar{s}$ and s, with values between zero and one denote the efficiency parameters of public capital at and off steady state respectively; I_t is public investment; and z^e is additional infrastructure generated by public investment. The second term of equation (10), $s\left(I_{z,t} - \bar{I}_z\right) + \bar{s}\bar{I}_z$, implies that one dollar public investment does not necessarily yield one dollar effective public capital. Hulten (1996) and Pritchett (2000) argue that the productivity of infrastructure in low-income countries is high while the return on public spending is low for the simple reason that a good deal of public investment spending does not increase the stock of productive capital.

The government budget constraint is defined as follows which equates its financing from domestic debt (b_t), external commercial debt ($d_{c,t}$), concessional debt (d_t), revenue from user fees on infrastructure ($\mu = f\delta P_{zo}$, with f being the recurrent cost), taxes and grants (G_t) with expenditures on interest payment on debt, infrastructure investment ($I_{z,t}$), and transfers (T_t).

$$P_t\Delta b_t + \Delta d_{c,t} + \Delta d_t = \frac{r_{t-1}-g}{1+g}P_t b_{t-1} + \frac{r_{dc,t-1}-g}{1+g}d_{c,t-1} + \frac{r_{d,t}-g}{1+g}d_{t-1} \quad (11)$$

$$+P_{z,t}I_{z,t} + T_t - h_t P_t c_t - G_t - \mu z_{t-1}^e$$

Where r, r_{dc} and r_d are interest rate on domestic debt, external commercial debt and concessional debt respectively. The interest rate on concessional debt is exogenous $r_{d,t} = r_d$, while the interest rate on external commercial debt incorporates a risk premium that depends on the deviations of the external public debt to GDP ratio $\left(\frac{d_t + d_{c,t}}{y_t}\right)$ from its (initial) steady-state value $\left(\frac{\bar{d}+\bar{d}_c}{\bar{y}}\right)$. That is,

$$r_{dc,t} = r^f + \vartheta_g EXP\left(\eta_g\left(\frac{d_t + d_{c,t}}{y_t} - \frac{\bar{d}+\bar{d}_c}{\bar{y}}\right)\right) \quad (12)$$

[4] From a technical point of view, the portfolio cost also ensure the stationarity of b_t^{s*} (Schmitt-Grohe and Uribe 2003).

Where r^f is the risk-free interest rate; ϑ_g is the public debt risk premium which is assumed to be constant; η_g is the public debt risk premium parameter; and $y_t = P_{x,t}q_{x,t} + P_{n,t}q_{n,t}$ is GDP.

Infrastructure as well as private capital are built by combining one imported machine/equipment with α_z units of a non-traded input. Therefore the supply price of infrastructure and private capital are determined by Equation 13 and 14.

$$P_{z,t} = P_{m,t} + a_z P_{n,t} \quad (13)$$

$$P_{k,t} = P_{m,t} + a_k P_{n,t} \quad (14)$$

Where $P_{m,t}$ is the relative price of imported machine/equipment and $P_{n,t}$ is the relative price of non-traded good.

The key feature of the model is to capture the dynamic interactions of public investment, growth, recurrent costs, and fiscal policy.

Equation (15) is the policy adjustment function

$$GAP_t = \frac{r_d - g}{1+g} d_{t-1} - d_t + \frac{r_{t-1} - g}{1+g} P_t b_{t-1} + \frac{r_{dc,t-1} - g}{1+g} d_{c,t-1} + P_{z,t} I_{z,t} + T_o - h_o P_t c_t - G_t - \mu z^e_{t-1} \quad (15)$$

GAP corresponds to expenditures (including debt service) less revenue on concessional borrowing when taxes (h_o) and transfers (T_o) are kept at their initial value. Combining (11) with (15) yield the following equation

$$GAP_t = P_t \Delta b_t + \Delta d_{c,t} + (h_t - h_o) P_t c_t - (T_t - T_o) \quad (16)$$

The term $P_{z,t}I_{z,t}$ in equation (14) corresponds to public investment outlays including costs overruns associated with absorptive capacity constraints. It is defined by equation (17)

$$P_{z,t} I_{z,t} = H_t \left(I_{z,t} - \bar{I}_z \right) \quad (17)$$

Because skilled administrators are in rare supply in small lower middle income countries and low-income countries, ambitious public investment programs are often undermined by poor planning, weak oversight, and poor coordination problems, all of which contribute to large cost overruns during the implementation phase. To capture this, new investment $\left(I_{z,t} - \bar{I}_z \right)$ is multiplied by H_t which in turn is defined as follows

$$H_t = \left(1 + \frac{I_{z,t}}{z_{t-1}} - \delta - g \right)^{\phi} \quad (18)$$

Where ϕ captures the severity of the absorptive capacity constraint in the public sector.

Debt sustainability requires that the tax (VAT) and/or transfers adjust to cover the debt burden or the gap (GAP). In this study, we assume that policy makers combine both tax increases and transfers cut to bear the burden. The targets for the debt-stabilizing level of the tax rate and transfers are defined as follows

$$h_t^{target} = h_o + (1 - \lambda) \frac{GAP_t}{P_t C_t} \quad (19)$$

and

$$T_t^{target} = T_o - \lambda GAP_t \quad (20)$$

Where $0 < \lambda < 1$ is the policy parameter that divide the fiscal adjustments between VAT and transfers. When $\lambda = 0$ (respectively $\lambda = 1$), then all the adjustments fall on tax (respectively on transfers).

In a given year, taxes are determined according to the reaction function outlined in Equation (21) and (22). h^u is a ceiling on tax and T^l is a floor for transfers. h_t, h_t^r, T_t and T_t^r are determined by the fiscal rules as follows

$$h_t = Min(h_t^r, h^u)$$

$$h_t^r = h_{t-1} + \lambda_1\left(h_t^{target} - h_{t-1}\right) + \lambda_2 \frac{\left(x_{t-1} - x^{target}\right)}{y_t}, \text{ with } \lambda_1 \text{ and } \lambda_2 > 0 \quad (21)$$

and

$$T_t = Max(T_t^r, T^l)$$

$$T_t^r = T_{t-1} + \lambda_3\left(T_t^{target} - T_{t-1}\right) - \lambda_4\left(x_{t-1} - x^{target}\right), \text{ with } \lambda_2 \text{ and } \lambda_4 > 0 \quad (22)$$

Where $x = b$ or d_c depending on whether the rule responds to domestic debt or commercial debt and y_t is GDP in a given year. Note that the target for debt x^{target}, is exogenously given. λ_1-λ_3 are fiscal reaction parameters in policy instrument terms. They determine whether the policy adjustment is slow or fast; setting these parameters requires a realistic assessment of the country's capacity for fiscal adjustment over different time horizons. Therefore, we examine different values for the parameter $\lambda_1$and assess the macroeconomic effects including debt sustainability. Finally, λ_2-λ_4 are fiscal reaction parameters in debt terms.

2. Calibration to Sierra Leone

The model's parameters are calibrated to match as much as possible Sierra Leone-specific estimates. Otherwise we rely on frequently used parameter values in the literature for low income countries, similar to Buffie and others (2012). Therefore, our calibration should be seen as a rough approximation of the Sierra Leonean economy, not a replica. This is an issue that should be further addressed in future applications of the model. Table 2 presents the calibration of the main parameters of the model. The trend per capita growth rate is 3.3 percent, which matches the average of 2004-11 in the wake of the civil war reported in World Development Indicators.

We start our calibration with the key parameters that govern the debt dynamics. These are essentially the parameters that underpin the institutional environment under which public investment is scaled up. The first parameter is the return on public investment, which in the first-order condition associated with the solution of the firms' optimization problems is equal to the marginal product of effective public capital net of depreciation as follows. No Sierra Leone-specific value for this parameter is available. Existing estimates in the literature for sub-Saharan Africa, as discussed in Buffie and others, (2012) points to different ranges with upper bounds ranging from 20 percent to 30 percent as the norm for countries with good governance. Presumably we assume that a return of 25 percent in the base case is a plausible value for Sierra Leone.

The second parameter which is the (in) efficiency of public investment captures an important real rigidity encountered in most of developing economies and pertaining to project executions. It captures the rate at which public investment flows translate into actual accumulation of public infrastructure. Put differently, it is a measure of the number of dollar units of actual public capital from a unit of dollar spent on public investment.

The creation and the implementation of many public investment projects in developing countries are often plagued by waste, leakage of resources, corruption and lack of appropriate management and technical soundness that ensure that projects have the highest possible rate of return. Thus, a dollar of public investment spending may often yield less than a dollar of public capital. Similar inefficiencies exist in the creation of private capital in part due to the lack of complementary public inputs. Consistent with the estimates in Hulten (1996) and Pritchett (2000) for sub-Saharan Africa,[5] our base case assumes that 40 percent of public investment fails to increase the stock of productive infrastructure and the efficiency parameter is set at 60 percent.[6] However, this assumption may be somewhat too conservative if for certain projects a strong regulatory framework is in place to line up selections with the government's priorities and make sure they are timely and efficiently implemented.

Efforts in "investing to invest" (i.e. higher efficiency of investment) can have important implications for growth dividends and debt sustainability (Collier, 2008). By raising the returns on public and private investment, scaled-up investment can generate more fiscal resource to repay debt and thus lower its path, which in turn further bolster the dynamism of the economy. In alternative scenarios, we investigate cases where the scaling up is associated with more optimistic views on the efficiency of public investment.

The third parameter which also entails real friction is the absorptive capacity restriction or bottlenecks in the execution of new investment projects. If present, such bottlenecks can drive up investment costs or lower budget execution ratios further which in turn hamper the required growth dividends and debt sustainability, as discussed in Collier et al. (2010), van der Ploeg (2011a), and Buffie et al. (2012). Empirical evidence by Foster and Briceño-Garmendia (2010) shows that budget execution ratios in sub-Saharan Africa ranged from 28 percent to 89 percent with the average being 66 percent. Indeed, many investment projects, especially infrastructure require coordination among the various layers of government bureaucracy and have to go through a process of planning, bidding, contracting, construction, and evaluation. It is generally believed that developing countries have a poor record of projects planning, coordination and management resulting in cost overruns and low execution rates. This has bred skepticism about the ability of these countries to scale up public investment. We buy such skepticism, in light of the current economic situation of Sierra

[5] The estimates range from 0.08 to 0.49, suggesting that public investment is inefficient in many LICs. It is also important to note that Pritchett's estimates were based on data from before 2000. A number of sub-Saharan African countries, including Sierra Leone, have made considerable progress in public financial management since then, as evidenced in improving assessments by international organizations.

[6] Sierra Leone is scored very low (in bottom quartile of the distribution) in the index for public investment management quality (PIMI) developed by Dabla-Norris and others (2011). This index comprises measures of the quality of appraisal, selection, management and evaluation of public investment projects.

Leone and assume execution rates of approximatively 80 percent and set the absorptive capacity constraint parameter at 20 percent to inform our baseline.[7] For a given level of investment scaling up, reducing the capacity restrictions can have significant effects on growth benefits as well as prospects for fiscal and debt sustainability. Thus, against the optimistic base case, we also investigate a scenario in which the scaling up is associated with reduced or no constraint.

Beyond the institutional factors underpinning the public investment-growth nexus, there exists an important set of macroeconomic parameters that also contributes to shape the reaction of the economy to debt and public capital accumulation. These are essentially factors capturing the cost of the borrowing (interest rates and debt risk premia), and the degree of international financial integration for the private sector (portfolio adjustment cost).

The portfolio adjustment cost parameter (η) is calibrated by specifying a value for the ratio of the interest rate differential on private domestic and external debt ($r_t - r_t^*$) to change in foreign debt to $(b_t^{s*} - \bar{b}^{s*})$, measured as a percentage of initial GDP. Calibrating $\eta = 1$ (respectively $\eta = 0$) entails lower degree of international financial integration for the private sector (respectively higher degree of integration). We set the parameter at relatively high level to match the fact that the private sector in Sierra Leone has some, but limited access to international capital markets. Regarding the public sector nonconcessional borrowing, we would expect a risk premium which is an increasing function of the level of the debt-to-GDP ratio by setting $\eta_g = 1$ in equation (12) when this type of borrowing is allowed; in the baseline $\eta_g = 0$. At the steady state equilibrium, the risk premium parameter is calibrated as the difference between the interest rate on public commercial debt and the risk-free foreign interest rate ($\vartheta_g = r_{dc,o} - r^f = 0.02$).[8]

In addition, the model parameterization attempts to match important characteristic feature of low-income countries which stems from the paucity of private savings. Consumers in developing countries including Sierra Leone are liquidity-constrained and depend mostly on subsistence income. This combined with the dearth of appropriate financial deepening and banking density undermines the mobilization of savings. The World Bank data on Sierra Leone indicates that there are roughly three bank branches per 100,000 persons; only 19 percent of the population holds a bank account; and only 1 percent of the population holds a loan from the banking system. Inversely, the low income level of the household is in turn a key factor hindering the financial deepening in Sierra Leone as are lack of sound collateral and weaknesses in the legal system. This entails the distinction between Ricardian and non-Ricardian households.[9] Reflecting this, we set the ratio of the supply of labor of non-

[7] This is more optimistic compared to the average sub-Saharan Africa of 66 percent.

[8] Note that the calibration assumes a No-Ponzi game condition where the debt term converges to zero at the steady state.

[9] The presence of non-Ricardian consumers (or consumers without consumption smoothing behavior) rules out any ricardian equivalence. It can be seen clearly that the slope of the Euler consumption smoothing equation derived from the first order condition of the non-Ricardian household optimization program ($c_t^s = c_{t+1}^s \left(\beta \frac{1+r_t}{1+g}\right)^{-\tau} \left(\frac{1+h_{t+1}}{1+h_t}\right)^{\tau}$) is an increasing function of the change in consumption tax rate. This reflects the fact that loose fiscal policy may not produce the desired effect

(continued…)

Ricardian to the supply of labor of savers (a) at 1.5 so that 60 percent of the consumers are non-Ricardian in Sierra Leone. We also use available recent data for Sierra Leone (especially 2005-12 for flow variables and 2011-12 for stock variables) to set the initial values for the tax rates on consumption, private consumption and trade/GDP shares, the share of remittances to GDP, the share of grants to GDP, the initial public investment to GDP ratio, as well as the initial external and domestic debt to GDP ratios.

We pick the cost shares of non-tradable input in the production of public capital to match the assumption that the import content of public capital is Sierra Leone is relatively high. Public infrastructure investment requires material, equipment and some kind of skill or technical expertise that are not produced locally. Therefore, assuming that the import content represents about 75 percent of the total public capital is plausible, especially in the set-up phase of iron ore mines.[10] We would expect that the high import content of infrastructure investment can help mitigate some of the short-term macro effects on the domestic economy of any investment scaling up.

Moreover, the parameters for capital's share in value added in the traded and non-traded sectors were chosen based on the social accounting matrix for the Sierra Leonean economy constructed by Fofana et al. (2014). Because of the poor quality of national accounts data in Sierra Leone, the gross operating surplus (GOS) share seems to be overestimated in both the traded and nontraded sectors. These shares was demeaned in our calibration to 32 percent and 40 percent in the tradable and nontradable sectors respectively. With the availability of data on the value-added share of the nontradable sector in GDP and the share of imports to GDP, along with other relevant parameters values, the distribution parameters for nontraded goods and for imported goods (ρ_n, ρ_m) are pin downed (note that $\rho_x+\rho_n+\rho_m=1$).

Finally, because of a lack of Sierra Leone's specific data, the following parameters are set at the same values as those used in Buffie and others (2012): Fiscal reaction parameters in policy instrument terms ($\lambda_1$and λ_3) and in debt terms (λ_2 and λ_4), private debt risk premium (u), public debt risk premium (ϑ_g), capital adjustment cost parameter (υ), Tobin's q elasticity of investment spending parameter (Ω), intertemporal elasticity of substitution (τ), intratemporal elasticity of substitution across goods (ϵ), real risk-free foreign interest rate (r^f).

Table 2: Calibration of Main Parameters (Base Case)

Parameter	Value	Definition
τ	0.34	Intertemporal elasticity of substitution
ϵ	0.90	Intratemporal elasticity of substitution across goods

when consumers anticipate tax increases especially when the loose fiscal policy cannot be sustained prompting continuously rising deficits and debt levels.

[10] However, as the iron ore mines move from the set-up phase and reach production capacity, this will lead to a gradual shift from machinery and equipment imports to increased shipments of consumer and intermediary goods, as well as fuel and lubricants imports.

α_x	0.32	Capital's share in value added in the traded sector
α_n	0.40	Capital's share in value added in the nontraded sector
α_k	0.49	Cost share of non-traded inputs in the production of private capital
α_z	0.43	Cost share of non-traded inputs in the production of public capital
δ	0.05	Depreciation rate*
ξ_x; ξ_n	0.00	Capital learning externalities
σ_x; σ_n	0.00	Sectoral output learning-by-doing
VA_n	0.48	Value-added in non-traded sector
Import/GDP	0.33	Import to GDP ratio
g	0.033	Trend growth rate
η	1.00	The portfolio adjustment costs parameter
η_g	0.00	Public debt risk premium parameter
r_o	0.10	Initial real interest rate on domestic debt
r_o^*	0.10	Initial real interest rate on private external debt
r^f	0.04	Real risk free foreign interest rate
r_d	0.00	Real interest rate on concessional loans
$r_{dc,o}$	0.06	Initial real interest rate on public commercial loans
u	0.04	Private debt risk premium
ϑ_g	0.02	Public debt risk premium
R_o	0.25	Initial return on infrastructure
b_o	0.09	Initial public domestic debt to GDP ratio
d_o	0.253	Initial public concessional debt to GDP ratio
G_o	0.017	Grants to GDP ratio
Rem_o	0.04	Remittances to GDP ratio
$I_{z,o}$	0.08	Initial ratio of infrastructure investment to GDP
$s;\bar{s}$	0.60	Efficiency of public investment
h_o	0.15	Initial consumption VAT
ϕ	2.00	Absorptive capacity parameter
$\lambda_1;\lambda_3$	0.25	Fiscal reaction parameters (policy instrument terms)
$\lambda_2;\lambda_4$	0.02	Fiscal reaction parameters (debt terms)
$a/(1+a)$	0.60	Share of non-saving household
Ω	2.00	Tobin's q-elasticity of investment spending
ψ_x/ψ_n	1.00	Elasticities of sectoral output with respect to infrastructure

*depreciation rate is similar for public capital and private capital in both the tradable and non-tradable sectors

IV. The Base Case Analysis

A country's public finances may appear sound now, but may be vulnerable if underlying weaknesses threaten its future fiscal position and limit the government's ability to respond to fiscal policy challenges. Unexpected shocks such as terms of-trade shifts, sudden stops in

capital inflows, natural disasters, and aid shortfalls can undermine public finances by reducing revenue, generating pressing expenditure needs, and making financing more difficult and expensive. Countries that have built up reserves in good times can draw on these resources during bad times. And those with low levels of debt may be able to increase their fiscal deficits, including through borrowing, during a downturn or even a crisis, without losing market confidence. But countries without such buffers are often forced to take emergency fiscal measures and have limited scope for countercyclical fiscal policy. Experience suggests that rigidities in the structure of the fiscal sector impinge on governments' ability to adapt to changing circumstances. By ossifying current fiscal structures, rigidities can undermine future macroeconomic stability, debt sustainability, and fiscal policy.

The spread of the Ebola presents a worrying sign for the short, medium and possibly long term economic activity and macroeconomic stability in Sierra Leone. The government response measures and earmarked spending to contain the epidemic would prove challenging with the immediate effect likely to put a threat in the smooth implementation of the country's development agenda. These include flagship infrastructure programs in road transport and energy and essential social spending such as on education and women's empowerment. The country's immediate financial requirement to halt the epidemic is now estimated to be nearly four times the annual health budget. It is anticipated that the initial estimates would be revised upwards due to continued spread of the disease extending the initial lifespan of the epidemic. Recent multi-donors ring fenced package contributed important financial resources while a considerable gap is yet to be covered. Efforts to close the gap would be challenging especially given shortfalls in revenue receipts.

Reflecting this hardship in the country's history, we revise downward the initial public infrastructure investment scaling-up strategy. Specifically, public infrastructure investment scaling up is front-loaded throughout the years from the initial level of 8 percent of GDP to a peak of 14.1 percent of GDP after 3 years. After 10 years, investment falls as quickly low to around 11 percent, where it stays permanently. The increase in the public investment simulated amounts to nearly 36.67 percent of initial GDP during the first 10 years (22.46 percent during the first 5 years) which is less ambitious compared to the planned investment scaling up outlined in the new poverty reduction strategy, *Agenda for Prosperity* (A4P).[11] In addition, to preserve long-term fiscal soundness and debt sustainability, we assume that the financing needs for much-needed infrastructure projects would be covered mainly through grants and highly concessional loans.[12] There is no adjustment on the tax side in the form of change to tax policy, so the consumption tax rate is maintained permanently at its initial level of 15 percent. The grant element of the borrowing is expected to remain above 5 percent of GDP in the first-five years of the investment scaling up phase. After this initial upshot, grant

[11] Total public investment exceeds 90 percent of the initial GDP over the 5 years of the country's medium-term development strategy (see discussion in section III).

[12] According to the GoSL, it expected that the public infrastructure investment estimates would be covered 43 percent by development partners' commitment and 15 percent through own budget with a funding gap of 42 percent.

aid is projected to decelerate somewhat to 2.43 percent of GDP before petering out around the long term level of 1.7 percent of GDP by year 10. Reflecting the non-programed spending by the GoSL to help weather the hemorrhagic viral disease (or the health sector in general), we assume no rigidity in the fiscal adjustment on the spending side, so total current spending (henceforth, interchangeably termed as transfers) is projected to increase slightly from 6.8 percent of GDP in the initial year to 7.1 percent of GDP after two years. Then it is projected to decline quickly to 5.4 percent of GDP after four years before climbing up again at 6.6 percent after seven years. The current spending GDP ratio would eventually go back to 5 percent after 10 years where again it starts increasing but at a slow space (figure 1).

Furthermore, reflecting rigidities in the adjustment on the spending side—for instance the share of public sector wages in total current spending rose 35 percent in 2005 to 50 percent in 2014 and is likely to rise due to planned massive recruitment in priority sectors (IMF staff report, 2014)—fiscal consolidation on the spending side might not be plausible. Therefore, alternatively we assume that the ratio of the total current spending to GDP will remain unchanged while in addition to securing grants and concessional loans, tax adjusts to close part of the fiscal gap in the short-medium term (figure 2).

To capture the first assumption of the fiscal adjustment (constrained tax adjustment versus unconstrained adjustment on the spending), we set the parameter dividing the fiscal adjustment, $\lambda = 1$ in equations (19)-(20) as well as the fiscal reaction parameters $\lambda_1 = \lambda_3 = 0.25$ and $\lambda_2 = \lambda_4 = 0.02$ in equations (21)-(22), implying that

$T_t^{target} = T_o - GAP_t$,

$h_t = h_t^{target} = h_o$,

and $T_t = T_t^r = T_{t-1} + \lambda_3\left(T_t^{target} - T_{t-1}\right) - \lambda_4\left(x_{t-1} - x^{target}\right)$.

The second assumption (constrained adjustment on the spending side versus unconstrained tax adjustment) implies that $\lambda = 0$ in equations (19)-(20) and that,

$$h_t^{target} = h_o + \frac{GAP_t}{P_t C_t}$$

$$T_t = T_t^{target} = T_o$$

and $h_t^r = h_{t-1} + \lambda_1\left(h_t^{target} - h_{t-1}\right) + \lambda_2 \frac{\left(x_{t-1} - x^{target}\right)}{y_t}$

A. Short-Run Effects

In this baseline public investment strategy with the two different mechanisms of fiscal adjustment, the results are similar (figure 1 and 2). The reason is that the financing needs for public investment is covered mainly through grants and highly concessional loans making the economy unaffected by both types of fiscal adjustment (tax and transfers). Thus, the interpretations that follow apply to figure 1 and 2 interchangeably.

The short term macroeconomic consequences of the baseline assumptions are relatively standard. An appreciation of the real exchange rate is a central part of the transmission mechanism in the grant-and concessional debt-financed investment scaling-up and current spending increase scenario. It consists of shifting factors from the export (tradable) sector to

those that are in high demand (non-tradable) due to government spending and the high demand for nontradable resources. This transmission mechanism involves not only the exchange rate but also other prices (e.g., wages). In countries with a flexible exchange rate, the first step would be a nominal appreciation of the exchange rate, which by reducing the producer price for export production in domestic currency lowers the marginal revenue product. For Sierra Leone the nominal exchange rate is fixed, which rules out a nominal appreciation. Instead, the scenario leads to an appreciation of the real exchange rate (i.e., the relative price of non-traded goods) by about 4 percent from its initial level by year three, which is somewhat moderate. It is worth pointing out that differences in the impact of external financing depend on how it is invested whether in goods and services requiring high import goods and services or requiring domestic capacity. In our baseline calibration, we assumed that the import intensities of Sierra Leone's public infrastructure is high and represents nearly 75 percent of total public capital.[13] Higher import intensity of basic infrastructure in a country with limited domestic capacity reduces the adverse real exchange rate, price and resource switching effects of Dutch disease, as opposed to public social services, which have a far higher nontraded content, primarily labor. The appreciation in the real exchange rate contributes to a marked deterioration in the current account deficit over the first three years, with a gradual narrowing down of the deficit thereafter as the real exchange rate depreciates. Accordingly, the export (tradable) sector is squeezed as shown by its marked decline over the first five years. In particular, the decline in the tradable sector is 3 percent below the steady state by year 3. In contrast, the non-tradable sector expands markedly over the first 10 years and after. By year 3, the nontradable increases by 5 percent and by year 30 the increase is 5.8 percent above the steady state. The reallocation of factors freed up in the tradable sector and diverted to nontradable is so high that the wages are bid up reflecting the Dutch Disease effects.

The extent of the appreciation depends on how easy it is to bring about the necessary factor reallocation. If the two sectors had a very similar factor composition, reallocation is relatively easy, and even a small appreciation would reduce the export sector significantly. Specifically, the appreciation would lower profitability in the export sector, trigger a large outflow of factors, and require practically no changes in relative factor prices or factor intensity for the factors to be absorbed in sectors where demand is high.[14]

[13] Investment in infrastructure require material, equipment, skilled and technical expertise that are not readily available in countries with low capacity including Sierra Leone.

[14] A multisectoral model like the World Bank MAMS model with the distinction between skilled and unskilled labor is well-suited to capture the sectoral reallocation of factors. In particular, skilled labor is more demanding in the non-tradable sector as it is in scarce supply in the early years while unskilled labor is in abundant supply (see Lofgren and Diaz-Bonilla, 2010 for more details).

Figure 1: Frontloaded investment scaling-up, constrained tax adjustment and increasing loans and grants

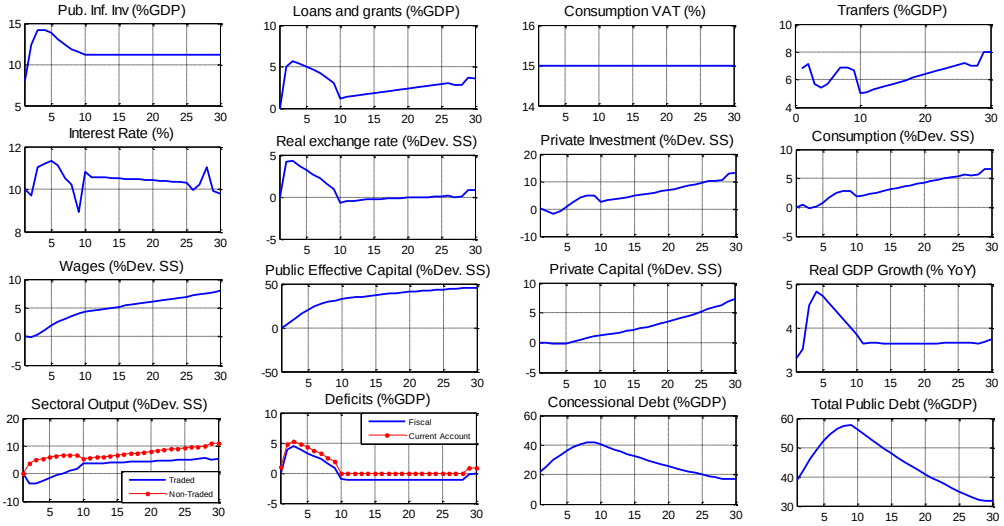
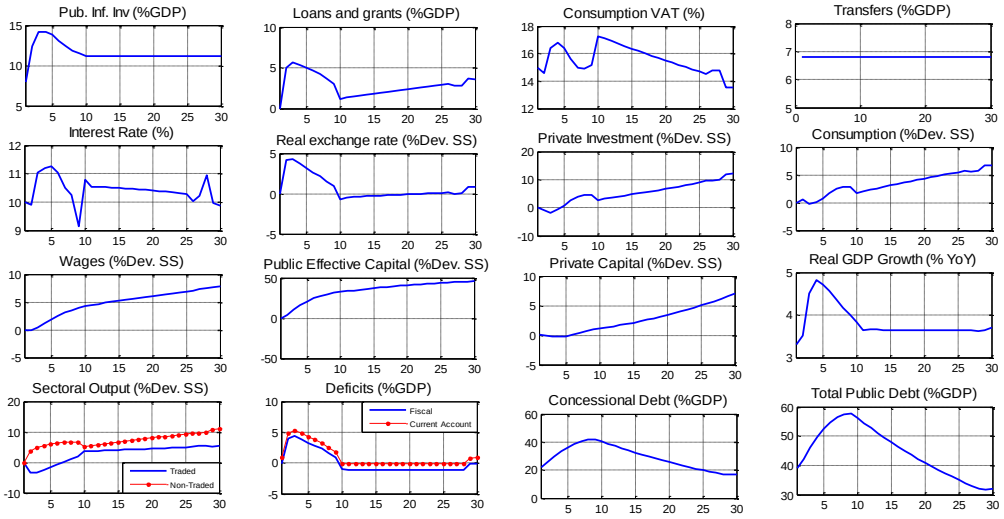


Figure 2: Frontloaded investment scaling-up, unconstrained tax adjustment and increasing loans and grants



B. Medium-to Long-Run Effects

Grant-financed infrastructure investment can halt the downside short-run effects when productivity improvements in the medium-to long-term raises GDP growth, incomes and helps ensure debt sustainability. Yet the way this bright side of the investment scaling up is brought about depends on certain conditions as discussed in section III and investigated in the simulations below.

The medium-run dynamics under the baseline are not worrisome. Since the government financing options fall exclusively on securing grants for the scaling up of investment, then the fiscal consolidation, either on the spending side or the revenue side is not painful and the economy does not suffer in the long term. In particular, note that the Euler consumption

smoothing equation is what governs the dynamics of ricardian household consumption. Since the consumption tax rate is constant, what underpins the dynamics of consumption of this category of household is interest rate movement at a given intertemporal elasticity of substitution. As for the non-ricardian households, their consumption is essentially driven by the government transfers (current spending). Finally, the overall consumption is a combination of the both types of consumption. Since 60 percent of households in the economy lives hand to mouth, then we suspect the overall consumption path would be driven mainly by this content and less by the counterpart content.

In summary, private consumption-GDP ratio in real term evolves hand-in-hand with transfers and inversely with the consumption tax rate whose adjustments are not painful in the long-run. In particular, private consumption is projected to decline slightly in year 4 (consumption tax rate increases by 2 percentage point and transfer declines by 1.5 percentage point in the same year). Then after the first five years, private consumption increases gradually relative to the steady stat as consumption tax rate declines and transfers increases. In particular, total private consumption is 5 percent higher relative to the steady state by year 25 when consumption tax rate and transfers converge to their steady state level.

Private investment is driven by market expectations through interest rate and risk premium. It is assumed that the private sector foreign borrowing is subject to portfolio adjustment costs, so access to the world capital market is constrained (see equation 9). In addition, the risk that the government's fiscal position can become source of instability for the private sector is part of the factors that underpin private investment. Even when debt is stable or declining under current policies, markets may be concerned about the government's continued ability to generate the requisite primary balances. In our base case, the primary deficit increases as a result of the decline in the consumption VAT and the lack of adjustment in transfers in figure 2 (or the increase in transfers and the lack of adjustment on the tax side in figure 1). As a result, the real interest rate increases fast enough, thus prompting private capital holders to entrenched cut in investment in the short term. Besides market confidence, in theory, positive impact of increases in the stock of infrastructure on future productivity can have a crowding-in effect by increasing the private investment. But this possibly occurs in the long term and under certain structural conditions. In the interim, private investment is likely to dip initially, which is in line with our findings.

In particular, private investment is initially declines by about 2.4 percent from the steady state by year 3 as the interest rate climbs up. Then it is projected to rise in the long term, albeit at a slow space, following the decline of the real interest rate and the occurrence of productivity gain. Accordingly, growth of private capital stock is stagnant during the first five years, while growth in the stock of infrastructure is speed up. But as the stock of public capital becomes effective in the long term, thus spurring the growth of the stock of private capital, then the latter outpaces it.[15] Relative to the steady state, public capital increases almost by 22.5 percent by year 5 while private capital stock does not accumulate by the same year. By year 20, public effective capital is 29 percent and private capital is 4.2 percent higher. Real per capita GDP growth rate peaks to 4.9 percent by year 4 before declining. By

[15] The relative slow space of public effective capital is due to decreasing return to capital in the long run.

year 14, the growth rate is 3.4 percent, which is barely 0.1 percentage points higher than the assumed long term growth rate of 3.3 percent.

During the borrowing phase, there is no need for fiscal consolidation and the deficit widens. The repayment phase of the concessional debt starts by year 10. As the repayment phase approaches and the government is willing to show goodwill, the deficit narrows quickly; current spending declines quickly below 5 percent of GDP and consumption VAT hikes up in level and reaches 17.5 percent at *t=10*. Following the twin deficits anomaly, a reduction in the fiscal balance translates into an improvement of the current account balance. The fiscal consolidation along with the growth dividends of public investment allow the government to honor the debt service. As expected, total public debt stock follows the sustainable path of the highly concessional loans component.[16] It first amounts to a peaks of 57.6 percent of GDP by year 9 and then starts declining quickly during the repayment phase. The forecasted debt level is not unreasonably burdensome, but other standard measures of debt sustainability like debt-to-exports would point to higher debt distress given the economy's growing dependence on iron ore exports (see section 7 for further discussion).

V. Alternative Assumptions

A. Closing the financing gap with external commercial borrowing

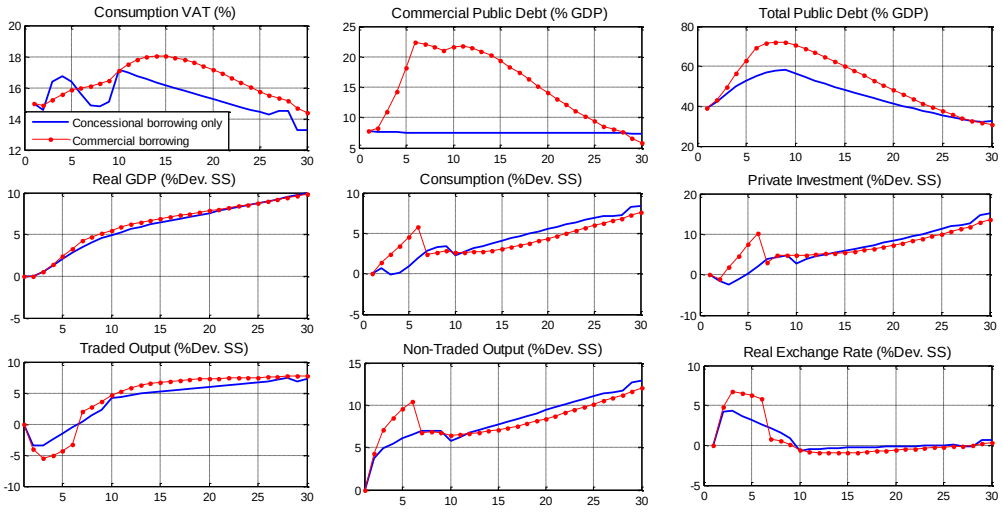
Under this scenario, we assume that given the exogenous path for concessional loans and grants (the baseline assumptions), the government accesses additional resources in the form of external commercial borrowing and domestic borrowing to fill the financing gap. Public investment strategy is similar to that of the base case scenario and consumption VAT is allowed to adjust. Given the access to additional resources, the fiscal adjustment is made easier in the initial years compared to the concessional borrowing-only case (figure 3). Accordingly, private consumption and investment are not crowded-out and increase in the initial years compared to the baseline. The ensuing increase in aggregate demand and demand for non-tradable following the additional resource means capacity constraints bind, so the real exchange rate appreciates further in the initial years.

Consequently, the real appreciation adversely impact the output in the traded good sector which contracts further (-5 percent after 3 years compared to -3 percent in the baseline). However, the negative effect of the real exchange rate appreciation is curbed by the lower tax adjustment and lower interest rate, which contributes to higher investment and higher output.

In the long run, consumption tax rate has to increase rapidly as commercial public debt peaks at 23 percent of GDP and total public debt peaks at 72 percent of GDP. This higher long run fiscal effort adversely impact private consumption and investment whose trajectories are below the concessional borrowing case-only. The upside of the long run fiscal adjustment is a debt dynamic that is shown to be favorable because commercial public debt and total public debt as a share of GDP gradually decrease after 9 year and eventually return to 10 percent and 39 percent respectively in year 25.

[16] Note that we assume that the government borrowing fall exclusively on concessional loans and grants and therefore keep constant the external commercial and domestic borrowing.

Figure 3: External commercial versus concessional borrowing only



B. Closing the financing gap with domestic borrowing versus external commercial borrowing

The domestic borrowing assumes a broadening of the investor base and domestic market capable to absorb part of the public sector borrowing requirements.[17] Although the current domestic debt stock is on a much lower level (it was 18.4 percent of GDP at end-2007 and 9.2 percent of GDP at end-2012), the rise in interest rate and the maturity structure highlight significant repayment risks.

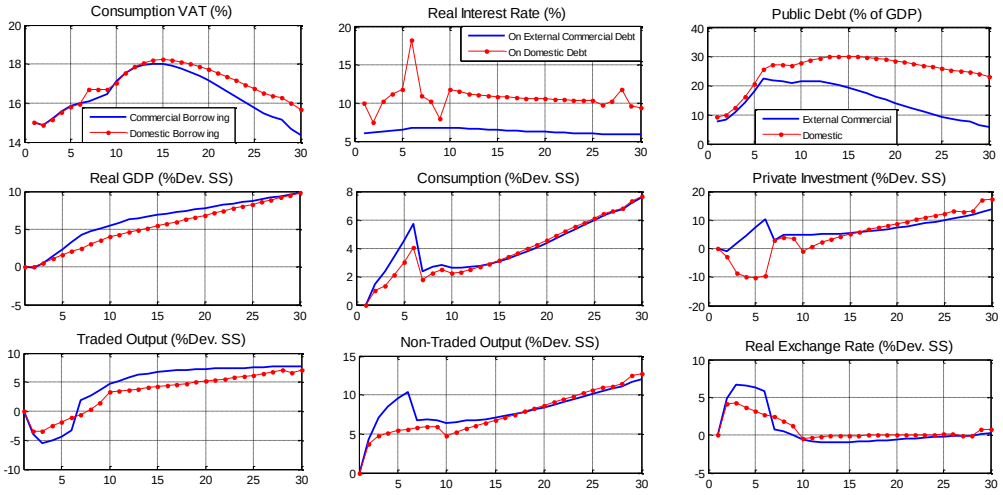
Borrowing domestically has some additional caveats. On the one hand, it does not add any additional resource to the economy but competes against private sector on available resource, which has a crowding-out effect on private consumption and investment. On the other hand, it has distortive effect on investment decisions by adding volatility to domestic interest rates (Buffie et al. 2012).

Figure 4 is a perfect characterization of these results for Sierra Leone. When the government borrows on domestic markets, domestic interest rate is volatile and private investment is crowded-out, especially for the first five years (investment contracts and remains in the negative territory for up to 7 years). In addition, domestic public debt is higher (30 percent of GDP in year 11 versus 21 percent of GDP by year 9 in the external commercial borrowing case only) and declines more slowly over time because financing terms are more expensive for domestic borrowing than for the external commercial borrowing. However, both types of debt accumulations are expected to remain moderate over the long run. Domestic debt stock is projected to decline from its peak level in year 9 to 26 percent of GDP in year 25 while external commercial debt stock declines to a level around 10 percent of GDP in the same year.

[17] This requires further achievement of the government's financial sector development plan.

These alternative financing sources secured for public investment indicate that in the short run policymakers can enjoy both higher growth (economic efficiency) and welfare improvement (unpainful fiscal adjustment). However, in the long run, policymakers face a trade-off between fiscal sustainability and social-friendly goals; indeed, the need for debt sustainability and fiscal tightening measures are more likely to damage investment, growth and social indicators.

Figure 4: Domestic borrowing versus external commercial borrowing



C. Alternative Case Investment Strategies

The alternative case investment strategies (aggressive and modest scenarios) assume the same economic structure of the economy as in the base case but different degrees of public investment scaling-up. The level of grants secured by the government is also similar to that of the baseline. Therefore, no additional financing from concessional borrowing is assumed in the case of more aggressive investment strategy. However, we assume that the government would access external commercial loans to finance part of the fiscal gap. In addition, we assume that coping with both public investment plans requires domestically adjusting the fiscal stance. The rigidity in the adjustment on the spending side would therefore entail some adjustments on the tax side only.

Aggressive public investment scaling up scenario

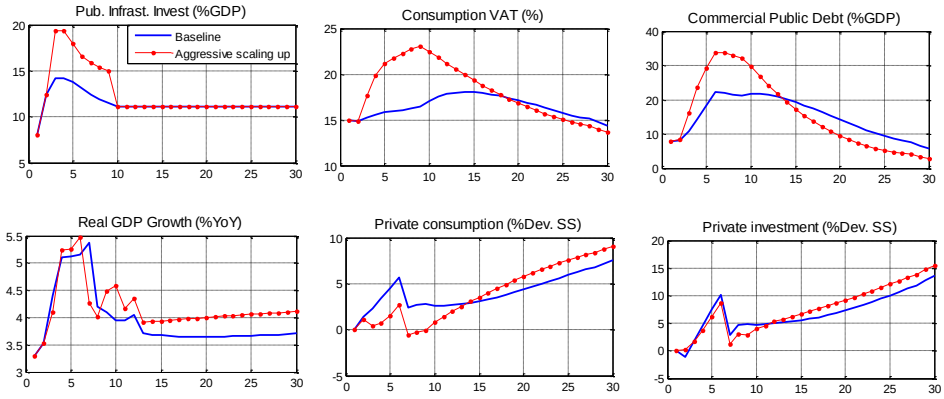
Transforming the Sierra Leonean economy in order to achieve middle income country status will require more aggressive investment strategy than what is assumed in the baseline. The authorities' aspirational plan is a medium-term spending profile that will be driven by public investment scaling up (IMF staff report, 2014).[18] Therefore, in this alternative investment scenario (figure 5), public investment is projected to rise from 8 percent of GDP to 19

[18] Actions are underway with the objective to prevent fiscal slippages, contain the wage bill and strengthen public investment management.

percent of GDP by year 4 (which is more than doubling the baseline investment level in four years), and then falls gradually to 11 percent of GDP, permanently, by year 10.

Assuming that the structural economic conditions remain unchanged and under the assumed financing strategies, the aggressive investment scaling up while beneficial in the long term, would require unfeasible fiscal consolidation in the medium term. The increase in the consumption tax rate is projected to be higher compared to the base case (consumption tax rate reaches a peak of 23 percent in year 9 compared to 17.5 percent in the baseline). Therefore the additional fiscal effort necessary for the alternative investment strategy represents 5.5 percentage points increase of the consumption tax that corresponds to the baseline investment strategy in year 9. Clearly, such fiscal adjustment is unrealistically achievable in the current context of the Sierra Leonean economy characterized by lower tax base, tax fraud and tax evasion (IMF staff report, 2014). The downside of the fiscal consolidation is lower private consumption and private investment in the short-to medium-term. In particular, private consumption path in the aggressive investment scaling up case is below that of the base case in the first 13 years. Private investment is also lower compared to the baseline, although the difference is marginal. The upside of the fiscal adjustment is a fast decreasing path of the external commercial public debt in the aggressive public investment case compared to the base case. In particular, external commercial public debt is 10 percent of GDP in year 20 in the aggressive public investment case and 14.5 percent of GDP in the base case, which is 4.5 percentage point lower. But the favorable debt dynamics is also the result of the higher long term growth benefits.

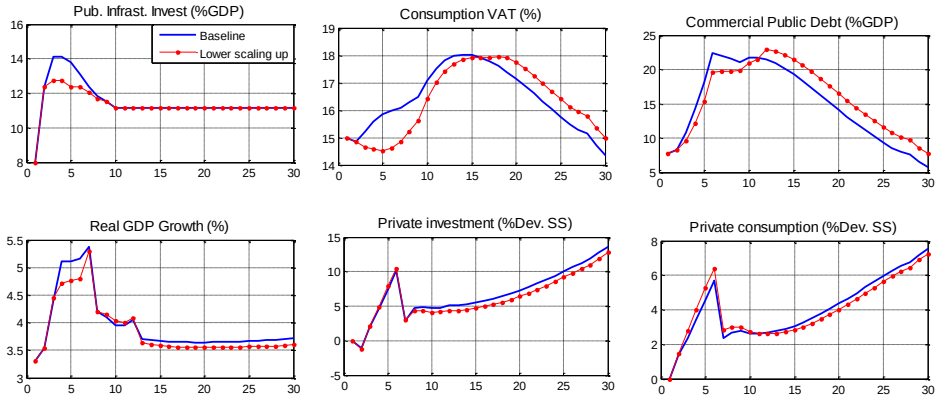
Figure 5: Aggressive public investment scaling up



Lower public investment scaling up scenario

This alternative "investment surge" experiment considers a smaller and frontloaded increase in public investment (at the peak time, the level of investment is 1.2 percentage point lower compared to the base case). As expected, more modest public investment strategy (figure 6) leads to smaller adjustment in tax rates. In addition, the relative merits of it are private consumption and private investment that expand, yet marginally in the short run compared to the baseline. However, modest investment scaling up is not without risk of jeopardizing long term goal such as higher GDP growth rate and sustainable debt path, especially when commercial loans finance part of the fiscal gap.

Figure 6: Lower public investment scaling up

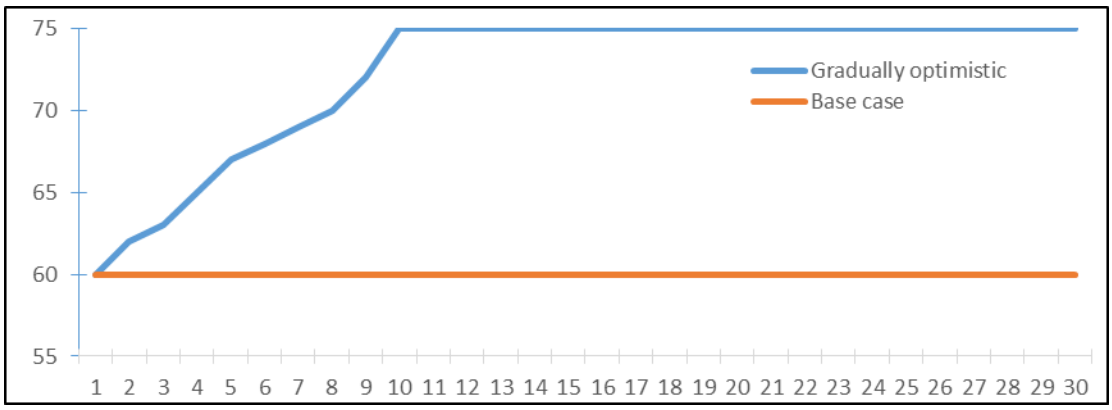


VI. Baseline investment strategy with structural reforms and Policy Conditions

A. Structural Reforms

So far we argued that public investment can be self-financing in the long run; the growth dividends that it entails can therefore help contain vulnerability to debt distress. However, the extent of the growth benefits depends on changes in the structural conditions of the economy (changes in efficiency or rate of return on public investment and absorptive capacity). These are essentially institutional factors. They contribute to shape the extent to which the public investment is translated into productive capital. It is generally believed that such factors are weak in fragile states including Sierra Leone. Indeed, the index of public investment management developed by Dabla-Norris et al (2011) ranks Sierra Leone in the bottom quartile, suggesting that the assumed parameter values underpinning such factors in the baseline may seem less conservative (see section III.2 for the discussion on the parameters values), and may suggest that the results discussed earlier are optimistic. This calls for more conservative assumptions. This section therefore conducts sensitivity analysis based on different assumptions of structural conditions of the Sierra Leonean economy: return on infrastructure (R), efficiency of public investment (s), user fees on infrastructure (f) and absorptive capacity (ϕ). We assume two different scenarios against the baseline parametrization: optimistic scenario and pessimistic scenario (table 3). The "optimistic scenario" assumes that some structural reforms would help improve the country's efficiency, but this may take time to implement. In this regard, this scenario reflects a "gradual" increase (or improvement) in the parameter related to efficiency from its baseline value (0.6) to 0.75 within 10 years (figure 7).

Figure 7: Optimistic scenario: Efficiency of public investment (s, in %)



In the "pessimistic scenario", the return on infrastructure is set at 15 percent versus 25 percent in the base case. Public investment is less efficient (40 percent) and user fees recoup only 30 percent of recurrent costs of infrastructure. The absorptive capacity binds more (ϕ=5 versus ϕ=2 in the base case).[19] In addition, the size of the scaling-up of public investment, the financing mode and fiscal adjustment are similar to those in the baseline.

Table 3: Sensitivity Analysis Assumptions

	Return on infrastructure (R)	Efficiency of public investment (s)	User fees on infrastructure (f)	Absorptive capacity (ϕ)
Base case	0.25	0.60	0.50	2.00
Pessimistic	0.15	0.40	0.30	5.00

Figure 8 (respectively figure 9) displays the results associated with the "optimistic scenario" (respectively "pessimistic scenario"). The transition paths under the optimistic scenarios are encouraging compared to the baseline and the pessimistic scenario. Specifically, the effective public capital as well as growth rate reach a much higher level compared to the baseline and total public debt is at a lower level. Fiscal adjustment (revenue side) is not painful. The paths are notably better in the long run. The ratio of external commercial public debt peaks at around 17.5 percent at *t=6*, while declining at 1.2 percent at *t=30*, below the base case scenario. Real per capita GDP growth rate reaches a much higher level compared to the base case scenario.

Furthermore, the short and long run outlook in the pessimistic scenario are discouraging. The path of the real per capita GDP growth rate increases below the assumed long-run growth rate of 3.3 percent and total public debt stock reaches a much lower level compared to the base case. In addition, private consumption path fall in the negative territory by year 7

[19]Lower value (e.g.: value 0) shows high absorptive capacity while higher value (e.g.: value 5) shows low absorptive capacity.

till year 25 and private investment is below the baseline parametrization as a result of the sharp fiscal adjustment.

We conclude that good institutional factors contribute significantly to the result of public investment and economic growth and sustainability. It is critical that the authorities of Sierra Leone strive to improve those structural factors such as the return of the infrastructure and the efficiency of the public investment, through structural reforms aimed at improving the institutional and regulatory frameworks of project selection and monitoring. Such reforms should include "investing in investing" or investment in capacities that foster new investments and institutional capacities (Collier, 2008).

Figure 8: Higher efficiency of public investment and allowing for commercial public debt

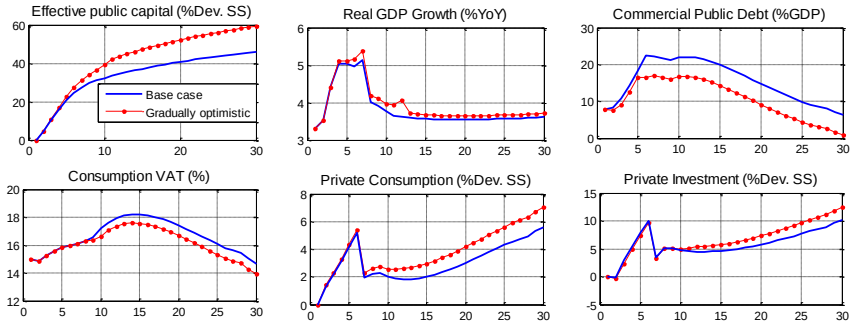
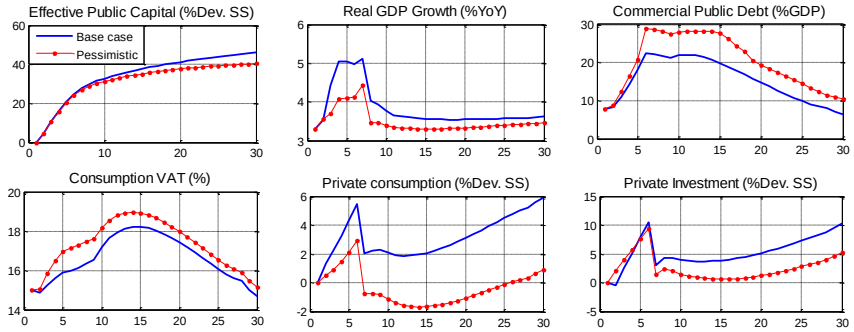


Figure 9: Lower structural conditions and allowing for commercial public debt



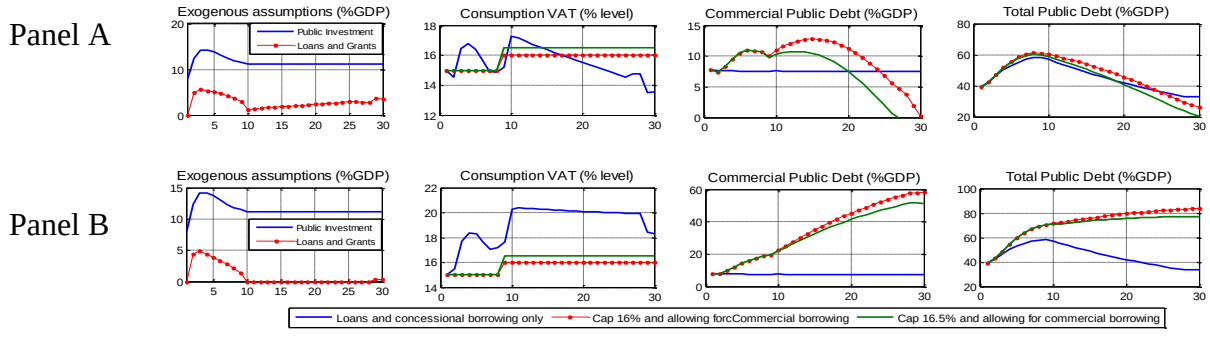
B. Policy Conditions: Fiscal Limits

Now we investigate how the fiscal policy conditions affect debt sustainability (figure 10). We capture this by comparing a scenario of unconstrained tax adjustment with a scenario where we assume that the tax adjustment is staggered. After all, fiscal adjustment in the context of the Sierra Leonean economy is subject to significant rigidities due to pressure on the spending side (e.g.: labor unions looking for better pay, entitlement spending) difficulties to improve the tax base, etc., and underlying expenditure pressures for non-programed and earmarked expenditure due to continued Ebola outbreak. Weak future fiscal position that limits the government's ability to respond countercyclically to downturns and shocks

increases risks to debt distress. The literature has recognized that a smaller tax base contributes to higher sovereign default risks in developing countries (e.g.: Hausmann, 2004; Mendoza and Oviedo, 2004; Celasun et al., 2007; Bohn, 1998, 2008; Ghosh et al., 2011 and Ostry et al., 2010; Bi, 2012; and Juessen et al., 2012). In addition, we distinguish between two cases pertaining to the degree and speed of grant-financing. The first case is similar to the assumed path of loans and grants in the baseline. Specifically, grant-financing is proportional to the degree of public investment scaling up during the first 10 years while growing disproportionately higher after 10 years (Panel A). The second case assumes that the path of loans and grants is permanently proportional to the degree of public investment scaling up (panel B). Furthermore, the public investment strategy is similar to that of the base case discussed earlier and we allow for external commercial borrowing. To capture rigidities in the tax adjustment, we cap the consumption tax rate at 16 percent (red line) and then at 16.5 percent (green line) by year 8.

As expected, it appears clearly that the size of the cap affects the debt path. Smaller size undermines the sustainability of total public debt at a given public investment strategy and structural condition. Considering panel A for instance, when the cap is 16 percent the total debt public debt amounts to 45.6 percent of GDP by year 20; it amounts to 42 percent of GDP by year 20 when the cap is 16.5 percent. More importantly, the way loans and grants adjusts to close the financing gap in the public investment scaling up matters in the presence of constrained tax adjustment. When loans and grants grow quickly than the scaled-up investment (panel A), the debt level is more manageable than otherwise (panel B). In particular, total public debt reaches 45.6 percent of GDP by year 20 in the first case versus more than 79 percent of GDP in the second case for a tax rate restricted to 16 percent.

Figure 10: Different fiscal limits and allowing for external commercial borrowing



C. Timing and Speed of Fiscal Adjustment

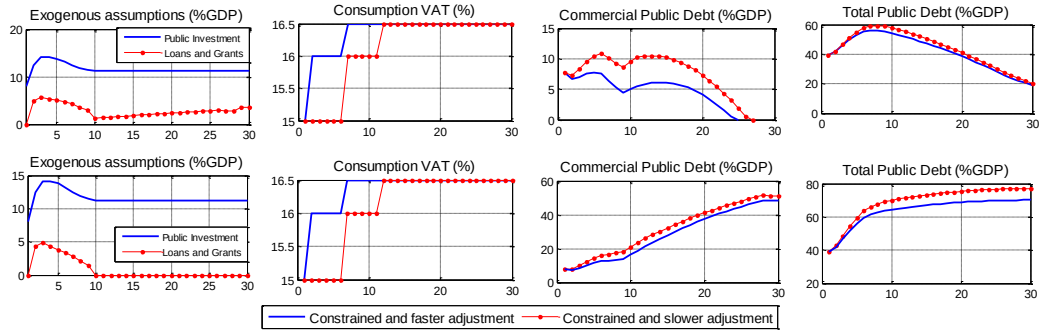
The timing and speed of fiscal adjustment are critical, although governments sometimes have little room for maneuver. For example, severe financing constraints may leave governments little choice but to consolidate, and politically sensitive spending (wage bill, anti-poverty spending, etc.) might prevent consolidation until the problems posed by current policies result in a crisis. But when governments have room to maneuver, as a rule, fiscal consolidation should occur during good times.

The parameters λ_1 and $\lambda_3$in equations (21)-(22) determine whether the fiscal policy adjustment is slow or fast (see box 1). Slow adjustment may require a debt level (second component of equations 21 and 22) above its target level until the gap between the current tax rates (h_t) and transfers (T_t) and their target levels (h_t^{target}) and (h_t^{target}) respectively, is close. At a faster pace, fiscal adjustment may not be feasible for Sierra Leone for the raisons mentioned earlier. We compare the debt sustainability impacts associated with faster and slower fiscal adjustment. The run in figure 11 simulates the case when the government speeds up versus delays or postpones the adjustment of the VAT. This is achieved by assuming discrete jumps in the tax rate. In the faster adjustment (respectively slower adjustment), the consumption VAT jumps immediately from the initial level of 15 percent to 16 percent from year 1 to 6 (respectively stuck at 15 percent over this period) and then to 16.5 percent by year 7 (respectively 16 percent). In addition, we distinguish between the case when the concessional loans and grants grow fast compared to the scaled-up public investment (panel A) and the case when both grow proportionately (panel B).

It stands out clearly that the faster adjustment entails lower debt level, while in the presence of delays in the adjustment, the debt blows up, especially when the inflow of loans and grants is proportional to the scaled-up investment (panel B). However, when the grant-financing grows faster than the investment scaling up (panel A), the government can enjoy postponing the fiscal adjustment without any risk of debt distress in the sense that the debt trajectory does not explode.

Figure 11: Speed of tax adjustments with external commercial borrowing and different paths of the grant-financing.

Panel A



Panel B

Box 1: Speed of Fiscal Adjustment

The equation of the tax rate dynamic (21) can be expressed in the form of Error Correction Model (ECM) as follows:

$$\Delta h_t = -\lambda_1\left(h_{t-1} - h_t^{target}\right) + \lambda_2 \frac{\left(x_{t-1} - x^{target}\right)}{y_t} \qquad (21)$$

Where λ_1 is the speed of adjustment parameter. It tells us by how many percent the tax rate deviation from its target (h_t^{target}) is corrected every year. The lag in h entails that the adjustment is sluggish.

Following Chiang (1984), (21) indicates that tax rate evolves sluggishly toward its target level at a constant speed ($-\lambda_1$) proportional to its distance from h^{target}:

$h_{t-1} - h^{target} \cong -\lambda_1(h_0 - h^{target})$, or using the adjustment time *t*:

$h_{t-1} - h^{target} \cong e^{-\lambda_1 t}(h_0 - h^{target})$.

We define the adjustment ratio α as: $\alpha = \frac{h_{t-1} - h_0}{h^{target} - h_0}$,

From (21),

$$\alpha = \frac{h_{t-1} - h_0}{h^{target} - h_0} = \frac{(h_{t-1} - h^{target}) + (h^{target} - h_0)}{h^{target} - h_0} = 1 - e^{-\lambda_1 t}$$

The time it takes to close α percent of the gap is therefore: $t = -\frac{\ln(1-\alpha)}{\lambda_1}$

When the speed of adjustment, $\lambda_1 = 0.25$, then it takes two to three years to cut half (i.e. $\alpha = 0.5$) the gap between the current tax rate and its target value. However, it takes one to two years to cut it half when the adjustment is speed up (e.g.: $\lambda_1 = 0.45$).

VII. Downside Risks

For the foreseeable future, downside risks are prevalent and will have adverse effects on debt sustainability, from the perspective of other standard measures of debt sustainability (not explored in this framework) such as debt-to-revenue and debt-to-exports. Volatility in the external and domestic outlook is part of the risks, given the country's growing dependence on iron ore export and the undiversified and narrow export base. Therefore, it is clear the economy is prone to extreme vulnerability to terms of trade shock. In addition, the protracted civil war has seriously damaged the human capital base of the country with the destruction of many basic infrastructures and the fleeing of many qualifies workers. Although progresses have been made thus far, the current Ebola epidemic and the ensuing risks to morbidity could halt the momentum and reverse the post conflict achievements. The economic costs of morbidity is felt in terms of foregone productivity of people directly affected by the epidemic, which in turn translates into foregone output. All of these risks undermine directly or indirectly public finances which can also undermine market expectations through increasing public debt risk premium. Clearly, in the case of commercial borrowing this is likely to induce unsustainable debt levels. But when grants and concessional lending are secured during such ill-times, the shocks are less prone to generate explosive paths of public

debt. Thus, given the path of the grant-financing similar to the baseline, we investigate the impacts of terms-of-trade (TOT) and total-factor productivity (TFP) shocks in the presence of external commercial debt-financing.

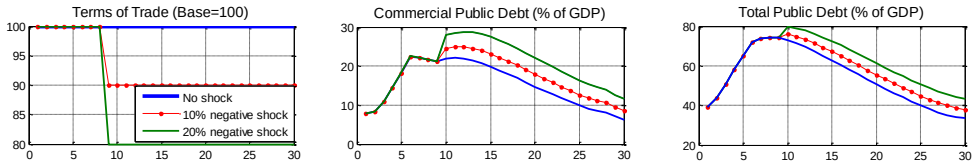
A. Terms-of-Trade Shocks

We investigate two scenarios of unexpected and permanent negative terms-of-trade shock hitting the economy at a time of higher economic vulnerability, i.e. when total public debt amounts to higher level. This period corresponds to year 9. The first scenario is 10 percent decline in the TOT while the second one assumes 20 percent decline.

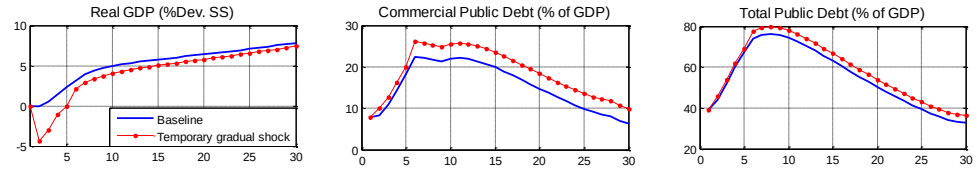
As exemplified in figure 12 (panel A) negative terms-of-trade shifts can lead to unsustainable debt levels. As expected, the magnitude of the shock matters for the debt level. In addition, the scale and speed at which loans and grants adjust to the scale of public investment matters. Here, we assumed that the concessional financing increases more than proportionally compared to public investment. If it was just proportional, then the debt paths would be explosive (see figure 11). Therefore, although our analysis indicates that Sierra Leone's debt distress is moderate, the narrow export base and difficulties to delink the economy from volatility in the iron ore resources could reverse that finding. This underscores the need to continue seeking mostly grants and highly concessional loans to cover the financing needs.

Figure 12: Negative TOT and TFP Shocks

Panel A
TOT Shock



Panel B
TFP Shock



B. Total Factor Productivity Shocks

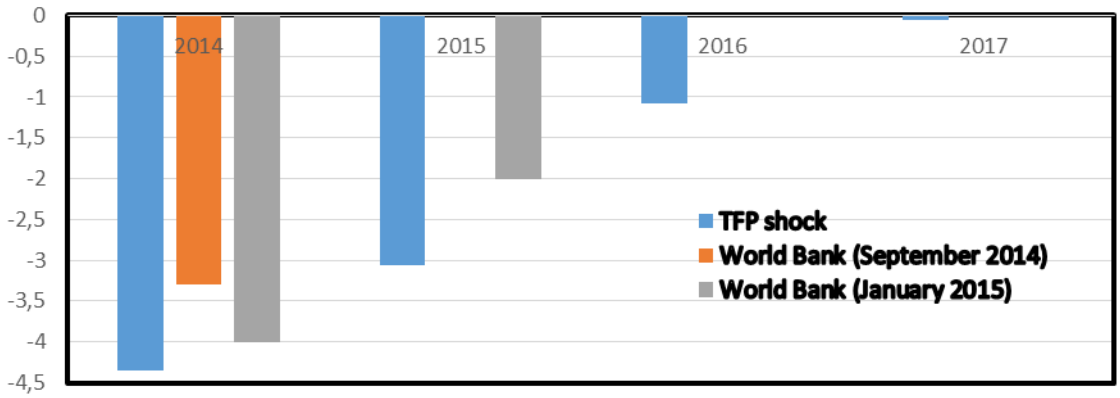
One of the main direct and indirect channel through which the economic impact of the Ebola epidemic operates is known to be the contraction in the labor supply due to sickness and death and the rising cost of healthcare recourses (World Bank, 2014). We investigate the implications for growth and debt sustainability of unexpected non-permanent (first-three years) negative total-factor productivity (TFP) shocks as a way to model disaster shocks. After all the Ebola outbreak and ensuing human and economic damage is similar to a natural disaster. The human damage is understood as a destruction of the human capital-base, most of skilled labor force dying from the disease and some fleeing the country to save their life and the life of their belongings. Moreover, as the country is cut off from the rest of the world, any migration of external skilled labor force to Sierra Leone is hampered. This, added to a protracted civil war that has already killed and displaced the labor force will convincingly imply a worsening of the total factor productivity and ultimately the domestic production and

supply. To capture this, we introduce a negative shock on TFP as a gradual, equal and simultaneous decline in the productivity scale factors in tradable and nontradable sectors over the first-three years. In particular, we assume a simultaneous and equal decrease of 5 percent, 3 percent and 1 percent in the TFP scale factors in "year 1", "year 2" and "year 3", respectively.

Panel B of figure 12 and figure 13 depict the results of the TFP shocks. Real GDP contracts relative to the steady state by 4.3 percent, 3.1 percent, and 1.1 percent and in "year 1", "year 2" and "year 3", respectively. These results are broadly close to the recent World Bank's estimates and forecasts. Indeed, at the beginning of the year 2014, the World Bank forecasted that GDP growth in 2014 would amount to 11.3 percent for Sierra Leone. In mid-August 2014, as a result of these factors, and bearing in mind that the risks are to the downside, the World Bank revised these estimates to 8.0 percent accordingly, which is 3.3 percentages point decline (World Bank, 2014). In January 2015, the actual GDP growth (7.3) points to 4 percentages point decline of GDP growth in 2014, and the World Bank forecasts that GDP growth in 2015 would contract by 2 percent.

On the public debt side, the TFP shocks do not induce explosive paths for public debt when the government contracts commercial loans. This is so because we assumed that the concessional loans component of the fiscal gap financing is higher in the long term. Indeed, the long term path of concessional loans is slightly more than proportional to the path of the public investment (see figure 11), which rules out any risks to larger debt burden.

Figure 13: Estimated GDP impact of Ebola (2014-17)



VIII. Concluding Remarks

Transforming the Sierra Leonean economy to achieve middle income status as planned by the authorities will require taking forceful steps to addressing structural and policy bottlenecks that impede the intended effect of public investment from being reaped. Based on different investment strategies and under certain structural economic conditions, more ambitious investment strategy, even when the government is able to secure loans and grants similar to the baseline level will require unrealistic and unachievable fiscal adjustment in the short term. These include, when the bulk of the adjustment assumes rigidities on the tax side,

cutting the current spending to cover the financing gap, recurrent spending and interest payment on debt. Such fiscal consolidation may incur high political costs but may also be at odd of successfully implementing the government's Agenda for Transformation. Intermediate investment scenario similar to the baseline provide the government with more feasible fiscal adjustment when accompanied by a sustained and faster trajectory of grant-financing. Given that the current debt situation of Sierra Leone is not worrisome, the country can enjoy seeking grants and concessional borrowing to finance critical development projects with high economic returns.

The model also suggests that external commercial borrowing could be a useful complement to concessional loans and would allow for some smoothing of the fiscal adjustment path. However, this may pose risks to debt distress with creditors and trigger debt crisis especially in the context where the country is vulnerable to terms-of-trade shock and other exogenous shock owing to its strong dependence on iron ore resources and Ebola-induced productivity shortfall. Alternatively, domestic borrowing would normally play only a limited role in this framework, in part owing to crowding-out effects.

In addition we find that good institutional factors contribute significantly to the result of public investment and economic growth and sustainability. It is critical that the authorities of Sierra Leone strive to improve those structural factors such as the return of the infrastructure and the efficiency of the public investment, through structural reforms aimed at improving the institutional and regulatory frameworks of project selection and monitoring. Such reforms should include "investing in investing" or investment in capacities that foster new investments and institutional capacities.

In drawing the conclusions for the Sierra Leonean economy we bear in mind that the model relies on some average parameters calculated for LICs. Knowing that the conclusions are sensitive to structural conditions, in particular regarding the returns to public capital, changes in the efficiency of investment, and that most of the parameters values underpinning them are average are not specific to Sierra Leone, further works might be needed to address this issue. Even with this in mind, the model still helps to give a sense of what will be the macroeconomic challenges of various investment and financing scenarios for structural transformation in Sierra Leone.

References

African Development Bank Group, 2014. "Diversifying the Bank's products to provide eligible ADF-only countries access to the ADB sovereign window". Unpublished

Bi, H., 2012. "Sovereign default risk premia, fiscal limits, and fiscal policy". European Economic Review 56 (3), 389–410.

Bohn, H., 1998. The behavior of U.S. public debt and deficits. Quarterly Journal of Economics 113 (3), 949–963.

Bohn, H., 2008. "The sustainability of fiscal policy in the United States". In: Neck, R., Sturm, J.-E. (Eds.), "Sustainability of Public Debt". MIT Press, Cambridge, MA.

Buffie, E., A. Berg, C. Patillo, R. Portillo, and L. F. Zanna, 2012, "Public Investment, Growth and Debt Sustainability: Putting Together the Pieces," IMF working paper WP/12/144.

Celasun, O., Debrun, X., Ostry, J. D., 2007. "Primary surplus behavior and risks to fiscal sustainability in emerging market countries: a "fan-chart" approach". IMF Staff Papers 53 (3), 401–425.

Chiang, Alpha C., 1984, "Fundamental Methods of Mathematical Economics", 3rd edition (New York: McGraw-Hill).

Collier, P. 2008, "Managing Resource Revenues: Lessons for Low Income Countries", African Economic Research Consortium 2008 Annual Conference.

Collier, P., 2010, "The Plundered Planet", New York: Oxford University Press.

Dabla-Norris, E., Brumby, J., Kyobe, A., Mills, Z., and Papageorgiou, C., 2011 "Investing in Public Investment: An Index of Public Investment Efficiency". IMF Working Paper/11/37.

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

Fofana, I., Balma, L., Traoré, F., and Kane, D. (2014). "Social Accounting Matrix for the Gambia, Liberia, Mauritania and Sierra Leone". AGRODEP data report 03.

Ghosh, A. R., Kim, J. I., Mendoza, E. G., Ostry, J. D., Qureshi, M. S., 2011. "Fiscal fatigue, fiscal space and debt sustainability in advanced economies". NBER Working Paper No. 16782.

Hausmann, R., 2004. "Good credit ratios, bad credit ratings: the role of debt structure". In: Kopits, G. (Ed.), "Rules-Based Fiscal Policy in Emerging Market Economics: Background, Analysis, and Prospects". Palgrave Macmillan, New York.

Hulten, C., 1996, "Infrastructure Capital and Economic Growth: How Well You Use It May Be More Important Than How Much You Have." NBER Working Paper, No. 5847.

International Monetary Fund, (2014), "Sierra Leone: First review of extended credit facility arrangement, request for modification of performance criteria, and financing assurances review". IMF Country Report No. 14/171

Juessen, F., Linnemann, L., Schabert, A., 2012. "Default risk premia on government bonds in a quantitative macroeconomic model". Tinbergen Institute Discussion Paper.

Lofgren, H., and Diaz-Bonilla, C., 2010, "MAMS: An economy-wide model for analysis of MDG country strategies—an application to Latin America and the Caribbean". Unpublished.

Mendoza, E. G., Oviedo, P. M., 2004. "Fiscal solvency and macroeconomic uncertainty in developing countries: the tale of the tormented insurer". Working Paper, Iowa State University.

Ogaki M, Ostry J, and Reinhart CM. 1996. "Saving behavior in low- and middle-income developing countries: a comparison". IMF Staff Papers 43: 38–71.

Ostry, J. D., Ghosh, A. R., Kim, J. I., Qureshi, M. S., 2010. "Fiscal space". IMF Staff note, SPN/10/11

Pritchett, L., 2000, "The Tyranny of Concepts: CUDIE (Cumulated, Depreciated, Investment Effort) is Not Capital." Journal of Economic Growth 5, 361-384.

Schmitt-Grohe S., Uribe, M. (2003), "Closing Small Open Economy Models", Journal of International Economics, 61, 163-185.

Redifer, L., 2010, "New Financing Sources for Africa's Infrastructure Deficit." IMF Survey Magazine: Countries and Regions.

Sy, A. (2013), "First borrow". Finance and development, 2013, Vol. 50, No. 2.

van der Ploeg, F., 2011a, "Fiscal Policy and Dutch Disease," International Economics and Economic Policy, vol. 8, pp. 121-131.

World Bank, (2014). "The economic impact of the 2014 Ebola epidemic", Report No. 90748.

Appendix

Table 1: Agenda for Prosperity ESTIMATES (in Millions US$)

	2013	2014	2015	2016	2017	Total	Partners	GoSL	Gap
Pillar 1: Economic diversification	66.4	307.4	481.1	448.0	442.3	1745.2	1299.9	57.6	387.7
Pillar 2: Managing Natural Resources	12.0	24.5	16.2	8.0	6.8	67.5	10.2	3.0	54.2
Pillar 3: Promoting Human Development	204	346	379	398	412	1739.9	1004.8	32.0	703.1
Pillar 4: International Competitiveness	286	381.8	390.0	300.1	195.8	1553.7	734.2	256.2	563.3
Pillar 5: Labor and Employment	10.5	10.5	10.5	10.5	10.5	52.3	23.9	1.53	26.9
Pillar 6: Social Protection	7.5	19.2	17.6	17.5	17.5	79.3		3.6	75.7
Pillar 7: Governance, Public sector and statistics reform	53.9	76.7	170.0	139.1	137.7	577.4	132.6	114.4	330.39
Pillar 8: Gender equality and women's empowerment	0.48	2.1	4.0	1.3	3.6	11.5	0.0	0.0	11.5
Total	633	1148.9	1450.7	1305.0	1208.7	5747.4	3205.6	464.8	2077.0

Source: Ministry of Finance, Agenda for Transformation (2013)