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A Framework for Ex-Ante Economic Impact Assessment of Tourism Investments

An Application to Haiti

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Abstract

This study develops a linked regional computable general equilibrium and micro-simulation (RCGE-MS) model to assess the regional economy-wide and poverty impacts of a US$36 million investment in tourism in the south of Haiti. The first social accounting matrix for Haiti with a base year of 2012/2013 was constructed to calibrate the model. This research addresses three key gaps identified in the tourism impact assessment literature. First, a destination-specific tourism demand and value chain analysis was used to calibrate the shocks implemented in the model. Second, the RCGE-MS approach moves beyond the representative household configuration to enable more robust analysis of tourism investment impacts on poverty and income inequality. Third, results of this modelling were used to inform a social cost-benefit analysis to provide greater transparency in the evaluation of trade-offs between investment alternatives. Results of this analysis showed a positive impact on sectoral activity, especially for the hotel and restaurant sector (182.1% in 2040) and a 2.0% increase in Gross Regional Product by 2040. The South's exports fell 4.7% below baseline and imports were 6.1% higher due to the inflow of foreign exchange, the appreciation of the regional real exchange rate, increased demand for most goods and services, and limited regional productive capacity. The rate of unemployment fell from 26% to 23%. The investment helped lift some of the region's poorest out of poverty, reducing the poverty headcount by 1.6 percentage points. Driving this result was an increase in employment, wages and non-labor income. The linked RCGE-MS approach proves to be a powerful tool for assessing how tourism investments affect regional economic activity and revealing the mechanisms through which tourism can contribute to increased employment opportunities and poverty reduction.

Keywords: Computable General Equilibrium, CGE, Tourism Investment, Regional Welfare, Poverty, International Investment, Benefit Cost.

JEL Code: C680, D610, R130, O120, O150, F210.

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1. Introduction and Context

1.1. The Haitian Context and the IDB's Sustainable Coastal Development Program

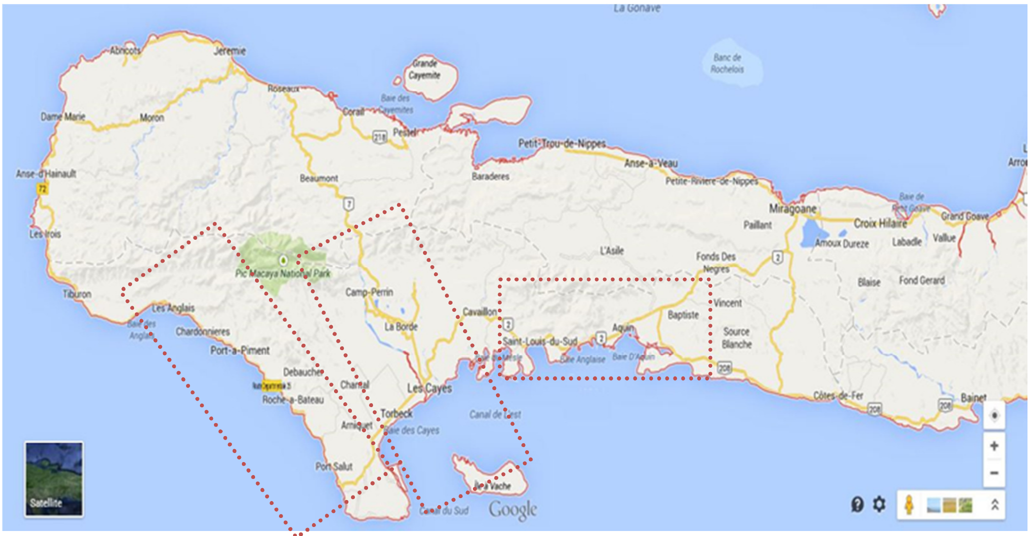
Haiti is the poorest country in the Western Hemisphere and one of the poorest in the world. In 2012, Gross National Income per capita was US$760. Of Haiti's population of 10.2 million, over half live on less than US$1 per day and 80% live on less than US$2 per day. Haiti is also extremely unequal; based on 2012 household survey data, Haiti has a Gini coefficient of 0.61, which has been constant since 2001 (World Bank 2014).

International donors have re-doubled efforts to stimulate economic growth and development in Haiti following the devastating impact of the 2010 earthquake. Investment in basic public services and in key productive sectors such as agriculture and manufacturing is needed, all within a context of regulatory reform. Recently, attention has been focused on catalyzing the re-birth of tourism. Haiti was once a well-known tourist destination considered the "pearl of the Antilles" and was one of the most frequented islands in the Caribbean from the 1950s to the 1980s. Thirty years of dictatorship rule and two decades of political and institutional crises, however, have all but erased Haiti from the tourist map for even the more adventure-minded global travelers (Trevelyan 2013).

Despite these challenges, tourism demand has been growing in recent years. Since 2007, Haiti received the highest volume of tourists during the first quarter of 2013 and between 2007 and 2011, international tourist volumes increased on average by 4.9% per year. In 2013, tourism contributed US$355.4 million (4.2% of Gross Domestic Product) and 139,000 jobs (3.6% of total employment) considering direct and indirect linkages (WTTC 2014).

The current government led by President Michel Martelly is the first to actively support tourism as a driver of growth. Based on Haiti's Tourism Master Plan, the South Coast, extending from Port a Piment to Jacmel, is a priority region for development (figure 1). The government's vision calls for the development and consolidation of complementary new and improved tourism options. The IDB's support has been confirmed in contributing to this initiative through the US$36 million investment in the Sustainable Coastal Tourism Program (HA-L1095). The Program's main lines of action include development of the tourism product through the enhancement of public tourist attractions; inclusion of local populations into the tourism value chain; basic infrastructure and services to attend to local and tourist needs, and; institutional strengthening and capacity building for enhanced management and development of the sector.

Figure 1. Haiti's South Department and Program primary Zones of Influence.



Source: Google Maps, 2014.

To assist in the design of the Program, the IDB has commissioned a number of studies. A tourism demand study was undertaken to project the future tourism demand with and without Program (Banerjee, Velasco, and Torres 2014). To provide opportunities for inclusive growth, a pro-poor value chain analysis was conducted focusing on the investment program area of intervention (Armitt, Ashley, and Goodwin 2014). The value chain analysis mapped the tourism value chain to identify nodes of opportunity for increasing linkages between the tourism sector and local populations and production processes, and increasing the share of tourism expenditure that reaches low income people (Armitt, Ashley, and Goodwin 2014, Ashley, Mitchell, and Spenceley 2009, Humphrey 2005, Humphrey and Schmitz 2000, Mitchell and Ashley 2009). This paper uses the results of the tourism demand and value chain analyses to inform the economy-wide evaluation of the tourism investment and calibrate the shocks to be implemented in the model developed herein.

1.2. Tourism as a Driver of Economic Growth and Development

The standard view of tourism investment is that it is a driver of economic growth and development with significant potential for poverty alleviation. In developing country contexts, tourism can provide a major source of new off-farm income in rural areas and help bridge inequalities between overpopulated urban areas, such as Port-au-Prince, and rural areas such as the South Coast. An increase in tourism demand can generate increased output from tourism-related sectors through direct, indirect and induced impacts where links between the tourism sector and other economic sectors exist. Where these linkages are strong, the well-publicized and often misused, multiplier effects of tourism investment arise (Gretton 2013, Vanhove 2005). Direct impacts include: employment generation, skill creation, higher wages, and new or improved access to basic services and infrastructure. Indirect channels include price and demand effects for land and local products including agriculture and food/beverage processing (Klytchnikova and Dorosh 2012).

Expansion of the tourism sector may, however, come at the expense of output from other sectors through crowding out effects, depending on factor supply constraints of labor, capital and land (Banerjee et al. 2015, Buiter 1976). Crowding out implies higher input prices, and reduced competitiveness in traditional export and import-competing markets through exchange rate appreciation. Higher prices can erode the price-competitiveness of 'up and coming' or emerging destinations. Furthermore, where public resources are used to finance tourism investment, private consumption growth tends to slow thereby constraining the potential positive income and employment impacts of tourism-based growth. Thus, to assess the net welfare impact of tourism investment, country-context is critical, especially consideration of factor supply constraints, domestic productive capacity to service the tourism sector, and the macroeconomic and fiscal policy environment (Dwyer, Forsyth, and Spurr 2003, Dwyer et al. 2000, Dwyer, Forsyth, and Spurr 2004).

2. Methods and Data

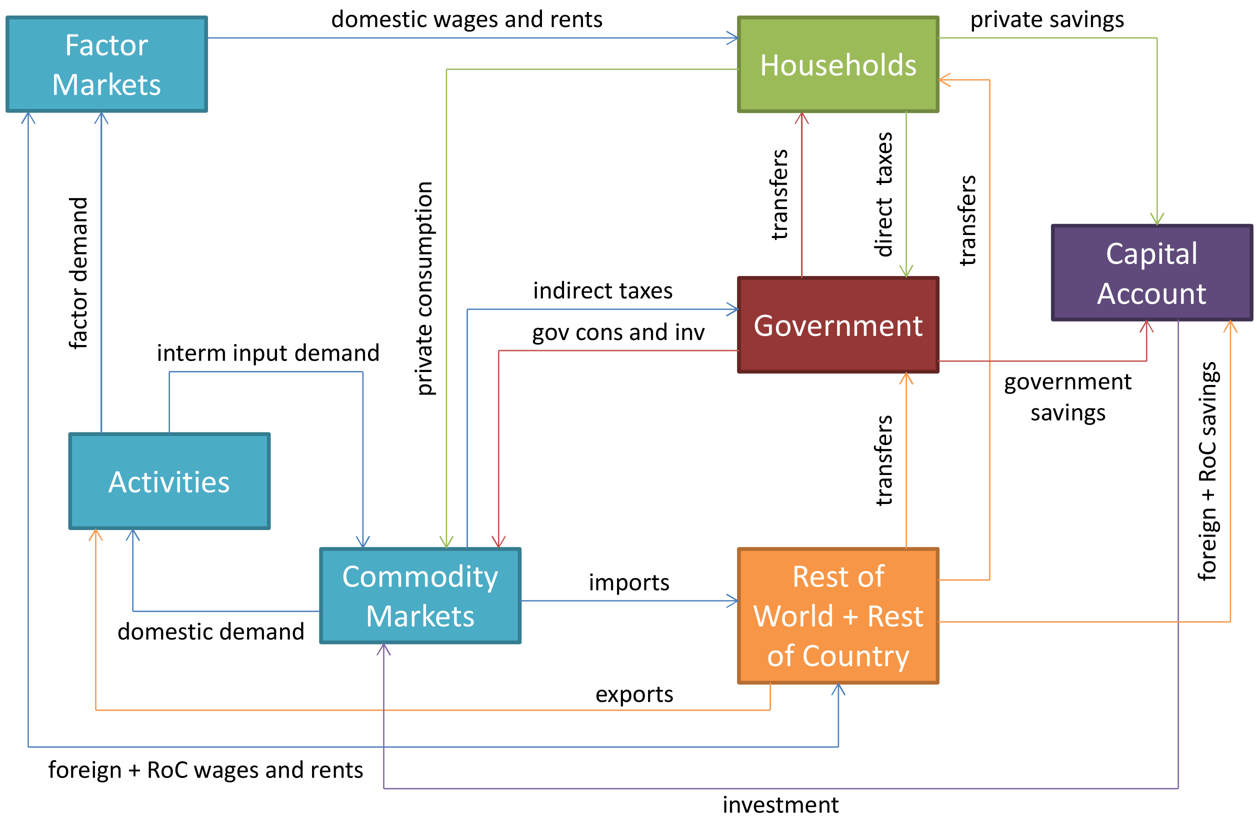
2.1. A Regional Computable General Equilibrium Model

In this study, we develop a single small open Regional recursive dynamic Computable General Equilibrium (RCGE) model to evaluate the economic impact of the IDB's Sustainable Coastal Tourism Program. The model integrates a relatively standard recursive dynamic computable general equilibrium model with additional equations and variables that single out: (a) the trade relations between the regional economy and the rest of the country, (b) the domestic and foreign tourism demand, and (c) the impact of public capital investment in infrastructure on sectoral productivity. Thus, compared to other CGE models, our RCGE offers a combination of policy-relevant features for the study of tourism investment (or policy) counterfactual scenarios in a regional economy. In Appendix A, the variables and equations of our RCGE model are presented.[1]

Figure 2 depicts the circular flow of income within the economy and between the economy and the rest of the country and world. Activities are industries that both demand (as intermediate inputs) and supply goods and services. Goods and services are consumed by households and governments, and supplied to export markets and foreign tourists. Activities also demand factors of production (labor, capital, land, natural resources) for their productive processes and make payments to these factors. These payments are transferred to households in the form of wages and rents. Households may also receive income from transfers from the government and transfers from the rest of the country or world (migrant labor, remittances, government subsidies, gifts, etc.). Households pay taxes, consume and save (invest in the capital account).

[1] As an alternative, we could have implemented the local economy-wide impact evaluation (LEWIE) approach proposed by Taylor and others (Taylor and Filipski 2014). However, insufficient data were available at the time; collection of these data would require highly targeted household and business surveys. In addition, we are interested in economy-wide effects at the regional level, beyond what a LEWIE may tell us. Nonetheless, the development of a baseline and ex-post LEWIE is proposed as a component of the IDB's Monitoring and Ex-Post Impact Evaluation Plan (Banerjee et al. 2014).

Figure 2: Flow of payments in the RCGE



Source: Authors' own elaboration.

The RCGE model mathematically describes the optimizing behavior of agents in their economic environment; it is a system of equations describing the utility maximizing behavior of consumers, profit maximizing behavior of producers, and the equilibrium conditions and constraints imposed by the macroeconomic environment. Agent behavior is represented by linear and non-linear first order optimality conditions and the economic environment is described as a series of equilibrium constraints for factors, commodities, savings and investment, the government, and rest of the world accounts (Lofgren et al. 2002). The model may be broken into a series of blocks, namely: production, factor markets, institutions, commodity markets, and macroeconomic balances. These model blocks are discussed in turn.

Production

The model's structure enables a given activity to produce more than one commodity, while any one commodity may be produced by more than one activity. Firms are price takers and minimize costs subject to nested technological constraints. Sectoral output is determined by combining value added with intermediate consumption through a fixed share, Leontief production function. Composite labor is a constant elasticity of substitution (CES) function of various types of labor indicating imperfect substitution between types of labor. Composite capital and land are also formed in this way. Value added is created by a CES function of factors (labor, capital. land and other natural resources) where firms employ factors until the value of the factor's marginal product is equal to the factor price.

Income and savings

Households receive income from labor, capital, land and transfers from other agents including remittances from abroad. Factor income is apportioned to households in fixed shares while income from transfers is the sum of all transfers for each household category. Households pay direct taxes and make transfers to the government, which constitute contributions to social assistance programs (e.g. employment insurance). The government is a consolidated institutional sector; in practical terms, and due to the lack of data, there is only one government which is the sum of central and local governments. Depending on the selected closure rule, government expenditures are exogenous. Disposable household income is equal to household income net of transfers, taxes and savings. Household savings are a linear function of disposable income.

Firms receive income from returns to capital and transfers from other agents. Firms pay income tax and also save. The government receives income from income tax paid by firms and households, indirect taxes on goods and services, capital taxes, import duties, production taxes on industries, payroll taxes from labor, export taxes, and income from transfers.

Income taxes for firms and households are a linear function of their total income. The rest of the world receives income from the sale of imports, returns to capital and transfers while foreign spending consists of export purchases and transfers to agents in the domestic economy. Transfers to households and firms are treated as proportional to their disposable income while household transfers to other institutions are treated as a linear function of total income.

Demand

Goods and services are demanded by households, domestic and foreign tourists, the government, investment and as transport and trade margins. Households have a Stone-Geary utility function, with a linear expenditure system (LES) describing household consumption. In a LES, households use their income to first consume a minimum level of subsistence goods and services. With the supernumerary income remaining, households purchase goods and services according to a linear relationship between income and consumption. LES differ from CES functions in that LES functions have non-unitary income elasticities between all pairs of goods enabling flexibility with regards to substitution possibilities in response to changes in relative prices.

Investment demand is composed of gross fixed capital formation (GFCF) and changes in inventories. GFCF is endogenous with total investment expenditure balanced by the savings and investment constraint where savings is endogenous. Inventory changes are exogenous in the model and fixed in volume. Investment in goods and services occurs in fixed shares. Government expenditures for a given budget also follow this logic.

Tourism demand by commodity can be exogenous or endogenous. In the current application, it is assumed that foreign tourism demand follows an exogenous path, which allows assessment of the impact of increased foreign tourism demand predicted by the destination-specific tourism demand and value chain analysis. The inflow of foreign tourism is an important source of foreign exchange for the South Department.

Supply and trade

The South Department is too small to affect prices in international and interregional markets and, as a consequence, the RoC and RoW (rest of country and rest of world, respectively) prices are taken to be exogenous. In the tradable goods sectors, the composite commodity price is a weighted average of local prices and import (i.e., from RoC and RoW) prices, whereas in most tourism sectors, prices are determined by local average costs. Thus, tourism services produced in the local economy are assumed to be non-tradable.

A constant elasticity of transformation (CET) function describes how industry output responds to changes in prices. This functional form implies that an industry may reorganize production in response to changes in prices, though they cannot perfectly or completely switch from the production of one commodity to another. Industries allocate output to domestic and foreign markets based on the assumption that the goods destined to one market are different from those destined to another market. This assumption is operationalized through a CET function.

World export prices are fixed (i.e. the world export demand curve is horizontal). Domestic and imported commodities are aggregated with a CES function. To reflect heterogeneity in goods and services with regards to their origin, goods and services consumed domestically are aggregate goods composed of domestically produced and imported goods, both from the rest the world and the rest of the Haiti.

Model dynamics

In the RCGE, growth over time is largely endogenous. The economy grows due to accumulation of capital determined by investment and depreciation, labor (determined by exogenously imposed projections), as well as because of improvements in total factor productivity (TFP) which have both endogenous and exogenous components. Apart from an exogenous component, TFP of any production activity potentially depends usually, positively on the levels of government capital stocks and economic openness.

On the supply side of the labor markets, unemployment is endogenous: for each labor type, the model includes a wage curve that imposes a negative relationship between the real wage and the unemployment rate (Blanchflower and Oswald 2004). As will be shown, the economic impacts of an increase in inbound tourism depend critically on the assumptions made about the extent of wage flexibility in the economy. In fact, the effects of tourism growth on economic variables will differ depending on the ability of the tourism-related sectors to obtain labor without pushing up wages. For non-labor factors, the supply curves are vertical in any single year.

2.2. RCGE Model Dataset

The basic accounting structure and much of the underlying data required to implement our RCGE model is derived from a Regional Social Accounting Matrix (RSAM) constructed for the South Department. An RSAM is a comprehensive, economy-wide statistical representation of a regional economy at a specific point in time. It is a square matrix with identical row and column accounts where each cell in the matrix shows a payment from its column account to its row account. It is used for descriptive purposes and is the key data input for a RCGE. Major accounts in a standard SAM are: activities that carry out production; commodities (goods and services) which are produced and/or imported and sold domestically and/or exported; factors used in production which include labor, capital, land and other natural resources; institutions such as households, government, and the rest of the country and the rest of the world. A stylized RSAM is provided in Appendix B.

Generally speaking, most features of the RSAM are familiar from social accounting matrices used in other models. However, our RSAM has some unconventional features related to the explicit treatment of (a) trade relations (i.e., exports and imports) between the South Department and the rest of Haiti, and (b) domestic and foreign tourism-related spending.

In this study, the RCGE model was calibrated with the newly-constructed RSAM for fiscal year (FY) 2013 and other data for Haiti and the South Department. The FY 2013 is the latest for which supply and use tables (i.e., the core required data) are available. The main sources of information for building the RSAM were the 2013 supply and use tables, national accounts, balance of payments, government data (specifically, budget and recurrent incomes and expenditures), and income and expenditure household survey data (IHSI 2003, 2012).[2] The RSAM was built following the methods and assumptions described by Jackson (1998), Lahr (1993) and Madsen and Jensen-Butler (1999). Please see Appendix B for further details (Jackson 1998, Lahr 1993, Madsen and Jensen-Butler 1999)

Table 1 shows the accounts in the RSAM, which determine the size (i.e. disaggregation) of the model. The RSAM includes 11 sectors (activities and commodities).[3] The factors of production include four types of labor, unskilled (no education and primary education), semi-skilled (secondary education), and skilled (tertiary education). The non-labor factors include a private capital stock, land, and a natural resource used in mining activities. The RSAM also identifies current accounts for institutions (household, government, rest of Haiti, rest of world, tourists

[2] This supply and use tables are believed to be the first update since the original I-O table dating back to 1975/76. To construct the government account of the RSAM, The Central Bank of the Republic of Haiti and the Ministry of Economics and Finance were consulted for balance of payments, and income and expenditure data.
[3] Unfortunately, the available data (i.e., national supply and use tables and regional employment) does not allow us to better identify the tourism-related industries in the RSAM (see Appendix B). For example, we cannot disaggregate the Transport and communications sector into its two sub-sectors.

from Haiti, and tourists from the rest of world), two investment accounts, and accounts for (national and local) taxes.

Table 1: Accounts in the Haiti South region FY 2013 regional social accounting matrix

Category	Item	Category	Item
Sectors (activities and commodities) (11)	Agriculture, forestry and fishing	**Factors (7)**	Labor, no education
	Mining		Labor, primary education
	Manufacturing		Labor, secondary education
	Electricity and water		Labor, tertiary education
	Construction		Capital
	Trade		Land
	Hotels and restaurants		Extractive natural resources
	Transport and communications	**Institutions (6)**	Households
	Financial services		Government
	Other market services		Rest of the world
	Other non-market services		Tourism demand, Rest of the world
Taxes	Activity tax		Rest of the country
	Commodity tax		Tourism demand, Rest of the country
	Commodity subsidy	**Savings-Investment (4)**	Savings
	Import tariff		Investment, private
	Direct tax		Investment, government
			Stock change

Source: Authors' own elaboration.

According to our estimates in the RSAM, the South Department's Gross Regional Product (GRP) reached 28,773 million gourdes in FY 2013 (see Table 1), equivalent to 7.8 percent of the national Gross Domestic Product (GDP). In FY 2013, the regional government current consumption was 1.9 percent of regional GRP. Remittances accounted for 19.1% of GRP.

Table 2: GRP structure (million gourdes)

Item	LCU	GDP Share
Total Demand		
Private consumption	16,604.5	57.9
Fixed investment	4,834.8	16.9
Stock change	2.5	0.0
Government consumption	561.0	2.0
Exports	2,045.5	7.1
Exports to RoC	16,946.7	59.1
Tourism demand RoC	0.0	0.0
Tourism demand RoW	375.4	1.3
Total	41,370.4	144.2
Total Supply		
GDP at market prices	28,686.2	100.0
Imports	8,852.6	30.9
Imports from RoC	3,831.6	13.4
Total	41,370.4	144.2

Source: Authors' own elaboration; South Department RSAM.

The production and trade structure of the South Department is reflected in panels (a) and (b) of Table 3, respectively (see Table 3.c for variable definitions). Column EMPshr in Table 3.a shows the share of each sector in total employment. For example, the tourism-related sector of hotels and restaurants represents one percent of total employment. In turn, Columns EXPshr and IMPshr of Table 3.b show the share of each sector in total exports and imports to and from the rest of world, respectively. Columns EXP-OUTshr and IMP-DEMshr of Table 3.b present, for each sector, the share of exports to RoW in production and the share of imports from RoW in consumption, respectively. For instance, while the mining products sector represents a significant share of export revenue (around 71.4%), their share in total value added is about 4%.

The Haiti South Department FY 2013 SAM reports taxes paid by institutions, commodity sales, activities, and tariffs; estimated total regional net tax revenue reached 5.6% of GRP in FY 2013, compared to 8% at the national level. In terms of trade with the rest of Haiti, columns (EXP-RoCshr) and (IMP-RoCshr) of Table 3b show the share of each sector in total exports and imports to and from the rest of the country, respectively.

Table 3.a: Sectoral production structure in FY 2013 (percent)

Commodity	VAshr	PRDshr	EMPshr
Agriculture, forestry and fishing	30.3	33.3	58.9
Mining	0.8	0.9	1.1
Manufacturing	4.1	7.7	3.0
Electricity and water	1.8	2.6	0.2
Construction	23.2	18.7	2.1
Trade	26.4	22.6	22.7
Hotels and restaurants	0.3	0.8	0.7
Hotels and restaurants, imports	0.0	0.0	0.0
Transport and communications	7.1	6.9	0.9
Financial services	2.1	2.1	0.2
Other market services	3.7	3.9	10.1
Other non-market services	0.3	0.3	0.2
Total	100.0	100.0	100.0

Table 3.b: Sectoral trade structure in FY 2013 (percent)

Commodity	EXPshr	EXP-OUTshr	IMPshr	IMP-DEMshr	EXP-RoCshr	EXP-RoC-OUTshr	IMP-RoCshr	IMP-RoC-DEMshr
Agriculture, forestry and fishing	16.7	2.8	19.3	20.1	45.2	53.2	20.3	8.8
Mining	0.0	0.0	0.1	13.0	2.2	96.4	1.0	62.1
Manufacturing	60.8	44.3	59.9	75.4	0.1	0.6	5.8	2.9
Electricity and water	0.0	0.0	0.0	0.0	2.7	40.5	1.2	6.5
Construction	0.0	0.0	0.0	0.0	21.2	44.4	9.4	7.4
Trade	0.0	0.0	0.0	0.0	24.1	41.7	11.4	7.1
Hotels and restaurants	12.9	89.3	0.0	0.0	0.0	0.0	0.0	0.2
Hotels and restaurants, imports	0.0	0.0	0.5	100.0	0.0	0.0	0.0	0.0
Transport and communications	6.2	5.0	17.0	26.7	0.8	4.7	36.5	24.8
Financial services	1.9	5.0	2.0	21.4	1.5	27.1	0.7	3.1
Other market services	1.4	2.0	1.2	6.9	1.9	19.3	1.0	2.4
Other non-market services	0.0	0.0	0.0	0.0	0.3	41.1	12.8	87.5
Total	100.0	5.6	100.0	25.3	100.0	39.2	100.0	25.3

Table 3.c: Variable definitions

Variable	Definition	Variable	Definition
VAshr	value-added share (%)	IMP-DEMshr	imports as share of domestic demand (%)
PRDshr	production share (%)	EXP-RoCshr	sector share in total exports to RoC (%)
EMPshr	share in total employment (%)	EXP-RoC-OUTshr	exports to RoC as share in sector output (%)
EXPshr	sector share in total exports (%)	IMP-RoCshr	sector share in total imports from RoC (%)
EXP-OUTshr	exports as share in sector output (%)	IMP-RoC-DEMshr	imports from RoC as share of domestic demand (%)
IMPshr	sector share in total imports (%)		

Source: Authors' own elaboration; South Department RSAM.

In 2013, foreign tourism spending in the Haiti South Department totaled 375.4 million of gourdes (Banerjee, Velasco, and Torres 2014). In turn, according to the RSAM, tourism-induced imports (from the rest of Haiti and the rest of the world) were estimated as 153 million of gourdes, or about 41 cents for every gourde of final (foreign) tourism expending in the South Department.[4] The difference between the two figures yields a tourism direct and indirect contribution of 222.4 million gourdes to the South's GRP. The direct tourism contribution to the South's GRP alone was 119.7 million gourdes. In terms of employment, the tourism industry in the South Department of Haiti generates 1,976 and 884 direct and indirect jobs, respectively; thus, total employment in tourism related industries is 2,860.

Beyond the RSAM, data related to the labor market, depreciation rates for private and public capital, and various elasticities are also used to calibrate the model. These data include number of workers and initial unemployment rates by skill level. The required (exogenous) elasticities include those in production, trade, consumption, and in the wage/rental rate curve. By and large, these data were obtained from best estimates in the literature. The robustness of results to

[4] The direct and indirect import content of tourism expenditure was estimated using standard input-output techniques (see (Smeral 2006). Certainly, this estimate is influenced by the assumptions made to estimate the domestic use matrix. Specifically, imports in the supply and use tables correspond to a column vector that reports total imports by commodity. Thus, we created an import matrix by pro-rating the totals across uses by applying the structure implied by the total use matrix; that is, for each row of the total use matrix we computed the percentage of the row total allocated to each sector. Then, we filled in the import matrix by multiplying each commodity total by the appropriate share for each sector. Finally, we subtracted the new import matrix from the total use matrix to obtain the domestic use matrix.

variation in these parameters was analyzed with a systematic sensitivity analysis described in detail in Appendix D.

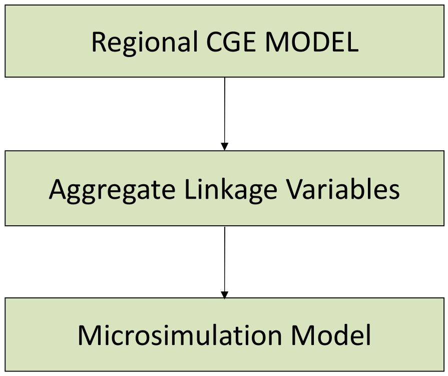
2.3. Microsimulation Model

While CGE models are effective in capturing aggregate responses to shocks introduced, for example, an increase in tourism demand through improved tourism destination marketing abroad, the standard configuration of a CGE model is not well suited for analysis of questions related to poverty and income inequality. This is due to the fact that most CGE models use a representative household (RH) formulation where all households in an economy are aggregated into one or a few households to represent household and consumer behavior. The main limitation of the RH formulation is that intra-household income distribution does not respond to shocks (e.g. a tourism investment) introduced into the model. Blake et al. (2009) and Wattanakuljarus and Coxhead (2008) are examples of CGE analyses which use the RH approach and explore tourism impacts on poverty and income distribution (Blake et al. 2009, Wattanakuljarus and Coxhead 2008).

To provide greater resolution with regards to household-level impacts, we generate results in terms of poverty and inequality at the micro level by linking the RCGE model with a microsimulation model (see Figure 3). The two are used in a sequential "top-down" fashion (i.e., without feedback): the RCGE communicates with the microsimulation model by generating a vector of real wages[5], aggregate employment variables such as labor demand by sector and the unemployment rate, and non-labor income. The functioning of the labor market thus plays an important role, and the RCGE model determines the changes in employment by factor type and sector, and changes in factor and product prices that are then used for the microsimulations. In Appendix C we present a more detailed description of the microsimulation model.

[5] The real wage is defined in terms of the CPI; see the RCGE model mathematical statement in the Appendix A.

Figure 3: The Macro-Micro approach



Source: Authors' own elaboration.

2.4. Microsimulation Model Dataset

The household survey data Enquête sur les Conditions de Vie des Ménages Après Seisme (ECVMAS) for the year 2012, conducted by the Haitian Institute of Statistics and Informatics (IHSI), is used to build the microsimulation model. These data cover 23,555 individuals in 4,930 households in all of Haiti. The ECVMAS is the latest available household survey in Haiti. No attempt was made to reconcile the household survey data with the national accounts. Instead, the results from the RCGE are transmitted to the microsimulation model as percentage deviations from base values. The ECVMAS 2012 was processed as part of the Socio-Economic Database for Latin America and the Caribbean (CEDLAS and The World Bank 2012).

Recent estimates from the World Bank were used for establishing the poverty line (World Bank 2014); at the national level, 58.64% was classified as poor and 23.74% extremely poor. In the South Department 65.47% was classified as poor and 25.51% extremely poor.

3. Simulations

3.1. Scenarios

This section presents the simulations and analyzes the results for both the RCGE and the microsimulation model. The following main scenarios were conducted: (a) the baseline scenario, which is the without Program scenario; (b) a government investment in tourism infrastructure and tourism sector institutional strengthening in the South Department; (c) an increase in tourism expenditure in the South Department, both in terms of foreign visitors, and; (d) a break-even scenario using the minimum tourism expenditure in the South Department required to make the Program viable. A detailed description follows:

Baseline scenario: this first simulation assumes that average past trends will continue into the period from FY 2013 to FY 2040. In fact, in the absence of better projections, it is assumed that Haiti's South Department is on a balanced growth path, which means that real (i.e., volume) variables, including tourism demand, grow at the same rate while relative prices do not change. The non-base simulations only deviate from the base beginning in FY 2015 to FY 2040.

Invest scenario: this simulation imposes increased government investment in tourism infrastructure and management financed with the IDB grant. Based on information from the IDB's Sustainable Coastal Tourism Program, yearly additional government investment was estimated as follows:

(a) The total investment financed through the IDB Program is US$36 million, equivalent to 1,502 million gourdes at base year (i.e., FY 2013) prices[6];
(b) Forty-four percent of total investment is spent in tourism infrastructure, equivalent to 2.3% of GRP in the base year[7];
(c) The remaining 56% of the $36 million investment is spent in government current consumption, equivalent to 2.9% of base year GRP. This represents investment in institutional strengthening and capacity building;
(d) The projected yearly investment schedule (disbursement) is 3% in 2015, 15% in 2016, 25% in 2017, 25% percent in 2018, and 32% in 2019; and
(e) Starting in 2016, an additional 8 percent of total cumulative infrastructure investment is spent on operation and maintenance.

Dem scenario: in this simulation, foreign tourist arrivals and demand increase. Based on demand projections prepared by the IDB, it is assumed that, due the implementation of the Program, foreign tourism demand will increase by 13.8% annually during 2017-2026 and 2.5% annually during 2027-2040; thus, starting in 2026, foreign tourism arrivals (and demand) remains 157.4% higher than in the reference scenario (Banerjee, Velasco, and Torres

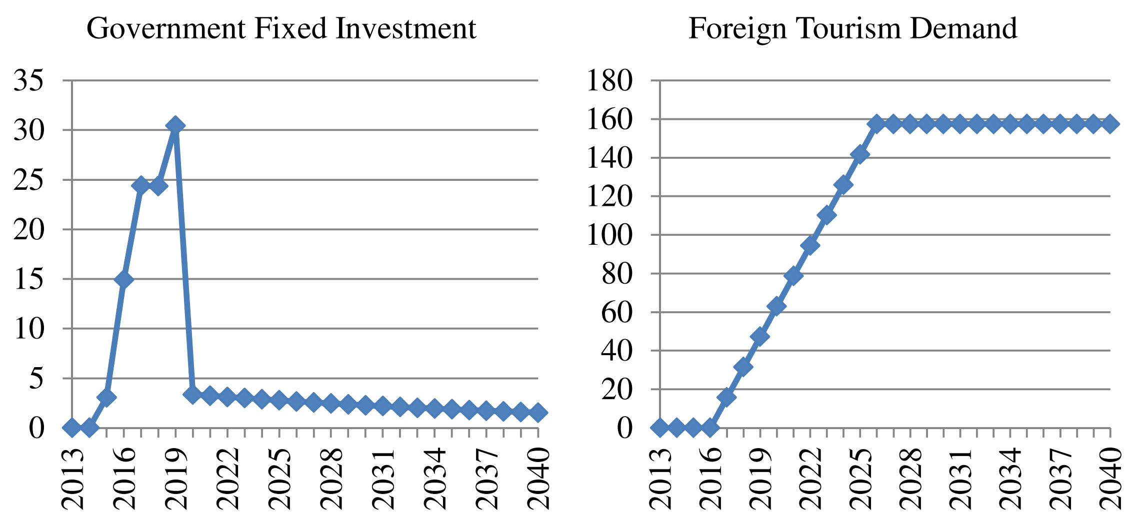
[6] In the FY 2013, and according to the RSAM, local and central government investment in the Haiti South Department was 593.7 million gourdes.
[7] 3.4% of projected GRP for FY 2015.

2014). More specifically, the increase in tourism leads to an increase in demand for goods and services such as accommodation, food, and transport.[8]

Combi scenario: this scenario models the invest and dem scenarios combined. For details, see Figure 4.

Combi-BE scenario: this scenario is similar to combi but uses the estimated minimum growth in tourism expenditure required for the Tourism Program investment to break even at a 12% discount rate. The break even compound rate of tourism expenditure was estimated at 102.96%. This compound growth rate implies that tourism expenditure in the South would need to increase from $9 million in the base year to $41.71 million by 2040 (Banerjee, Velasco, and Torres 2014). Notice, however, that a constant growth rate for tourism arrivals (and demand) between 2014 and 2040 is assumed in this scenario.

Figure 4: Definition of scenarios **invest** and **demand** (% deviation from base)



Source: Authors' own elaboration.

At the macro level, our RCGE, as any other CGE model, requires the specification of the equilibrating mechanism for three macroeconomic balances. For the non-base scenarios: (a) the government fiscal account is balanced via adjustments in transfers to/from the RoC – implicitly representing transfers to/from the central government; (b) private investment in the South

[8] The share of each commodity in total tourism spending was obtained from (Armitt, Ashley, and Goodwin 2014).

Department follows an exogenously imposed path; given this path, adjustments in savings from the rest of Haiti clear the savings-investment balance; and (c) the real exchange rate equilibrates inflows and outflows of foreign exchange, by influencing export and import quantities. The non-trade-related payments of the (local) balance of payments (transfers and foreign investment) are non-clearing, following exogenously imposed paths.

In addition, given the regional character of the model, we need to impose a mechanism to clear the current account of the "balance of payments" between the local economy and the rest of the country. Specifically, we assume a flexible real exchange rate with respect to the RoC, with equilibrium achieved through changes in the price of local non-tradable commodities; i.e., prices for non-tradable commodities are region-specific, while for tradable commodities the local price is a weighted average of the price of three different varieties: local, from the RoC, and from the RoW.

3.2. Results

3.2.1. Aggregate Results

The base year of the model is FY 2013. For the base scenario, which serves as a benchmark for comparisons, we impose an average growth of 4 percent, based on projections from the April 2014 IMF World Economic Outlook (IMF 2014).[9] In addition, due to the assumption of a balanced growth path, the following assumptions are also imposed: (a) macro aggregates are kept fixed as a share of regional GRP at base year values; (b) transfers to/from government/RoC/RoW to households are also kept fixed as a fixed share of GRP; and (c) tax rates are fixed over time.

Table 4 and Figure 5 show key macroeconomic results for the base and all scenarios for the year 2019 (i.e. the year when the project investment is completed) and 2040. In Table 4, Absorption, Private Consumption (PrvCon), Government Consumption (GovCon), exports and imports are for the South Department alone. Exports-RoC and Imports-RoC are exports and imports from the rest of the country toward or from the rest of the world, respectively. GDP at market prices (GDPMP) is for the South Department. REXR is the real exchange rate for Haiti, REXR-RoC is the South Department's real exchange rate toward the rest of the country. Wages, Capital Returns (CapRet) and the Unemployment Rate (UERat) are all for the South Department alone.

[9] The exogenous part of total factor productivity growth is adjusted to generate such a growth path. In non-base scenarios, GRP growth is endogenous.

As shown, the increase in government investment financed with the IDB Program has a positive impact on the activity level (simulation **invest**). On the other hand, the inflow of foreign resources gives rise to slower export growth and faster import growth, both induced by an appreciation of the (regional) real exchange rate.[10] In turn, the expansion of tourism demand tends to expand domestic absorption more rapidly than it expands GRP, also causing deterioration in the trade balance (scenario **dem**). In other words, the increase in "tourism exports" also generates an appreciation of the real exchange rate that hurts the tradable sectors. Besides, slower export growth here is a function of increasing domestic demand and prices in the South due to the Program Investment. Where factor supply constraints exist (labor/capital/land/natural resources), increased domestic prices relative to world prices result in a reallocation of resources toward domestic production and meeting more rapid growth in domestic demand.

[10] Notice that "exports" do not include tourism-related spending made by foreigners. Certainly, the latest correspond to tourism exports, but the two are treated differently in the model and Table 4.

Figure 5.a: Change in real private consumption 2014-2040 (percent deviation from base)

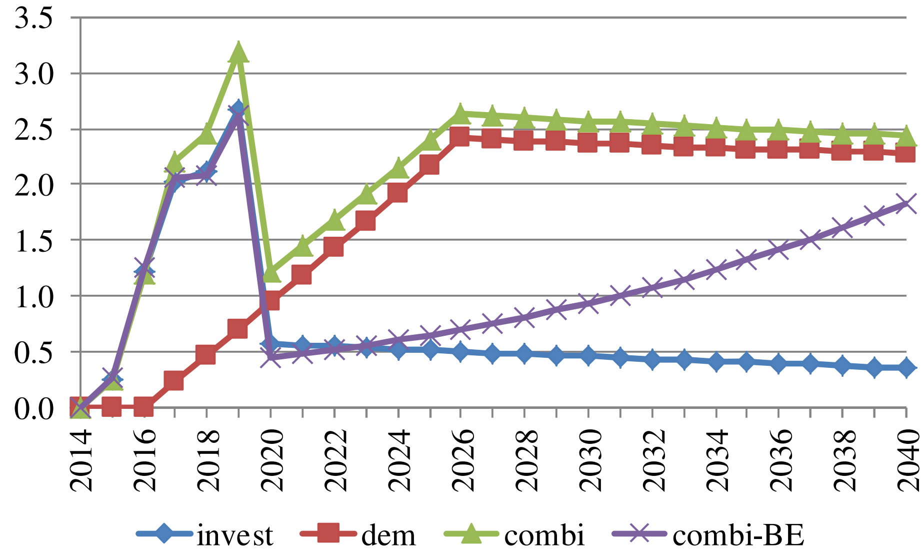
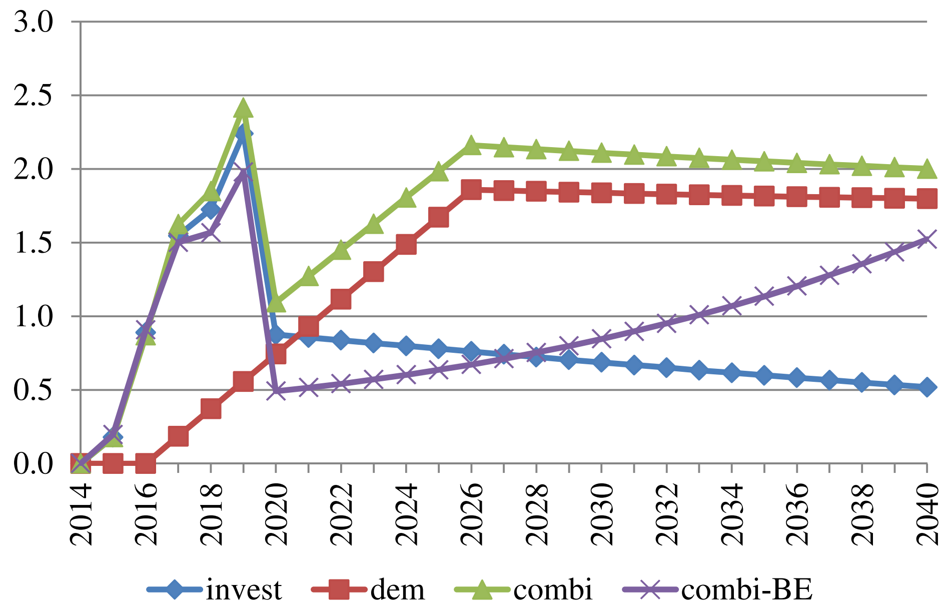


Figure 5.b: Change in real gross regional product 2014-2040 (percent deviation from base)



Source: Authors' own elaboration.

Table 4: Change in real macro indicators (percent deviation from base)

	base (LCU)	invest		dem		combi		combi-BE	
Item	2013	2019	2040	2019	2040	2019	2040	2019	2040
Absorption	35,493	2.9	0.4	1.0	3.3	3.6	3.4	2.8	2.5
Private consumption	16,605	2.7	0.4	0.7	2.3	3.2	2.4	2.6	1.8
Government consumption	561	40.5	1.6	0.0	0.0	40.5	1.6	40.5	1.6
Exports to rest of world	2,045	-2.5	1.1	-1.5	-5.1	-4.7	-4.7	-3.6	-3.3
Imports from rest of world	8,853	3.8	0.3	1.9	6.0	5.5	6.1	3.9	4.5
Exports to rest of Haiti	16,947	2.4	0.5	0.4	1.3	2.3	1.5	2.0	1.1
Imports from rest of Haiti	3,832	6.1	0.5	0.3	1.1	6.1	1.4	5.8	1.0
GRP at market prices	28,686	2.2	0.5	0.6	1.8	2.4	2.0	2.0	1.5
RER wrt rest of world	1	-2.9	0.3	-1.4	-4.2	-4.5	-4.1	-3.4	-3.0
RER wrt rest of Haiti	1	0.3	0.1	0.0	0.1	0.3	0.1	0.3	0.1
Wage, average	1	0.8	0.1	0.4	1.2	1.1	1.2	0.8	0.9
Capital return, average	1	2.1	0.4	0.5	1.6	2.3	1.7	1.9	1.3
Unemployment rate	26.0	24.4	25.8	25.2	23.4	23.7	23.4	24.3	24.0

LCU = million gourdes

Source: Authors' own elaboration.

3.2.2. Sectoral Results

At the sectoral level, service industries catering directly to tourists, including Hotels and restaurants, are strongly stimulated by the expansion in tourism (simulation **dem**). On the other hand, the upward pressure on prices and the real exchange rate leads to reduced competitiveness of traditional export sectors. Specifically, Table 5 shows a decrease in value added in Agriculture, forestry and fishing, and Manufacturing. To some extent, this result changes when labor and capital are in larger supply (i.e., more elastic supply curves). In other words, if wage increases are constrained and extra labor used would otherwise have been unemployed, these types of 'crowding out' effects are less substantial.

Table 5: Change in sectoral real value added, exports, and imports (percent deviation from base)

	base (LCU)	invest		dem		combi		combi-BE	
Commodity	2013	2019	2040	2019	2040	2019	2040	2019	2040
Value Added									
Agriculture, forestry and fishing	8,325	0.9	0.4	0.1	0.3	0.5	0.3	0.5	0.2
Mining	213	0.9	0.4	0.1	0.6	0.6	0.6	0.5	0.4
Manufacturing	1,114	-0.6	0.9	-0.4	-1.6	-1.6	-1.3	-1.3	-0.8
Electricity and water	487	1.8	0.5	0.5	2.0	1.9	2.2	1.5	1.5
Construction	6,393	2.5	0.4	0.2	0.2	2.3	0.3	2.1	0.4
Trade	7,261	3.5	0.7	0.9	3.0	3.9	3.3	3.2	2.4
Hotels and restaurants	87	0.9	0.1	42.0	140.4	42.9	140.5	9.4	101.3
Transport and communications	1,940	2.3	0.6	0.6	1.9	3.2	2.7	2.8	2.2
Financial services	576	2.9	0.8	0.5	1.5	2.9	1.9	2.5	1.5
Other market services	1,014	2.2	0.6	1.1	4.8	3.6	5.5	2.8	3.8
Other non-market services	87	37.9	2.9	1.0	4.4	38.0	6.6	37.0	5.0
Exports									
Agriculture, forestry and fishing	405	-3.0	0.7	-1.6	-5.0	-5.2	-4.8	-4.0	-3.6
Manufacturing	1,473	-2.6	1.3	-1.5	-5.3	-5.0	-5.0	-3.9	-3.5
Imports									
Agriculture, forestry and fishing	1,711	3.7	0.2	1.5	4.7	5.0	4.6	3.8	3.4
Manufacturing	5,301	3.6	0.3	2.0	6.5	5.5	6.6	3.9	4.9

LCU = million gourdes

Source: Authors' own elaboration.

Certainly, the key mechanisms which determine the size of the economic impacts resulting from increased tourism demand include: factor supply constraints, exchange rate appreciation, and current government economic policy (Dwyer et al. 2000). In Appendix D we perform a detailed sensitivity analysis of our model results.

In terms of sectoral employment, results are shown in Table 6.

Table 6: Change in sectoral employment (percent deviation from base)

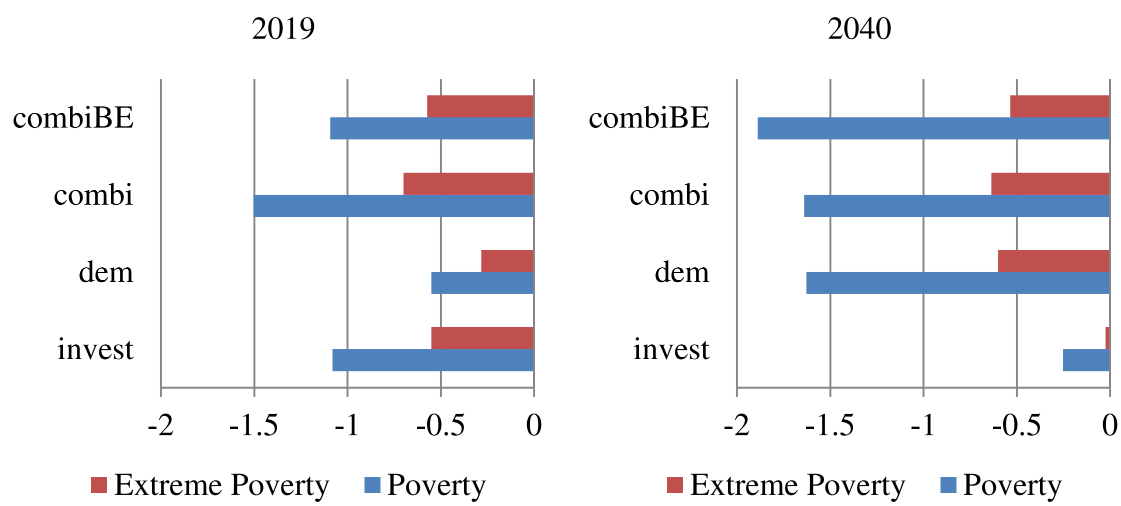
	base ('000)	invest		dem		combi		combi-BE	
Sector	2013	2019	2040	2019	2040	2019	2040	2019	2040
Agriculture, forestry and fishing	145.1	0.8	0.1	0.2	0.6	0.9	0.6	0.8	0.5
Mining	2.6	1.1	0.1	0.2	1.0	1.2	1.0	1.1	0.7
Manufacturing	7.4	-1.2	0.9	-0.6	-1.2	-2.1	-0.8	-1.8	-0.7
Electricity and water	0.4	4.3	0.5	1.5	4.6	5.7	4.9	4.5	3.8
Construction	5.2	5.5	0.2	0.6	1.9	6.1	2.0	5.6	1.6
Trade	56.0	4.6	0.6	1.3	4.4	5.7	4.7	4.7	3.5
Hotels and restaurants	1.7	0.9	0.0	68.7	183.9	68.1	182.1	13.2	148.3
Transport and communications	2.0	3.3	0.5	1.0	3.4	3.9	3.6	3.1	2.6
Financial services	0.4	3.1	0.6	0.6	2.1	3.6	2.6	3.1	1.9
Other market services	25.0	4.7	0.5	2.8	8.2	6.8	8.1	4.5	6.2
Other non-market services	0.6	41.5	2.5	1.1	4.8	42.2	6.8	41.1	5.2
Total	246.5	2.3	0.3	1.2	3.5	3.2	3.6	2.3	2.8

Source: Authors' own elaboration.

3.2.3. Distributive Results

In terms of poverty, results show that the poverty headcount rate in the South Department falls by 1.6 percentage points in the last year of the simulation period in the combined scenario (figure 6). The main drivers of this result are a decrease in unemployment, a higher average wage, and an increase in non-labor income.

Figure 6: Change in poverty (percentage points from base)



Source: Authors' own elaboration.

3.2.4. Cost-Benefit Analysis

As discussed, the results of the **combi** scenario represent the direct and indirect economic impact of an increase in government investment in tourism infrastructure combined with an increase in inbound tourism, given the model assumptions. Thus, given that the project cost is part of the simulations, the cost-benefit analysis can be conducted by simply analyzing the RCGE-MS results for the indicator of interest which is GRP. In other words, the simulated direct and indirect impacts using the RCGE-MS model provide the benefit and cost estimates for this calculation. Notice, however, that conventional cost-benefit accounting does not capture all of the indirect benefits highlighted by simulations using economy-wide models. Analytically:

$$NPV = \sum_{t=0}^{20} \frac{Y_t - Y_t^0}{(1+r)^t}$$

where

NPV = net present value

$t = 0$ is 2015

$t = 25$ is 2040

Y_t = indicator of interest in year t

Y_t^0 = indicator of interest in year t in reference scenario

r = discount rate (12% in our case)

Table 7: net present value, millions of gourdes

mill gourdes		
Scenario	RCGE	RCGE - invest
invest	3,051	1,783
dem	3,475	2,208
combi	5,421	4,154
combi-BE	3,042	1,775

Source: Authors' own elaboration.

Table 7 shows that in the combi scenario, the NPV for the investment is 5,421 million gourdes. Although the investment is a grant, if the Government of Haiti were required to repay the investment, the NPV declines to 4,154 million gourdes.

4. Discussion and Policy Implications

This paper developed a consistent and quantitative framework for the assessment of investment in tourism development and its impacts on regional economies and household welfare. Three key gaps in the tourism impact assessment literature were addressed. First, a destination-specific tourism demand and value chain analysis was used to calibrate the simulations. Second, the RCGE-MS approach enabled the analysis of tourism investment impacts on poverty and income inequality indicators at the level of the individual households sampled. Third, modelling results generated here were used in a cost-benefit analysis. The analytical power of this framework derives from its ability to capture inter-sectoral dynamics, the impacts of factor constraints, interactions between the regions modelled, the rest of the country and the rest of the world, and household-level income and poverty indices.

This framework was applied to simulate the impacts of a US$36 million investment in tourism development in Haiti's South Department to improve public spaces, facilities and services, and strengthen tourism sector governance. While the investment resulted in a positive impact on local economic activity, export growth slowed while imports grew more quickly, both induced by the appreciation of the regional real exchange rate. The expansion of tourism demand leads to domestic absorption increasing more rapidly than the regional product which results in a deterioration of the regional trade balance. The increase in domestic prices results in the reallocation of scarce factors toward domestic production to meet increased tourist demand.

At the sectoral level, those sectors catering more directly to tourism experience the highest rates of growth, while those sectors further removed from the tourism value chain grow more slowly. Assumptions around the scarcity of skilled labor drive the magnitudes of these aforementioned effects. The cost benefit analysis shows that the investment is viable with a 12% discount rate when treated as a non-reimbursable grant as well as a reimbursable loan, thus lending support to the business case for the investment.

Results at the household level show that the investment could reduce the poverty headcount rate in the South Department by 1.6 percentage points. This result was driven by the decrease in unemployment, higher average wages and increased non-labor income accruing to households. In the first few years of the intervention, it is the investment stimulus itself that has the greatest impact on spurring growth and reducing poverty. Employment in construction and related sectors drives average wages upward and has a positive impact on household income. As all works are installed within 5 years of the investment commencing, the expected increase in tourism demand has a larger and more sustained positive impact on local economic development, employment and welfare. The sensitivity analysis confirms that the results reported here are robust to significant variability in model parameters.

This work raises three key issues for the analysis of tourism investments. First, estimating with and without program tourist demand is a critical input into the analysis. Investment in developing the tourism product and the direct, indirect and induced benefits that this generates is one aspect of the growth stimulus. As demonstrated in this analysis, the larger and more sustained stimulus occurs through the increase in tourism expenditure. The estimation of the with program tourism demand is a critical element of the analysis, and is often overlooked or improperly formulated in tourism impact assessments. A robust tourism investment analysis requires accurate projections of how tourism demand will respond to the specific features of the investment. Modelling results are highly sensitive to variations around the with program tourism demand estimates.

Second, a country or region’s capacity to absorb public sector funding and effectively implement the investment program is a critical element of success. This poses challenges to states with new or weak institutions governing tourism. These features of institutional capacity and absorptive capabilities, although not modelled here, are amenable to simulation in the RCGE-MS framework through the imposition of conversion coefficients or lags in the period over which the investment program is implemented and the economic response is generated.

Third, in considering the long-run sustainability of the investment in public tourism goods and services, the private sector response is a critical determinant of success. The simulations presented here show the minimum private sector response to increased demand for goods and services arising from the investment in infrastructure as well as increased future tourism demand for goods and services. The private sector has the potential to enhance the overall growth and welfare impact of the investment through hedging toward increased tourism growth and create a virtuous cycle of public and private investment and tourism expansion. To achieve this end, some degree of risk will need to be assumed by the private sector. Through public private partnerships, however, a shared agenda between the public and private sector may be forged while the public sector may lend support through reducing some of the risks involved in bolder investment initiatives.

Finally, the RCGE-MS framework has the potential to be used as a tool to assess investment alternatives as an integral component of tourism investment design. This may be particularly powerful where the data exist to develop a highly disaggregated model to represent those sectors most closely linked with the tourism value chain, and; quality household survey data for the tourism program Zone of Influence exist. Where program objectives are clearly defined, such as maximizing regional growth or reducing poverty, the simulation of alternative investments can help in identifying the most efficient and effective pathways.

APPENDIX A: MATHEMATICAL STATEMENT OF RCGE MODEL

A.1. Introduction

The mathematical presentation of the RCGE uses some notational conventions: capital letters for endogenous variables, lowercase letters for exogenous variables, and Greek letters for behavioral parameters. The endogenous variables with an over bar are assumed to be exogenous as part of the "closure rule" of the model.[11] Besides, all variables at time (t-1) are exogenous at time t. The following set names also apply:

a = activities

c = commodities

i = institutions (i.e., households, enterprises, government, rest of the country, and rest of the world)

insdng = domestic non-government institutions

h = households

e = enterprises

gov = government

roc = rest of the country (i.e., rest of Haiti)

row = rest of the world

inv = investment

invg = government investment

invng = non-government investment

A.2. Equations and Variables

Endogenous Variables

$AWF_{f,t}$ average remuneration of factor f

[11] The closure rule determines the mechanisms equalizing demand and supply in all markets featuring the model.

$CALTFP_{f,t}$ tfp in calibration run

$CON_{h,t}$ household consumption expenditure

CPI_{t} consumer price index

DPI_{t} index for domestic producer prices (PDS-based)

EG_{t} government expenditure

EXR_{t} exchange rate (dom. currency per unit of for. currency)

$GADJ_{t}$ government demand scaling factor

$GFCF_{inv,t}$ gross fixed capital formation

$IND_{f,a,t}$ non-government investment by destination

$KG_{invg,t}$ government capital stock

$MPS_{i,t}$ marginal propensity to save for dom non-government inst insdng

$MPSADJ_{t}$ savings rate scaling factor

$PA_{a,t}$ output price of activity a

$PDD_{c,t}$ demand price for comm c produced and sold domestically

$PDER_{c,t}$ price for composite QD-QER

$PDMR_{c,t}$ price for composite QD-QMR

$PDS_{c,t}$ supply price for comm c produced and sold domestically

$PE_{c,t}$ export price for c (domestic currency)

$PER_{c,t}$ RoC export price for c (domestic currency)

$PINTA_{a,t}$ price of intermediate aggregate

$PK_{inv,t}$ replacement cost of capital

$PM_{c,t}$ import price for c (domestic currency)

$PMR_{c,t}$ RoC import price for c (domestic currency)

$PQ_{c,t}$ composite commodity price for c

$PVA_{a,t}$ value-added price for activity a

$PX_{c,t}$ producer price for commodity c

$QA_{a,t}$ level of activity a

$QD_{c,t}$ quantity sold domestically of domestic output c

$QDER_{c,t}$ QD-QER aggregate for comm c

$QDMR_{c,t}$ QD-QMR aggregate of comm c

$QE_{c,t}$ quantity of exports for commodity c

$QER_{c,t}$ quantity of exports to RoC for commodity c

$QF_{f,a,t}$ quantity demanded of factor f from activity a

$QFS_{f,t}$ supply of factor f

$QG_{c,t}$ quantity of government demand for commodity c

$QH_{c,h,t}$ quantity consumed of commodity c by household h

$QINT_{c,a,t}$ quantity of commodity c as intermediate input to activity a

$QINTA_{a,t}$ quantity of aggregate intermediate input

$QINV_{c,t}$ quantity of investment demand for commodity c

$QM_{c,t}$ quantity of imports of commodity c

$QMR_{c,t}$	quantity of imports from RoC of commodity c
$QQ_{c,t}$	quantity of goods supplied domestically (composite supply)
$QROCT_{c,t}$	RoC tourism demand quantity of comm c
$QROWT_{c,t}$	RoW tourism demand quantity of comm c
$QT_{c,t}$	quantity of trade and transport demand for commodity c
$QVA_{a,t}$	quantity of aggregate value added
$QX_{c,t}$	quantity of domestic output of commodity c
$REXR_{t}$	real exchange rate
$RGDPFC_{c,t}$	real GDP at factor cost (at constant base-year prices)
$RGFCF_{inv,t}$	real gross fixed capital formation
RSG_{t}	real government savings
SG_{t}	government savings
$SH_{i,t}$	savings domestic non-government institution i
$SROC_{t}$	RoC savings (foreign currency)
$SROW_{t}$	foreign savings (foreign currency)
$TFP_{a,t}$	total factor productivity index
$TR_{i,i',t}$	transfers from dom inst insdng to inst ins
$UERAT_{f,t}$	unemployment rate for factor f
$WALRAS_{t}$	dummy variable (zero at equilibrium)
$WF_{f,t}$	average price of factor f

$WFDIST_{f,a,t}$ wage distortion factor for factor f in activity a

$YF_{f,t}$ factor income

YG_t government revenue

$YH_{i,t}$ income of (domestic non-government) institution insdng

$YIF_{i,f,t}$ income of institution ins from factor f

Parameters and Exogenous Variables

$sh^F_{i,f}$ share for inst ins in the income of factor f

$\overline{mps}_{i,t}$ marginal propensity to save for dom non-gov inst insdng

$\overline{qg}_{c,t}$ quantity of government demand for commodity c

$\overline{rgfcf}_{inv,t}$ real gross fixed capital formation

$ta_{a,t}$ rate of tax on producer gross output value

$tq_{c,t}$ rate of sales tax

$ty_{i,t}$ rate of direct tax on dom inst ins

$tf_{f,t}$ rate of direct tax on factor income

$tfact_{f,a,t}$ rate of factor use tax

$te_{c,t}$ export tax rate for commodity c

$tm_{c,t}$ import tariff rate for commodity c

$trnsfr_{ac,i,t}$ transfers from insp to ins or factor

$sh^{TR}_{i,i',f}$ share of inst ins in post-tax post-sav income of inst insp

$pwe_{c,t}$ export price for c (foreign currency)

$pwm_{c,t}$	import price for c (foreign currency)
$pwer_{c,t}$	export price for c to RoC (foreign currency)
$pwmr_{c,t}$	import price for c from RoC (foreign currency)
$qdstk_{c,t}$	changes in inventories
$icd_{c,c'}$	trade and transport input of c per unit of comm cp produced and sold domest
$ice_{c,c'}$	trade and transport input of c per unit of comm cp exported
$icm_{c,c'}$	trade and transport input of c per unit of comm cp imported
$icer_{c,c'}$	trade and transport input of c per unit of comm cp exported to RoC
$icmr_{c,c'}$	trade and transport input of c per unit of comm cp imported from RoC
$\overline{qroct}_{c,c',t}$	RoC tourism demand quantity of comm c
$\overline{qrowt}_{c,c',t}$	RoW tourism demand quantity of comm c
$\delta_{f,a}^{VA}$	share parameter for CES activity production fn
ϕ_{a}^{VA}	efficiency parameter in the value added production fn for a
σ_{a}^{VA}	elasticity of substitution between factors
ρ_{a}^{VA}	exponent in the value added production fn for a
$tfpexog_{a,t}$	exogenous component of sectoral TFP
$\theta_{a,c}$	yield of output c per unit of activity a
$ica_{c,a}$	intermediate input c per unit of aggregate intermediate
iva_{a}	aggregate value added coefficient for act a
$inta_{a}$	aggregate intermediate input coefficient for act a

$\delta_{c,h}^{LES}$	marg shr of hhd cons on commodity c
$qhmin_c$	subsist cons of com c for hhd h
δ_c^M	Armington function share parameter for imports commodity c
δ_c^{DMR}	Armington function share parameter for composite QDMR commodity c
ϕ_c^Q	Armington function shift parameter for commodity c
σ_c^Q	elasticity of substitution between dom goods and imports for c
ρ_c^Q	Armington function exponent for commodity c
δ_c^E	CET function share parameter for exports commodity c
δ_c^{DER}	CET function share parameter for composite QDER commodity c
ϕ_c^X	CET function shift parameter for commodity c
σ_c^X	elasticity of transformation between dom sales and exports for c
ρ_c^X	CET function exponent for commodity c
δ_c^{MR}	Armington function share parameter for RoC imports commodity c
δ_c^{DD}	Armington function share parameter for domestic commodity c
ϕ_c^{DMR}	Armington function shift parameter for commodity c
σ_c^{DMR}	elasticity of substitution between dom goods and imports for c
ρ_c^{DMR}	Armington function exponent for commodity c
δ_c^{ER}	CET function share parameter for RoC exports commodity c
δ_c^{DS}	CET function share parameter for domestic commodity c
ϕ_c^{DER}	CET function shift parameter for commodity c

σ_c^{DER}	elasticity of transformation between dom sales and exports for c
ρ_c^{DER}	CET function exponent for commodity c
η^{roct}	constant price elasticity of RoC tourism demand (< 0)
η^{rowt}	constant price elasticity of RoW tourism demand (< 0)
$cwts_c$	consumer price index weights
$dwts_c$	domestic sales price weights
$phillips_f$	elasticidad-desempleo del salario factor f
$fprd_{f,a,t}$	productivity term for factor f in act a
κ	velocidad movilidad del capital entre actividades
$cc_{c,inv}$	quantity of commodity c per unit of investment inv
δ^{ng}	depreciation rate for non-government capital
δ^{g}	depreciation rate for government capital

Equations

Production Function

Top Level: Value Added Demand

$$QVA_a = iva_a QA_a \tag{PF1}$$

Top Level: Intermediate Inputs Demand

$$QINTA_a = inta_a QA_a \tag{PF2}$$

Second Level: Value Added

$$QA_a = TFP_a \phi_a^{VA} \left(\sum_f \delta_{f,a}^{VA} \left(fprd_{f,a} FD_{f,a} \right)^{-\rho_a^{VA}} \right)^{\frac{-1}{\rho_a^{VA}}} \tag{PF3}$$

$$FD_{f,a} = \left(\frac{PVA_a}{WF_f WFDIST_{f,a} \left(1 + tfact_{f,a}\right)} \right)^{\sigma_a^{VA}} \left(\delta_{f,a}^{VA}\right)^{\sigma_a^{VA}} \left(TFP_a \phi_a^{VA}\right)^{\sigma_a^{VA}-1} QVA_a \, fprd_{f,a}^{\sigma_a^{VA}-1} \quad \text{(PF4)}$$

$$TFP_a = tfpexog_a CALTFP \prod_{invg} \left(\frac{KG_{invg}}{KG_{invg}^0} \right)^{tfpelas_{a,invg}} \quad \text{(PF5)}$$

Second Level: Intermediate Inputs

$$QINT_{c,a} = ica_{c,a} QINTA_a \quad \text{(PF6)}$$

Production Commodities

$$QX_c = \sum_a \theta_{a,c} QA_a \quad \text{(PF7)}$$

Production Prices

$$PVA_a QVA_a = PA_a \left(1 - ta_a\right) QA_a - PINTA_a QINTA_a \quad \text{(PF8)}$$

$$PINTA_a = \sum_c PQ_c ica_{c,a} \quad \text{(PF9)}$$

$$PA_a = \sum_c \theta_{a,c} PX_c \quad \text{(PF10)}$$

Trade with RoC

RoC Prices

$$PMR_c = pwmr_c + \sum_{ct} PQ_{ct} icmr_{ct,c} \quad \text{(TC1)}$$

$$PER_c = pwer_c - \sum_{ct} PQ_{ct} icer_{ct,c} \quad \text{(TC2)}$$

QDD + QMR

$$QDMR_c = \phi_c^{DMR} \left(\delta_c^{MR} QMR_c^{-\rho_c^{DMR}} + \delta_c^{DD} QD_c^{-\rho_c^{DMR}} \right)^{-\frac{1}{\rho_c^{DMR}}} \quad \text{(TC3)}$$

$$\frac{QMR_c}{QD_c} = \left(\frac{PDD_c}{PMR_c} \frac{\delta_c^{MR}}{\delta_c^{DD}} \right)^{\frac{1}{1+\rho_c^{DMR}}} \quad \text{(TC4)}$$

$$PDMR_c QDMR_c = PDD_c QD_c + PMR_c QMR_c \tag{TC5}$$

QDS + QER

$$QDER_c = \phi_c^{DER}\left(\delta_c^{ER} QER_c^{\rho_c^{DER}} + \delta_c^{DS} QD_c^{\rho_c^{DER}}\right)^{\frac{1}{\rho_c^{DER}}} \tag{TC6}$$

$$\frac{QER_c}{QD_c} = \left(\frac{PER_c}{PDS_c}\frac{\delta_c^{DS}}{\delta_c^{ER}}\right)^{\frac{1}{\rho_c^{DER}-1}} \tag{TC7}$$

$$PDER_c QDER_c = PDS_c QD_c + PER_c QER_c \tag{TC8}$$

International Trade

World Prices

$$PM_c = (1 + tm_c) EXR.pwm_c + \sum_{ct} PQ_{ct} icm_{ct,c} \tag{TW1}$$

$$PE_c = (1 - te_c) EXR.pwe_c - \sum_{ct} PQ_{ct} ice_{ct,c} \tag{TW2}$$

Supply of Products -- Dom + Imp

$$PDD_c = PDS_c + \sum_{ct} PQD_{ct} icd_{ct,c} \tag{TW3}$$

$$QQ_c = \phi_c^{Q}\left(\delta_c^{M} QM_c^{-\rho_c^{Q}} + \delta_c^{DMR} QDMR_c^{-\rho_c^{Q}}\right)^{-\frac{1}{\rho_c^{Q}}} \tag{TW4}$$

$$\frac{QM_c}{QDMR_c} = \left(\frac{PDMR_c}{PM_c}\frac{\delta_c^{M}}{\delta_c^{DMR}}\right)^{\frac{1}{1+\rho_c^{Q}}} \tag{TW5}$$

$$PQ_c QQ_c = \left(PDMR_c QDMR_c + PM_c QM_c\right)(1 + tq_c) \tag{TW6}$$

Demand of Products -- Dom + Exp

$$QX_c = \phi_c^{X}\left(\delta_c^{E} QE_c^{\rho_c^{X}} + \delta_c^{DER} QDER_c^{\rho_c^{X}}\right)^{\frac{1}{\rho_c^{X}}} \tag{TW7}$$

$$\frac{QE_c}{QDER_c} = \left(\frac{PE_c}{PDER_c}\frac{\delta_c^{DER}}{\delta_c^{E}}\right)^{\frac{1}{\rho_c^{X}-1}} \tag{TW8}$$

$$PX_c QX_c = PDER_c QDER_c + PE_c QE_c \tag{TW9}$$

Incomes and Savings

Factors

$$YF_f = \sum_a WF_f WFDIST_{f,a} FD_{f,a} + trnsfr_{f,row} EXR + trnsfr_{f,roc} \tag{Y1}$$

$$YIF_{i,f} = sh^F_{i,f} YF_f \left(1 - tf_f\right) \tag{Y2}$$

Domestic Non-Government Institutions; $i \in insdng$

$$YH_i = \sum_f YIF_{i,f} + trnsfr_{i,gov} CPI + \sum_{i' \in insdng} TR_{i,i'} + trnsfr_{i,row} EXR + trnsfr_{i,roc} \tag{Y3}$$

$$MPS_i = \overline{mps}_i MPSADJ \tag{Y4}$$

$$SH_i = mps_i YH_i \left(1 - ty_i\right) \tag{Y5}$$

$$TR_{i',i} = sh^{TR}_{i',i} \left(1 - MPS_i\right)\left(1 - ty_i\right) YH_i \tag{Y6}$$

Households

$$CON_h = \left(1 - \sum_i sh^{TR}_{i,h}\right)\left(1 - MPS_h\right)\left(1 - ty_h\right) YH_h \tag{Y7}$$

Government

$$
\begin{aligned}
YG = & \sum_h ty_h YH_h \\
& + \sum_c tm_c EXR.pwm_c QM_c \\
& + \sum_c te_c EXR.pwe_c QE_c \\
& + \sum_a ta_a PA_a QA_a \\
& + tq_c \left(PDMR_c QDMR_c + PM_c QM_c \right) \\
& + \sum_f tf_f YF_f + \sum_{f,a} WF_f WFDIST_{f,a} FD_{f,a} tfact_{f,a} \\
& + trnsfr_{gov,row} EXR + trnsfr_{gov,roc} + \sum_{insdng} TR_{gov,insdng} \\
& + \sum_f YIF_{gov,f}
\end{aligned}
\qquad \text{(Y8)}
$$

$$EG = \sum_c PQ_c QG_c + \sum_{i \in insdng} trnsfr_{i,gov} CPI + trnsfr_{row,gov} EXR + trnsfr_{roc,gov} \qquad \text{(Y9)}$$

$$SG = YG - EG \qquad \text{(Y10)}$$

$$RSG = \frac{SG}{CPI} \qquad \text{(Y11)}$$

Rest of the World

$$
\begin{aligned}
& \sum_c pwe_c QE_c + \sum_{ac} trnsfr_{ac,row} + \frac{\sum_c PQ_c QROWT_c}{EXR} + SROW = \\
& \sum_c pwm_c QM_c + trnsfr_{row,gov} + \frac{\sum_{i \in insdng} TR_{row,i}}{\overline{EXR}} + \frac{\sum_f YIF_{row,f}}{\overline{EXR}}
\end{aligned}
\qquad \text{(Y12)}
$$

Rest of the Country

$$
\begin{aligned}
& \sum_c pwee_c QER_c + \sum_{ac} trnsfr_{ac,roc} + \sum_c PQ_c QROCT_c + SROC = \\
& \sum_c pwmr_c QMR_c + trnsfr_{roc,gov} + \sum_{i \in insdng} TR_{roc,i} + \sum_f YIF_{roc,f}
\end{aligned}
\qquad \text{(Y13)}
$$

Final Consumption

Households

$$QH_{c,h} = qhmin_{c,h} + \frac{\delta^{LES}_{c,h}}{PQ_c}\left(CON_h - \sum_{c'} PQ_{c'} qhmin_{c',h}\right) \quad \text{(FD1)}$$

Investment

$$QINV_c = \sum_{inv} cc_{c,inv} RGFCF_{inv} \quad \text{(FD2)}$$

Government

$$QG_c = \overline{qg}_c GADJ \quad \text{(FD3)}$$

Trade and Transport Margins

$$QT_c = \sum_{c'} \left(icm_{c,c'} QM_{c'} + ice_{c,c'} QE_{c'} + icd_{c,c'} QD_{c'} + icmr_{c,c'} QMR_{c'} + icer_{c,c'} QER_{c'}\right) \quad \text{(FD4)}$$

Tourism Demand (RoC and RoW); exogenous if eta_roct = 0 and eta_rowt = 0

$$QROCT_c = \overline{qroct}_c \left(\frac{PQ_c}{PQ_c^0}\right)^{\eta^{roct}} \quad \text{(FD5)}$$

$$QROWT_c = \overline{qrowt}_c \left(\frac{PQ_c / EXR}{PQ_c^0 / EXR^0}\right)^{\eta^{rowt}} \quad \text{(FD6)}$$

Unemployment

$$\frac{WF_f}{CPI} = \frac{WF_f^0}{CPI^0}\left(\frac{UERAT_f}{UERAT_f^0}\right)^{phillips_f} \quad \text{(U1)}$$

Equilibrium Conditions

Factor Markets

$$FS_f\left(1 - UERAT_f\right) = \sum_a FD_{f,a} \quad \text{(EQ1)}$$

Commodity Markets

$$\sum_h QH_{c,h} + \sum_a QINT_{c,a} + QINV_c + QG_c + QT_c + qdstk_c + QROCT_c + QROWT_c = QQ_c \tag{EQ2}$$

Savings-Investment

$$\sum_c PQ_c qdstk_c + \sum_{inv} GFCF_{inv} = \sum_{i \in insdng} SH_i + SG + EXR.SROW + SROC \tag{EQ3}$$

Miscellaneous

Consumer Price Index

$$\sum_c PQ_c cwts_c = CPI$$

Index for Domestic Producer Prices

$$\sum_c PDS_c dwts_c = DPI$$

Real Exchange Rate

$$REXR = \frac{EXR}{DPI}$$

Real GDP at Factor Cost

$$RGDP = \sum_a PVA_a^{00} QVA_a$$

Investment by Destination; Dynamics

$$PK_{inv} = \sum_c cc_{c,inv} PQ_c \tag{D1}$$

$$RGFCF_{inv} = \frac{GFCF_{inv}}{PK_{inv}} \tag{D2}$$

$$AWF_f = \frac{\sum_a FD_{f,a} WF_f WFDIST_{f,a}}{\sum_a FD_{f,a}} \quad \text{(D3)}$$

$$IND_{k,a} = RGFCF_{invng} \frac{FD_{k,a}}{\sum_{a'} FD_{k,a'}} \left[1 + \kappa \left(\frac{WF_k WFDIST_{k,a}}{AWF_k} - 1 \right) \right] \quad \text{(D4)}$$

$$FD_{k,a} = \left(1 - \delta_k^{ng}\right) FD_{k,-1} + IND_{k,a,-1} \quad \text{(D5)}$$

Government RGFCF

$$RGFCF_{inv} = rgfcf_{invg} \quad \text{(D6)}$$

$$KG_{invg,a} = \left(1 - \delta^g\right) KG_{invg,-1} + RGFCF_{invg,-1} \quad \text{(D7)}$$

APPENDIX B: TECHNICAL NOTE ON THE CONSTRUCTION OF THE RSAM FOR HAITI'S SOUTH DEPARTMENT

B.1. Introduction

The aim of this technical appendix is to document in detail the steps that have been followed to build the Regional Social Accounting Matrices (RSAM) for Haiti's South Department which was used to calibrate our Regional Computable General Equilibrium (RCGE) model, a recursive dynamic computable general equilibrium model developed for IDB for tourism investment analysis. For a comprehensive description of the RCGE, see Appendix A.

To outline, this section proceeds as follows. The basic concepts that define the RSAM are introduced in Section 2. The data requirements to construct the RSAM for Haiti's South Department are identified and described in Section 3. The final section details the steps undertaken to construct the RSAM from a national SAM.

B.2. A Regional Social Accounting Matrix

A SAM (and a RSAM) is a matrix representation of the interrelationships existent in an economy at the level of individual production sectors, factors, and institutions. As stated in Round (2003), "it is a comprehensive, flexible, and disaggregated framework which elaborates and articulates the generation of income by activities of production and the distribution and redistribution of income between social and institutional groups".

The SAM is composed of accounts. For each of these, a cell represents a payment column-wise and a receipt row-wise. Hence, columns represent expenditures for each account whereas rows record the matching incomes. Due to the accounting consistency of the SAM, total expenditure of every account must be equal to its total income. In other words, the total of every row must be equal to the corresponding total of the column. The basic structure of a RSAM is presented in Table B.1.

Table B.1: stylized regional social accounting matrix

	spending									
income	activities	com	factors	households	gov local	gov central	RoC	RoW	sav-inv	total
activities		dom-prod								inc firms
com	IO			C	G	G	E	E	I	demand
factors	VA						INC-F	INC-F		inc fac
households			VA		TR	TR	TR	TR		inc hhd
gov local	T	T		T			TR	TR		inc gov loc
gov central	T	T								inc gov cent
RoC		M	INC-F	TR	TR					out LCU
RoW		M	INC-F	TR	TR					out forex
sav-inv				SH	SG local	SG central	SROC	SROW		sav
total	spnd firms	supply	spnd fac	spnd hhd	spnd gov loc	spnd gov cent	in LCU	in forex	inv	

Source: Authors' own elaboration.

Definitions: com = commodities, dom-prod = domestic production, gov = government, RoC = rest of the country, RoW = rest of the world, IO = intermediate consumption, VA = value added, T = taxes, M = imports, INC-F = factor income to/from abroad, TR = transfers, C = private consumption, G = government consumption, E = exports, I = investment, SH = households savings, SG = government savings, and; SF = foreign savings.

The logic behind the SAM transactions is the following. Activities buy intermediate inputs; pay for factors of production, thus generating the value added at factor prices; and pay indirect taxes. All these expenditures are financed with the payments that each activity receives for the sale of its output.

Aggregate supply and demand are both recorded in the commodities accounts. For each commodity, the corresponding account records the sales of aggregate supply (domestic output plus imports from the rest of the country and the rest of the world, and related taxes) as follows: to activities as these demand intermediate goods; to households, government and investment as these demand final goods; and to the rest of the country and the rest of the world as these demands the regions' exports.

Factors earn returns from their involvement in domestic and foreign (including the RoC) production, and they distribute them, net of taxes, to their owners which generally are households and enterprises.

Institutions (households, enterprises[12], government, rest of the country, and rest of the world) receive incomes from production factors and (net) transfers that can be either spent in purchasing commodities or saved.

Savings from households, the local and central governments (that is, the current account balance), the rest of the country, and the rest of the world (that is, the current account balance with an opposite sign) add to aggregate savings and these, in turn, are equal to the level of investment in the regional economy.

Gross regional product (GRP) at factor cost builds as activities remunerate factors of production, that is, value added. GRP at market prices equals GRP at factor cost plus indirect taxes and tariffs, which should also be equal to total final demand plus exports minus imports, both from the RoC and RoW.

B.3. Data

The main sources of information when constructing a national SAM are usually national supply and use tables (SUT), and other databases such as regional accounts, fiscal data, and the balance of payments. The SUT provide information on production, intermediate consumption, final demand (i.e. household and government consumption), exports, and value added. In our case, we first built a national SAM that was later regionalized using non-survey techniques. In doing so, the national SUT were combined with regional data on sectoral employment from the most recent household survey. In our case, the SAM and RSAM base year was selected based on the available information. Specifically, the more recent year with a complete set of national accounts data was selected as the base year which was fiscal year 2013.

[12] The SAM and RSAM built do not separate enterprises from the households. A single account, named hhd, is taken as representative of the domestic private sector.

B.4. Steps in Building the RSAM

Typically, we start with a relatively aggregate SAM that, in a stepwise fashion, is disaggregated drawing on additional data in different areas.[13] Specifically, the process followed has a top-down structure, entailing three steps: (i) construction of an aggregate national SAM (hereafter, Macro SAM); (ii) disaggregation of the Macro SAM into a matrix with a relatively large sectoral breakdown (hereafter, SAM), and; (iii) regionalization of the SAM to make it suitable for the calibration of our regional CGE model (hereafter RSAM).

B.5. Macro SAM

In the first step of building the RSAM, a very schematic representation of the economy was generated, using macroeconomic aggregates from the national accounts. In case needed, information from other sources, adjusted to maintain consistency, was next used to improve the representation of the economy. In particular, data on public finances and balance of payments were factored in to complete the construction of the national Macro SAM. This secondary data was especially critical to adjust the current account balances of the government and the rest of the world, among others. Specifically, the data sources are: national accounts data from IHSI (Institut Haïtien de Statistique et d'Informatique), including the SUT, complemented with (a) fiscal data from the Ministère de l'Economie et des Finances, and; (b) balance of payments data from the Bank of the Republic of Haiti.

The estimated Macro SAM is presented in Table B.2, where the following abbreviations are used:

- act = activities
- com = commodities
- f-lab = labor
- f-cap = capital
- tax-act = activity taxes
- tax-com = commodity taxes
- sub-com = commodity subsidies
- tax-imp = import tariffs

[13] The top-down approach for the SAM-building process is described with more detail in Reinert and Roland-Holst (1997).

- tax-dir = direct taxes
- hhd = households
- gov = government
- row = rest of the world
- sav = savings
- invng = non-government investment
- invg = government investment
- dstk = stock change

Table B.2: Macro SAM for Haiti FY 2013(million gourdes)

	act	com	f-lab	f-cap	tax-act	tax-com	sub-com	tax-imp	tax-dir	hhd	gov	row	sav	inv	invg	dstk	total
act		551,672															551,672
com	193,105									352,791	31,267	66,542		96,078	13,450	57	753,290
f-lab	114,027											0					114,027
f-cap	233,281											3,119					236,401
tax-act	11,259																11,259
tax-com		427															427
sub-com		-3,845															-3,845
tax-imp		12,067															12,067
tax-dir										9,449							9,449
hhd			114,027	235,747							4,195	77,407					431,375
gov					11,259	427	-3,845	12,067	9,449	1,049		10,271					40,677
row		192,970	0	654						10,765	69						204,458
sav										57,321	5,146	47,118					109,585
inv													96,078				96,078
invg													13,450				13,450
dstk													57				57
total	551,672	753,290	114,027	236,401	11,259	427	-3,845	12,067	9,449	431,375	40,677	204,458	109,585	96,078	13,450	57	

Source: Authors' own elaboration.

B.6. (National) SAM

At this stage, the aim is to build a more disaggregated SAM, which would be as large as the data available would allow it. Specifically, the Macro SAM and sectoral information from the SUT provided by the IHSI were used as the main inputs to initiate the disaggregation for activities and commodities. In Table B.3, we list the 20 activities and 38 commodities identified in the Haiti (national) SAM.

Table B.3: activities and commodities in the Haiti (national) SAM FY 2013

Activities	Commodities
Agriculture, hunting and forestry; Fishing	Products of agriculture and horticulture; Live animals and animal prod
Mining and quarrying	Forestry and logging products
Food products and beverages	Fish and other fishing products
Tobacco products	Salt
Textiles, wearing apparel, and leather	Stone, sand and clay
Wood and of products of wood and cork	Electricity
Paper and paper products; Publishing	Water
Chemicals and chemical products; Rubber and plastics prod	Meat, fish, fruit, vegetables, oils and fats
Other non-metallic mineral products	Dairy products
Basic metals	Grain mill products, starches and starch products; other food products
Fabricated metal products; Machinery and equipment	Beverages
Other manufactures	Tobacco products
Electricity and water supply	Yarn and thread; woven and tufted textile fabrics
Construction	Textile articles other than apparel
Wholesale and retail trade	Knitted or crocheted fabrics; wearing apparel
Hotels and restaurants	Leather and leather products; footwear
Transport, storage and communications	Products of wood, cork, straw and plaiting materials
Financial intermediation	Pulp, paper and paper products; printed matter and related articles
Other market services	Coke oven products; refined petroleum products
Other non-market services	Basic chemicals; Other chemical products; man-made fibres
	Rubber and plastics products
	Glass and glass products and other non-metallic products n.e.c.
	Furniture; other transportable goods n.e.c.
	Wastes or scraps
	Basic metals
	Metal products, machinery and equipment
	Construction services
	Wholesale trade services; Retail trade services
	Lodging; food and beverage serving services
	Transport services
	Postal and Telecommunication services
	Financial and related services
	Real estate services
	Public administration
	Education, Health, and Recreational, cultural, and sporting services
	Other services
	Domestic services
	Services provided by extraterritorial organizations and bodies

Source: Authors' own elaboration.

In addition, various other complementary adjustments were implemented during the building process of the SAM:

- split of gross operating surplus/mixed income into its two components using the ECVMAS 2012; mixed income was associated with non-salaried workers
- non-profit final consumption was added to be part of the private sector account, hhd;

- financial intermediation services indirectly measured were registered as an input for the financial sector;
- direct purchases were consolidated with the relevant sectors[14];
- imports, exports and cif/fob adjustments are all accounted for in the single SAM account pertaining to the rest of the world, "row", and;
- the stock variation is a component of the total gross investment; this is expressed in the SAM as a payment done by the savings-investment account, savings ("sav") to the stock variation account, "dstk".

B.7. Regional SAM for the South Department

The standard national SAM was regionalized to reflect the productive structure of the Haiti South Department, in order to make it suitable to calibrate our RCGE model. The regional SAM for a single-region has exactly the same aspect as the national SAM, but imports also include inflows coming from other regions within Haiti (i.e., the rest of the country) and final demand will also comprise of exports to other regions within Haiti. Ideally, the RSAM would have had dedicated accounts for the local and the central government levels (see below).

In estimating our non-survey RSAM, the technical coefficients matrix was assumed to be equal to its national counterpart, which is called the "national technology assumption". It is convenient to mention what these technical coefficients mean: they express the amount of input of commodity c per unit of output of activity a, regardless of the geographic origin of input of commodity c. This means that the national inter-industry transactions matrix to be used as a starting point has to be a total flow matrix, thus including both nationally produced and imported inputs (i.e. the cell IO in Table B.1). So, the implicit hypothesis is that technology, in the production function sense, is spatially invariant within Haiti (Lahr, 1993).

In our case, the regionalization was carried using the regional proportion of industry's employment. Thus, our key assumption is that labor productivity (i.e. output per worker) is the same at the regional and at the national levels. Specifically, the ECVH identifies the following activities or industries: Agriculture, hunting and forestry; Fishing; Mining and quarrying; Manufacturing; Electricity, gas and water supply; Construction; Wholesale and retail trade;

[14] Direct purchases usually represent the expenditure on transport and communication services of the governmental and private sector abroad and from foreign individuals in the country.

Hotels and restaurants; Transport, storage and communications; Financial intermediation; Real estate, renting and business activities; Public administration and defense; Education; Health and social work; and Other service activities.

Typically, a SAM specifies the investment in a slightly different setup to that of the RSAM for our model. The RSAM for our RCGE includes at least two investment accounts: one for the private sector, and one for the services that are provided by the government. This disaggregation implies that investment by sector of origin and by sector of destination is specified. As a first step, it was assumed that the composition of the capital good is the same independent of the sector of destination. This is achieved by maintaining the disaggregation of investment by sector of origin as this is initially accounted for in the national SAM.

In addition, using national information from ECVH, labor was disaggregated into four types according to the educational level as follows: unskilled (no education and primary education), semi-skilled (secondary education), and skilled (tertiary education).

APPENDIX C: THE MICROSIMULATION MODEL

In this Appendix we provide a more detailed discussion of the microsimulation model. As explained, labor market and non-labor income results from the RCGE model are introduced into the microsimulations in order to produce a counterfactual labor income for each individual in the household survey. Then, household per capita income is recalculated to compute the new poverty and income inequality results.

The microsimulation model follows the non-parametric method described in Vos and Sanchez (2010) but extended to consider changes in non-labor.[15] First, the labor market structure is defined in terms of rates of unemployment U among different segments of the population at working age (in this case, defined according to skill), the structure of employment S (in this case, defined according to sector of activity S) and (relative) remuneration W1, as well as the overall level of remuneration W2. The labor-market structure can thus be written as

$$\lambda = (U, S, W1, W2),$$

and the effect of altering each of its four parameters on poverty and inequality can then be analyzed by simulating counterfactual individual earnings and family incomes. Briefly, the model selects at random (with multiple repetitions) from the corresponding labor groups the individuals who will change labor market status (i.e., employment/unemployment and sector) and assigns wages to new workers according to parameters for the average groups. Then, the new wage and employment levels for each individual result in new household per capita incomes that are then used to determine the new poverty and income distribution results. Analytically, we ca write

$$yl_i = f(\lambda, X_i)$$

where

yl_i = individual labor income

X_i = individual characteristics; e.g., skill level

[15] In turn, this approach is an extension of the earnings inequality method developed by Almeida dos Reis and Paes de Barros (1991).

In each counterfactual scenario, labor market conditions might change and in turn impact the individual labor income; i.e.,

$$yl_i^* = f\left(\lambda^*, X_i\right)$$

where λ^* refers to the simulated labor market structure parameters.

The labor market variables and procedures that link the RCGE model with the microsimulations are as follows. The "unemployment effect" is simulated by changing the labor status of the active population in the ECVMAS (2012) sample based on the results from the RCGE model. For instance, if according to the RCGE simulations, unemployment decreases at the same time that employment increases for, say, semi-skilled workers in sector A, the microsimulation model "hires" randomly from the ECVMAS sample among the unemployed semi-skilled labor force. As explained above, individual incomes for the newly employed are assigned based on their characteristics (e.g. educational level) by looking at similar individuals that were originally employed. If the RCGE simulations indicate a decrease in employment for a specific labor category and sector, the microsimulation program "fires" the equivalent percentage from the type of labor and sector, and the counterfactual income for those newly unemployed is zero.

The "sectoral structure effect" is simulated by changing the sectoral composition of employment. For those individuals that move from one sector to another, we simulate a counterfactual labor income based on their characteristics and on their new sector of employment, again by looking at individuals that were originally employed in the sector of destination.

To model the change in relative wages, wages for a given labor category (e.g. semi-skilled workers in sector A) are adjusted according to the changes from the RCGE simulations but keeping the aggregate average wage for the economy constant. The impact of the change in the aggregate average wage for the economy is simulated by changing all labor incomes in all sectors, by the same proportion, based on the changes resulting from the RCGE simulations. Next, all the previous steps are repeated several times and averaged.

For non-labor incomes, government transfers and remittances from abroad are proportionally scaled up or down using changes taken from the RCGE model. The final step in the microsimulation model is to adjust the micro data such that the percentage change in the household per capita income matches the change in household per capita income, for each representative household in the RCGE simulations. Thus, this residual effect implicitly accounts for changes in all items not previously considered (i.e. non-labor and non-transfer incomes) such as natural resource and capital rents.

APPENDIX D: SENSITIVITY ANALYSIS

As usual, the results of our RCGE model are a function of (a) the model structure (e.g., functional forms used to model production and consumption decisions, macroeconomic closure rules, among other elements); (b) the base year data used for model calibration (i.e., the RSAM), and; (c) the values assigned to the model elasticities or, more generally, to the model's free parameters.

Certainly, the elasticities used in this study implicitly carry an estimation error, as in any similar model. Consequently, a systematic sensitivity analysis of the results was performed with respect to the value assigned to the model elasticities. Hence, if the conclusions of this analysis are robust to changes in the set of elasticities used for model calibration, there will be greater confidence in the results generated by the RCGE presented in Section 3.

In order to perform the systematic sensitivity analysis, it is assumed that each of the model elasticities is uniformly distributed around the "central" value used to obtain the results presented in the main text. The range of variation allowed for each elasticity is +/- 80%; that is, a wide range of variation for each model elasticity was considered. Then, a variant of the method originally proposed by Harrison and Vinod (1992) was undertaken for the systematic sensitivity analysis. In short, the aim is to solve the model iteratively with different sets of elasticities. Thus, a distribution of results was obtained for building confidence intervals for each of the model results. In what follows, the method for implementing the systematic sensitivity analysis is described.

Step 1. In the first step, the distribution (i.e., lower and upper bound) for each of the model parameter that will be modified as part of the systematic sensitivity analysis was computed: elasticities of substitution between primary factor of production, trade-related elasticities, expenditure elasticities, and unemployment elasticities for the wage curves.

Step 2. In the second step, the model is solved repeatedly, each time employing a different set of elasticities; it is, therefore, a "Monte Carlo" type of simulation. First, the value for each model elasticity was randomly selected. Second, the model is calibrated using the selected elasticities. Third, the same counterfactual scenarios as described in this paper are executed. Then, the preceding steps are repeated several times, 500 in this case, with sampling with replacement for the value assigned to the elasticities.

Table D.1 shows the percentage change in private consumption estimated (a) under the "central" elasticities, and (b) 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 in the main text are significant, while estimates presented in Table 4 are within the confidence intervals reported in Table D.1. For example, there is virtual certainty that the combi scenario has a positive effect on private consumption in the South region of Haiti.

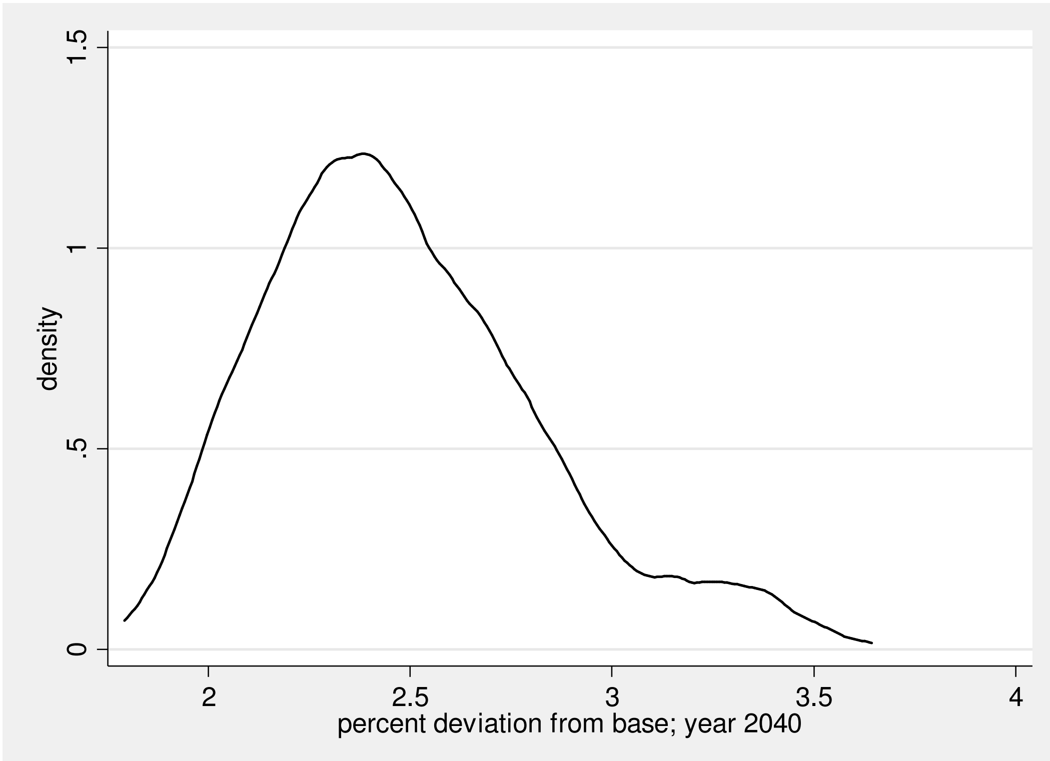
Table D.1: Sensitivity analysis; real private consumption percent deviation from base; year 2040 95% confidence interval under normality assumption

Scenario	Central Elast	Mean	Standard Dev	Lower Bound	Upper Bound
invest	0.3542	0.3476	0.0285	0.2918	0.4034
dem	2.2866	2.3331	0.3525	1.6422	3.0239
combi	2.4438	2.4838	0.3450	1.8076	3.1601
combi-BE	1.8379	1.8771	0.2414	1.4039	2.3504

Source: Authors' own elaboration.

Figure D.1 shows non-parametric estimates of the density function for the percentage change in 2040 in private consumption in the combi scenario. Again, we see that the sign of the results (i.e., positive) is not changed when model elasticities are allowed to differ in +/- 80% of their "central" value.

Figure D.1: sensitivity analysis; real private consumption percent deviation from base; scenario combi; year 2040 non-parametric estimation density function



Source: Authors' own elaboration.

APPENDIX E. REGIONAL/NATIONAL CGE MODEL MANUAL[16]

This document describes how the RCGE model developed in this paper can be implemented in GAMS (General Algebraic Modeling System). The model may be calibrated with data from either (a) a region that trades with the rest of the world and/or the rest of the country, or (b) a country that trades with the rest of the world. Moreover, the model provides special treatment for tourism-related applications. A detailed description of the model equations can be found in Appendix A of this document.

[16] Developed by Martin Cicowiez, Centro de Estudios Distributivos, Laborales y Sociales (CEDLAS)-Universidad Nacional de La Plata.

E.1. GAMS Code Organization

Figure 1 shows the organization of the files that comprise the GAMS model code.

Figure 1: Organization of Files

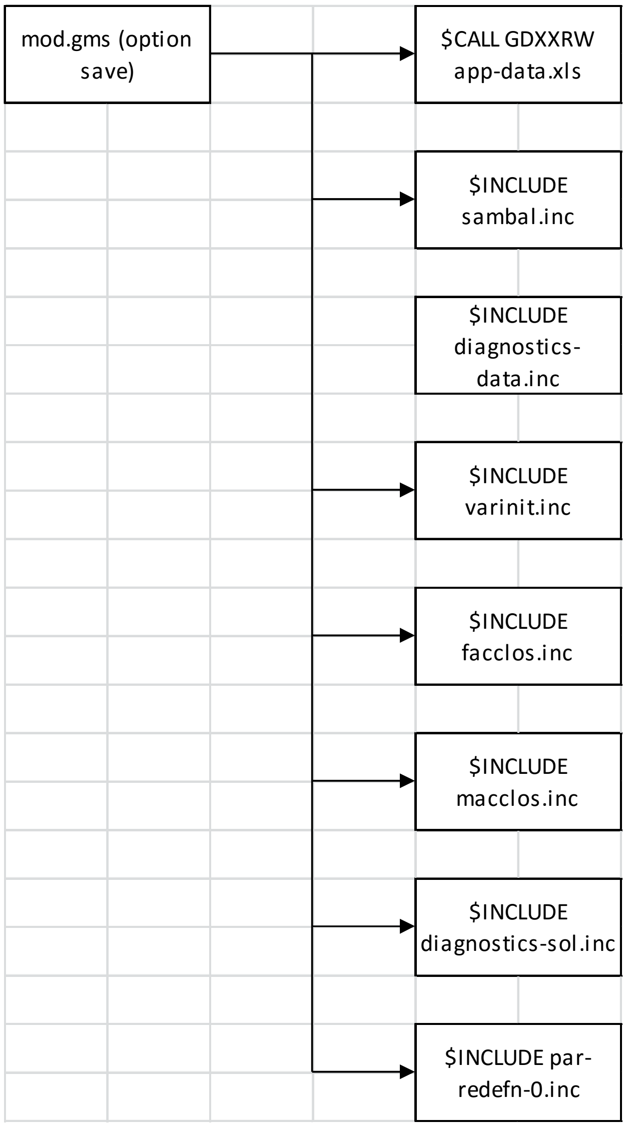
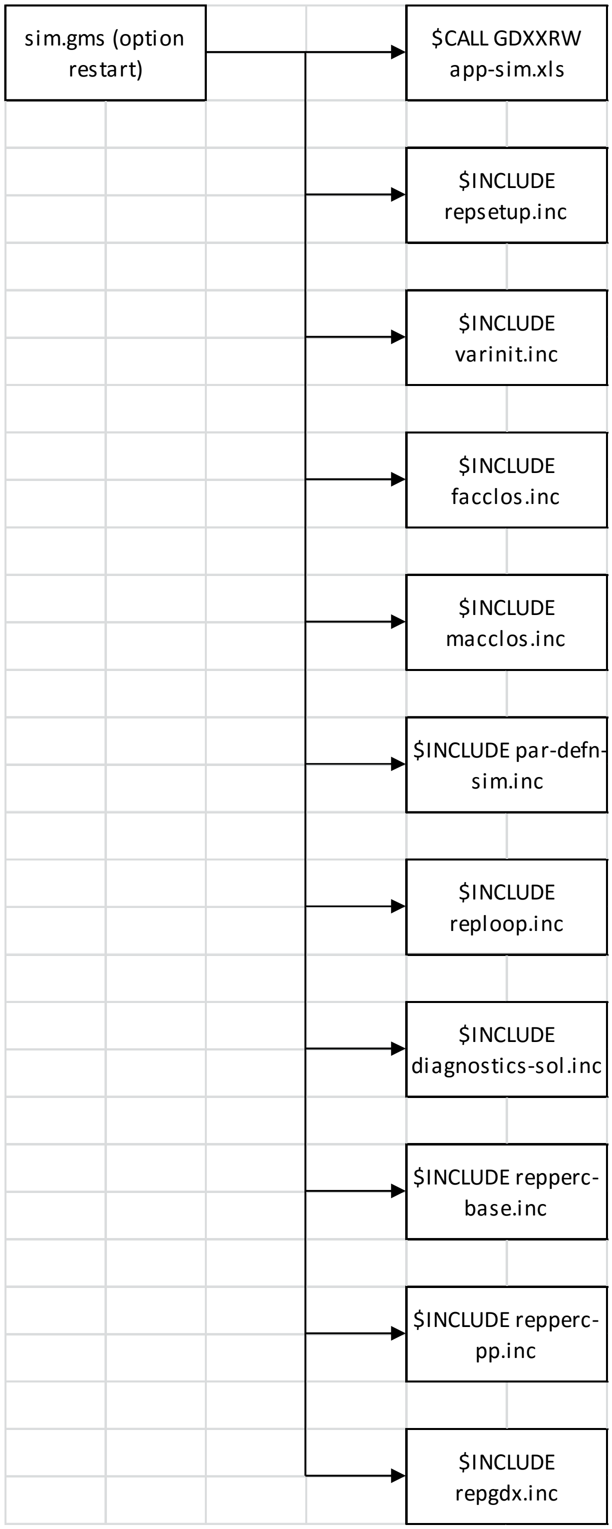


Figure 1: Organization of Files – cont.



Source: Authors' own elaboration.

The GAMS model code consists of two main files; mod.gms and sim.gms. The sequence to run the model is the following:

1. **mod.gms** using the command line option s=save\mod
2. **sim.gms** using the command line option r=save\mod s=save\sim

The model is coded for ease of use with different databases by maintaining separate the theory of the model from the data used in model calibration. This model contains the following four sets of files:

- "demo" can be used as a starting point (i.e. template) for new applications that use the model to analyze a region that trades with both the rest of the country and with the rest of the world;
- "demo2" can be used as a template for new applications that use the model to analyze a policy change at the national level;
- "hti2013" is the 2013 database for Haiti, and;
- "htisud2013v2" is the 2013 database for the regional model of Haiti's South Department used in this paper.

Each set of files has two components, one for data and another for defining simulations. Additionally, certain features of the model are enabled or disabled depending on the information entered in the data file. Upon completion, the model code generates a file with reports (report.gdx) in GDX format, GAMS' own data format.[17]

E.2. Steps to Implement the Model

In general, to use a new database with this model, the following steps should be followed:

1. Create copies of demo-data.xls and demo-sim.xls: these files are located in the **user-files** folder

[17] One can also use the file rep.gms using the line option r = save command\sim, r = save\rep to generate specific reports that are stored in an Excel file in addition to the GDX repsum.gdx file.

2. Rename the copies made in the previous step to something like app-data.xls and app-sim.xls; where *app* refers to the name given to the new model's application.

3. In the mod.gms file, modify the statement $SET app2 demo for $SET app2app.

E.3. The Data File

This section describes each of the sheets in the Excel workbook that contains the information used to calibrate the model. To generate the title, we use the name of each sheet along with the name of the defining parameter, identifying their dimensions.

dmod – dmod

In this sheet, the user chooses the type of model to be used. The possible values are:

dmod=0 to use the model in static or one period mode; in this case, the simulated shocks should be introduced for the first year included in the sub index or set *t* (see below).

dmod=1 to use the dynamic model assuming that the dynamic calibration is carried out by imposing a growth rate exogenous on GDP of the country being modeled, while assuming that the total factor productivity is exogenous. In addition, one may specify the growth rates of other variables such as labor supply, land, public consumption, among others. To clarify, in the simulation scenarios, the GDP growth rate is always endogenous.

dmod=2 to use the dynamic model but assuming that the dynamic calibration is performed under the assumption that the economy is modeled on a path of balanced growth. In this case, the growth rate specified in the *ssgrw* sheet (see below) applies to all model quantities, while relative prices remain unchanged.

Time-related sets

Because this is a dynamic model, t and tsol(t) sub-indexes were added (see Table E.1). The sub-index *t* refers to all the periods for which the model can be solved while the sub index "tsol" (t) contains the periods for which the model is actually solved.

Table E.1: Time sub-indices

Set	Description
t	All periods
tsol(t)	Solution Periods

Source: Authors' own elaboration.

SAM-related sets

Table E.2 lists the sub-indices or sets that are defined through the Excel data file for the calibration. The domain of each sub index is indicated in parentheses. The other model sets are defined automatically. During model implementation, the number of required SAM accounts was minimized; for example, the account representing direct taxes can be anything, just as long as it is indicated in the taxdir (itax) set. Furthermore, the only mandatory account name in the SAM is total, because this account is explicitly referenced in the GAMS model code (see mod.gms file).

In some cases, the content of one or more sets determines which features of the model will be used. For example, if the set taxdir(itax) is left without elements, it means that the SAM does not contain information on direct taxes on institutional income. Thus, this tax will not be implemented in the model. It should be noted, however, that the user could introduce new taxes in the SAM if desired.

Table E.2: SAM sub-indices

Set	Description
ac	Global set (SAM accounts and other items)
a(ac)	Activities
aagr(a)	Agricultural activities
amnf(a)	Manufacturing activities
asvc(a)	Service activities
c(ac)	Commodities
cagri(c)	Agricultural commodities
cmnf(c)	Manufacturing commodities
csvc(c)	Service commodities
tacd(ac)	Domestic trade and transport margins
tacmr(ac)	Imports to rest of country trade and transport margins
tacer(ac)	Exports to rest of country trade and transport margins
tacm(ac)	Import trade and transport margins
tace(ac)	Export trade and transport margins
f(ac)	Factors
flab(f)	Labor factors
fcap(f)	Capital factors
fuendog(f)	Factors with endogenous unemployment
ins(ac)	Institutions
insd(ac)	Domestic institutions
insdng(insd)	Domestic non-government institutions
h(insdng)	Households
insgov(insd)	Government
insroc(ins)	Rest of the country
insrow(ins)	Rest of the world

Set	Description
roct(ac)	Rest of the country tourism demand account
rowt(ac)	Rest of the world tourism demand account
itax(ac)	All taxes
taxvat(itax)	Value-added taxes on activities
taxcom(itax)	Sales tax
taxact(itax)	Tax on producer gross output value
taxdir(itax)	Direct tax on domestic institutions
taximp(itax)	Import tariff
taxexp(itax)	Export tax
taxfac(itax)	Direct tax on factors such as social security tax
taxfact(itax)	Tax on factor use, such as alternative social security tax
sav(ac)	Savings
inv(ac)	Investment
invng(inv)	Non-government investment
invg(inv)	Government investment
dstk(ac)	Changes in inventories

Source: Authors' own elaboration.

sam – SAM(ac,acp)

In this sheet, the SAM is introduced. Then, the "scaling" sheet can be used to re-scale the SAM if necessary. In general, it is recommended that there are no major differences between the maximum and minimum values in the SAM. Furthermore, it is preferred that the SAM values do not exceed 99999; these criteria improve the GAMS SOLVER's performance in finding the solution.

mtfactf -- mtfactf(taxfact,f)

In this sheet, a relationship is established between SAM accounts which relate to taxes on the employment of factors from productive activities (see first column in Table E.3), and SAM accounts which relate to factors of production (see second column in Table E.3). In other words, it indicates the tax base of each tax on factors of the SAM. As shown in the example in Table E.3, with YES, a relationship between elements in rows and columns is established; each tax account can only relate to a single factor of production.

Table E.3: Example maptfactf

maptfactf(taxfact,f)		
tf-land	f-land	YES
tf-lab-unsk	f-lab-unsk	YES
tf-lab-sk	f-lab-sk	YES
tf-cap	f-cap	YES
tf-natres	f-natres	YES

Source: Authors' own elaboration.

In the case of Haiti's South Department, the SAM does not have information on this tax and therefore, maptfactf sheet is left blank for this model application.

mapaggreg – mapaggreg(ac,acp)

This sheet is used to aggregate SAM accounts. For example, Table E.4 shows how sub-com account can be eliminated by adding its contents to the tax-com account.

Table E.4: mapaggreg example

mapaggreg(ac,acp)		
sub-com	tax-com	YES
f-labn	f-lab	YES
f-labp	f-lab	YES
f-labs	f-lab	YES
f-labt	f-lab	YES

Source: Authors' own elaboration.

ssgrw -- ssgrw(idat)

In this sheet, the steady state growth rate is specified; it is used for overwriting gdpgrw, qfacgrw and popgrw values when dmod=2. In this case, the relevant idat elements are gdp, pop and qlab (see Table E.5).

Table E.5: ssgrw example

ssgrw(idat)	
gdp	0.0400
pop	0.0135
qlab	0.0250

Source: Authors' own elaboration.

If the dynamic calibration model is selected assuming that the economy is on a path of balanced growth (i.e., dmod = 2), the total factor productivity growth rate is computed as:

tfpgrw(t) = (1+ssgrw('gdp'))/(1+ssgrw('qlab')) - 1;

gdpgrw – gdpgrw(t)

In this sheet, the GDP's annual growth rate of the modeled country are introduced. The information is used to perform dynamic calibration of the model when dmod=1. That is, the information entered here is ignored when the model is calibrated under the assumption that the economy is on a path of balanced growth. Obviously, it is also ignored when the static version of the model (i.e., dmod = 0) is used.

pop – pop(h,t)

In this sheet the population projections for each of the model's representative households is introduced; this information is used to update the minimum consumption of each good. The information entered is ignored when dmod = 2.

qfbase – qfbase(f,a)

In this sheet the number of employees is introduced by type of job factor demanded by each activity is introduced. Information is entered as a table with factors in rows and activities in columns.

qfacgrw – qfacgrw(f,t)

In this sheet, growth rates for exogenous factor supply are introduced. In particular, information for labor, land factors and natural resources is introduced. Meanwhile, capital endogenously evolves according to levels of investment (see Table E.6).

Table E.6: qfacgrw example

qfacgrw(f,t)	2014	2015	2016	2017	2018	2019	2020
f-lab-unsk	0.281304	0.281304	0.0259261	0.0259261	0.0259261	0.0259261	0.0259261
f-lab-sk	0.281304	0.281304	0.0259261	0.0259261	0.0259261	0.0259261	0.0259261

Source: Authors' own elaboration.

dinam – dinam (r,idat)

Relevant information to the dynamic version of the model is introduced in this sheet (see Table E.7). The netprfrat column refers to the net rate of return on capital; it is used to estimate the initial stock of private capital when the economy is not assumed to be on a path of balanced growth (i.e., dmod = 1). The row kappa is used to value the parameter of the same name that measures the rate at which new capital can move between sectors. The rows deprcap and deprcapgov refer to private and public capital depreciation rates, respectively.

Table E.7: dinam example

dinam(idat)	
netprfrat	0.15
kappa	0.5
deprcap	0.065
deprcapgov	0.025

Source: Authors' own elaboration.

unemp – unemp(f,idat)

In this sheet, the information needed to implement the model with endogenous unemployment is entered (see Table E.8). Particularly, the UERAT0 column refers to the initial unemployment rate; a 7.5% unemployment rate is introduced as 0.075. On the other hand, the column phillips refers to the unemployment elasticity of the factor wages indicated in the first columns of the table.

Table E.8: unemp example

Unemp(f,idat)		
	UERAT0	Phillips
f-lab-unsk	0.2395	-0.05
f-lab-sk	0.3483	-0.05

Source: Authors' own elaboration.

prodelas – prodelas(a)

In this sheet, the values of substitution elasticity among primary factors of production are introduced. Note that the added value production function is a CES type. An elasticity must be entered for each activity in the SAM. Table E.9 shows an example.

Table E.9: prodelas example

prodelas(a)	
a-agrforfish	0.243
a-min	0.200
a-mnf	1.213
a-elewat	1.260
a-construc	1.400
a-trade	1.680
a-hotelrest	1.680
a-tmscomm	1.575
a-fin	1.260
a-othsvcmark	1.260
a-othsvcnonmrr	1.260

Source: Authors' own elaboration.

tradelas – tradelas(c,idat)

In this sheet, elasticity values are entered for commerce, for both the rest of the country and rest of the world. In column "sigma Q" ("sigma X") Armignton (CET) elasticities are introduced. Meanwhile, the columns sigma_DMR and sigma_DER refer to the combination of local products with imports and exports, respectively. As shown, elasticities may vary among products. Table E.10 shows an example.

Table E.10: tradelas example

Tradelas(c,idat)	sigma_Q	sigma_X	sigma_DMR	sigma_DER
c-agrforfish	0.9	1.25	1.8	2.5
c-min	0.9	1.25	1.8	2.5
c-mnf	0.9	1.25	1.8	2.5
c-elewat	0.9	1.25	1.8	2.5
c-construc	0.9	1.25	1.8	2.5
c-trade	0.9	1.25	1.8	2.5
c-hotelrest	0.9	1.25	1.8	2.5
c-tmscomm	0.9	1.25	1.8	2.5
c-fin	0.9	1.25	1.8	2.5
c-othsvcmark	0.9	1.25	1.8	2.5
c-othsvcnonmrr	0.9	1.25	1.8	2.5

Source: Authors' own elaboration.

leselas -- leselas(c,h)

In this page the income-expenditure elasticities for each product identified in the SAM[18] are specified.

The estimation of these elasticities can be through household survey data which contains information on household consumption. Furthermore, Seale et. al (2003) provide comparable estimates for many countries (Seale, Regmi, and Bernstein 2003)[19].

frisch -- frisch(h)

[18] Please note that, in case it is necessary, the model code will "re- scale" these elasticities to meet the Engel condition of aggregation, that is:

$$\sum_c w_{ch}\eta_{ch} = 1$$

where w_{ch} is the share of good /service c in the total household consumption h, and η_{ch} is the income elasticity of demand for commodity c in home h.

[19] See http://www.ers.usda.gov/publications/tb-technical-bulletin/tb1904.aspx

In this page the Frisch parameter value, which is used to calibrate the "Stone - Geary" utility function is defined. A value must be specified for each of the model's representative households. The Frisch parameter is defined as the ratio of total income and discretionary income. The definition of this parameter's value may be based on estimates provided in Lluch et al. (1977), where the Frisch parameter increases from -7.5 to -2.0 when per capita income goes from $100 to $3,000 in 1970 US dollars (Lluch, Powell, and Williams 1977). Lluch et al.'s estimated ratio is: $frisch = -36\, ypc^{-0.36}$, where ypc is income per capita expressed in 1970 US dollars.

tfpelas0 -- tfpelas0(a,ac)

In this sheet the elasticity of total factor productivity for each activity for the different public capital stocks is introduced. Elements of the invg set are usually considered, particularly public infrastructure stocks. Additionally, one may incorporate the elasticity of total factor productivity of each activity with regards to the level of the economies openness. This is calculated by dividing the sum of exports and imports with GDP.

tourismelas -- tourismelas(ac)

In this sheet price elasticities of demand for tourism-related sectors are introduced; its value is used when tdemexog (c) is different from 1.

facclos0 – facclos(f)

In this sheet the closure rule (i.e., how to balance supply and demand) is chosen for each of the production factors identified in the SAM. Three alternatives are available: (1) mobile factors across sectors with full employment, (2) immobile factors (i.e., specific to each sector) with full employment, and (3) mobile factors with unemployment. The second alternative is often used for capital mobility in the context of the short/medium term, where it is assumed that the installed capital cannot move easily between productive sectors. In fact, this is the option used in implementing the dynamic model. The third option assumes that the factor supply curve is horizontal, that is, labor supply is perfectly elastic. Table E.11 shows which variables are endogenous and which are exogenous for each closure alternative.

Table E.11: facclos(f)

No.	Factor Closure	WFDIST(f,a)	WF(f)	QF(f,a)	QFS(f)
1	Full Employment, Mobile Factor	Fixed	Flexible	Flexible	Fixed
2	Full Employment, Sector Specific	Flexible	Fixed	Fixed	Flexible
3	Unemployment, Mobile Factor	Fixed	Fixed	Flexible	Flexible

Source: Authors' own elaboration.

numeraire0 – numeraire0

In this sheet, the model's numeraire is chosen (Table E.12); four pre-programmed alternatives are offered: (1) the numeraire is the consumer price index; (2) the numeraire is the internal price index for the producer; (3) the numeraire is the nominal exchange rate against the rest the world, and; (4) the numeraire is the nominal exchange rate with the rest of the country. In the fourth case, the numeraire is a dummy variable that allows modeling the real exchange rate of the modeled region distinct from the rest of the country. The application for Haiti's South Department uses the fourth option.

Table E.12: Numeraire

No.	Numeraire	CPI	DPI	EXR	XR
1	Consumer Price Index	Fixed	Flexible	Flexible	Flexible
2	Producer Price Index	Flexible	Fixed	Flexible	Flexible
3	Rest of World Exchange Rate	Flexible	Flexible	Fixed	Flexible
4	Rest of Country Exchange Rate	Flexible	Flexible	Flexible	Flexible

Source: Authors' own elaboration.

govclos0 – govclos0

In this sheet the closure rule is chosen to balance the public budget; four alternatives are offered. Table E.13 shows the exogenous and endogenous variables for each case. Certainly, the model could also be expanded to incorporate alternatives to balance government revenues and expenditures, for example, through modifications of one or more tax rates.

Table E.13: govclos

No.	Variable Balancing Public Investment	RSG	GADJ	TRADJ(row)	TRADJ(roc)
1	Real Government Savings	Flexible	Fixed	Fixed	Fixed
2	Real Government Consumption	Fixed	Flexible	Fixed	fixed
3	Transfers From Rest Of World	Fixed	Fixed	Flexible	Fixed
4	Transfers From Rest Of Country	Fixed	Fixed	Fixed	Flexible

Source: Authors' own elaboration.

siclos0 – siclos0

In this sheet, the closure rule is chosen to match savings and investment; four preprogrammed alternatives are offered. Table E.14 shows the exogenous and endogenous variables for each case. Naturally, options 3 and 4 will or will not be feasible depending on the choice made for rowclos0 and rocclos0, respectively. That is:

(1) flex foreign savings; if rowclos=2 is infeasible, and;

(2) flex RoC savings; if rocclos= 2 is infeasible.

Table E.14: Siclos

No.	Variable Balancing Investment and Savings	RGFCF	MPSADJ	SROW(1)	SROC(2)
1	Investment	Flexible	Fixed	See rocclos	See rocclos
2	Household savings rate	Fixed	Flexible	See rowclos	See rowclos
3	World savings	Fixed	Fixed	Flexible	See rowclos
4	National savings	Fixed	Fixed	See rocclos	Flexible

Source: Authors' own elaboration.

rowclos0 – rowclos0

In this sheet, the closure rule is chosen for the external sector or rest of the world. This rule determines how currency inputs are balanced with currency outputs. In the first case, the real exchange rate is the endogenous variable that drives exports and imports to meet the restrictions imposed by keeping the value of the balance of the payments current account constant. In the second case, it is assumed that the real exchange rate is exogenous while the rest of the world's savings is flexible. Table E.15 shows the choice of exogenous and endogenous variables in each case.

Table E.15: rowclos

No.	Variable Balancing Foreign Exchange Inputs and Outputs	SROW	REXR
1	Real Exchange Rate	Fixed	Flexible
4	World Savings	Flexible	Fixed

Source: Authors' own elaboration.

rocclos0 – rocclos0

In this sheet, the closure rule is chosen for the current account of the modeled region compared to the rest of the country (Table E.16). The options offered are similar to those discussed in the case of rowclos0.

Table E.16: rocclos

No.	Variable Balancing Rest of Country Current Account	SROC	RXR
1	Real Exchange Rate	Fixed	Flexible
4	World Savings	Flexible	Fixed

Source: Authors' own elaboration.

tdemexog – tdemexog(ac)

This sheet determines the way the demand from tourism-related sectors is modeled (Table E.17). For cases where tdemexog = 1, it is assumed that tourism demand evolves exogenously. However, for cases where tdemexog is zero, a constant price elasticity demand function is incorporated. Typically, tourism demand is disaggregated by foreign and/or domestic tourists.

Table E.17: tdemexog example

tdemexog(ac)	
row-t	1

Source: Authors' own elaboration.

scaling

In this sheet, values that allow the SAM (column sam) and/or the number of workers in each production activity (column QLAB – see qfbase sheet) to be re-scaled are introduced. Entering the number 1 means that re-scaling is not performed.

tfpelassim -- tfpelassim(sim,a,ac)

In this sheet, changes to the elasticities of factor productivity for each activity for public capital stocks may be modified. Note that tfpelassim should only be used when the model is used in static mode (dmod=0) or when the base scenario is generated under the assumption of a balanced growth path (dmod=2).

layout

This sheet tells you how the information is organized for the model in the Excel file. In general, it should not be modified by the user.

E.4. The Simulations File

This section describes the sheets from the Excel file that the model uses to define the desired simulated simulations. The model code that accompanies this paper includes several examples. It should be noted that the same simulation name may appear in more than one simulation parameter. For example, you can define a scenario that combines a tariff reduction of a particular good with an increase in the world price of that same good.

sim – sim

In this sheet a name is given to each of the simulations to be defined. The same comments apply as for the simpler model. An example is shown in Table E.18; in addition to the "base" simulation that must always exist, is the example scenario.

Table E.18: sim example

Sim
base
num-2
infra
invest
dem
combi-intra
combi
dem-BE
combi-BE

Source: Authors' own elaboration.

simcur -- simcur(sim)

This sheet indicates which simulations included in the sim set will run. It is necessary that the "base" simulation is included in simcur which is used in reports to compute the change in the model variables in relation to the baseline scenario.

facclossim – facclossim(sim,f)

This sheet defines the mechanism for balancing supply and demand for each factor of production that will be used in each simulation. Whenever a value is not specified, the assigned value from the simulated "base" scenario will be used. When a numeraire is specified in the "base" scenario, the value defined in the database for the reference scenario is used. The available values that can be used are shown in Table E.11 (facclos0).

numerairesim -- numerairesim(sim)

In this sheet the numeraire to be used in each simulation is defined. Whenever a value is not specified, the assigned value from the simulated "base" scenario will be used. When a numeraire is specified in the "base" scenario, the value defined in the database for the reference scenario is used. The values that can be used are shown in Table E.12 (numeraire0).

govclossim – govclossim (sim)

In this sheet the government's closure rule for each simulation is defined. Whenever a value is not specified, the assigned value from the simulated "base" scenario will be used. When a numeraire is specified in the "base" scenario, the value defined in the database for the reference scenario is used. The values that can be used are shown in Table E.13 (govclos0).

siclossim – siclossim (sim)

In this sheet the closure rule for saving - investment that will be used in each simulation is defined. Whenever a value is not specified, the assigned value from the simulated "base" scenario will be used. When a numeraire is specified in the "base" scenario, the value defined in the database for the reference scenario is used. The available values that can be used are shown in Table E.14 (siclos0)

rowclossim – rowclossim(sim)

In this sheet the closure rule for the external sector that will be used in each simulation is defined. Whenever a value is not specified, the assigned value from the simulated "base" scenario will be used. When a numeraire is specified in the "base" scenario, the value defined in the database for the reference scenario is used. The available values that can be used are shown in Table E.15 (rowclos0)

rocclossim – rocclossim(sim)

In this sheet the closure rule for the payment balance current account, in regards to the rest of the country, is defined. This will be used for each simulation. Whenever a value is not specified, the assigned value from the simulated "base" scenario will be used. When a numeraire is specified in the "base" scenario, the value defined in the database for the reference scenario is used. The available values that can be used are shown in Table E.16 (rocclos0).

cpisim – cpisim(sim,t)

In this sheet, the scenarios which modify the value of the model numeraire are defined. In the case of this paper, the Consumer Price Index (CPI) is used as the numeraire. In general, this sheet is used to verify that the model is homogeneous to degree zero in prices. This means that upon doubling the numeraire, all nominal variables (i.e. prices and income) also double, while quantities remain unchanged. The counterfactual CPI is defined as:

CPI(t) = CPI0(t)   if CPISIM(sim,t) = 0

CPI(t) = CPI0(t) * CPISIM(sim,t)   if CPISIM(sim,t) <> 0

In other words, the shocks are introduced as deviations from the base scenario; for example, a value of 2 implies a 100% increase. The same applies to the other parameters used to define shocks. Moreover, when no values are inserted into the cpisim sheet, the values from the reference scenario, with the same also applying to the other parameters in the simulation.

tmsim -- tmsim(sim,c,t)

In this sheet, scenarios that simulate changes in tariff rates are defined. The counterfactual tariff for good c is computed in the simulation SIM as:

tm(c,t) = tm0(c,t)   if tmsim(sim,c,t) = 0

tm(c,t) = tm0(c,t) * tmsim(sim,c,t)   if tmsim(sim,c,t) <> 0

That is, the shocks are introduced as deviations from the base scenario value; for example, a value of 1.25 implies an increase of 25%. An example is shown in Table E.19. This example shows that the tarcut scenario simulates a unilateral tariff reduction of 85% for the following heavy manufactured goods: c- chemrubplast, c- nonmetmin, c- basmet, and c- metprod.

Table E.19: tmsim Example

Tmsim(sim,c,t)	Tm=tm0 x tmsim	
		2013
tarcut	c-chemrubpla	0.15
tarcut	c-nonmetmin	0.15
tarcut	c-basemet	0.15
tarcut	c-metprod	0.15

Source: Authors' own elaboration.

tesim -- tesim(sim,c,t)

In this sheet, scenarios that simulate changes in tax rates on exports, if any are defined. The simulated imposed tax rate is calculated as:

te(c,t) = te0(c,t)   if tesim(sim,c,t) = 0 te(c,t) = te0(c,t) * tesim(sim,c,t)   if tesim(sim,c,t) <> 0

te2sim -- tesim(sim,c,t)

In this sheet, scenarios that simulate changes in tax rates on exports are also defined. In this case, the counterfactual tax rate is introduced directly. That is, the simulated tax rate is calculated as:

te(c,t) = te0(c,t)   if te2sim(sim,c,t) = 0

te(c,t) = te2sim(sim,c,t)   if te2sim(sim,c,t) <> 0

tqsim – tqsim(sim,c,t)

In this sheet, scenarios that simulate changes in rates of sales tax are defined. The counterfactual tax rate is computed in a similar way to the previous cases.

tasim – tasim(sim,a,t)

In this sheet, scenarios that simulate changes in tax rates on productive activities are defined. The counterfactual tax rate is computed in a similar way to the previous cases.

tfpsim -- tfpsim(sim,a,t)

In this sheet, scenarios that simulate changes in total factor productivity for one or more sectors are defined. Implicitly, the scale parameter in the value added production functions are modified. The following describes how to compute the counterfactual TFP:

tfpexog(a,t) = tfpexog0(a,t)   if tfpsim(sim,a,t) = 0

tfpexog(a,t) = tfpexog0 (a) * tfpsim(sim,a,t)   if tfpsim(sim,a,t) <> 0

qgbarsim – qgbarsim(sim,c,t)

In this sheet, scenarios are defined where public consumption and/or public supply of goods and services are modified. Shocks here are introduced similarly to the cases described above. In particular, the shocks are introduced as a deviation with regards to public consumption for the corresponding period in the base scenario.

qgbar2sim – qgbar2sim(sim,c,t)

In this sheet, scenarios are defined also where public consumption and/or public supply of goods and services are modified. Unlike the previous case, here the changes are introduced in absolute values. Consequently, the value of the shock must be expressed in the same units as the SAM.

trnsfrsim -- trnsfrsim(sim,ac,ins,t)

In this sheet, shocks that modify the following transfers are defined: (a) transfers from the rest of the world to local institutions; (b) transfers from the rest of the world to factors of production factors; (c) transfers from the rest of the world to local factors, and; (d) transfers from the government to the other institutions. On the other hand, note that transfers originating from local non-governmental institutions are a fixed proportion of their income. The simulated transfer from ins to ac is calculated as:

trnsfr(ac,ins,t) = trnsfr0(ac,ins,t) if trnsfrsim(sim,ac,ins,t)) = 0

trnsfr(ac,ins,t) = trnsfr0(ac,ins,t) * trnsfrsim(sim,ac,ins,t) if trnsfrsim(sim,ac,ins,t)) <> 0

where ac can include institutions and/or factors of production.

trnsfr2sim – trnsfr2sim(sim,ac,ins,t)

In this sheet, scenarios are defined where the transfers to/from the modeled country or region are modified. Unlike the previous case, here the changes are introduced in absolute values. Consequently, the values must be expressed in the same units as in the SAM.

srowsim -- SROWSIM(sim,t)

In this sheet, shocks affecting the savings of the rest of the world are introduced. This information will only be used if, for the same simulation being defined, the value of rowclos is equal to 1; in other words SROW is set as an exogenous variable. The method for calculating the simulated value of SROW is similar to that described above for other simulation parameters.

pwesim -- pwesim(sim,c,t)

In this sheet, shocks that modify the modeled country's world export prices are defined. The method for calculating the simulated pwe value is similar to that described above for other simulation parameters.

pwmsim -- pwmsim(sim,c,t)

In this sheet, shocks that modify the modeled country's world import prices are defined. The method for calculating the simulated pwm value is similar to that described above for other simulation parameters.

qroctbarsim -- qroctbarsim(sim,c,t)

In this sheet, shocks related to domestic tourism demand are defined. The method for calculating the simulated value of qroctbar is similar to that described above for other simulation parameters. That is:

qroctbar(c,t) = qroctbar0(c,t) if qroctbarsim(sim,c,t)=0

qroctbar(c,t) = qroctbar0(c,t)*qroctbarsim(sim,c,t) if qroctbarsim(sim,c,t)<>0

qrowtbarsim -- qrowtbarsim(sim,c,t)

In this sheet, shocks related to international tourism demand are defined. The method for calculating the simulated value of qrowtbar is similar to that described above for other simulation parameters. That is:

qrowtbar(c,t) = qrowtbar0(c,t) if qrowtbarsim(sim,c,t)=0

qrowtbar(c,t) = qrowtbar0(c,t)*qrowtbarsim(sim,c,t) if qrowtbarsim(sim,c,t)<>0

rgfcfbarsim -- rgfcfbarsim(sim,inv,t)

In this sheet, scenarios are defined where investment demand by destination is modified. The method for calculating the simulated value of rgfcfbar is similar to that described above for other simulation parameters.

rgfcfbar2sim – rgfcfbar2sim(sim,inv,t)

In this sheet, scenarios are defined where investment demand by destination is modified. However, unlike the previous case, here the changes are introduced in absolute values. Consequently, the values must be expressed in the same units as in the SAM.

rgfcfbar(inv,t) = rgfcfbar0(inv,t) + rgfcfbar2sim(sim,inv,t)

(additional to base gfcf)

tfpelassim -- tfpelassim(sim,a,ac)

In this sheet, changes to total factor productivity elasticities for each activity arising from changes to stocks of public capital. It is important to note that tfpelassim should only be adjusted when the model is used in its static mode (i.e. dmod=0) or when the baseline reference scenario is generated under the assumption of a balanced growth path (i.e. dmod=2). Otherwise, modifying the value of tfpelassim would require that the baseline reference scenario to be recreated.

layout

This sheet presents how information will be organized in the Excel file. In general, it should not be modified by the user.

E.5. The Report File

The file report (i.e., reporte.gdx) is generated at the end of the execution simulations file sim.gms. The report includes: (1) all endogenous variables (variable name + X); (2) the percentage change from the base for all endogenous variables (variable name + XP); (3) the parameters used to define the counterfactual scenarios (parameter name + x), and; (4) some reports calculated as described below.

- modsolstat(solcol,t,sim): solver and model status. Because the RCGE model is a constrained non-linear system, the solver and model status should be 1 and 16, respectively. Otherwise, there has been an error.
- SIMSAM(ac,acp,t,sim): a collection of SAMs defined from the results generated by each simulation contained in the simcur set.
- simsambalchk(ac,t,sim): is a parameter that allows verification of the equality between SIMSAM rows and columns.
- MACROSAM(ac2,ac2p,t,sim): contains an aggregate SAM for each simulated scenario.
- macrosambalchk(ac2,t,sim): is a report parameter for ascertaining whether the macrosam in MACROSAM is properly balanced.

- gdpindic(igdp,kgdp,t,sim): a summary table that includes GDP and its components, both in real and nominal terms, as well as in absolute terms and as a proportion of GDP.
- gdpindicXP(igdp,kgdp,t,sim): is a summary similar to the previous one but presents thee above indicators in percentage changes from values in the base scenario.
- sectorstruc(ac,sectorcol,t,sim): is a table that describes the sectoral structure of the economy, for both production and foreign trade. For example, the table contains the participation of each good in total exports and imports, the participation of imports in total consumption, and the participation of exports in total production.
- sectorindic(ac,sectorcol2,kgdp,t,sim): is a table similar to the table above, but unlike the previous one, it presents information in absolute values. The sectorindicxp table presents the results as percentage changes from the base scenario.
- fiscalindic(fiscalcol,t,sim): contains fiscal indicators such as the ratio of public savings to GDP, and the ratio between tax revenue and GDP, among others.
- taxstruc(ac,taxcol,t,sim): contains information on tax revenues in absolute terms, as a proportion of the total of taxes collected, and as a proportion of GDP.
- bopindic(bopcol,kgdp,t,sim): contains information on the balance of payments in domestic currency, as a proportion of GDP, and in foreign currency.
- actvashr(a,t,sim): contains information on the share of each activity in total value added.
- ev(h,t,sim): is the equivalent variation.
- cv(h,t,sim): is the compensating variation.
- tourindic(ac,ac,kgdp,t,sim): contains reports specific to the tourism sector, such as the national and international tourism demands.

The reports that are expressed in local currency are expressed in the currency of the original SAM. The model can be used in combination with iGAMS/ISIM - MAMS, with some additional reports also generated directly in Excel[20].

[20] For further reading and guidance see also:
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