

The Impact of Infrastructure Spending in Sub-Saharan Africa

A CGE Modeling Approach

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Abstract

The authors constructed a standard computable general equilibrium (CGE) model to explore the economic impact of increased spending on infrastructure in six African countries: Benin, Cameroon, Mali, Senegal, Tanzania, and Uganda. The basic elements of the model are drawn from EXTER, adjusted to accommodate infrastructure externalities. Seven sectors were considered: food crop agriculture, export agriculture, mining and oil, manufacturing, construction, private services, and public services.

Four sets of simulations were conducted: baseline nonproductive investments, roads, electricity, and telecoms. For each set of simulations, five funding schemes were considered: reduced public expenditure; increased value-added taxes; increased import duties; funding from foreign aid; and increased income taxes. In general, the funding schemes had similar qualitative and quantitative effects on macro variables. For road

and electricity investment, there were relatively large quantitative differences and some qualitative differences among funding schemes at the macro level.

Sectoral analysis revealed further disparities among countries and investment types. The same type of investment with the same funding sources had varying effects depending on the economic structure of the sector in question. The authors find that few sectors are purely tradable or non-tradable, having instead variable degrees of openness to trade.

If the current account needs to be balanced, funding investment through foreign aid produces the strongest sectoral effects because strong price and nominal exchange rate adjustments are needed to clear the current account balance. In addition, the capital/labor ratio of each sector plays an important role in determining its winners and losers.

This paper—a product of the Sustainable Development Division, Africa Region—is part of a larger effort in the department to improve the global knowledge base on African infrastructure as part of the Africa Infrastructure Country Diagnostic. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The author may be contacted at savard@worldbank.org.

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With donors anticipating large potential increases in Sub-Saharan African infrastructure financing, this report seeks to understand how such financing might be fiscally sustainable. Our immediate priority is to buttress the flagship infrastructure study by highlighting investment. To what extent, we ask, are investments in infrastructure compatible with fiscal sustainability? We employ a computable general equilibrium (CGE) approach in an effort to compare the impact that higher spending on infrastructure might have in six African countries. As described in Adam and Bevan (2004), the literature shows that infrastructure investment can contribute to so-called Dutch disease (whereby one booming sector adversely affects that country's other economic sectors—in particular, the non-booming tradable sector). Adam and Bevan show that the adverse effect can be attenuated if nontradable sectors also benefit from infrastructure investment externalities. They construct an aggregated model to verify this impact and apply their hypothesis to Ugandan data.

In this report, we drop the dichotomous classification of sectors as tradable and nontradable. In most African countries, some sectors are nontradable (such as the construction sector) and some are mostly tradable (such as rent agriculture). As a rule, however, sectors have a variable relative share of exports over total production. We extend the Adam-Bevan concept to differentiated externalities of infrastructure spending; a disaggregated model allows for a matrix of externalities among both the productive sectors and the type of infrastructure expenditure. For this exercise, we draw on Savard and Adjovi (1998), who analyze the externalities of health and education investment in different productive sectors.

Our model introduces an additional element by imposing increases in public expenditure to maintain and repair new public infrastructure. These increases are included in government budget constraints while funding options are investigated through fiscal policy and foreign aid. The model introduces different taxation modes to provide a solid basis for a comparative analysis of the various financing options.

A comparative analysis allows us to determine whether the case of Uganda set out in Adam and Bevan (2004) is a special scenario. The models are disaggregated into five to seven sectors. These sectors capture country differences according to their respective economic structures. We use the following seven sectors in all models: food crop agriculture, export agriculture, mining and oil, manufacturing, construction, private services, and public services.

1 The social accounting matrix for six countries

Geography, demographics, and economic structure were all considered in selecting the six African countries studied here (Tanzania, Uganda, Senegal, Mali, Benin, and Cameroon). These were chosen not only to maximize country coverage but also to ensure that varied economic realities were captured.

The analysis focuses on a number of items—among them the differential sectoral effects of investments, budgetary impacts, welfare changes for all agents of the model (households, government, firms, and rest of the world), and other macro and sectoral variables of the model. The choice of the macroeconomics of the models in part determines which variables are analyzed. The number of sectors and the reference year for each social accounting matrix (SAM) are furnished in table 1. Each SAM was aggregated to obtain a format that was close to uniform.

Table 1. Presentation of the selected countries

Countries (reference year)	Size (km ²)	Population (million)	GDP/capita (US\$)	Main production	Main export	Geography	Number of sectors in SAM
Tanzania (2000)	945,000	37.0	700	Agri	Agri	Coastal	7
Uganda (1999)	236,000	27.2	1,500	Agri, Serv	Coffee	Landlocked	7
Senegal (1996)	196,000	11.1	1,700	Serv	Peanuts/fish	Coastal	6
Mali (2001)	1,240,000	12.3	900	Agri	Cotton, gold	Landlocked	7
Benin (2000)	112,000	7.4	1,200	Agri	Cotton	Coastal	5
Cameroon (2000)	474,000	16.3	1,900	Agri, oil	Coffee, oil	Coastal	7

2 The advantages of the CGE approach

The advantages of the CGE model are many, among them the way it allows researchers to study in more detail the consequences of increasing public infrastructure in African economies. The archetype model uses more agents than those employed in the more standard macro-type models. We have four explicit agents in the model: households, firms, government, and the rest of the world. The advantage of this model compared with the Adam-Bevan model is a richer presentation of production sectors. In their study, Adam and Bevan introduce a competing import sector, an export sector, and a nontradable sector. Although that approach is illustrative, we find in most disaggregated SAMs in Africa that few sectors are purely tradable or nontradable. They have instead varying degrees of openness to trade. Generally, the construction sector is nontradable, and the agricultural sector cannot be described as either fully tradable or nontradable. We observe some export of subsistence agriculture in most African countries. In some the proportion of exports on total production can be relatively large. For export crops, the rate can also be quite variable. The service sector also has a fair amount of variation from one country to another. By using this breakdown instead of that used by Adam and Bevan, we anticipate that Dutch disease might not be quite as virulent as predicted.

The CGE model also has the advantage of being fully coherent. All accounts must be balanced. This model also allows us to identify the winners and losers of the different scenarios analyzed, to simulate various fiscal policies to fund investment, and to provide a comparative analysis of winners and losers. With disaggregated production sectors in seven areas, we are able to highlight not only the winners and losers, but also the gainers and losers from the agent's end, such as whether households will be favored over firms.

By conducting a comparative analysis we illustrate the importance or nonimportance of structural differences between the six African countries. By using the same behavioral assumptions, the same externality parameters, and the same macroclosure rules the modeler is able to isolate structural effects in different countries. The countries selected for analysis here have disparate economic structures, so it is possible that these will provide insightful insights.

We also compare funding options for infrastructure investment in terms of distributional impact, in addition to effects on real exchange rates and efficiency. Sensitivity analyses are done not only on the general level of externalities but also on the sectoral differences of these externalities. Moreover, we will simulate different levels of infrastructure investment to get a sense of realistic goals.

3 The model

The basic elements of the model are drawn from the EXTER model of Decaluwé and others (2001) which we adjusted in order to introduce infrastructure externalities so that there is a function with sector-specific elasticity for infrastructure investment. We therefore prepared the model to consider four types of investment: road infrastructure, health, education, and telecom.

The main hypothesis of our model is that production is determined by a three-way system: total production of the branch (XS) comprises fixed value-added shares (VA) and intermediate consumptions (CI), as is generally assumed in CGE modeling. The relationship determining the level of VA is a Cobb-Douglas function between composite labor (LD) and capital (KD). This value-added function is multiplied by the externality, which is a ratio of new investment over past investment with a sector-specific elasticity. Producers minimize their cost of producing VA subject to the production function (Cobb-Douglas). Optimal labor-demand equations are derived from this minimization process. We assume that capital is partly fixed among sectors because after a policy shock in Africa it is difficult in the short to medium term to convert capital for use in a new production sector. Intermediate consumption is modeled as fixed shares from input/output ratios calculated on the basis of SAM. This modeling is typical.

This is a small, open-economy model to which world prices of imports and exports are exogenous. We posed the Armington hypothesis (1969) for import demand whereby domestic consumers can substitute domestically produced goods with imports (imperfectly) by relying on a sector-specific elasticity of substitution. In sectors where local consumers are indifferent to imported versus local goods, one sees high elasticity of substitution and, inversely, a small elasticity of substitution, where consumers prefer one good versus the other. A high elasticity in one sector implies that a change in relative price between the locally produced good (competing with the imported good) and the imported good will have a strong substitution effect. For example, if the price of the locally produced good increases compared with the price of the imported good, local consumers will substitute the imported good. If the elasticity of substitution is low, this same change in relative price will have only a slight substitution effect. The elasticity of substitution depends *inter alia* on differentiation between the goods and on the preference of local consumers. The relative price of the two goods is the other determinant of the ratio of demand between imported goods versus local goods. On the export side, producers can sell goods on the local market or export their production; they are influenced by relative prices in each market and by their elasticity when the good is transformed for one market or the other.

The different agents' income equations are consistent with the structure presented in the SAM. In this model, factor allocations are exogenous while factor payments are endogenous. Because capital is fixed by sector, we have six capital payments and one wage. Dividends paid to households are also endogenous and depend on a firm's income after taxes. The private firm's income is the balance of capital remuneration not paid to households, to which must be added government subsidies and transfers from the rest of the world. Government revenue comprises production taxes, customs duties, household, and private firm taxes as well as transfers from the rest of the world (budgetary assistance). The government spends its budget on consumption of public goods, transfers to households, subsidies to private firms, and transfers to the rest of the world and savings.

The demand function of households is derived from a utility-maximization process (Cobb-Douglas utility function), which leads to demand functions that are fixed-value shares for each good. Investment demand is broken down into private investment made by households, the rest of the world, and firm and public investment from government savings. Investment demand is also specified with a fixed-value share function; we already described the demand for intermediate goods, which are fixed volume shares based in input-output matrix shares.

The price equations are standard. We used the GDP deflator as a price index, and as stated earlier, international prices (imports and exports) are exogenous; accordingly, the country has no control over the prices applied to the world market.

The key assumptions of this model are based on infrastructure spending, positive externalities, infrastructure, and budget constraints. Hence, it is important to look at the series of equations directly related to these elements. Other equations of the model also play important indirect roles but these effects are generated via the general equilibrium effects of the simulated policies. We first examine government income sources (equation 1.1). The government draws its revenues from indirect taxes on output (Ti), direct taxes on household (Td) and firms (Tde) and import duties (Tim).

$$1.1 \ Yg = \sum_{im} Tim_{im} + Td + Tde + \sum_m Ti_m + Trg + Teg + Tgm$$

The other sources of income are transfers from other agents; these transfers can be negative or positive depending on the country. Three other agents provide transfers from other agents: households (Tgm), firms (Teg), and the rest of the world (Trg). Generally, the Tgm is a negative value, reflecting the fact that the government pays the transfers to households. In countries where public firms are still important, transfers to government are positive if the aggregate public firms make profits; if they run deficits, they are negative. The rest of the world transfers are made up mainly of foreign aid to Africa, a likely funding source for infrastructure investments.

This first equation (1.1) does not provide a complete picture because investment will also be linked to government expenditure on public services. The next equation (1.2) is the budget constraint for government, which will spend part of its income (Yg) on public services or expenditure (G) and the other part on government savings (Sg), which will be used entirely for public investment.

$$1.2 \ Sg = Yg - G$$

At this point, the closure rule¹ used to balance this budget constraint is key to our analysis. We introduce an additional assumption that percentage increases in public infrastructure investment will generate higher operation and maintenance costs. Hence, the level of government expenditure will be a function of its original expenditure (Go) plus the operation and maintenance of new infrastructure. This is because empirical studies have shown that new public infrastructure generates higher operation and maintenance costs, which varies by region and type of infrastructure investment. We compute imposed increases in expenditure by computing the increase in public investment ($Itp - Itpo$) and premultiplying ω ,

¹ The closure rule consists in determining the variable of adjustment to reach an investment objective and hence the government savings will be exogenous.

which is the ratio of the maintenance cost over investment expenditure. The government expenditure (G) will be determined with the following equation (1.3):

$$1.3 \quad G = G_o + \omega(Itp - Itp_o)$$

A parameter (ω) is used to adjust for the type of infrastructure investment that will be simulated. The following parameters were computed from expected annual investment needs for 2005–2010 in Sub-Saharan Africa from Fay and Yepes (2003). We simply computed that ratio between investment needs and maintenance costs.

- Roads, 0.84
- Sanitation, 1.29
- Water, 1.38
- Telecom, 0.74
- Electricity, 0.90

This assumption for public expenditure is equivalent to establishing what it will be. As we fix, or establish, investment objectives, the public investment (Itp) will also be exogenous; implicitly, the government savings will also be exogenous given the identity of equation 1.4.

$$1.4 \quad Itp = Sg$$

Given these assumptions, only one element can be adjusted to balance out the government budget constraint (equation 1.2). The only variable we can use to adjust the budget constraint is government income Yg . As this variable is not free in the model (it is determined by the income generated from all sources of income), one variable of this equation must be rendered endogenous. One option would be to leave the Trg endogenous, which would mean the objectives for public investment will be met by more foreign aid. The other option would be to endogenize one of the tax rates (household income tax, firms' income tax, production tax, or import duties). An intermediate option that could be simulated is to assume an exogenous rise in foreign aid (Trg) and to let an internal tax rate adjust for the rest of the funds needed to meet public investment objectives.

The other important element is the externality equation (1.5), along with its role in increased total productivity of factors of the value-added equation (1.6). For this, we draw on the vast literature linking public infrastructure to factor productivity in the private sector, such as that modeled by Dumont and Mesplé-Soms (2001) in a CGE context—although our externality function does not use private investment. The function defining the externality is defined with the following function:

$$1.5 \quad \theta_i = \left(\frac{Itp}{Itp_o} \right)^{\xi_i}$$

where θ_i is the externality or sectoral productivity effect, which is a function of the ratio of new public investment (Itp) over past public investment (Itp_o) with a sector-specific elasticity (ξ_i). We do not model a direct private sector displacement or crowding effect tied to increased public investment. The externality

of public infrastructure investment produces an increase in total factor productivity. This link to the value added (Va) is taken into account in the Cobb-Douglas function of the following equation (1.6):

$$1.6 Va_m = \theta_i A_m Ld_m^{\alpha_m} Kd_m^{1-\alpha_m}$$

where A is the scale parameter, Ld , the labor demand, Kd , the capital demand, and α the Cobb-Douglas parameter. Hence, an increase in θ_i represents a Hicks's neutral productivity improvement, like the one modeled in Yeaple and Golub (2007).² With this formulation, infrastructure investment can act as a source of comparative advantage because the function is sector specific. Model equilibrium conditions are also standard. The commodity market is balanced by adjusting the market price of each commodity. The labor market balances out by adjusting the nominal wage. One should also note that labor supply is fixed and that there is no unemployment.³ The current account balance is fixed; accordingly, the nominal exchange rate varies to allow the real exchange rate to clear the current account balance. The same archetype is applied to the six countries. Minor adjustments are needed to account for the different fiscal structures and the agents' transfer matrix. Externality elasticities are also adapted.

4 A structural comparison of the economies

In this section we highlight the structural differences and similarities of the economies studied. It is important to focus on structural issues, as all the models we have constructed operate on the same hypotheses and behavioral parameters. The differences observed in each scenario stem from the unique structure of the SAMs derived from the differing economic structures of the countries of interest. We do not present the complete SAM for the economies but focus instead on a few structural characteristics. As in all CGE models, the labor/capital ratio of the production sectors always plays an important role in the results obtained from policy simulations. Other important ratios are the weight of the sectors in the GDP, the export/output ratio, and the import/total consumption ratio.

Let us first look at the weight of the sectors in the total GDP of the different countries (table 2).

From this table we learn that the economies of Senegal (23 percent) and Cameroon (24 percent) rely less than the other four countries on agriculture. The other countries range from 37 percent for Mali to 45 percent for Uganda. At 7 percent each, Benin and Cameroon have the smallest export agriculture sectors; Tanzania has the largest at 17 percent. The oil sector is important for Cameroon (10 percent), while the mining sector (gold) is very important for the Malian economy (11 percent). The industrial sector is relatively small in all countries, ranging from 9 percent in Mali to 20 percent in Cameroon. The construction sector accounts only for 2 percent of the Cameroonian economy, whereas it represents 10 percent for Tanzania. Other countries fall between these two extremes. The largest country differences are found in private services, where nearly half the Senegalese economy (47 percent) depends on services but

² This formulation is also commonly used in the literature estimating parameters of the externalities of public infrastructure on total factor productivity such as Ashauer (1989), Munnell (1990), Bajo-Rubio and Sosvilla-Rivero (1993), Gramlich (1994), and Dessus and Herrera (1996) among others.

³ This does not mean that we assume that there is zero unemployment in the countries but simply that unemployment is exogenous to the model.

in Tanzania, only 22 percent. Public services are quite similar, with most countries at about 8 percent; the two extremes are Cameroon with a high of 10 percent and Uganda with a low of 4 percent.

Table 2. Weight of the productive sectors in total GDP

	Crop agriculture	Export agriculture	Mining and gas	Industries	Construction	Private services	Public services
Benin	0.35	0.07	n.a.	0.14	n.a.	0.36	0.07
Cameroon	0.17	0.07	0.10	0.20	0.02	0.35	0.10
Mali	0.21	0.16	0.11	0.09	0.06	0.28	0.07
Senegal	0.12	0.11	n.a.	0.17	0.04	0.47	0.09
Tanzania	0.26	0.17	0.02	0.16	0.10	0.22	0.06
Uganda	0.32	0.13	0.0007	0.11	0.08	0.31	0.04

n.a. = not applicable.

In table 3, we present the labor/capital ratio for each country. This is important because pressures on the factor market will benefit labor- or capital-intensive sectors depending on the policy simulated. Hence, these ratios will be informative for the sectoral analysis provided below:

Table 3. Labor/capital ratios by sector and countries

	Crop agriculture	Export agriculture	Mining and gas	Industries	Construction	Private services	Public services
Benin	0.03	0.03	n.a.	0.20	n.a.	0.20	1.00
Cameroon	3.69	1.01	0.03	0.66	5.09	0.98	1.00
Mali	0.13	0.07	0.11	0.64	2.38	0.30	1.00
Senegal	0.02	0.64	n.a.	0.32	0.21	0.21	1.00
Tanzania	2.83	1.74	0.07	1.08	0.59	0.53	1.00
Uganda	1.07	0.94	0.28	0.88	1.43	1.42	1.00

n.a. = not applicable.

Before analyzing this table, we should highlight the fact that a different methodological approach is at the root of important differences noted in the table. For national accounts, it is common practice to place small household farmers' surplus in the capital account. In the modeling world, some believe this should not be done in a SAM but should be placed instead in the labor payment account. Without complete information on each SAM, we did not modify them. But some modelers have modified these numbers—particularly in Cameroon and Tanzania, and probably in Uganda. In the three other countries, the modelers have probably kept the SAM as the input-output table. This explains the large differences for the two agricultural sectors. One tendency that emerges is that, with the exception of Senegal, crop agriculture is more labor intensive than export agriculture. In Senegal, export agriculture includes the very labor-intensive groundnut. The mining sector is very capital intensive, especially the oil sector in Cameroon, and the least intensive in Uganda. For industries, we observe differences between Tanzania, whose very labor-intensive industry has a ratio above 1 (1.08), and Benin, with the least intensive (cotton) at a ratio of 0.2. Construction is also labor intensive, except in Senegal and Tanzania.

The next structural feature is the exports on total output by sector (table 4).

Table 4. Export/output ratios by sector and countries

	Crop agriculture	Export agriculture	Mining and gas	Industries	Construction	Private services
Benin	0.06	0.08	n.a.	0.18	n.a.	0.38
Cameroon	0.01	0.12	0.95	0.15	0.00	0.07
Mali	0.04	0.33	1.00	0.002	0.00	0.09
Senegal	0.01	0.06	n.a.	0.32	0.01	0.12
Tanzania	0.03	0.15	0.09	0.02	0.41	0.04
Uganda	0.01	0.04	0.00	0.23	0.00	0.06

n.a. = not applicable.

One interesting feature of this table is the relatively similar ratios for the export agriculture sector (with the exception of Mali at 33 percent). But many agricultural products, prior to export, undergo a first round of transformation by the industrial sector. Tanzania's 41 percent for the construction sector is another surprising feature. Some countries export a lot of their industrial production, such as Senegal (32 percent) and Uganda (23 percent). But others export very little, such as Mali at 0.2 percent and Tanzania at 2 percent. We also see disparities in the export of private services, ranging from 38 percent in Benin to 4 percent in Tanzania. The most important export sector for Tanzania and Mali in relative terms is export agriculture, whereas for Uganda and Senegal it is industry. Benin's most important export sector is private services, while the oil and mining sector is Cameroon's.

The final structural feature presented here (table 5) is imported goods over total national consumption, which includes final household and government consumption, intermediate inputs to the sectors, and demand for investment goods.

Table 5. Ratios of imports to total demand by sector and countries

	Crop agriculture	Export agriculture	Mining and gas	Industries	Construction	Private services
Benin	0.05	0.00	n.a.	0.27	n.a.	0.03
Cameroon	0.01	0.03	0.88	0.22	0.01	0.07
Mali	0.04	0.09	0.00	0.61	0.00	0.06
Senegal	0.25	0.04	n.a.	0.39	0.00	0.08
Tanzania	0.02	0.05	0.60	0.30	0.32	0.03
Uganda	0.01	0.00	0.75	0.39	0.00	0.10

n.a. = not applicable.

The agricultural sectors contain interesting features. Senegal is the only significant importer of crop agriculture (25 percent), where all other countries are below 5 percent. Regarding export agriculture, four countries import some goods likely destined for the industrial sector. Gas and mining is an imported good in Cameroon, Tanzania, and Uganda. With the exception of Cameroon (22 percent), all countries have high import ratios for industrial goods. Once again, Tanzania (at 32 percent) imports a lot of construction goods or services, especially in comparison with figures that are close to zero in the other countries. The importation of private services ranges from 3 percent in Tanzania to 10 percent for Uganda.

In light of the above figures, we can expect differentiated effects in our simulations. The other structural features not presented here but nevertheless with a role to play include public investment, household consumption, and government fiscal structure.

5 The simulations

To analyze the impact of increased investment in infrastructure and different funding mechanisms, we isolate three types of infrastructure investments and perform a baseline set of simulations on unproductive investments to provide a reference point for the comparative analysis. We present four sets of simulations: (1) baseline nonproductive investments, (2) road infrastructure, (3) electricity, and (4) telecom infrastructure. We then perform five simulations for each of the productive investments and four for the unproductive investments. The productive investments are distinguished by externality parameters. The scale of public investment in infrastructure is maintained as a constant throughout the simulations; we perform an increase of 20 percent.

In the first funding scheme, we lessen other public expenditure to fund the investments and their maintenance. Productive externalities will contribute to increased economic activity, which will increase government revenues. It is important to highlight this fact. Hence, the funding requirements are not equal to the investment and operation costs. In the second funding option, we increase the value-added tax (VAT). In the third, we increase import duties. In the fourth, foreign aid is the funding source. The final option is to increase income taxes to provide the required funds. This comparative analysis allows us to highlight the most efficient funding mechanism and to explore the effects on different macroeconomic and sectoral variables. We present the simulations in a synthetic form in table 6.

Because each of these simulations was performed on six country models, we produced 114 simulations. The complete results are presented country by country in the appendix. We selected two funding schemes for each type of investment for the impact analyses presented in this paper.

6 Impact analysis of the scenarios

In this section we concentrate on the macroeconomic variables by highlighting the main sectoral effects for one funding option for each type of investment. We undertake a detailed comparative analysis

1 Nonproductive investment	1a) VAT funding
	1b) Import duties funding
	1c) Foreign aid funding
	1d) Income tax funding
2 Roads	2a) Reduction in other public expenditure
	2b) VAT funding
	2c) Import duties funding
	2d) Foreign aid funding
	2e) Income tax funding
3 Electricity	3a) Reduction in other public expenditure
	3b) VAT funding
	3c) Import duties funding
	3d) Foreign aid funding
	3e) Income tax funding
4 Telecom	4a) Reduction in other public expenditure
	4b) Reduction in other public expenditure
	4c) VAT funding
	4d) Import duties funding
	4e) Foreign aid funding

between countries for two funding options affecting each of the four different investment strategies. We therefore analyze in detail 8 of the 19 scenarios for the six countries. This approach facilitates comparative analyses of the investment strategies and the efficiency of different funding modalities. The unproductive investment option is the baseline scenario. In each productive investment scenario, we observe an increase in GDP—a direct consequence of our externality hypothesis. Because we have assumed that our total endowment of productive factors is exogenous, growth in GDP is generated directly by the production externalities of public investment. The relative importance of this increase between simulation sets is directly determined by the externality elasticities we selected and by the relative importance of the economic sectors. When looking at results, keep in mind a key hypothesis: our current account balance is fixed. The current account is balanced by adjusting the nominal exchange rate. In the tables below, we present the nominal exchange rate as the penultimate variable. This rate can also be interpreted as the real exchange rate because our price index is exogenous. So the variation in the nominal exchange rate is equivalent to the variation in the real exchange rate.

Before proceeding to the analysis, we should note that for Uganda we have increased public investment by only 5 percent. We were constrained here given the high level of public investment for the reference period. Simulating a 20 percent increase was not possible for the foreign aid scenario. Given the nominal increase in size, it produced an excessive pressure on the nominal exchange rate.

Investment in nonproductive infrastructure

We use this simulation as the baseline scenario, which can be interpreted as an investment in the construction of monuments, in the army (if the country is not in conflict), or other types of nonproductive government investments. We look at two funding options to increase nonproductive public investment. The first is an increase in the VAT and the second is an increase in import duties. Below we analyze the simulations for the six countries.

Investment funded by the value-added tax

In this simulation, we increased nonproductive public investment (investment that does not produce production externalities for other productive sectors); the increase in government spending is funded by a uniform increase of the effective VAT. At the reference period, the VAT is not uniform and the differentiated structure remains after simulation. We apply a uniform tax increase so the percentage adjustment is the same for all sectors—if the tax rate in the sector is positive at the reference period. We hold exogenous other public expenditures made by government but assume, as was explained earlier, that new investment will require some new operational expenditures. Hence the 20 percent increase in government savings, while new public expenditure for operational costs of new investment is funded by the increase in VAT. In this simulation as in others an important structural distinction between countries is the initial nominal public investment. If this is very low at the reference period, the 20 percent increase will be smaller in nominal terms than in the countries where public investment for the reference period is substantial. Let us first look at the macro results for all countries in table 7.

Table 7. Macroeconomic results for nonproductive investments, VAT funded

Variable	Definition	Nonproductive investment (VAT funded)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.09	0.06	0.29	0.02	0.02	0.25
EV	Equivalent variation	0.09	0.06	0.26	0.02	0.02	0.23
s	Wage	4.42	0.49	1.29	0.07	0.11	0.56
yg	Government income	14.70	3.19	5.90	5.44	3.14	6.36
ye	Firm income	-0.71	-0.18	-0.45	-0.08	-0.13	-0.64
g	Total government expenditure	11.96	1.73	5.38	3.52	2.49	7.27
It	Total private investment	0.04	-0.17	-0.45	-0.13	-0.16	-0.86
e	Nominal exchange rate	1.69	0.03	0.07	0.02	-0.12	0.35
GDP	GDP	0.02	0.00	0.01	0.00	0.00	0.00

This option seems to favor households over firms in all countries because wages expand more than the average rental rate of capital. The increase in government income derives from the increased VAT to fund new investment. Since investment in public expenditure does not produce externalities, the government does not benefit from increased income from economic growth. Therefore the hike in income can be attributed almost exclusively to the VAT increase to fund the operational costs of new public investments. For comparative purposes, this will be useful in the other scenarios for observing how growth influences government income. The other common feature is that the simulation produces higher wages because public services must grow to meet the operational needs created by new investment. In addition, this sector places more pressure on the labor market than on the capital market.

Comparing the impact on aggregate representative household income, we note increases for all countries, with the strongest impact on Senegal and Cameroon because wage hikes are strongest for these two countries, as is the steepest drop in firm income. Total private investment falls in all countries (crowding out of private investment by public investment) with the exception of Benin; growth in private investment in Benin is relatively small (0.04 percent).

Investment funded by import duties

For the import duties funding option we analyze both the macro and sectoral results. In this case, we let the import duties adjust uniformly from the reference situation where we observed distorted effective rates. The macro results are presented in table 8.

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Table 8. Macroeconomic results for nonproductive investments, funded by import duties

Variables	Definition	Nonproductive investment (import duties funded)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.10	0.08	0.29	0.04	0.02	0.35
EV	Equivalent variation	0.09	0.08	0.26	0.04	0.02	0.32
s	Wage	4.81	0.72	1.27	0.10	0.11	0.78
yg	Government income	14.70	3.19	5.90	5.44	3.14	6.36
ye	Firm income	-0.77	-0.26	-0.44	-0.13	-0.14	-0.89
g	Total government expenditure	11.96	1.73	5.38	3.52	2.49	7.27
It	Total private investment	-0.18	-0.25	-0.65	-0.52	-0.85	-1.16
e	nominal exchange rate	-1.20	-0.70	-1.38	-1.00	-2.39	-1.92
GDP	GDP	0.01	0.00	0.01	0.00	0.00	0.00

At the macro level, the results largely resemble the VAT-funded scenario. As seen in the previous section, the government income effect is by definition the same. The negative effect is stronger for all countries on private investment. The largest difference between the two funding options for this variable is observed for Uganda, which falls from -0.16 percent to -0.85 percent.

Table 9. Sectoral results for nonproductive investments, funded by import duties

Variable	Sector	Nonproductive investment (import duties)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Va (value added or output)	Crop agriculture	-0.14	-0.08	-0.03	-0.14	-0.08	-0.87
	Export agriculture	-0.19	-0.07	-0.95	-0.38	-0.27	-0.60
	Mining and gas		-0.25		-0.04	0.06	-0.10
	Industries	-0.65	-0.15	-1.08	-0.25	-0.64	-0.60
	Construction		0.47	1.88	0.17	1.05	5.24
	Private services	-1.10	-0.14	-0.35	-0.09	-0.12	-0.52
	Public services	7.60	1.09	4.24	2.32	2.27	4.19
pq (market prices)	Crop agriculture	0.25	0.18	-0.08	0.14	0.07	0.74
	Export agriculture	-1.08	0.00	0.38	0.47	-0.04	1.67
	Mining and gas		-0.31		0.23	1.71	0.71
	Industries	3.38	0.65	1.69	0.54	0.02	2.65
	Construction		0.65	6.07	0.60	0.49	2.24
	Private services	0.80	0.35	0.28	0.10	0.15	0.73
	Public services	4.05	0.61	1.09	0.18	0.21	1.13
r Borrowing rate of capital	Crop agriculture	-0.49	0.01	-0.13	-0.09	-0.03	-0.34
	Export agriculture	-2.42	-0.44	-1.19	-0.49	-0.45	-0.42
	Mining and gas		-1.83		-0.51	0.40	-2.84
	Industries	0.86	0.32	-3.17	-0.37	-1.26	-0.73
	Construction		1.39	12.88	0.58	1.91	7.12
	Private services	-1.85	0.09	-0.72	-0.14	-0.10	-0.27

A common effect observed in the four investment scenarios is the strong increase in output⁴ for public services compared with other productive sectors. This occurs by definition given the operational cost constraint; the construction sector also shows an increase since it benefits directly from public investment by building the infrastructure. Given the constraint of factors in the model, the increased output of these two sectors is compensated by a reduction of output for all other sectors; this is valid in all countries. Because we do not have investment externalities in this scenario, labor is taken from the other sectors in order for the construction and public services sectors to increase production. We observe only one exception—the mining and gas sector in Uganda, which increases output slightly by 0.06 percent. That sector in Uganda is very small (0.07 percent of GDP) and capital intensive. Given the pressure on the labor market, which generates wage increases in all countries, the more labor-intensive sectors are penalized. No clear tendency is observed for any one most negatively affected sector; with the exception of the industrial sector in Senegal and Uganda, a different sector is affected in each country. In Benin it is private services, in Cameroon crop agriculture, in Mali mining and gas, and in Tanzania export agriculture. As a consequence, the policy and funding schemes do not produce uniform sectoral results among the countries. We can therefore conclude that the structural effects of the economies dominate the behavioral effects.

As for the price effects, higher import duties raise most prices in most countries. But the predominant effect on prices remains on the demand side for the construction sector. Given the increase in demand for construction goods via the increase in public investment, we observe the strongest price increase (or second biggest) for this sector in all countries. In general, crop agriculture and private services seem to be the least affected sectors in most countries.

As mentioned above, pressure on the factor markets is focused on labor, so we observe rising wages in all countries. This implies that capital becomes relatively more abundant, and its price (the borrowing rate) falls accordingly in most sectors and for all countries. We observe a few exceptions to this trend, such as industry in Benin and Mali and mining and gas in Uganda. Once again the capital payment rate in the construction sector increases in all countries given the strong pressure from the demand side.

Investment in road infrastructure

For the road investment option, the scenarios do now have production externalities. The first systematic difference from the baseline scenario is that we now observe increases in GDP generated by sector-specific externalities. These add some sectoral variations when compared with the baseline simulations.

Investment funded by foreign aid

In this scenario, we assume that new investment is funded by grants from foreign donors. Table 9 presents the macro results of this investment option and funding scheme:

⁴ Value added and output exhibit the same variation changes because they are linked with a fixed share parameter from the Leontief hypothesis.

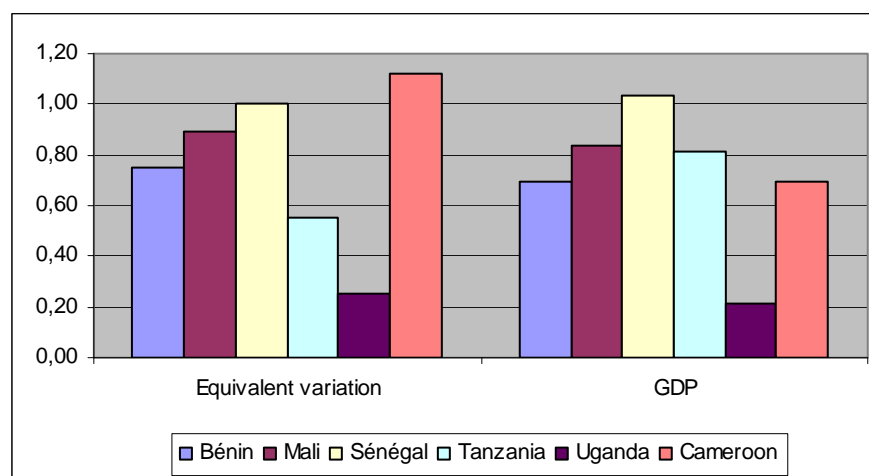
Table 9. Macroeconomic results for road investments, funded by foreign aid

Variables	Definition	Road (foreign aid funded)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.74	0.87	1.01	0.55	0.21	1.07
EV	Equivalent variation	0.75	0.89	1.00	0.55	0.25	1.12
s	Wage	4.88	1.77	2.00	0.82	0.42	1.84
yg	Government income	13.53	2.93	5.43	5.00	2.89	5.85
ye	Firm income	-0.12	0.51	0.69	0.80	-0.05	-0.62
g	Total government expenditure	10.05	1.46	4.52	2.96	2.09	6.11
It	Total private investment	0.17	0.71	0.04	1.31	-3.45	-0.27
e	nominal exchange rate	-4.85	-2.25	-4.24	-1.61	-11.68	-6.31
GDP	GDP	0.69	0.84	1.03	0.81	0.21	0.70

Here we see differences in impact on GDP between countries. In Benin the GDP increases by only 0.69 percent whereas an increase of 1.03 percent is observed for Senegal and 0.84 percent for Mali,⁵ as seen in figure 1.

Once again, the differences are not major, but since behavioral equations and external elasticities are the same, the differences originate in variation between countries in the sectoral structure of GDP. If a sector is larger and it receives a smaller externality, then the country will benefit less than where the larger sector benefits the most

Figure 1. GDP and EV changes for road investments, funded by foreign aid



from road investment increases. Looking at the equivalent variation graphically, we note that the strongest effect is in Cameroon, followed by Senegal. The weakest positive effect is found in Tanzania. In some countries, such as Senegal, the positive impact on households (equivalent variation) is similar to the change in GDP, while it is quite different in others such as Cameroon and Tanzania. As opposed to the baseline scenario, households do not emerge systematically as the winners over firms (that is the case for five of the countries, but in Tanzania firms are the biggest winners). Moreover, in the baseline scenario firms lose to households in all six countries, but in this case, firms increase their revenues in three countries, and in countries where revenue decreases the reductions are smaller than in the baseline case.

⁵ As we have mentioned the investment change simulated in Uganda was one-quarter of what was performed in other countries. The result on GDP for Uganda is around one-quarter of that for Tanzania and Mali.

Although the wage rate does increase in all countries, there are also relatively large differences between countries, ranging from 0.42 percent in Uganda to 4.88 percent in Benin.

Given the superior performance of private firms as well as of households, the economy generates more private savings; accordingly, private investment increases in four countries, decreasing only in Uganda and Cameroon. This funding option, combined with our exogenous current account balance, produced strong pressure on the nominal exchange rate⁶. Because we impose an inflow of funds and the current account balance (CAB) must remain constant, we will need to import more and export less to maintain the CAB constant. An appreciation of the nominal exchange rate leads us to this result. Hence, we observe a decline in the nominal exchange rate in all countries. The importance of the reduction is strongly related to the relative importance of foreign aid needed to fund road construction. This is the case for Uganda, where the nominal exchange rate diminishes by 11.7 percent. Tanzania has the weakest drop at 1.6 percent.

Investment funded by cuts in other public expenditure

In this scenario, road investment is financed by reducing other public expenditures. For example, the government could curtail other services to fund road construction and operation. We have assumed that other curtailed services do not produce externalities (positive or negative). Table 10 presents the macro results for this scenario.

Table 10. Macro results of road investments, funded by reduction of other public expenditure

Variable	Definition	Road (funded by reduction of other public expenditure)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.60	0.76	0.51	0.45	0.16	0.38
EV	Equivalent variation	0.61	0.76	0.50	0.45	0.16	0.38
s	Wage	-3.22	0.76	-0.28	0.57	0.14	0.31
yg	Government income	1.77	0.61	0.84	0.87	0.21	0.69
ye	Firm income	1.20	0.87	1.50	1.13	0.29	1.16
g	Total government expenditure	-9.08	-1.07	-3.85	-2.39	-2.15	-11.79
It	Total private investment	0.79	1.08	1.43	2.51	0.44	2.02
e	Nominal exchange rate	1.10	-0.61	-0.46	0.57	0.23	-0.27
GDP	GDP	0.69	0.84	1.03	0.81	0.21	0.70

The GDP effects are the same as in the previous scenario because the externalities produced are the same. For households, however, we note weaker positive effects on equivalent variations in all countries. The biggest reductions are found for Cameroon (from 1.12 percent to 0.38 percent) and Senegal (from 1.0 percent to 0.5 percent). The other countries experience only slight decreases of the positive effect. Given the reduction in public services, a downward pressure on labor versus the previous simulation takes place; this reduces the positive effect on wages in four countries and reverses the positive effect to a negative effect in Benin and Senegal. When compared to the previous simulation and the baseline case, it is interesting that in all countries firms are clear winners compared to households. This situation also

⁶ If fact, we could use the real exchange rate easily as our price index is exogenous in the model and is fixed at 1.

produced increased private investment in all countries. Tanzania and Cameroon experience the largest increases, of 2.51 percent and 2.02 percent respectively.

We also note a varied effect on the nominal exchange rate, with an appreciation in three countries (Mali, Senegal, and Cameroon) and depreciation in the other three (Benin, Tanzania, and Uganda). This is a consequence of the different import and export structures in the six countries. The sectoral effects are presented in table 11.

Table 11. Sectoral results for road investments, funded by import duties

		Road (reduction of other public expenditure)					
Variable	Sector	Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Va (value added or output)	Crop agriculture	1.03	0.92	0.95	0.83	0.22	1.34
	Export agriculture	1.50	1.37	1.91	1.25	0.36	1.53
	Mining and gas		1.54		1.52	0.09	1.59
	Industries	1.75	0.83	1.75	0.82	0.35	1.18
	Construction		2.25	3.32	2.05	1.66	8.70
	Private services	1.24	0.5	1.19	0.61	-0.01	0.72
	Public services	-7.05	-1.43	-3.46	-2.06	-2.20	-4.25
pq Market prices	Crop agriculture	-0.02	-0.12	-0.24	-0.30	-0.11	-0.36
	Export agriculture	0.03	-0.59	-0.64	-0.70	-0.20	-0.37
	Mining and gas		-0.97		-0.05	0.18	-0.28
	Industries	0.89	-0.36	-0.73	0.19	0.07	0.10
	Construction		0.03	5.71	0.94	0.45	0.16
	Private services	-0.37	0.38	-0.51	0.42	-0.02	0.10
	Public services	-2.19	0.4	-0.41	0.51	0.05	0.24
r Borrowing rate of capital	Crop agriculture	0.98	0.8	0.96	0.46	0.10	0.84
	Export agriculture	1.43	0.71	1.06	0.38	0.14	0.61
	Mining and gas		0.55		-0.08	-1.34	1.21
	Industries	3.26	1.24	0.47	0.91	0.54	1.67
	Construction		2.53	16.23	3.40	2.51	9.51
	Private services	1.34	0.97	0.72	1.02	-0.08	0.84

Our first observation in comparing these results with the baseline case is that all sectors increase output—the direct result of road investment externalities. As we cut other public services to fund the investment, this sector falls in all countries compared with increases for the baseline scenario. To analyze the sectoral effects, one must include the road externality parameters (see appendix). We note that the mining, export agriculture, and construction sectors benefit the most. As other general equilibrium effects are at play, it is not this ranking of the direct effects that dominates the final effect for all the countries. In fact, Benin's industrial sector gains the most. When the construction sector (which, again, benefits from the increased demand created by greater public expenditure) is excluded, export agriculture (Senegal and Uganda) or mining and oil (Mali, Tanzania, and Cameroon) benefit the most.

The crop agriculture and private services sectors profit the least. We also observe a slight reduction in private services in Uganda, the only sector beside public services in any country not increasing output. Both agricultural prices (crop and export) fall in all countries except for Benin's export agriculture (rising

0.03 percent). Export agriculture decreases more than crop agriculture in all countries but Benin. Construction prices increase due to demand pressure from the increase in investment but other prices do not follow a specific trend. Given the positive externality effects, most capital payment rates increase in all countries. The only exceptions are mining and oil in Tanzania (−0.08 percent) and Uganda (−1.34 percent), and private services (−0.08 percent) in Uganda.

Investment in electricity infrastructure

In this section, we analyze investment in electricity infrastructure. The main characteristic here vis-à-vis road infrastructure is that, in terms of externalities, industries are the main winners, followed by the construction and mining/oil sectors. Moreover, the operating costs of electricity infrastructure versus road infrastructure are 7 percent higher, which requires more funding to be sustained.

Investment funded by the value added tax

The first funding option analyzed for electricity infrastructure investment is the value added tax (VAT). This funding option was also used for the nonproductive investment scenario. We present the macro results in table 12.

Table 12. Macro results of electricity investments, funded by VAT

Variable	Definition	Electricity (VAT funded)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0,70	0,59	0,91	0,49	0,16	0,90
EV	Equivalent variation	0,62	0,57	0,84	0,47	0,16	0,83
s	Wage	4,18	0,83	2,02	0,74	0,27	1,40
yg	Government income	13,97	3,03	5,61	5,17	2,98	6,04
ye	Firm income	−0,04	0,56	0,41	0,69	0,06	0,10
g	Total government expenditure	10,77	1,56	4,84	3,17	2,24	6,54
It	Total private investment	0,61	0,73	0,41	1,72	0,16	0,65
e	Nominal exchange rate	1,43	0,58	0,11	0,48	0,05	0,28
GDP	GDP	0,66	0,63	0,83	0,72	0,18	0,80

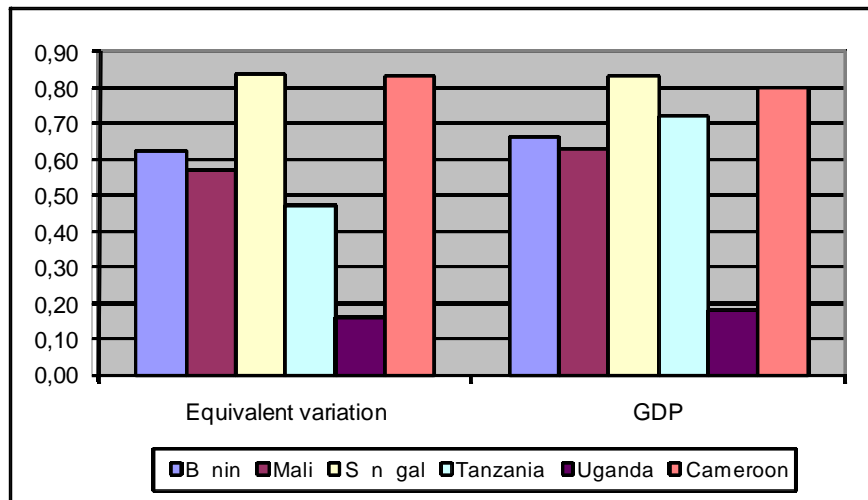
This is an interesting scenario to compare with the baseline case because the funding mechanism used is the same. Before moving to a comparative analysis, however, we compare GDP growth with the previous scenario. For this comparison, see the changes in GDP in figure 2.

In this case, we have Senegal benefiting the most, followed by Cameroon. The ranking is quite different, arising from structural differences between economies and from the externalities of electricity investments. As with the previous simulation, the country differences are relatively small, from 0.63 percent in Mali to 0.83 percent in Senegal. In the case of road investment, household gains were not systematically lower than GDP growth. In fact in three countries it was the opposite. In the case of electricity GDP growth dominates household gains with the exception of Cameroon and Senegal where the gap is very small (less than 0.03 percent in both countries). Another change is that households gain more than firms in five of six countries. The only exception is Tanzania, where firm income increased by

0.69 percent compared to 0.49 percent for households. There is even a negative impact on firm income for Benin. Because there are positive externalities, all agents in all countries gain compared to the nonexternality option. Given the positive effect on firm income in most countries and on household income, there is an increase in private savings and consequently in total private investment for all countries. The strongest increase is in Tanzania (1.72 percent) and the weakest in Senegal (0.41 percent). The replacement effect described in the nonproductive investment scenario is completely eliminated by externality effects. We did not get as clear an effect in the two funding scenarios for road investment as for electricity investment.

The impact on wages is similar in intensity to the baseline and in country ranking. In some cases the impact is larger here and in other cases the change in wage rate was larger for the nonproductive investment case. We still observe relatively large differences in wage rate changes, from the largest change for Benin with 4.18 percent to only 0.74 percent for Tanzania.

Figure 2. GDP and EV changes for electricity investments, funded by VAT



We observe an increase in the nominal exchange rate, favoring an increase exports and a reduction of imports to clear the current account balance. While it is positive for all countries, the strongest effect on the nominal exchange rate is in Benin (1.43 percent) and the weakest in Mali (0.63 percent). We present the sectoral effect of the electricity investment with the VAT funding option in table 13.

In light of these results, we can see that the elasticity of externalities does not play a dominant role in affecting sectors in the six countries; these are the same as in the baseline case. As in the previous simulation, we would expect the construction sector to do best because it profits from the strong increase in demand and from its favorable ranking in terms of externality of electricity investment. We observe this in all countries except Uganda, where the biggest winner is public services (the operational cost increase accounts for this). It is also surprising that industry in Senegal and in Uganda shows subsiding output. This decrease can be explained by the fact that in these two countries the VAT is much higher on the goods produced by this sector than in the other sectors. It is also interesting (but not surprising) that crop agriculture output falls or is constant in all countries, while export agriculture jumps slightly in Benin (+0.24 percent) and in Cameroon (+0.43 percent). This is due to low electricity externalities.

With the exception of private services in Senegal and Tanzania, almost all market prices jump. These upswings dampen the effects of higher wages on household welfare in every country studied. Comparisons of the ranking of market-price effects across countries do not reveal any particular trend.

Table 13. Sectoral results for electricity investments, VAT funded

Variable	Sector	Electricity (VAT funded)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Va (value added or output)	Crop agriculture	-0.06	0.01	0.00	-0.07	-0.04	-0.27
	Export agriculture	0.24	0.27	-0.15	0.15	-0.06	0.43
	Mining and gas		0.41		0.38	0.07	0.34
	Industries	1.18	1.17	-0.31	0.93	-0.17	0.68
	Construction		1.65	3.56	2.26	1.29	7.03
	Private services	-0.05	0.88	0.91	0.94	0.14	0.49
	Public services	6.96	1.03	3.51	1.85	1.88	3.61
pq Market prices	Crop agriculture	1.22	0.69	0.76	0.75	0.25	1.22
	Export agriculture	2.60	0.45	0.54	0.54	0.15	1.41
	Mining and gas		0.93		0.80	0.20	0.46
	Industries	1.77	0.26	1.54	0.19	0.76	1.44
	Construction		0.34	4.89	0.63	0.73	1.37
	Private services	2.37	0.01	-0.72	-0.15	0.35	0.78
	Public services	3.56	0.50	1.29	0.53	0.35	1.34
r Borrowing rate of capital	Crop agriculture	1.12	0.74	1.20	0.62	0.19	1.03
	Export agriculture	2.92	0.72	0.92	0.56	-0.01	1.72
	Mining and gas		1.27		0.99	0.15	0.45
	Industries	0.21	-0.86	-0.76	-0.99	-1.13	-1.47
	Construction		1.21	12.48	3.14	1.84	8.21
	Private services	-2.17	0.26	-0.64	0.56	0.06	0.35

With the exception of Benin, we note a dwindling capital payment rate for industry when excluding the construction sector. In Benin and Senegal, capital payment rates decline for private services. But all others rise or remain steady. The largest increases are seen in the two agricultural sectors and in mining and gas for all countries—again, excluding the construction sector.

Electricity investment funded by income tax

In this section, we compare the second funding option for electricity investments. This is the first scenario in which we fund investment with a household income tax increase. We would expect this option to be least favorable to households (as opposed to firms) at least in aggregate terms. This is because households fund these investments through higher taxes. At least this is the partial equilibrium we would achieve. But since we are working in a general equilibrium context the outcome might be different because price and income effects are taken into account, and in the VAT option, consumers face higher prices, which also impairs their welfare. The macro results are presented in table 14.

Here we compare the income tax funding scenario with the VAT option. Starting with the equivalent variation, we compare the results with what we estimated would happen. The household impact is almost identical to the VAT option in all countries. We observe minuscule differences in four countries where the income tax option is more favorable—by 0.02 percent in Benin, Mali, and Tanzania, and by 0.07 percent in Cameroon. (These figures represent the gap between the income tax funding option and the VAT funding option; thus they do not appear directly in the table above.) The impact on GDP is identical

for all countries. The change in wage rate is stronger in all countries except Senegal, where the effect is only slightly less than in the VAT case. The effect on firms' income is also quite similar, although the situation reverses for Cameroon, which falls from a +0.1 percent to -0.11 percent.

Table 14. Macro results of electricity investments, funded by income tax

Variables	Definition	Electricity (income tax funded)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.70	0.61	0.90	0.50	0.16	0.99
EV	Equivalent variation	0.64	0.59	0.84	0.49	0.16	0.90
S	Wage	4.52	0.99	2.00	0.77	0.28	1.59
Yg	Government income	13.97	3.03	5.61	5.17	2.98	6.04
Ye	Firm income	-0.10	0.50	0.41	0.65	0.06	-0.11
G	Total government expenditure	10.77	1.56	4.84	3.17	2.24	6.54
It	Total private investment	0.42	0.67	0.23	1.40	-0.45	0.40
E	Nominal exchange rate	-1.13	0.06	-1.09	-0.34	-1.96	0.80
GDP	GDP	0.67	0.63	0.83	0.72	0.18	0.80

The strongest effects on the macro variable are on the nominal exchange rates. Previously all rates rose, but here they plummet in four countries. Uganda presents the starkest decrease, going from a 0.05 percent increase to a drop of 1.96 percent. Also, total investment in Uganda dwindled to -0.45 percent from what had been a positive effect of 0.16 percent. Overall, this funding option strongly resembles the VAT option, with the greatest difference found in the nominal exchange rates. The policymaker could therefore choose either option without creating major differentiated effects, at least at the macro level.

The investment in telecom infrastructure

For our final investment option, we analyze telecom infrastructure investment. Here we analyze the foreign aid and import duties funding options. As shown in the elasticity table (see appendix), the two service sectors and the construction sector benefit the most. The two agricultural sectors also profit, followed by industries and mining/gas.

Investment funded by foreign aid

We focus our comparative analysis here on the baseline and on road investment, as this option was also funded with foreign aid. The macro results are presented in table 15.

This simulation provides an interesting result. The impact on GDP is almost identical for all countries. The lower scale of the Uganda simulation aside, results range from a low 0.42 percent increase in Cameroon to a high of 0.55 percent in Senegal. This is the most minimal country difference in all of the simulations analyzed thus far. The effects are similar for household impact, although they are more differentiated than that observed for GDP (figure 3). Cameroon is the only exception to these similar results, with a positive effect on households twice as large as the GDP increase.

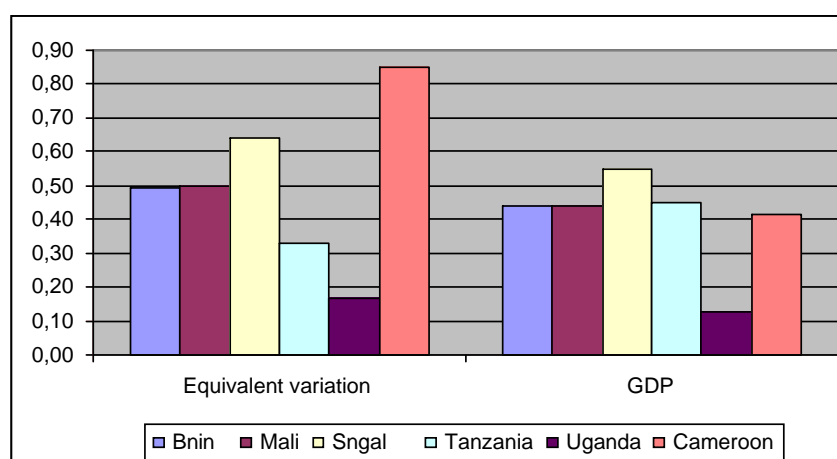
Table 15. Macro results of telecom investments, funded by foreign aid

Variable	Definition	Telecom (funded by foreign aid)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.49	0.50	0.65	0.32	0.14	0.82
EV	Equivalent variation	0.49	0.50	0.64	0.33	0.17	0.85
s	Wage	4.15	1.26	1.55	0.51	0.32	1.50
yg	Government income	12.79	2.77	5.13	4.73	2.73	5.53
ye	Firm income	-0.25	0.15	0.19	0.37	-0.11	-0.83
g	Total government expenditure	8.85	1.28	3.98	2.61	1.84	5.38
It	Total private investment	-0.05	0.26	-0.45	0.30	-3.46	-0.76
e	Nominal exchange rate	-4.96	-1.39	-4.27	-1.87	-11.38	-5.51
GDP	GDP	0.44	0.44	0.55	0.45	0.13	0.42

As in other simulations, the wage rate change is strongest in Benin (4.15 percent) and weakest in Tanzania (0.51 percent). For all countries except Tanzania, the household impact is more favorable than the impact on firms.

For road investment funded by foreign aid, we observe an important currency appreciation (or a reduction in the nominal exchange rate) in all countries. In fact, the impact on the nominal exchange rate is almost the same in four countries and is slightly lower for Mali (-1.39 percent compared with -2.25 percent for road investment) and for Cameroon (-5.51 percent compared with -6.31 percent for road investment).

Figure 3. GDP and EV changes for telecom investments, funded by foreign aid



We note that sectoral effects vary greatly between countries while the impact on GDP shows changes that are almost identical (table 16). With the exception of Tanzania, all countries have two sectors that cut production. Moreover, the country ranked effects are completely different. We therefore cannot discuss specific trends at the sectoral output level for this scenario.

Table 16. Sectoral results for telecom investments, funded by foreign aid

		Telecom (foreign aid)					
Variable	Sector	Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Va (value added or output)	Crop agriculture	0.26	0.28	0.37	0.20	0.08	-0.43
	Export agriculture	0.34	0.37	-0.22	0.04	-0.40	-0.07
	Mining and gas		-0.06		0.29	0.92	0.04
	Industries	-1.64	0.39	-0.53	0.44	-1.33	0.18
	Construction		1.59	2.56	0.93	1.92	7.75
	Private services	-0.48	0.46	0.38	0.51	0.04	0.03
	Public services	2.62	0.79	3.59	1.70	3.65	3.17
pq Market prices	Crop agriculture	-0.30	0.19	-0.78	0.07	-0.15	0.68
	Export agriculture	-0.55	-0.23	-0.66	0.07	-0.46	0.80
	Mining and gas		-0.34		-1.06	-9.60	-5.42
	Industries	0.51	-0.83	-1.79	-0.51	-4.39	-0.68
	Construction		-0.04	5.41	-0.03	-1.52	-0.17
	Private services	-0.56	-0.03	-1.26	-0.31	-1.82	0.10
	Public services	6.07	0.47	0.38	0.23	-1.74	0.93
r Borrowing rate of capital	Crop agriculture	0.04	0.55	1.68	0.29	0.28	0.48
	Export agriculture	-0.38	-0.18	-0.19	-0.14	-0.76	0.44
	Mining and gas		-2.09		0.74	4.32	-6.75
	Industries	5.60	1.59	-1.77	0.84	-2.67	1.25
	Construction		2.37	15.80	0.80	3.23	9.90
	Private services	-3.02	0.50	-0.98	0.13	0.10	0.25

We observe that most prices drop in all countries. This phenomenon occurs in contrast to the options for which taxes funded the investment. The price effects are starkly different for the six countries. For Benin the biggest decrease is in private services; for Mali and Senegal it is in industries; and for Tanzania, Cameroon, and Uganda it is in mining and gas. Crop agriculture and export agriculture prices fall in Benin, Senegal, and Uganda, whereas in Cameroon and Tanzania they rise. But in Mali the crop agriculture price rises while that for export agriculture falls. The price effects are felt most dramatically in Uganda, where vast amounts of foreign aid places strong pressure on the exchange rate and other prices.

Finally, capital payment rates follow the same trend as other sectoral variables for this simulation; no specific trend is observed on the ranked effects. We note, however, that all rates rise for crop agriculture while export agriculture prices fall in five of six countries. Cameroon is the lone exception, showing 0.44 percent growth. As in other simulations, the capital payment rate in Senegal ballooned for the construction sector, rising 15.8 percent; in Cameroon it grew 9.9 percent. The capital payment rates in Tanzania are all below 1 percent; the steepest rise was in industries at 0.84 percent.

Investment funded by import duties

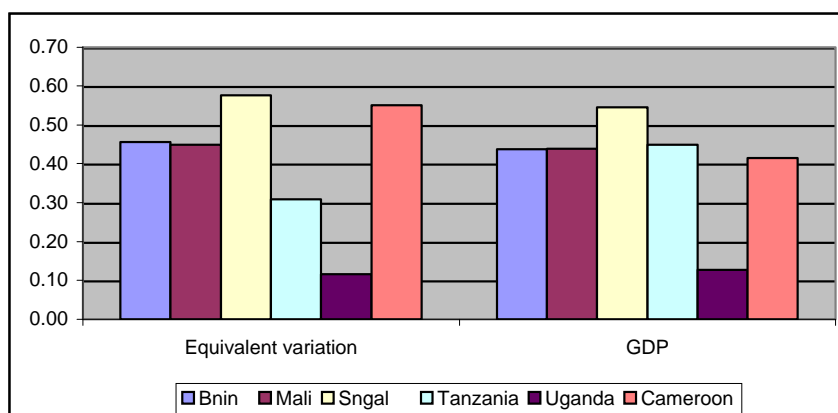
Our final simulation analyzes investment in telecom infrastructure funded by import duties (table 17), which we compare with the baseline scenario, also funded by import duties.

Table 17. Macro results of telecom investments, funded by import duties

Variable	Definition	Telecom (funded Import duties)					
		Benin	Mali	Senegal	Tanzania	Uganda	Cameroon
Ym	Aggregate household income	0.48	0.46	0.62	0.31	0.12	0.60
EV	Equivalent variation	0.46	0.45	0.58	0.31	0.12	0.55
s	Wage	3.88	0.94	1.45	0.49	0.21	1.01
yg	Government income	12.79	2.77	5.13	4.73	2.73	5.53
ye	Firm income	-0.21	0.26	0.22	0.40	0.03	-0.27
g	Total government expenditure	8.85	1.28	3.98	2.61	1.84	5.38
It	Total private investment	0.24	0.38	0.05	0.73	-0.44	-0.07
e	Nominal exchange rate	-0.95	-0.32	-1.10	-0.64	-1.75	-1.55
GDP	GDP	0.44	0.44	0.55	0.45	0.13	0.41

The impact of this type of funding on GDP is almost identical for all countries, as also found in the previous two simulations. For the foreign aid-funded telecom infrastructure investment, households improve their situation in contrast to the reference period baseline scenario; the greatest effects are seen for Senegal and for Cameroon. This differs from the foreign aid case, where Cameroon was the most affected. When funded by foreign aid, the positive effect is stronger for households in all six countries. The country rankings are the same as in the previous simulation.

Figure 4. GDP and EV changes for telecom investments, funded by import duties



The impact on wages here is weaker than in the foreign aid-funded case, and the country rankings remain the same. The effect is greater for firms than for households; the situation is better in all countries than in the foreign aid-funded option. Households win over firms in all countries but Tanzania. In the foreign aid-funded option, investment increased slightly in only two countries, Mali (0.26 percent) and Tanzania (0.3 percent). But for the import duties funding option we observe investment growth in four countries while it plunges in Uganda and Cameroon, which suffered less negative investment with the foreign aid funding option.

Finally, in this case the nominal exchange rate is not under as much pressure as in the previous case; changes are all below 2 percent. The steepest drop is in Uganda (-1.75 percent) and in Cameroon (-1.55 percent). We observe declines in the nominal exchange rate for all six countries.

General comparative analysis

To summarize our comparative analyses, most simulations produce similar qualitative and quantitative effects on some macro variables in some cases (such as in telecom investment). These similar cases were more the exception, however, than the rule—and for road and electricity investment, we observe relatively large differences quantitatively, with some qualitative differences at the macro level.

An interesting conclusion is that the sectoral analysis reveals disparities between countries and between types of investment. Given the identical behavioral equations and elasticities in the models, the differences were greater than expected. The only variance in the models was found in country economic structure, which played an important role in the final results.

The results also showed that general equilibrium effects are important to consider because price effects often dominate income effects vis-à-vis changes in household welfare. We also have cases where firms won over households and others where the situation was reversed. The two options were often observed for the same simulation and Tanzania often emerged as an exception.

7 Conclusion

This ambitious modeling exercise has allowed us to analyze the impact of scaling up infrastructure investment in six African countries, each with different economic structures. Different economic structures produced diverse results for identical investments funded by the same sources within the same model. Therefore, the structure of the economy where these policies will be applied needs to be taken into account. Our analysis also shows that even with a relatively aggregated production structure in the models, we do not have sectors so clear-cut that they can be classified as tradable and nontradable. One often finds in the literature that production sectors such as export agriculture are classified as tradable, but our figures reveal that most of the production in this sector is destined to local industries that will eventually export a transformed product. We also have a construction sector in Tanzania that is tradable whereas it is nontradable in other countries. This is certainly at the root of the unique results for this country.

Another important conclusion is that if the current account needs to be balanced, then funding investment through foreign aid produces the strongest sectoral effects. This is because strong price and nominal exchange rate adjustments are needed to clear the current account balance. The sectoral effects are strongly influenced by the structure of imports and exports observed in each country, as well as by the size of the inflow of funds required to finance public infrastructure. It is therefore important to analyze such reforms in as disaggregated a model as possible, and to fully take into account the structural characteristics of the country. An important structural characteristic is the capital/labor ratio in different productive sectors. This plays an important role in determining the winners and losers as relative effects on factor payments are strongly related to capital/labor ratios.

An important caveat should be added to our findings: The characteristics of the different sectors in terms of export behavior and preferences between imports and locally produced goods are likely to vary from one country to another. We assumed for the sake of comparative analysis that these were the same.

Relaxing this hypothesis would certainly have amplified the country differences we observed in our models. A good illustration of this is the preference of national consumers for either imported or locally produced rice. In certain countries, consumers have a strong preference for Asian-produced rice (Senegal); in others they prefer locally produced rice (Mali). On the export side, a landlocked country will have a smaller export CET elasticity than a coastal country with good port and airport infrastructure. These differences could be quite large. It is much more difficult for a landlocked country to export perishable agricultural products than for a coastal country near large markets.

Adding these assumptions into the analysis would only have enriched the conclusions stated here and would reinforce the caveat of using aggregated models that distinguish only two or three sectors such as tradable and nontradable sectors. On the other hand, the comparative analysis would have been more difficult with these differences in the models.

8 References

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Appendix A Externality parameter

Externality elasticities by sector

Sector	Externality elasticities			
	Nonproductive	Road	Electricity	Telecom
Crop agriculture	0.000	0.050	0.001	0.020
Export agriculture	0.000	0.075	0.015	0.025
Mining and gas	0.000	0.085	0.020	0.015
Industries	0.000	0.035	0.100	0.015
Construction	0.000	0.055	0.075	0.045
Private services	0.000	0.025	0.055	0.035
Public services	0.000	0.050	0.050	0.050

Appendix B Complete country-specific results

Benin > Nonproductive investments > Macro results

Variable	Definition	Reference	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,250,000.00	0.02	0.09	0.10	0.02	-0.06
EV	Equivalent variation		0.02	0.09	0.09	0.02	-0.06
s	Wage	1.00	0.98	4.42	4.81	0.98	-4.22
yg	Government income	214,000.00	8.75	14.70	14.70	8.75	1.14
g	Total government expenditure	132,000.00	2.28	11.96	11.96	2.28	-10.12
ye	Firm income	135,000.00	-0.16	-0.71	-0.77	-0.16	0.70
It	Total private investment	463,000.00	-0.23	0.04	-0.18	-0.23	0.17
GDP	GDP	1,320,000.00	0.00	-0.02	-0.01	0.00	-0.01
e	Nominal exchange rate	1.00	-2.92	1.69	-1.20	-2.92	0.89

Benin > Nonproductive investments > Sectoral results

Variable	Sector	Base	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	461,000.00	-0.03	-0.12	-0.14	-0.03	0.13
	Export agriculture	95,000.00	-0.01	-0.13	-0.19	-0.01	0.18
	Industries	190,000.00	0.48	-0.31	-0.65	0.48	1.05
	Private services	477,000.00	-0.51	-1.29	-1.10	-0.51	0.84
	Public services	93,400.00	1.75	7.71	7.60	1.75	-7.39
pq Market prices	Crop agriculture	1.01	-0.14	0.28	0.25	-0.14	0.25
	Export agriculture	1.00	0.53	0.00	-1.08	0.53	2.01
	Industries	1.10	-0.78	2.49	3.38	-0.78	0.85
	Private services	1.06	-0.36	3.15	0.80	-0.36	-0.61
	Public services	1.00	0.52	3.95	4.05	0.52	-2.94
r Rental rate of capital	Crop agriculture	1.00	-0.12	0.08	-0.49	-0.12	0.36
	Export agriculture	1.00	0.50	-0.61	-2.42	0.50	2.38
	Industries	1.00	3.88	2.53	0.86	3.88	1.92
	Private services	1.00	-2.06	-3.37	-1.85	-2.06	0.66

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Benin > Road investments > Macro results

Variable	Definition	Reference	Roads (percent variation)				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,250,000.00	0.60	0.73	0.73	0.74	0.74
EV	Equivalent variation		0.61	0.68	0.69	0.75	-1.53
s	Wage	1.00	-3.22	4.27	4.60	4.88	5.33
yg	Government income	214,000.00	1.77	13.53	13.53	13.53	13.53
g	Total government expenditure	132,000.00	-9.08	10.05	10.05	10.05	10.05
ye	Firm income	135,000.00	1.20	-0.03	-0.09	-0.12	-0.21
It	Total private investment	463,000.00	0.79	0.66	0.47	0.17	-1.12
GDP	GDP	1,320,000.00	0.67	0.66	0.67	0.66	0.67
e	Nominal exchange rate	1.00	1.10	1.79	-0.69	-4.85	0.79

Benin > Road investments > Sectoral results

Variable	Sector	Base	Roads				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	461,000.00	1.03	0.82	0.80	0.79	0.74
	Export agriculture	95,000.00	1.50	1.24	1.19	1.21	1.16
	Industries	190,000.00	1.75	0.56	0.26	0.87	0.47
	Private services	477,000.00	1.24	-0.61	-0.44	-0.83	-0.46
	Public services	93400.00	-7.05	6.05	5.96	6.64	5.94
pq Market prices	Crop agriculture	1.01	-0.02	0.00	-0.03	-0.61	-1.97
	Export agriculture	1.00	0.03	-1.65	-2.56	-2.17	-3.34
	Industries	1.10	0.89	2.30	3.06	-1.68	0.66
	Private services	1.06	-0.37	2.87	0.85	-0.01	-0.09
	Public services	1.00	-2.19	3.77	3.86	3.20	3.88
r Rental rate of capital	Crop agriculture	1.00	0.98	0.73	0.23	0.25	-1.33
	Export agriculture	1.00	1.43	-1.11	-2.68	-1.39	-2.81
	Industries	1.00	3.26	3.77	2.29	6.29	4.28
	Private services	1.00	1.34	-2.16	-0.84	-2.88	-0.24

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Benin > Electricity investments > Macro results

Variable	Definition	Reference	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,250,000.00	0.95	0.70	0.70	0.72	0.72
EV	Equivalent variation		0.93	0.62	0.64	0.70	-1.56
s	Wage	1.00	12.88	4.18	4.52	4.81	5.30
yg	Government income	214,000.00	25.13	13.97	13.97	13.97	13.97
g	Total government expenditure	132,000.00	28.93	10.77	10.77	10.77	10.77
ye	Firm income	135,000.00	-1.36	-0.04	-0.10	-0.14	-0.22
It	Total private investment	463,000.00	-0.45	0.61	0.42	0.11	-1.22
GDP	GDP	1,320,000.00	0.54	0.64	0.64	0.64	0.64
e	Nominal exchange rate	1.00	-11.79	1.43	-1.13	-5.44	0.41

Benin > Electricity investments > Sectoral results

Variable	Sector	Base	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	461,000.00	-0.31	-0.06	-0.09	-0.09	-0.15
	Export agriculture	95,000.00	-0.04	0.24	0.19	0.22	0.17
	Industries	190,000.00	0.77	1.18	0.86	1.51	1.09
	Private services	477,000.00	-2.25	-0.05	0.12	-0.28	0.11
	Public services	93,400.00	19.10	6.96	6.86	7.58	6.83
pq Market prices	Crop agriculture	1.01	0.05	1.22	1.19	0.59	-0.83
	Export agriculture	1.00	0.08	2.60	1.59	2.11	0.80
	Industries	1.10	-5.21	1.77	2.56	-2.35	0.09
	Private services	1.06	-0.42	2.37	0.30	-0.59	-0.66
	Public services	1.00	8.25	3.56	3.66	2.96	3.69
r Rental rate of capital	Crop agriculture	1.00	0.04	1.12	0.61	0.64	-1.01
	Export agriculture	1.00	0.19	2.92	1.25	2.72	1.12
	Industries	1.00	6.03	0.21	-1.28	2.78	0.80
	Private services	1.00	-7.12	-2.17	-0.80	-2.92	-0.17

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Benin > Telecom investments > Macro results

Variable	Definition	Reference	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,250,000.00	0.36	0.48	0.48	0.49	0.50
EV	Equivalent variation		0.36	0.44	0.46	0.49	-1.68
s	Wage	1.00	-3.65	3.56	3.88	4.15	4.59
yg	Government income	214,000.00	1.45	12.79	12.79	12.79	12.79
g	Total government expenditure	132,000.00	-9.60	8.85	8.85	8.85	8.85
ye	Firm income	135,000.00	1.03	-0.15	-0.21	-0.25	-0.32
It	Total private investment	463,000.00	0.55	0.43	0.24	-0.05	-1.28
GDP	GDP	1,320,000.00	0.42	0.42	0.42	0.42	0.42
e	Nominal exchange rate	1.00	0.78	1.45	-0.95	-4.96	0.49

Benin > Telecom investments > Sectoral results

Variable	Sector	Base	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	461,000.00	0.49	0.28	0.26	0.26	0.20
	Export agriculture	95,000.00	0.62	0.36	0.31	0.34	0.29
	Industries	190,000.00	1.35	0.21	-0.07	0.51	0.12
	Private services	477,000.00	1.45	-0.34	-0.18	-0.56	-0.19
	Public services	93,400.00	-7.22	5.50	5.41	6.07	5.39
pq (Market prices)	Crop agriculture	1.01	0.27	0.29	0.26	-0.30	-1.61
	Export agriculture	1.00	1.61	-0.06	-0.96	-0.55	-1.71
	Industries	1.10	0.84	2.21	2.94	-1.64	0.63
	Private services	1.06	-0.83	2.28	0.35	-0.48	-0.55
	Public services	1.00	-2.57	3.18	3.27	2.62	3.29
r Rental rate of capital	Crop agriculture	1.00	0.74	0.50	0.02	0.04	-1.48
	Export agriculture	1.00	2.36	-0.14	-1.65	-0.38	-1.80
	Industries	1.00	2.65	3.17	1.76	5.60	3.67
	Private services	1.00	1.06	-2.32	-1.05	-3.02	-0.46

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Mali > Nonproductive investments > Macro results

Variable	Definition	Reference	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,480,726.40	-0.02	0.06	0.08	0.14	0.09
EV	Equivalent variation		-0.02	0.06	0.08	0.14	-0.55
s	Wage	1.00	-0.20	0.49	0.72	1.18	0.76
yg	Government income	278,133.30	0.10	3.19	3.19	3.19	3.19
g	Total government expenditure	255,957.00	-1.62	1.73	1.73	1.73	1.73
ye	Firm income	477,113.00	0.07	-0.18	-0.26	-0.42	-0.27
It	Total private investment	439,511.00	0.07	-0.17	-0.25	-0.42	-0.42
GDP	GDP	1,819,413.40	0.00	0.00	0.00	0.00	0.00
e	Nominal exchange rate	1.00	0.07	0.03	-0.70	-2.19	-0.19

Mali > Nonproductive investments > Sectoral results

Variable	Sector	Base	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	379,937.10	0.03	-0.05	-0.08	-0.12	-0.15
	Export agriculture	297,375.30	0.01	-0.04	-0.07	-0.13	-0.08
	Mining and gas	206,350.40	0.03	-0.08	-0.25	-0.48	-0.12
	Industries	167,281.20	0.09	-0.21	-0.15	0.02	-0.25
	Construction	116,213.20	1.24	0.24	0.47	0.85	0.62
	Private services	516,027.70	0.04	-0.21	-0.14	-0.20	-0.20
	Public services	136,228.50	-1.49	1.20	1.09	1.31	1.29
pq (Market prices)	Crop agriculture	1.01	0.01	0.12	0.18	0.17	-0.34
	Export agriculture	1.02	0.00	0.07	0.00	-0.33	-0.40
	Mining and gas	1.00	0.09	-0.10	-0.31	-0.85	-0.33
	Industries	1.17	0.04	0.37	0.65	-1.37	-0.07
	Construction	1.02	0.11	0.97	0.65	0.09	0.32
	Private services	1.03	-0.05	0.62	0.35	0.33	0.06
	Public services	1.00	-0.11	0.49	0.61	0.38	0.39
r Rental rate of capital	Crop agriculture	1.00	0.04	0.04	0.01	0.15	-0.52
	Export agriculture	1.00	0.03	-0.12	-0.44	-0.96	-0.46
	Mining and gas	1.00	0.15	-0.37	-1.83	-3.67	-0.43
	Industries	1.00	0.03	-0.04	0.32	1.24	0.11
	Construction	1.00	1.56	0.83	1.39	2.40	1.65
	Private services	1.00	-0.02	-0.43	0.09	0.32	-0.13

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Mali > Road investments > Macro results

Variable	Definition	Reference	Roads (% variation)				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,480,726.40	0.76	0.82	0.83	0.87	0.84
EV	Equivalent variation		0.76	0.81	0.83	0.90	0.37
s	Wage	1.00	0.76	1.29	1.45	1.80	1.49
yg	Government income	278,133.30	0.61	2.93	2.93	2.93	2.93
g	Total government expenditure	255,957.00	-1.07	1.46	1.46	1.46	1.46
ye	Firm income	477,113.00	0.87	0.68	0.62	0.50	0.61
It	Total private investment	439,511.00	1.08	0.90	0.83	0.70	0.71
GDP	GDP	1,819,413.40	0.85	0.85	0.85	0.84	0.85
e	Nominal exchange rate	1.00	-0.61	-0.64	-1.19	-2.29	-0.81

Mali > Road investments > Sectoral results

Variable	Sector	Base	Roads				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	379,937.10	0.92	0.86	0.84	0.81	0.79
	Export agriculture	297,375.30	1.37	1.33	1.31	1.26	1.30
	Mining and gas	206,350.40	1.54	1.45	1.32	1.15	1.42
	Industries	167,281.20	0.83	0.60	0.64	0.77	0.57
	Construction	116,213.20	2.25	1.49	1.67	1.95	1.78
	Private services	516,027.70	0.50	0.32	0.37	0.33	0.32
	Public services	136,228.50	-1.43	0.59	0.50	0.67	0.65
pq (Market prices)	Crop agriculture	1.01	-0.12	-0.04	0.00	-0.01	-0.39
	Export agriculture	1.02	-0.59	-0.54	-0.59	-0.83	-0.88
	Mining and gas	1.00	-0.97	-1.11	-1.27	-1.66	-1.28
	Industries	1.17	-0.36	-0.11	0.09	-1.41	-0.44
	Construction	1.02	0.03	0.67	0.42	0.01	0.18
	Private services	1.03	0.38	0.88	0.67	0.66	0.46
	Public services	1.00	0.40	0.85	0.94	0.77	0.78
r Rental rate of capital	Crop agriculture	1.00	0.80	0.80	0.77	0.87	0.38
	Export agriculture	1.00	0.71	0.59	0.35	-0.04	0.34
	Mining and gas	1.00	0.55	0.16	-0.95	-2.33	0.11
	Industries	1.00	1.24	1.19	1.46	2.14	1.30
	Construction	1.00	2.53	1.98	2.40	3.15	2.59
	Private services	1.00	0.97	0.66	1.05	1.22	0.88

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Mali > Electricity investments > Macro results

Variable	Definition	Reference	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,480,726.40	0.53	0.59	0.61	0.65	0.62
EV	Equivalent variation		0.53	0.57	0.59	0.65	0.16
s	Wage	1.00	0.32	0.83	0.99	1.32	1.02
yg	Government income	278,133.30	0.81	3.03	3.03	3.03	3.03
g	Total government expenditure	255,957.00	-0.85	1.56	1.56	1.56	1.56
ye	Firm income	477,113.00	0.74	0.56	0.50	0.38	0.49
It	Total private investment	439,511.00	0.90	0.73	0.67	0.55	0.54
GDP	GDP	1,819,413.40	0.63	0.63	0.63	0.63	0.63
e	Nominal exchange rate	1.00	0.61	0.58	0.06	-1.00	0.42

Mali > Electricity investments > Sectoral results

Variable	Sector	Base	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	379,937.10	0.07	0.01	-0.01	-0.04	-0.06
	Export agriculture	297,375.30	0.31	0.27	0.24	0.20	0.24
	Mining and gas	206,350.40	0.50	0.41	0.29	0.13	0.39
	Industries	167,281.20	1.39	1.17	1.21	1.34	1.14
	Construction	116,213.20	2.38	1.65	1.82	2.10	1.93
	Private services	516,027.70	1.06	0.88	0.93	0.89	0.88
	Public services	136,228.50	-0.90	1.03	0.95	1.11	1.10
pq Market prices	Crop agriculture	1.01	0.61	0.69	0.73	0.73	0.35
	Export agriculture	1.02	0.40	0.45	0.40	0.17	0.12
	Mining and gas	1.00	1.07	0.93	0.78	0.40	0.77
	Industries	1.17	0.02	0.26	0.46	-0.97	-0.06
	Construction	1.02	-0.27	0.34	0.11	-0.28	-0.12
	Private services	1.03	-0.46	0.01	-0.18	-0.19	-0.38
	Public services	1.00	0.07	0.50	0.59	0.43	0.43
r Rental rate of capital	Crop agriculture	1.00	0.74	0.74	0.71	0.82	0.34
	Export agriculture	1.00	0.83	0.72	0.50	0.12	0.48
	Mining and gas	1.00	1.65	1.27	0.23	-1.09	1.23
	Industries	1.00	-0.81	-0.86	-0.60	0.05	-0.75
	Construction	1.00	1.73	1.21	1.61	2.34	1.80
	Private services	1.00	0.56	0.26	0.64	0.80	0.48

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Mali > Telecom investments > Macro results

Variable	Definition	Reference	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,480,726.40	0.38	0.44	0.46	0.50	0.46
EV	Equivalent variation		0.38	0.43	0.45	0.50	-0.01
s	Wage	1.00	0.26	0.77	0.94	1.28	0.97
yg	Government income	278,133.30	0.50	2.77	2.77	2.77	2.77
g	Total government expenditure	255,957.00	-1.19	1.28	1.28	1.28	1.28
ye	Firm income	477,113.00	0.51	0.32	0.26	0.14	0.25
It	Total private investment	439,511.00	0.62	0.44	0.38	0.25	0.25
GDP	GDP	1,819,413.40	0.44	0.44	0.44	0.44	0.44
e	Nominal exchange rate	1.00	0.24	0.21	-0.32	-1.41	0.05

Mali > Telecom investments > Sectoral results

Variable	Sector	Base	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	379,937.10	0.39	0.33	0.31	0.28	0.26
	Export agriculture	297,375.30	0.48	0.44	0.41	0.37	0.41
	Mining and gas	206,350.40	0.32	0.23	0.11	-0.06	0.21
	Industries	167,281.20	0.44	0.22	0.26	0.39	0.19
	Construction	116,213.20	1.88	1.13	1.31	1.59	1.42
	Private services	516,027.70	0.64	0.45	0.50	0.46	0.46
	Public services	136,228.50	-1.27	0.71	0.63	0.79	0.78
pq Market prices	Crop agriculture	1.01	0.08	0.15	0.20	0.19	-0.19
	Export agriculture	1.02	0.01	0.06	0.00	-0.23	-0.28
	Mining and gas	1.00	0.34	0.21	0.05	-0.34	0.04
	Industries	1.17	0.20	0.44	0.65	-0.83	0.12
	Construction	1.02	-0.03	0.60	0.36	-0.04	0.12
	Private services	1.03	-0.32	0.17	-0.02	-0.03	-0.23
	Public services	1.00	0.11	0.55	0.64	0.47	0.48
r Rental rate of capital	Crop agriculture	1.00	0.47	0.47	0.44	0.55	0.06
	Export agriculture	1.00	0.55	0.43	0.20	-0.18	0.19
	Mining and gas	1.00	0.71	0.33	-0.75	-2.09	0.29
	Industries	1.00	0.70	0.65	0.91	1.59	0.76
	Construction	1.00	1.75	1.22	1.63	2.37	1.82
	Private services	1.00	0.25	-0.05	0.33	0.50	0.17

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Senegal > Nonproductive investments > Macro results

Variable	Definition	Reference	Nonproductive investment				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,500,000.00	-0.34	0.29	0.29	0.32	0.43
EV	Equivalent variation		-0.33	0.26	0.26	0.31	-2.12
s	Wage	1.00	-1.55	1.29	1.27	1.40	1.92
yg	Government income	539,000.00	-0.03	5.90	5.90	5.90	5.90
g	Total government expenditure	295,000.00	-5.44	5.38	5.38	5.38	5.38
ye	Firm income	935,000.00	0.56	-0.45	-0.44	-0.48	-0.67
It	Total private investment	860,000.00	0.51	-0.45	-0.65	-1.29	-0.74
GDP	GDP	2,100,000.00	-0.01	-0.01	-0.01	-0.01	-0.01
e	Nominal exchange rate	1.00	-0.43	0.07	-1.38	-5.44	-0.80

Senegal > Nonproductive investments > Sectoral results

Variable	Sector	Base	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	252,000.00	0.04	-0.05	-0.03	-0.01	-0.12
	Export agriculture	221,000.00	0.73	-0.96	-0.95	-1.07	-0.72
	Industries	361,000.00	0.41	-1.12	-1.08	-1.26	-0.71
	Construction	91200.00	2.77	1.86	1.88	2.25	2.07
	Private services	995,000.00	0.19	-0.32	-0.35	-0.46	-0.57
	Public services	180,000.00	-4.33	4.18	4.24	5.05	4.44
pq Market prices	Crop agriculture	1.02	-0.26	0.12	-0.08	-1.07	-1.90
	Export agriculture	1.02	-0.49	0.49	0.38	-0.66	-0.16
	Industries	1.14	-0.44	1.67	1.69	-2.32	-0.58
	Construction	1.01	5.75	6.15	6.07	5.24	5.76
	Private services	1.02	-0.61	0.46	0.28	-0.82	-0.74
	Public services	1.00	-1.16	1.15	1.09	0.31	0.90
r Rental rate of capital	Crop agriculture	1.00	0.03	-0.70	-0.13	1.18	-3.14
	Export agriculture	1.00	0.31	-1.18	-1.19	-1.36	0.05
	Industries	1.00	0.11	-3.31	-3.17	-3.74	-1.02
	Construction	1.00	15.47	12.81	12.88	15.45	14.86
	Private services	1.00	-0.46	-0.52	-0.72	-1.21	-1.35

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Senegal > Road investments > Macro results

Variable	Definition	Reference	Roads (% variations)				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,500,000.00	0.51	1.00	0.99	1.01	1.10
EV	Equivalent variation		0.50	0.91	0.92	1.00	-0.89
s	Wage	1.00	-0.28	1.92	1.90	2.00	2.40
yg	Government income	539,000.00	0.84	5.43	5.43	5.43	5.43
g	Total government expenditure	295,000.00	-3.85	4.52	4.52	4.52	4.52
ye	Firm income	935,000.00	1.50	0.71	0.72	0.69	0.55
It	Total private investment	860,000.00	1.43	0.69	0.53	0.04	0.46
GDP	GDP	2,100,000.00	1.02	1.02	1.02	1.01	1.02
e	Nominal exchange rate	1.00	-0.46	-0.08	-1.19	-4.24	-0.75

Senegal > Road investments > Sectoral results

Variable	Sector	Base	Roads				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	252,000.00	0.95	0.88	0.89	0.91	0.82
	Export agriculture	221,000.00	1.91	0.59	0.60	0.51	0.78
	Industries	361,000.00	1.75	0.55	0.58	0.45	0.88
	Construction	91200.00	3.32	2.62	2.63	2.91	2.78
	Private services	995,000.00	1.19	0.79	0.76	0.68	0.59
	Public services	180,000.00	-3.46	3.10	3.15	3.75	3.29
pq Market prices	Crop agriculture	1.02	-0.24	0.05	-0.11	-0.85	-1.50
	Export agriculture	1.02	-0.64	0.10	0.02	-0.77	-0.39
	Industries	1.14	-0.73	0.87	0.89	-2.15	-0.84
	Construction	1.01	5.71	6.01	5.95	5.32	5.71
	Private services	1.02	-0.51	0.30	0.16	-0.67	-0.62
	Public services	1.00	-0.41	1.38	1.33	0.74	1.19
r Rental rate of capital	Crop agriculture	1.00	0.96	0.40	0.84	1.84	-1.50
	Export agriculture	1.00	1.06	-0.09	-0.10	-0.22	0.87
	Industries	1.00	0.47	-2.19	-2.09	-2.52	-0.41
	Construction	1.00	16.23	14.18	14.23	16.20	15.75
	Private services	1.00	0.72	0.67	0.51	0.14	0.02

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Senegal > Electricity investments > Macro results

Variable	Definition	Reference	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,500,000.00	0.39	0.91	0.90	0.93	1.02
EV	Equivalent variation		0.38	0.84	0.84	0.92	-1.11
s	Wage	1.00	-0.34	2.02	2.00	2.11	2.54
yg	Government income	539,000.00	0.69	5.61	5.61	5.61	5.61
g	Total government expenditure	295,000.00	-4.13	4.84	4.84	4.84	4.84
ye	Firm income	935,000.00	1.25	0.41	0.41	0.38	0.23
It	Total private investment	860,000.00	1.20	0.41	0.23	-0.29	0.16
GDP	GDP	2,100,000.00	0.82	0.82	0.82	0.81	0.81
e	Nominal exchange rate	1.00	-0.31	0.11	-1.09	-4.39	-0.61

Senegal > Electricity investments > Sectoral results

Variable	Sector	Base	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	252,000.00	0.07	0.00	0.01	0.03	-0.06
	Export agriculture	221,000.00	1.25	-0.15	-0.14	-0.24	0.05
	Industries	361,000.00	0.96	-0.31	-0.27	-0.41	0.03
	Construction	91200.00	4.32	3.56	3.57	3.89	3.73
	Private services	995,000.00	1.33	0.91	0.88	0.79	0.69
	Public services	180,000.00	-3.53	3.51	3.55	4.21	3.71
pq Market prices	Crop agriculture	1.02	0.44	0.76	0.59	-0.22	-0.91
	Export agriculture	1.02	-0.27	0.54	0.45	-0.40	0.01
	Industries	1.14	-0.19	1.54	1.55	-1.73	-0.31
	Construction	1.01	4.56	4.89	4.82	4.14	4.57
	Private services	1.02	-1.59	-0.72	-0.87	-1.75	-1.70
	Public services	1.00	-0.62	1.29	1.25	0.61	1.10
r Rental rate of capital	Crop agriculture	1.00	1.80	1.20	1.68	2.74	-0.84
	Export agriculture	1.00	2.17	0.92	0.92	0.77	1.95
	Industries	1.00	2.11	-0.76	-0.64	-1.11	1.15
	Construction	1.00	14.68	12.48	12.53	14.67	14.18
	Private services	1.00	-0.59	-0.64	-0.82	-1.21	-1.33

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Senegal > Telecom investments > Macro results

Variable	Definition	Reference	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	1,500,000.00	0.13	0.63	0.62	0.65	0.74
EV	Equivalent variation		0.13	0.58	0.58	0.64	-1.30
s	Wage	1.00	-0.79	1.47	1.45	1.55	1.96
yg	Government income	539,000.00	0.42	5.13	5.13	5.13	5.13
g	Total government expenditure	295,000.00	-4.61	3.98	3.98	3.98	3.98
ye	Firm income	935,000.00	1.02	0.22	0.22	0.19	0.04
It	Total private investment	860,000.00	0.97	0.21	0.05	-0.45	-0.02
GDP	GDP	2,100,000.00	0.53	0.53	0.53	0.53	0.53
e	Nominal exchange rate	1.00	-0.35	0.05	-1.10	-4.27	-0.64

Senegal > Telecom investments > Sectoral results

Variable	Sector	Base	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	252,000.00	0.40	0.34	0.35	0.37	0.28
	Export agriculture	221,000.00	1.21	-0.13	-0.13	-0.22	0.06
	Industries	361,000.00	0.78	-0.43	-0.40	-0.53	-0.10
	Construction	91200.00	2.97	2.25	2.26	2.56	2.42
	Private services	995,000.00	0.90	0.49	0.46	0.38	0.29
	Public services	180,000.00	-3.85	2.92	2.96	3.59	3.11
pq Market prices	Crop agriculture	1.02	-0.14	0.16	-0.01	-0.78	-1.44
	Export agriculture	1.02	-0.54	0.24	0.15	-0.66	-0.27
	Industries	1.14	-0.32	1.34	1.36	-1.79	-0.43
	Construction	1.01	5.80	6.12	6.06	5.41	5.81
	Private services	1.02	-1.10	-0.26	-0.40	-1.26	-1.21
	Public services	1.00	-0.79	1.04	0.99	0.38	0.84
r Rental rate of capital	Crop agriculture	1.00	0.78	0.21	0.66	1.68	-1.74
	Export agriculture	1.00	1.14	-0.05	-0.06	-0.19	0.93
	Industries	1.00	1.30	-1.44	-1.32	-1.77	0.39
	Construction	1.00	15.83	13.72	13.77	15.80	15.34
	Private services	1.00	-0.38	-0.43	-0.59	-0.98	-1.09

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Tanzania > Nonproductive investments > Macro results

Variable	Definition	Reference	Nonproductive investment				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	7,925.60	-0.07	0.02	0.04	0.05	0.02
EV	Equivalent variation		-0.07	0.02	0.04	0.05	-0.46
s	Wage	1.00	-0.20	0.07	0.10	0.13	0.05
yg	Government income	668.13	0.09	5.44	5.44	5.44	5.44
g	Total government expenditure	516.07	-3.40	3.52	3.52	3.52	3.52
ye	Firm income	2,293.57	0.26	-0.08	-0.13	-0.17	-0.06
It	Total private investment	1,228.04	0.50	-0.13	-0.52	-1.07	-0.41
GDP	GDP	7,582.43	0.00	0.00	0.00	0.00	0.00
e	Nominal exchange rate	1.00	0.29	0.02	-1.00	-2.58	0.06

Tanzania > Nonproductive investments > Sectoral results

Variable	Sector	Base	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1,964.70	0.08	-0.19	-0.14	-0.15	-0.35
	Export agriculture	1,311.08	0.12	-0.28	-0.38	-0.48	-0.31
	Mining and gas	141.43	0.03	-0.05	-0.04	-0.01	-0.04
	Industries	1,242.16	0.08	-0.53	-0.25	0.06	-0.23
	Construction	780.66	0.86	0.53	0.17	-0.20	0.62
	Private services	1,672.10	0.02	-0.05	-0.09	-0.11	-0.11
	Public services	470.30	-2.36	2.28	2.32	2.51	2.29
pq Market prices	Crop agriculture	1.02	-0.15	0.20	0.14	0.08	-0.07
	Export agriculture	1.02	-0.14	0.24	0.47	0.22	-0.10
	Mining and gas	1.06	0.24	0.28	0.23	-1.62	-0.10
	Industries	1.10	0.05	0.74	0.54	-0.80	-0.05
	Construction	1.00	0.87	0.95	0.60	-0.05	0.73
	Private services	1.00	-0.03	0.19	0.10	-0.09	-0.05
	Public services	1.00	-0.07	0.21	0.18	0.00	0.07
r Rental rate of capital	Crop agriculture	1.00	-0.09	-0.20	-0.09	-0.07	-0.42
	Export agriculture	1.00	-0.01	-0.37	-0.49	-0.62	-0.44
	Mining and gas	1.00	0.21	-0.73	-0.51	-0.03	-0.52
	Industries	1.00	-0.05	-0.95	-0.37	0.26	-0.40
	Construction	1.00	2.15	1.51	0.58	-0.40	1.73
	Private services	1.00	-0.15	-0.08	-0.14	-0.18	-0.28

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Tanzania > Road investments > Macro results

Variable	Definition	Reference	Roads (% variation)				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	7,925.60	0.45	0.53	0.54	0.55	0.52
EV	Equivalent variation		0.45	0.51	0.53	0.55	0.15
s	Wage	1.00	0.57	0.77	0.80	0.82	0.75
yg	Government income	668.13	0.87	5.00	5.00	5.00	5.00
g	Total government expenditure	516.07	-2.39	2.96	2.96	2.96	2.96
ye	Firm income	2,293.57	1.13	0.87	0.83	0.80	0.89
It	Total private investment	1,228.04	2.51	2.03	1.73	1.31	1.81
GDP	GDP	7,582.43	0.81	0.81	0.81	0.81	0.81
e	Nominal exchange rate	1.00	0.57	0.36	-0.41	-1.61	0.39

Tanzania > Road investments > Sectoral results

Variable	Sector	Base	Roads				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1,964.70	0.83	0.62	0.66	0.66	0.51
	Export agriculture	1,311.08	1.25	0.95	0.87	0.79	0.92
	Mining and gas	141.43	1.52	1.46	1.46	1.49	1.47
	Industries	1,242.16	0.82	0.35	0.57	0.81	0.58
	Construction	780.66	2.05	1.79	1.52	1.24	1.86
	Private services	1,672.10	0.61	0.56	0.54	0.52	0.51
	Public services	470.30	-2.06	1.51	1.54	1.68	1.51
pq Market prices	Crop agriculture	1.02	-0.30	-0.04	-0.08	-0.13	-0.24
	Export agriculture	1.02	-0.70	-0.41	-0.24	-0.43	-0.68
	Mining and gas	1.06	-0.05	-0.02	-0.05	-1.46	-0.31
	Industries	1.10	0.19	0.72	0.57	-0.45	0.12
	Construction	1.00	0.94	1.00	0.74	0.25	0.84
	Private services	1.00	0.42	0.58	0.51	0.37	0.40
	Public services	1.00	0.51	0.73	0.70	0.57	0.62
r Rental rate of capital	Crop agriculture	1.00	0.46	0.38	0.46	0.48	0.20
	Export agriculture	1.00	0.38	0.10	0.00	-0.10	0.04
	Mining and gas	1.00	-0.08	-0.80	-0.63	-0.27	-0.64
	Industries	1.00	0.91	0.21	0.66	1.14	0.64
	Construction	1.00	3.40	2.91	2.18	1.44	3.08
	Private services	1.00	1.02	1.08	1.03	1.00	0.92

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Tanzania > Electricity investments > Macro results

Variable	Definition	Reference	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	7,925.60	0.41	0.49	0.50	0.51	0.48
EV	Equivalent variation		0.40	0.47	0.49	0.51	0.09
s	Wage	1.00	0.53	0.74	0.77	0.80	0.73
yg	Government income	668.13	0.83	5.17	5.17	5.17	5.17
g	Total government expenditure	516.07	-2.44	3.17	3.17	3.17	3.17
ye	Firm income	2,293.57	0.97	0.69	0.65	0.62	0.71
It	Total private investment	1,228.04	2.23	1.72	1.40	0.96	1.49
GDP	GDP	7,582.43	0.72	0.72	0.72	0.72	0.72
e	Nominal exchange rate	1.00	0.69	0.48	-0.34	-1.59	0.51

Tanzania > Electricity investments > Sectoral results

Variable	Sector	Base	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1,964.70	0.14	-0.07	-0.03	-0.04	-0.20
	Export agriculture	1,311.08	0.48	0.15	0.08	-0.01	0.13
	Mining and gas	141.43	0.45	0.38	0.39	0.42	0.39
	Industries	1,242.16	1.43	0.93	1.16	1.41	1.17
	Construction	780.66	2.53	2.26	1.97	1.67	2.33
	Private services	1,672.10	1.00	0.94	0.91	0.89	0.89
	Public services	470.30	-1.91	1.85	1.88	2.03	1.85
pq (Market prices)	Crop agriculture	1.02	0.47	0.75	0.70	0.66	0.53
	Export agriculture	1.02	0.23	0.54	0.72	0.52	0.26
	Mining and gas	1.06	0.77	0.80	0.77	-0.72	0.50
	Industries	1.10	-0.36	0.19	0.03	-1.04	-0.44
	Construction	1.00	0.57	0.63	0.35	-0.16	0.46
	Private services	1.00	-0.32	-0.15	-0.22	-0.37	-0.34
	Public services	1.00	0.30	0.53	0.50	0.36	0.41
r Rental rate of capital	Crop agriculture	1.00	0.70	0.62	0.71	0.72	0.43
	Export agriculture	1.00	0.85	0.56	0.46	0.36	0.50
	Mining and gas	1.00	1.76	0.99	1.17	1.55	1.16
	Industries	1.00	-0.26	-0.99	-0.52	-0.02	-0.54
	Construction	1.00	3.67	3.14	2.38	1.59	3.32
	Private services	1.00	0.50	0.56	0.50	0.47	0.39

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Tanzania > Telecom investments > Macro results

Variable	Definition	Reference	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	7,925.60	0.23	0.30	0.31	0.32	0.30
EV	Equivalent variation		0.22	0.30	0.31	0.33	-0.08
s	Wage	1.00	0.25	0.46	0.49	0.51	0.44
yg	Government income	668.13	0.52	4.73	4.73	4.73	4.73
g	Total government expenditure	516.07	-2.84	2.61	2.61	2.61	2.61
ye	Firm income	2,293.57	0.71	0.44	0.40	0.37	0.46
It	Total private investment	1,228.04	1.53	1.04	0.73	0.30	0.82
GDP	GDP	7,582.43	0.45	0.45	0.45	0.45	0.45
e	Nominal exchange rate	1.00	0.36	0.15	-0.64	-1.87	0.18

Tanzania > Telecom investments > Sectoral results

Variable	Sector	Base	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1,964.70	0.37	0.16	0.20	0.20	0.04
	Export agriculture	1,311.08	0.51	0.20	0.12	0.04	0.17
	Mining and gas	141.43	0.32	0.26	0.27	0.29	0.27
	Industries	1,242.16	0.46	-0.02	0.20	0.44	0.22
	Construction	780.66	1.76	1.50	1.22	0.93	1.57
	Private services	1,672.10	0.61	0.55	0.52	0.51	0.50
	Public services	470.30	-2.12	1.53	1.56	1.70	1.53
pq Market prices	Crop agriculture	1.02	-0.11	0.16	0.11	0.07	-0.05
	Export agriculture	1.02	-0.20	0.09	0.27	0.07	-0.18
	Mining and Gas	1.06	0.39	0.43	0.39	-1.06	0.13
	Industries	1.10	0.15	0.69	0.53	-0.51	0.08
	Construction	1.00	0.67	0.74	0.46	-0.03	0.57
	Private services	1.00	-0.26	-0.09	-0.17	-0.31	-0.28
	Public services	1.00	0.18	0.40	0.37	0.23	0.28
r Rental rate of capital	Crop agriculture	1.00	0.27	0.19	0.27	0.29	0.01
	Export agriculture	1.00	0.34	0.05	-0.04	-0.14	0.00
	Mining and gas	1.00	0.93	0.19	0.37	0.74	0.36
	Industries	1.00	0.61	-0.11	0.35	0.84	0.33
	Construction	1.00	2.80	2.30	1.56	0.80	2.47
	Private services	1.00	0.16	0.21	0.16	0.13	0.05

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Uganda > Nonproductive investments > Macro results

Variable	Definition	Reference	Nonproductive investment				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	875,000.00	-0.01	0.02	0.02	0.05	0.02
EV	Equivalent variation		-0.01	0.02	0.02	0.06	-0.61
s	Wage	1.00	-0.07	0.11	0.11	0.27	0.12
yg	Government income	163,000.00	-0.01	3.14	3.14	3.14	3.14
g	Total government expenditure	103,000.00	-2.50	2.49	2.49	2.49	2.49
ye	Firm income	113,000.00	0.09	-0.13	-0.14	-0.33	-0.15
It	Total private investment	105,000.00	0.06	-0.16	-0.85	-5.11	-0.55
GDP	GDP	834,000.00	0.00	0.00	0.00	0.00	0.00
e	Nominal exchange rate	1.00	-0.09	-0.12	-2.39	-15.98	-0.31

Uganda > Nonproductive investments > Sectoral results

Variable	Sector	Base	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	270,000.00	0.01	-0.09	-0.08	-0.01	-0.33
	Export agriculture	112,000.00	0.06	-0.24	-0.27	-0.69	-0.33
	Mining and gas	577.00	-0.05	-0.18	0.06	1.19	-0.12
	Industries	94,100.00	0.12	-0.59	-0.64	-1.98	-0.21
	Construction	66,700.00	1.47	0.95	1.05	1.93	1.18
	Private services	260,000.00	-0.17	-0.10	-0.12	-0.10	-0.05
	Public services	31,600.00	-2.40	2.13	2.27	5.12	2.49
pq Market prices	Crop agriculture	1.00	-0.07	0.10	0.07	-0.24	-0.16
	Export agriculture	1.00	-0.02	0.01	-0.04	-0.64	-0.21
	Mining and gas	1.34	-0.10	0.09	1.71	-13.50	-0.25
	Industries	1.10	-0.06	0.90	0.02	-6.28	-0.16
	Construction	1.01	0.44	0.91	0.49	-2.27	0.40
	Private services	1.02	-0.15	0.47	0.15	-2.52	0.01
	Public services	1.00	-0.11	0.35	0.21	-2.50	0.00
r Rental rate of capital	Crop agriculture	1.00	-0.05	-0.06	-0.03	0.24	-0.52
	Export agriculture	1.00	0.04	-0.38	-0.45	-1.16	-0.56
	Mining and gas	1.00	-0.29	-0.71	0.40	5.91	-0.43
	Industries	1.00	0.19	-1.15	-1.26	-3.92	-0.33
	Construction	1.00	2.44	1.72	1.91	3.58	2.14
	Private services	1.00	-0.35	-0.06	-0.10	0.09	0.03

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Uganda > Road investments > Macro results

Variable	Definition	Reference	Roads (% variation)				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	875,000.00	0.16	0.18	0.19	0.21	0.19
EV	Equivalent variation		0.16	0.18	0.18	0.25	-0.35
s	Wage	1.00	0.14	0.29	0.30	0.42	0.31
yg	Government income	163,000.00	0.21	2.89	2.89	2.89	2.89
g	Total government expenditure	103,000.00	-2.15	2.09	2.09	2.09	2.09
ye	Firm income	113,000.00	0.29	0.10	0.09	-0.05	0.09
It	Total private investment	105,000.00	0.44	0.26	-0.32	-3.45	-0.07
GDP	GDP	834,000.00	0.21	0.21	0.21	0.20	0.21
e	Nominal exchange rate	1.00	0.23	0.22	-1.69	-11.68	0.05

Uganda > Road investments > Sectoral results

Variable	Sector	Base	Roads				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	270,000.00	0.22	0.14	0.15	0.19	-0.07
	Export agriculture	112,000.00	0.36	0.12	0.09	-0.23	0.04
	Mining and gas	577.00	0.09	-0.02	0.18	0.96	0.03
	Industries	94100.00	0.35	-0.25	-0.29	-1.29	0.07
	Construction	66700.00	1.66	1.21	1.30	1.97	1.41
	Private services	260,000.00	-0.01	0.05	0.03	0.05	0.09
	Public services	31600.00	-2.20	1.64	1.76	3.86	1.95
pq Market prices	Crop agriculture	1.00	-0.11	0.04	0.01	-0.21	-0.18
	Export agriculture	1.00	-0.20	-0.17	-0.21	-0.65	-0.35
	Mining and gas	1.34	0.18	0.35	1.74	-9.84	0.05
	Industries	1.10	0.07	0.89	0.15	-4.52	-0.02
	Construction	1.01	0.45	0.85	0.50	-1.55	0.42
	Private services	1.02	-0.02	0.51	0.25	-1.74	0.12
	Public services	1.00	0.05	0.44	0.32	-1.71	0.14
r Rental rate of capital	Crop agriculture	1.00	0.10	0.09	0.11	0.31	-0.30
	Export agriculture	1.00	0.14	-0.22	-0.28	-0.81	-0.37
	Mining and gas	1.00	-1.34	-1.70	-0.77	2.97	-1.46
	Industries	1.00	0.54	-0.60	-0.69	-2.69	0.10
	Construction	1.00	2.51	1.90	2.06	3.32	2.25
	Private services	1.00	-0.08	0.17	0.14	0.29	0.25

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Uganda > Electricity investments > Macro results

Variable	Definition	Reference	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	875,000.00	0.14	0.16	0.16	0.14	0.17
EV	Equivalent variation		0.14	0.16	0.16	0.14	-0.40
s	Wage	1.00	0.11	0.27	0.28	0.11	0.29
yg	Government income	163,000.00	0.18	2.98	2.98	0.18	2.98
g	Total government expenditure	103,000.00	-2.21	2.24	2.24	-2.21	2.24
ye	Firm income	113,000.00	0.26	0.06	0.06	0.26	0.05
It	Total private investment	105,000.00	0.35	0.16	-0.45	0.35	-0.19
GDP	GDP	834,000.00	0.18	0.18	0.18	0.18	0.18
e	Nominal exchange rate	1.00	0.07	0.05	-1.96	0.07	-0.12

Uganda > Electricity investments > Sectoral results

Variable	Sector	Base	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	270,000.00	0.05	-0.04	-0.03	0.05	-0.26
	Export agriculture	112,000.00	0.20	-0.06	-0.09	0.20	-0.14
	Mining and gas	577.00	0.19	0.07	0.28	0.19	0.12
	Industries	94,100.00	0.46	-0.17	-0.21	0.46	0.17
	Construction	66,700.00	1.76	1.29	1.39	1.76	1.50
	Private services	260,000.00	0.09	0.14	0.12	0.09	0.19
	Public services	31,600.00	-2.15	1.88	2.01	-2.15	2.20
pq Market prices	Crop agriculture	1.00	0.10	0.25	0.22	0.10	0.02
	Export agriculture	1.00	0.12	0.15	0.11	0.12	-0.04
	Mining and gas	1.34	0.02	0.20	1.65	0.02	-0.11
	Industries	1.10	-0.10	0.76	-0.02	-0.10	-0.19
	Construction	1.01	0.31	0.73	0.36	0.31	0.27
	Private Services	1.02	-0.21	0.35	0.07	-0.21	-0.06
	Public services	1.00	-0.06	0.35	0.23	-0.06	0.04
r Rental rate of capital	Crop agriculture	1.00	0.19	0.19	0.21	0.19	-0.22
	Export agriculture	1.00	0.37	-0.01	-0.07	0.37	-0.16
	Mining and gas	1.00	0.53	0.15	1.14	0.53	0.40
	Industries	1.00	0.06	-1.13	-1.22	0.06	-0.40
	Construction	1.00	2.48	1.84	2.01	2.48	2.22
	Private services	1.00	-0.20	0.06	0.03	-0.20	0.15

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Uganda > Telecom investments > Macro results

Variable	Definition	Reference	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	875,000.00	0.09	0.12	0.12	0.14	0.12
EV	Equivalent variation		0.09	0.11	0.12	0.17	-0.40
s	Wage	1.00	0.06	0.20	0.21	0.32	0.21
yg	Government income	163,000.00	0.13	2.73	2.73	2.73	2.73
g	Total government expenditure	103,000.00	-2.28	1.84	1.84	1.84	1.84
ye	Firm income	113,000.00	0.22	0.03	0.03	-0.11	0.02
It	Total private investment	105,000.00	0.30	0.13	-0.44	-3.46	-0.20
GDP	GDP	834,000.00	0.13	0.13	0.13	0.12	0.13
e	Nominal exchange rate	1.00	0.12	0.11	-1.75	-11.38	-0.05

Uganda > Telecom investments > Sectoral results

Variable	Sector	Base	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	270,000.00	0.10	0.02	0.03	0.08	-0.18
	Export agriculture	112,000.00	0.18	-0.07	-0.09	-0.40	-0.14
	Mining and gas	577.00	0.08	-0.02	0.17	0.92	0.02
	Industries	94,100.00	0.26	-0.33	-0.37	-1.33	-0.01
	Construction	66700.00	1.62	1.19	1.28	1.92	1.39
	Private services	260,000.00	-0.02	0.04	0.02	0.04	0.08
	Public services	31,600.00	-2.23	1.50	1.62	3.65	1.80
pq Market prices	Crop agriculture	1.00	-0.05	0.09	0.07	-0.15	-0.12
	Export agriculture	1.00	-0.02	0.01	-0.03	-0.46	-0.17
	Mining and gas	1.34	0.07	0.24	1.59	-9.60	-0.05
	Industries	1.10	0.04	0.83	0.11	-4.39	-0.05
	Construction	1.01	0.41	0.80	0.46	-1.52	0.38
	Private services	1.02	-0.16	0.35	0.10	-1.82	-0.03
	Public services	1.00	-0.05	0.33	0.22	-1.74	0.04
r Rental rate of capital	Crop agriculture	1.00	0.07	0.06	0.08	0.28	-0.31
	Export agriculture	1.00	0.17	-0.19	-0.24	-0.76	-0.33
	Mining and gas	1.00	0.11	-0.24	0.68	4.32	-0.01
	Industries	1.00	0.46	-0.65	-0.73	-2.67	0.03
	Construction	1.00	2.45	1.85	2.01	3.23	2.20
	Private services	1.00	-0.26	-0.02	-0.05	0.10	0.06

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Cameroon > Nonproductive investments > Macro results

Variable	Definition	Reference	Nonproductive investment				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	5,409,614.00	-0.19	0.25	0.35	0.62	0.20
EV	Equivalent variation		-0.19	0.23	0.32	0.65	-1.68
s	Wage	1.00	-0.43	0.56	0.78	1.38	0.43
yg	Government income	1,500,596.00	0.31	6.36	6.36	6.36	6.36
g	Total government expenditure	656,249.00	-6.56	7.27	7.27	7.27	7.27
ye	Firm income	2,118,815.00	0.50	-0.64	-0.89	-1.58	-0.49
It	Total private investment	1,213,585.00	0.66	-0.86	-1.16	-2.01	-1.69
GDP	GDP	6,395,129.00	0.00	0.00	0.00	0.00	0.00
e	Nominal exchange rate	1.00	0.35	0.35	-1.92	-6.81	-0.06

Cameroon > Nonproductive investments > Sectoral results

Variable	Sector	Base	Nonproductive				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	108,8074.00	0.41	-0.72	-0.87	-1.17	-1.48
	Export agriculture	419,908.00	0.71	-0.47	-0.60	-0.79	-0.44
	Mining and gas	623,479.00	0.03	-0.02	-0.10	-0.29	-0.01
	Industries	1,266,964.00	0.57	-0.85	-0.60	-0.37	-0.26
	Construction	108,698.00	7.78	5.62	5.24	7.14	6.88
	Private services	2,265,916.00	0.21	-0.56	-0.52	-0.61	-0.64
	Public services	622,090.00	-4.55	4.34	4.19	4.56	4.53
pq Market prices	Crop agriculture	1.00	-0.26	0.59	0.74	0.84	-0.01
	Export agriculture	1.02	0.05	1.09	1.67	1.08	-0.07
	Mining and gas	1.04	0.46	0.40	0.71	-6.74	-0.06
	Industries	1.11	0.21	2.31	2.65	-0.94	-0.06
	Construction	1.00	0.34	2.01	2.24	-0.20	0.26
	Private services	1.03	-0.13	1.11	0.73	0.47	-0.19
	Public services	1.00	-0.27	0.96	1.13	0.84	0.27
r Rental rate of capital	Crop agriculture	1.00	0.09	-0.36	-0.34	-0.12	-1.45
	Export agriculture	1.00	0.98	-0.39	-0.42	-0.20	-0.44
	Mining and gas	1.00	0.51	-0.04	-2.84	-8.70	-0.05
	Industries	1.00	1.01	-1.56	-0.73	0.44	-0.22
	Construction	1.00	8.91	7.35	7.12	10.09	8.76
	Private services	1.00	0.00	-0.57	-0.27	0.12	-0.87

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Cameroon > Road investments > Macro results

Variable	Definition	Reference	Roads (% variation)				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	5,409,614.00	0.38	0.76	0.84	1.07	0.71
EV	Equivalent variation		0.38	0.71	0.78	1.12	-0.90
s	Wage	1.00	0.31	1.15	1.34	1.84	1.04
yg	Government income	1,500,596.00	0.69	5.85	5.85	5.85	5.85
g	Total government expenditure	656,249.00	-5.68	6.11	6.11	6.11	6.11
ye	Firm income	2,118,815.00	1.16	0.19	-0.03	-0.62	0.32
It	Total private investment	1,213,585.00	2.02	0.72	0.46	-0.27	0.01
GDP	GDP	6,395,129.00	0.71	0.70	0.70	0.70	0.70
e	Nominal exchange rate	1.00	-0.27	-0.28	-2.21	-6.31	-0.62

Cameroon > Road investments > Sectoral results

Variable	Sector	Base	Roads				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1,088,074.00	1.34	0.36	0.23	-0.02	-0.28
	Export agriculture	419,908.00	1.53	0.52	0.41	0.25	0.55
	Mining and gas	623,479.00	1.59	1.55	1.48	1.32	1.55
	Industries	1,266,964.00	1.18	-0.03	0.18	0.37	0.47
	Construction	108,698.00	8.70	6.84	6.52	8.14	7.93
	Private services	2,265,916.00	0.72	0.06	0.10	0.01	-0.01
	Public services	622,090.00	-4.25	3.31	3.19	3.50	3.46
pq Market prices	Crop agriculture	1.00	-0.36	0.36	0.49	0.56	-0.15
	Export agriculture	1.02	-0.37	0.52	1.01	0.50	-0.47
	Mining and gas	1.04	-0.28	-0.33	-0.09	-6.34	-0.72
	Industries	1.11	0.10	1.87	2.15	-0.86	-0.12
	Construction	1.00	0.16	1.57	1.76	-0.30	0.09
	Private services	1.03	0.10	1.15	0.83	0.61	0.05
	Public services	1.00	0.24	1.28	1.43	1.18	0.70
r Rental rate of capital	Crop agriculture	1.00	0.84	0.45	0.46	0.64	-0.48
	Export agriculture	1.00	0.61	-0.54	-0.58	-0.40	-0.59
	Mining and gas	1.00	1.21	0.73	-1.69	-6.68	0.72
	Industries	1.00	1.67	-0.54	0.17	1.17	0.61
	Construction	1.00	9.51	8.18	7.98	10.50	9.38
	Private services	1.00	0.84	0.35	0.60	0.93	0.09

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Cameroon > Electricity investments > Macro results

Variable	Definition	Reference	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	5,409,614.00	0.51	0.90	0.99	1.22	0.85
EV	Equivalent variation		0.51	0.83	0.90	1.27	-0.78
s	Wage	1.00	0.54	1.40	1.59	2.11	1.29
yg	Government income	1,500,596.00	0.77	6.04	6.04	6.04	6.04
g	Total government expenditure	656,249.00	-5.52	6.54	6.54	6.54	6.54
ye	Firm income	2,118,815.00	1.10	0.10	-0.11	-0.70	0.23
It	Total private investment	1,213,585.00	1.99	0.65	0.40	-0.33	-0.07
GDP	GDP	6,395,129.00	0.80	0.79	0.80	0.80	0.80
e	Nominal exchange rate	1.00	0.29	0.28	-1.68	-5.87	-0.07

Cameroon > Electricity investments > Sectoral results

Variable	Sector	Base	Electricity				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1,088,074.00	0.72	-0.27	-0.40	-0.65	-0.93
	Export agriculture	419,908.00	1.46	0.43	0.33	0.17	0.47
	Mining and gas	623,479.00	0.38	0.34	0.27	0.11	0.34
	Industries	1,266,964.00	1.94	0.68	0.90	1.10	1.21
	Construction	108,698.00	8.94	7.03	6.71	8.37	8.15
	Private services	2,265,916.00	1.17	0.49	0.53	0.44	0.42
	Public services	622,090.00	-4.12	3.61	3.48	3.79	3.75
pq Market prices	Crop agriculture	1.00	0.48	1.22	1.36	1.44	0.70
	Export agriculture	1.02	0.51	1.41	1.92	1.41	0.41
	Mining and gas	1.04	0.51	0.46	0.71	-5.68	0.06
	Industries	1.11	-0.36	1.44	1.73	-1.33	-0.59
	Construction	1.00	-0.07	1.37	1.56	-0.53	-0.14
	Private services	1.03	-0.29	0.78	0.45	0.23	-0.34
	Public services	1.00	0.28	1.34	1.49	1.24	0.74
r Rental rate of capital	Crop agriculture	1.00	1.43	1.03	1.05	1.24	0.08
	Export agriculture	1.00	2.93	1.72	1.70	1.89	1.68
	Mining and gas	1.00	0.94	0.45	-1.98	-7.03	0.44
	Industries	1.00	0.78	-1.47	-0.75	0.26	-0.29
	Construction	1.00	9.57	8.21	8.01	10.59	9.44
	Private services	1.00	0.86	0.35	0.61	0.96	0.10

THE IMPACT OF INFRASTRUCTURE SPENDING IN SUB-SAHARAN AFRICA

Cameroon > Telecom investments > Macro results

Variable	Definition	Reference	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Ym	Aggregate household income	5,409,614.00	0.15	0.52	0.60	0.82	0.47
EV	Equivalent variation		0.15	0.48	0.55	0.85	-1.08
s	Wage	1.00	0.02	0.83	1.01	1.50	0.73
yg	Government income	1,500,596.00	0.55	5.53	5.53	5.53	5.53
g	Total government expenditure	656,249.00	-6.01	5.38	5.38	5.38	5.38
ye	Firm income	2,118,815.00	0.87	-0.07	-0.27	-0.83	0.06
It	Total private investment	1,213,585.00	1.43	0.18	-0.07	-0.76	-0.51
GDP	GDP	6,395,129.00	0.41	0.41	0.41	0.41	0.41
e	Nominal exchange rate	1.00	0.32	0.31	-1.55	-5.51	-0.02

Cameroon > Telecom investments > Sectoral results

Variable	Sector	Base	Telecom				
			Reduction in other public expenditure	VAT	Import duties	Foreign aid	Income tax
Va Value added or output	Crop agriculture	1.088.074.00	0.87	-0.07	-0.19	-0.43	-0.69
	Export agriculture	419.908.00	1.16	0.19	0.08	-0.07	0.22
	Mining and gas	623.479.00	0.29	0.26	0.19	0.04	0.26
	Industries	1.266.964.00	0.96	-0.21	-0.01	0.18	0.27
	Construction	108.698.00	8.28	6.49	6.19	7.75	7.54
	Private services	2.265.916.00	0.71	0.07	0.11	0.03	0.00
	Public services	622.090.00	-4.33	2.99	2.87	3.17	3.13
pq Market prices	Crop agriculture	1.00	-0.22	0.48	0.60	0.68	-0.02
	Export agriculture	1.02	-0.05	0.81	1.29	0.80	-0.14
	Mining and gas	1.04	0.44	0.39	0.63	-5.42	0.02
	Industries	1.11	0.24	1.96	2.23	-0.68	0.02
	Construction	1.00	0.26	1.63	1.82	-0.17	0.20
	Private services	1.03	-0.39	0.62	0.31	0.10	-0.44
	Public services	1.00	0.01	1.02	1.16	0.93	0.46
r Rental rate of capital	Crop agriculture	1.00	0.66	0.28	0.30	0.48	-0.62
	Export agriculture	1.00	1.42	0.30	0.26	0.44	0.25
	Mining and gas	1.00	0.78	0.33	-1.99	-6.75	0.31
	Industries	1.00	1.74	-0.40	0.29	1.25	0.72
	Construction	1.00	8.93	7.65	7.47	9.90	8.81
	Private services	1.00	0.16	-0.31	-0.07	0.25	-0.56

About AICD



This study is a product of the Africa Infrastructure Country Diagnostic (AICD), a project designed to expand the world’s knowledge of physical infrastructure in Africa. AICD will provide a baseline against which future improvements in infrastructure services can be measured, making it possible to monitor the results achieved from donor support. It should also provide a better empirical foundation for prioritizing investments and designing policy reforms in Africa’s infrastructure sectors.



AICD is based on an unprecedented effort to collect detailed economic and technical data on African infrastructure. The project has produced a series of reports (such as this one) on public expenditure, spending needs, and sector performance in each of the main infrastructure sectors—energy, information and communication technologies, irrigation, transport, and water and sanitation. *Africa’s Infrastructure—A Time for Transformation*, published by the World Bank in November 2009, synthesizes the most significant findings of those reports.



AICD was commissioned by the Infrastructure Consortium for Africa after the 2005 G-8 summit at Gleneagles, which recognized the importance of scaling up donor finance for infrastructure in support of Africa’s development.



The first phase of AICD focused on 24 countries that together account for 85 percent of the gross domestic product, population, and infrastructure aid flows of Sub-Saharan Africa. The countries are: Benin, Burkina Faso, Cape Verde, Cameroon, Chad, Côte d’Ivoire, the Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, and Zambia. Under a second phase of the project, coverage is expanding to include as many other African countries as possible.



Consistent with the genesis of the project, the main focus is on the 48 countries south of the Sahara that face the most severe infrastructure challenges. Some components of the study also cover North African countries so as to provide a broader point of reference.



The World Bank is implementing AICD with the guidance of a steering committee that represents the African Union, the New Partnership for Africa's Development (NEPAD), Africa's regional economic communities, the African Development Bank, the Development Bank of Southern Africa, and major infrastructure donors.



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The data underlying AICD's reports, as well as the reports themselves, are available to the public through an interactive Web site, www.infrastructureafrica.org, that allows users to download customized data reports and perform various simulations. Inquiries concerning the availability of data sets should be directed to the editors at the World Bank in Washington, DC.

