Human Development

Simulations in a CGE model for Haiti

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Inter-American
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Martín Cicowiez[1] and Agustín Filippo[2]

Simulations

This document presents the group of simulations related to "Human Development", and analyzes the results for both the CGE model and the microsimulation model. In a companion document, we provide a detailed description of the reference scenario results (Cicowiez and Filippo, 2018a). In addition, a document that provides an introduction and describes the method and data used in this study is also available (Cicowiez and Filippo, 2018b).

1. Scenarios

In Haiti, public spending in health and education, and social protection remains limited, constraining the government's ability to provide services and offer equal opportunities to its citizens. In addition, Haiti's tax system generates limited resources for the government and tends to be regressive (Singh and Barton-Dock, 2015). In this set of simulations, more fiscal space is created through exogenous increases for foreign aid (grants) or increases in direct taxation. Then, the government makes use of the resulting addition to fiscal space to expand

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spending and service delivery in education (scenarios gconedu-tdir and gconedu-frt) and health (scenarios gconhlt-tdir and gconhlt-frt). Thus, the purpose of this set of simulations is to assess what those different options entail in terms of promoting economic growth and reducing poverty. As before, the baseline scenario is the same as in the first set of simulations. On the other hand, the counterfactual model closure rule assumes that adjustments in public spending on human development clear the government budget. Specifically, the following four simulations were implemented:

- gconedu-tdir = increase in (real) public spending in education equivalent to 2.5 percentage points of GDP combined with increase in skilled labor supply; specifically, the share of skilled labor in total labor supply gradually increases from 32 percent in 2015 to 47 percent in 2030
- gconedu-ftr = same increase in public spending in education as previous scenario combined with increase in skilled labor supply; specifically, the share of skilled labor in total labor supply gradually increases from 32 percent in 2015 to 47 percent in 2030
- gconhlt-tdir = increase in (real) public spending in health equivalent to 2.5 percentage points of GDP combined with one percent yearly increase in labor productivity
- gconhlt-ftr = same increase in public spending in health as previous scenario combined with one percent yearly increase in labor productivity

In both health scenarios, the increase in labor productivity reflects the expected increase in the health status of the Haitian population that would be derived from increased/improved government provision of health-related services.

2. Aggregate Results

Figure 1 and Table 1 show key macroeconomic results for the base and the non-base scenarios for the year 2016 (i.e., the year when all scenarios start deviating from the base) and 2030, the last simulation year. In the base scenario, the economy evolves according to recent trends, as described in the companion document that presents the results from the "Government and Institutional Capacity" simulations (Cicowiez and Filippo, 2018a) .

Figures 2, 3 and 4 summarize the main transmission channels for human development scenarios through government spending in education or health and government financing. As explained in Cicowiez and Filippo (2018b), our CGE model assumes that there is no full employment of labor. As shown by our results (see Figure 5), this specification allows us to capture mismatches between the supply of and demand for skilled labor. In fact, scenarios gconedu-tdir and gconedu-ftr show that investing in human capital without sufficient creation of skilled jobs results in higher rates of (skilled) unemployment and skill mismatches in the labor market. These outcomes can be catalysts of underemployment, resulting in negative repercussions in terms of rising inequality of income and opportunities, and less poverty reduction. These undesirable trade-offs can be avoided only if other policies improve the environment for stimulating a structural change towards technologies and activities that absorb larger amounts of skilled labor, improve the content of education and ensure that skills created by the education system are in high demand by the productive sector (Sánchez and Cicowiez, 2014). In other words, unemployment of skilled labor, for example, may signal that investments in human capital do not go hand in hand with economic changes that are necessary to adequately absorb the population of skilled workers.

As summarized in Figure 3, the impact on the rest of the economy from spending in human development depends on the financing mechanism. In case the marginal financing for education spending comes from direct taxes, growth declines for private consumption and investment. On the other hand, when marginal financing comes from foreign grants, the negative impact from increased domestic resource mobilization on private investment will be absent. However, the inflow of foreign resources will give rise to a slower export growth and faster import growth, both will be induced by an appreciation of the real exchange rate. In the case of government spending in health, qualitative results are similar. However, in the longer run, the positive impacts of increased labor productivity dominate (see Figure 1). Figure 4 summarizes the main transmission channels in the health spending scenarios gcon-tdir and gcon-ftr. Naturally, impacts through the government financing mechanisms are the same as in the education spending scenarios.

The additional public spending in education and health has a positive impact on the relative demand for skilled workers, initially pushing up their relative wage. Thus, expanding expenditure in human development requires careful preparation to align the speed of expenditure increases with the ability of education and training programs to deliver properly educated workers. There may also be a need to monitor wage pressures to avoid large increases in the wage bill that could crowd out other expenditures.

Figure 1a: change in real private consumption 2013-2030
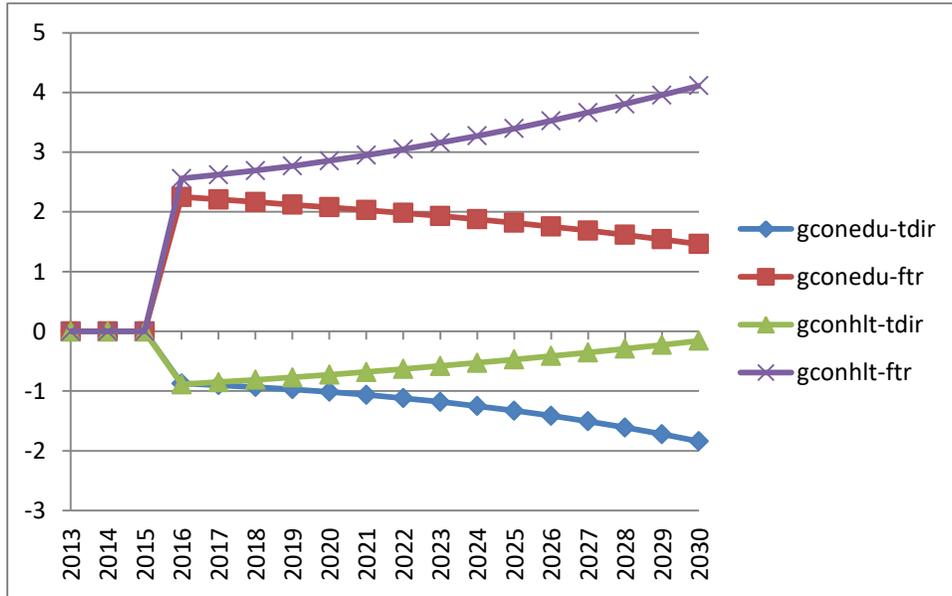## (percent deviation from base)

Figure 1b: change in real GDP at factor cost 2013-2030
(percent deviation from base)
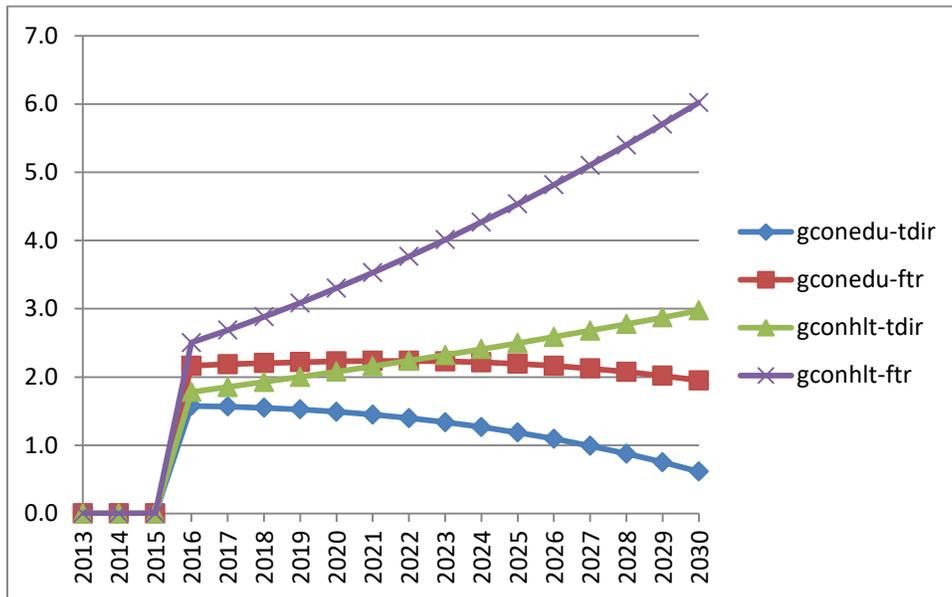
Source: Author's elaboration.

Table 1: change in real macro indicators
(percent deviation from base)

Item	base	gconedu-tdir		gconedu-ftr		gconhlt-tdir		gconhlt-ftr	
	2013	2016	2030	2016	2030	2016	2030	2016	2030
Absorption	493,643	1.13	0.42	3.63	3.28	1.28	2.14	4.04	5.96
Private consumption	352,731	-0.87	-1.84	2.25	1.46	-0.89	-0.16	2.56	4.11
Fixed investment	109,528	-0.56	-1.77	0.68	0.63	-0.55	-0.15	0.84	3.49
Private fixed investment	50,796	-1.20	-3.83	1.47	1.36	-1.19	-0.32	1.81	7.52
Government fixed investment	58,732	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government fixed inv, infra	56,624	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Change in stocks	57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Government consumption	31,327	28.59	28.59	28.59	28.59	31.00	31.00	31.00	31.00
Exports	44,879	-0.82	-4.07	-11.83	-12.40	-0.65	3.35	-12.21	2.78
Imports	171,307	-0.14	-1.03	2.81	1.78	-0.09	0.98	3.18	5.10
GDP at market prices	367,215	1.48	0.50	2.08	1.82	1.68	2.87	2.41	5.93
Net indirect taxes	19,907	-0.19	-1.40	0.90	0.15	-0.13	1.15	1.15	4.74
GDP at factor cost	347,308	1.58	0.61	2.16	1.95	1.78	2.97	2.50	6.02
Real exchange rate	1.00	0.12	-0.66	-3.17	-2.24	0.18	0.19	-3.36	-0.43
Wage, average	1.00	1.90	2.93	1.66	2.90	2.04	2.34	1.80	2.55
Capital return, average	1.00	-0.47	0.22	2.41	0.09	-0.44	1.06	2.75	0.80
Unemployment rate	31.72	-2.70	2.58	-6.60	-1.44	-3.12	-5.72	-7.47	-11.97
2013 = million gourdes									

Source: Author's elaboration.

Figure 2: main transmission channels education spending scenarios; through government spending

↑gov spnd edu	→	↑sk LS and ↓unsk LS	→	↑sk unemp and ↓unsk unemp	→	↑hhd cons spnd and sav
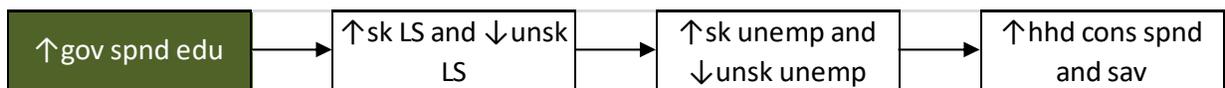
Figure 3a: main transmission channels gconedu-tdir; through government financing

↑gov spnd edu	→	↑direct tax rate	→	↓household disposable income
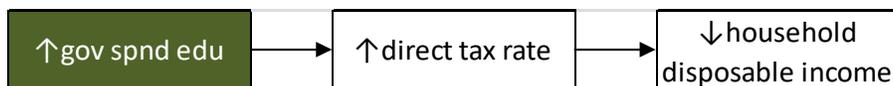
Figure 3b: main transmission channels gconedu-ftr; through government financing

| ↑gov spnd edu | → | ↑foreign aid | → | ↓real exchange rate | → | ↓exports and ↑imports |
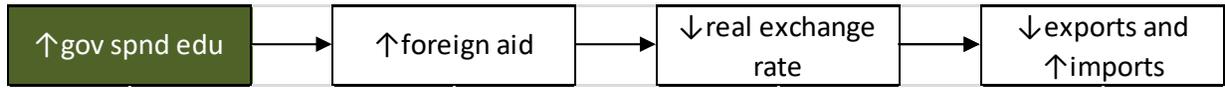
Figure 4: main transmission channels health spending scenarios; through government spending

| ↑gov spnd health | → | ↑labor productivity | → | ↑output | → | ↑wages and ↓unemployment |

| ↑hhd income | → | ↑hhd cons and sav |
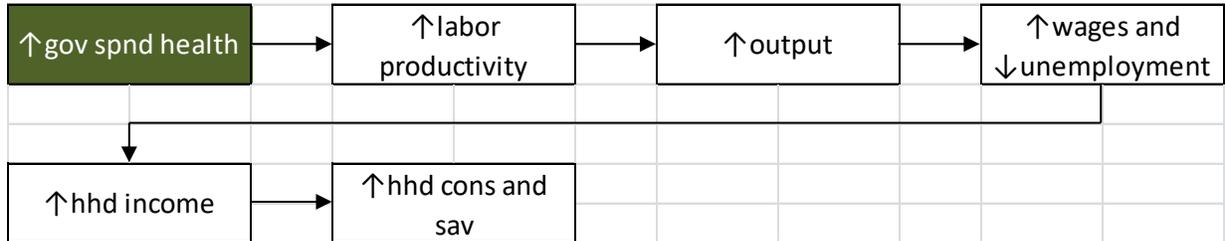
Figure 5: change in unemployment 2030
(percentage points from base)

■ skilled ■ unskilled
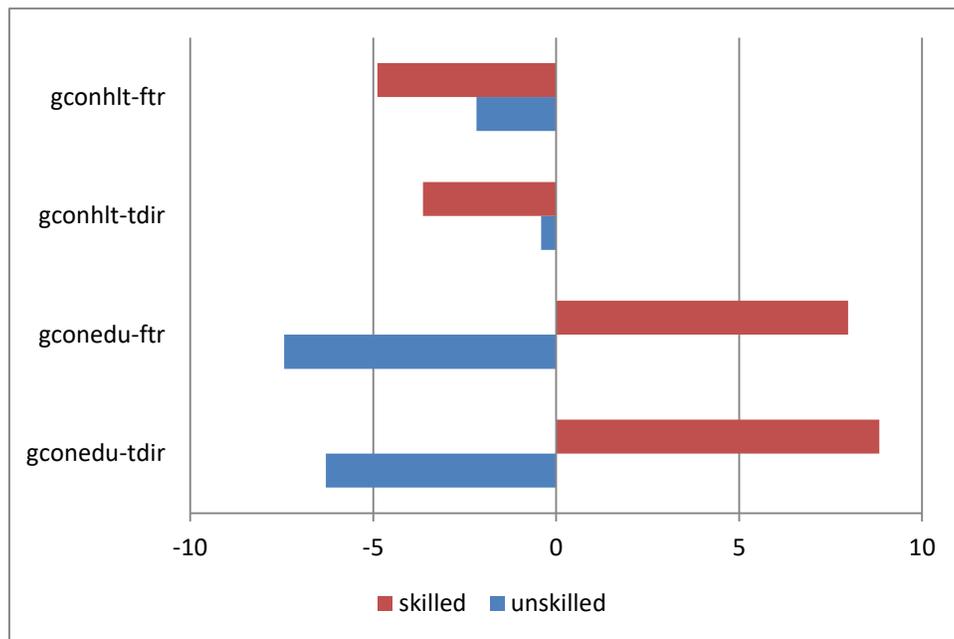
3. Sectoral Results

At the sectoral level, the wining sectors are those promoted by the government increased spending. For all other sectors, the impact on output is a function of their export and import orientation, and their importance in the consumption baskets of households.

Figure 6: change in sectoral real value added in 2030 scenario gconhlt-dir (percent deviation from base)

Source: Author's elaboration.

Table 2: change in sectoral real value added, exports, and imports
(percent deviation from base)

	base	gconedu-tdir		gconedu-ftr		gconhlt-tdir		gconhlt-ftr	
Commodity	2013	2016	2030	2016	2030	2016	2030	2016	2030
Value added									
Agr, hunting and forestry; Fishing	67,345	-0.34	-1.50	-0.05	-0.92	-0.29	0.31	0.08	1.88
Mining and quarrying	560	-1.07	-2.40	1.72	1.02	-1.07	-0.10	2.04	4.96
Food prod and beverages	6,639	-0.50	-1.58	-0.24	-0.24	-0.48	0.14	-0.13	2.82
Tobacco prod	118	-0.65	-1.60	-0.16	0.06	-0.66	-0.01	-0.05	2.99
Textiles, wearing apparel and leather	9,609	-1.24	-4.91	-17.23	-17.65	-1.02	5.13	-17.78	2.93
Wood and of prod of wood and cork	1,227	0.09	-1.64	0.88	0.65	0.22	1.50	1.19	6.11
Paper and paper prod; Publishing	1,856	-0.83	-2.34	1.36	0.70	-0.79	0.53	1.69	5.86
Chemicals; Rubber and plastics	839	0.21	-1.22	1.47	1.46	0.32	1.49	1.78	6.29
Other non-metallic mineral prod	1,426	-0.21	-1.52	1.20	1.21	-0.17	0.54	1.44	4.87
Basic metals	204	-1.05	-2.79	0.27	-0.04	-1.05	0.00	0.50	5.12
Fabricated metal prod; Mach and equip	208	0.00	-2.63	-3.05	-2.91	0.14	1.61	-3.00	5.27
Other manufactures	2,449	-0.90	-3.97	-5.59	-5.70	-0.84	0.37	-5.73	3.23
Electricity and water supply	6,366	-0.10	-1.04	1.32	1.43	-0.06	0.72	1.54	4.67
Construction	83,021	-0.51	-1.72	0.71	0.66	-0.50	-0.08	0.87	3.54
Wholesale and retail trade	90,090	-0.15	-1.43	1.70	0.95	-0.08	1.04	2.03	5.18
Hotels and restaurants, foreign tourism	1,134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transport, storage and comm	34,190	-0.31	-1.35	0.99	0.95	-0.27	0.72	1.22	4.79
Financial intermediation	6,990	3.44	2.94	4.05	4.56	3.78	5.18	4.54	8.84
Other market services	11,490	-0.36	-1.69	1.49	1.16	-0.32	0.59	1.77	5.16
Education, government	770	800.00	800.00	800.00	800.00	0.00	0.00	0.00	0.00
Health, government	2,227	0.00	0.00	0.00	0.00	300.00	300.00	300.00	300.00
Other government services	18,552	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2013 = million gourdes									

Table 2 (cont.): change in sectoral real value added, exports, and imports
(percent deviation from base)

| Commodity	base	gconedu-tdir		gconedu-ftr		gconhlt-tdir		gconhlt-ftr	
	2013	2016	2030	2016	2030	2016	2030	2016	2030
Exports									
Agr, hunting and forestry; Fishing	3,263	0.17	-2.19	-3.27	-4.26	0.38	0.74	-3.29	-0.10
Food prod and beverages	892	-0.50	-3.22	-6.21	-4.88	-0.37	0.79	-6.39	2.78
Textiles, wearing apparel and leather	21,600	-1.31	-5.22	-19.12	-19.18	-1.07	5.52	-19.75	2.87
Wood and of prod of wood and cork	906	-0.26	-4.65	-10.11	-7.54	0.03	2.16	-10.39	5.30
Chemicals; Rubber and plastics	599	-0.10	-2.50	-3.62	-1.93	0.03	1.50	-3.65	5.85
Other non-metallic mineral prod	6	-0.32	-3.44	-6.39	-3.76	-0.20	0.74	-6.62	4.69
Fabricated metal prod; Mach and equip	501	-0.49	-4.45	-9.36	-7.96	-0.32	1.56	-9.70	4.11
Other manufactures	8,161	-0.87	-4.65	-8.65	-8.29	-0.78	0.59	-8.98	2.73
Transport, storage and comm	3,801	-0.40	-1.66	-1.20	-0.31	-0.36	0.77	-1.12	4.76
Financial intermediation	566	2.69	2.91	1.43	3.60	2.93	5.00	1.71	8.77
Imports									
Agr, hunting and forestry; Fishing	26,478	-0.80	-1.08	2.46	1.70	-0.87	-0.01	2.72	3.68
Mining and quarrying	136	-1.26	-2.78	2.98	1.41	-1.25	-0.04	3.43	5.78
Food prod and beverages	24,386	-0.54	-1.03	2.49	1.78	-0.57	-0.15	2.75	2.95
Tobacco prod	546	-0.61	-1.19	2.93	2.04	-0.64	-0.22	3.23	3.28
Textiles, wearing apparel and leather	29,163	-0.63	-1.98	-0.92	-2.30	-0.60	1.25	-0.76	3.72
Wood and of prod of wood and cork	2,595	0.21	-0.92	4.73	3.30	0.32	1.38	5.30	6.80
Paper and paper prod; Publishing	2,185	-0.86	-2.11	3.59	1.90	-0.83	0.45	4.09	5.94
Chemicals; Rubber and plastics	25,695	0.41	-0.70	4.24	3.09	0.53	1.61	4.77	6.73
Other non-metallic mineral prod	2,098	-0.22	-1.31	2.93	2.06	-0.17	0.61	3.31	5.07
Basic metals	3,799	-1.02	-2.60	1.79	0.74	-1.01	-0.01	2.13	5.17
Fabricated metal prod; Mach and equip	19,595	0.69	-0.55	4.48	3.45	0.84	1.92	5.03	7.34
Other manufactures	1,204	-1.07	-1.84	4.64	3.44	-1.10	-0.34	5.15	5.30
Hotels and restaurants	2,047	2.85	1.41	12.46	7.94	3.19	3.86	13.73	11.30
Transport, storage and comm	27,048	-0.21	-1.02	3.35	2.28	-0.18	0.66	3.75	4.81
Financial intermediation	2,853	4.22	2.98	6.77	5.55	4.66	5.38	7.48	8.92
Other market services	1,476	-0.47	-1.28	4.34	2.43	-0.43	0.82	4.88	5.57

2013 = million gourdes

Source: Author's elaboration.

4. Distributive Results

The poverty impact captured in the microsimulation model depends essentially on two factors:

the change in the labor market conditions and the increase in per capita disposable (i.e., net of

taxes and savings) income. In all four human development scenarios, the 2030 poverty rate is lower than for the baseline, mainly as a result of a decrease in unskilled unemployment (see Figure 5), a higher average wage, and a decrease in the wage gap between unskilled and skilled labor. Once more, we use growth-incidence curves to assess the distributional impact of the various scenarios. In Figure 8a we see that the gconedu-ftr scenario has a pro-poor impact, with even negative impact on the highest percentiles of the income distribution. As explained, this is related to the increase in the unemployment rate of skilled workers. On the other hand, the health scenario with foreign financing generates growth-incidence curve that is positive and is nearly flat. Certainly, the poverty effect would be larger if a multidimensional measure of poverty were considered instead of only monetary poverty.

Figure 7: change in poverty
(percentage points from base)
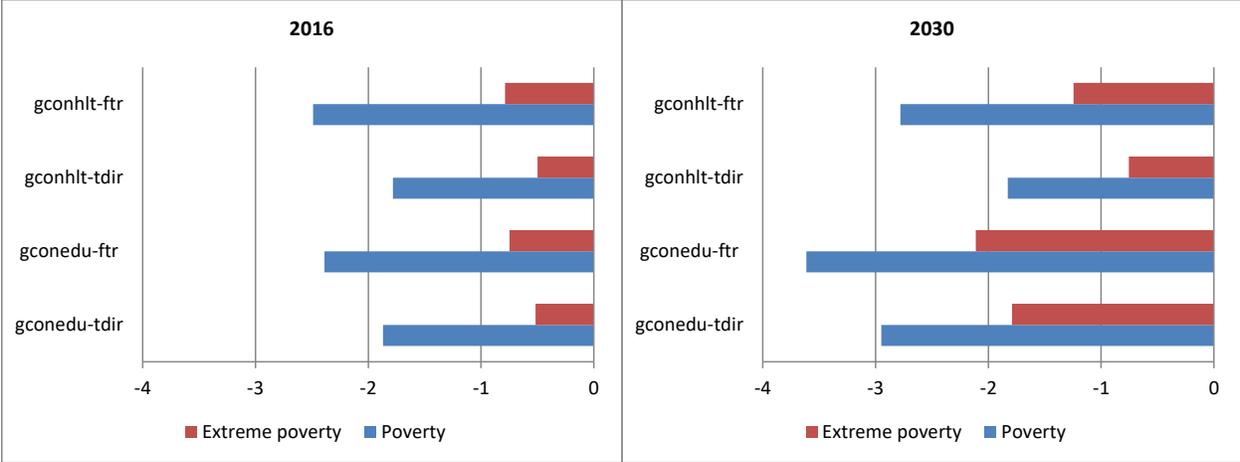
Source: Author's elaboration.

*Figure 8a: growth-incidence curves scenario gconedu-ftr; 2030
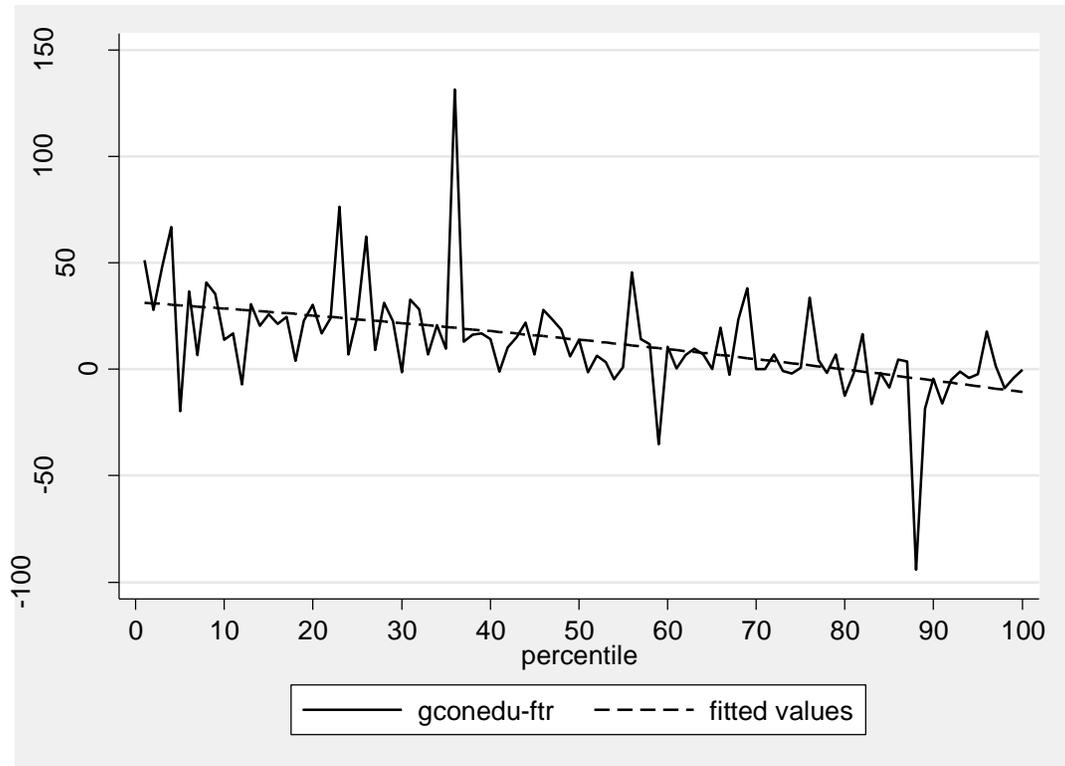household per capita income
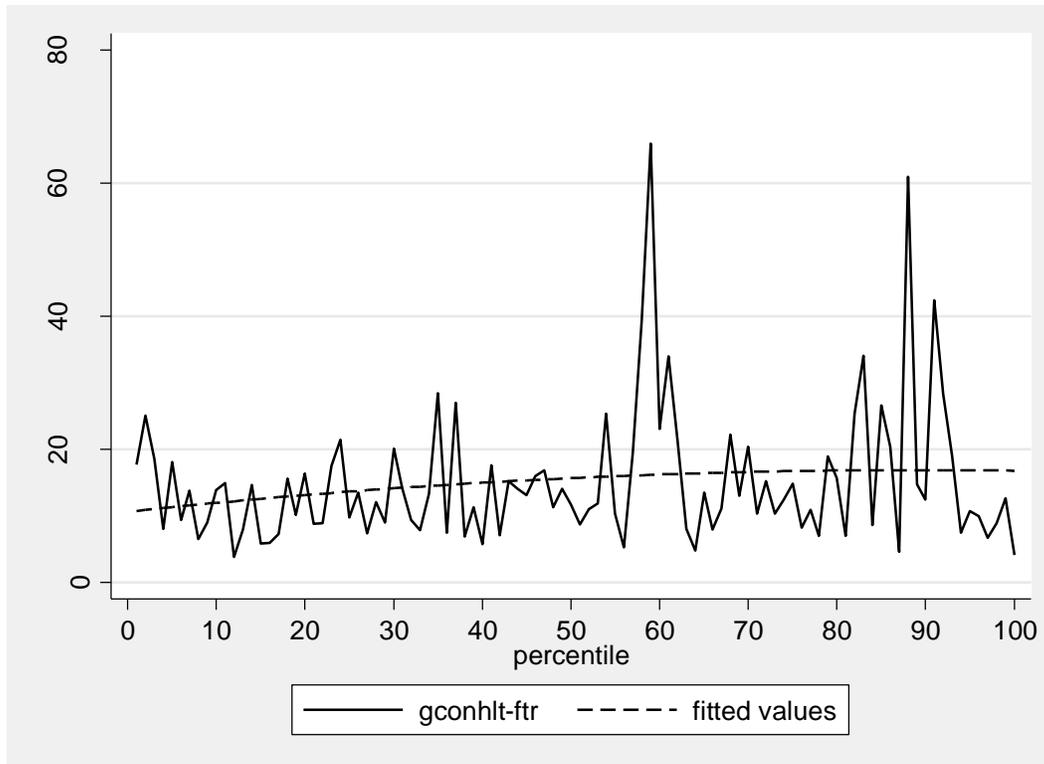proportional changes by percentile*

Figure 8b: growth-incidence curves scenario gconhlt-ftr; 2030
household per capita income
proportional changes by percentile

5. Sensitivity Analysis

In a companion document (i.e., "Government and Institutional Capacity"), we discuss the

relevance of conducting sensitivity analysis when applying the CGE method. In this section, we

focus on sensitivity analysis with respect to the values assigned to production and consumption

elasticities for the simulations presented in previous sections. Table 4 shows the percentage

change in private consumption estimated (i) under the central elasticities, and (ii) as the

average of the 500 observations generated by the sensitivity analysis. For the second case, the

upper and lower bounds under the normality assumption were also computed; notice that all runs from the Monte Carlo experiment receive the same weight. As can be seen, the results reported above are significant, while estimates presented in Table 1 are within the confidence intervals reported in Table 3. For example, there is virtual certainty that the **gconhlt-ftr** scenario has a positive effect on private consumption.

Table 4: sensitivity analysis; real private consumption in 2030
percent deviation from base
95% confidence interval under normality assumption

Scenario	Central elast	Mean	Standard dev	Lower bound	Upper bound
gconedu-tdir	-1.841	-1.682	0.221	-2.116	-1.248
gconedu-ftr	1.461	1.607	0.218	1.180	2.034
gconhlt-tdir	-0.159	-0.186	0.082	-0.346	-0.026
gconhlt-ftr	4.112	4.017	0.178	3.669	4.366

Source: Author's elaboration.

References

Cicowiez, Martin and Agustin Filippo, 2018a, Government and Institutional Capacity. Simulations in a CGE Model for Haiti, Project Document, Inter-American Development Bank.

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Singh Raju Jan and Mary Barton-Dock, 2015, Haiti: Toward a New Narrative, Systematic Country Diagnostic, Washington, DC: World Bank.

Sánchez, Marco V. and Martín Cicowiez, 2014, Trade-offs and Payoffs of Investing in Human Development, World Development, 62: 14-29.

Appendix: Additional Simulation Results

Figure A.1: real private consumption
average annual growth rate 2014-2030; percent
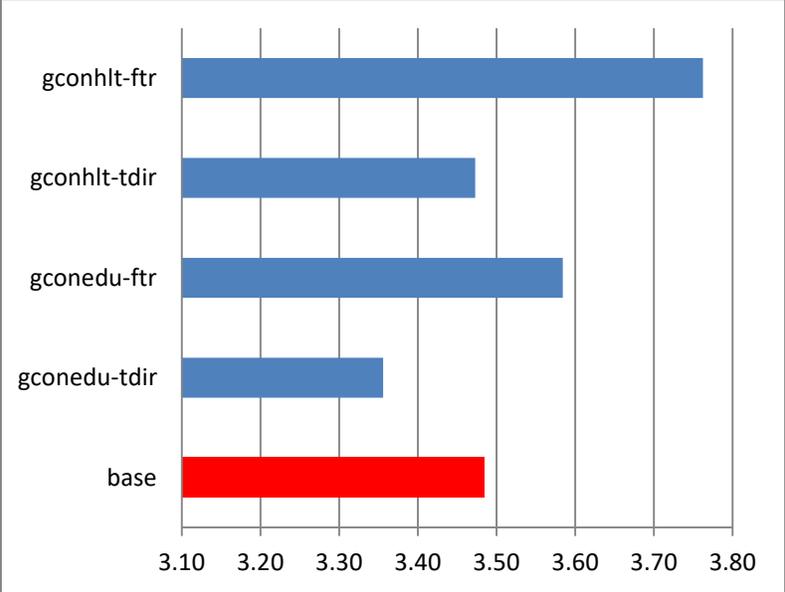
Table A.1: real macroeconomic aggregates
average annual growth rate 2014-2030; percent

Item	base 2013	base	gconedu-tdir	gconedu-ftr	gconhlt-tdir	gconhlt-ftr
Absorption	493,643	3.58	3.61	3.80	3.73	3.98
Private consumption	352,731	3.48	3.36	3.58	3.47	3.76
Fixed investment	109,528	3.60	3.48	3.64	3.59	3.84
Private fixed investment	50,796	3.60	3.33	3.69	3.58	4.10
Government fixed investment	58,732	3.60	3.60	3.60	3.60	3.60
Government fixed inv, infra	56,624	3.60	3.60	3.60	3.60	3.60
Change in stocks	57	3.57	3.57	3.57	3.57	3.57
Government consumption	31,327	4.49	6.25	6.25	6.38	6.38
Exports	44,879	4.36	4.07	3.44	4.59	4.55
Imports	171,307	3.81	3.74	3.94	3.88	4.16
GDP at market prices	367,215	3.57	3.60	3.69	3.77	3.97
Net indirect taxes	19,907	3.80	3.70	3.81	3.88	4.12
GDP at factor cost	347,308	3.57	3.61	3.70	3.77	3.97
Real exchange rate	1.00	-0.32	-0.36	-0.47	-0.30	-0.35
Wage, average	1.00	0.23	0.42	0.42	0.38	0.40
Unemployment rate	31.72	25.49	26.14	25.12	24.03	22.44
2013 = million gourdes						