

Production and Productive Sectors

Simulations in a CGE model for Haiti

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Production and Productive Sectors

Simulations in a CGE model for Haiti.

Martín Cicowiez¹ and Agustín Filippo²

Simulations

This document presents the group of simulations related to “Production and Productive Sectors”, and analyzes the results for both the CGE model and the microsimulation model. In a companion document (Cicowiez and Filippo 2018a), we provide a detailed description of the reference scenario results. 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 the first set of simulations presented here we show the effects of increased exogenous total factor productivity growth in various sectors of the Haitian economy. It should be noted that we do not model the source of this productivity growth. In the agricultural sector, productivity growth could be the result of investments in agricultural research and extension and/or increased use of improved seeds. In the non-agricultural sectors, productivity growth could be the result of technical change and/or improved management. Instead, our focus is on the

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effects of these productivity changes on other sectors of the economy (spillover effects) and on household incomes.

As documented in, among others, Singh and Barton-Dock (2015), and Katz (2018) Haiti's suffers from insufficient and poor infrastructure. Naturally, island economies such as Haiti are extremely dependent on the quality, frequency and cost of the means of transport that link them to export and import markets. Accordingly, the efficiency and effectiveness of transport contribute to the competitiveness of these countries. In this second group of simulations, we therefore consider increases in government investment in agriculture and transport infrastructure. For agriculture, even though 40 percent of jobs in Haiti are in agriculture, the country is far from developing a commercial agribusiness sector. In fact, the agriculture sector in Haiti has been declining for many years, the result of neglected rural infrastructure, weak research and extension, poorly defined land tenure, limited access to credit, and under-investment in human capital (Singh and Barton-Dock, 2015).

In both cases, the infrastructure simulations were run under alternative assumptions about the source of financing for the required additional government capital spending: foreign direct taxes (tdir), domestic borrowing (dbor), and foreign borrowing (fbor). Technically, this means that the rules for balancing the government accounts varied across scenarios, with sufficient increases in the indicated financing source playing the role of clearing the government balance. Compared to the base, another change in these scenarios is a modification in the rule for achieving savings-investment balance; specifically, private investment adjusts endogenously to maintain balance between total savings (from different sources) and total investment (i.e., investment becomes savings-driven). Consequently, these scenarios capture the crowding-out

of private investment when domestic sources are used to finance the increase in government investment in infrastructure. In our Haiti CGE model, infrastructure stocks, determined by publicly financed investment, affects growth in sectoral total factor productivities.³

Largely, tourism is viewed as a sector that can be a driver of economic growth and development, with significant potential for poverty alleviation. Thus, within the productive sector scenarios, we also assess the effects of an exogenous increase in foreign tourism arrivals. To that end, we extended our Haiti CGE model following Banerjee et al. (2015). Briefly, such extensions imply that foreign tourism is a source of (a) demand for (mostly) domestic commodities (goods and services), and (b) foreign exchange.

Specifically, the following non-base simulations were simulated:

- tfp_{agr} = 25 percent increase in agriculture TFP
- tfp_{agr-ex} = 25 percent increase in agriculture TFP combined with increase in agriculture export intensity (i.e., the ratio between exports and output is exogenously increased)⁴
- tfp_{mnf} = 25 percent increase in manufactures TFP
- tfp_{svc} = 25 percent increase in (non-government) services TFP
- $infagr-t_{dir}$ = increase in agriculture infrastructure equivalent to 2.5 percent of GDP, with direct tax financing
- $infagr-d_{bor}$ = increase in agriculture infrastructure equivalent to 2.5 percent of GDP, with domestic borrowing financing
- $infagr-f_{bor}$ = increase in agriculture infrastructure equivalent to 2.5 percent of GDP, with foreign borrowing financing

³ For a more detailed description of the links between infrastructure and TFP, see Appendix A.

⁴ Technically, we re-calibrate the behavioral parameters of the Constant Elasticity of Transformation function so that its so that, at given prices (PE_0 and PD_0) and given output level ($QX_0=QX_1$), the optimal QE/QD ratio changes as imposed with unchanged revenue at the new optimal quantities; i.e., $PX_0*QX_0 = PX_0*QX_1 = PE_0*QE_0 + PD_0*QD_0 = PE_0*QE_1 + PD_0*QD_1$.

- infttrns-tidir = increase in transport infrastructure equivalent to 2.5 percent of GDP, with direct tax financing
- infttrns-dbor = increase in transport infrastructure equivalent to 2.5 percent of GDP, with domestic borrowing financing
- intrns-fbor = increase in transport infrastructure equivalent to 2.5 percent of GDP, with foreign borrowing financing
- tourism = 25% increase in tourist arrivals

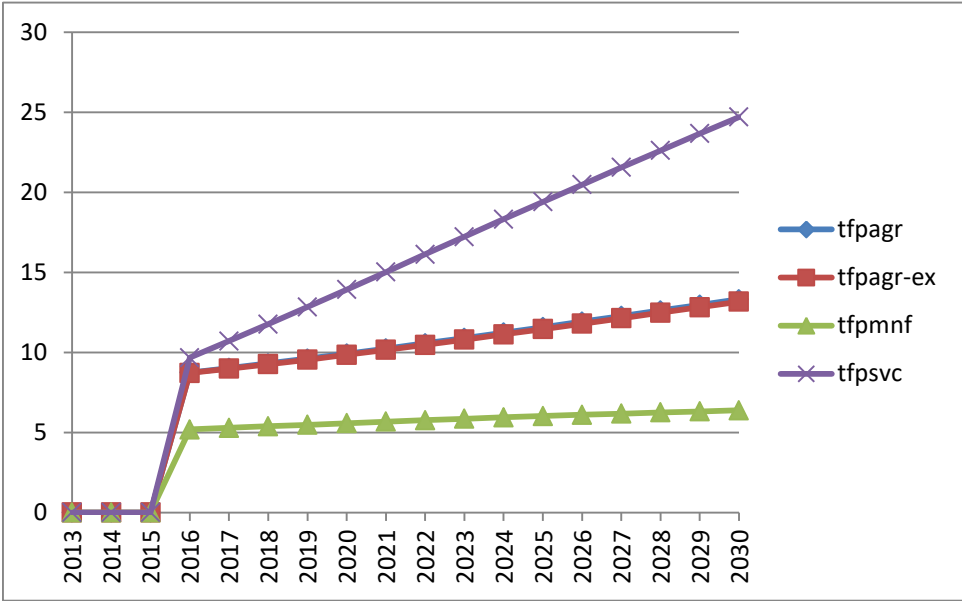
2. Aggregate Results

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).

Figure 2 summarizes the main transmission channels in the total factor productivity scenario tfpagr. For the other TFP scenarios, the main transmission channels are similar, although the targeted sector differs. In the four TFP scenarios, increased total factor productivity results in increased output of a sector, but a reduction in the amount of labor, land (only for agriculture), and capital used in that sector. (In the tfpagr-ex scenario, the increase in export orientation for agriculture lessens the decrease in sectoral factor use.) The increase in supply of the sector’s goods (or services) results in a decline in the real price since demand increases (brought about by increases in household incomes and investment demand) are in general less than the increase in supply. At the same time, the reduction in the use of factors of production from the

sector experiencing the productivity shock frees up these factors for use in other sectors of the economy. Thus, real GDP and household income rise in all scenarios. The size of the change in real GDP, the changes in output quantities and prices, and changes in incomes of various household groups all vary according to which sector is shocked (see Table 1).

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



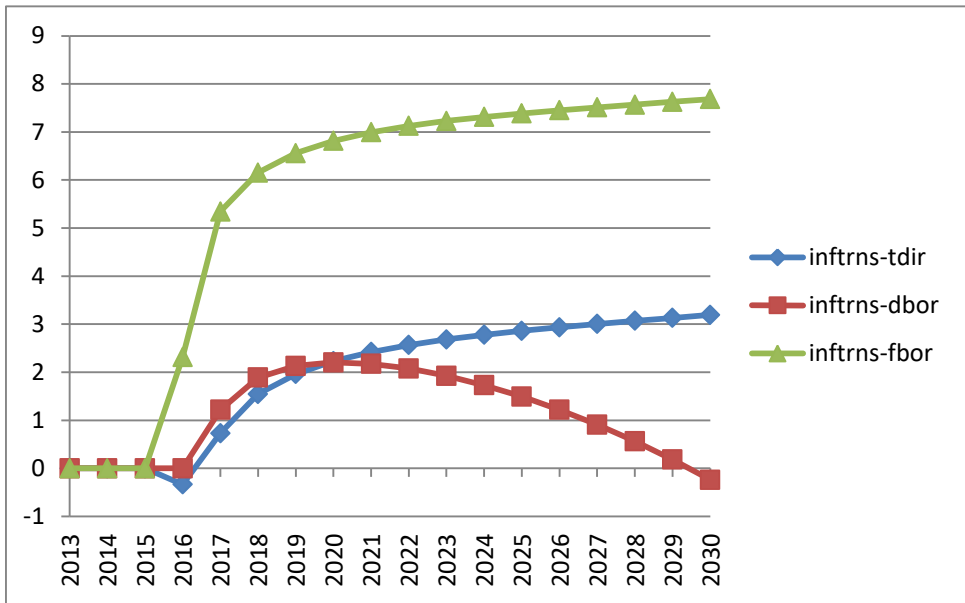
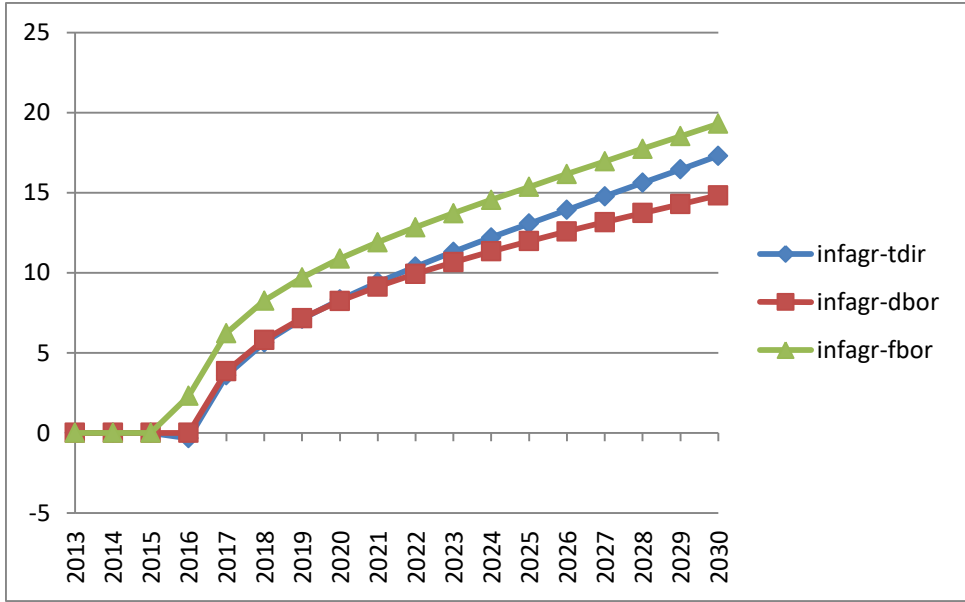
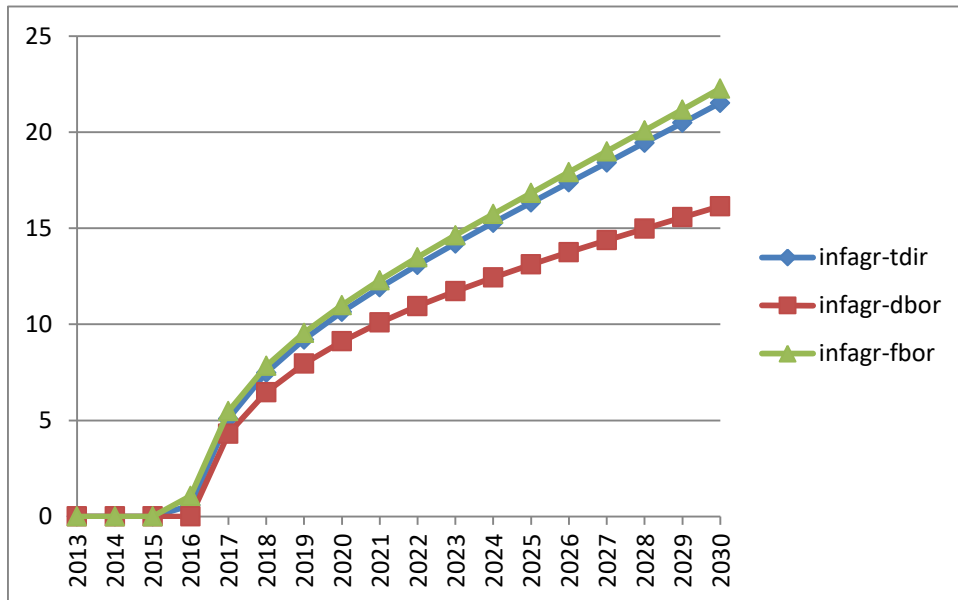
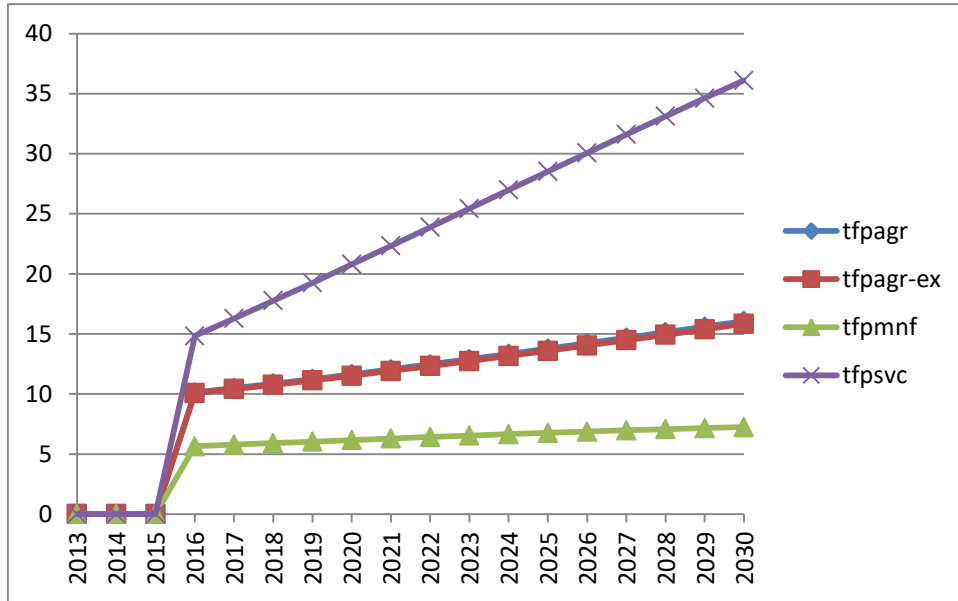
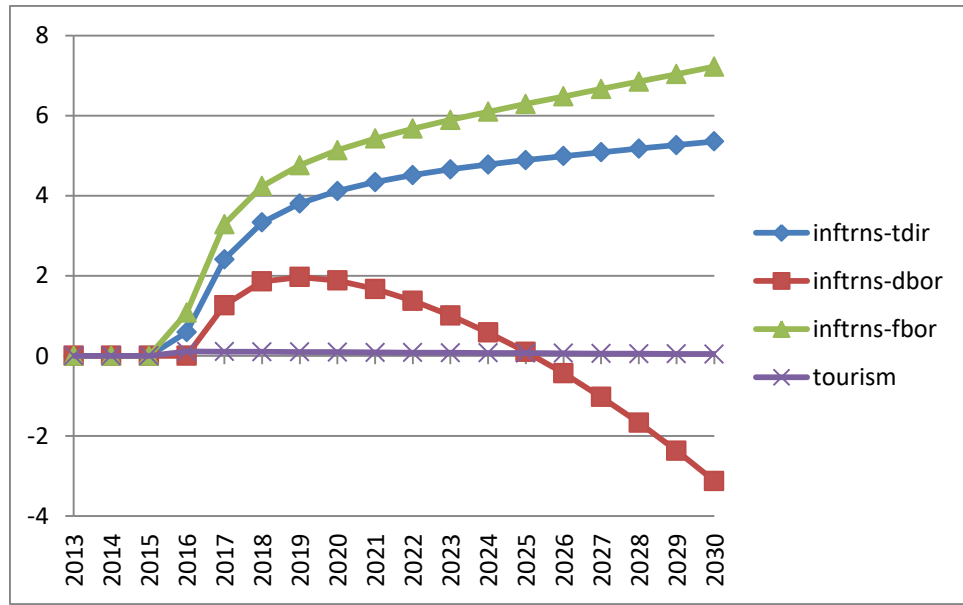


Figure 1b: change in real GDP at factor cost 2013-2030
(percent deviation from base)





Source: Author's elaboration.

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

Item	base 2013	tfpagr 2016	tfpagr 2030	tfpagr-e 2016	tfpagr-e 2030	tfpmnf 2016	tfpmnf 2030	tfpsvc 2016	tfpsvc 2030
Absorption	493,643	7.20	11.72	7.17	11.58	4.05	5.11	10.82	26.01
Private consumption	352,731	8.74	13.32	8.71	13.17	5.19	6.38	9.67	24.69
Fixed investment	109,528	4.36	10.54	4.30	10.39	1.57	2.75	17.75	38.84
Private fixed investment	50,796	9.41	22.73	9.27	22.41	3.38	5.94	38.27	83.74
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exports	44,879	27.77	49.29	27.79	48.44	37.24	42.42	45.48	109.91
Imports	171,307	7.00	13.36	6.99	13.12	9.32	11.47	11.67	30.06
GDP at market prices	367,215	9.88	16.15	9.84	15.97	5.73	7.21	14.77	35.72
Net indirect taxes	19,907	8.71	16.50	8.47	16.08	9.49	11.85	16.41	41.95
GDP at factor cost	347,308	10.13	16.07	10.07	15.84	5.65	7.25	14.84	36.11
Real exchange rate	1.00	3.04	4.58	2.70	4.45	-7.58	-7.78	10.59	11.99
Wage, average	1.00	6.06	8.09	5.68	7.81	1.39	2.21	-1.09	5.03
Capital return, average	1.00	13.83	7.37	13.78	7.33	7.36	4.55	4.32	-16.95
Unemployment rate	31.72	-13.33	-28.87	-13.96	-28.90	-16.74	-21.55	-18.24	-44.45
2013 = million gourdes									

(*) Note: exports in Table 1 include tourism exports.

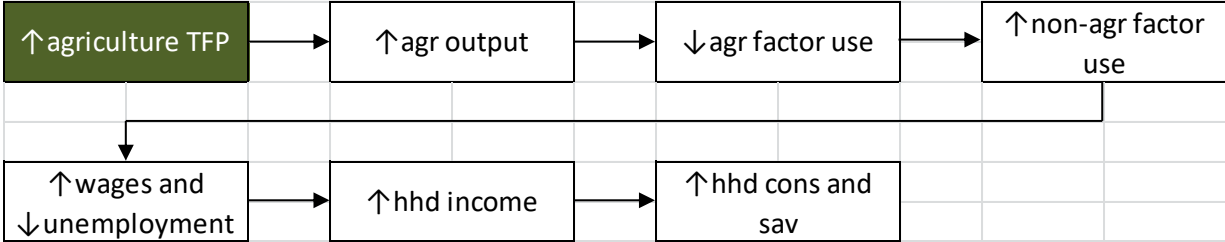
*Table 1 (cont.): change in real macro indicators
(percent deviation from base)*

Item	base	infagr-tdir		infagr-dbor		infagr-fbor	
	2013	2016	2030	2016	2030	2016	2030
Absorption	493,643	0.42	15.55	0.00	11.64	2.54	17.34
Private consumption	352,731	-0.34	17.30	0.00	14.83	2.31	19.30
Fixed investment	109,528	2.99	15.19	0.00	5.40	4.02	16.88
Private fixed investment	50,796	-4.07	20.82	-10.52	-0.29	-1.84	24.46
Government fixed investment	58,732	9.10	10.32	9.10	10.32	9.10	10.32
Government fixed inv, infra	56,624	9.43	10.70	9.43	10.70	9.43	10.70
Change in stocks	57	0.00	0.00	0.00	0.00	0.00	0.00
Government consumption	31,327	0.00	0.00	0.00	0.00	0.00	0.00
Exports	44,879	-0.61	60.33	0.00	47.84	-10.06	52.91
Imports	171,307	-0.14	16.35	0.00	12.93	2.34	17.60
GDP at market prices	367,215	0.56	21.40	0.00	16.05	1.05	22.17
Net indirect taxes	19,907	-0.01	19.88	0.00	15.05	0.89	20.42
GDP at factor cost	347,308	0.59	21.52	0.00	16.15	1.08	22.27
Real exchange rate	1.00	-0.88	4.34	0.00	3.24	-3.63	4.14
Wage, average	1.00	0.89	12.95	0.00	10.85	0.69	12.75
Capital return, average	1.00	3.10	21.98	0.00	26.55	5.58	21.03
Unemployment rate	31.72	-0.69	-38.76	0.00	-32.35	-4.00	-40.41
2013 = million gourdes							

Item	base	inftrns-tdir		inftrns-dbor		inftrns-fbor		tourism		
	2013	2016	2030	2016	2030	2016	2030	2016	2030	
Absorption	493,643	0.42	3.74	0.00	-2.37	2.54	7.60	0.12	0.05	
Private consumption	352,731	-0.34	3.19	0.00	-0.24	2.31	7.68	0.16	0.08	
Fixed investment	109,528	2.99	6.71	0.00	-9.92	4.02	9.87	0.03	-0.02	
Private fixed investment	50,796	-4.07	-3.07	-10.52	-38.91	-1.84	3.76	0.06	-0.03	
Government fixed investment	58,732	9.10	15.16	9.10	15.16	9.10	15.16	0.00	0.00	
Government fixed inv, infra	56,624	9.43	15.72	9.43	15.72	9.43	15.72	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Exports	44,879	-0.61	7.16	0.00	-9.55	-10.06	-3.84	0.94	0.58	
Imports	171,307	-0.14	2.01	0.00	-2.56	2.34	5.72	0.34	0.20	
GDP at market prices	367,215	0.56	5.05	0.00	-3.27	1.05	6.92	0.12	0.05	
Net indirect taxes	19,907	-0.01	4.49	0.00	-2.59	0.89	6.60	0.31	0.19	
GDP at factor cost	347,308	0.59	5.35	0.00	-3.13	1.08	7.22	0.11	0.04	
Real exchange rate	1.00	-0.88	0.76	0.00	-1.52	-3.63	-1.09	-0.40	-0.26	
Wage, average	1.00	0.89	0.85	0.00	-2.13	0.69	0.74	-0.02	-0.04	
Capital return, average	1.00	3.10	11.36	0.00	18.58	5.58	10.71	0.34	0.20	
Unemployment rate	31.72	-0.69	-13.22	0.00	-2.83	-4.00	-18.62	-0.66	-0.48	
2013 = million gourdes										

Source: Author’s elaboration.

Figure 2: main transmission channels agriculture TFP scenario



Source: Author’s elaboration.

Figure 3 and Figure 4 summarize the main transmission channels for the second group of counterfactual simulations, through government investment in infrastructure and government

financing, respectively. In the agriculture infrastructure scenarios, yearly GDP growth gains between 1 (domestic borrowing) and 1.4 (foreign borrowing) percentage points and is accompanied by expansion, not only in government demands, but also in private consumption and private investment as additional infrastructure permit private incomes and savings to grow more rapidly with a positive feedback into the growth process (see Table 1). Moreover, an increase in the agriculture-specific infrastructure capital stock raises total factor productivity in agriculture.

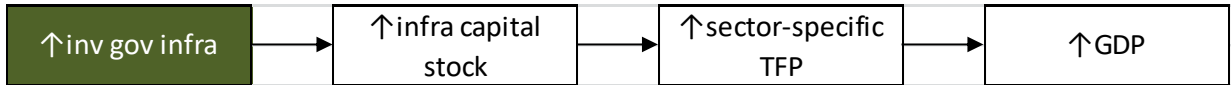
For the transport infrastructure scenarios, given its smaller direct contribution to GDP, the acceleration of growth in GDP is weaker.⁵ Besides, note that the impact on the rest of the economy from increased investment in transport infrastructure depends on the financing mechanism. In case the marginal financing comes from domestic borrowing, growth declines for private consumption, investment, and GDP. On the other hand, when marginal financing comes from foreign sources (in the form of grants or borrowing), 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.

As showed, financing the infrastructure investments through increased foreign financing allows each of the domestic household groups to increase their consumption level at a higher growth rate (see Table C.1). This may seem to suggest that increasing foreign financing is a better alternative but, in reality, it simply reflects that the analysis that we are conducting ignores the

⁵ For transport, we assume that infrastructure investment has a positive effect on transport sector TFP. However, we may also assume that it also has a positive impact on other sectors TFP; see Perrault et al. (2012).

accumulation of assets by the actors in the model: if foreign financing consist of foreign direct investment or foreign borrowing, they will tend to reduce the share of output that is available to Haitian residents.

Figure 3: main transmission channels infrastructure scenarios; through government investment



Source: Author’s elaboration.

Figure 4a: main transmission channels infra-tdir; through government financing

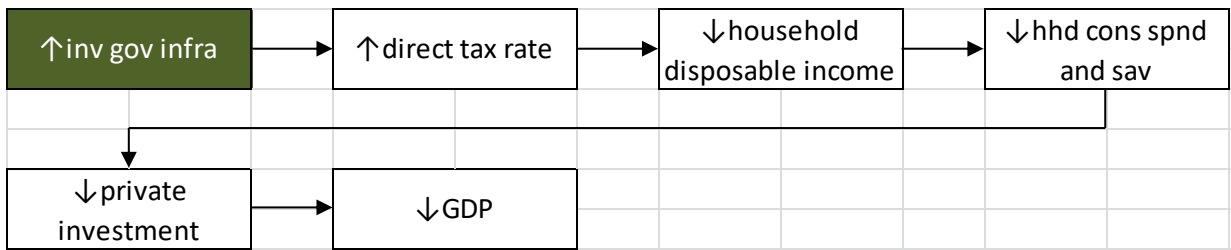


Figure 4b: main transmission channels infra-dbor; through government financing

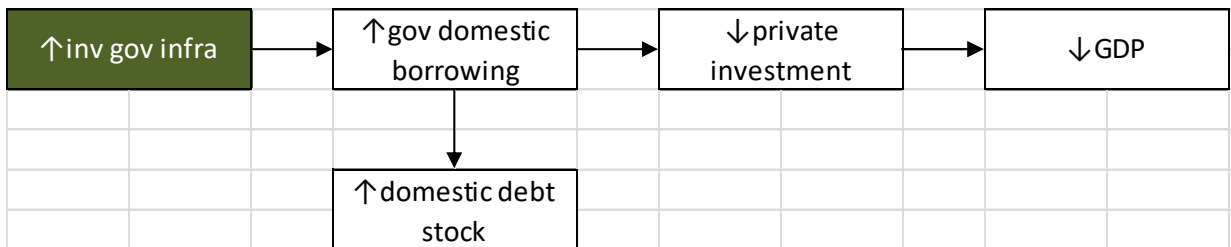
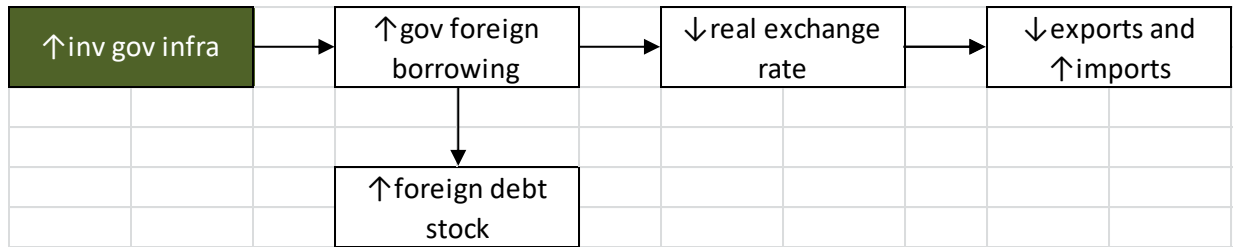


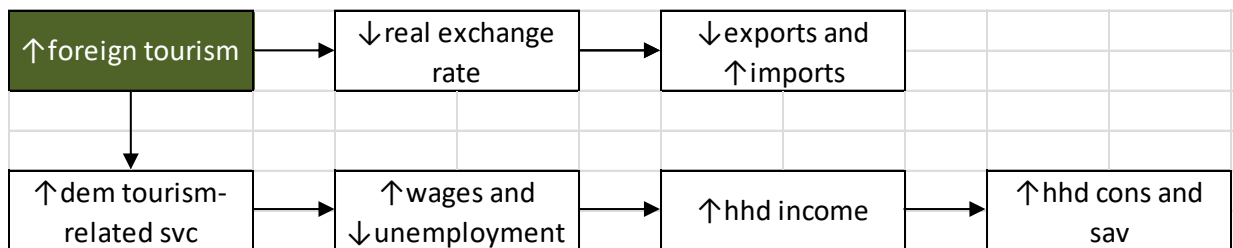
Figure 4c: main transmission channels infra-fbor; through government financing



Source: Author’s elaboration.

Figure 5 summarizes the main transmission channels in the tourism scenario. Overall, higher household income growth is achieved with increased foreign tourism demand, because these inflows of foreign exchange increase total resources in the economy. However, as shown in Table 1, the expansion of tourism demand tends to expand domestic absorption more rapidly than it expands GDP, also causing deterioration in the trade balance. In other words, the increase in “tourism exports” also generates an appreciation of the real exchange rate that hurts the tradable sectors.

Figure 5: main transmission channels tourism



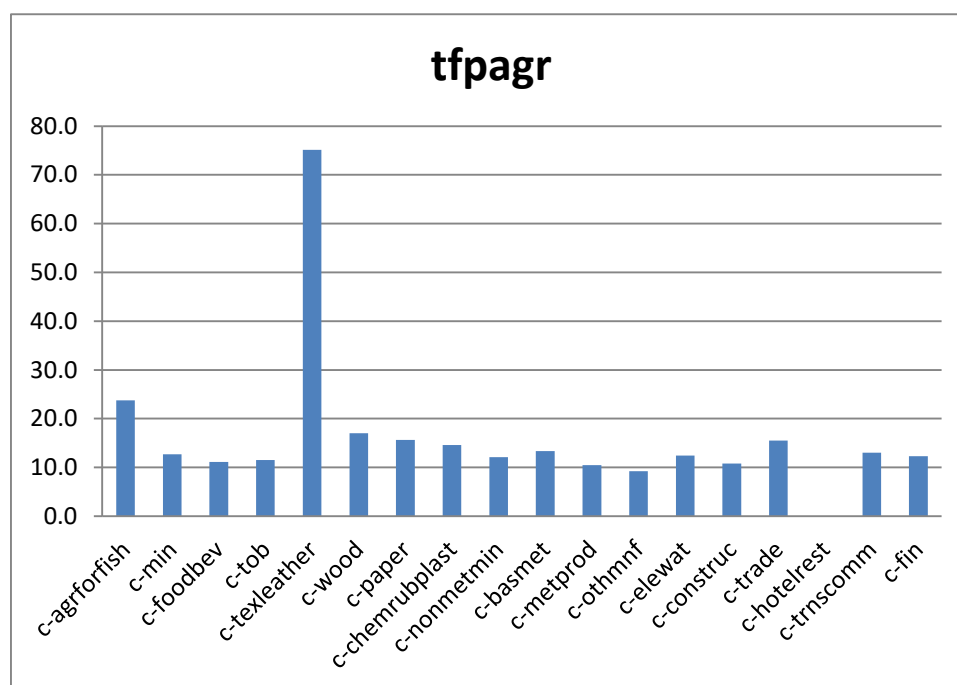
Source: Author’s elaboration.

3. Sectoral Results

In all TFP and infrastructure scenarios we found that the most favored sector in terms of VA growth acceleration is Textiles, wearing apparel and leather. Again, this is explained by its relatively high export-to-output ratio.

For the tourism scenario, service industries selling directly to tourists, including Hotels and restaurants, are strongly stimulated by the expansion in tourism. On the other hand, the upward pressure on prices and the real exchange rate leads to reduced competitiveness of traditional export sectors (see Table 2).

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



Source: Author's elaboration.

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

Commodity	base	tfpagr		tfpagr-ex		tfpmnf		tfpsvc	
	2013	2016	2030	2016	2030	2016	2030	2016	2030
<i>Value added</i>									
Agr, hunting and forestry; Fishing	67,345	19.98	23.78	20.56	24.06	1.85	2.49	4.84	11.27
Mining and quarrying	560	7.26	12.70	7.20	12.53	3.54	4.42	17.67	40.18
Food prod and beverages	6,639	6.86	11.11	6.70	10.96	6.25	6.05	8.81	21.92
Tobacco prod	118	6.87	11.53	6.69	11.36	4.50	4.92	10.28	23.19
Textiles, wearing apparel and leather	9,609	43.06	75.11	39.05	71.31	67.05	72.18	57.15	104.17
Wood and of prod of wood and cork	1,227	10.32	16.99	10.01	16.69	6.92	6.42	21.18	47.67
Paper and paper prod; Publishing	1,856	8.99	15.66	8.79	15.37	11.65	12.30	19.89	48.23
Chemicals; Rubber and plastics	839	7.80	14.61	7.68	14.41	10.09	9.54	17.17	50.51
Other non-metallic mineral prod	1,426	5.53	12.08	5.46	11.91	6.51	6.65	15.95	43.25
Basic metals	204	6.12	13.32	5.95	13.08	5.86	6.70	24.77	69.03
Fabricated metal prod; Mach and equip	208	2.35	10.46	1.90	10.06	7.23	5.18	32.00	134.61
Other manufactures	2,449	1.41	9.19	0.85	8.72	8.90	6.59	37.69	165.12
Electricity and water supply	6,366	5.46	12.44	5.37	12.22	4.06	6.11	17.27	42.99
Construction	83,021	4.63	10.77	4.58	10.62	1.67	2.86	17.54	38.73
Wholesale and retail trade	90,090	9.50	15.52	9.43	15.30	7.54	8.92	15.62	39.91
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	7.19	13.02	7.10	12.84	3.16	4.53	20.87	46.47
Financial intermediation	6,990	6.84	12.28	6.66	12.04	3.74	4.56	22.67	51.31
Other market services	11,490	8.40	15.56	8.37	15.37	5.01	6.97	10.99	39.15
Education, government	770	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Health, government	2,227	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	tfpagr		tfpagr-ex		tfpmnf		tfpsvc	
	2013	2016	2030	2016	2030	2016	2030	2016	2030
<i>Exports</i>									
Agr, hunting and forestry; Fishing	3,263	55.63	53.38	92.45	90.63	-9.79	-10.89	2.18	-0.29
Food prod and beverages	892	9.82	16.58	8.98	16.16	4.49	1.32	27.71	50.07
Textiles, wearing apparel and leather	21,600	46.65	80.32	42.23	76.22	72.88	77.23	62.38	111.41
Wood and of prod of wood and cork	906	10.86	22.78	9.47	22.07	-5.67	-7.77	56.19	109.19
Chemicals; Rubber and plastics	599	4.15	14.20	3.67	13.87	9.17	6.86	28.22	82.46
Other non-metallic mineral prod	6	-1.11	9.88	-1.70	9.54	6.72	2.67	32.12	98.34
Fabricated metal prod; Mach and equip	501	-2.34	7.92	-3.19	7.34	3.79	0.25	48.01	201.64
Other manufactures	8,161	-0.84	7.83	-1.63	7.26	9.16	5.69	46.18	205.78
Transport, storage and comm	3,801	5.58	12.46	5.33	12.22	-2.26	-0.83	36.46	70.91
Financial intermediation	566	6.69	12.37	6.35	12.08	-1.26	-0.57	39.45	74.05
<i>Imports</i>									
Agr, hunting and forestry; Fishing	26,478	-4.34	2.84	-3.91	2.87	11.92	14.45	9.11	25.36
Mining and quarrying	136	9.16	14.50	9.15	14.33	6.30	7.06	23.06	43.24
Food prod and beverages	24,386	4.07	7.12	4.22	7.10	3.15	5.38	4.08	13.14
Tobacco prod	546	3.59	7.07	3.74	7.03	4.21	6.27	4.02	14.05
Textiles, wearing apparel and leather	29,163	12.79	24.97	12.08	24.01	17.47	22.58	15.72	37.61
Wood and of prod of wood and cork	2,595	8.42	12.87	8.48	12.75	6.04	7.38	15.29	31.65
Paper and paper prod; Publishing	2,185	10.95	16.41	10.89	16.16	7.93	9.36	17.40	36.66
Chemicals; Rubber and plastics	25,695	9.91	14.55	9.97	14.42	7.13	8.24	15.06	35.25
Other non-metallic mineral prod	2,098	7.50	12.56	7.53	12.43	1.84	4.06	17.71	33.31
Basic metals	3,799	7.40	13.64	7.33	13.43	6.71	7.51	20.31	57.76
Fabricated metal prod; Mach and equip	19,595	8.30	13.94	8.29	13.77	5.62	6.91	18.17	38.20
Other manufactures	1,204	9.16	14.14	9.32	14.07	3.78	6.29	12.75	17.33
Hotels and restaurants	2,047	16.37	18.84	16.62	18.70	17.82	15.68	14.69	30.89
Transport, storage and comm	27,048	8.90	13.61	8.99	13.47	9.15	10.43	6.00	23.81
Financial intermediation	2,853	7.00	12.21	6.98	12.02	9.04	10.04	7.53	30.86
Other market services	1,476	13.82	16.77	13.96	16.63	13.08	13.03	15.25	27.71
2013 = million gourdes									

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

Commodity	base	infagr-tdir		infagr-dbor		infagr-fbor	
	2013	2016	2030	2016	2030	2016	2030
Value added							
Agr, hunting and forestry; Fishing	67,345	-0.06	39.08	0.00	36.77	0.19	39.60
Mining and quarrying	560	0.20	13.97	0.00	9.07	2.56	16.18
Food prod and beverages	6,639	-0.19	13.48	0.00	10.76	0.04	14.64
Tobacco prod	118	-0.29	13.85	0.00	11.20	0.14	15.23
Textiles, wearing apparel and leather	9,609	-0.97	94.75	0.00	78.12	-14.75	82.03
Wood and of prod of wood and cork	1,227	-0.44	18.77	0.00	14.05	0.24	20.78
Paper and paper prod; Publishing	1,856	-0.42	16.75	0.00	12.04	1.43	18.68
Chemicals; Rubber and plastics	839	-0.33	15.10	0.00	10.21	0.76	17.14
Other non-metallic mineral prod	1,426	1.16	14.16	0.00	6.93	2.35	16.10
Basic metals	204	0.42	13.40	0.00	6.78	1.53	15.54
Fabricated metal prod; Mach and equip	208	-0.24	4.28	0.00	-3.07	-2.83	5.43
Other manufactures	2,449	0.17	1.89	0.00	-7.02	-3.80	2.47
Electricity and water supply	6,366	-0.29	12.88	0.00	8.51	0.91	14.41
Construction	83,021	2.85	15.42	0.00	5.87	3.87	17.09
Wholesale and retail trade	90,090	-0.07	19.09	0.00	14.82	1.49	20.47
Hotels and restaurants, foreign tourism	1,134	0.00	0.00	0.00	0.00	0.00	0.00
Transport, storage and comm	34,190	-0.18	14.48	0.00	10.32	0.92	16.00
Financial intermediation	6,990	-0.01	13.43	0.00	8.99	0.53	14.59
Other market services	11,490	-0.19	17.57	0.00	12.71	1.38	19.38
Education, government	770	0.00	0.00	0.00	0.00	0.00	0.00
Health, government	2,227	0.00	0.00	0.00	0.00	0.00	0.00
Other government services	18,552	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	infagr-tdir		infagr-dbor		infagr-fbor	
	2013	2016	2030	2016	2030	2016	2030
Exports							
Agr, hunting and forestry; Fishing	3,263	-0.16	102.41	0.00	101.23	-3.05	101.53
Food prod and beverages	892	-0.33	17.00	0.00	11.08	-5.14	17.62
Textiles, wearing apparel and leather	21,600	-1.04	101.30	0.00	83.45	-16.38	87.41
Wood and of prod of wood and cork	906	-0.56	18.56	0.00	8.66	-8.82	19.50
Chemicals; Rubber and plastics	599	-0.35	9.47	0.00	2.05	-3.27	11.17
Other non-metallic mineral prod	6	-0.12	2.31	0.00	-7.66	-5.24	3.82
Fabricated metal prod; Mach and equip	501	-0.43	-5.07	0.00	-14.85	-7.92	-4.77
Other manufactures	8,161	-0.18	-3.34	0.00	-13.28	-6.77	-3.34
Transport, storage and comm	3,801	-0.20	11.27	0.00	5.87	-0.87	12.64
Financial intermediation	566	-0.10	11.98	0.00	6.88	-1.09	12.94
Imports							
Agr, hunting and forestry; Fishing	26,478	0.02	0.27	0.00	-2.46	2.78	1.34
Mining and quarrying	136	0.29	17.59	0.00	12.61	3.89	20.12
Food prod and beverages	24,386	-0.13	9.31	0.00	8.08	2.43	10.71
Tobacco prod	546	-0.19	8.89	0.00	7.66	2.81	10.49
Textiles, wearing apparel and leather	29,163	-0.38	31.59	0.00	26.27	-0.67	29.95
Wood and of prod of wood and cork	2,595	-0.43	15.24	0.00	12.38	3.39	17.61
Paper and paper prod; Publishing	2,185	-0.40	20.20	0.00	16.65	3.36	22.31
Chemicals; Rubber and plastics	25,695	-0.35	17.88	0.00	14.59	2.90	20.09
Other non-metallic mineral prod	2,098	1.67	17.45	0.00	11.04	4.34	19.44
Basic metals	3,799	0.51	15.63	0.00	9.78	2.89	17.86
Fabricated metal prod; Mach and equip	19,595	-0.02	16.62	0.00	12.46	3.20	19.01
Other manufactures	1,204	1.42	20.99	0.00	15.75	6.28	23.81
Hotels and restaurants	2,047	-0.72	24.18	0.00	20.91	7.41	27.65
Transport, storage and comm	27,048	-0.17	17.93	0.00	15.18	2.85	19.63
Financial intermediation	2,853	0.09	14.96	0.00	11.20	2.19	16.33
Other market services	1,476	-0.20	23.97	0.00	21.52	3.86	25.71
2013 = million gourdes							

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

Commodity	base	inftrns-tdir		inftrns-dbor		inftrns-fbor		tourism	
	2013	2016	2030	2016	2030	2016	2030	2016	2030
Value added									
Agr, hunting and forestry; Fishing	67,345	-0.06	0.55	0.00	-2.29	0.19	1.33	0.03	0.01
Mining and quarrying	560	0.20	2.22	0.00	-5.76	2.56	6.75	0.11	0.03
Food prod and beverages	6,639	-0.19	0.33	0.00	-3.93	0.04	2.17	0.79	0.94
Tobacco prod	118	-0.29	1.17	0.00	-2.96	0.14	3.44	-0.07	-0.06
Textiles, wearing apparel and leather	9,609	-0.97	2.86	0.00	-15.24	-14.75	-14.14	-2.32	-2.42
Wood and of prod of wood and cork	1,227	-0.44	1.07	0.00	-6.19	0.24	4.23	0.13	0.14
Paper and paper prod; Publishing	1,856	-0.42	2.26	0.00	-5.10	1.43	6.35	0.09	0.01
Chemicals; Rubber and plastics	839	-0.33	2.93	0.00	-5.22	0.76	6.62	-0.01	-0.06
Other non-metallic mineral prod	1,426	1.16	4.12	0.00	-7.96	2.35	7.78	0.03	-0.02
Basic metals	204	0.42	4.92	0.00	-6.84	1.53	8.59	-0.07	-0.14
Fabricated metal prod; Mach and equip	208	-0.24	3.04	0.00	-11.81	-2.83	2.95	-0.52	-0.57
Other manufactures	2,449	0.17	7.09	0.00	-12.14	-3.80	4.64	-0.68	-0.76
Electricity and water supply	6,366	-0.29	2.65	0.00	-4.28	0.91	6.03	0.11	0.05
Construction	83,021	2.85	6.52	0.00	-9.66	3.87	9.66	0.03	-0.01
Wholesale and retail trade	90,090	-0.07	3.15	0.00	-3.34	1.49	6.34	0.23	0.14
Hotels and restaurants, foreign tourism	1,134	0.00	0.00	0.00	0.00	0.00	0.00	25.00	25.00
Transport, storage and comm	34,190	-0.18	23.48	0.00	15.42	0.92	27.37	0.04	-0.02
Financial intermediation	6,990	-0.01	8.18	0.00	0.37	0.53	10.52	0.03	-0.03
Other market services	11,490	-0.19	2.22	0.00	-5.33	1.38	6.05	0.14	0.07
Education, government	770	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Health, government	2,227	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other government services	18,552	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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

Commodity	base	inftrns-tdir		inftrns-dbor		inftrns-fbor		tourism	
	2013	2016	2030	2016	2030	2016	2030	2016	2030
Exports									
Agr, hunting and forestry; Fishing	3,263	-0.16	-1.06	0.00	-3.19	-3.05	-3.51	-0.43	-0.30
Food prod and beverages	892	-0.33	-0.82	0.00	-11.26	-5.14	-2.61	-0.22	0.29
Textiles, wearing apparel and leather	21,600	-1.04	2.99	0.00	-16.37	-16.38	-15.64	-2.57	-2.62
Wood and of prod of wood and cork	906	-0.56	-0.05	0.00	-17.04	-8.82	-3.18	-1.20	-0.70
Chemicals; Rubber and plastics	599	-0.35	1.57	0.00	-12.11	-3.27	2.70	-0.51	-0.39
Other non-metallic mineral prod	6	-0.12	0.34	0.00	-18.52	-5.24	0.40	-0.76	-0.52
Fabricated metal prod; Mach and equip	501	-0.43	1.62	0.00	-19.66	-7.92	-2.54	-1.13	-1.06
Other manufactures	8,161	-0.18	8.06	0.00	-14.52	-6.77	3.05	-1.01	-1.05
Transport, storage and comm	3,801	-0.20	53.66	0.00	39.95	-0.87	56.75	-0.16	-0.15
Financial intermediation	566	-0.10	9.46	0.00	-0.28	-1.09	10.58	-0.18	-0.17
Imports									
Agr, hunting and forestry; Fishing	26,478	0.02	1.98	0.00	-1.93	2.78	5.53	0.40	0.25
Mining and quarrying	136	0.29	3.38	0.00	-4.23	3.89	8.99	0.21	0.09
Food prod and beverages	24,386	-0.13	1.15	0.00	-0.09	2.43	4.81	1.31	1.28
Tobacco prod	546	-0.19	1.01	0.00	-0.15	2.81	5.20	0.27	0.17
Textiles, wearing apparel and leather	29,163	-0.38	1.62	0.00	-4.19	-0.67	1.11	-0.22	-0.41
Wood and of prod of wood and cork	2,595	-0.43	1.78	0.00	-2.13	3.39	7.36	0.61	0.45
Paper and paper prod; Publishing	2,185	-0.40	2.45	0.00	-2.28	3.36	7.74	0.32	0.16
Chemicals; Rubber and plastics	25,695	-0.35	4.02	0.00	-0.83	2.90	9.11	0.24	0.12
Other non-metallic mineral prod	2,098	1.67	5.85	0.00	-4.49	4.34	10.32	0.18	0.09
Basic metals	3,799	0.51	4.07	0.00	-5.78	2.89	8.46	0.08	-0.04
Fabricated metal prod; Mach and equip	19,595	-0.02	5.43	0.00	-1.02	3.20	10.83	0.18	0.07
Other manufactures	1,204	1.42	3.28	0.00	-4.01	6.28	10.20	0.40	0.29
Hotels and restaurants	2,047	-0.72	2.68	0.00	-1.12	7.41	11.22	0.65	0.29
Transport, storage and comm	27,048	-0.17	-3.03	0.00	-6.59	2.85	1.33	0.28	0.15
Financial intermediation	2,853	0.09	6.90	0.00	1.05	2.19	10.48	0.24	0.12
Other market services	1,476	-0.20	3.34	0.00	0.49	3.86	8.16	0.43	0.23
2013 = million gourdes									

Source: Author's elaboration.

4. Distributive Results

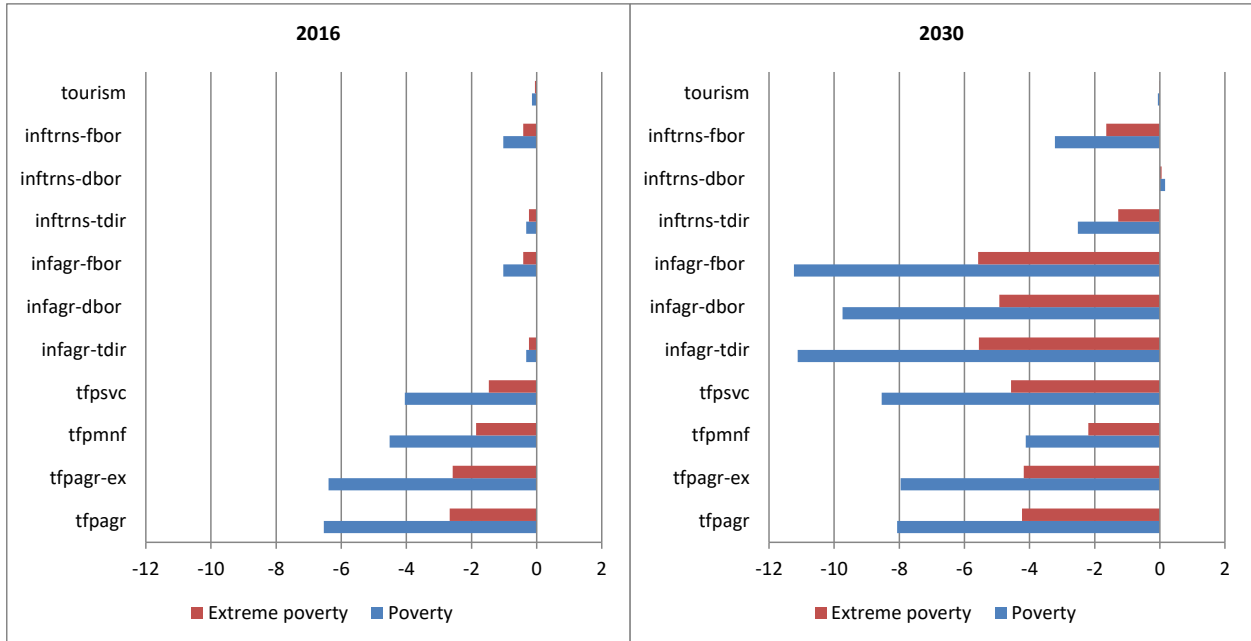
The poverty impact captured in the microsimulation model depends essentially on two factors:

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

taxes and savings) income. In all TFP and agriculture infrastructure scenarios, the 2030 poverty rate is lower than for the baseline (see Figure 7), mainly as a result of a decrease in unemployment, a higher average wage, and, given that agriculture is relatively intensive in the use of unskilled labor, a decrease in the wage gap between unskilled and skilled labor. For example, due to the decrease in unemployment (i.e., from 25.5 to 15.5 in 2030), the poverty rate decreases 5.4 percentage points in the infagr-fbor scenario. In turn, the increase in the average wage level decreases poverty by additional 4.4 percentage points. It is interesting to note that the sectoral change (i.e., increase in the employment share of manufactures and services) also has a positive impact on poverty. Again, we use growth-incidence curves to assess the distributional impact across the whole income distribution. In the tfpagr and infagr-fbor scenarios, growth is pro-poor (i.e., decreasing); see panels (a) and (b) of Figure 8, respectively. As expected, the poverty impact is stronger under infagr-fbor scenario, given that the increase in public investment has a positive (Keynesian; i.e., increase in final demand) effect that is absent in the tfpagr scenario.

For the tourism scenario, we do not find significant impacts of poverty and inequality. However, it is expected that an increase in foreign tourism will have positive and significant local (i.e., regional/sub-national) impacts (see Banerjee et al. (2015)).

Figure 7: change in poverty
(percentage points from base)



Source: Author's elaboration.

Figure 8a: growth-incidence curves scenario tfp-agr; 2030
household per capita income
proportional changes by percentile

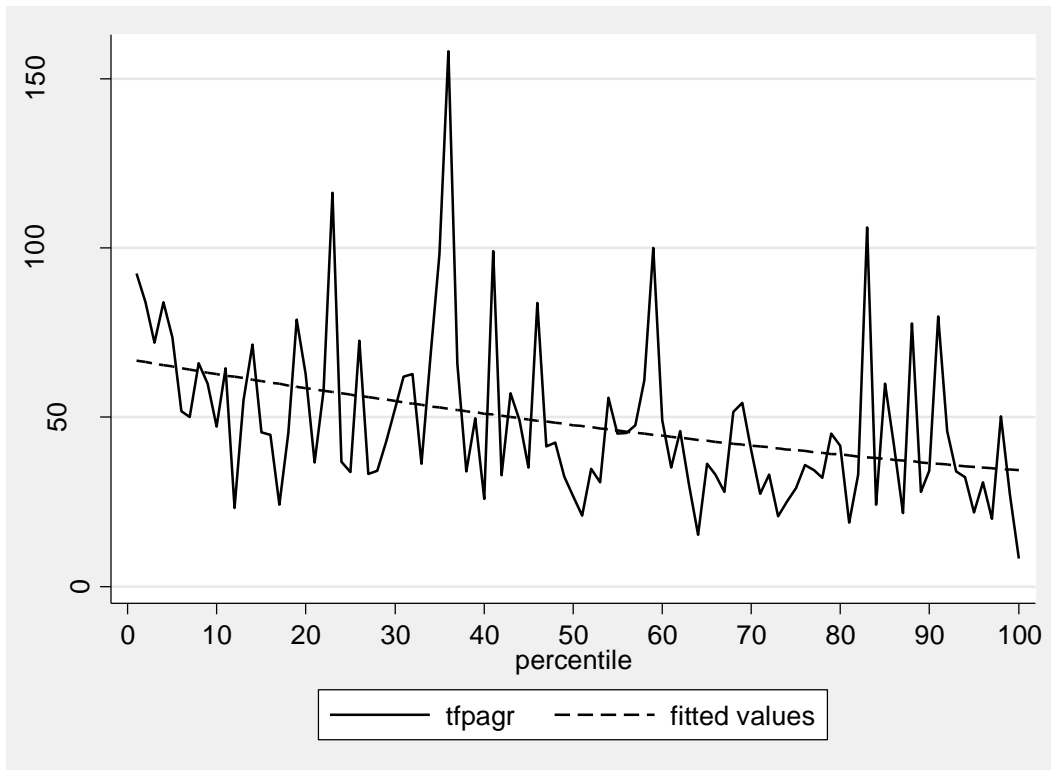
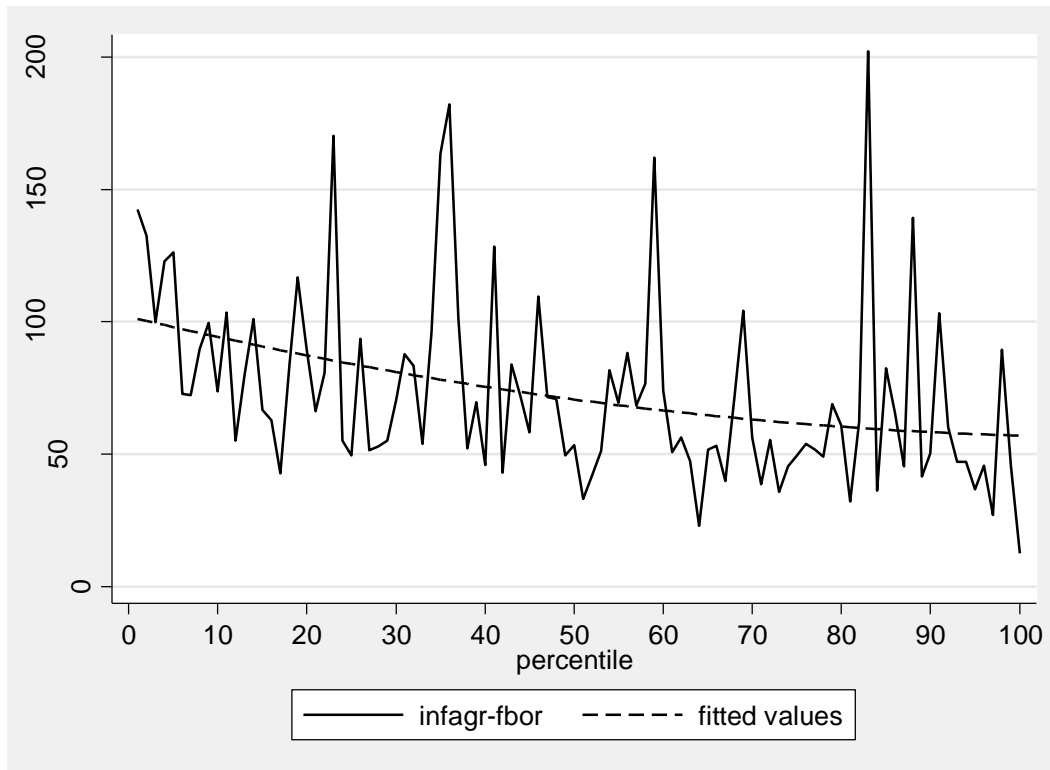


Figure 8b: growth-incidence curves scenario infagr-fbor; 2030
household per capita income
proportional changes by percentile



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 3 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 **tourism** scenario has a small but positive effect on private consumption.

*Table 3: 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
tfpagr	13.321	13.504	0.892	11.756	15.253
tfpagr-ex	13.171	13.356	0.880	11.632	15.080
tfpmnf	6.384	6.306	0.679	4.975	7.637
tfpsvc	24.694	24.314	1.506	21.363	27.265
infagr-tdir	17.297	17.606	1.700	14.273	20.939
infagr-dbor	14.829	15.183	1.828	11.601	18.765
infagr-fbor	19.305	19.702	1.379	16.999	22.405
inftrns-tdir	3.193	3.117	0.829	1.491	4.743
inftrns-dbor	-0.237	-0.192	0.772	-1.706	1.322
inftrns-fbor	7.684	7.710	0.394	6.939	8.482
tourism	0.078	0.075	0.014	0.048	0.103

Source: Author's elaboration.

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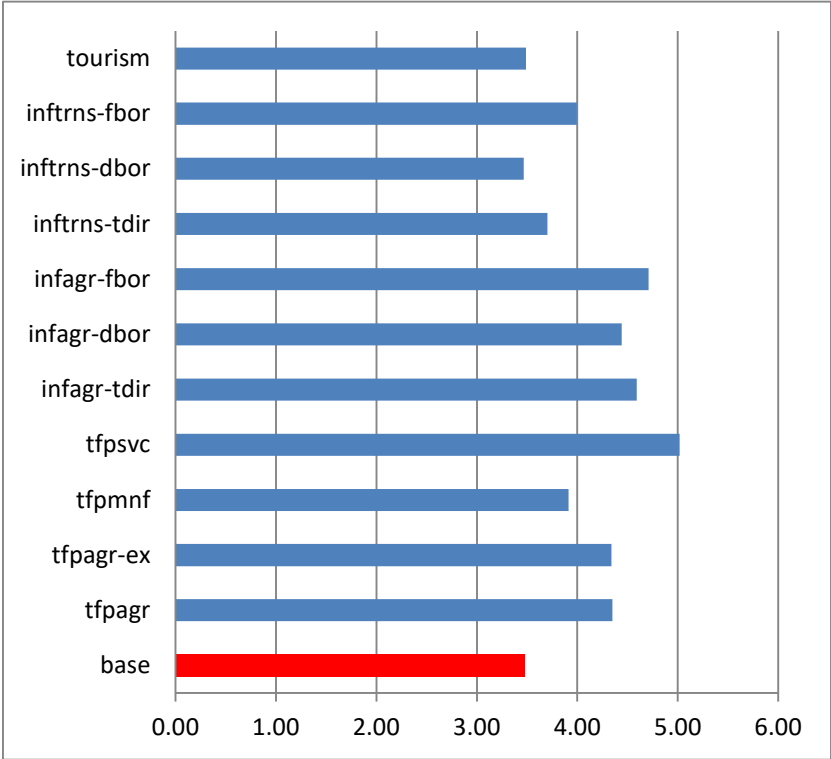
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Appendix: Additional Simulation Results

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	base	tfpagr	tfpagr-ex	tfpmnf	tfpsvc
	2013					
Absorption	493,643	3.58	4.35	4.34	3.92	5.19
Private consumption	352,731	3.48	4.35	4.34	3.91	5.02
Fixed investment	109,528	3.60	4.30	4.29	3.79	5.89
Private fixed investment	50,796	3.60	5.03	5.01	4.00	7.89
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	4.49	4.49	4.49	4.49
Exports	44,879	4.36	7.18	7.14	6.85	9.65
Imports	171,307	3.81	4.68	4.67	4.57	5.65
GDP at market prices	367,215	3.57	4.61	4.60	4.05	5.70
Net indirect taxes	19,907	3.80	4.86	4.83	4.58	6.25
GDP at factor cost	347,308	3.57	4.60	4.59	4.05	5.72
Real exchange rate	1.00	-0.32	-0.02	-0.03	-0.85	0.44
Wage, average	1.00	0.23	0.75	0.73	0.37	0.56
Unemployment rate	31.72	25.49	18.13	18.12	19.99	14.16
2013 = million gourdes						

*Table A.1 (cont): real macroeconomic aggregates
average annual growth rate 2014-2030; percent*

Item	base	base	infagr-tdir	infagr-dbor	infagr-fbor
	2013				
Absorption	493,643	3.58	4.58	4.34	4.69
Private consumption	352,731	3.48	4.59	4.44	4.71
Fixed investment	109,528	3.60	4.58	3.96	4.68
Private fixed investment	50,796	3.60	4.92	3.58	5.12
Government fixed investment	58,732	3.60	4.28	4.28	4.28
Government fixed inv, infra	56,624	3.60	4.31	4.31	4.31
Change in stocks	57	3.57	3.57	3.57	3.57
Government consumption	31,327	4.49	4.49	4.49	4.49
Exports	44,879	4.36	7.69	7.11	7.35
Imports	171,307	3.81	4.87	4.66	4.94
GDP at market prices	367,215	3.57	4.92	4.60	4.96
Net indirect taxes	19,907	3.80	5.06	4.77	5.09
GDP at factor cost	347,308	3.57	4.92	4.61	4.96
Real exchange rate	1.00	-0.32	-0.03	-0.10	-0.05
Wage, average	1.00	0.23	1.04	0.92	1.03
Unemployment rate	31.72	25.49	15.61	17.24	15.19
2013 = million gourdes					

*Table A.1 (cont): real macroeconomic aggregates
average annual growth rate 2014-2030; percent*

Item	base 2013	base	infrns-tdir	infrns-dbor	infrns-fbor	tourism
Absorption	493,643	3.58	3.83	3.41	4.09	3.58
Private consumption	352,731	3.48	3.70	3.47	4.00	3.49
Fixed investment	109,528	3.60	4.05	2.88	4.25	3.60
Private fixed investment	50,796	3.60	3.39	0.25	3.86	3.60
Government fixed investment	58,732	3.60	4.58	4.58	4.58	3.60
Government fixed inv, infra	56,624	3.60	4.61	4.61	4.61	3.60
Change in stocks	57	3.57	3.57	3.57	3.57	3.57
Government consumption	31,327	4.49	4.49	4.49	4.49	4.49
Exports	44,879	4.36	4.84	3.66	4.09	4.40
Imports	171,307	3.81	3.95	3.63	4.20	3.83
GDP at market prices	367,215	3.57	3.91	3.34	4.03	3.57
Net indirect taxes	19,907	3.80	4.10	3.62	4.24	3.81
GDP at factor cost	347,308	3.57	3.93	3.35	4.05	3.57
Real exchange rate	1.00	-0.32	-0.27	-0.42	-0.39	-0.33
Wage, average	1.00	0.23	0.28	0.08	0.28	0.22
Unemployment rate	31.72	25.49	22.12	24.77	20.74	25.37
2013 = million gourdes						