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Investment Scaling-up and the Role of Government: the Case of Benin

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Investment Scaling-up and the Role of Government: the Case of Benin

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Abstract

This paper studies the fiscal implications for the Beninese economy of scaling up of public investment when the government is subject to inefficiencies on the spending and on the tax collection side. While scaling up of public investments results in higher long-run output and consumption levels, a fiscal stabilization package is required in order to preserve fiscal sustainability. A welfare analysis shows that consumers' welfare is increased when the government smoothes the fiscal adjustment via higher borrowing. Moreover, the comparison between several stabilization packages highlights the fact that higher welfare is achieved when the government relies mostly on taxation of capital as this allows higher levels of consumption to materialize earlier. Lower fiscal costs can however be achieved if the government manages to reduce inefficiency in tax collection. Finally, we consider a change in the trade regime that causes a decline in revenues. We find that the higher fiscal burden required to preserve fiscal sustainability would completely wipe out the welfare gain of higher public investments.

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I. Introduction

The question of whether government investments have an impact on economic growth as well as the nature of trade-off between increases in capital stock and fiscal sustainability have long been at the center of the debate in development economics. From a theoretical point of view, the arguments in favor of higher capital spending from governments are: the higher rates of return due to lack of productive capital, the higher potential growth due to the removal of bottlenecks to development and the complementarity between public and private capital. Moreover, whenever concessional funding is available, such capital investments can occur with lower risks for fiscal sustainability.

On the other hand, however, in many countries public spending is not entirely efficient for a variety of reasons, so that the fraction of public investment which actually pays a return ends up being lower than the original investment. Moreover, when faced with the prospect of fiscal consolidation, they might have problems in raising tax rates or broadening the tax base, therefore creating threats to public debt sustainability. Finally, developing countries can also be subject to large external shocks, which affect their growth and revenue generating capacity and can have large negative consequences for the profile of public debt if they happen during a period of scaling up of public investments.

This paper uses a DSGE model to illustrate all of these issues. It analyzes the macro fiscal implications of scaling-up investments allowing for a rich set of fiscal tools, inefficiencies both in public spending side and in tax collection as well as external shocks. We use a modified version of the model originally developed by Buffie et al. (2012) which is tailored to developing countries. Compared to their model, we extend the analysis along four dimensions: (i) we enrich the set of fiscal tools by introducing differentiated tax rates on domestic consumption, labor and capital; (ii) we endogenize labor supply; (iii) we introduce government inefficiency in tax collection which we calibrate using results from estimation and (iv) we introduce windfall revenues.

We calibrate this model to the experience of Benin and assess how the government's plan of scaling up of public investments impacts the macroeconomic performance of the country and fiscal sustainability. We analyze the case in which the authorities face a given amount of concessional financing and close their financing gap with higher taxes, as well as the case in which they can access further borrowing. In either case we assess the impact of different fiscal stabilization packages and compare their welfare implications.

Finally, we analyze the effects on the dynamics of public debt in case the country is hit by a large external shock during the scaling up period. The shock takes the form of the liberalization in the Nigerian trade regime. This is particularly important for the Beninese economy as it constitutes a loss of government revenue of around two percentage points of GDP.

The results show that a large scaling up of public investments in Benin does require a fiscal adjustment package. According to the welfare analysis the best policy response entails smooth fiscal adjustment with some mix of higher tax rates and higher government borrowing to cover the financing gap. From the point of view of the mix of taxes, the fiscal adjustment which is preferred by consumers is the one which imposes higher tax rates on firms' profits. Despite the fact that such tax increase penalizes private investments, it also allows consumption to be smoother over time, which is welfare enhancing from the consumers' point of view. This result however hinges on the assumption of international immobility of capital. We also show that higher efficiency in tax collection can function as a good substitute for increases in tax rates. Finally, the results also caution against possible optimism as the same fiscal package would not be able to prevent unsustainable public debt in case Nigeria were to liberalize its trade regime.

II. Evaluation of Infrastructure Needs

As most African countries, Benin too has pressing infrastructure needs, especially in the areas of transport, irrigation, water and sanitation services, power and information and communication technology (ICT) (see Dominguez-Torres and Foster 2011). In absolute terms, Benin's infrastructure spending needs are in line with other countries in the region. According to the World Bank, such needs are around 16.6 percent of GDP, of which 10 percent are capital investments and the rest expenditure for operation and maintenance (O&M). This measure is very similar to the average infrastructure needs estimated for Sub-Saharan African countries and for the ECOWAS region. They are on the other hand slightly lower than infrastructure needs estimated for the average Low Income Countries (22 percent).

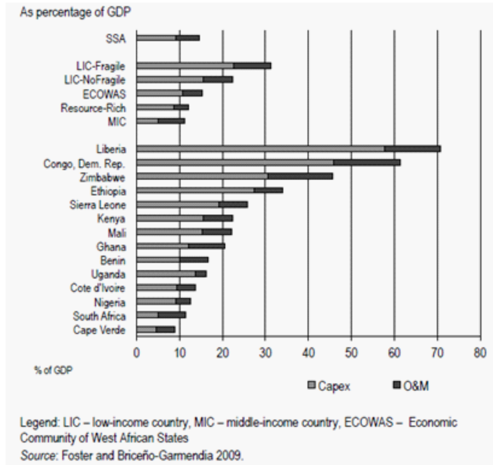

Figure 1 - Infrastructure Spending Needs

Benin's existing public investment spending amounts to almost 10.5 percent of GDP, if 2005 GDP is taken into account (figure 2). Of this, about 6.3% are public investments and the rest are expenditures for operation and maintenance. This represents an average level of spending, almost at par with the average spending burden for low-income, non fragile countries.

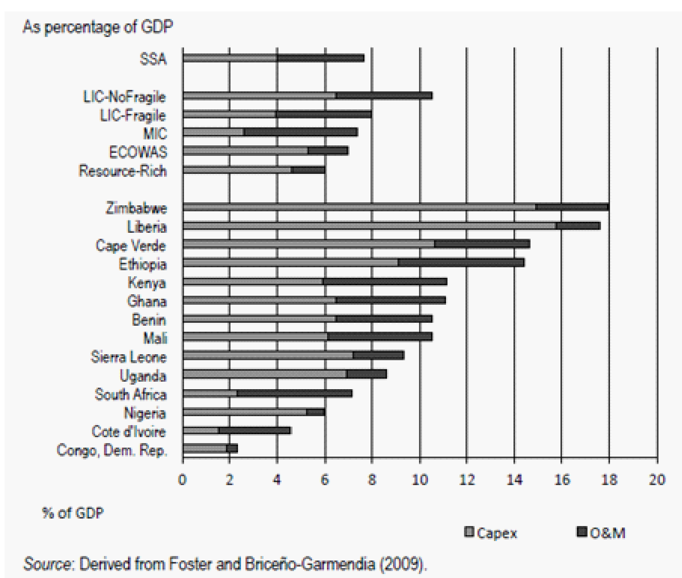

Figure 2 - Existing Capital and Operation and Maintenance Spending

In terms of financing of capital investments, Benin receives broadly as much development aid as other non-fragile low income countries (Figure 3) mostly concentrated in the water and sanitation sector. On the other hand, Benin's information and communication technology (ICT) and power sector receive larger shares of public funding than those of the low-income countries as a group. All together, infrastructure sectors in Benin, except for irrigation, receive comparable funding to other non fragile countries.

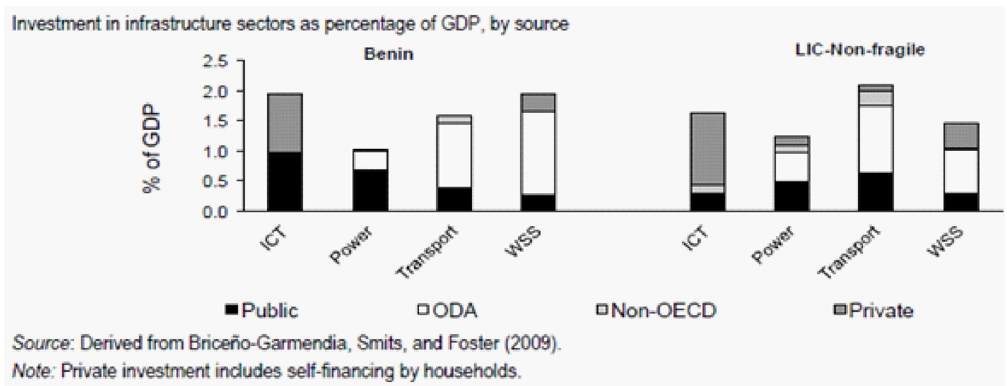

Figure 3 - Investment in Infrastructure Sectors as Percentage of GDP

The need to increase public investments has therefore to come to terms with possible funding constraints. Fiscal space, however, can be generated also by reducing existing inefficiencies both in the phase of implementation of government spending and in revenue collection.

The former is one area where much work needs to be done in Benin. As a matter of fact, the completion rates for public investments are in general relatively low. In 2012 for instance, the completion rate was about 42%, with an even lower rate for public investments financed by foreign capital (23.4%). The execution rate was different across line ministries with low execution rates for those charged of "priority social expenditure". There are various reasons for such low implementation rates. A recent report by the World Bank[1] has highlighted: (i) the lack of coherence between the multi-year planned expenditure and the yearly expenditure envelop; (ii) difficulties of the treasury system in handling big investment projects; (iii) the long delays of the procedures of public procurement; (iv) lack of human capital of the agents involved; (v) difficulties in the payment process. Such constraints in the best case cause delays or under-execution of expenditures, while in the worst case translate into large unallocated budget resources. In the case of Benin unallocated resources are significant. These funds are then reallocated by the Ministry of Finance to other line ministries and then tend to be fully executed. These dynamics result in a public expenditure process which is less transparent, less

[1]Stimuler l'Execution du Budget d'Investissement des Pays de l'UEMOA Pour un Meilleur Impact sur le Developpement

efficient and less productive.

Inefficiencies are also present in the process of tax collection. These include tax exemptions, poor tax collection and tax elusion that reduce potential collection. The level of tax exemptions remains elevated, although on a declining trend. Also, the absence of a system of effective physical controls in the firms and of risk-based analysis at customs posts lowers private sector's incentives to comply with tax regulations (see Rota-Graziosi et al. 2012 and Parent et al. 2013).

III. The model

The model is a medium scale open economy DSGE model along the lines of Buffie et al (2012). If features three agents: (i) households (ii) firms and (iii) government. Since the main focus of the paper is fiscal adjustment and public investment we will describe the government sector in more detail.

A. Firms

The economy produces two types of goods: traded good (x) and non traded good (n). In each sector j labor L_j, capital k_j and public effective capital z_j^e are combined using a Cobb-Douglas technology to produce output q_j:

$$q_{x,t} = A_{x,t} \left(z_{t-1}^e\right)^{\phi_x} \left(k_{x,t-1}\right)^{\alpha_x} \left(L_{x,t}\right)^{1-\alpha_x} \tag{1}$$

$$q_{n,t} = A_{n,t} \left(z_{t-1}^e\right)^{\phi_n} \left(k_{n,t-1}\right)^{\alpha_n} \left(L_{n,t}\right)^{1-\alpha_n} \tag{2}$$

where α_x, α_n represents capital productivity and ϕ_x, ϕ_n is public capital productivity. Both private and public capital are produced by combining one imported machine with a_j (where $(j = k, z)$) units of a non-traded input. The supply price of private capital and infrastructure are thus:

$$p_{k,t} = p_{mm,t} + a_k p_{n,t} \tag{3}$$

$$p_{z,t} = p_{mm,t} + a_z p_{n,t} \tag{4}$$

where p_n is the price of the non traded good and p_{mm} is the price of imported goods.

The firms optimize their profits so that the marginal productivity of capital and labor is equal to their marginal costs. This yields the following input demand equations:

$$\begin{aligned} (1-\alpha_n)\frac{q_{n,t}}{L_{n,t}} &= \frac{w_t}{p_{n,t}} && (5)\\ (1-\alpha_x)\frac{q_{x,t}}{L_{x,t}} &= \frac{w_t}{p_{x,t}} && (6)\\ \alpha_n\frac{q_{n,t}}{k_{n,t-1}} &= \frac{r_{n,t}}{p_{n,t}} && (7)\\ \alpha_x\frac{q_{x,t}}{k_{x,t-1}} &= \frac{r_{x,t}}{p_{x,t}} && (8) \end{aligned}$$

B. The Government

B.1. Government Inefficiencies

Government Investment. As in Baxter and King (1993), we allow for a productive public investment. Public capital evolves according to a standard law of motion:

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

where $i_{z,t}$ denotes government investment, z_t represent the public capital,[2] g is the long run growth rate of real GDP, δ represents the depreciation of capital. However, given the nature of the economy, only a fraction of the public capital is effective:

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

where z_t^e represents the effective public capital, $\overline{z}$ is the capital at the initial level (steady state level) and $\overline{s} \in [0,1]$, $s \in [0,1]$ are two parameters that regulate the efficiency at the steady state and off the steady state respectively. This implies that one dollar of public spending does not translate in one dollar of effectively produced capital. The two expressions above can be combined to yield:

$$(1+g)\,z_t^e = (1-\delta)\,z_{t-1}^e + s\left(i_{z,t} - \overline{i_z}\right) + \overline{s}\overline{i_z} \tag{11}$$

Tax Collection. The government collects taxes on capital, labor and consumption. Formally this can be expressed as:

$$TAX_{c,t} = \tau_{c,t}P_t c_t + \tau_{k,t}\left(r_{x,t}k_{x,t} + r_{n,t}k_{n,t}\right) + \tau_{l,t}w_t L_t \tag{12}$$

where $\tau_{c,t}$ is a consumption value added tax, $\tau_{k,t}$ denotes a tax on capital profits, $\tau_{l,t}$ represents a tax on labour, P_t is the price level, c_t represent consumption, $r_{x,t}$ and $r_{n,t}$ are the rental rate in the traded and non traded sector, $k_{x,t}$ and $k_{n,t}$ are the level of capital in the traded and non

[2] This can be thought as the actual level of infrastructures at a certain date.

traded sector, w_t is the wage rate and L_t represents total labor supply. Furthermore, we assume that the government is inefficient in collecting the taxes. In particular, only a fraction of the outstanding amount of collected taxes $TAX_{c,t}$ enters in the government budget constraint:

$$TAX_t = \phi_G TAX_{c,t} \tag{13}$$

where the parameter $0 \leq \phi_G \leq 1$ captures the government inefficiencies in collecting taxes.

B.2. Government Budget Constraint

The government faces a standard budget constraint. Besides levying taxes it collects revenue from user fees imposed on existing infrastructures and it benefits from windfall revenue. The revenues are spent on on debt services and infrastructure needs. When revenues fall short, the deficit is covered by borrowing. In particular, the government can issue three types of debt: domestic debt b_t, external concessional debt d_t and external commercial debt $d_{c,t}$. Formally, its budget constraint can be written as:

$$\begin{aligned} P_t\Delta b_t + \Delta d_{c,t} + \Delta d_t \;&=\; \frac{r_{t-1}-g}{1+g}P_t b_{t-1} + \frac{r_{d,t-1}-g}{1+g}d_{t-1} + \frac{r_{dc,t-1}-g}{1+g}d_{c,t-1} \\ &\quad + P_{z,t}I_{z,t} + \mathfrak{T}_t - TAX_t - \mathfrak{T}\mathfrak{R}_t - \mu z^e_{t-1} \end{aligned} \tag{14}$$

where $\mathfrak{T}\mathfrak{R}_t$ are windfall revenues and $\mathfrak{T}_t$ are transfers. User fees μ are expressed as a fraction f of recurrent costs: $\mu = f\delta P_{zo}$. r, r_d, r_{dc} represent the real interest rates on domestic, concessional and commercial loans. The interest rate on external commercial debt is contracted at a premium over a risk free world interest rate r_f:

$$r_{dc,t} = r_f + \nu_g e^{\eta_g\left(\frac{d_t+d_{c,t}}{y_t} - \frac{\overline{d}+\overline{d_c}}{\overline{y}}\right)} \tag{15}$$

where $y_t = P_{x,t}q_{x,t} + P_{n,t}q_{n,t}$ denotes GDP. $P_{z,t}I_{z,t}$ are public investments, which are modeled to capture inefficiencies and bottlenecks at the implementation phase:

$$I_{z,t} = H_t\left(i_{z,t} - \overline{i_z}\right) + \overline{i_z} \tag{16}$$

where $H_t = \left(1 + \frac{i_{z,t}}{z_{t-1}} - \delta - g\right)^{\phi}$. The parameter $\phi \geqslant 0$ is a parameter that determines the severity of the absorptive capacity constraint in the public sector. With this feature the model captures the idea that the government faces large cost overruns during the implementation phase such as poor planning skills, weak oversight and coordination problems. Note that the constraint affects only new projects since in the steady state this is equal to one.

B.3. Fiscal adjustment

Given the path for public investments and concessional borrowing we can define the gap before fiscal adjustment as:

$$\begin{aligned} GAP_t &= \frac{r_{t-1}-g}{1+g}P_t b_{t-1} + \frac{1+r_d}{1+g}d_{t-1} - d_t + \frac{r_{dc,t-1}-g}{1+g}d_{c,t-1} + P_{z,t}I_{z,t} + \mathfrak{T}_0 \\ &\quad -\phi_G\left[\tau_{c,0}P_t c_t + \tau_{l,0}w_t L_t + \tau_{k,0}\left(r_{x,t}k_{x,t} + r_{n,t}k_{n,t}\right)\right] - \mathfrak{TR}_t - \mu z^e_{t-1} \end{aligned} \tag{17}$$

where tax rates are set at the initial level (subscript 0). This allow us to find the financing need of the government at time t. Using this definition, we can express the budget constraint, in any period of time, as:

$$\begin{aligned} GAP_t &= \phi_G\left[\left(\tau_{c,t}-\tau_{c,0}\right)P_t c_t + \left(\tau_{l,t}-\tau_{l,0}\right)w_t L_t + \left(\tau_{k,t}-\tau_{k,0}\right)\left(r_{x,t}k_{x,t}+r_{n,t}k_{n,t}\right)\right] \\ &\quad + P_t\Delta b_t + \Delta d_{c,t} + \mathfrak{T}_t \end{aligned} \tag{18}$$

Depending on the policy implemented, the fiscal gap can be closed by consumption taxes, capital taxes, labor taxes or by borrowing on the market. Government borrowing can be either calibrated using an exogenous path or allowed to adjust endogenously. The response of tax rates is modeled via fiscal reaction functions, which differ depending on whether government borrowing is considered exogenous or endogenous.

Exogenous Debt In this case the path of government borrowing is considered exogenous; it is all concessional and calibrated to be about 30 percent of the investment scaling up. Taxes are the only variables which can adjust to cover the fiscal gap. They move according to the following reaction functions:

$$\tau_{c,t} = \tau_{c,0} + \lambda_{\tau_{c,t}}\frac{GAP_t}{P_t c_t} \tag{19}$$

$$\tau_{k,t} = \tau_{k,0} + \lambda_{\tau_{k,t}}\frac{GAP_t}{\left(r_{x,t}k_{x,t}+r_{n,t}k_{n,t}\right)} \tag{20}$$

$$\tau_{l,t} = \tau_{l,0} + \lambda_{\tau_{l,t}}\frac{GAP_t}{w_t L_t} \tag{21}$$

where $\tau_{c,0}$, $\tau_{k,0}$, $\tau_{l,0}$ represents the steady state value of the respective tax. The coefficients $\lambda_{\tau_{c,t}}$, $\lambda_{\tau_{k,t}}$, $\lambda_{\tau_{l,t}}$ represent a policy parameter that splits the fiscal adjustment among taxes. Note that the following relationship needs to hold: $\lambda_{\tau_{c,t}} + \lambda_{\tau_{k,t}} + \lambda_{\tau_{l,t}} = 1$.

Endogenous Debt Differently from the previous case here we allow the government to borrow externally to close part of the fiscal gap. In this case, tax rates are constrained by a maximum achievable rate:

$$\tau_{c,t} = \min\left(\tau^r_{c,t}, \tau^u_{c,t}\right) \tag{22}$$
$$\tau_{k,t} = \min\left(\tau^r_{k,t}, \tau^u_{k,t}\right) \tag{23}$$
$$\tau_{l,t} = \min\left(\tau^r_{l,t}, \tau^u_{l,t}\right) \tag{24}$$

where $\tau^u_{l,t}, \tau^r_{c,t}, \tau^u_{k,t}$ are the ceilings on taxes. The values $\tau^r_{l,t}, \tau^r_{c,t}, \tau^r_{k,t}$ are set through fiscal reaction functions that take into account the level of debt in the economy:

$$\tau^r_{c,t} = \tau_{c,t-1} + \lambda_1\left(\tau^{\text{target}}_{c,t} - \tau_{c,t-1}\right) + \lambda_2\frac{(d_{c,t-1} - d^{\text{target}}_c)}{y_t} \tag{25}$$
$$\tau^r_{k,t} = \tau_{k,t-1} + \lambda_3\left(\tau^{\text{target}}_{k,t} - \tau_{k,t-1}\right) + \lambda_4\frac{(d_{c,t-1} - d^{\text{target}}_c)}{y_t} \tag{26}$$
$$\tau^r_{l,t} = \tau_{l,t-1} + \lambda_5\left(\tau^{\text{target}}_{l,t} - \tau_{z,t-1}\right) + \lambda_6\frac{(d_{c,t-1} - d^{\text{target}}_c)}{y_t} \tag{27}$$

The parameters λ_1, λ_3, λ_5 represent the degree of pashing in of taxes increases. The term d^{target}_c represents the steady state value of external commercial debt. Similarly, the parameters λ_2, λ_4, λ_6 represent the degree of how taxes adjusts to changes in the level of debt. The target for each tax rate is defined as:

$$\tau^{\text{target}}_{c,t} = \tau_{c,0} + \lambda_{\tau_{c,t}}\frac{GAP_t}{P_t c_t} \tag{28}$$
$$\tau^{\text{target}}_{k,t} = \tau_{k,0} + \lambda_{\tau_{k,t}}\frac{GAP_t}{(r_{x,t}k_{x,t} + r_{n,t}k_{n,t})} \tag{29}$$
$$\tau^{\text{target}}_{l,t} = \tau_{l,0} + \lambda_{\tau_{l,t}}\frac{GAP_t}{w_t L_t} \tag{30}$$

As in the previous case we have $\lambda_{\tau_{c,t}} + \lambda_{\tau_{k,t}} + \lambda_{\tau_{l,t}} = 1$.

C. Households

The economy features two different types of households: optimizers ($\mathfrak{s}$) and hand to mouth ($\mathfrak{h}$). The former have access to financial market so they can smooth their consumption over time, the latter do not have access to financial markets and they consume all their income within the period.

Household consumption good is an aggregate of domestically produced tradable goods c_x, domestic non tradable goods c_n and foreign produced tradable goods c_m. These are combined into a CES basket:

$$c_t^i = \left[\rho_x^{\frac{1}{\varepsilon}}\left(c_{x,t}^i\right)^{\frac{\varepsilon-1}{\varepsilon}} + \rho_m^{\frac{1}{\varepsilon}}\left(c_{m,t}^i\right)^{\frac{\varepsilon-1}{\varepsilon}} + \rho_n^{\frac{1}{\varepsilon}}\left(c_{n,t}^i\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \quad \text{with} \quad i = \mathfrak{h}, \mathfrak{s} \tag{31}$$

where ρ_x, ρ_m, ρ_n are the distribution parameters and ε is the intratemporal elasticity of substitution. The price level P_t is an aggregate of the prices of the different goods:

$$P_t = \left[\rho_x\left(p_{x,t}\right)^{1-\varepsilon} + \rho_m\left(p_{m,t}\right)^{1-\varepsilon} + \rho_n\left(p_{n,t}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \tag{32}$$

Optimization of the consumer across different types of goods yields standard demand functions:

$$c_{j,t}^i = \rho_j\left(\frac{p_{j,t}}{P_t}\right)^{-\varepsilon} c_t^i \quad \text{with} \quad i = x, n, mj = \mathfrak{h}, \mathfrak{s} \tag{33}$$

C.1. Optimizing Households

Optimizing consumers maximize their lifetime consumption subject to a budget constraint and standard capital accumulation equation:

$$\max \sum_{t=0}^{\infty} \beta^t \frac{\left(c_t^{\mathfrak{s}}\right)^{1-1/\tau}}{1-1/\tau} - \frac{\kappa}{1+\psi}\left(L_t^{\mathfrak{s}}\right)^{1+\psi} \tag{34}$$

subject to:

$$\begin{aligned} P_t b_t^{\mathfrak{s}} + b_t^{\mathfrak{s}*} = {} & (1-\tau_{k,t})\left(r_{x,t}k_{x,t-1}^{\mathfrak{s}} + r_{n,t}k_{n,t-1}^{\mathfrak{s}}\right) + (1-\tau_{t,l})\left(w_t L_t^{\mathfrak{s}}\right) \\ & + \frac{\mathfrak{T}_t}{1+a} - \frac{1+r_{t-1}^*}{1+g} b_{t-1}^{\mathfrak{s}*} - \frac{1+r_{t-1}}{1+g} P_t b_{t-1}^{\mathfrak{s}} - \mathfrak{P}_t^{\mathfrak{s}} \\ & - p_{k,t}\left(i_{x,t}^{\mathfrak{s}} + i_{n,t}^{\mathfrak{s}} + AC_{x,t}^{\mathfrak{s}} + AC_{n,t}^{\mathfrak{s}}\right) + (1+\tau_{c,t}) P_t c_t - \mu z_{t-1}^e + \Phi_t^{\mathfrak{s}} + \mathfrak{C}_t^{\mathfrak{s}} \end{aligned} \tag{35}$$

where $\beta = 1/\left[(1+\varrho)(1+g)^{(1-\tau)/\tau}\right]$ is the discount factor, τ is the intertemporal elasticity of substitution, $\Phi_t^{\mathfrak{s}}$ are profits from domestic firms and $\mathfrak{C}_t^{\mathfrak{s}} = (1-\phi_G) TAX_{c,t}$. Capital in the traded and non traded sector evolves according to the following law of motion:

$$(1+g) k_{x,t}^{\mathfrak{s}} = i_{x,t}^{\mathfrak{s}} + (1-\delta) k_{x,t}^{\mathfrak{s}} \tag{36}$$

$$(1+g) k_{n,t}^{\mathfrak{s}} = i_{n,t}^{\mathfrak{s}} + (1-\delta) k_{n,t}^{\mathfrak{s}} \tag{37}$$

The model also features adjustment costs to physical capital - $AC_{x,t}^{\mathfrak{s}}$ and $AC_{n,t}^{\mathfrak{s}}$ - and for portfolio allocations - $\mathfrak{P}_t^{\mathfrak{s}}$. These costs are modeled as quadratic and take the following form:

$$AC_{j,t}^{\mathfrak{s}} = \frac{\nu}{2}\left(\frac{i_{j,t}^{\mathfrak{s}}}{k_{j,t-1}^{\mathfrak{s}}} - \delta - g\right)^2 k_{j,t-1}^{\mathfrak{s}} \tag{38}$$

$$\mathfrak{P}_t^{\mathfrak{s}} = \frac{\eta}{2}\left(b_t^{\mathfrak{s}*} - \overline{b}_t^{\mathfrak{s}*}\right)^2 \tag{39}$$

where the subscript $j = x, n$ and $b_t^{\mathfrak{s}*}$ represents private foreign borrowing. The maximization problem delivers the following first order conditions:

$$\left(\frac{c_t^s}{c_{t+1}^s}\right)^{-\frac{1}{\tau}} = \left(\beta\frac{1+r_t}{1+g}\frac{1+\tau_{c,t}}{1+\tau_{c,t+1}}\right) \tag{40}$$

$$(1+r_t)\frac{P_{t+1}}{P_t} = \frac{1+r_t^*}{\left[1-\eta\left(b_t^{s*}-\overline{b^{s*}}\right)\right]} \tag{41}$$

$$\kappa\left(L_t^{\mathfrak{s}}\right)^{\psi} = \frac{(1-\tau_{t,l})}{(1+\tau_{c,t})}w_t\left(c_t^s\right)^{-\frac{1}{\tau}} \tag{42}$$

$$(1+r_t)\frac{P_{t+1}}{P_t}\frac{P_{k,t}}{P_{k,t+1}}\left(1+\upsilon\Upsilon_{x,t}^s\right) = \frac{(1-\tau_{k,t})\,r_{x,t+1}}{P_{k,t+1}}+1-\delta+ \tag{43}$$

$$+\upsilon\Upsilon_{x,t+1}^s\left(\frac{i_{x,t+1}^s}{k_{x,t}^s}+1-\delta\right)-\frac{\upsilon}{2}\left(\Upsilon_{x,t+1}^s\right)^2 \tag{44}$$

$$(1+r_t)\frac{P_{t+1}}{P_t}\frac{P_{k,t}}{P_{k,t+1}}\left(1+\upsilon\Upsilon_{n,t}^s\right) = \frac{(1-\tau_{k,t})\,r_{n,t+1}}{P_{k,t+1}}+1-\delta+ \tag{45}$$

$$+\upsilon\Upsilon_{n,t+1}^s\left(\frac{i_{n,t+1}^s}{k_{n,t}^s}+1-\delta\right)-\frac{\upsilon}{2}\left(\Upsilon_{n,t+1}^s\right)^2 \tag{46}$$

where $\Upsilon_{j,t}^s = \left(\frac{i_{j,t+1}^s}{k_{j,t}^s}-\delta-g\right)$ with $j = x, n$. Finally, a further assumption regards the return on debt contracted externally, which is supposed to pay a premium over the commercial debt contracted by the government:

$$r_t^* = r_{dc,t} + \mathfrak{u}$$

C.2. Non-optimizing households

Non-optimizing consumers have the same utility function as the optimizing households:

$$\max\sum_{t=0}^{\infty}\beta^t\frac{\left(c_t^{\mathfrak{h}}\right)^{1-1/\tau}}{1-1/\tau}-\frac{\kappa}{1+\psi}\left(L_t^{\mathfrak{h}}\right)^{1+\psi} \tag{47}$$

They consume their income from labor income each period:

$$(1+\tau_{c,t})\,P_t c_t^{\mathfrak{h}} = (1-\tau_{t,l})\,w_t L^{\mathfrak{h}} + \frac{a}{1+a}\mathfrak{T}_t \tag{48}$$

Static maximization of the utility function give the following labor supply function:

$$\kappa\left(L_t^{\mathfrak{h}}\right)^{\psi} = \frac{(1-\tau_{t,l})}{(1+\tau_{c,t})}w_t\left(c_t^{\mathfrak{h}}\right)^{-\frac{1}{\tau}} \tag{49}$$

D. Market clearing conditions

Flexible wages and prices ensures that demand equals supply in the labor market:

$$L_x + L_n = L_t^{\mathfrak{s}} + L_t^{\mathfrak{h}} \tag{50}$$

In the non-traded market, after aggregating across types of consumers we obtain:

$$q_{n,t} = \rho_n \left(\frac{p_{n,t}}{P_t}\right)^{-\varepsilon} c_t + a_k \left(i_{x,t} + i_{n,t} + AC_{x,t} + AC_{n,t}\right) + a_z \mathfrak{I}_{z,t} \tag{51}$$

Finally, the aggregate budget constraint of consumers and government produce the accounting identity that growth in the country's net foreign debt equals the difference between national spending and national income:

$$\begin{aligned} d_t - d_{t-1} + d_{c,t} - d_{c,t-1} + b_t^* - b_{t-1}^* &= \frac{r_d - g}{1+g} d_{t-1} + \frac{r_{dc,t-1} - g}{1+g} d_{c,t-1} + \frac{r_{t-1}^* - g}{1+g} b_{t-1}^* + \\ &+ P_{z,t}\mathfrak{I}_{z,t} + p_{k,t}\left(i_{x,t} + i_{n,t} + AC_{x,t} + AC_{n,t}\right) + \\ &+ P_t c_t - p_{n,t} q_{n,t} - p_{x,t} q_{x,t} - \mathfrak{TR}_t + \mathfrak{P}_t^{\mathfrak{s}} \end{aligned} \tag{52}$$

IV. Calibration

The model has been calibrated to match as close as possible the specificity of Benin. The value added in the non traded sector is set at 0.42 which represents the average of the real GDP share of tertiary sector from 2000 to 2012. The value of the imports to GDP ratio is set at 27.5 which, as in the previous case, is an average over the same period. The real interest rate of the domestic debt is set at the 2012 value, 4%. The ratio of savers to non savers is calibrated such that around 30% of households have access to finance.[3] This is admittedly higher than official statistics on financial sector penetration suggest, but ideally we would like to account also for the presence of informal lending. Regarding the public investment, the initial ratio of public investment to GDP is set at 6%. As for the financing of investments, we assume that about 30% of the planned public investment will be covered by concessional borrowing.

All the fiscal parameters are set at the 2012 values. The steady state value of the consumption tax rate is equal to 18% , the value of the capital tax rate to 30%, the tax rate on labor to 20%. The initial ratio of public domestic debt to GDP is set at 12.1%, the ratio of public concessional debt to GDP is equal to 16.5%. Windfall revenues are instead calibrated to 2%

[3] Calibrating the parameter of credit constrained agents with a higher value does not qualitatively affect the results.

of the GDP. As explained in Section V.D, this reflects estimates of the revenue collected from imported goods which are then re-exported informally to neighboring Nigeria. The revenue originated from such transactions are modeled as windfall revenues because they result from trade diversion due solely to the prohibitive tariffs applied by Nigeria.

The policy instruments term of the fiscal reaction parameters ($\lambda_{1,3,5}$) are set at 0.25 and the debt term of the fiscal reaction function parameters ($\lambda_{2,4,6}$) are set at 0.02. In the baseline case all taxes have the same weight on the debt to GDP ratio, that is $\lambda_{\tau_{c,t}} = \lambda_{\tau_{k,t}} = \lambda_{\tau_{l,t}} = 1/3$. When we allow only one tax to react, we set its weight to 1 and all of the weights on the other taxes to zero.

Given that some data is not available for Benin, for some of the remaining parameters we follow Andrle et al. (2012) which discuss the calibration of a similar model for Togo, a similar economy. These are: the capital share in value added in the traded sector $\alpha_x = 0.25$, the capital share in value added in the non-traded sector $\alpha_x = 0.30$, the portfolio adjustment parameter $\eta = 1$, the user fee for infrastructure service $f_0 = 0.5$, the initial return on infrastructure $R_{z,0} = 0.25$. Regarding the efficiency of public investment we set the parameters at $s = 0.5$ and $\bar{s} = 0.5$ based on the estimates of Pritchett (2000) for sub-Saharan Africa.

Finally, the government inefficiency parameter in collecting taxes is set at $\phi_G = 0.4$. Theoretically this parameter varies between zero and one, with one representing perfect efficiency. Our calibration comes from our estimates of a Stochastic Frontier Model a la Battese and Coelli (1995) for total tax revenue to GDP. We estimated this model using a specification similar to Pessino and Fenochietto (2010). In particular we regressed the tax revenue to GDP on real GDP per capita, inflation, openness to international trade, the share of agriculture in total value added, consumption to GDP ratio, gross fixed capital formation to GDP ratio, the share of urban population, share of natural resources in GDP and the ratio of M2 to GDP to proxy financial deepening. The sample used for the estimation ran between 1980 and 2011. The estimation of the stochastic frontier model allows us to back up the time series of the inefficiency in tax collection over the sample period. We then calibrate the parameter ϕ_G using the average value between 2007 and 2011. The figure below shows that Benin's inefficiency is at around 0.4, which is about the median for our sample of low income countries.

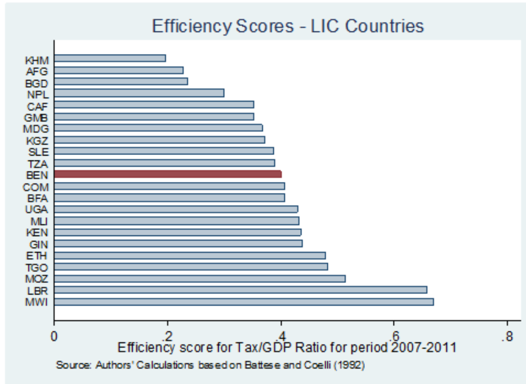

Figure 4 - Efficiency Scores - LIC Countries

For most developing countries the inefficiency parameter is below one, implying that tax revenues are lower than the revenue implied by existing tax rates and tax bases. The reason for this discrepancy is not only corruption - as often mentioned - but also the presence of informal economy and the incidence of a wide range of special tax treatments and exemptions. These can have a very sizeable effect on tax collection. In Benin, for instance, the VAT rate is 18% but the existing revenues on consumption goods imply a tax rate of only about $7-8\%$.

The values of the main calibrated parameters are reported in Table 3.

Parameter	Value	Definition
τ	0.34	Intertemporal elasticity of substitution
ϵ	0.5	Intratemporal elasticity of substitution
α_x	0.25	Capital share in value added in the traded sector
α_n	0.30	Capital share in value added in the non-traded sector
α_k	0.5	Cost share of non-traded inputs in the production of private capital
α_z	0.5	Cost share of non-traded inputs in the production of public capital
δ_x,δ_n,δ_z,	0.05	Depreciation rates
g	0.0086	Growth Rate
d_0	0.165	Initial public concessional debt to GDP Ratio
b_0	0.121	Initial public domestic debt to GDP Ratio
$\tau_{c,0}$	0.18	Initial consumption VAT rate
$\tau_{k,0}$	0.30	Initial capital tax rate
$\tau_{l,0}$	0.20	Initial labor tax rate
$I_{Z,0}$	0.06	Initial ratio of public investment to GDP
ϕ_G	0.4	Efficiency in tax collection
s	0.5	Efficiency of public investment

Table 1 - Calibration of Key Parameters

V. Results

The richness of the model allows us to run a wide variety of experiments on how to best finance a given build up of public investments. In our baseline model we assume that the government can adjust all of the different tax rates and that such tax rates are unconstrained. As a second step we then re-run the model assuming that the government can adjust only one tax rate, while the others are constrained at their steady state value. For each of these scenarios we analyze both the case in which the the path of external concessional borrowing is exogenous and the case in which the government can incur into higher external borrowing to meet the remaining financing needs.

The comparison across different fiscal stabilization packages is conducted through welfare analysis. We compute the welfare loss in terms of consumption equivalent as in Schmitt-Grohé and Uribe (2007).[4] We start by expressing the household utility function in a recursive form:

$$V_t = U\left(C_t, L_t\right) + \beta E_t V_{t+1} \tag{53}$$

and then take a second order approximation of this function at the steady state. Using the second order solution of the model we calculate the value of V_t under each policy scenario and compare the results in terms of consumption equivalent. This is given by the fraction of consumption required to equate welfare under a given policy to the welfare under the baseline case. The result is therefore a measure of the welfare loss in units of steady state consumption, with higher values of the loss indicating less desirable policies.

We then explore the role of government inefficiencies and analyze the effects of a change in our calibrated parameter for inefficiency in revenue collection (ϕ_G). We expect this to impact the need for fiscal adjustment and hence have real effects on output and consumption. As pointed out in the previous section, this experiment can also be interpreted as the result of broadening the tax base.

Finally, in Section V.D we look at what happens when the scaling up of public investments takes place simultaneously with a liberalization of the trade regime in Nigeria. This is modeled as a reduction of the windfall revenues from 2 percent of GDP to zero (see also Rota-Graziosi et al. 2012).

A. Baseline Model

Our results (Figure 5) show that the buildup of public investments produces satisfactory results in terms of growth. The growth rate of GDP per capita in fact increases to 2.5 percent on

[4]See Schmitt-Grohe and Uribe (2007) and Faia and Monacelli (2007) for a detailed discussion of the methodology.

impact and remains high (between 2.5 and 2 percent) during most of the scaling-up period before reverting back towards its steady state level. The path of public investment is such that the stock of public capital net of depreciation stays broadly constant at the level reached after the scaling up exercise[5] (second panel from the top left of Figure 5), which implies that the growth of GDP per capita remains slightly higher than in the original steady state.

In this exercise the path of debt (all concessional) is considered exogenous. After the scaling-up period, its dynamics are governed by the growth of output and revenues. We also assume that the government does not borrow externally on non-concessional terms (top right panel of Figure 5) and we hold domestic debt fixed at its steady state value. Hence, the dynamic of the overall stock of debt reflects that of concessional borrowing. Concessional debt increases up to 27 percent of GDP from an initial value of about 16 and it starts declining after 8 years. The pace of the reduction is relatively fast so that after about 20 years it is only slightly above its starting point.

Three main factors contribute to the fiscal sustainability of the scaling up: (i) the presence of fiscal space thanks to the low initial stock of public debt; (ii) the fact that most of the scaling up is financed by debt contracted on concessional basis and (iii) the adjustment of tax rates. The VAT on domestic consumption increases by 0.8 percentage points, the tax on capital goods increases by slightly more than two percentage points and the tax on labor increases by slightly less than one percentage point. This fiscal tightening is however short lived. After the end of the scaling up of public investments tax rates decrease rapidly and reach a level which is slightly higher than their starting point to allow for the payment of interest rates on the newly accumulated stock of public debt. As the burden of such payments decreases, tax rates converge back to their initial level.

Private consumption initially remains flat, mostly because the higher GDP growth is compensated by a higher VAT tax rate, but it picks up as soon as the VAT rate starts declining and reaches a level almost 6 percent higher than what before the scaling up. Similar dynamics can be observed for private investments which, however, decrease markedly for the first 5 years. This evidence of crowding out can be explained both by the increase in the capital tax rate and in the interest rate which, during the initial period of scaling up increases by about 2 percentage points. As soon as private capital starts responding to higher public investment the interest rate decreases – although it remains at a level slightly higher than its original value. It is important to remember that in this model, domestic interest rate is not controlled by the monetary authority but rather serves the purpose of clearing domestic capital markets as well as facilitating inter-temporal consumption reallocation through the standard Euler equation – together with taxes.

[5] This assumption not only is more realistic than assuming a declining capital stock, but also allows us to consider the fiscal implications of sustaining the higher stock of public capital.

Our baseline scenario shows that the increase in public investments does not necessarily come at the cost of jeopardizing fiscal discipline. In fact, the fiscal balance, after a period of mild deficit turns into a surplus of about 1 percent of GDP. This can be understood as the effect of slightly larger tax rates and a larger tax base due to an increase in growth. In fact, both consumption and private capital increase and – because of the large increase in output and labor productivity – wages increase as well. Overall, an increase in public investments can therefore be beneficial to public finances whenever: (i) the fiscal reaction function of the government is sensitive to the increase in the initial stock of debt so that taxes adjust right away and (ii) the initial stock of debt is such that debt sustainability does not require an excessive increase in tax rates.

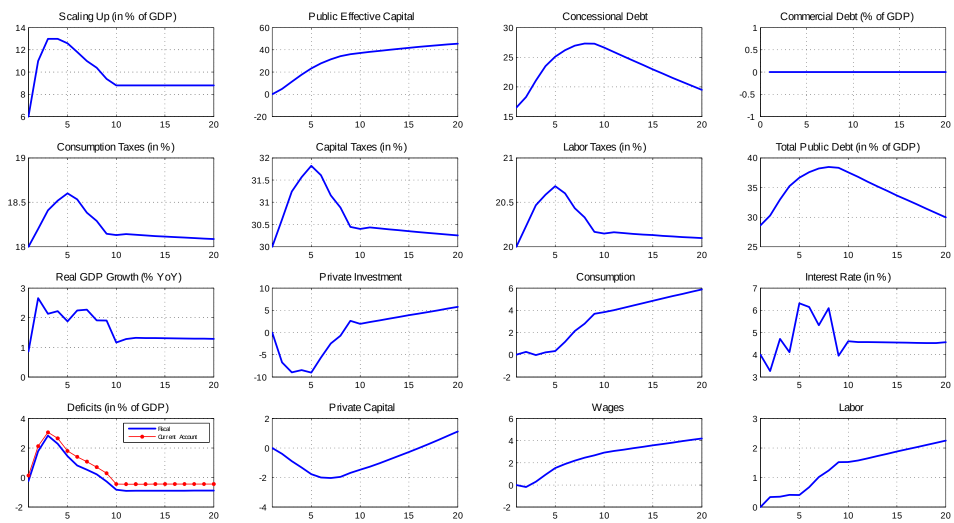

Figure 5 - Baseline Case - Only Taxes Adjust to Close the Fiscal Gap

The figure below compares our baseline scenario with a case in which external commercial debt is allowed to adjust endogenously to the financing of the fiscal gap. The results show that debt helps supporting a smoother fiscal adjustment. This allows consumption to start increasing from period 1 and lowers the crowding-out effect on private investments. However, because the tax rates remain slightly higher than in the previous case, private consumption reaches a level which is slightly lower than under the baseline scenario. Commercial debt increases by six percent of GDP but it declines relatively fast. As a result total debt increases by slightly more than in the previous case but the overall debt dynamics does not result altered. It is important to notice, however, that this relies on the assumption that the interest rate on newly contracted commercial debt does not respond to the higher debt to GDP ratio.

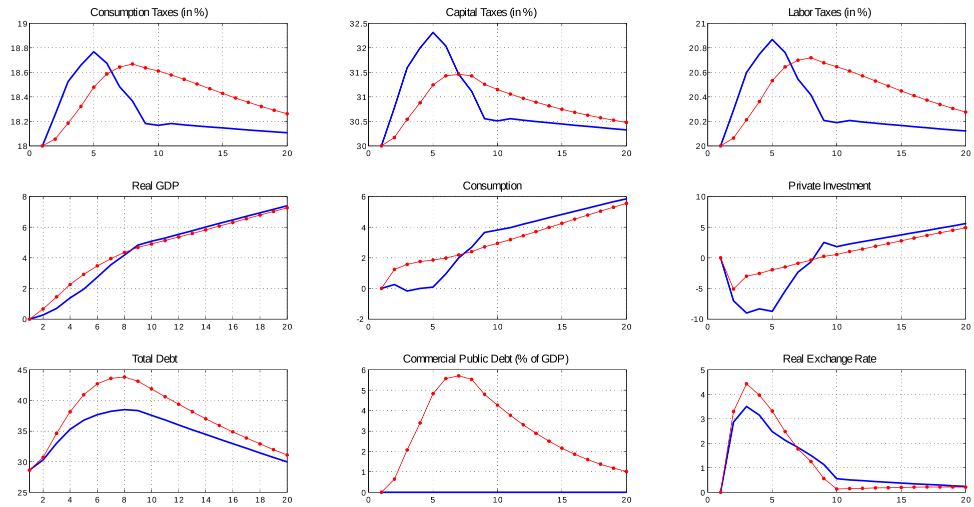

Figure 6 - Allowing for Public Debt to Close the Fiscal Gap - The blue line represents the baseline case, the red line the case in which commercial public debt is allowed to close the fiscal gap.

The welfare comparison between these two cases (Table 2) clearly shows that contracting public debt to smooth out fiscal adjustments leads to higher consumers' welfare. In fact, despite the fact that under this scenario the long-run level of consumption is slightly lower than in the model without endogenous debt, smoothing the fiscal adjustment allows consumption to increase in the earlier years leading to a larger positive welfare gain.

Table 2 - Welfare Comparison

Model without public debt	0.0892
Model with public debt	-

B. Fiscal Stabilization Packages and Welfare Implications

Adjustment through Consumption Taxes: When only consumption taxes are allowed to adjust (Figure 7), their increase during the scaling-up period is higher than in the baseline case. They reach about 21 percent and therefore cause consumption to decline slightly on impact. On the other hand, however, the fact that taxes on capital do not increase has a positive effect on the dynamics of private investments in the sense that their initial crowding out is lower. The overall long-run effects on real GDP is therefore slightly higher than in the baseline case, but the effects on consumption and private investments are instead similar. Real GDP increases by almost 8% while private consumption and private investments increase by about 6 and 5 percent of their initial steady state value respectively.

When the public debt is allowed to adjust endogenously (Figure 7, red line) the basic insights from the results of the previous section carry through. Namely, higher borrowing allows for a lower increase in the consumption tax rate and for a smoother fiscal adjustment. As a consequence consumption raises also on impact and the crowding out of private investments is limited in size and time as it lasts only for the first two periods. Compared to the baseline case, the increase in total public debt is only marginally higher and after peaking around 8 years after the beginning of the scaling-up it slowly declines towards its initial value. The model predicts the debt to GDP ratio to reach 35% 20 years after the beginning of the scaling up, which is only 5 percentage points larger than the initial stock.

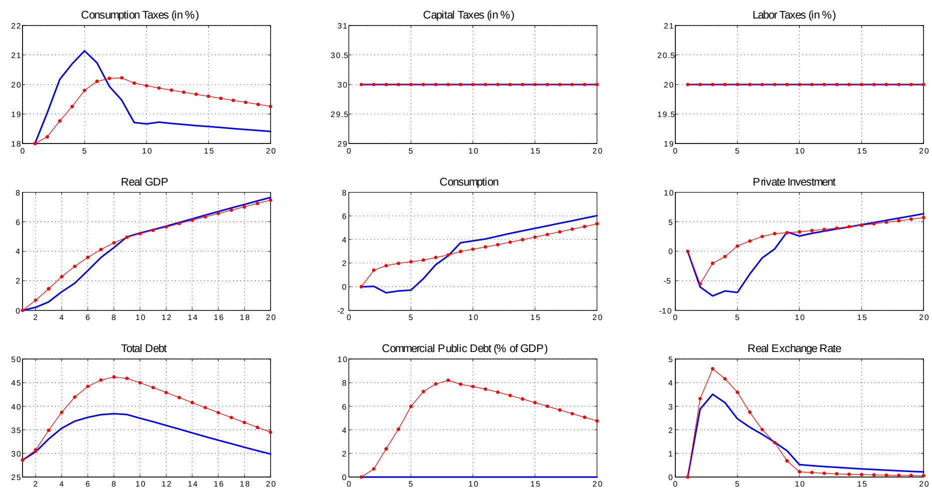

Figure 7 - Only Consumption Tax Adjusts to Close the Fiscal Gap - The blue line represents the case in which only taxes close the fical gap, the red line the case in which commercial public debt is allowed to close the fiscal gap.

Adjustment through Labor Taxes: When only labor taxes are allowed to adjust to close the fiscal gap the results are similar to the previous case (Figure 8). Even in this case the fiscal adjustment generates a crowding out effect of private consumption. With labor taxes the crowding out effect is larger than with consumption taxes, given that higher labor taxes also reduce labor supply. The crowding out effect on private investments is instead similar to the baseline case. After the initial decline, however, both private consumption and private investments increase and after 20 years they are respectively 6 and 5 percent higher than their initial steady state. To ensure sustainability of the public finances, the labor tax increases by almost 4 percentage points - compared to less than one percentage point in the baseline case. The highest tax rate is reached on the fifth year, after which it progressively declines and remains 1 percentage point higher than its initial value. Even in this case a smoother fiscal adjustment can be obtained with higher borrowing (Figure 8, red line). As in the previous case, higher debt eliminates the crowding out effect on private consumption and reduces that on private investments. Similarly to the previous cases, the debt to GDP ratio here peaks at about 45 percent, before progressively declining. The higher productivity of capital increases private wages therefore increasing the base for the labor tax. This effect causes the debt to GDP ratio to decline faster than the previous case with the burden of fiscal adjustment falling on private consumption.

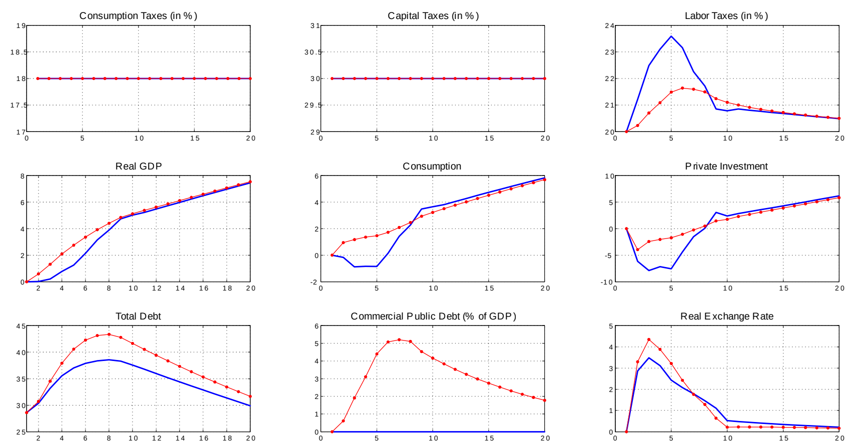

Figure 8 - Only Labor Tax Adjusts to Close the Fiscal Gap - The blue line represents the case in which only taxes close the fical gap, the red line the case in which commercial public debt is allowed to close the fiscal gap.

Adjustment through Capital Taxes: The figure below shows the effects of the buildup of public investments when the taxes on capital goods are the only one allowed to adjust. To ensure public debt sustainability the tax rate on capital goods needs to increase by eight percentage points (compared to 2.5 in the baseline case) before declining to a level slightly higher than the initial steady state. As expected, this scenario allows consumption to increase very fast on impact and causes a larger decrease in private investments which – even after the installment of public capital is over – do not increase above steady state level. Compared to the baseline case, this causes losses in terms of long-run consumption and output. In fact, the increase in capital taxes represents an extra burden on private capital other than the standard crowding-out effect caused by higher interest rates. Overall, however, the effect of the increase in public capital dominates, so that output still increases in the long-run.

Long-run costs are present also when the government is allowed to smooth out the increase in capital tax through domestic borrowing (Figure 9, red line), even if the increase in capital taxes is contained to about five percentage points. However, when the government can access extra funds, private investments do not decrease as much as before and private consumption increases by more during the first ten years.

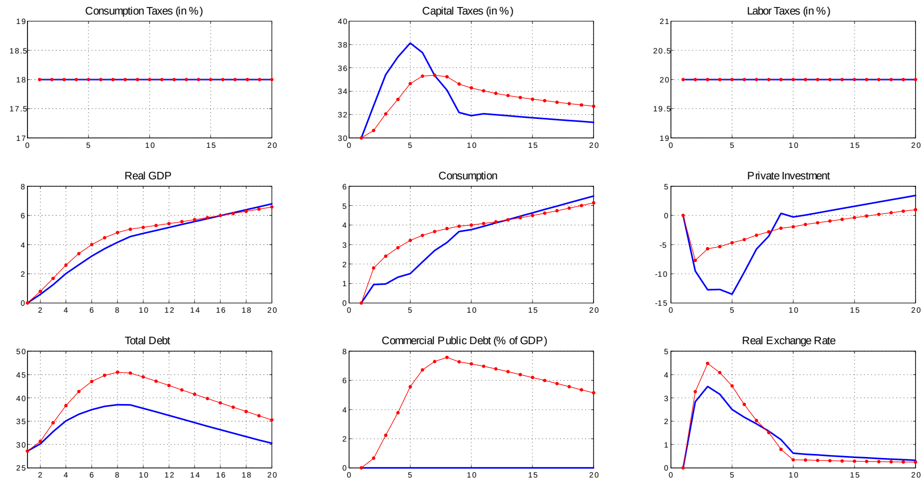

Figure 9 - Only Capital Tax Adjusts to Close the Fiscal Gap - The blue line represents the case in which only taxes close the fical gap, the red line the case in which commercial public debt is allowed to close the fiscal gap.

Welfare Comparison of Stabilization Packages: The larger increase in consumption achieved by imposing the fiscal adjustment only on capital makes the policy options of Figure 9 preferred in terms of welfare. The losses of imposing fiscal adjustment by levying taxes on labor and consumption amount respectively to 5.7 and 6.9 percent (Table 3). They are even higher (10.1 and 11.7 percent respectively) when the government is allowed to smooth the fiscal adjustment through higher borrowing, given that in this case consumption increases very rapidly during the first year of scaling-up. However, as Figure 9 shows, higher taxes on capital have a long-run cost in terms of lower levels of output and consumption. While the lower consumption does not carry a lot of weight in consumers' present value utility, the loss in terms of output causes the debt to GDP ratio to decline at a lower pace. Hence, even with a fiscally responsible government, the scaling up of investment generates a debt profile which is more vulnerable to shocks and which might carry risks for fiscal sustainability. It should be emphasized, however, that the result of the optimality of taxation on capital hinges on the assumption that private capital is not internationally mobile. Removing this assumption will most likely overturn this result. The optimality of smoothing tax adjustments with higher debt, however, will not be affected.

Table 3 - Welfare Comparison

Consumption Tax	0.069	0.117
Labor Tax	0.057	0.101
Capital Tax	-	-

C. Government Inefficiencies

In this section we examine the effect of a marginal improvement in efficiency in tax collection. So far in our exercise the inefficiency parameter ϕ_G has been calibrated to 0.4 (see Section IV). The figure below compares the effect of the scaling up of public investments in the baseline case – blue line – with the case in which ϕ_G improves to 0.5 – red line. We can see that in the case of higher efficiency there are some gains in terms of long-run effects on consumption and private investments. This is mostly due to lower tax rates as they increase less than in the baseline case and decline faster in the medium run. Because of higher efficiency public debt accumulation is also lower although not dramatically so. Commercial public debt increases about 2 percentage points of GDP less than in the baseline case causing total debt to peak at 43 percent of GDP instead than 44 percent of GDP. Due to larger tax bases, however, the decline in the debt to GDP ratio (especially the commercial debt) is faster than in the baseline case.

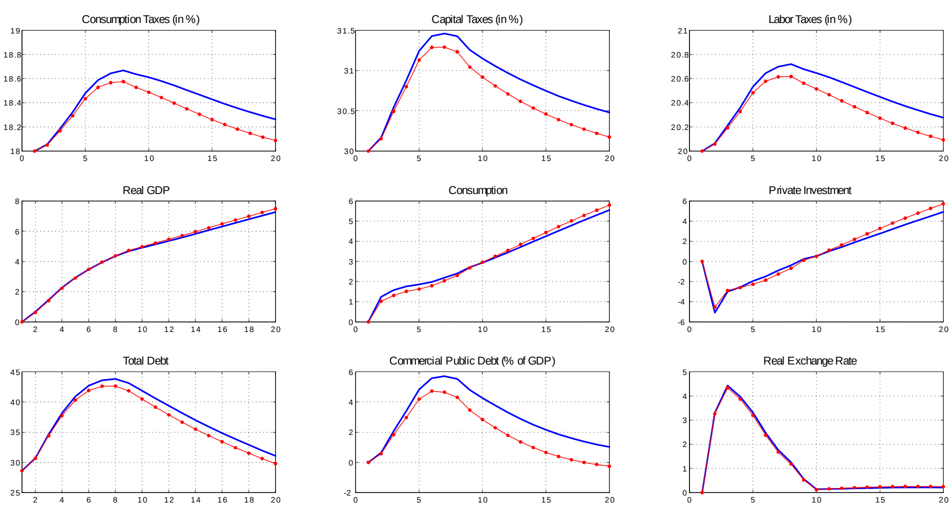

Figure 10 - The Macroeconomic consequences of an increase of the efficiency in tax collection - The blue line represents the baseline case and the red line the case in which the government efficiency is higher.

D. External Shocks: A Decrease in Tariffs Revenues

As a final exercise we simulate the effects on the required fiscal adjustment in case the buildup of public investments took place together with a liberalization of international trade practices in Nigeria. In terms of our model, this is equivalent to a loss of windfall revenue for the Beninese government equal to two percentage points of GDP.

The origins of this windfall revenue are to be found in the particular trade relationships between Benin and Nigeria. The restrictive Nigerian trade regime and its relatively porous borders make of Benin the preferred import platform for goods that the African giant forbids either formally - through import bans - or informally - through prohibitive tariff rates. The Beninese government has committed with the Nigerian government not to export goods which are forbidden on the other side of the borders. Hence, the only way for Beninese importers to reach the Nigerian market is to import the forbidden goods and declare them for domestic consumption, pay tariff duties and VAT and then re-export them informally into Nigeria. From the point of view of the government, this represents a net gain as it receives tax revenue on goods which - under normal circumstances - would be exported directly to Nigeria. A liberalization of the Nigerian trade regime would therefore wash away all of these extra revenues. Estimations performed using customs-level data[6] suggests that the amount of such windfall revenue is somewhat close to two percentage points of GDP. This relies on the assumption that once Nigeria liberalizes its trade regime, goods destined to that market will still be imported through Cotonou, but they will be cleared for international transit. Hence loss in revenue is the net result of the loss of VAT and tariff revenues and the gains from higher revenues that would be collected on goods in international transit.

Figure 11 compares the baseline scenario of public investment buildup with this alternative scenario. In both exercise we have used the assumption that higher domestic borrowing is endogenous and used to smooth out the tax adjustments. This exercise clearly shows the risks that the Beninese government could be subject to. In absence of the windfall revenue, in fact, tax rates increase substantially more than in the baseline case and stay persistently above their initial steady state. Consumption tax increases up to 20 percent; capital taxes increase up to 34 percent and labor taxes increase to slightly more than 22 percent. Higher tax rates have long-run effects on all real variables. Output increases by 3 percentage points less than in the baseline case, while consumption and private investments do not increase in the long-run compared to their original steady state. The entire growth is therefore driven by higher public capital and private activity is completely crowded out with evident negative welfare consequences. Total public debt increases up to 55 percent of GDP after 8 periods and then declines slowly although it remains persistently above its initial level. The commercial public debt follows a similar path and declines even more slowly, therefore exposing the country to interest rate risks. Again, it is important to remember that lowering the available concessional funding, or allowing interest rates to respond endogenously to the accumulation of debt would considerably worsen the outcome and potentially make the debt to GDP ratio unsustainable.

[6] Customs level data at the 6 digit level of the Harmonized System (HS6).

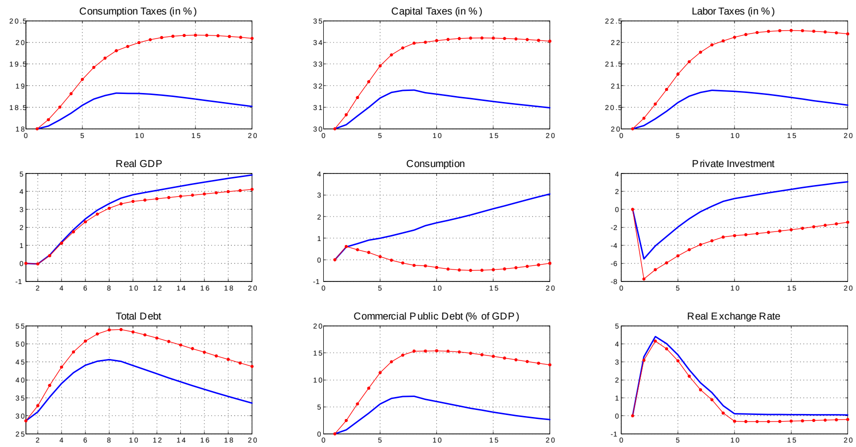

Figure 11 - The Macroeconomic Consequences of a Decrease in Tariffs Revenues - The blue line represents the baseline case and the red line the case in which windfall revenues are absent.

VI. Conclusion

In this paper we analyzed the macro-fiscal consequences of a buildup of public investments in Benin. We used a DSGE model similar to that proposed by Buffie et al. (2012) which we modified to include a richer set of tax instruments, endogenous labor supply, as well as windfall revenues and government inefficiencies in tax collection.

Our results show that in general the buildup of public investments has positive effects on long-run output, consumption and private investments. To preserve fiscal sustainability, however, the government needs to pursue a stabilization policy and increase tax rates during the period of investment buildup. The increase in tax rates, however, can be smoothed out if the government recurs to increase domestic borrowing. with higher welfare gains from the point of view of the consumers. In terms of the optimal fiscal policy mix our welfare analysis shows that consumers are better off if the government relies mostly on profit taxes. Despite the fact that such taxes have adverse implications for private investments and hence yield a lower level of long-run output and consumption, they allow private consumption to increase steeply in the shor to medium term and therefore result in higher consumers' welfare.

Our results also highlight the importance of eliminating government inefficiencies in tax collection. We calibrate government inefficiency in tax collection based on a stochastic frontier estimation of tax revenue to GDP similar to Pessino and Fenochietto (2010). This type of inefficiency could be interpreted both as a friction in tax collection as well as the incidence of informal economy. In fact, reducing inefficiencies reduces the role for increasing tax rates while at the same time increasing the speed of debt reduction in the aftermath of the scaling up period.

Finally, through the calibration of windfall revenues we also highlight the considerable risks posed to Benin's fiscal sustainability by a possible trade liberalization of Nigeria. The required fiscal adjustment would be much stronger, to the point that it would nullify potential welfare gains of higher public investments.

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