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The Composition of Public Expenditure and Growth:

A Small-Scale Intertemporal Model for Low-Income Countries

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Abstract

This paper presents a small-scale intertemporal model of endogenous growth that accounts for the composition of public expenditure and externalities associated with public capital. Government spending is disaggregated into various components, including maintenance, security, and investment in education, health, and core infrastructure. After studying its long-run properties, the model is calibrated for Haiti, using country-specific information as well as parameter estimates from the literature. A variety of policy experiments are then reported, including a reallocation of spending aimed at creating fiscal space to promote public investment; an improvement in fiscal management that leads to a reduction in tax collection costs; higher spending on security; and a composite fiscal package.

This paper—a product of the Latin America and Caribbean Economic Policy Division, Latin America and Caribbean Poverty Reduction Department—is part of a larger effort in the department to understand the issues of the linkages between public expenditure, growth, and poverty. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at epintomoreira@worldbank.org.

The Composition of Public Expenditure and Growth: A Small-scale Intertemporal Model for Low-Income Countries

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Contents

I. Introduction

The link between the composition of public expenditure and growth in developing countries has been the subject of renewed attention in recent years. A number of studies have documented, in particular, that episodes of fiscal adjustment have often been associated with large cuts in public investment; such cuts have translated into adverse effects on growth and poverty reduction. The ongoing debate on "fiscal space" has also led to renewed thinking on this issue. Various observers have pointed out that, in this context, creating fiscal space for public investment in infrastructure, health, or education, for instance, involves dynamic trade-offs; to evaluate these trade-offs requires a dynamic framework that accounts explicitly for the various channels through which the composition of government expenditure and public capital affects the economy. [1]

This paper contributes to the existing literature by proposing a dynamic, small-scale endogenous growth model to evaluate the effect of the composition of public expenditure on growth in low-income developing countries. A key feature of the model is that government spending is disaggregated into various components, including maintenance, security, and investment in education, health, and core infrastructure. In addition, it also accounts for the externalities associated with infrastructure, in terms of its impact on education and health (see Agénor and Moreno-Dodson (2007)). Deininger and Okidi (2003), for instance, in a study of Uganda, found that the benefit of education and health care for growth depends on complementary investments in electricity and other infrastructure.[2]

In addition, the model accounts for improved political stability and reduction in violence. Political instability affects private sector confidence. As documented by Poirson (1998), for instance, using data on economic security

[1]Swaroop (1999) emphasized the need to strengthen the macro dimension in the analysis of World Bank public expenditure reviews (PERs).

[2]There is also some evidence suggesting that education may condition the benefits (or efficiency) of infrastructure. As noted by van de Walle (1995), for instance, investment in education may enhance the marginal impact of irrigation projects.

ratings for 53 developing countries for the period 1984-95, economic security has a positive and significant effect on private investment and growth.[3] Improvements in economic security contribute to the rise of private investment by decreasing downside uncertainty on the return to investment and securing property rights. In addition, improved security may enhance the efficiency of resource allocation and thus growth. In the model, spending on security lowers violence and increases private sector confidence in the economy's prospects; this tends to reduce the rate of time preference and to increase private saving—which in turn stimulates private investment and growth.

The rest of the paper is organized as follows. Section II presents the model. Section III characterizes the equilibrium and the balanced growth path. Section IV describes the calibration procedure and the solution method. The model is calibrated for Haiti, using country-specific information as well as parameter estimates from the literature. Section V presents several experiments: an increase in public investment, a "fiscal space" exercise involving a reallocation of spending, a strengthening of fiscal management taking the form of a reduction in tax collection costs, and an increase in security spending. A composite fiscal package (involving spending on security) is also analyzed. The last section presents some concluding remarks.

[3]The ratings used by Poirson relate to twelve features affecting private investment decisions : government leadership, external conflict risk, corruption, rule of law, racial and ethnic tensions, political terrorism, civil war threats, quality of the bureaucracy, risk of repudiation of contracts, risk expropriation by the government, political rights, and civil liberties. She found that private investment is mostly influenced by the risk of expropriation, the degree of civil liberty, and the quality of the bureaucracy. By contrast, reductions in expropriation risks and political terrorism are the most important security factors that bear on economic growth. Corruption and contract repudiation also affect growth, but only in the long run.

II. Structure of the Model

We consider a small open economy in which four categories of goods are produced: a commodity (produced by the private sector), and three types of services—education and health (both of which produced by the government and the private sector) and infrastructure (produced solely by the government). The privately-produced commodity is a tradable good whose price is taken as given; it can be used for either consumption or investment. Production is consumed only domestically and represents the sole source of supply on the domestic market.[4] The provision of education and health services by the public sector are free of charge, whereas public infrastructure services are sold at a nominal price that is fully indexed on the price of the private good.[5] Excess demand for all services prevails; quantities consumed are thus supply-determined. There is a single, infinitely lived household-producer, which includes all workers (educated and non-educated, employed in either the public or private sector) in the economy.

1. Production of Health Services and Effective Labor

Production of public health services requires combining inputs at several levels. At the first level, public capital in infrastructure, $KG_I(t)$, and public capital in health, $KG_H(t)$, must be combined to obtain the "effective" capital stock in the production of health services. Assuming also a Cobb-Douglas technology yields

$$KG_{IH}(t) = AHC \cdot [\theta I(t) \cdot KG_I(t)]^{\beta HC} \cdot [\theta H(t) \cdot KG_H(t)]^{1-\beta HC}, \qquad (1)$$

where $AHC > 0$, $\beta HC \in (0,1)$, and θI and θH are quality indicators of public infrastructure capital and health capital, respectively.

[4]We therefore abstract from trade flows and balance-of-payments considerations. Because, as discussed below, borrowing is fixed as a proportion of output, and aid (in the form of grants) adjusts residually to balance the budget, issues of external debt sustainability do not arise. Extending the analysis to account fully for the external sector (along the lines for instance of the SPAHD models developed by Agénor, Bayraktar, and El Aynaoui (2007), and Pinto Moreira and Bayraktar (2007)), would be a valuable extension of the analysis.

[5]The price of the private good is therefore used as the numéraire.

At the second level, the effective capital stock is combined with medical personnel, which represents a fraction χ_{GH} of the public labor force, L_{EG}, to produce health services:

$$YG_H(t) = AH \cdot [\chi_{GH} \cdot L_{EG}(t)]^{\beta H} \cdot [KG_{IH}(t)]^{1-\beta H}, \qquad (2)$$

where $AH > 0$ and $\beta H \in (0,1)$.

The private sector also produces health services. With an eye to practical application of our framework, and because data on the production of health services by the private sector are generally unavailable, we assume that the value of that production is equal to the household's spending on health services, which is given as a constant fraction χ_{PH} of total private spending, $C_P(t)$.[6]

Assuming that private and public services are perfectly substitutable, the total supply of health services, H(t), measured in terms of the price of the private commodity, is given by

$$H(t) = YG_H(t) + \chi_{PH} \cdot C_P(t). \qquad (3)$$

The price of private health services is assumed to be fully indexed on the price of the private commodity; the relative price of private health services in equation (3) is thus unity.

Effective (educated) labor employed in private production, T(t), is produced by combining the supply of health services to the prevailing stock of educated labor in that sector, $L_{EP}(t)$:

[6]We therefore do not account explicitly for the fact that private production of health services requires private capital. We do account, however, for the use of educated labor, as shown in (18).

$$T(t) = AT \cdot [L_{EP}(t)]^{\beta T} \cdot [H(t)]^{1-\beta T}, \quad (4)$$

where $AT > 0$ and $\beta T \in (0,1)$. The view taken here, therefore, is that health is labor augmenting. Because human capital is embodied in workers, people can provide "effective" human capital services only if they are healthy.

2. Production of Commodities

Private production, $Y(t)$, is also specified as a multi-level (Cobb-Douglas) process. At the first level, production requires combining effective educated labor, $T(t)$, and private physical capital, $K_P(t)$, to produce a composite input, $J(t)$:

$$J(t) = AJ \cdot [T(t)]^{\beta J} \cdot [K_P(t)]^{1-\beta J}, \quad (5)$$

where $AJ > 0$ and $\beta J \in (0,1)$.

At the second level, the composite input $J(t)$ is combined with uneducated labor, $L_R(t)$, to produce a composite input, $V(t)$:

$$V(t) = AV \cdot [J(t)]^{\beta V} \cdot [L_R(t)]^{1-\beta V}, \quad (6)$$

where $AV > 0$ and $\beta V \in (0,1)$.

At the final level, the supply of commodities, $Y(t)$, is obtained by combining the composite input $V(t)$ with (quality-adjusted) public capital in infrastructure, and land:

$$Y(t) = AY \cdot [V(t)]^{\beta Y1} \cdot LAND^{\beta Y2} \cdot [\theta I(t) \cdot KG_I(t)]^{1-\beta Y1-\beta Y2}, \quad (7)$$

where AY > 0 and $\beta Y1$, $\beta Y2 \in (0,1)$. Land in the economy is in fixed supply; it cannot be produced and does not depreciate. For simplicity, the total quantity of land available is normalized to unity.

3. Population, Schooling Technology, and Labor Supply

Total population, N(t), grows at the rate $g_N(t)$:

$$N(t) = [1 + g_N(t)] \cdot N(t-1), \tag{8}$$

where $g_N(t)$, the difference between the fertility rate and the mortality rate, is assumed to be inversely related to the lagged level of consumption per capita:

$$g_N(t) = g_N^0 + \beta_N[C_P(t-1)/N(t-1)] - \beta_{NN}[C_P(t-1)/N(t-1)]^2, \tag{9}$$

where $g_N^0 > 0$ is the autonomous rate of growth of the population, and β_N, $\beta_{NN} > 0$. This equation captures implicitly the impact of higher standards of living on fertility, and the induced demographic transition. At first, as consumption per head increases, the growth rate of the population rises as well. However, beyond a certain point (given by $\beta_N/2\beta_{NN}$), further increases in consumption per capita lead to declines in the population growth rate. There is therefore an inverted U-shape relationship between consumption per capita and population growth.[7]

The active population, $L_A(t)$, is a fraction of the total population:

$$L_A(t) = (1 - a_D - a_S) \cdot N(t), \tag{10}$$

where $a_D \in (0,1)$ measures the share of dependents (defined as the number of children under the age of mandatory schooling and adults over the age of 65), both

[7]This specification is in line with the assumption underlying the long-run model of growth and development proposed by Hansen and Prescott (2002), in which the population growth rate is

as a share of the total population), and $a_S \in (0,1)$ denotes the share of students. Both coefficients are taken to be constant.[8]

The supply of raw labor, $L_R(t)$, is the difference between the active population and the total supply of educated labor:

$$L_R(t) = L_A(t) - L_E(t). \tag{11}$$

The transformation of raw labor into educated labor requires an accumulation of skills that takes place in part through a publicly-funded education system, which is free of charge. In line with the micro evidence reviewed by Agénor and Moreno-Dodson (2007), and as before, we specify a multi-level nested Cobb-Douglas structure to highlight the role of infrastructure and health on education.

At the first level, the stock of public capital in infrastructure, $KG_I(t)$, and the stock of public capital in education, $KG_E(t)$, produce a composite input, which is referred to as "effective" education capital, $KG_{IE}(t)$:

$$KG_{IE}(t) = AEC \cdot [\theta I \cdot KG_I(t)]^{\beta EC} \cdot [\theta E(t) \cdot KG_E(t)]^{1-\beta EC}, \tag{12}$$

where $AEC > 0$, $\beta EC \in (0,1)$, and θE is an indicator of the quality of the stock of public capital in education.

At the second level, effective education capital, $KG_{IE}(t)$, and the number of teachers on government payroll (which represent a fraction $\chi_{GE} \in (0,1)$ of total public employment), are combined to produce a composite public education input, denoted $Z(t)$:

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increasing (decreasing) in per capita consumption when living standards are low (high). This leads to a hump-shaped relationship between population growth and living standards.

[8]The analysis could be extended to account for the fact that the proportion of the population wishing to acquire an education is positively related to the ratio of wages for educated labor and raw labor.

$$Z(t) = AZ \cdot [\chi_{GE} \cdot L_{EG}(t)]^{\beta Z} \cdot [KG_{IE}(t)]^{1-\beta Z}, \quad (13)$$

where $AZ > 0$ and $\beta Z \in (0,1)$.

At the third level, the total number of students, $STU(t) = a_S \cdot N(t)$, is combined with the supply of health services to determine a composite input, which we refer to as the "effective" supply of students, SH:

$$SH(t) = AS \cdot [STU(t)]^{\beta S} \cdot [H(t)]^{1-\beta S}, \quad (14)$$

where $AS > 0$ and $\beta S \in (0,1)$. Thus, as documented in several studies (reviewed for instance in Agénor and Moreno-Dodson (2007)) health improves the capacity of "raw" students to learn.

At the fourth level, the "production" of newly-educated workers by the public sector, $NE^G(t)$, depends on the fraction $\chi_{SH}{}^G \in (0,1)$ of the effective supply of students SH attending public schools, as well as the composite public education input, Z:

$$NE^G(t) = AE \cdot [\chi_{SH}{}^G \cdot SH(t)]^{\beta E} \cdot [Z(t)]^{1-\beta E}, \quad (15)$$

where $AE > 0$ and $\beta E \in (0,1)$.

As before, because data on the production of education services by the private sector are not always readily available, we assume that the value of that production (measured in terms of the number of educated individuals "produced" by private schools) is proportional to household spending on education services, which is given as a constant fraction χ_{PE} of total private spending.[9] Assuming that

[9]Again, we do not account explicitly for the fact that private production of education services requires private capital, but we do account for the use of educated labor (see equation (18)).

private and public services are perfectly substitutable yields the total number of educated workers produced in the economy, NE, as

$$NE(t) = NE^{G}(t) + \eta_{NE} \cdot \chi_{PE} \cdot C_{P}(t), \tag{16}$$

where $\eta_{NE} = NE^{P}(0) / \chi_{PE} \cdot C_{P}(0) > 0$ is a ratio (fixed at its base-period value) that measures the "conversion rate" between real household spending on education services and the production of newly-educated workers by the private sector. In equation (16), the price of private education services is also assumed to be fully indexed on the price of the private commodity.

Given this flow equation, the total stock of educated labor in the economy, $L_E(t)$, is, at any given moment in time,

$$L_E(t+1) = NE(t) + (1 - \delta_E) \cdot L_E(t), \tag{17}$$

where $\delta E \in (0,1)$ is the rate of attrition of the stock of educated labor, assumed constant. Assuming that public sector employment (which consists only of educated workers) is fixed as a proportion a_{GE} of total supply, the supply of educated labor involved in private production of commodities is determined residually as

$$L_{EP}(t) = (1 - a_{PE} - a_{PH} - a_{GE}) L_E(t), \tag{18}$$

where a_{PE} (a_{PH}) is the share of the educated labor force involved in the private production of education (health) services.

Wages in the private sector are assumed to be fully flexible; there is therefore no open unemployment of either category of labor.[10]

[10]Wage rigidity could easily be introduced to generate open unemployment. Our assumption, however, is consistent with the evidence showing that disguised unemployment (or under-employment in the informal sector) is more common than open unemployment in many low-income countries; see Agénor (2006) for a discussion.

4. Consumption and Investment Decisions

The household-producer maximizes the present discounted value of utility, given by

$$\max U = \Sigma_{t=1}^{\infty} u[C_P(t),H(t)]/[1+\rho(t)]^{t-1}, \tag{19}$$

where $C_P(t)$ is aggregate private consumption at t, $\rho(t) > 0$ the time preference rate, $u[C_P(t),H(t)]$ the instantaneous utility function. For tractability, we assume that instantaneous utility is separable in consumption of commodities and consumption of health services :

$$u[C_P(t),H(t)] = \log[H(t)] + [C_P(t)]^{1-1/\sigma}/(1 - 1/\sigma), \tag{20}$$

where $\sigma \neq 1$ is the intertemporal elasticity of substitution.[11]

The resource constraint faced by the household-producer is given by

$$(1+\tau_C)C_P(t) + \Delta K_P(t+1) + \delta_P(t)\cdot K_P(t) + p_I\cdot KG_I(t-1) \tag{21}$$

$$= (1-\tau_Y)Y(t) + w_G L_{EG}(t) + TR(t) + CG_T(t),$$

where $p_I\cdot KG_I(t-1)$ represents user fees on public infrastructure services (with p_I the real price of these services, measured in terms of the price of the domestic private commodity, assumed constant), $w_G(t)L_{EG}(t)$ the public sector wage bill (with w_G the real wage, measured in terms of the price of the private commodity, also

[11] An alternative and more general specification would be to assume as in Agénor and Neanidis (2006, 2007) that the household's instantaneous utility function is given by $u[C_P(t),H(t)] = [(C_P(t)^{\kappa}H(t)^{1-\kappa}]^{1-1/\sigma}/(1-1/\sigma)$, where $\kappa \in (0,1)$. Coefficient κ (respectively, $1-\kappa$) measures the relative contribution of consumption (respectively, health) to utility. This specification implies that utility is non-separable in consumption of goods and health services; an increase in consumption of health services raises the utility derived from consuming final goods. There is therefore gross complementarity.

assumed constant), $CG_T(t)$ transfers from the government, TR(t) net private transfers from abroad (or remittances), $\tau_Y \in (0,1)$ the tax rate on factor income, $\tau_C \in (0,1)$ the tax rate on consumption spending, and $\delta_P(t) \in (0,1)$ the depreciation rate of private capital. For simplicity, we assume that public sector wages, as well as raw labor employed in private production, are not subject to direct taxation.[12] We also assume that spending on health and education services are subject to the same tax rate as other components of private expenditure, τ_C. In addition, given that the household holds no domestic debt, interest payments on that debt do not appear as a resource in (21).

The discount rate ρ is endogenous, as a result of three factors. First, it depends negatively on consumption of health services, H(t), as in Agénor (2006). The idea here is that better health leads to a greater weight being attached to future consumption, and therefore tends to lower the degree of impatience. Second, it depends also negatively on *total* government spending on security, defined as the sum of spending on salaries of public employees involved in security (the army, the police, and the judiciary), given by $w_G\chi_{GS}L_{EG}(t)$, where $\chi_{GS} \in (0,1)$, and other current spending on security, given by $CG_S(t)$. The view here is that spending on security lowers violence, improves political stability, and raises private sector confidence in the economy's future prospects; this tends to reduce preference for the present. Both of these effects tend therefore to increase private saving—and thus to stimulate investment and growth.[13] Third, as in Kam (2005), the rate of time preference is positively related to wealth—that is, the stock of private capital in the present context. This tends to lower saving and thus the rate of economic growth.

[12]Alternatively, for public sector workers, wages can be interpreted as net of taxes.

[13]Improved health may also imply that the return to education may accrue over longer periods of time. This, in turn, would raise incentives to accumulate human capital, lower the rate of time preference, and stimulate saving and growth. However, in the present setting we cannot capture this effect directly, given the assumption of infinite horizon.

Using $K_P(t)$ as a scale variable, the discount rate can be written as[14]

$$\rho(t) = \rho_0 \cdot [H(t)/K_P(t)]^{-\rho H} \cdot \{[w_G \chi_{GS} L_{EG}(t) + CG_S(t)]/K_P(t)\}^{-\rho S}, \quad (22)$$

where ρH, $\rho S > 0$ and ρ_0 is a base-period value.

The accumulation equation for private physical capital is given by

$$K_P(t+1) = I_P(t) + [1 - \delta_P(t)]K_P(t). \quad (23)$$

As in Agénor (2005*c*), the rate of depreciation of the private capital stock, $\delta_P(t)$, is assumed to depend inversely on the ratio of public spending on core infrastructure maintenance, $CG_{MI}(t)$, to the stock of private capital, with a one-period lag:

$$\delta_P(t) = 1 - \varepsilon_P [CG_{MI}(t-1)/K_P(t-1)]^{\chi P}, \quad (24)$$

where $\varepsilon_P \in (0,1)$ and $\chi P > 0$.[15] Thus, maintenance expenditure on public infrastructure enhances the durability of private capital.

5. Composition of Government Spending and Budget Constraint

The government collects taxes (on wages of educated workers, private capital income, and private consumption), and spends on goods and services (including for maintenance and security purposes). It also services its debt and invests in education, health, and core infrastructure. Education and health services are provided free of charge, whereas core infrastructure is subject to fees. It receives foreign assistance, which serves to balance the budget.

[14] As in Agénor (2006), the use of the private capital stock as a scale variable can be justified by a wealth effect.

[15] These restrictions on coefficients ε_P and χP are sufficient to ensure that $\delta_P(t) \in (0,1)$ as long as $CG_{MI}(t-1)/K_P(t-1) < 1$, $\forall t$.

Formally, total government spending, G(t), is given by the sum of consumption (current) spending, CG(t), capital (investment) spending, IG(t), and interest payments:

$$G(t) = CG(t) + IG(t) + r_D \cdot D(t-1), \tag{27}$$

where D(t) is total government debt and r_D the constant interest rate on that debt.

Current spending consists of salaries to public sector (educated) workers, $w_G L_{EG}(t)$, spending on maintenance, $CG_M(t)$, spending on security (other than salaries for the army, police, and judiciary), $CG_S(t)$, transfers to households, $CG_T(t)$, and other spending on private commodities, $CG_O(t)$:

$$CG(t) = w_G L_{EG}(t) + CG_M(t) + CG_S(t) + CG_T(t) + CG_O(t). \tag{28}$$

Spending on security and other items, as well as transfers to households, are assumed to be fixed fractions of output:

$$CG_j(t) = \theta_j \cdot Y(t), \tag{29}$$

where $\theta_j \in (0,1)$ and j = S,O,T.

Maintenance outlays are assumed to be proportional to total depreciation of all components of the public capital stock:

$$CG_M(t) = \Sigma_h CG_{Mh}(t) = \Sigma_h \theta_{Mh} \cdot \delta_{Gh}(t) \cdot KG_h(t-1), \tag{30}$$

where $\theta_{Mh} > 0$ is a scale parameter for capital stock h and $\delta_{Gh}(t) \in (0,1)$ denotes the rate of depreciation of public capital in category h, with h = E,H,I.

Total public investment is taken to be a fixed fraction of output:

$$IG(t) = \theta_{IG} \cdot Y(t), \tag{31}$$

where $\theta_{IG} > 0$.

Public investment is allocated to education, IG_E, health, IG_H, and core infrastructure, IG_I, as well as a residual item, IG_O:

$$IG(t) = IG_E(t) + IG_H(t) + IG_I(t) + IG_O(t). \tag{32}$$

Each component is given as a fixed fraction of total investment:

$$IG_h(t) = \kappa_h \cdot IG(t), \tag{33}$$

where $\kappa_h \in (0,1)$, $\Sigma\kappa_h = 1$, and h = E,H,I,O. The coefficients κ_h are thus policy parameters, which can be used to study the impact of changes in the allocation of public investment.

Stocks of public capital in education, health, and infrastructure are given by

$$KG_h(t+1) = \varphi_h \cdot IG_h(t) + [1 - \delta_{Gh}(t)] \cdot KG_h(t), \tag{34}$$

where $\varphi_h \in (0,1)$ is a parameter that measures the efficiency of public investment, and h = E,H,I.[16] As discussed at length by Agénor, Bayraktar, and El Aynaoui (2007), the case $\varphi_h < 1$ reflects the fact that investment outlays are subject to inefficiencies, which tend to limit their positive impact on the public capital stock. The case of "full efficiency" corresponds to $\varphi_h = 1$.

[16]As in Agénor, Bayraktar, and El Aynaoui (2007), the residual category $IG_O(t)$ is assumed to have only demand-side (flow) effects, not supply-side effects. Consequently, we do not explicitly account for stock accumulation.

The rate of depreciation of each public capital stock, $\delta_{Gh}(t)$, depends inversely on the ratio of public spending on infrastructure maintenance, $CG_{MI}(t)$, to the relevant stock of public capital, with a one-period lag:

$$\delta_{Gh}(t) = 1 - \varepsilon_{Gh}[CG_{Mh}(t-1)/KG_h(t-1)]^{\chi Gh}, \tag{35}$$

where $\varepsilon_{Gh} \in (0,1)$ and $\chi Gh > 0$, with h = E,H,I.[17] Thus, maintenance expenditure enhances the durability of public capital.

We assume that taxes are subject to collection costs; these costs (which are measured in terms of the private commodities) reduce the yield of each tax j by a proportion $q_j \in (0,1)$.[18] Put differently, tax collection costs are linear in tax revenues. We also assume that user fees are also subject to the same type of collection costs, which reduce net revenue by a proportion q_I. Total government revenues, R(t), are thus given by

$$R(t) = (1-q_Y)\tau_Y Y(t) + (1-q_C)\tau_C C_P(t) + (1-q_I)p_I \cdot KG_I(t-1). \tag{36}$$

Using (27) and (36), the government budget balance, B(t), is thus given by

$$B(t) = R(t) + A(t) - G(t), \tag{37}$$

where A(t) is the flow of aid, namely, grants. By definition, any budget surplus (deficit) must be matched by a reduction (increase) in debt, $\Delta D(t)$. In addition, we assume here that borrowing is a fixed fraction of output:

$$\Delta D(t) = - B(t) = \theta_D \cdot Y(t), \tag{38}$$

[17]These restrictions on coefficients ε_{Gh} and χGh are sufficient to ensure that $\delta_{Gh}(t) \in (0,1)$ as long as $CG_{Mh}(t-1)/KG_h(t-1) < 1$, $\forall t$.

[18]Collection costs refer here only to direct administrative costs incurred by governments. See Bird and Zolt (2005) for a further discussion.

where $\theta_D \in (0,1)$. The budget balance is thus given from "below the line." Given (37) and (38), the level of aid can be solved residually as

$$A(t) = G(t) - R(t) - \theta_D \cdot Y(t). \quad (39)$$

In this mode, therefore, the model allows potential users to calculate aid requirements, for a given path of spending, taxes (net of collection costs), and borrowing. Alternatively, the model could be solved for a specific component of spending or taxes, for a given level of aid—as a share, for instance, of output, in the form $A(t) = \theta_A \cdot Y(t)$, where $\theta_A \in (0,1)$.

6. Private Capital Formation

The budget constraint of the private sector, equation (21), together with (23), (29), and the assumption that remittances are fixed as a fraction $\theta_R \in (0,1)$ of output, can be rearranged to give

$$I_P(t) = (1+ \theta_R + \theta_T - \tau_Y)Y(t) + w_G L_{EG}(t) - (1 + \tau_C)C_P(t) - p_I \cdot KG_I(t-1), \quad (40)$$

which determines private investment.[19]

7. Quality Indicators

The indicators of quality of public capital, θI, θH, and θE, are all related through a logistic function to indicators of excess demand (or congestion) on public services, in each case with a one-period lag. The indicator of quality of public infrastructure, θI, is related to the ratio of public infrastructure capital itself to the stock of private capital:

[19]Consolidating the budget constraints (39), (40), and the current account (or foreign savings) gives the aggregate resource constraint of the economy. We do not specify it here, however, because we do not explicitly account for trade flows.

$$\theta I(t) = \theta I_0 / \{\theta I_0 + (1 - \theta I_0) \cdot \exp[-(KG_I(t-1)/K_P(t-1))]\}. \quad (41)$$

The indicator of quality of public capital in health, θH, is related to the ratio of the stock of public capital in health to the size of the population:

$$\theta H(t) = \theta H_0 / \{\theta H_0 + (1 - \theta H_0) \cdot \exp[-(KG_H(t-1)/N(t-1))]\}. \quad (42)$$

The indicator of quality of public capital in education, θE, is related to

$$\theta E(t) = \theta E_0 / \{\theta E_0 + (1 - \theta E_0) \cdot \exp[-(KG_E(t-1)/\chi_{SH}^{G} \cdot STU(t-1)]\}. \quad (43)$$

This indicator is thus related to (the lagged value of) the ratio of the stock of public capital in education itself to the number of students attending public schools. This specification captures congestion effects in the public education system due to overcrowded classrooms, as discussed for instance in Agénor (2005*a*). The higher the number of students in public schools relative to the existing stock of capital in education, the lower the quality of that stock.

Coefficients in all of these equations have the following properties: $\theta h \in (0,1)$, $\theta h \to 1$ if $x \to \infty$, and $\theta h \to \theta h_0$ if $x \to 0$, where x denotes the relevant ratio, and h = E,H,I. Thus, all quality indicators are bounded between zero and unity, and display a zone of "increasing returns."

III. Equilibrium and the Balanced Growth Path

In the present setting, a decentralized (perfect foresight) equilibrium can be defined as follows:

Definition 1. *A decentralized equilibrium is a set of infinite sequences for the quantities C(t), N(t), $L_E(t)$, $K_P(t)$, and $K_{Gh}(t)$, for t=1 to ∞, and h=I,E,H, such*

that C(t) and K_P(t) maximize equation (19) subject to (21), and N(t), L_E(t), K_P(t), and K_{Gh}(t) satisfy equations (8), (17), (23), and (34).

This equilibrium can be characterized as follows. The household-producer maximizes (19) subject to the budget constraint (21), taking the income and consumption tax rates, τ and τ_C, the discount rate, $\rho(t)$, the depreciation rate, $\delta_P(t)$, spending on government-provided infrastructure services, $p_I \cdot KG_I(t-1)$, transfers, TR(t) and $CG_T(t)$, and wage payments, $w_G L_{EG}(t)$, as given. Using (20), the current-value Hamiltonian for this problem can be written as

$$H = \log[H(t)] + [C_P(t)]^{1-1/\sigma}/(1 - 1/\sigma) + \lambda(t)[(1-\tau_Y)Y(t) + w_G L_{EG}(t)$$

$$- (1 + \tau_C)C_P(t) + TR(t) + CG_T(t) - I_P(t) - p_I \cdot KG_I(t)],$$

where $\lambda(t)$ is the co-state variable associated with constraint (21).

Solution to this problem yields the familiar first-order conditions

$$[C(t)]^{-1/\sigma} = (1 + \tau_C)\lambda(t),$$

$$\lambda(t+1)/\lambda(t) = [1 + \rho(t)]/[(1-\tau_Y)\partial Y(t)/\partial K_P(t) + 1 - \delta_P(t)],$$

together with constraint (21) and the transversality condition

$$\lim_{t \to \infty} \lambda(t)K_P(t) = 0. \qquad (44)$$

The first condition equates the marginal utility of consumption to the shadow value of private capital, $\lambda(t)$. The second is the standard Keynes-Ramsey consumption rule; the expression $(1-\tau_Y)[\partial Y(t)/\partial K_P(t)]$ is the after-tax marginal physical product of private capital.

Combining the first-order conditions, using (22), and letting the marginal product of private capital be $r_P(t) = \partial Y(t)/\partial K_P(t)$, yields the Euler equation

$$C(t+1)/C(t) = [\ \{(1-\tau_Y)r_P(t) + 1- \delta_P(t)\}/ \qquad (45)$$

$$\{1 + \rho_0[H(t)/K_P(t)]^{-\rho H}\cdot\{[w_G\chi_{GS}L_{EG}(t) + CG_S(t)]/K_P(t)\}^{-\rho S}\}\ ]^{\sigma},$$

which determines the dynamics of consumption. From equations (5), (6), and (7), the marginal product of private capital is given by

$$r_P(t) = \beta Y1\cdot\beta V\cdot(1-\beta J)\cdot Y(t)/K_P(t). \qquad (46)$$

In principle, the equations of the model could be further manipulated to lead to a condensed dynamic system of six nonlinear difference equations in terms of $c_P(t) = C_P(t)/K_P(t)$, $n(t) = N(t)/K_P(t)$, $le(t) = LE(t)/K_P(t)$, and $k_h(t) = KG_h(t)/K_P(t)$, for h = I,E,H. These equations, together with the initial conditions $n(0) = N(0)/K_P(0)$, $le(0) = LE(0)/K_P(0)$, and $k_h(0) = KG_h(0)/K_P(0)$, for h = I,E,H, and the transversality condition (44) determine the dynamics of the decentralized economy. A balanced-growth path (BGP) can therefore be defined as follows:

Definition 2. *The BGP is a set of infinite sequences for the ratios c(t), n(t), le(t), and $k_h(t)$, for t=1 to ∞, and h = I,E,H, satisfying Definition 1, such that for initial conditions* n*(0), le(0), and $k_h(0)$, the difference equations characterizing the condensed dynamic system and the transversality condition (44) are satisfied, and consumption, population, the stock of educated labor, as well as the stocks of private and public capital, all grow at the same constant rate* $1 + \gamma$.

Thus, in a steady state, $c(t+1) = c(t) = c^{SS}$, $k_h(t+1) = k_h(t) = k_h^{SS}$, $\forall h = I,H,E$, etc., where the superscript SS is used to denote a steady-state value. By implication, output of both commodities and health services, H(t) and Y(t), also

grow at the same constant rate, and the ratios $h(t) = H(t)/K_P(t)$ and $y(t) = Y(t)/K_P(t)$ are constant as well at h^{SS} and y^{SS}.

The steady-state growth rate can be written in many equivalent ways. In particular, from (45), we obtain

$$1 + \gamma = \{[(1-\tau_Y)r^{SS} + 1 - \delta_P^{SS}\}/(1 + \rho^{SS})\}^{\sigma}. \quad (47)$$

Given the assumption of perfect foresight, consumption in the model is a jump variable. Thus c(t) is also a jump variable, whereas n(t), le(t) and $k_h(t)$ are all predetermined variables. Saddlepath stability requires therefore one unstable (positive) root. However, because of the relative complexity of the condensend dynamic system (six difference equations), Routh-Hurwicz conditions cannot be explicitly verified. Thus, it cannot be established analytically that the long-run equilibrium is saddlepoint stable and that the BGP is unique; even in a local sense, saddlepath stability is not guaranteed. We will therefore turn to calibration and numerical techniques to analyse the properties of the model—and, in so doing, check whether stability holds under plausible values for the parameters.

The Appendix provides a summary list of equations.

IV. Calibration and Solution

This section describes the calibration of the model, prior to its subsequent use for analyzing the impact of public expenditure on growth. As indicated in the introduction, the calibration is done for Haiti, using country-specific information as well as parameter estimates from the literature that we deem relevant for low-income countries.[20] The calibration is done throughout under the assumption that

[20] There is therefore no country-specific econometric work in the present paper that deals with Haiti. Further technical work would of course help to refine our calculations, which remain illustrative in nature.

the length of a period corresponds to a year. To facilitate the matching of equations and parameters between this section and Section II, we follow the presentation of the model in that section.

1. Calibration

The model is calibrated for 2005, the most recent year for which we were able to construct a complete set of macro accounts. Data on national accounts and fiscal accounts were used to produce estimates.

Consider first the production of health services. The share parameter βHC, which determines the roles of public capital in infrastructure and public capital in health in determining the "effective" capital stock in the production of health services (see equation (1)) is set at 0.3. The share βH of medical personnel in the public production of health services (see equation (2)) is set at 0.6. In the same equation, the fraction χ_{GH} of the total public labor force that is employed as medical workers is set at 0.015, which corresponds to the value for Haiti in 2005. In equation (3), the share χ_{PH} of total private spending allocated by households to expenditure on health services is calculated as 0.032 for Haiti as well.

The share parameter βT in equation (4), which determines how the prevailing stock of educated labor in the private sector and health services are combined to create effective (educated) labor, is set at 0.7.

In the production of commodities, the share parameter βJ, which determines how effective labor and the private capital stock are combined to produce the intermediate input J (see equation (5)), is set at 0.7. Similarly, the share parameter βV, which determines how the composite input J and raw labor are combined to produce the intermediate input V (see equation (6)), is set at 0.8.

In equation (7), we normalize output of commodities, Y at 168,000,000,000, which corresponds to the value of Haiti's GDP in 2005. The stocks of public capital in infrastructure, health and education are taken to be relatively small to begin with. The infrastructure capital-output ratio is set at 0.6, the education capital-output ratio at 0.3, and the health capital-output ratio is set at 0.3. Overall, the aggregate (weighted) public capital-output ratio is quite low by industrial-country standards, but it is consistent with the average estimate of the net public capital stock obtained by Arestoff and Hurlin (2005*b*, Table 3) for a large group of developing countries.[21] The ratio of private capital to output is set at 1.4. The resulting private-aggregate public capital ratio is thus about 1.1. Put differently, of the two components of physical capital, public capital is the relatively scarce factor; this is consistent with the view (shared by many observers) that lack of public infrastructure in low-income countries (including Haiti) is a major impediment to growth and private capital accumulation. Coefficients $\beta Y1$ and $\beta Y2$, which determine directly the relative importance of the composite input V and land, are set at 0.7 and 0.15, respectively; by comparison, the value of $\beta Y2$ used by Hansen and Prescott (2002), for instance, is 0.3.

The estimates of $\beta Y1$ and $\beta Y2$ imply that the elasticity of output of commodities with respect to public capital in infrastructure, given by $1-\beta Y1-\beta Y2$, is equal to 0.15. This value corresponds to the one estimated by Easterly and Rebelo (1993) and used by Rioja (2005). By comparison, Baier and Glomm (2001) and Rioja and Glomm (2003) use an estimate of 0.1, which is close to the figure of 0.11 estimated by Hulten (1996).[22] Calderon and Serven (2005) also estimate the elasticity of GDP to infrastructure (proxied by a synthetic index of physical assets that includes energy, roads, and telecommunications) to be 0.138 for a group of developing countries, whereas Suescun (2005, p. 15) focusing only on Colombia, found a value of 0.147. By comparison, Esfahani and Ramirez (2003, Table 4) found

[21]The Arestoff-Hurlin estimates are based on the perpetual inventory method, which consists essentially in cumulating total capital expenditure flows by central governments.

[22]Baldacci, Hillman, and Kojo (2004, p. 533) found an elasticity of the growth rate per capita with respect to public capital expenditure that ranges from 0.06 to 0.08 for a group of 39 low-income countries for the period 1999-2001.

estimates of the elasticities of per capita GDP growth ranging from 0.08 to 0.16, when infrastructure capital is measured as the number of telephone lines or power generation capacity, whereas Canning (1999) estimates an elasticity of output per worker with respect to infrastructure (as measured by the number of telephone lines) that is on average 0.14 for his full sample, and close to 0.26 for higher-income countries. Similarly, Arestoff and Hurlin (2005, Tables 2 and 7) found elasticities of output per worker ranging from 0.05 to 0.19 when infrastructure stocks are used, and from 0.04 to 0.22 when estimates of public capital stocks are used, in the absence of threshold effects. Thus, the estimate used here is consistent with the upper range of the values estimated by Esfahani and Ramirez, and Arestoff and Hurlin, as well as the lower range of Canning's results.[23]

It should also be noted that, given the multi-level Cobb-Douglas specification adopted here, the "true" elasticity of output with respect to educated labor is $\beta T \cdot \beta J \cdot \beta V \cdot \beta Y1$, whereas the elasticity of output with respect to private capital is given by $(1-\beta J) \cdot \beta V \cdot \beta Y1$, given the above estimates, we obtain, respectively, 0.27 and 0.17. The latter estimate is significantly lower than the share of private capital in output used in other studies, which is 0.36 for Alonso-Carrera and Freire-Serén (2004, p. 852), 0.4 for instance in Ortigueira (1998, p. 337) and Rivas (2003, Table 1), and 0.45 in Rioja and Glomm (2003, Table 2).

Consider now population and the production of education labor. The initial level of population is set at 8,536,844, which corresponds to Haiti's population in 2005. The growth rate of the total population in equation (9) is assumed to be constant, equal to 2.2 percent, which corresponds to Haiti's value in 2005.

In equation (10), coefficients a_D and a_S, which measure respectively the share of dependents and the share of students (both as a share of the total

[23]Colletaz and Hurlin (2006, Table 5), using a smooth threshold regression approach, found estimates ranging from 0.07 (for France, Ireland, and the United States, for instance) to values as high as 0.29 for Norway and 0.38 for Portugal.

population) are calibrated as 0.252 and 0.163, which correspond to Haiti's value in 2005.

The share parameter ßEC, which determines how the effective stocks of public capital in infrastructure and education are combined to produce the composite input $KG_{IE}(t)$ (see equation (12)), is set at 0.35. Thus, infrastructure plays a relatively important role in determining how much physical capital is used in the education technology.

In equation (13), the share parameter ßZ, which determines how the composite public capital input and the number of teachers on government payroll are combined to produce the composite input Z, is set at 0.8. Thus, physical capital is as important as teachers in producing educated labor. In the same equation, the fraction χ_{GE} representing the share of teachers in total public employment is calibrated as 0.176, equal to Haiti's value in 2005.

The share parameter ßS, which determines how health services and the number of students are combined to determine the composite input SH (see equation (14)), is set at 0.8. In equation (15), the share parameter ßE, which determines how the composite inputs SH and Z are combined to determine the number of newly-educated workers by the public sector, is set at 0.6. In this equation, the share of the "effective" supply of students enrolled in the public schools, χ_{SH}^{G}, is simply set equal to the share of *actual* students enrolled in that sector, which is 0.185 for Haiti in the base period.

Given the nested structure of the model, the "true" elasticity of the production of newly-educated workers by the public sector with respect to the public capital stock in education is given by $(1-\beta EC)\cdot(1-\beta Z)\cdot(1-\beta E)$. From the estimates above, this value is 0.052. Although our estimate is smaller than the value used by Chen (2005), it is close to the value used by Rioja (2005) and the econometric estimate obtained by Blankenau et al. (2005) for their full sample.

Similarly, Perli and Sakellaris (1998) used a share of physical capital in final output of the education sector between 0.11 and 0.17. The estimate used here is probably quite appropriate for the group of low-income countries where education (at least at the primary and secondary levels) is to a very large extent publicly provided.[24]

In equation (16), the share χ_{PE} of total private spending allocated by households to expenditure on health services is calibrated as 0.047 for Haiti in the base year. The share η_{NE}, which measures the base-period ratio of the number of educated individuals "produced" by private schools and private spending on education, is set at 0.00002, which represents the figure observed for Haiti in 2005. In (15) and (16), to estimate the flow variables NE(t) and $NE^G(t)$, we proceed as follows. We first calculate the change in the total number of people who become literate within a year, by taking literacy rates in two consecutive years, multiplying them by the total population in that year, and taking the absolute difference. This gives us an estimate of NE(t). We then apply to that estimate the actual share of students enrolled in public schools to obtain an estimate of $NE^G(t)$.

In equation (17), the rate of attrition of the educated labor force is set at 0.01. This compares to a value of 0.1 used by Alonso-Carrera and Freire-Serén (2004, p. 852) as an estimate of the rate of depreciation of human capital. In equation (18), the coefficient proportion a_{GE}, which measures the share of public sector employment in the total supply of educated workers, is calculated as 0.015, whereas a_{PE} and a_{PH}, the shares of the educated labor force involved in the private production of education and health services, respectively, are calculated as 0.017 and 0.001, all of which are the values for Haiti in 2005. By implication, the share of educated workers employed in private production of commodities, $1-a_{PE}-a_{PH}-a_{GE}$, is equal to 0.967. This gives an initial private capital-educated labor ratio in private production of 78,581, and an overall capital-labor ratio of 87, 480. Keeping in mind that "educated labor" in the present context includes both skilled and

[24]Blankenau et al. (2005) found that the elasticity of human capital with respect to government spending on education is close to zero for low-income countries, but this runs counter to intuition. It also does not account for the heterogeneity in public school enrollment discussed in the conclusion.

unskilled workers employed in production, these ratios (together with the capital-output ratios mentioned earlier) capture fairly well the view that the country considered is poor and endowed with a relatively abundant supply of labor (with only part of it educated), while facing at the same time a relative scarcity of physical (particularly public) capital.

In equation (20), σ, the intertemporal elasticity of substitution, is set at 0.4. This relatively low value is consistent with the evidence indicating that the intertemporal elasticity of substitution tends to be low at low levels of income (see Ogaki, Ostry and Reinhart (1996) and Agénor and Montiel (2007)), a result that may reflect either short planning horizons or liquidity constraints, as discussed for instance by Agénor (2004, Chapter 2).[25]

In the resource constraint of the private sector, equation (21), private consumption is set at 93.3 percent of output. This value is quite sensible for many low-income countries, where limited private resources are allocated to savings and investment. It corresponds to the value observed for Haiti in 2005. The tax rate on (factor) income, τ_Y, is calculated as 0.042, whereas the tax rate on consumption is calculated as 0.057, both of which correspond to the values observed for Haiti in 2005. The first value is in line with actual ratios for many low-income countries, where taxation (which is essentially indirect in nature) provides a more limited source of revenue than in higher-income countries. The coefficient θ_O in that equation, which measures the share of other current government spending allocated to transfers to households, is calculated as 0.009, which corresponds to the value observed for Haiti in 2005.

Coefficients ρH and ρS in the discount rate function (equation (22)) are set at 0.01, respectively. The estimate of the first coefficient is based on the results in Lawrance (1991), who identified an (inverse) relationship between the rate of time

[25]Of course, using even lower values of the intertemporal elasticity of substitution would "flatten" the response of consumption to shocks. However, they would not affect the direction of the effect discussed below.

preference and the level of income, with an elasticity of 0.058 (Table 1, page 65). Assuming that spending on health is services is more or less proportional to income (or expenditure, given the low degree of intertemporal substitution), this elasticity can be used as an approximation of proportional to ρH. To ensure a reasonable initial value of the discount rate (given the values of ρH and ρS and the initial values of $H(t)/K_P(t)$ and $CG_S(t)/K_P(t)$), we set ρ_0 such that the value of ρ in the initial period is equal to 0.04. In this case, ρ_0 is equal to 0.037. The rate of time preference, ρ, is set at 4 percent, a fairly conventional choice in this literature. This leads to a discount factor of approximately 0.96 (see, for instance, Canton (2001, Table 1), and Ghosh and Roy (2004, Tables 1 and 2)).

In equation (24), the rate of depreciation of the private capital stock, $\delta_P(t)$, is defined in such a way that its initial value is equal to 6.8 percent. This value corresponds to the average value estimated by Bu (2006, Table 7) for three low-income countries in Africa. In that equation, we set $\chi P = 0.002$, and then calibrated ε_P as 0.94.

Turning now to the government budget, in equation (27), the effective interest rate on the public debt is calculated as 0.024. The shares of current and capital spending in total government spending are set equal to 0.64 and 0.3 respectively, implying a share of interest payments of 0.06. These shares correspond to those observed for Haiti in 2005.

In equation (28), the shares of salaries to public sector workers, maintenance, spending on security (other than salaries), and transfers in total current spending are equal to 0.38, 0.11, 0.15, and 0.27, respectively, implying a share of spending on other categories of 0.1. These shares imply that, the coefficients θ_j in equations (29), which measure the shares of spending on security (excluding salaries of security personnel), transfers, and other items in GDP, are equal to 0.014, 0.009, and 0.024, respectively. In equation (30), the coefficients θ_{MI}, θ_{MH},and θ_{ME},is set so that the value

of total spending on maintenance for each item is indeed equal to their share in total current spending, that is, 0.40, 0.23, and 0.21, respectively.

Coefficient θ_I, which measures in equation (31) the share of total public investment in GDP is equal to 0.04, the value for Haiti in 2005. The allocation of public investment between education, health, infrastructure, and other categories, is determined by the coefficients κ_E, κ_H, κ_I, κ_O, which are calculated as 0.053, 0.054, 0.36, and 0.53, respectively. These ratios correspond to those observed for Haiti in 2005.

In equation (34), the degree of (in)efficiency of public investment, that is, φ_h for h = E,H,I, is set uniformly at 0.5. Arestoff and Hurlin (2005) found values of φ ranging from 0.4 to 0.6 for a group of developing countries. In the experiments reported below, we use at first the uniform value of 0.5, and perform subsequently a sensitivity analysis. In equation (35), the rates of depreciation of each capital stock, $\delta_{Gh}(t)$, is set so that the ratios are equal to 2.5 percent in the base period. Similar values are used by Agénor, Bayraktar, and El Aynaoui (2007), and Pinto Moreira and Bayraktar (2007). The coefficient χGh is set at 0.001, and then ε_{Gh} is calibrated as 0.979.

In equation (36), the coefficients measuring the tax collection costs, q_C and q_Y, are set at 0.03 and 0.06 respectively, whereas the cost of collecting infrastructure fees q_I, is set at 0.06. Thus, collecting income taxes and fees are assumed to be twice as costly as collecting consumption taxes.[26] The value of 0.03 corresponds to the average of administrative costs (in proportion of taxes collected) estimated by Gallagher (2005, p. 127) for a group of low-income developing countries. In equation (38), the coefficient θ_D, which measures the ratio of borrowing (both domestic and foreign) as a fixed fraction of output is set at 0.007, which corresponds to the value observed for Haiti in 2005.

[26]Note that we assume that the cost of collecting taxes on both components of factor income (wages and profits) is the same. In practice, however, collection costs may be higher for non-wage income. See Agénor and Neanidis (2006) for a more detailed discussion.

In the private investment equation (40), the share of foreign transfers as a proportion of GDP, θ_R, is set at 0.21, which corresponds to the value observed for total transfers for Haiti in 2005. Finally, for the quality indicators defined in (41), (42), and (43), coefficients θh_0 are chosen so that the initial values of these indicators is relatively low, at 0.4.

2. Solution Procedure

Calibration of the model around these initial values and parameters (which involves also determining appropriate multiplicative constants in the production functions for health services, commodities, educated labor, etc.) produces the baseline solution. Given the values described above the initial steady-state growth rate is equal to 2 percent.

Private consumption, in the model, is a forward-looking variable. To account for initial jumps in that variable, we use the "extended path" method of Fair and Taylor (1984) to generate numerical solutions.[27] This procedure is quite convenient because it allows one to solve perfect foresight models in their nonlinear form, through an iterative process. The terminal condition imposed on consumption (the only forward-looking variable here) is that its growth rate at the terminal horizon (t+10 periods here) must be equal to the growth of the private capital stock, given the condition that $c_P(t) = C_P(t)/K_P(t)$ must be constant along the balanced growth path. In the next section, we examine the baseline solution and the results of various simulations.

3. Baseline Solution

We need to build a baseline scenario to be able to conduct policy experiments with the model. In the baseline scenario, budget deficit as a share of

[27]See Kolsrud (2001) for a compact presentation of the Fair-Taylor algorithm and a comparison with other solution techniques.

GDP is taken fixed to make aid endogenous. It should be noted that this closure rule can be changed. The shares of all other components of spending remain constant at base period values. The efficiency parameter of public investment is equal to the uniform value of 0.5.

Table 1 presents the baseline scenario. Given that current conditions continue, the growth rate of real GDP per capita at market prices is estimated to increase only slightly which is basically caused by the supply side effect of increasing public investment as a share of GDP from 4.5 percent to 5.7 percent, and private investment from 32.3 percent in 2007 to 38.1 percent in 2015. The low growth rate leads to a minor drop in the poverty rate whether we use Ravallion's adjusted elasticity or the growth elasticity of -1.0 (See Figure 1). For example, the poverty rate with Ravallion's adjusted elasticity decreases from 55.0 percent in 2007 to 52.8 percent in 2015. If the current trends were to be maintained, the prospects of reducing poverty would not be realized and the MDGs of halving poverty by 2015 would not be achieved. Thus the results indicate that approximately 5 percent foreign aid in percent of GDP cannot be enough to obtain desired growth rates.

V. Policy Experiments

This section illustrates the properties and implications of the model by considering six different policy experiments: an increase in public investment (financed by aid); a budget-neutral reallocation of spending toward health; an improvement in fiscal management that takes the alternative forms of a reduction in collection costs, an increase in security spending; and a composite fiscal package, that combines elements of all the individual experiments listed above. In line with the favorable international environment that Haiti faces currently, all

experiments are conducted under the assumption that the overall budget deficit is constant and aid is the balancing item in the government budget.[28]

1. Increase in Public Investment

Our first experiment consists of a temporary increase in total public investment in GDP by 5 percentage points starting in 2008 until 2011, then dropping by 1 percentage point each year after that, to eventually return to the initial baseline value. We consider two variants: first, the case where the efficiency parameter of public investment is constant throughout at 0.5, and the second the case where the efficiency parameter (for all categories of public investment) improves gradually over time. In both scenarios, investment is totally financed by foreign aid, due to the closure rule described earlier.

Simulation results for the first variant are shown in Table 2. As in all subsequent tables, they are displayed as absolute differences from the baseline scenario.

The direct effect of the increase in public investment is on the stock of public capital in infrastructure, which tends to stimulate output. Because the growth in output exceeds the increase in consumption, private capital formation expands.[29] By 2015, private investment increases by nearly 1.7 percentage points of GDP. Thus, the rise in public investment crowds in private investment through an indirect complementarity effect. In turn, the increase in private investment raises the stock of private capital over time; this, combined with the increase in the stock of public capital in infrastructure, tends to increase the marginal productivity of all other production inputs. At the same time, the rise in public

[28]As indicated earlier, one could also consider the case where aid is fixed in proportion of GDP, with the balancing item in the budget being either a component of non-interest expenditure, or a tax rate.

investment in education leads to an increase in the stock of capital in education and the public education input, and therefore to a higher supply of educated workers.[30] In addition to improvements in the public infrastructure and education capital stock, the increase in the stock of public capital in health raises the efficiency of educated labor in production. The productivity gains associated with the combined effect of improved effective labor, and increased marginal productivity of all inputs, contribute to higher output. In terms of growth rates, output per capita remains on a sustained basis at 0.3 percentage points above its level in the baseline case. However, although growth is higher, it is not enough to entail a substantial drop in the poverty rate; even in the case of neutral growth elasticity, the poverty rate drops by only 1.1 percentage points by 2015 (See Figure 2).

In the second variant, in addition to higher public investment as described above, efficiency of all categories of public investment is assumed to improve uniformly over time. Specifically, we assume that the efficiency parameter remains constant at 0.5 in 2006 and 2007, and then increases to 0.8 by 0.1 point each year between 2008 and 2010. After 2010, it remains constant at 0.8. This case may represent the reforms aimed at improving governance and eliminating mismanagement of public resources—a key policy challenge in Haiti, as in many other developing countries.

Table 3 summarizes the simulation results. Now, because of improved efficiency of public investment, the rate of accumulation of all categories of public capital is higher, thereby magnifying productivity effects on private inputs. In turn, higher rates of factor accumulation lead to higher growth rates of GDP per capita, relative to the first variant. For example, Table 3 shows that the growth rate of output relative to the baseline value rises to 0.6 in 2015, whereas it was only 0.2 in

[29]In the model, given that the estimate of the intertemporal elasticity of substitution that we use is relatively low (in line with the evidence for low-income countries), consumption smoothing is significant, implying relatively small changes over time in private expenditure.

Table 2. This higher growth rate of GDP per capita translates into a lower poverty rate (See Figure 3). With a growth elasticity of -1.0, the drop in the poverty rate reaches 2.5 percentage points by 2015 (relative to the baseline scenario) in case of higher efficiency of public investment, compared to 1.1 percent drop with the first variant of the experiment.

2. Spending Reallocation

Our third experiment is a typical "fiscal space" experiment. It consists of two components. First, starting in 2008, there is a permanent reduction of 1 percentage point of GDP in "other" public spending which is reallocated to investment (across the board, that is, keeping constant the initial shares in public capital formation). Second, the share of the residual category "other" in public investment is reduced permanently by 5 percentage points, with the whole amount reallocated to investment in health. Given that the experiment consists of a spending reallocation, foreign aid requirements do not change on impact (although they may change subsequently, given the dynamics of the model).

The simulation results are presented in Table 4. The impact on output growth per capita is relatively weak. It increases only by 0.1 percentage points by 2015. As a result, the effect on poverty is weak as well (See Figure 4). The proportion of poor drops by only 0.2 percentage points in the case of a neutral-growth elasticity. Thus, the results indicate that, by itself, and given the magnitude of the shock, higher public health investment is not enough to have a strong impact on growth, despite its positive effect on the productivity of the labor force and its positive effect on the incentive to save (which results from a reduction in the rate of time preference).

[30]The ratio of educated workers to population changes only slightly, however, due to a relatively low degree of substitution between teachers and public capital stock in the production of education services.

3. Tax Reform

In this set of experiments, collection costs are reduced by half starting in 2008 and the effective direct tax rate is increased by 1 percentage point over three years, starting in 2008. We consider again two variants: first, we assume that public spending does not change; second, we consider the case where the additional resources generated by the tax reform are allocated to investment.

The results of the first variant are shown in Table 5. The direct effect of the tax reform is an increase in tax revenues. But given that public spending does not change, and that the budget deficit is constant, the increase in revenues translates almost one to one into a fall in foreign aid requirements (See Figure 5). Moreover, the impact on growth is largely negative: higher income taxes tend to induce households to consume more today and to reduce saving rates. As a result of this intertemporal effect, private investment drops, thereby lowering the marginal productivity of all production inputs. As a result, output drops and poverty worsens.

In the second variant, we reallocate (across the board) the additional revenues generated by higher income taxes and lower collection costs, to public investment. The results are shown in Table 6. This time around, private investment increases as well due to the improvement in the public infrastructure capital stock which stimulates output (and thus after-tax income) and savings. As a result, the impact on growth is positive. The growth rate of output per capita increases by 0.8 percentage points by 2015, compared to a 0.1 percentage point drop in Table 5. Thus, the poverty rate declines now by 2.4 percent by 2015, in the case of a neutral growth elasticity (See Figure 6). This last experiment illustrates well the importance of reallocating additional revenue from fiscal reforms to investment (assuming that external financing conditions do not change). Otherwise, the disincentive effects of taxation on private savings and investment may well lead to lower growth and higher poverty.

4. Increase in Security Spending

This experiment consists of an increase in security spending by 3 percentage points of GDP between 2008 and 2011, followed by an increase of 2.5 percent in 2012, 2 percent in 2013, and 1.5 percent in 2014 and 2015. Given the budget closure rule, higher security spending is essentially financed by foreign aid, which rises at about the same rate. Table 7 presents the simulation results when the elasticity of security spending, ρS, in Equation (22) is taken to be 0.01. In this case, there are almost no discernible effects on growth and poverty (See Figure 7).

By contrast, Table 8 shows the results when the elasticity of security spending, ρS, is equal to 0.1. Conceptually, this case corresponds to a situation where security concerns have a relatively large impact on agents' rate of preference for the present; in such conditions, improvements in security, to the extent that they translate into reductions in crime and violence, may translate into greater incentives to "think about" the future, and thus to save. Indeed, the results show that the impact of higher security spending on growth is now quite significant. The growth rate rises by about 0.1 percentage points by 2015, whereas the poverty rate drops by about 0.12 by 2015 when the growth elasticity is neutral (See Figure 8). Again, the higher value of ρS leads to a higher growth rate because private sector confidence in the economy's future prospects improves more with higher security spending. By inducing a greater reduction in preference for the present, private saving increases. This generates therefore a stronger effect on private investment and growth.

5. A Composite Fiscal Package

We now consider a composite fiscal package, which combines several of the previous experiments.

1. An increase in total public investment in GDP by 5 percentage points starting in 2008 until 2011, then dropping by 1 percentage point each year after 2011;
2. A permanent reduction of 1 percentage point of GDP, starting in 2008, in the "other" category of public spending which is reallocated (across the board) to investment, with at the same time a permanent reduction in the share of the category "other" in public investment by 5 percentage points, reallocated in its entirety to health;
3. An increase in the effective indirect tax rate to 6 percentage points starting in 2008;
4. An increase in the direct tax rate by 1 percent for 3 years, starting in 2008;
5. An increase in security spending by 3 percentage points of GDP between 2008 and 2011, 2.5 percent in 2012, 2 percent in 2013, and 1.5 percent in 2014 and 2015.
6. A reduction in collection costs by half, starting in 2008.

Table 9 presents the simulation results. We observe two opposite effects on growth and poverty. As the tax rates increase, people start saving less, as discussed earlier. As a result private investment and private capital accumulation slows down. This leads to an initial negative impact on the fiscal package on growth and poverty. But at the same time, the higher tax rates and lower collection costs raise government revenue, which increases public investment and thus the various components of public capital. Over time, the larger public capital stock, directly and indirectly, raises saving and investment, increases output, and lowers poverty. In the medium term, the impact on growth turns out to be positive. While the growth rate of real GDP per capita increases by 0.5 on average, the poverty rate with a growth elasticity of -1.0 drops by 2.2 percent in 2015 (See Figure 9).

If the elasticity of security spending, ρS, rises, the effect on growth improves slightly. Table 10 shows the simulation results when ρS is taken as 0.1 instead of 0.01, as in Table 9. In this case, private investment increases more,

because (as discussed earlier) private sector confidence in the economy's future prospects improves. This leads to a higher rate of output growth and lower poverty (See Figure 10).

The impact on growth improves even more if the government applies a lower increase in the direct tax rate and makes it effective later. Table 11 shows the case when the direct tax rate increases by 0.5 percentage points only between 2010 and 2013 and then stays constant. The lower rise in the direct tax rate leads a lower drop in savings during the initial phase of adjustment, and therefore to a lower negative effect on private investment. In this case, the growth rate of real GDP per capita increases by 0.53 percentage points on average, compared to the 0.5 increase shown in Table 9. As a result, the poverty rate (with a growth elasticity of -1.0) decreases by 2.5 percentage points in 2015, instead of 2.2 (See Figure 11). Table 12 shows that the effect of changes in fiscal policy on growth and poverty get even better when the elasticity of security spending is raised to 0.1, given that in this case it leads to higher private investment (See Figure 12).

VI. Concluding Remarks and Policy Implications

This paper presents a small-scale intertemporal model of endogenous growth in which the composition of public expenditure, and externalities associated with infrastructure, in terms of its impact on education and health, are explicitly accounted for. One of the key features of the model is that government spending is disaggregated into different components such as maintenance, security, and investment in education, health, and infrastructure. In addition, it also accounts for improved political stability and reduction in violence.

The model is applied to Haiti to derive policy implications useful for both policymakers and donors. The policy experiments include an increase in public investment and its efficiency, a "fiscal space" exercise involving a reallocation of spending, a strengthening of fiscal management taking the form of a reduction in

tax collection costs, an increase in security spending, and a composite fiscal package.

Overall, the results of our policy experiments illustrate that the impact of changes in fiscal policy will depend on how it affects the behavior of the private sector (notably through incentives to save and invest) and how additional revenue is allocated by the government. Regarding the latter, it is worth pointing out that even tax reforms that are considered to be highly regressive (involving sharp increases in indirect tax rates) may end up being beneficial to the poor, to the extent that the resources that they generate are allocated to productive capital accumulation. Moreover, these effects may vary in opposite direction over time: effects on poverty may be negative short-term but may be become favorable over time. Thus, dynamic trade-offs may emerge in the design of fiscal reforms and using a dynamic model (such as the one developed in this paper) is essential to capture them.

Appendix
Summary List of Equations

Production of Health Services and Effective Labor

$$KG_{IH}(t) = AHC \cdot [\theta I(t) \cdot KG_I(t)]^{\beta HC} \cdot [\theta H(t) \cdot KG_H(t)]^{1-\beta HC} \quad (A1)$$

$$YG_H(t) = AH \cdot [\chi_{GH} \cdot L_{EG}(t)]^{\beta H} \cdot [KG_{IH}(t)]^{1-\beta H} \quad (A2)$$

$$T(t) = AT \cdot [L_{EP}(t)]^{\beta T} \cdot [H(t)]^{1-\beta T} \quad (A3)$$

Production of Commodities

$$J(t) = AJ \cdot [T(t)]^{\beta J} \cdot [K_P(t)]^{1-\beta J} \quad (A4)$$

$$V(t) = AV \cdot [J(t)]^{\beta V} \cdot [L_R(t)]^{1-\beta V} \quad (A5)$$

$$Y(t) = AY \cdot [V(t)]^{\beta Y1} \cdot [\theta I(t) \cdot KG_I(t)]^{1-\beta Y1-\beta Y2} \quad (A6)$$

Population, Labor Supply, and Schooling Technology

$$N(t) = [1+ g_N(t)] \cdot N(t-1) \quad (A7)$$

$$g_N(t) = g_N^0 + \beta_N [C_P(t-1)/N(t-1)] - \beta_{NN} [C_P(t-1)/N(t-1)]^2 \quad (A8)$$

$$L_A(t) = (1 - a_D - a_S) \cdot N(t) \quad (A9)$$

$$L_R(t) = L_A(t) - L_E(t) \quad (A10)$$

$$KG_{IE}(t) = AEC \cdot [\theta I(t) \cdot KG_I(t)]^{\beta EC} \cdot [\theta E(t) \cdot KG_E(t)]^{1-\beta EC} \quad (A11)$$

$$Z(t) = AZ \cdot [\chi_{GE} \cdot L_{EG}(t)]^{\beta Z} \cdot [KG_{IE}(t)]^{1-\beta Z} \quad \text{(A12)}$$

$$SH(t) = AS \cdot [STU(t)]^{\beta S} \cdot [H(t)]^{1-\beta S} \quad \text{(A13)}$$

$$NE^{G}(t) = AE \cdot [\chi_{SH}{}^{G} \cdot SH(t)]^{\beta E} \cdot [Z(t)]^{1-\beta E} \quad \text{(A14)}$$

$$NE(t) = NE^{G}(t) + \eta_{NE} \cdot \chi_{PE} \cdot C_P(t) \quad \text{(A15)}$$

$$L_E(t+1) = NE(t) + (1 - \delta_E) \cdot L_E(t) \quad \text{(A16)}$$

$$L_{EP}(t) = (1 - a_{PE} - a_{PH} - a_{GE}) L_E(t) \quad \text{(A17)}$$

Household Consumption and Wealth

$$\rho(t) = \rho_0 \cdot \rho[H(t)/K_P(t)]^{-\rho H} \cdot \{[\, w_G \chi_{GS} L_{EG}(t) + CG_S(t)]/K_P(t)\}^{-\rho S} \quad \text{(A18)}$$

$$C(t+1)/C(t) = [\{(1-\tau_Y) r_P(t) + 1 - \delta_P(t)\}/[1 + \rho(t)]]^{\sigma} \quad \text{(A19)}$$

$$r_P(t) = \beta Y1 \cdot \beta V \cdot (1-\beta J) \cdot Y(t)/K_P(t) \quad \text{(A20)}$$

$$K_P(t+1) = I_P(t) + [1 - \delta_P(t)] K_P(t) \quad \text{(A21)}$$

$$\delta_P(t) = 1 - \varepsilon_P [CG_{MI}(t-1)/K_P(t-1)]^{\chi P} \quad \text{(A22)}$$

Composition of Public Spending and Budget Constraint

$$G(t) = CG(t) + IG(t) + r_D \cdot D(t-1) \quad \text{(A23)}$$

$$CG(t) = w_G L_{EG}(t) + CG_M(t) + CG_S(t) + CG_T(t) + CG_O(t) \quad \text{(A24)}$$

$$CG_j(t) = \theta_j \cdot Y(t), \qquad j = S,O,T \tag{A25}$$

$$CG_M(t) = \theta_M \cdot \Sigma_h CG_{Mh}(t) = \theta_M \cdot \Sigma_h \delta_{Gh}(t) \cdot KG_h(t-1) \tag{A26}$$

$$IG(t) = \theta_I \cdot Y(t) \tag{A27}$$

$$IG_h(t) = \kappa_h \cdot IG(t), \qquad h = E,H,I,O \tag{A28}$$

$$KG_h(t) = \varphi_h \cdot IG_h(t-1) + [1 - \delta_{Gh}(t)] \cdot KG_h(t-1) \tag{A29}$$

$$\delta_{Gh}(t) = 1 - \varepsilon_{Gh}[CG_{Mh}(t-1)/KG_h(t-1)]^{\chi^{Gh}} \tag{A30}$$

$$T(t) = (1-q_Y)\tau_Y Y(t) + (1-q_C)\tau_C C_P(t) + (1-q_I)p_I \cdot KG_I(t-1) \tag{A31}$$

$$A(t) = G(t) - T(t) - \theta_D \cdot Y(t) \tag{A32}$$

$$Q(t) = q_Y \tau_Y Y(t) + q_C \tau_C \cdot C_P(t) + q_I p_I \cdot KG_I(t-1) \tag{A33}$$

Private Capital Formation

$$I_P(t) = (1+\theta_R+\theta_T-\tau_Y)Y(t) + w_G L_{EG}(t) + \theta_O \cdot CG_O(t) - (1 + \tau_C)C_P(t) - p_I \cdot KG_I(t-1) \tag{A34}$$

Stocks of Public Capital: Quality Indicators

$$\theta I(t) = \theta I_0 / \{\theta I_0 + (1 - \theta I_0) \cdot \exp[-(KG_I(t-1)/K_P(t-1))]\} \tag{A35}$$

$$\theta H(t) = \theta H_0 / \{\theta H_0 + (1 - \theta H_0) \cdot \exp[-(KG_H(t-1)/N(t-1))]\} \tag{A36}$$

$$\theta E(t) = \theta E_0 / \{\theta E_0 + (1 - \theta E_0) \cdot \exp[-(KG_E(t-1)/\chi_{SH}^{G} \cdot STU(t-1)]\} \tag{A37}$$

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Table 1
Haiti : Baseline scenario, 2007-15

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.4	0.3
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	55.5	55.3	55.2	55.1	55.0	54.8	54.8	54.7	54.6
Poverty rate-Growth elasticity of -1.0	55.0	54.6	54.3	53.9	53.6	53.4	53.1	52.9	52.8
Government Sector (% of GDP)									
Total resources (including grants)	13.5	13.9	14.3	14.7	14.7	14.7	14.7	14.7	14.7
Total revenues	9.6	9.6	9.5	9.5	9.4	9.4	9.4	9.5	9.5
Direct taxes	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
Indirect taxes	4.9	4.8	4.7	4.7	4.6	4.6	4.6	4.6	4.6
User fees	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
Foreign aid (grants)	3.9	4.3	4.8	5.2	5.2	5.2	5.2	5.2	5.2
Total expenditure	11.8	12.2	12.6	12.9	12.9	12.9	12.9	13.0	13.0
Spending on goods and services (total)	6.6	6.6	6.5	6.5	6.5	6.5	6.5	6.6	6.6
Spending on maintenance	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7
Wages and salaries	3.4	3.5	3.5	3.5	3.5	3.6	3.6	3.6	3.7
Security	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Other	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Investment	4.5	4.9	5.3	5.7	5.7	5.7	5.7	5.7	5.7
Interest payments	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overall fiscal balance including grants (cash basis)	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Memorandum items									
Private investment (% of GDP)	32.3	34.1	35.6	36.7	37.6	38.1	38.4	38.3	38.1
Public investment (% of total public expenditure)	32.1	34.0	35.8	37.5	37.5	37.5	37.5	37.5	37.4
Health (% of public investment)	5.4	6.4	7.4	8.4	9.4	9.4	9.4	9.4	9.4
Infrastructure (% of public investment)	36.4	36.9	37.4	37.9	38.9	39.9	39.9	39.9	39.9
Education (% of public investment)	7.3	9.3	11.3	13.3	15.3	15.3	15.3	15.3	15.3
Other (% of public investment)	50.9	47.4	43.9	40.4	36.4	35.4	35.4	35.4	35.4
Aid (% of total revenue)	40.3	45.3	50.3	55.0	55.4	55.5	55.5	55.3	55.0
Total Aid (% of public investment)	85.3	87.6	89.3	90.5	90.9	91.0	91.1	91.0	90.9
Total debt (% of GDP)	29.0	28.8	28.7	28.6	28.5	28.5	28.5	28.6	28.7
Educated labor (in % of population)	37.4	37.8	38.3	38.8	39.3	39.8	40.4	40.9	41.5

Note: The “adjusted” elasticity formula proposed by Ravallion (2004) is -9.3*(1-Gini)^3 = -1.13 where Gini index is 50.5 for Haiti.

Table 2
Haiti : Higher Total Public Investment, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.3	0.3	0.3	0.4	0.3	0.3	0.2
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.1	-0.2	-0.3	-0.3	-0.4	-0.4
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.2	-0.3	-0.5	-0.7	-0.9	-1.0	-1.1
Government Sector (% of GDP)									
Total resources (including grants)	0.0	5.0	5.0	5.0	5.0	4.0	3.0	2.0	1.0
Total revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect taxes	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
User fees	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Foreign aid (grants)	0.0	5.0	5.0	5.0	5.0	4.0	3.0	2.0	1.0
Total expenditure	0.0	5.0	5.0	5.0	5.0	4.0	3.0	2.0	1.0
Spending on goods and services (total)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wages and salaries	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Security	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.0	5.0	5.0	5.0	5.0	4.0	3.0	2.0	1.0
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.0	0.3	0.5	0.8	1.1	1.4	1.6	1.7
Public investment (% of total public expenditure)	0.0	16.9	16.1	15.4	15.4	13.0	10.3	7.3	3.9
Health (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aid (% of total revenue)	0.0	52.3	52.8	53.1	53.2	42.7	31.9	21.2	10.5
Total Aid (% of public investment)	0.0	6.2	5.2	4.4	4.2	3.6	2.9	2.1	1.0
Total debt (% of GDP)	0.0	0.0	-0.1	-0.2	-0.3	-0.4	-0.4	-0.5	-0.5
Educated labor (in % of population)	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.006

Table 3
Haiti : Higher Total Public Investment and Higher Efficiency of Public Investment, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.5	0.7	0.8	0.8	0.7	0.7	0.6
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.3	-0.4	-0.6	-0.7	-0.8	-1.0
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.3	-0.7	-1.1	-1.5	-1.9	-2.2	-2.5
Government Sector (% of GDP)									
Total resources (including grants)	0.0	5.0	5.0	5.0	4.9	3.9	2.9	1.9	0.9
Total revenues	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Direct taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect taxes	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2
User fees	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2
Foreign aid (grants)	0.0	5.0	5.0	5.0	5.0	4.0	3.0	2.0	0.9
Total expenditure	0.0	5.0	5.0	5.0	4.9	3.9	2.9	1.9	0.9
Spending on goods and services (total)	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Wages and salaries	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2
Security	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.0	5.0	5.0	5.0	5.0	4.0	3.0	2.0	1.0
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.0	0.5	1.1	1.7	2.3	2.9	3.4	3.8
Public investment (% of total public expenditure)	0.0	16.9	16.2	15.5	15.5	13.1	10.4	7.4	4.1
Health (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aid (% of total revenue)	0.0	52.3	53.0	53.4	53.5	42.9	32.1	21.2	10.3
Total Aid (% of public investment)	0.0	6.2	5.2	4.4	4.2	3.5	2.8	1.8	0.6
Total debt (% of GDP)	0.0	0.0	-0.2	-0.3	-0.5	-0.7	-0.9	-1.1	-1.2
Educated labor (in % of population)	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.010	0.014

Table 4
Haiti : Reallocation of spending to health , 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Poverty rate-Growth elasticity of -1.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2
Government Sector (% of GDP)									
Total resources (including grants)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
User fees	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Foreign aid (grants)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total expenditure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spending on goods and services (total)	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wages and salaries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Security	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Investment	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.3
Public investment (% of total public expenditure)	0.0	3.4	3.4	3.3	3.3	3.3	3.3	3.3	3.3
Health (% of public investment)	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Aid (% of total revenue)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Total Aid (% of public investment)	0.0	-8.0	-7.6	-7.2	-7.2	-7.2	-7.2	-7.2	-7.2
Total debt (% of GDP)	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Educated labor (in % of population)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5
Haiti : Lower collection cost, higher direct tax rate, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2
Poverty rate-Growth elasticity of -1.0	0.0	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.6
Government Sector (% of GDP)									
Total resources (including grants)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total revenues	0.0	1.2	2.2	3.2	3.2	3.2	3.2	3.2	3.2
Direct taxes	0.0	1.1	2.1	3.0	3.0	3.0	3.0	3.0	3.0
Indirect taxes	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
User fees	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Foreign aid (grants)	0.0	-1.2	-2.2	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1
Total expenditure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Spending on goods and services (total)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wages and salaries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Security	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	-1.0	-2.2	-3.3	-3.5	-3.7	-3.8	-3.9	-4.0
Public investment (% of total public expenditure)	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Health (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aid (% of total revenue)	0.0	-16.2	-28.0	-38.7	-38.9	-39.0	-38.9	-38.8	-38.6
Total Aid (% of public investment)	0.0	-24.2	-40.6	-54.7	-54.7	-54.7	-54.8	-54.7	-54.7
Total debt (% of GDP)	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3
Educated labor (in % of population)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6
Haiti : Lower collection cost, higher direct tax rate, new revenue to investment in infrastructure, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.2	0.5	0.7	0.7	0.8	0.8	0.8
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.1	-0.3	-0.4	-0.6	-0.8	-0.9
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.1	-0.4	-0.8	-1.2	-1.6	-2.0	-2.4
Government Sector (% of GDP)									
Total resources (including grants)	0.0	1.2	2.1	3.1	3.1	3.1	3.0	3.0	3.0
Total revenues	0.0	1.2	2.2	3.1	3.1	3.1	3.0	3.0	3.0
Direct taxes	0.0	1.1	2.1	3.0	3.0	3.0	3.0	3.0	3.0
Indirect taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
User fees	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2
Foreign aid (grants)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total expenditure	0.0	1.2	2.1	3.1	3.1	3.1	3.0	3.0	3.0
Spending on goods and services (total)	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Wages and salaries	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2
Security	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.0	1.2	2.2	3.1	3.1	3.1	3.0	3.0	3.0
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.0	0.2	0.6	1.2	1.8	2.4	3.0	3.7
Public investment (% of total public expenditure)	0.0	5.0	8.1	10.7	10.7	10.8	10.8	10.9	10.9
Health (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aid (% of total revenue)	0.0	-5.1	-9.3	-13.7	-13.8	-13.9	-14.1	-14.1	-14.2
Total Aid (% of public investment)	0.0	-17.1	-25.8	-32.0	-32.2	-32.4	-32.6	-32.8	-33.0
Total debt (% of GDP)	0.0	0.0	-0.1	-0.2	-0.4	-0.6	-0.8	-1.0	-1.2
Educated labor (in % of population)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7
Haiti : Higher security spending, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.000	-0.001	0.000	0.001	0.002	0.002	0.003	0.003	0.003
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001	-0.002	-0.003
Poverty rate-Growth elasticity of -1.0	0.000	0.001	0.000	0.000	-0.001	-0.002	-0.004	-0.005	-0.007
Government Sector (% of GDP)									
Total resources (including grants)	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Total revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Direct taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
User fees	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Foreign aid (grants)	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Total expenditure	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Spending on goods and services (total)	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wages and salaries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Security	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Public investment (% of total public expenditure)	0.0	-5.8	-6.0	-6.1	-6.2	-5.3	-4.3	-3.3	-3.3
Health (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aid (% of total revenue)	0.0	31.4	31.6	31.8	31.9	26.6	21.3	15.9	15.9
Total Aid (% of public investment)	0.0	60.7	56.1	52.2	52.2	43.6	34.9	26.2	26.2
Total debt (% of GDP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Educated labor (in % of population)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8
Haiti : Higher security spending and Elasticity of Security Spending, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.000	-0.013	0.003	0.016	0.026	0.037	0.046	0.054	0.059
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.000	0.003	0.002	-0.001	-0.006	-0.014	-0.023	-0.034	-0.046
Poverty rate-Growth elasticity of -1.0	0.000	0.007	0.006	-0.003	-0.017	-0.037	-0.061	-0.090	-0.121
Government Sector (% of GDP)									
Total resources (including grants)	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Total revenues	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Direct taxes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect taxes	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1
User fees	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Foreign aid (grants)	0.0	3.0	3.0	3.0	3.0	2.5	2.1	1.6	1.6
Total expenditure	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Spending on goods and services (total)	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wages and salaries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Security	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Investment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.5
Public investment (% of total public expenditure)	0.0	-5.8	-6.0	-6.1	-6.1	-5.2	-4.3	-3.3	-3.2
Health (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aid (% of total revenue)	0.0	31.2	31.5	31.7	31.8	26.7	21.5	16.4	16.3
Total Aid (% of public investment)	0.0	60.9	56.5	52.7	52.9	44.4	35.8	27.2	27.2
Total debt (% of GDP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Educated labor (in % of population)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1

Table 9
Haiti : Combined shock with lower collection cost, higher direct tax and security spending, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.1	0.5	0.6	0.6	0.7	0.7	0.6	0.5
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.2	-0.4	-0.5	-0.6	-0.7	-0.8
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.3	-0.6	-0.9	-1.3	-1.6	-1.9	-2.2
Government Sector (% of GDP)									
Total resources (including grants)	0.0	8.0	8.0	8.0	8.0	6.5	5.0	3.5	2.5
Total revenues	0.0	1.5	2.4	3.4	3.4	3.4	3.4	3.4	3.4
Direct taxes	0.0	1.1	2.1	3.0	3.0	3.0	3.0	3.0	3.0
Indirect taxes	0.0	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1
User fees	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2
Foreign aid (grants)	0.0	6.5	5.6	4.6	4.6	3.1	1.6	0.1	-0.9
Total expenditure	0.0	8.0	8.0	8.0	8.0	6.5	5.0	3.5	2.5
Spending on goods and services (total)	0.0	2.5	2.5	2.5	2.5	2.0	1.5	1.0	1.0
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Wages and salaries	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Security	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Other	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Investment	0.0	5.5	5.5	5.5	5.5	4.5	3.5	2.5	1.5
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	-1.2	-1.8	-2.4	-1.9	-1.3	-0.7	-0.2	0.2
Public investment (% of total public expenditure)	0.0	12.3	11.5	10.8	10.8	9.5	8.1	6.4	3.3
Health (% of public investment)	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Aid (% of total revenue)	0.0	53.5	36.9	21.6	21.6	9.8	-2.0	-13.7	-21.5
Total Aid (% of public investment)	0.0	16.5	6.2	-3.2	-3.4	-9.6	-17.1	-26.4	-31.4
Total debt (% of GDP)	0.0	0.0	-0.1	-0.3	-0.5	-0.6	-0.8	-0.9	-1.1
Educated labor (in % of population)	0.000	0.000	0.000	0.002	0.004	0.008	0.012	0.016	0.020

Table 10
Haiti : Combined shock with higher security expenditure, direct taxes, and elasticity of security expenditure, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.5	0.6	0.6	0.7	0.7	0.6	0.6
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.2	-0.4	-0.5	-0.6	-0.8	-0.9
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.3	-0.6	-0.9	-1.3	-1.7	-2.0	-2.3
Government Sector (% of GDP)									
Total resources (including grants)	0.0	8.0	8.0	8.0	8.0	6.5	5.0	3.4	2.4
Total revenues	0.0	1.4	2.4	3.3	3.3	3.3	3.3	3.3	3.3
Direct taxes	0.0	1.1	2.1	3.0	3.0	3.0	3.0	3.0	3.0
Indirect taxes	0.0	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.0
User fees	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2
Foreign aid (grants)	0.0	6.5	5.6	4.6	4.6	3.1	1.6	0.1	-0.9
Total expenditure	0.0	8.0	8.0	8.0	8.0	6.5	5.0	3.4	2.4
Spending on goods and services (total)	0.0	2.5	2.5	2.5	2.5	2.0	1.5	1.0	1.0
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Wages and salaries	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2
Security	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Other	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Investment	0.0	5.5	5.5	5.5	5.5	4.5	3.5	2.5	1.5
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	-1.1	-1.5	-1.8	-1.0	-0.2	0.5	1.3	1.9
Public investment (% of total public expenditure)	0.0	12.3	11.5	10.8	10.8	9.5	8.1	6.4	3.3
Health (% of public investment)	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Aid (% of total revenue)	0.0	53.2	37.0	22.3	22.5	11.1	-0.3	-11.5	-18.8
Total Aid (% of public investment)	0.0	17.7	7.7	-1.6	-1.4	-7.5	-14.9	-24.3	-29.5
Total debt (% of GDP)	0.0	0.0	-0.1	-0.3	-0.5	-0.7	-0.8	-1.0	-1.1
Educated labor (in % of population)	0.000	0.000	-0.003	-0.007	-0.012	-0.020	-0.029	-0.040	-0.053

Table 11
Haiti : Combined shock with lower collection cost, higher security spending, and direct tax incresing later, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.6	0.8	0.8	0.8	0.7	0.6	0.5
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.3	-0.4	-0.6	-0.7	-0.9	-1.0
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.3	-0.7	-1.2	-1.6	-1.9	-2.3	-2.5
Government Sector (% of GDP)									
Total resources (including grants)	0.0	8.0	8.0	8.0	7.9	6.4	4.9	3.4	2.4
Total revenues	0.0	0.5	0.4	0.9	1.4	1.9	2.3	2.4	2.4
Direct taxes	0.0	0.1	0.1	0.6	1.1	1.6	2.1	2.1	2.1
Indirect taxes	0.0	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1
User fees	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2
Foreign aid (grants)	0.0	7.5	7.5	7.1	6.6	4.6	2.6	1.1	0.1
Total expenditure	0.0	8.0	8.0	8.0	7.9	6.4	4.9	3.4	2.4
Spending on goods and services (total)	0.0	2.5	2.5	2.5	2.5	2.0	1.5	1.0	0.9
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Wages and salaries	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2
Security	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Other	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Investment	0.0	5.5	5.5	5.5	5.5	4.5	3.5	2.5	1.5
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	-0.2	0.3	0.5	0.6	0.8	0.8	1.3	1.7
Public investment (% of total public expenditure)	0.0	12.3	11.5	10.8	10.8	9.6	8.1	6.5	3.3
Health (% of public investment)	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Aid (% of total revenue)	0.0	72.7	73.5	63.2	53.6	31.4	10.9	-1.9	-10.5
Total Aid (% of public investment)	0.0	25.8	24.1	18.4	13.9	4.7	-6.5	-14.6	-18.0
Total debt (% of GDP)	0.0	0.0	-0.2	-0.4	-0.6	-0.8	-1.0	-1.1	-1.2
Educated labor (in % of population)	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.009	0.013

Table 12
Haiti : Combined shock with lower collection cost, higher security spending, elasticity of security spending, and direct tax incresing later, 2007-15
(Deviation from the Baseline scenario)

	Years								
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Real GDP per capita at market prices (% change)	0.0	0.0	0.6	0.8	0.8	0.8	0.8	0.7	0.6
Poverty rate-Ravallion's adjusted elasticity (Gini = 66.0)	0.0	0.0	-0.1	-0.3	-0.4	-0.6	-0.8	-0.9	-1.0
Poverty rate-Growth elasticity of -1.0	0.0	0.0	-0.3	-0.7	-1.2	-1.6	-2.0	-2.4	-2.7
Government Sector (% of GDP)									
Total resources (including grants)	0.0	8.0	8.0	8.0	7.9	6.4	4.9	3.4	2.4
Total revenues	0.0	0.5	0.4	0.9	1.4	1.8	2.3	2.3	2.3
Direct taxes	0.0	0.1	0.1	0.6	1.1	1.6	2.1	2.1	2.1
Indirect taxes	0.0	0.3	0.3	0.2	0.2	0.1	0.1	0.0	0.0
User fees	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.2
Foreign aid (grants)	0.0	7.5	7.5	7.1	6.6	4.6	2.6	1.1	0.1
Total expenditure	0.0	8.0	8.0	8.0	7.9	6.4	4.9	3.4	2.4
Spending on goods and services (total)	0.0	2.5	2.5	2.5	2.5	2.0	1.4	0.9	0.9
Spending on maintenance	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Wages and salaries	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2	-0.2
Security	0.0	3.0	3.0	3.0	3.0	2.5	2.0	1.5	1.5
Other	0.0	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Investment	0.0	5.5	5.5	5.5	5.5	4.5	3.5	2.5	1.5
Interest payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Overall fiscal balance including grants (cash basis)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memorandum items									
Private investment (% of GDP)	0.0	0.0	0.7	1.1	1.5	1.8	2.1	2.8	3.5
Public investment (% of total public expenditure)	0.0	12.3	11.6	10.8	10.8	9.6	8.2	6.5	3.4
Health (% of public investment)	0.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Infrastructure (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Education (% of public investment)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other (% of public investment)	0.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Aid (% of total revenue)	0.0	72.1	72.7	62.7	53.5	31.9	12.1	-0.3	-8.4
Total Aid (% of public investment)	0.0	27.0	25.6	20.1	15.9	6.8	-4.3	-12.5	-16.1
Total debt (% of GDP)	0.0	0.0	-0.2	-0.4	-0.6	-0.8	-1.0	-1.2	-1.3
Educated labor (in % of population)	0.000	0.000	-0.003	-0.008	-0.016	-0.025	-0.035	-0.047	-0.059

Figure 1
Haiti : Baseline scenario, 2007-15

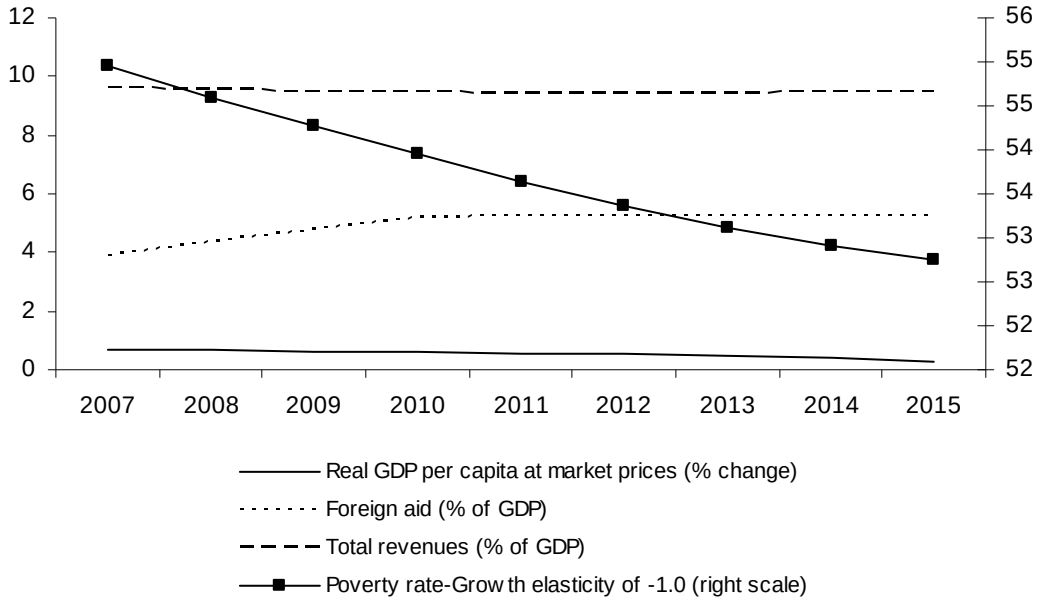

Figure 2
Haiti : Higher Total Public Investment, 2007-15
(Deviation from the Baseline scenario)

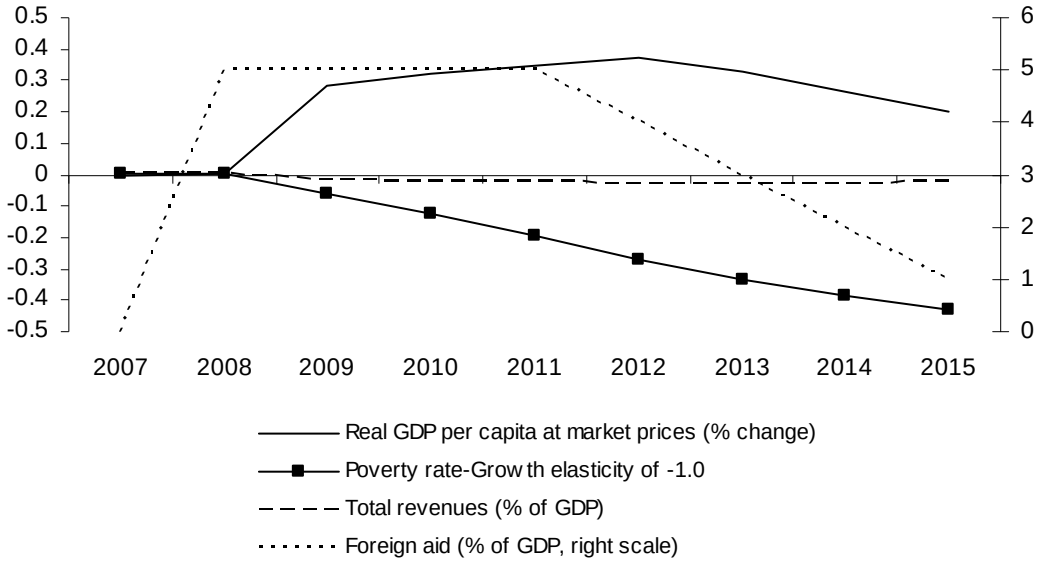

Figure 3
Haiti : Higher Total Public Investment and Higher Efficiency of Public Investment, 2007-15
(Deviation from the Baseline scenario)

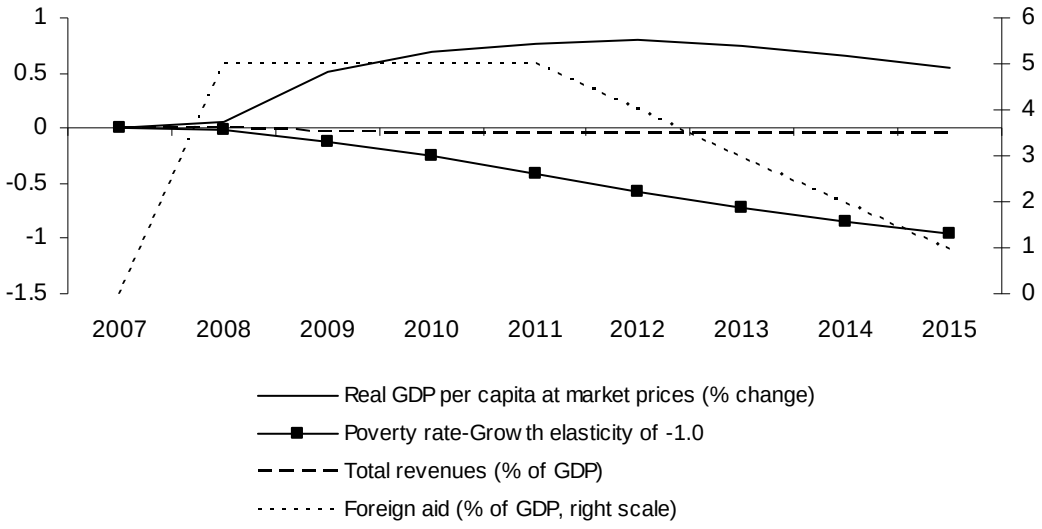

Figure 4
Haiti : Reallocation of spending to health , 2007-15
(Deviation from the Baseline scenario)

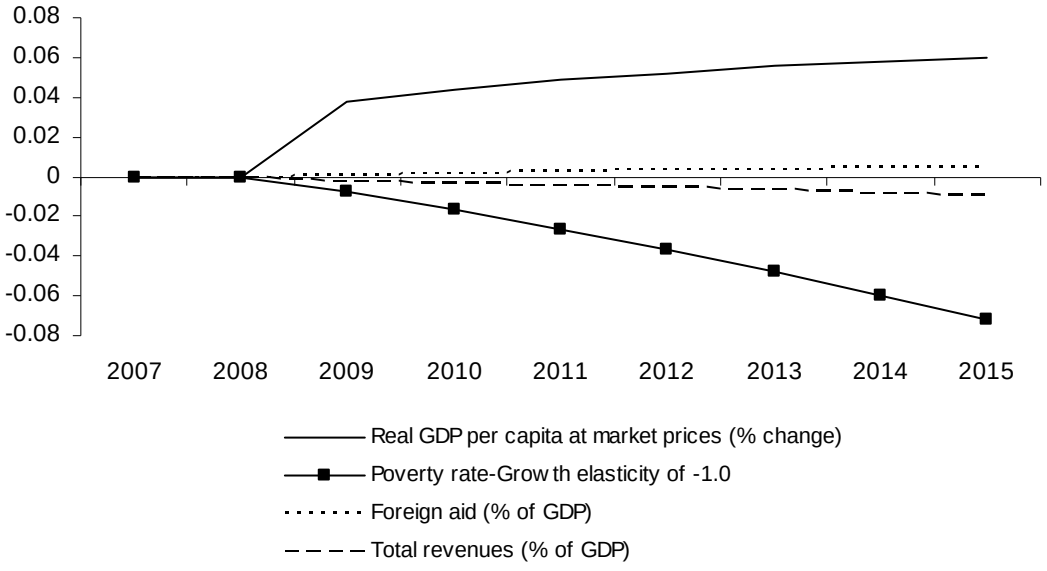

Figure 5
Haiti : Lower collection cost, higher direct tax rate, 2007-15
(Deviation from the Baseline scenario)

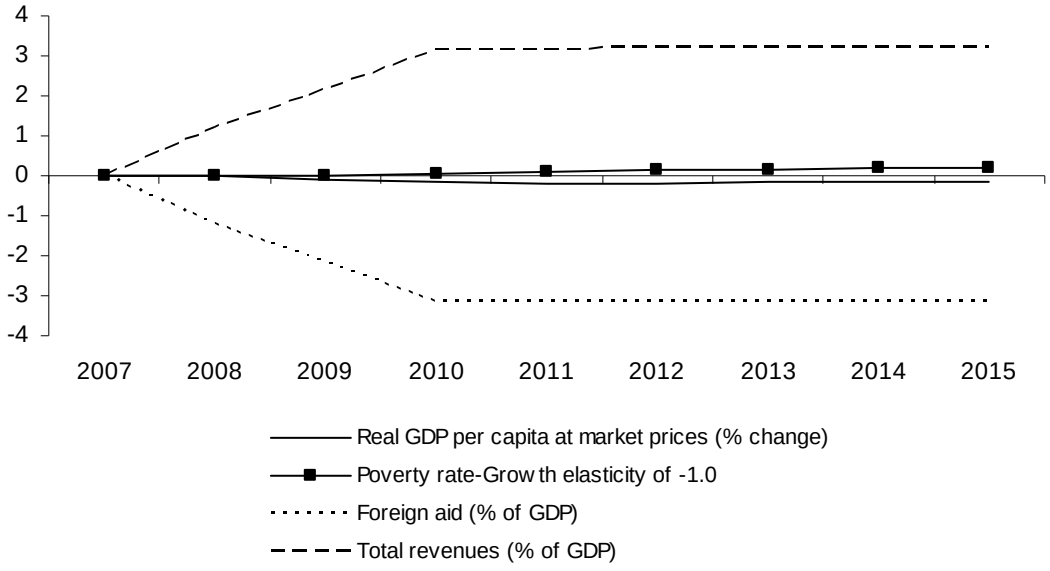

Figure 6
Haiti : Lower collection cost, higher direct tax rate, new revenue to investment in infrastructure, 2007-15
(Deviation from the Baseline scenario)

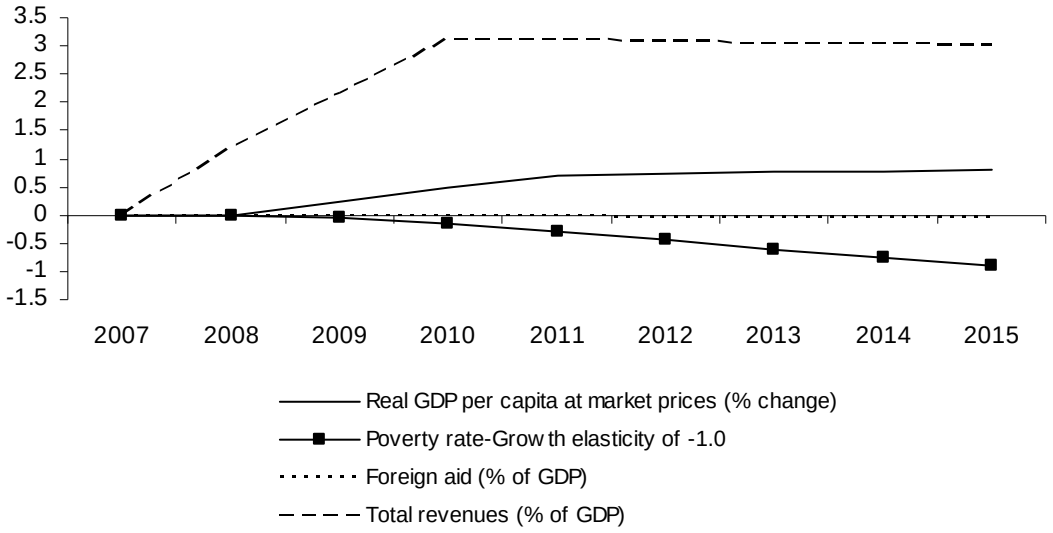

Figure 7
Haiti : Higher security spending, 2007-15
(Deviation from the Baseline scenario)

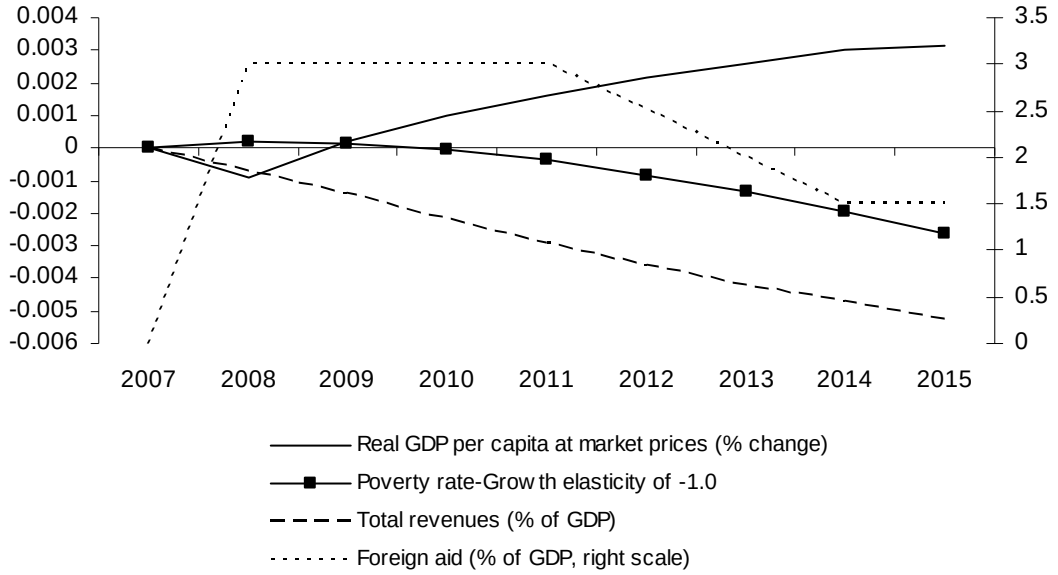

Figure 8
Haiti : Higher security spending and Elasticity of Security Spending, 2007-15
(Deviation from the Baseline scenario)

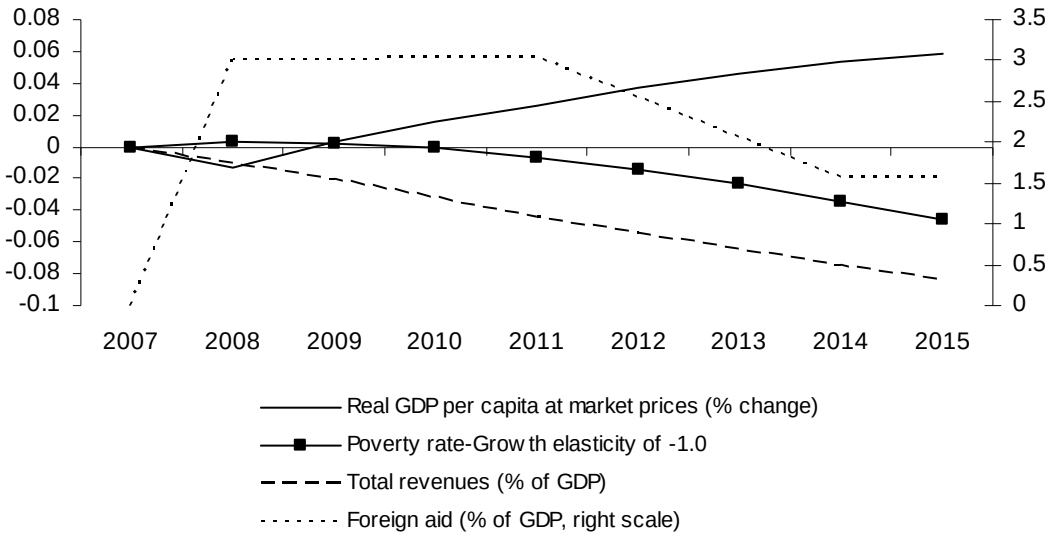

Figure 9
Haiti : Combined shock with lower collection cost, higher direct tax and security spending, 2007-15
(Deviation from the Baseline scenario)

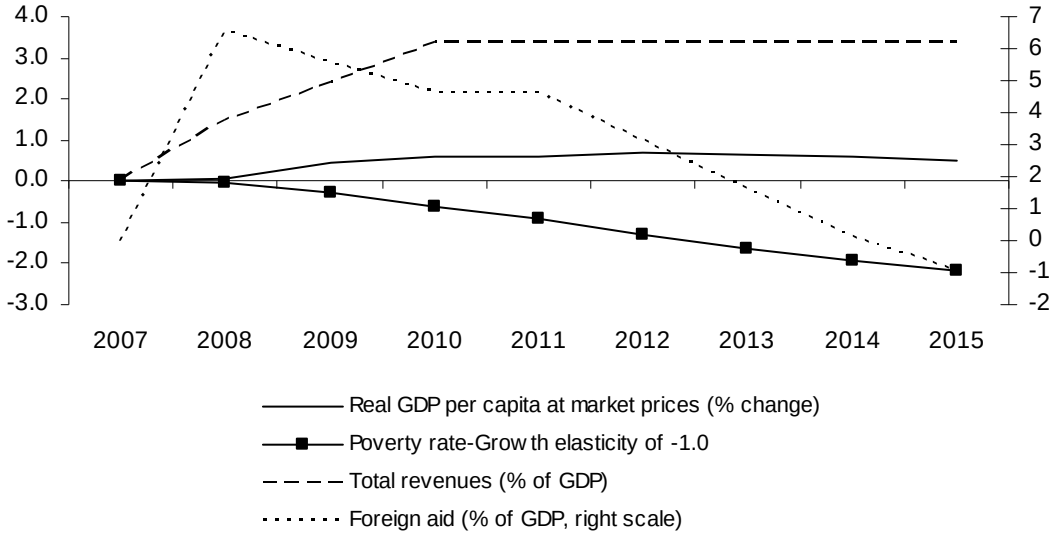

Figure 10
Haiti : Combined shock with higher security expenditure, direct taxes, and elasticity of security expenditure, 2007-15 (Deviation from the Baseline scenario)

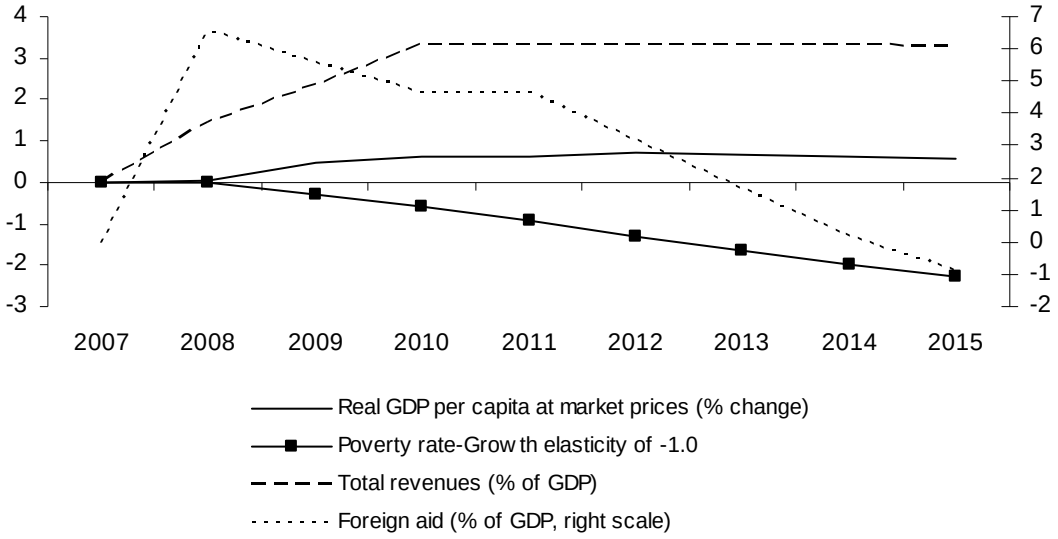

Figure 11
Haiti : Combined shock with lower collection cost, higher security spending, and direct tax incresing later, 2007-15
(Deviation from the Baseline scenario)

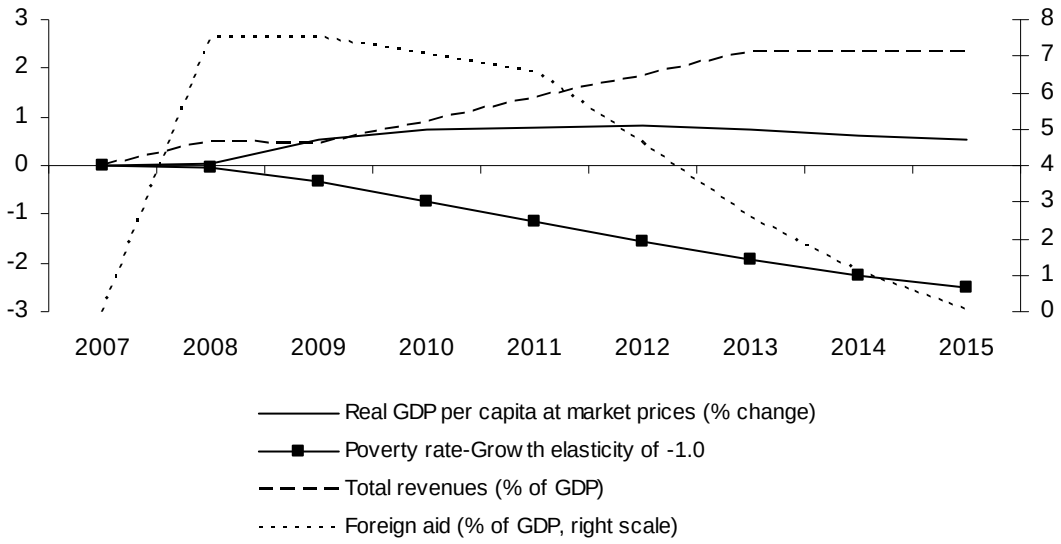

Figure 12
Haiti : Combined shock with lower collection cost, higher security spending, elasticity of security spending, and direct tax incresing later, 2007-15
(Deviation from the Baseline scenario)