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TN
No. 7

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September 2018

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Abstract

This study assesses the economy-wide impacts of private investments in the hotel industry in Jamaica. Specifically, the paper develops a tourism-extended Social Accounting Matrix (SAM) and a dynamic Computable General Equilibrium (CGE) model tailored to the Jamaican economy. To analyze impacts in terms of poverty and inequality, the CGE model results are linked with a microsimulation model that uses Jamaica's Survey of Living Conditions. The results demonstrate that private tourism investments leading to an expansion of foreign tourism demand can have positive impacts on national economies in terms of GDP, employment, household incomes, and poverty reduction. However, the distribution of benefits is dependent on socioeconomic factors such as the distribution of factor endowments among households. At the sectoral level, sectors catering more directly to tourism experience the highest rates of growth, while more export-oriented sectors do not fare as well given the upward pressure on prices and the real exchange rate due to higher tourism spending.

JEL Classification: L83, C68, I3, O1
Keywords: Tourism, private sector investment, poverty, economic growth, inequality

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1 Introduction

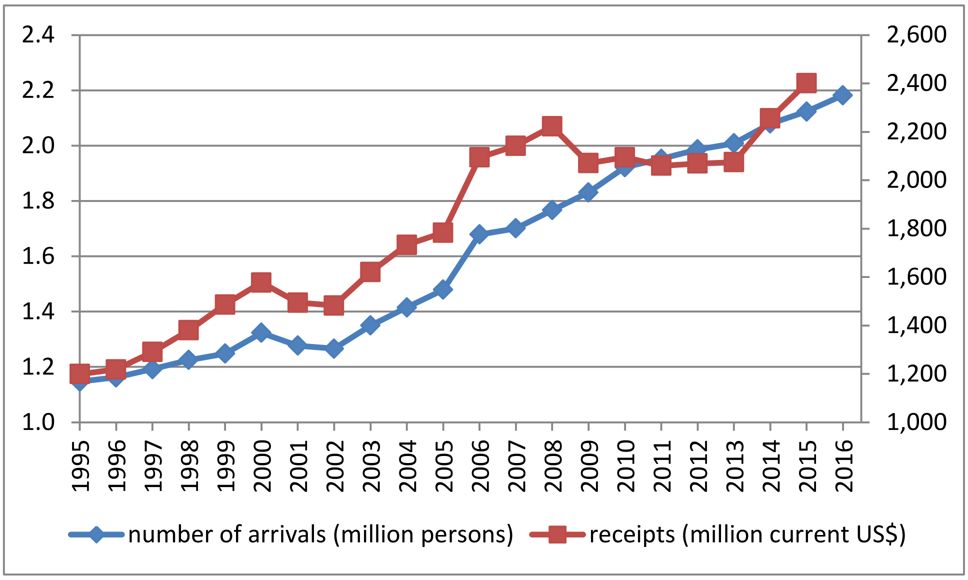
Jamaica features diverse natural resources as well as rich cultural heritage, which provide a range of attractions for tourists. In fact, tourism has been an important sector of Jamaica's economy since the 1950s (Taylor, 2003). International arrivals in Jamaica – excluding cruise passengers – have grown from around 1.7 million visitors in 2006 to 2.2 million in 2016 (see Figure 1.1); i.e., on average, the number of tourists grew 2.7% yearly between 2006 and 2016.[3]

Tourism is a major source of foreign exchange for the economy, and a potentially powerful means of reducing poverty. In fact, together with remittances, tourism is one of the major sources of foreign exchange: in 2016, earnings from tourism and remittances each accounted for about 15% of Gross Domestic Product (GDP). The Statistical Institute of Jamaica estimates that the industry's share of total GDP in 2015 was 7.8% (STATINJA, 2017). The Bahamas, the Dominican Republic, and Mexico recorded receipts from international tourism equivalent to 22%, 9%, and 2% of GDP, respectively, showing the variability of the importance of the sector across economies in the Latin American and Caribbean (LAC) region. In 2015, receipts from international tourism as a share of exports were 58% in Jamaica (ranking 12 out of 195 countries), which compares to 78%, 37%, and 5% in The Bahamas, the Dominican Republic, and Mexico, respectively (UNWTO, 2017).

Tourism also has the potential to promote the economic and social inclusion of women. For example, women account for approximately 59% of hotel and restaurant employees in Latin America and 55% in the Caribbean (UNWTO and UN Women, 2010).

[3] In the same period, the number of cruise passengers arriving in Jamaica increased from around 1.3 million to 1.6 million.

Figure 1.1: Number of foreign tourist arrivals (left axis) and foreign tourism receipts (right axis)



Source: World Tourism Organization.

The tourism supply chain involves a wide range of sectors of society and the economy. The industry's contribution to growth, poverty reduction, and long-term development depends upon complex and dynamic economic, social, environmental, and institutional linkages, spillovers, and externalities. In this study we develop and apply a computational tool to assess the impact of (private) tourism-related investments. Specifically, we develop a tourism-extended Social Accounting Matrix (SAM) and dynamic Computable General Equilibrium (CGE) and microsimulation models for Jamaica. We build on previous work as published in Banerjee et al. (2015, 2016) by focusing on private investments in the hotel industry and the sectoral composition of the tourist per capita spending. In recent years, the CGE method has been used as a tool for coherent and forward-looking economy-wide analysis of tourism-related shocks from a medium- to long-run perspective (Dwyer, 2015; Blake, 2015). In this paper, we contribute to this literature by analyzing the impact of a private investment in the accommodation industry combined with an increase in the inflow and spending of foreign tourists in a relatively small island economy such as Jamaica.

The results show that increased private investment in the hotel industry, together with higher tourism spending, has a positive impact on GDP, employment, household incomes, and poverty in Jamaica. In terms of inequality, the study does not find statistically significant changes in any of the scenarios considered. Impacts on GDP growth at the sectoral level show that service industries catering directly to tourists, including hotels, restaurants, and recreation activities, are strongly stimulated by the expansion in tourism investment. However, upward pressure on prices and the real exchange rate due to higher tourism spending leads to reduced competitiveness and a decrease in employment and value added in manufacturing and mining, two of Jamaica's most export-oriented sectors.

This paper is organized as follows. Section 2 provides an overview of the literature on tourism and growth. Section 3 provides a non-technical description of our CGE model for Jamaica and its current database. Section 4 presents the model simulation scenarios and results. Finally, we provide concluding remarks in Section 5. Appendix A provides additional detail regarding the CGE model used for this study. Appendix B presents the results from systematic sensitivity analysis with respect to selected elasticities. Appendix C provides additional simulation results.

2 Literature Review[4]

In this section, we provide a concise review of recent literature that has assessed the impact of the tourism industry on growth and poverty using diverse methods. Currently, tourism is one of the fastest growing economic sectors, generating 10% of global GDP and 30% of global exports in the services sectors (UNWTO, 2017). Tourism employs one out of 10 workers across the globe, equivalent to 118 million jobs in 2017 (WTTC, 2018). Pablo-Romero and Molina (2013) found positive correlation between tourism and economic growth in 55 of 87 econometric studies reviewed that use time series, panel data, and cross-sectional data. This relationship also bears out in the case of LAC where Eugenio-Martin et al. (2004) confirmed this finding for 21 countries in the region between 1985 and 1998, particularly as this applies to low and middle-income countries. Furthermore, using panel data for the period 1990-2005, a study by Fayissa et al. (2011) found that a 10% increase in tourism expenditure in the LAC region can increase per capita GDP by 0.4%. The overall relationship between tourism and economic growth in the region generally appears positive, though how benefits are distributed is more variable (Moreda et al., 2017).

The distribution of benefits depends on a variety of factors which may be destination or activity-specific and conditioned by the country context, among other features. For instance,

[4] This section draws from Banerjee et al. (2017).

Mitchell and Ashley (2010) review diverse empirical literature (i.e., CGE, input-output, regression analysis, qualitative micro enterprises/livelihoods analysis, and pro poor value chain analysis) for destinations in Africa, Asia and, Latin America, and find evidence that 10% to 30% of tourism expenditure tends to accrue to the poor. In a recent study using a dynamic CGE model similar to ours, Njoya and Seetaram (2017) map the primary channels through which tourism can impact the poor, both positively and negatively. These include poor peoples' labor participation in the tourism value chain, tax collection which may be then transferred to the poor, price channels with currency appreciation as an example, and complex dynamic channels which can affect the socioeconomic environment of the destination and thus the setting in which the poor develop their livelihood activities. In their application to Kenya, they find that, where the economy of a destination is characterized by lower skilled and labor-intensive sectors, there is a great probability that tourism development will increase the income of the poor. Interestingly, Jamaica's labor market is also dominated by (mostly unskilled) labor intensive activities.

In the LAC context, a number of country case studies have been undertaken to understand the dynamics between tourism development and poverty reduction (Moreda et al., 2017). For example, in Costa Rica and Nicaragua, evidence from time series econometrics suggests that a 1% increase in foreign tourism expenditure reduces poverty by 0.58% and 0.64%, respectively (Vanegas et al., 2015). In Panama, using a SAM multiplier model, Klytchnikova and Dorosh (2012) found that 20% of national income derived from tourism expenditure reached the poor; this impact increased to 43% in particularly poor though tourism-oriented destinations in the country. In Haiti, using a regional CGE model, Banerjee et al. (2015) found that a US$36 million public investment in tourism could reduce the number of people living in poverty by 1.6%. In Ecuador, analysis undertaken by Croes et al. (2015) using a SAM multiplier model found a strong potential for tourism to reduce poverty and inequality – given the hypothetical nature of their simulation exercise. Finally, where island states are concerned, Jiang et al. (2011) found that for the 16 island states considered in their study, human development indicators and GDP per capita were positively correlated with tourism intensity – defined as the ratio of tourists to residents.

Interestingly, most applications of CGE modeling to the tourism sector assess the impact of changes in (a) tourism arrivals, (b) tourism per capita expenditure, and (c) public investments in tourism-related infrastructure. Thus, our study is unique in using a CGE model to assess the economy-wide impact of an (exogenous) increase in private investment in the tourism sector.

3 Method and Data

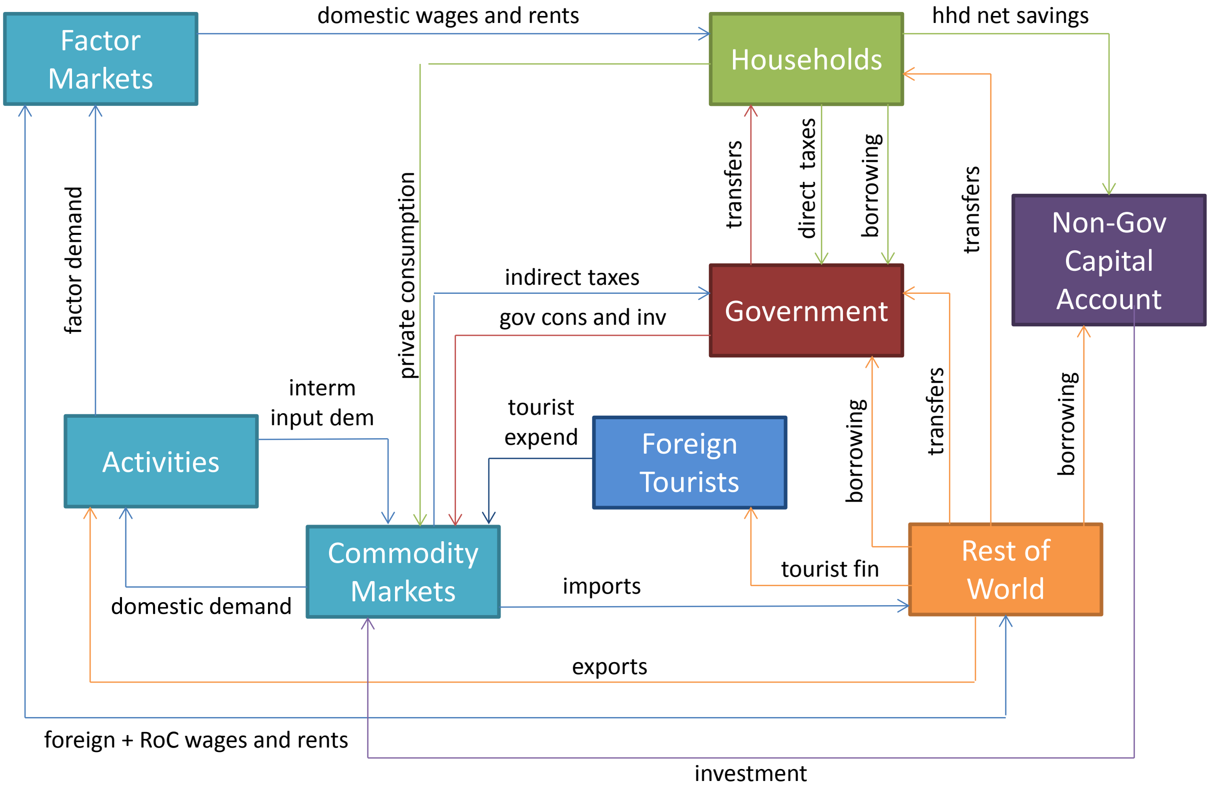
The tourism industry is not a single and clearly identified sector. On the contrary, it is composed of many sectors such as hotels, restaurants, food and beverages, transport, among others. Similarly, investments in tourism also target diverse sectors, from infrastructure development, the provision of basic public services such as water and sanitation, and capacity building in the services sector, as well as institutional strengthening in terms of tourism sector governance. Thus, to assess the impact of various policy interventions, private investments, and/or external shocks related to the tourism sector, a framework that considers all economic sectors and their inter-linkages is essential (see, for example, Dwyer (2015)). In this study, a tourism-extended recursive dynamic CGE model for Jamaica was developed and implemented. CGE modelling offers a systematic method for predicting both the direction and approximate sizes for the impacts of policies, changes in private investment, and external shocks on different agents.

Model

In a nutshell, our model integrates a relatively standard recursive dynamic CGE model (see, for example, Lofgren et al. (2002) and Robinson (1989)) with additional equations and variables that single out: (a) the foreign tourism demand as the product of the number of foreign tourists and their spending per capita, and (b) the impact of private investments in the tourism sector. More precisely, our starting point for model development was our previous work as published in Banerjee et al. (2015, 2016). However, in this particular application we focus on private investments in tourism-related activities such as hotels, instead of public investments in tourism-related infrastructure. Thus, compared to other CGE models, the CGE that was developed for this particular application offers relevant features for the study of tourism investment and/or tourist arrivals and expenditure scenarios in a national economy.

Figure 3.1 depicts, for each simulation period, the circular flow of income within the economy and between the economy and the rest of the world. The major building blocks of our CGE model may be divided into: (a) activities (the entities that carry out production); (b) commodities (activity outputs or, exceptionally, imports without domestic production; linked to markets); (c) factors (also linked to markets); and (d) institutions (households, the government, the rest of the world, and foreign tourists). In the Jamaica application (and database) of our CGE model, most blocks in Figure 3.1 are disaggregated based on the available data.

Figure 3.1: Circular income flow in the CGE; within-period module

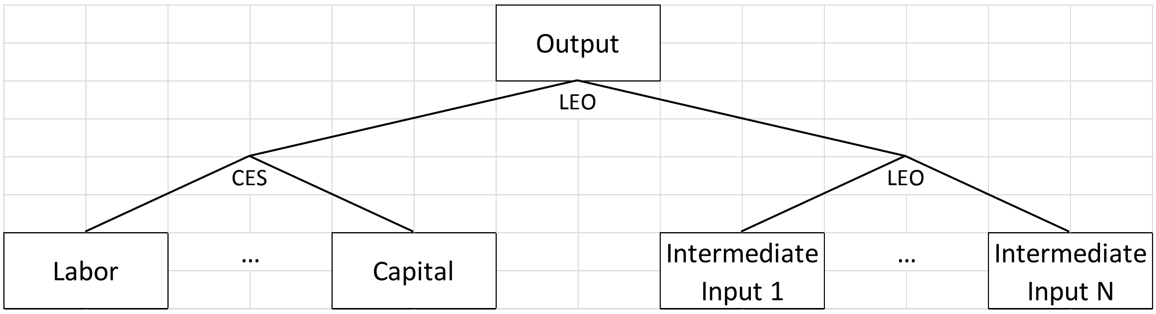


Source: Author's own elaboration.

In any single year, our CGE model for Jamaica has the structure summarized in the above figure. Activities produce, selling their output at home – to both residents and foreign tourists -- or abroad to the trading partners of Jamaica. The activities use their revenues to cover costs (of intermediate inputs, factor hiring, and taxes). Their decisions regarding factor employment, which determines the output level, are driven by profit maximization. The shares of their outputs that are exported and sold domestically depend on relative sales prices in these two destinations.

Figure 3.2 provides additional detail on the production technology of production activities. The level (or quantity) of any activity and its output quantities (via yield coefficients) are a Constant Elasticity of Substitution (CES) function of the quantities of factors employed (in this example labor and capital). Intermediate input use is a Leontief (LEO) function of the activity levels.[5]

Figure 3.2: Production function -- factor and intermediate input demand



Note: CES and LEO refer to constant elasticity of substitution and Leontief production functions, respectively, and there are N commodities used as intermediate inputs.
Source: Authors' elaboration.

Returning to Figure 3.1, our CGE model for Jamaica includes four types of institutions: households, the government, foreign tourists, and the rest of the world. As shown, households earn incomes from factors, transfers from the government, and transfers from the rest of the world. These incomes are used for direct taxes, savings, and consumption. After deducting net financing of the government (which in the real world equals household lending to the government minus household interest earnings) and resources needed for changes in foreign reserves, household savings are used to finance private investment. Household consumption decisions change in response to income and price changes. By construction (and as required by the household budget constraints), the consumption value of the households equals their income net of direct taxes and savings.

The government gets its receipts from taxes, transfers from abroad, and net financing (borrowing net of interest payments) from households and the rest of the world. It uses these receipts for transfers to households, consumption, and investment (to provide the capital stocks required for government services).[6] To remain within its budget constraint, it either adjusts some part(s) of its spending on the basis of available receipts or mobilizes additional receipts of one or more types in order to finance its spending plans.

[5] CES, Leontief (or fixed coefficients) and Constant Elasticity of Transformation (CET) functional forms are widely used in CGE modeling.

[6] The government primary deficit is defined as spending on consumption, investment, and domestic transfers minus taxes and transfers from abroad. This deficit is covered by domestic and foreign net financing.

Foreign wages and rents is the only non-trade payment to the rest of the world; it is typically an exogenous projection. The non-trade payments received from the rest of the world consist of tourism expenditures, net transfers to households, foreign borrowing, and foreign investment, net of changes in foreign reserves. Total financing from the rest of the world (to the government and to the non-government capital account) is positive (negative) if the model country has a deficit (surplus) in its non-borrowing payments. The balance of payments clears (inflows and outflows are equalized) via adjustments in the real exchange rate (the ratio between the international and domestic price levels), influencing export and import quantities and values.

In this application, international tourism receipts are modeled as the product between per capita tourism expenditures and the number of tourists arriving in Jamaica (see equation 1). In fact, the simulations in the next section consider an increase in the number of foreign tourist arrivals combined with an increase in their spending per capita. Alternatively, the model allows modeling foreign tourism demand using a constant elasticity demand function (see equation 2). In the latter case, the modeled country would face a downward-sloping demand curve for its tourism exports. In both cases, total tourism demand is disaggregated across domestically produced commodities in fixed proportions.[7] In equation 2, foreign tourists' demand is a function of local (tourism-related) prices relative to the exchange rate EXR_t.

(1) $$QTRSMROW_{c,t} = qtrsmrowpc_{c,t} \cdot qtrsmrowpop_t$$

(2) $$QTRSMROW_{c,t} = \overline{qtrsmrow}_{c,t} \left(\frac{PQ_{c,t}/EXR_t}{PQ_c^0/EXR^0}\right)^{\eta^{trsmrow}}$$

where

t: time

c: tourism-related commodities such as hotels and restaurants

$QTRSMROW_{c,t}$: rest of the world tourism demand quantity of commodity c

$PQ_{c,t}$: the price for commodity c in Jamaica

EXR_t: exchange rate

$qtrsmrowpc_{c,t}$: demand quantity of commodity c per foreign tourist

[7] In addition, note that the model allows for the identification of one or more tourism demand modalities.

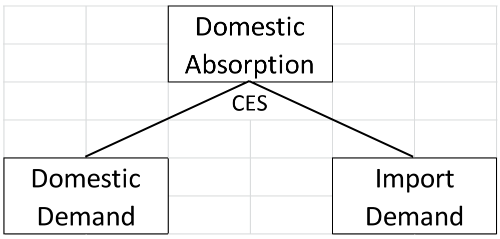
$qtrsmrowpop_t$: number of foreign tourists arriving in Jamaica

$\eta^{trsmrow}$: (constant) price elasticity of foreign tourism demand (< 0)

On the supply side, the modeling of alternative tourism modalities – for example, all-inclusive beach resorts, boutique hotels, eco-lodges – is straightforward, provided the required data is available. In fact, if data is available, the model can consider different cost structures for the different tourism modalities on the supply side.

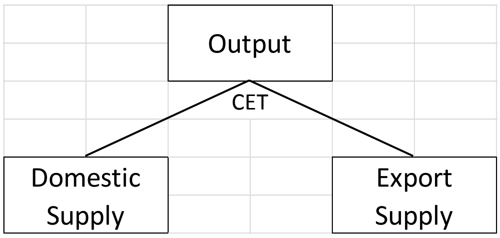
In commodity markets, flexible prices ensure balance between demands for domestic output from domestic demanders and supplies to the domestic market from domestic suppliers. The parts of domestic demands that are for imports face exogenous world prices; under the common small-country assumption, prices in foreign currency are fixed. On the basis of relative prices, domestic demanders decide on the split between domestic purchases and imports (see Figure 3.3). Similarly, domestic suppliers (the activities) also consider relative prices when deciding on the allocation of their output between domestic supplies and exports (see Figure 3.4). For exports, we also assume that Jamaica faces exogenous world prices.

Figure 3.3: Allocation of domestic demands across alternative sources



Note: The demand structure in the figure applies to each of the commodities singled out in the SAM and model.
Source: Authors' elaboration.

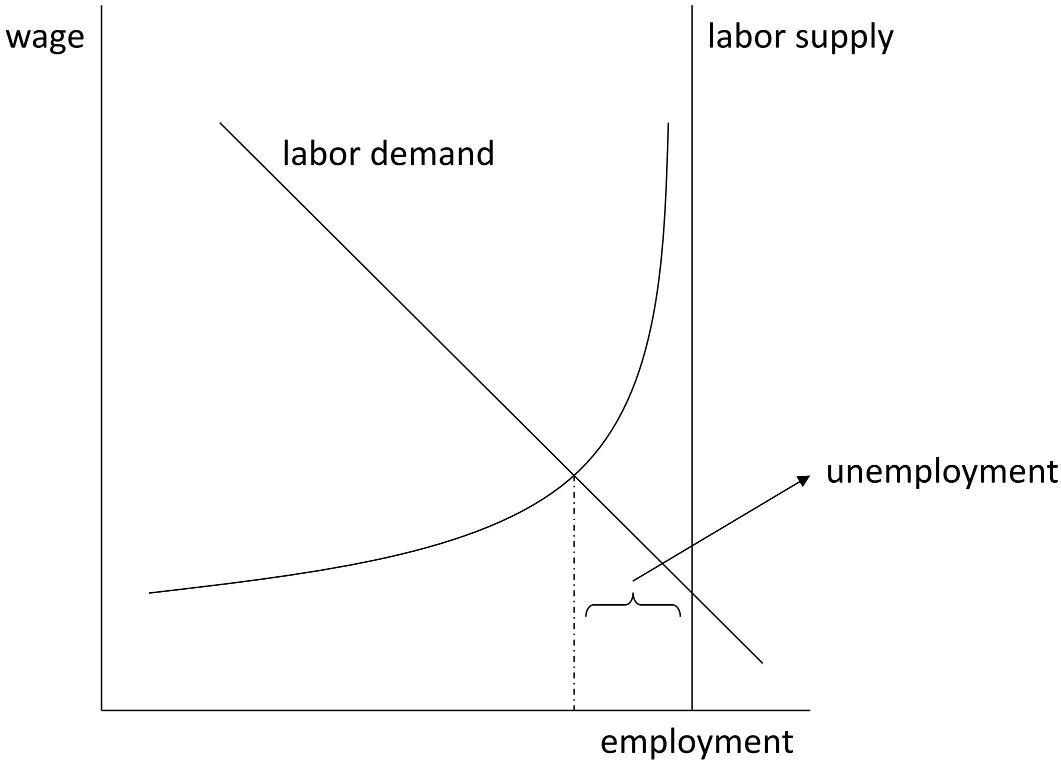
Figure 3.4: Allocation of output across alternative destinations



Note: CET refers to constant elasticity of transformation function; the supply structure in the figure applies to each of the commodities singled out in the SAM and model.
Source: Authors' elaboration.

For non-labor factors, markets reach balance between demands and supplies via rent adjustments. Across all factors, the demand curves are downward-sloping, reflecting the responses of production activities to changes in wages. In labor markets, unemployment may be endogenous. If so, the model includes a wage curve that establishes a negative relation between the real wage and the unemployment rate or, alternatively, a positive relation between the real wage and the employment rate (see Figure 3.5). For non-labor factors, full employment is assumed.

Figure 3.5: Labor market specification



Source: Authors' elaboration.

The above discussion refers to the functioning of the model economy in a single year. In our Jamaica CGE, growth over time is endogenous. The economy grows due to accumulation of capital (determined by investment and depreciation), exogenous growth in the stocks of labor and other non-capital factors (for example, agricultural land), and growth in total factor productivity (TFP). Apart from an exogenous component, the TFP of any production activity potentially depends on the levels of capital stocks (typically government infrastructure stocks).

Data

Social Accounting Matrix

The basic accounting structure and much of the underlying data required to implement our Jamaica CGE model will be derived from a Social Accounting Matrix (SAM).[8] A SAM is a

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[8] Technically, the SAM is used to calibrate the CGE model. In other words, the SAM is used to compute benchmark (or initial) values for all behavioral parameters and exogenous variables in the CGE model.

comprehensive, economy-wide statistical representation of the modeled 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 can be used for descriptive purposes and is the key data input for a CGE. Major accounts in a standard SAM are: (a) activities that carry out production; (b) commodities (goods and services) which are produced and/or imported and sold domestically and/or exported; (c) factors used in production which include labor, capital, land and other natural resources; and (d) institutions such as households, government, tourists, and the rest of the country and world. Generally speaking, most features of the Jamaica SAM are familiar from social accounting matrices used in other models.[9] However, the Jamaica SAM has non-conventional features related to the explicit treatment of foreign tourism-related spending together with the corresponding inflow of foreign exchange.

In most cases, a SAM is built using supply and use tables (SUTs) as the starting point. However, in the case of Jamaica, given that the latest available SUTs are 10 years old (i.e., they refer to the year 2007), we also used as much data as possible from the Statistical Institute of Jamaica and other government agencies; i.e., 2015 national accounts on GDP by activity and GDP by expenditure, the 2015 tourism satellite account, balance of payments, government receipts and spending, and household surveys such as the four waves of the 2014 Labor Force Survey and the 2012 Survey of Living Conditions.[10]

The disaggregation of our Jamaica SAM coincides with that of the rest of the model database. As shown in Table 3.1, it is disaggregated into 17 sectors (activities and commodities) – one in agriculture, one in mining, three in manufacturing, and 12 in services – with each activity producing a single commodity for which it is the only domestic producer. The factors are split into labor, private capital, and natural resources (two types: agricultural land and a natural resource used in extractive industries). The institutions are split into households, government, the rest of world, and domestic and foreign tourists. A set of auxiliary accounts covers the different tax instruments, as well as trade and transport margins on domestic sales, imports, and exports.

[9] See Pyatt and Round (1985) or King (1981) for a more detailed introduction to SAM construction and interpretation.

[10] In a related study, we use the 2011 Population and Housing Census to regionalize the national SAM.

Table 3.1: Accounts in the Jamaica 2015 SAM

Category - #	Item	Category - #	Item
Activities and products (17)	Agriculture, for and fishing	**Factors (4)**	Labor
	Mining		Capital
	Food, beverages and tob		Land
	Textiles and wearing app		Extractive resource
	Other manufacturing	**Taxes (5)**	Tax, activities
	Electricity and water		Tariffs
	Construction		Tax, commodities
	Trade		Tax, income
	Hotels		Tax, bauxite
	Restaurants	**Intitutions (4)**	Households
	Transport		Government
	Communications		Rest of the world
	Financial services		Domestic tourism
	Real estate and bus serv		Foreign tourism
	Gov serv, edu and health	**Inst capital accounts (3)**	Capital acc households
	Recreation		Capital acc government
	Other services		Capital acc rest of the world
Distribution margins (3)	Margin, domestic	**Investment (3)**	Investment, non-government
	Margin, imports		Investment, government
	Margin, exports		Changes in Inventories

Source: Authors' own elaboration.

On the basis of the SAM data, Table 3.2 summarizes the sectoral structure of the Jamaican economy: sectoral shares in value added, production, employment, exports and imports, as well as the split of domestic sectoral supplies between exports and domestic sales, and domestic sectoral demands between imports and domestic output. For instance, while the hotel industry represents a significant share of exports (around 26.9%), its shares of value added, and production are much smaller (i.e., 3.1 and 4.3%, respectively). In turn, the share of its output that is consumed by foreign tourists (i.e., exported) is around 94.8%. In turn, the Jamaica SAM singles out the expenditures on accommodation and restaurants by residents in Jamaica that travel abroad; i.e., "Hotels, imports" and "Restaurants, imports" in Table 3.2. For instance, in 2015, "imports" of hotel and restaurants services represented 3.8 and 1.1% of total imports, respectively.[11]

Interestingly, while (primary) agriculture represents a significant share of employment (around 17.8%), its shares of value added, production, and exports are much smaller (in the

[11] In 2015, total international tourism expenditures were equivalent to 6.2% of total imports.

range of 2-7.6%). On the imports side, other manufacturing (such as machinery and equipment) represents a relatively large share of total imports – about 59.5%. In addition, the share of domestic demands of other manufacturing met via imports reaches 61.3%.

Table 3.2: Sectoral structure of Jamaica's economy in 2015 (percent)

Commodity	Value added	Output	Employment	Exports	Exports-output ratio	Imports	Imports-demand ratio
Agriculture, for and fishing	7.6	6.5	17.8	2.0	4.1	1.1	4.6
Mining	2.2	2.9	0.5	14.6	84.3	0.0	0.4
Food, beverages and tob	5.0	8.8	3.6	5.3	8.0	7.3	18.3
Textiles and wearing app	0.1	0.1	0.1	0.1	5.0	1.7	71.2
Other manufacturing	4.4	8.3	2.7	12.2	18.6	59.5	61.3
Electricity and water	3.4	4.5	0.8	0.4	1.4	0.1	0.4
Construction	7.7	7.7	7.3	0.0	0.0	0.1	0.3
Trade	18.7	15.4	20.0	0.0	0.0	0.9	1.5
Hotels	3.1	4.3	3.2	26.9	94.8	0.0	0.0
Hotels, imports	0.0	0.0	0.0	0.0	0.0	3.8	100.0
Restaurants	1.2	2.4	4.6	4.1	27.9	0.0	0.0
Restaurants, imports	0.0	0.0	0.0	0.0	0.0	1.1	100.0
Transport	4.2	5.7	4.3	13.3	39.6	5.6	23.9
Communications	3.7	2.8	2.3	3.2	19.1	1.7	14.4
Financial services	8.6	7.2	2.3	2.1	5.0	3.4	10.6
Real estate and bus serv	10.9	8.2	6.5	2.5	5.3	11.9	27.5
Gov serv, edu and health	15.0	10.5	14.0	0.0	0.0	0.1	0.2
Recreation	2.2	3.1	1.6	9.8	51.0	1.3	9.4
Other services	2.1	1.5	8.4	3.5	38.2	0.5	7.0
Total	100.0	100.0	100.0	100.0	16.1	100.0	23.4

Source: Authors' calculations based on 2015 Jamaica SAM and employment data.

Table 3.3 shows the factor shares in total sectoral value added. For example, the table shows that agriculture is relatively intensive in the use of labor and land, while mining is intensive in the use of capital and the extractive natural resource. Interestingly, based on information from the 2007 SUTs, Table 3.3 shows that hotels and restaurants have similar factor intensities. Certainly, when analyzing the results from simulations, it is often important to be aware of these aspects of sectoral structure. In the tourism industry, we see that hotels and restaurants are relatively labor-intensive.

Table 3.3: Sectoral factor intensity (percent)

	Labor	Capital	Natural resources	Total
Agriculture, for and fishing	45.1	20.8	34.1	100.0
Mining	34.9	40.7	24.3	100.0
Food, beverages and tob	53.6	46.4	0.0	100.0
Textiles and wearing app	44.9	55.1	0.0	100.0
Other manufacturing	43.4	56.6	0.0	100.0
Electricity and water	32.4	67.6	0.0	100.0
Construction	72.2	27.8	0.0	100.0
Trade	63.2	36.8	0.0	100.0
Hotels	66.2	33.8	0.0	100.0
Restaurants	66.8	33.2	0.0	100.0
Transport	71.8	28.2	0.0	100.0
Communications	28.5	71.5	0.0	100.0
Financial services	52.9	47.1	0.0	100.0
Real estate and bus serv	31.4	68.6	0.0	100.0
Gov serv, edu and health	99.3	0.7	0.0	100.0
Recreation	65.4	34.6	0.0	100.0
Other services	66.0	34.0	0.0	100.0
Total	59.9	37.0	3.1	100.0

Source: Authors' calculations based on 2015 Jamaica SAM.

Table 3.4 shows the demand composition for each commodity. For instance, the bulk of construction services is demanded by gross fixed capital formation – e.g., for building and/or expanding a hotel. In turn, about 26% of restaurant services was demanded by foreign tourists visiting Jamaica.

Table 3.4: Demand structure (percent)

	Intermediate use	Dist margins	Private cons	Fixed investment	Change in inventories	Gov cons	Exports	International tourism	Total
Agriculture, for and fishing	42.4	0.0	53.4	0.3	0.0	0.0	3.9	0.0	100.0
Mining	16.3	0.0	0.0	0.0	-0.2	0.0	83.9	0.0	100.0
Food, beverages and tob	30.8	0.0	63.2	0.0	0.0	0.0	6.0	0.0	100.0
Textiles and wearing app	10.9	0.0	88.0	0.1	0.2	0.0	0.8	0.0	100.0
Other manufacturing	51.7	0.0	28.2	14.2	0.2	0.0	5.7	0.0	100.0
Electricity and water	59.0	0.0	39.7	0.0	0.0	0.0	1.4	0.0	100.0
Construction	25.5	0.0	0.0	74.5	0.0	0.0	0.0	0.0	100.0
Trade	8.2	82.4	5.7	3.7	0.0	0.0	0.0	0.0	100.0
Hotels	5.6	0.0	0.2	0.0	0.0	0.0	0.0	94.3	100.0
Hotels, imports	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
Restaurants	5.8	0.0	68.3	0.0	0.0	0.0	0.0	25.9	100.0
Restaurants, imports	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	100.0
Transport	59.3	0.0	10.0	0.0	0.0	0.0	18.9	11.8	100.0
Communications	50.0	0.0	34.9	0.0	0.0	0.0	15.1	0.0	100.0
Financial services	52.5	0.0	43.3	0.0	0.0	0.0	4.2	0.0	100.0
Real estate and bus serv	59.7	0.0	35.9	0.6	0.0	0.0	3.8	0.0	100.0
Gov serv, edu and health	4.7	0.0	21.4	0.0	0.0	73.9	0.0	0.0	100.0
Recreation	8.3	0.0	45.8	1.4	0.0	0.0	3.4	41.1	100.0
Other services	4.4	0.0	60.3	0.0	0.0	0.0	0.0	35.3	100.0
Total	35.4	8.8	31.0	8.0	0.1	5.3	5.9	5.6	100.0

Source: Authors' calculations based on 2015 Jamaica SAM.

Non-SAM Data

In addition to the SAM, our tourism-extended dynamic CGE model requires a set of elasticities (for production, consumption and trade; econometrically estimated and/or obtained from the literature); and base-year (i.e., 2015) estimates for sectoral employment levels and unemployment. Furthermore, given that this is a dynamic model, we need to project the modeled economy under the assumption of a "business as usual" (BaU) scenario. Then, the BaU scenario will serve as a reference for comparing the non-base simulation scenarios; i.e., scenarios in which one or more shocks are introduced are compared to the said baseline or reference scenario. For the BaU, we require base-year capital stocks, a baseline projection for population and labor force growth, and a baseline projection for GDP growth.

In this application, the chosen values for elasticities are as follows: (a) the elasticities of substitution among factors (i.e., labor, capital, and natural resources) are in the 0.2-0.9 range, lower for natural resource activities such as agriculture (0.25) and mining (0.2) (Narayanan et al., 2012); (b) the wage curve unemployment elasticity is -0.5 (Blanchflower and Oswald, 2005); and (c) on the basis of Sadoulet and de Janvry (1995) and Annabi et al. (2006), trade-related elasticities are in the 2 and 2.15 range for the substitution between imports and domestic purchases and transformation between exports and domestic sales, respectively. In addition, and given the uncertainty with respect to our elasticity values, in Appendix B we conducted a systematic sensitivity analysis of our simulation results with respect to their values; it indicated that the results presented here are robust.

Microsimulation Model and Data

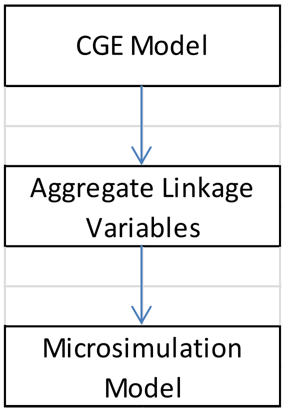
As discussed, CGE models are effective in capturing macro and meso[12] responses to shocks such as an increase in tourist arrivals. However, the standard configuration of a CGE model is not well-suited for analysis of questions related to poverty and income inequality. This is due to the fact that most 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 introduced into the model.

Consequently, in order to provide greater resolution with regard to household-level impacts, we generate results in terms of poverty and inequality at the micro level by linking the CGE model with a microsimulation model. The two models interact in a sequential "top-down" fashion (i.e., without feedback): the CGE communicates with the microsimulation model by generating a vector of (real) wages[13], aggregate employment variables such as labor demand by sector and the unemployment rate, and non-labor income such as government transfers and remittances. In Figure 3.6, these are depicted as the Aggregate Linkage Variables between the CGE model and the microsimulation model. The functioning of the labor market thus plays an important role in the microsimulation model. In turn, the CGE 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.

[12] Meso is a word of Greek origin meaning middle, the level between macro and micro at which most SAMs and CGEs are located; i.e., without data at the level of individual micro units (households or firms) but more disaggregated than what is typical for macro analysis. Typically, considering around 40 activities and commodities.

[13] The real wage is defined in terms of the CPI.

Figure 3.6: The Macro-Micro approach



Source: Authors' elaboration.

To build the microsimulation model, the Jamaica Survey of Living Conditions (JSLC) for 2012, conducted by the Statistical Institute of Jamaica (STATINJA), was used. These data cover 20,532 individuals in 6,579 households in all of Jamaica. The JSLC is the only available household survey in Jamaica that covers both income and spending. No attempt was made to reconcile the household survey data with the national accounts. Instead, the results from the CGE model are transmitted to the microsimulation model as percentage deviations from base values. To estimate poverty, we used the poverty line and the food poverty line for 2012; the national poverty rates are calculated as 19.8% and 7.5%, respectively.

The microsimulation model follows the non-parametric method described in Vos and Sanchez (2010) but was extended to consider changes in non-labor income.[14] First, the labor market structure is defined in terms of rates of unemployment *U* among different segments of the population of working age (in this case, defined according to skill), the structure of employment *S* (in this case, defined according to sector of activity *S*; in other words, the share of each industry in total employment) and (relative) remuneration *W1*, as well as overall level of remuneration *W2*. The labor-market structure can thus be written as

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

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

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

individuals who will change labor market status as a response to the shock(s) being simulated (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 can write

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

where

yl_i: individual labor income

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

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

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

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

The labor market variables and procedures that link the CGE model with the microsimulations are as follows. This "unemployment effect" is simulated by changing the labor status of the active population in the JSCL 2012 sample, based on the results from the CGE model. For instance, if according to the CGE simulations, unemployment decreases at the same time that employment increases for skilled workers in sector A, the microsimulation model "hires" randomly from the JSCL 2012 sample among the unemployed skilled workers. However, the order in which workers are moved between labor market statuses is the same in all scenarios. For instance, if two scenarios require that 10 individuals be moved from being unemployed to being employed, the same 10 individuals are selected in both scenarios. 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 CGE 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, the wage level for a given labor category (e.g., skilled workers in sector A) are adjusted according to the changes from the CGE 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 from the CGE simulations. Next, all the previous steps are repeated several times and averaged.

In turn, non-labor incomes, such as government transfers and remittances from abroad, are proportionally scaled up or down using changes taken from the CGE 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 the level of household per capita income – for each representative household in the CGE simulations. Thus, this residual effect implicitly accounts for changes in all items not previously considered such as natural resource and capital rents.

Finally, we should note that our CGE model can only solve for the relative prices and the real variables of the economy. In other words, inflation cannot occur in our CGE model. Thus, in order to anchor the absolute price level, a normalization rule has been applied. The CPI is chosen as the numéraire, so all changes in nominal prices and incomes in simulations are relative to the weighted unit price of households' initial consumption bundle (i.e., a fixed CPI).

4 Simulations and Results

Scenario Design

This section presents the simulations and analyzes the results. To illustrate the use of the Jamaican model and dataset we have developed, the following five scenarios were simulated and analyzed:

1. **base**: the baseline or reference scenario is the "business as usual" scenario;
2. **trsm10+**: US$200 million yearly increase of private investment in hotels during 2018-2020. An increase of US$200 million is equivalent to 1.4% of GDP in 2015, and can pay for an additional 800 hotel rooms in a year on top of the base growth in the number of

rooms (assuming an average cost of US$250,000 per room in a four or five-star hotel).[15] Given that the total number of rooms available in the country is approximately 25,000, the increase in the room supply is around 6.2% (assuming an approximate 3% baseline growth and a 3.2% growth on top of the baseline created by the investment shock). This is slightly above the average 3% increase in room supply in the Caribbean during the last 15 years, but it is below the 8% increase in the supply of rooms in Jamaica in 2016.[16] Subsequently (i.e., 2021-2030), and representing additional maintenance costs, private investment in hotels is around US$2.5 million higher than in the baseline (see Figure 4.1a). In all years, the increase in private investment is financed with foreign resources. In practice, most of the large hotel investments in Jamaica are financed through foreign debt and/or FDI. Overall, we assess the impact of US$600 million in tourism-related FDI over a three-year period. In addition, this scenario assumes that foreign tourism spending is, every year during the period 2021-2030, 10% higher than in the baseline (see Figure 4.1b) (More specifically, the simulated increase is 5% in 2019, 7.5% in 2020, and 10% afterwards). This might result from a combination of (a) an increase in tourist arrivals, and (b) an increase in spending per tourist. For instance, in 2021 the number of foreign tourist arrivals could increase from 2.47 million in the baseline to 2.56 (+3.5%) while their spending per capita could increase from US$975 in the baseline to US$1,036 (+6.3%) -- at constant 2015 prices.[17]

3. **trsm20+**: same investment as in **trsm10+** but the increase in foreign tourism spending is 20% higher every year during the period 2021-2030 than in the baseline. Actually, such an increase in foreign tourism spending would require an increase in spending per capita as it would be implausible to attain only with an increase in the number of arrivals of foreign tourists.
4. **trsm10-**: same investment as in **trsm10+** but foreign tourism spending is 10% lower than in the baseline during the period 2021-2030 (see Figure 4.1b). (More specifically, the

[15] In the period 2013-2016, FDI in the tourism industry was on average US$213.6 million per year. Therefore, our non-base scenarios assume that FDI in the tourism industry increases by about 94% relative to its recent trend (i.e. US$200 million above the baseline).

[16] Jamaica Tourist Board, Annual Travel Statistics 2016.

[17] In addition, we also ran a simulation with the same increase in private investment in hotels but without the increase in foreign tourist arrivals – results are not shown but are available from the authors upon request. In other words, the number of foreign tourist arrivals as well as their per capita spending is assumed constant at their baseline values. Interestingly, the long-run effects of this simulation are negative, given that Jamaica over-invests in the accommodation sector. In other words, there is an increase in the number of hotel rooms not accompanied by an increase in the number of (foreign) tourists.

simulated decrease is 5% in 2019, 7.5% in 2020, and 10% afterwards). For instance, under the assumption that spending per tourist remains constant, in 2030 the number of tourists would be 2.85 million compared to 3.17 million in the baseline. Thus, this scenario could reflect the impact of a natural disaster.

5. **trsm20-**: same investment as in **trsm10+** but foreign tourism arrivals is 20% lower than in the baseline. Again, this scenario could reflect the impact of a natural disaster.

In reality, any tourism-related scenario would be likely to contain some of the elements present in this set of scenarios. In what follows, all simulations cover the period 2015-2030. The initial year, 2015, was selected in light of data availability (see above). The base simulation was designed to replicate trends since 2015 at the macro and sectoral levels. From 2018 and onwards, it assumes that past trends will continue. In what follows, all shocks are introduced during the period 2018-2030; i.e., base and non-base scenarios are the same up to and including 2017.

Figure 4.1a: Definition of non-base scenarios; change in private investment in hotels (billion J$ 2015)

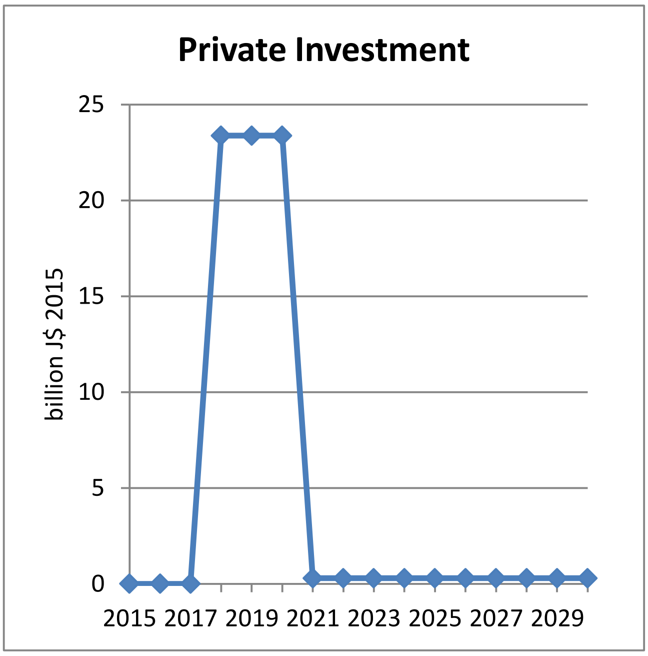
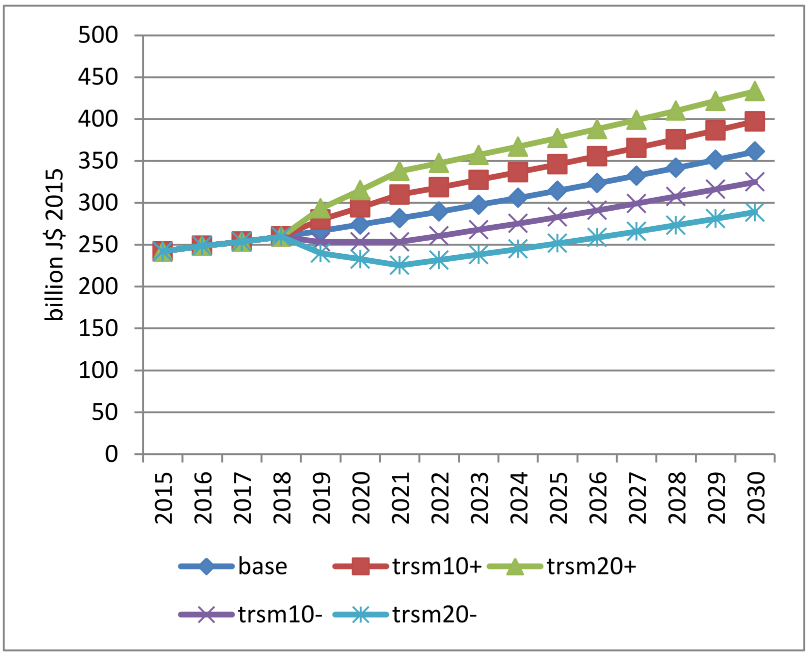


Figure 4.1b: Definition of non-base scenarios; foreign tourism spending (billion J$ 2015)



Source: Authors' elaboration.

Results and Analysis

Base Scenario

For the period from the base year (2015) up to 2017, we draw on available information and estimates to generate a plausible picture of Jamaica's economic development that is the same for all simulations, including observed growth rates for real GDP at factor cost for the year 2016. Drawing on projections from the International Monetary Fund's April 2017 World Economic Outlook (IMF, 2017), we impose an average growth rate of 2.6% for the period 2017-2030. In addition, we assume that government provision of government services, transfers from government to households, and government domestic and foreign net financing are all kept fixed as shares of GDP at their base-year values. Taxes are fixed at their base-year rates, which means that they will grow at the same pace as the overall economy.

For (foreign) tourism receipts, the baseline scenario assumes, based on recent data, (a) constant per capita real spending, and (b) an exogenous growth rate for tourist arrivals equal to the GDP growth rate. (For the period 1995-2016, the simple correlation between real GDP and foreign tourist arrivals is 0.75; i.e., positive and statistically significant.)

At the macro level, our CGE model for Jamaica – like any other CGE model – requires the specification of equilibrating mechanisms ("closures") for three macroeconomic balances:

government, savings-investment, and the balance of payments. For the base scenario, the following closures are used: (a) government: its accounts are balanced via adjustments in the direct tax rate; (b) savings-investment: household savings adjust to generate exogenous GDP shares for domestically financed private investment while government investment is financed within the government budget; and (c) balance of payments: the real exchange rate equilibrates this balance by influencing export and import quantities and values; the non-trade-related payments of the balance of payments (transfers and non-government net foreign financing) are non-clearing, kept fixed as shares of GDP.

In the non-base scenarios, the treatment of the balance of payments is the same as for the base – the real exchange rate adjusts to equate the inflows and outflows of foreign exchange. For the balance between savings and (private) investment, instead of imposing a fixed GDP share for private investment, it becomes the clearing variable, adjusting to make use of available financing in the context of exogenous household savings rates. For the government balance, the treatment is the same as for the base (with a flexible direct tax rate).[18]

For each simulation, our CGE model provides the evolution over time for a wide range of indicators including: (a) macro outcomes: GDP (split into private and government consumption and investment; exports; imports); the composition of the government budget, the balance of payments, and the savings-investment balance; total factor productivity; domestic and foreign debt stocks; (b) sectoral structure of production, incomes, exports, and imports; trade flows disaggregated by trading partner; and (c) labor market: wages, unemployment, and employment by sector.

Figures 4.2-4.4 show key macroeconomic results for the base.[19] In the base scenario, the economy evolves according to recent trends, with most macro aggregates growing at 2.7-2.8% per year during 2018-2030. The exchange rate appreciates slightly over time. The

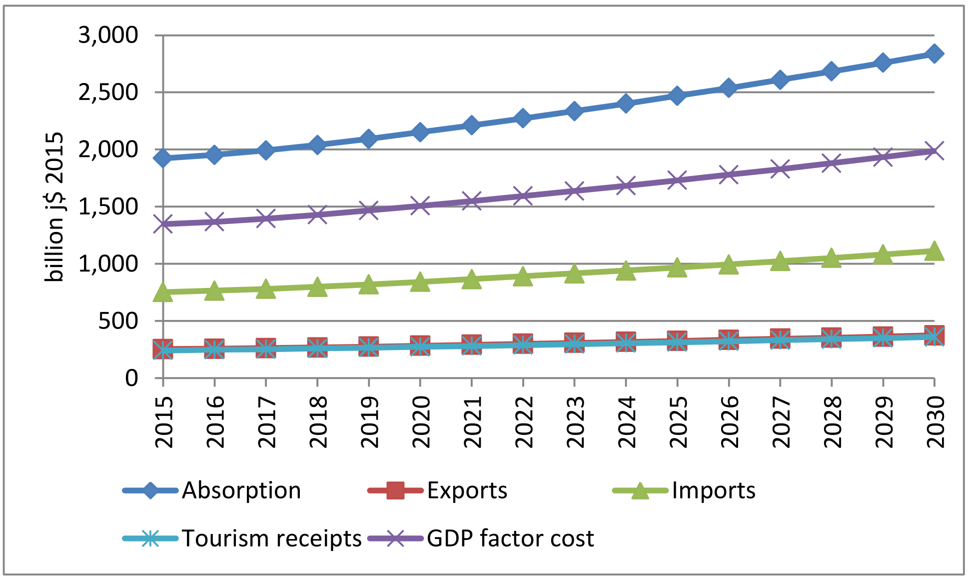
[18] It is important to note that, for the non-base simulations, parameters related to the balances for savings-investment and the government are adjusted so that the introduction of changes in the treatment of these balances *without any other changes* have no impact on the results – thus, the base results are replicated exactly. However, when other changes are introduced (like a change in tourist arrivals), then the exact treatment of, for example, the savings-investment balance has an impact on the results. More concretely, the base scenario generates a path for household savings rates that is consistent with the private investment GDP shares that are imposed. For all non-base scenarios, the path of household savings rates from the base are imposed while the private investment GDP share is now endogenous. If this were the only change introduced in a non-base scenario, then the results would be the same as for the base. However, if another shock is introduced, then the response will be different when private investment is savings-driven as opposed to having an exogenous GDP share (the base assumption).

[19] Tables C.1-C.5 in Appendix C show additional results for base and non-base scenarios, covering macro and sector indicators as well as the government budget and the balance of payment.

growth in GDP is sufficient to bring about a relatively rapid expansion of employment. The unemployment rate is reduced from 13.5% in 2015 to 8.8% in 2030. Real wage grows at a rate of 1.7% per year on average.

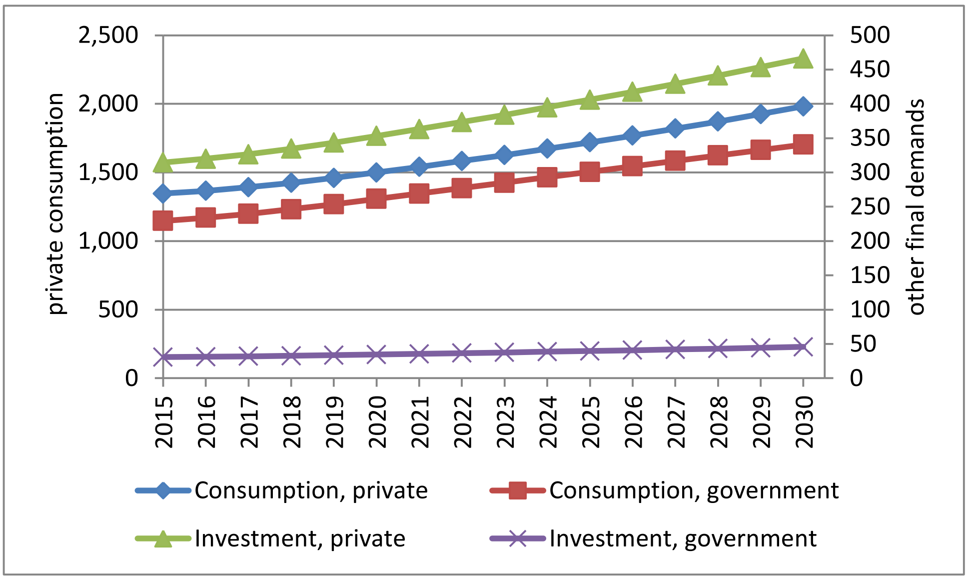
In terms of sectoral structure (see Figure 4.5), growth for agriculture is relatively low due to slow growth of land supplies (which are assumed to grow by 0.1% annually) and low income elasticities of demand. The sectoral structure of value added and exports changes in favor of manufacturing and services, which enjoy more favorable supply and demand conditions. Among services, hotel and restaurants growth is strongly influenced by foreign tourist arrivals. Consequently, the growth rate in tourism-related industries follows closely the GDP growth rate (see above). Per-capita household consumption grows at a rate of 2.6% per year, leading to a significant decrease in the poverty rate, from 20.8 in 2015 to 9.1 in 2030 (Figure 4.6).

Figure 4.2: Base scenario; selected macroeconomic indicators (billion J$ 2015)



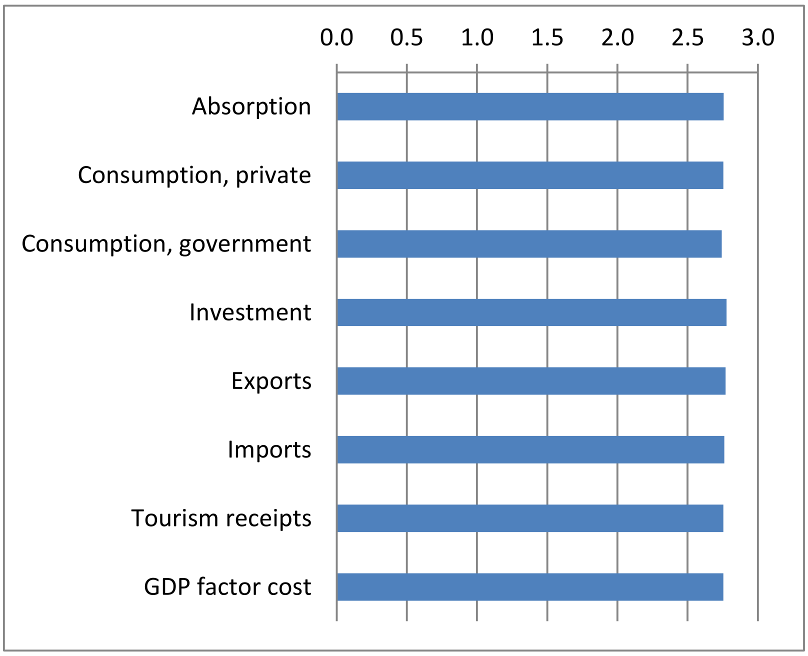
Source: Authors' calculations based on simulation results.

Figure 4.3: Base scenario; domestic final demands (billion J$ 2015)



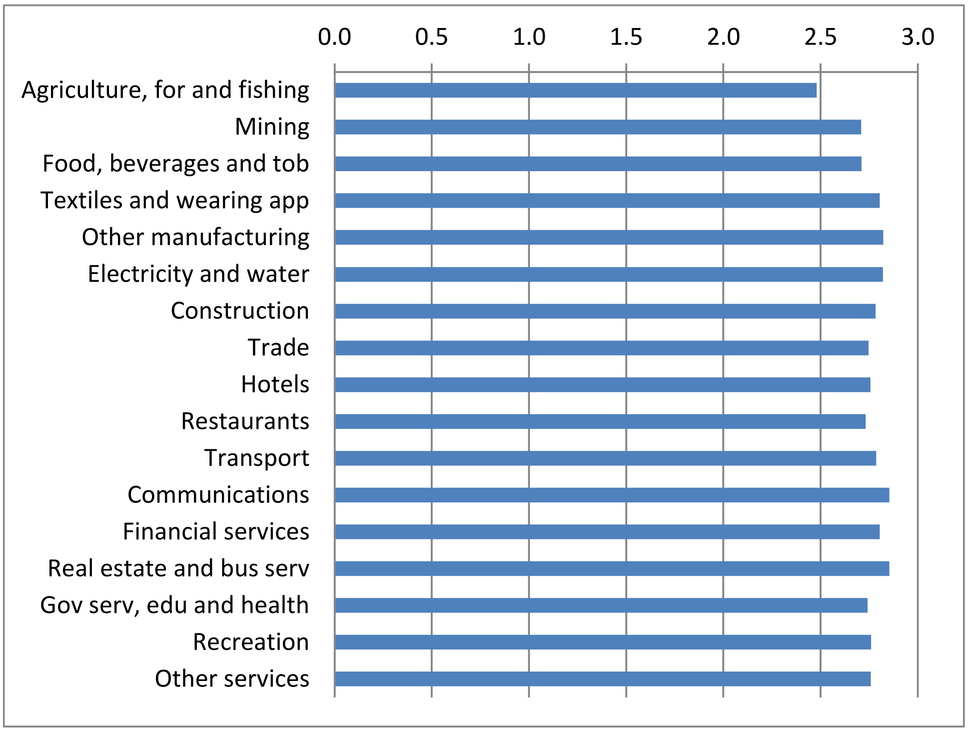
Source: Authors' calculations based on simulation results.

Figure 4.4: Base scenario; real annual macroeconomic growth 2018-2030 (%)



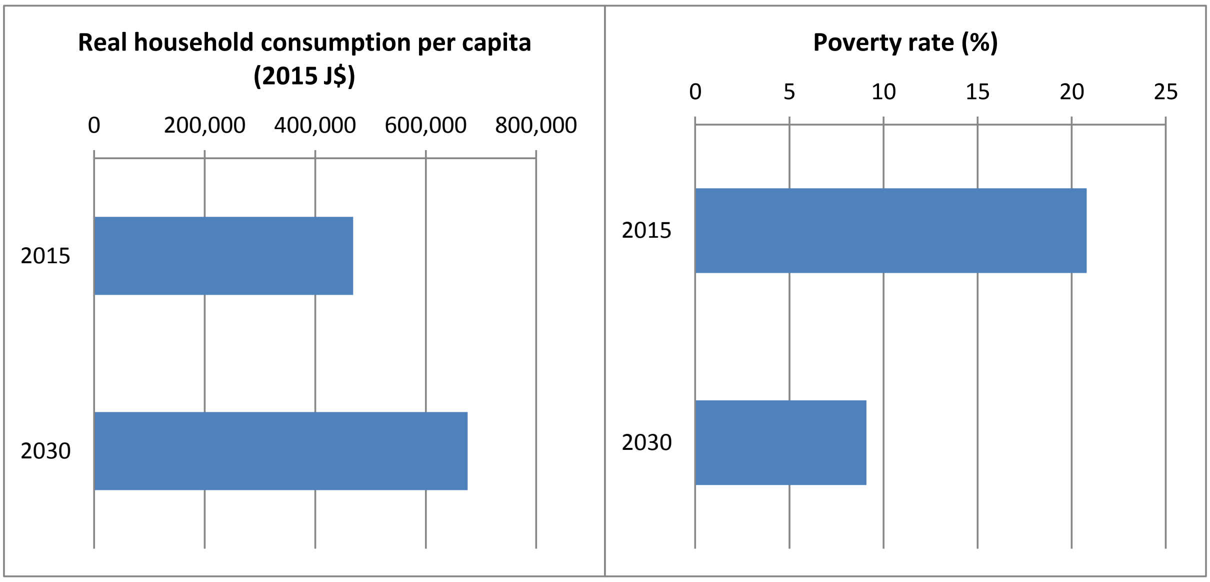
Source: Authors' calculations based on simulation results.

Figure 4.5: Base scenario; real annual sector growth 2018-2030 (%)



Source: Authors' calculations based on simulation results.

Figure 4.6: Base scenario; Real household consumption per capita and headcount poverty



Source: Authors' calculations based on simulation results.

Non-Base Scenarios

Figure 4.7 summarizes the main transmission channels for the increase in private investment in hotels financed through foreign financing – see panels a and b1. Naturally, an increase in investment in hotels will have a positive impact on the supply of accommodation services – i.e., the number/quality of hotel rooms will increase. Besides, when financing for additional investment comes from foreign borrowing, the inflow of foreign resources will give rise to a slower export growth and faster import growth, both induced by an appreciation of the real exchange rate.

Figure 4.8 summarizes the main transmission channels for the increase in receipts from foreign tourism. Overall, higher household income growth is achieved with increased foreign tourism demand, because these inflows of foreign exchange increase total resources in the economy. However, as shown in Figure 4.9 below, the increase in "tourism exports" also generates an *appreciation* of the real exchange rate that hurts the tradable sectors.

Figure 4.7a: Main transmission channels for private investment in hotels

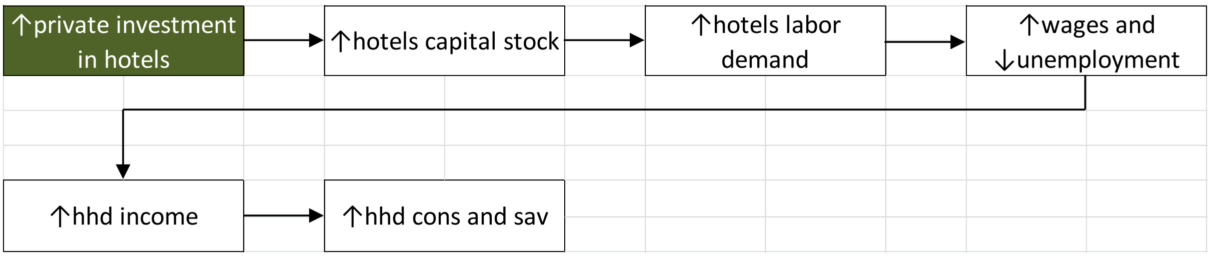


Figure 4.7b1: Main transmission channels for foreign financing of private investment in hotels

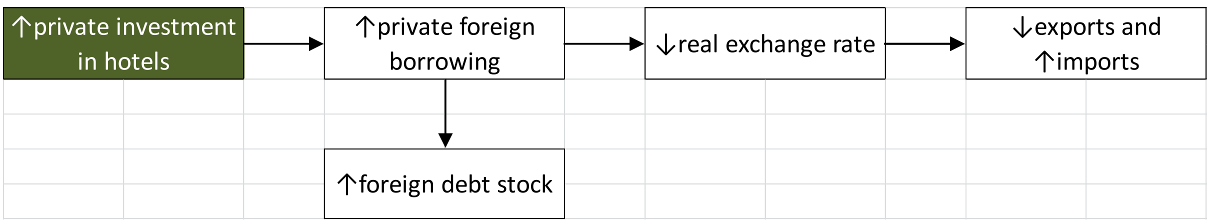
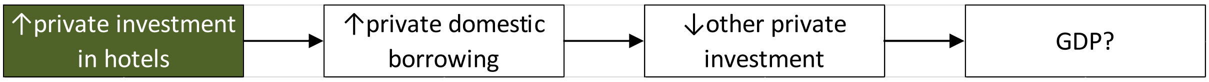
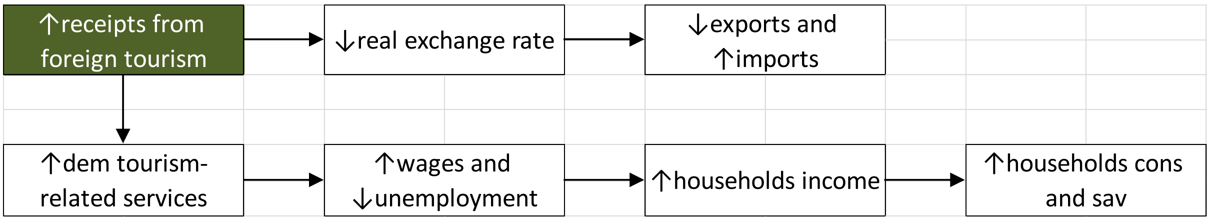


Figure 4.7b2: Main transmission channels for domestic financing of private investment in hotels (*)



(*) this second financing option is not currently considered in the simulations.
Source: Author's elaboration.

Figure 4.8: Main transmission channels for tourism increase



Source: Author's elaboration.

Macro Results

The main results for the non-base scenarios are presented in Figures 4.9-4.13; additional information is found in Tables C.1-C.5 in Appendix C. As shown in Figures 4.9 and 4.10, the increase in private investment in hotels financed with foreign resources has a positive impact on the activity level – see results in Table C.1 for year 2018 in simulations trsm10+ and trsm20+. On the other hand, the inflow of foreign resources gives rise to slower export growth and faster import growth, both of which are induced by an appreciation of the real exchange rate.[20] In turn, the expansion of tourism demand tends to expand domestic absorption more rapidly than it expands GDP, also causing deterioration in the (non-tourism) trade balance (again, see scenario trsm10+ and trsm20+). In other words, the increase in receipts from foreign tourism also generates an appreciation of the real exchange rate that hurts the tradable sectors. And, slower export growth here is a function of increasing domestic demand and prices in Jamaica due to the investment. Thus, 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 in order to meet more rapid growth in domestic demand, which include demand by tourists visiting Jamaica.

[20] Notice that "exports" do not include tourism-related spending made by foreigners. Certainly, the latter corresponds to tourism exports, but the two are treated differently in the model and Figure 4.9.

Figure C.1 in Appendix C provides information on the time path for deviations from the base for private consumption and investment for our set of scenarios. It shows that the short- and long-run effects of the four scenarios are similar. However, in the short-run, the increase in private investment financed with foreign resources has a positive impact during the period 2018-2020. As explained, this period corresponds to the expansion of the accommodation sector. Overall, scenarios with decreased (foreign) tourist arrivals and spending show results of opposite sign.

In the past, numerous authors have estimated income multipliers related to tourism expansions using input-output analysis. Overall, estimates range between 0.37 and 1.98 (Dwyer and Forsyth, 1998). However, income multipliers greater than unity are suspect since the typical input-output approach assumes no constraints on capacity. In contrast to input-output analysis, which always produces a gain to the economy, CGE modeling acknowledges that price increases due to resource constraints may limit the increase in economic activity caused by an increase in (foreign) tourism spending. In fact, as our results show, it may even lead to contractions in economic activity in some sectors. Consequently, our estimate of the income multiplier for the year 2030 and the trsm20+ scenario is 0.38, which is on the low end of the above spectrum. Mostly, this is due to the existence of capacity constraints.

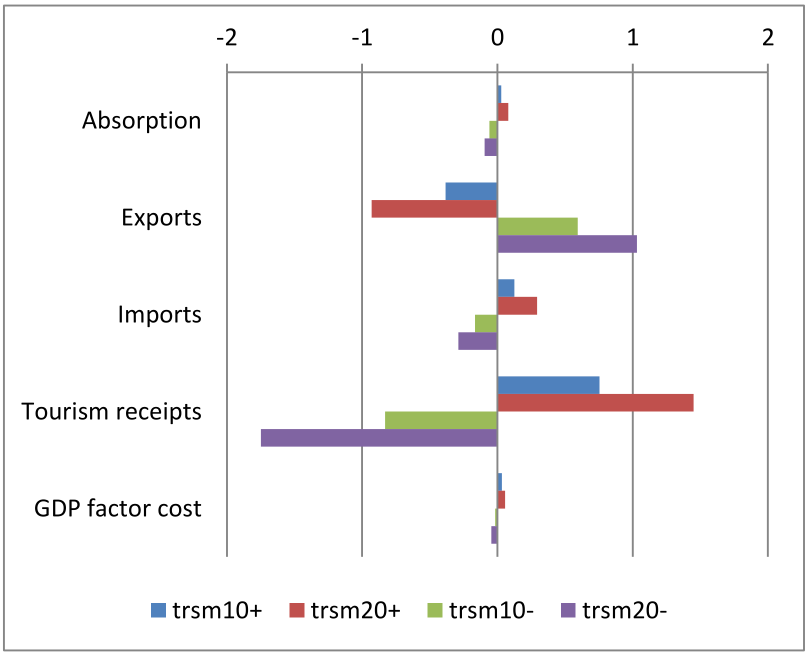
Sectoral Results

Unsurprisingly, at the sectoral level, service industries catering directly to tourists, including hotels and restaurants, are strongly stimulated by the expansion in foreign tourism spending (simulation trsm10+ and trsm20+). In 2022, scenario trsm20+ shows that employment in hotels and restaurants is 6.6 and 6.3% higher than in the base, respectively (see Table C.2). On the other hand, the upward pressure on prices and the real exchange rate leads to reduced competitiveness of the other (non-tourism) export sectors. Specifically, Figure 4.13 and Table C.2 show a decrease in employment and value added in manufacturing and mining, two of the most export-oriented sectors (see Table 3.2). In turn, scenarios trsm10- and trsm20- show that a 10 and 20% decrease in foreign tourism spending combined with an increase FDI in the accommodation industry, would cause a strong reduction in the number of workers employed in the hotel sector (again, see Table C.2). Certainly, our simulations show that 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 (also, see Dwyer et al., 2000). In the period 2018-2020, due to the increase in private investment in hotels, there is a relatively large expansion of the construction industry. Afterwards, and due to an increase in the income and savings level, construction output is still higher than in the baseline.

Distributive Results

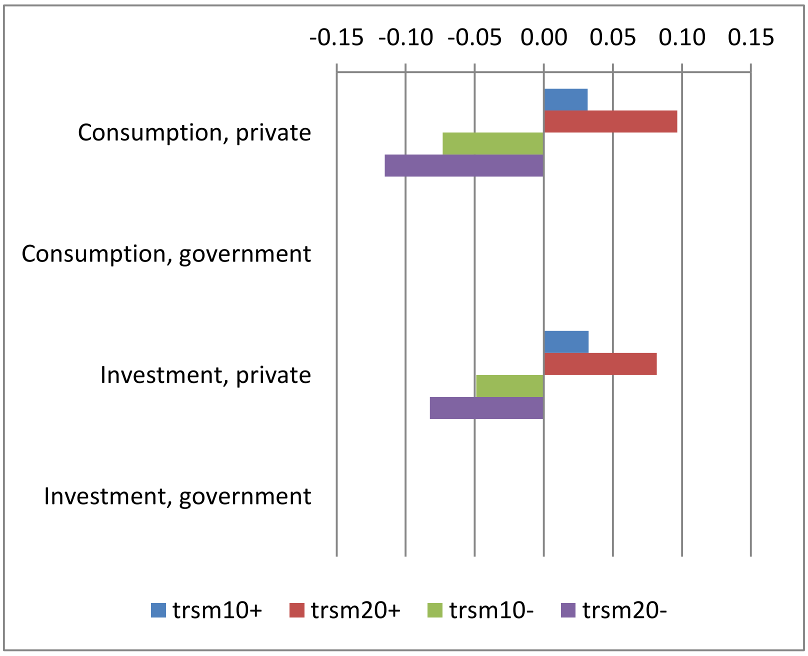
In terms of poverty, our results show, for example, that the poverty headcount ratio in Jamaica falls by about 0.3 percentage points and 0,11 percentage points with respect to the base scenario in 2022 and 2030 in the trsm20+ scenario, respectively (Figure 4.12). The main drivers of this result are a decrease in unemployment, a higher average wage, and an increase in non-labor income for households linked to the tourism industry. Interestingly, in the medium- to long-run, the negative impact of the real exchange rate appreciation reduces the gains brought about by the increase in foreign tourism spending. In terms of inequality, we do not find statistically significant changes.

Figure 4.9: Macro growth by simulation (percentage point deviation for average annual growth from base scenario)



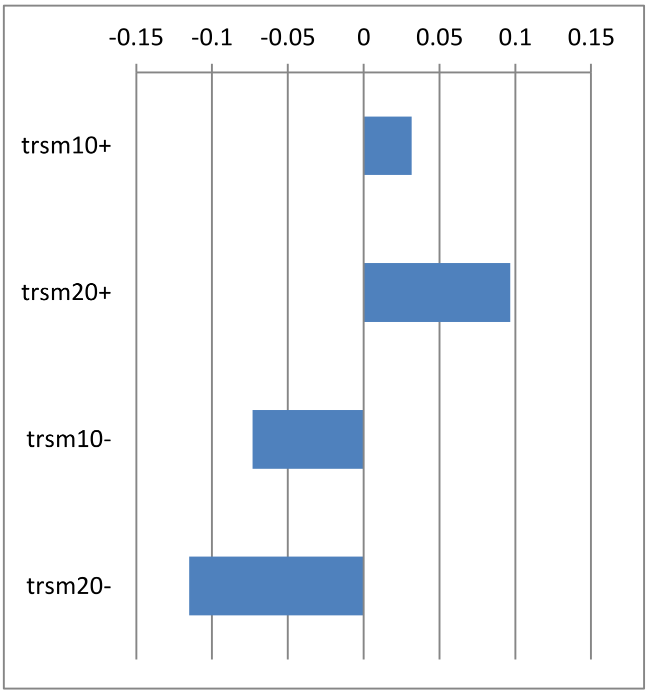
Source: Authors' calculations based on simulation results.

Figure 4.10: Consumption and investment growth by simulation (percentage point deviation for average annual growth from base scenario)



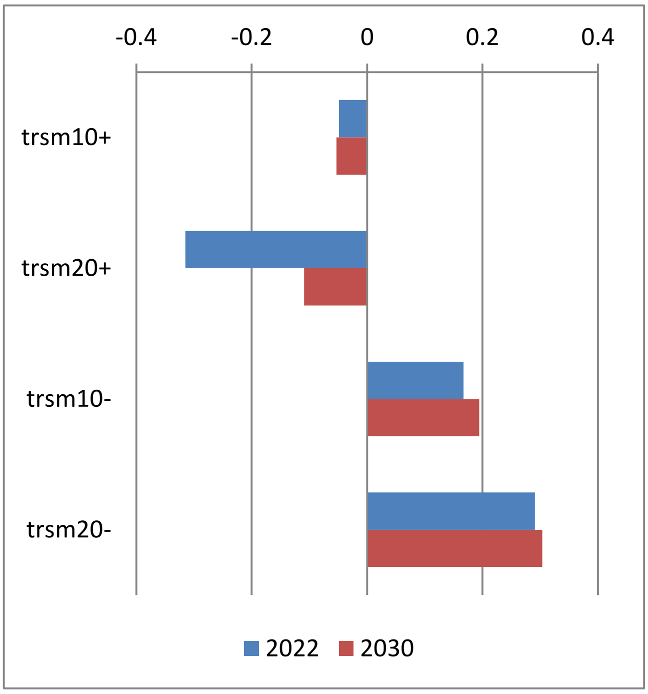
Source: Authors' calculations based on simulation results.

Figure 4.11: Real household consumption per capita growth by simulation (percentage point deviation for average annual growth from base scenario)



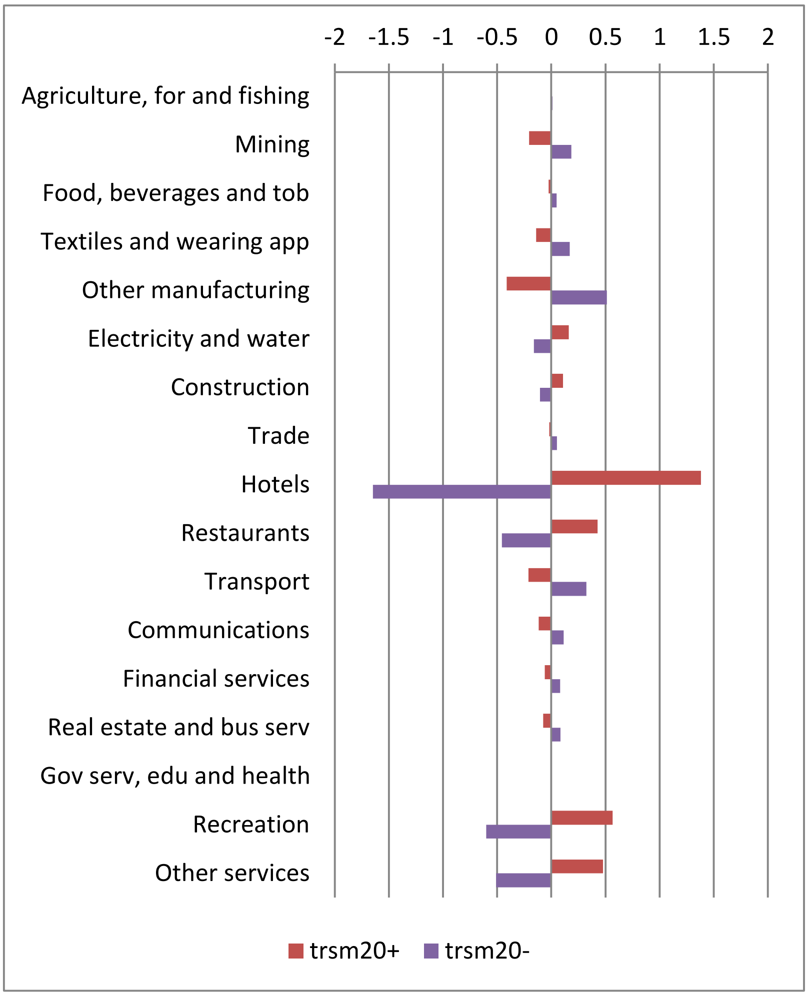
Source: Authors' calculations based on simulation results.

Figure 4.12: Headcount poverty by simulation in 2022 and 2030 (percentage point deviation from base scenario)



Source: Authors' calculations based on simulation results.

Figure 4.13: Sectoral GDP growth by simulation (percentage point deviation for average annual growth from base scenario) (*)



*To simplify, Figure 4.13 only shows results for the trsm20+ and trsm20- non-base scenarios.
Source: Authors' calculations based on simulation results.

5 Concluding Remarks

In this paper, a consistent and quantitative framework was developed for the assessment of private investments in the hotel industry, and its impacts on a national economy and household welfare. The tourism sector's contribution to growth, poverty reduction and long-term development depends upon complex and dynamic economic, social, environmental, and institutional linkages, spillovers, and externalities. The results demonstrate that tourism and tourism investment have positive impacts on national economies, though the distribution of benefits is dependent on socioeconomic factors such as the distribution of factor endowments among households. The sectoral distribution of benefits is also conditioned by these factors and the initial conditions at the destination – for example, in terms of the sectoral structure of the economy. Invariably, there are winners and losers when a new investment (or policy) is implemented.

In this study, we applied this framework to simulate the impacts of a US$600 million private investment in tourism in Jamaica. To summarize, our results showed that the investment combined with an expansion of foreign tourism demand resulted in a positive impact on GDP, employment, household incomes, and poverty. On the other hand, the expansion of foreign tourism demand leads to domestic absorption increasing more rapidly than the GDP which results in a deterioration of the merchandise trade balance. In turn, at the sectoral level, 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. For instance, service industries such as hotels and restaurants are strongly stimulated by the expansion in tourism – their value-added increases by 19% and 5.5% respectively when tourist demand increases by 20%. On the other hand, the real exchange rate appreciation leads to reduced competitiveness of the other (non-tourism) export sectors such as manufacturing and mining.

In addition, the results show that a 20% increase in tourism spending together with more private investment in the hotel industry could reduce poverty in the country by 0.3 percentage points in 2022 with respect to the BAU scenario. This result is equivalent to a 2.3% average annual decrease in poverty versus the BAU scenario between 2018-2030, and it is mainly driven by a decrease in unemployment and a higher average wage. This could represent approximately 120,000 Jamaicans - about 4% of today's population- being lifted out of poverty during the 13-year timeframe. In terms of inequality, the study does not find statistically significant changes in any of the scenarios.

Overall, findings show that investments in hotel infrastructure can bring important development impacts to local economies in developing countries. As global demand for tourism continues to grow and tourism services supply adjusts to changing preferences, it will be important to further understand what the economy-wide impacts are of different types of tourism investments e.g., all-inclusive versus limited-services hotels. Multilateral Development Banks and impact investors working with the private sector have a key role to play in promoting tourism investments that encourage broader development impacts.

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Appendix A: Tourism-Extended National Computable General Equilibrium Model Mathematical Statement

To simplify model presentation, this mathematical statement assumes the following: all tax rates are exogenous, no consumption subsidies, no regulated industries, and transfers that follow rules (e.g., are an exogenous share of GDP) are considered as exogenous variables. Of course, these elements are available in the model code, which is written in GAMS (General Algebraic Modeling System) and solved as a system of non-linear equations. In addition, the model presentation assumes the following macroeconomic closure rule is in place: endogenous direct tax rates clear the government budget, non-government investment is endogenous and clears the savings-investment balance (i.e., investment is savings-driven), and movements in the real exchange clear the current account of the balance of payments.

A.1. Notation

The mathematical presentation of the CGE uses the notational conventions shown in Table A.1. Tables A.2-A.5 define model sets, variables, and parameters.

Table A.1: Notational principles

Items	**Notation**
Sets	Lower-case Latin letters as subscripts to variables and parameters
Endogenous variables	Upper-case Latin letters (without a bar)*
Exogenous variables**	Upper-case Latin letters with a bar*
Parameters**	Lower-case Latin letters* or lower-case Greek letters (with or without superscripts)

* The names of Latin letter variables and parameters that refer to prices, quantities, and factor wages (rents) start with *P*, *Q*, and *WF*, respectively.
** The distinction between exogenous variables and parameters is that the latter always have exogenous values whereas the former under alternative assumptions may be endogenous.

Table A.2: Sets

Name	**Description**
$t \in T$	time periods (simulation years)
$a \in A$	activities (or industries)
$c \in C$	commodities (i.e., goods and services)
$c \in CT(\subset C)$	transactions commodities (services paid under distribution margins)
$i \in INS$	institutions (i.e., households, enterprises, government, rest of the country, and rest of the world)
$i \in INSDNG$	domestic non-government institutions

$h \in H$	Households
$inv \in INV$	Investment
$invng \in INVNG$	non-government investment
$invg \in INVG$	government investment
$gov \in INS$	government
$row \in INS$	rest of the world

Table A.3: Variables

Name	Description
$CON_{h,t}$	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
$KG_{invg,t}$	government capital stocks
$MPS_{i,t}$	marginal propensity to save for dom non-government inst insdng
$MPSADJ_t$	savings rate scaling factor
$NDFG_t$	government net domestic financing
$NFFG_t$	government net foreign financing
$NFFINS_{i,t}$	net foreign financing domestic non-government institution i (FCU)
$PA_{a,t}$	output price of activity a
$PDD_{c,t}$	demand price for commodity c produced and sold domestically
$PDS_{c,t}$	supply price for comm c produced and sold domestically
$PE_{c,t}$	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)
$PQ_{c,t}$	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
$QE_{c,t}$	quantity of exports 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
$QINVDEST_{inv,t}$	volume of gross fixed capital formation by destination
$QINVDESTA_{f,a,t}$	volume of non-government fixed investment by activity
$QM_{c,t}$	quantity of imports of commodity c

$QQ_{c,t}$	quantity of goods supplied domestically (composite supply)
$QTRSMROW_{c,t}$	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
$RNDF_{t}$	real government net domestic financing
$SAVG_{t}$	government savings
$SAVINS_{t}$	savings domestic non-government institution i
$SAVROW_{t}$	foreign savings (foreign currency)
$SHIF_{i,f,t}$	share for institution *i* in the income of factor *f*
$TFP_{a,t}$	total factor productivity index
$TRII_{i,i',t}$	transfers from dom inst insdng to inst ins
$TY_{i,t}$	rate of income tax for household h
$TYADJ_{t}$	scaling factor for income tax rate
$UERAT_{f,t}$	unemployment rate for factor f
$WF_{f,t}$	average price of factor f
$WFAVG_{f,t}$	average remuneration 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
$YI_{i,t}$	income of (domestic non-government) institution insdng
$YIF_{i,f,t}$	income of institution i from factor f

Table A.4: Latin letter parameters

Name	**Description**
$qhmin_{c,h}$	subsistence cons of com *c* for household *h*
$\overline{mps}_{i,t}$	marginal propensity to save for domestic non-government institution *i*
$\overline{qg}_{c,t}$	quantity of government demand for commodity *c*
$\overline{qinvdest}_{inv,t}$	volume of gross fixed capital formation by destination
$ta_{a,t}$	rate of tax on producer gross output value
$tq_{c,t}$	rate of sales tax
$tf_{f,t}$	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
$shii_{i,i'}$	share of institution *i* in post-tax post-savings income of institution *i'*
$pwe_{c,t}$	export price for *c* (foreign currency)
$pwm_{c,t}$	import price for *c* (foreign currency)
$qdstk_{c,t}$	changes in inventories
$icd_{c,c'}$	trade and transport input of c per unit of commodity c’ produced and sold domestically
$ice_{c,c'}$	trade and transport input of c per unit of commodity c’ exported

$icm_{c,c'}$	trade and transport input of c per unit of commodity c' imported
$qtrsmrowpc_{c,t}$	RoW tourism demand quantity of commodity c per tourist
$qtrsmrowpop_t$	RoW number of tourists
$\overline{qtrsmrow}_{c,t}$	RoW tourism demand quantity of commodity c
$tfpexog_{a,t}$	exogenous component of sectoral TFP
$ica_{c,a}$	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
$cwts_{c,h}$	consumer price index weights
$dwts_c$	domestic sales price weights
$capcomp_{inv,c}$	quantity of commodity c per unit of investment inv
$deprcap_f$	depreciation rate for non-government capital
$deprcap_{gov}$	depreciation rate for government capital
$\overline{nffins}_{i,t}$	base-year net foreign financing domestic non-government institution i (FCU)

Table A.5: Greek letter parameters

Name	**Description**
$\delta^{va}_{f,a}$	share parameter for CES activity production fn
φ^{va}_{a}	efficiency parameter in the value added production fn for a
σ^{va}_{a}	elasticity of substitution between factors
ρ^{va}_{a}	exponent in the value added production fn for a
$\theta_{a,c}$	yield of output c per unit of activity a
$\delta^{les}_{c,h}$	marg shr of hhd cons on commodity c
φ^{q}_{c}	Armington function shift parameter for commodity c
σ^{q}_{c}	elasticity of substitution between dom goods and imports for c
ρ^{q}_{c}	Armington function exponent for commodity c
δ^{m}_{c}	Armington function share parameter for imports commodity c
δ^{dd}_{c}	Armington function share parameter for domestic commodity c
φ^{x}_{c}	CET function shift parameter for commodity c
σ^{x}_{c}	elasticity of transformation between dom sales and exports for c
ρ^{x}_{c}	CET function exponent for commodity c
δ^{e}_{c}	CET function share parameter for exports commodity c
δ^{ds}_{c}	CET function share parameter for domestic commodity c
$\eta^{trsmrow}$	constant price elasticity of RoW tourism demand (< 0)
η^{wf}_{f}	elasticity of wage with respect to unemployment rate
κ	sensitivity of the allocation of new capital for f (in FCAPNG) across activities (in A) to current deviations of activity capital rents from the economy-wide average

A.2. Equations

The model equations are organized in the following eight groups: production, incomes and savings, prices, foreign and domestic trade, final consumption, equilibrium conditions, miscellaneous, and investment by destination (i.e., dynamics).

Production Function

Firstly, we describe the production function, which is organized in two levels (see Figure A.1). As shown in the figure, we use nested Leontief (i.e., fixed coefficients) and CES (Constant Elasticity of Substitution) production functions. Equations PF1 and PF2 show that value added ($QVA_{a,t}$) and the aggregate of intermediate inputs ($QINTA_{a,t}$) are a fixed proportion of the activity production level ($QA_{a,t}$), respectively.

Equations PF3-PF5 represent the first order conditions of the optimization problem solved by the representative firm in each industry or activity (i.e., cost minimization/profit maximization). The value added production technology is a CES function. The remuneration to factor f paid by the activity a is computed as $WF_{f,t} \cdot WFDIST_{f,a,t}$, where $WFDIST_{f,a,t}$ is a "distortion" factor that allows modeling cases in which the factor remuneration differs across activities.[21] As we will see, this method to compute the remuneration of factor f in each activity allows to easily selecting among alternative closures (i.e., mechanisms to equalize supply and demand) in the factor markets.[22]

Equation PF6 computes sectoral total factor productivity (TFP) as a function of (a) an exogenous component, and (b) the size of the public infrastructure capital stocks. Thus, an increase in the provision of public infrastructure of type *invginf* (e.g., roads) would have positive impacts on sectoral TFP, more or less strong depending on the value assigned to the $tfpelas_{a,invg}$ elasticity parameter. In equation PF6, variable KG^0_{inv} refers to the public capital stock in sector *inv* in the base year. In other words, our model assumes that, based on available empirical evidence, that public infrastructure has positive externalities on sectoral TFP. For model calibration, the initial public capital stock can be estimated through alternative methods; for example, based on recent data for public investments.

[21] In this presentation we assume that its value is exogenous for labor and exogenous for capital; its value can be computed by combining the social accounting matrix with employment data by activity.

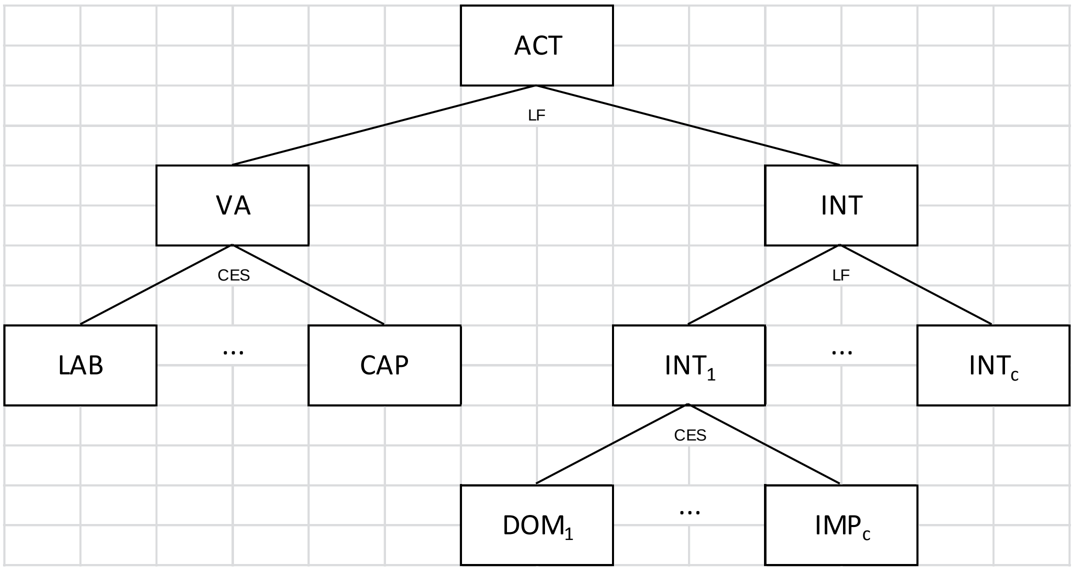
[22] Besides, for the factors considered as specific, equation (PF4) is interpreted as an equilibrium condition between factor supply and demand.

Individual intermediate inputs are also a fixed share of output. However, note that in equation PF6 intermediate inputs are a fixed share of the aggregate intermediate input which, in turn, is a fixed proportion of output (equation PF2).[23]

Equation PF7 computes the production of each product on the basis of the $\theta_{a,c}$ parameter, which represents the production of product *c* per unit produced of activity a. Thus, following the supply and use tables, our model differentiates between activities and commodities/products. In addition, an activity can produce more than commodity and the same commodity may be produced by more than one activity.

Equation PF8 implicitly defines the price of value added, as all other variables in that equation are determined elsewhere in the model. For each activity, the price of its intermediate input composite ($QINTA_{a,t}$) is a weighted average of the prices of each of the commodities that is demanded as an intermediate input (equation PF9), with $ica_{c,a}$ as weights. As we have seen, $ica_{c,a}$ is the quantity of commodity *c* used as an intermediate input in activity a per unit of $QINTA_{a,t}$. The price of each activity is a weighted average of the prices of the commodities it produces (equation PF10).

Figure A.1: Production function



where ACT=activities, VA=value added, INTA=aggregate of intermediate inputs, LAB=labor, CAP=capital, INT=intermediate consumption, DOM=domestic, and IMP=imported. Source: Author's own elaboration.

[23] Note that, unlike the $ica_{c,a}$ parameters, the Leontief technical coefficients are expressed as share of output.

Table A.6: Equations for production function

PF1	$QVA_{a,t} = iva_a \cdot QA_{a,t}$	$t \in T$ $a \in A$
PF2	$QINTA_{a,t} = inta_a \cdot QA_{a,t}$	$t \in T$ $a \in A$
PF3	$QVA_{a,t} = TFP_{a,t} \cdot \varphi_a^{va} \left(\sum_{f \in F} \delta_{f,a}^{va} \cdot QF_{f,a,t}^{-\rho_a^{va}} \right)^{\frac{-1}{\rho_a^{va}}}$	$t \in T$ $a \in A$
PF4	$QF_{f,a,t} = \left(\frac{\delta_{f,a}^{va} \cdot PVA_{a,t}}{WF_{f,t} \cdot \overline{WFDIST}_{f,a,t}} \right)^{\sigma_a^{va}} \left(TFP_{a,t} \cdot \varphi_a^{va} \right)^{\sigma_a^{va}-1} \cdot QVA_{a,t}$	$t \in T$ $f \in FMOB$ $a \in A$
PF5	$\overline{QF}_{f,a,t} = \left(\frac{\delta_{f,a}^{va} \cdot PVA_{a,t}}{\overline{WF}_{f,t} \cdot WFDIST_{f,a,t}} \right)^{\sigma_a^{va}} \left(TFP_{a,t} \cdot \varphi_a^{va} \right)^{\sigma_a^{va}-1} \cdot QVA_{a,t}$	$t \in T$ $f \in FNMOB$ $a \in A$
PF6	$TFP_{a,t} = tfpexog_{a,t} \cdot \prod_{inv \in INVGINF} \left(\frac{KG_{inv,t}}{KG_{inv}^0} \right)^{\eta_{a,inv}^{tfp}}$	$t \in T$ $a \in A$
PF7	$QINT_{c,a,t} = ica_{c,a} \cdot QINTA_{a,t}$	$t \in T$ $c \in c$
PF8	$QX_{c,t} = \sum_{a \in A} \theta_{a,c} \cdot QA_{a,t}$	$t \in T$ $c \in C$ $a \in A$
PF9	$PVA_{a,t} \cdot QVA_{a,t} = PA_{a,t}\left(1 - ta_{a,t}\right)QA_{a,t} - PINTA_{a,t} \cdot QINTA_{a,t}$	$t \in T$ $a \in A$
PF10	$PINTA_{a,t} = \sum_{c \in C} PQ_{c,t} \cdot ica_{c,a}$	$t \in T$ $a \in A$
PF11	$PA_{a,t} = \sum_{c \in C} \theta_{a,c} \cdot PX_{c,t}$	$t \in T$ $a \in A$

Foreign and Domestic Trade

Equations TW1 and TW2 define domestic prices of exports ($PE_{c,t}$) and imports ($PM_{c,t}$), respectively. It is assumed that the modeled economy is small; thus, world prices for exports and imports are given ($pwe_{c,t}$ and $pwm_{c,t}$; also, see below). The government can collect tariffs on imports and taxes on exports, at rates $tm_{c,t}$ and $te_{c,t}$, respectively. Besides, the model also considers trade and transport margins applied to exports and imports; i.e., $ice_{c',c}$ and $icm_{c',c}$ represent the quantity of trade/transport commodity *ct* per unit of exports and imports of commodity *c*, respectively. Equation TW3 computes the demand price of the domestic product, by adding to its supply price the corresponding trade and transport margin. Thus, parameter $icd_{c',c}$ refers to the quantity of commodity *c*' (i.e., trade and transport;

distribution services) that is required to move one unit of domestic product c from the producer to the consumer.

On the consumption side, and following the Armington (1969) assumption, we assume that products are also differentiated based on their country of origin (e.g., Jamaican rum is different from Guatemalan rum). Consequently, it is possible to consider two-way trade (i.e., the same product is exported and imported simultaneously). To model the imperfect substitution between domestic and imported products, we use a CES function (equation TW4).[24] Equation TW5 is the tangency condition that determines the domestic/imported mix of total supply/demand for each product. Equation TW6 computes the supply price of the composite product $QQ_{c,t}$ as a weighted average of the domestic and imported varieties of commodity c.

On the production side, production can be sold in the domestic market and/or exported to the rest of the world. In terms of modeling, we use a CET (Constant Elasticity of Transformation) function (equation TW7).[25] Equation TW8 corresponds to the first order conditions of the profit maximization problem solved by the producer. Equation (TW9) is the zero profit condition for the production of commodity c, from where price $PX_{c,t}$ is obtained.

Finally, equation TW10 in this bloc is the total demand for commodities that provide trade and transport margins; the demand for such commodities is linked to domestic products, imports and exports.

Table A.7: Equations for trade with rest of the world

TW1	$PE_{c,t} = \left(1 - te_{c,t}\right) EXR_t \cdot pwe_{c,t} - \sum_{c' \in CT} PQ_{c',t} \cdot ice_{c',c}$	$t \in T$ $c \in C$
TW2	$PM_{c,t} = \left(1 + tm_{c,t}\right) EXR_t \cdot pwm_{c,t} + \sum_{c' \in CT} PQ_{c',t} \cdot icm_{c',c}$	$t \in T$ $c \in C$
TW3	$PDD_{c,t} = PDS_{c,t} + \sum_{c' \in CT} PQ_{c',t} \cdot icd_{c',c}$	$t \in T$ $c \in C$
TW4	$QQ_{c,t} = \varphi_c^q \left(\delta_c^m \cdot QM_{c,t}^{-\rho_c^q} + \delta_c^{dd} \cdot QD_{c,t}^{-\rho_c^q}\right)^{\frac{-1}{\rho_c^q}}$	$t \in T$ $c \in C$
TW5	$\frac{QM_{c,t}}{QD_{c,t}} = \left(\frac{PDD_{c,t}}{PM_{c,t}} \cdot \frac{\delta_c^m}{\delta_c^{dd}}\right)^{\sigma_c^q}$	$t \in T$ $c \in C$

[24] The elasticity of substitution between domestic purchases and imports is $\sigma_c^q = 1/\left(1 + \rho_c^q\right)$.

[25] The elasticity of transformation between domestic sales and exports is $\sigma_c^x = 1/(\rho_c^x - 1)$.

TW6	$\left(PQ_{c,t} \cdot QQ_{c,t} = PDD_{c,t} \cdot QD_{c,t} + PM_{c,t} \cdot QM_{c,t}\right)\left(1 + tq_{c,t}\right)$	$t \in T$ $c \in C$
TW7	$QX_{c,t} = \varphi_c^x \left(\delta_c^e \cdot QE_{c,t}^{\rho_c^x} + \delta_c^{ds} \cdot QD_{c,t}^{\rho_c^x}\right)^{\frac{1}{\rho_c^x}}$	$t \in T$ $c \in C$
TW8	$\frac{QE_{c,t}}{QD_{c,t}} = \left(\frac{PE_{c,t}}{PDS_{c,t}} \cdot \frac{\delta_c^{ds}}{\delta_c^e}\right)^{\sigma_c^x}$	$t \in T$ $c \in C$
TW9	$PX_{c,t} \cdot QX_{c,t} = PDS_{c,t} \cdot QD_{c,t} + PE_{c,t} \cdot QE_{c,t}$	$t \in T$ $c \in C$
TW10	$QT_{c,t} = \sum_{c' \in C} icd_{c,c'} \cdot QD_{c',t} + \sum_{c' \in C} icm_{c,c'} \cdot QM_{c',t} + \sum_{c' \in C} ice_{c,c'} \cdot QE_{c',t}$	$t \in T$ $c \in C$

Factor Incomes and Endowments

Equation F1 computes the total income of factor *f*. The first term on the right hand side corresponds to total factor payments from activities. Besides, factor *f* can receive transfers from the rest of the world (second term) and the rest of the country (third term). Thus, the model allows capturing the income of household members that commute between the local economy and the rest of the country. Similarly, households in the local economy can receive capital income from investments in the rest of the country. Equation F2 computes the institutional shares in factor incomes as function of the institutional endowments of factors. In turn, equation F3 computes the income received by each institution for being the owner of factor *f*, net of the applicable local and central (direct) taxes on factor income. Equation F4 computes factor supplies by adding the factors endowments of institutions.

Table A.8: Equations for factor incomes and endowments

F1	$YF_{f,t} = \sum_{a \in A} WF_{f,t} \cdot WFDIST_{f,a,t} \cdot QF_{f,a,t} + trnsfr_{f,row,t} \cdot EXR_t$	$t \in T$ $f \in F$
F2	$SHIF_{i,f,t} = \frac{ENDOW_{i,f,t}}{\sum_{i' \in INS} ENDOW_{i',f,t}}$	$t \in T$ $i \in INS$ $f \in F$
F3	$YIF_{i,f,t} = SHIF_{i,f,t} \cdot YF_{f,t}\left(1 - tf_{f,t}\right)$	$t \in T$ $i \in INS$ $f \in F$
F4	$QFS_{f,t} = \sum_{i \in INS} ENDOW_{i,f,t}$	$t \in T$ $f \in F$

Institutions

Domestic Non-Government Institutions

Equation I1 computes the income of the domestic non-government institution i(insdng) (i.e., households and enterprises) as the sum of two elements: (1) factor income, and (2) transfers from other institutions. Equation I2 defines the marginal propensity to save for the domestic non-government institutions. Initially, variable $MPSADJ_t$ is equal to one.[26] Equation I3 computes the value of savings for each domestic non-government institution in the model, as a linear function of disposable income. In equation I4, transfers from a domestic non-government institution *i* (e.g., households, enterprises, others) to institution *i*' are modeled as an exogenous share of the income of institution *i* net of savings and direct taxes. Equation I5 computes the consumption spending by households as their income net of transfers to other institutions, savings, and direct taxes. Household consumption expenditure is distributed across commodities according to a Stone-Geary utility function, from which a linear expenditure system is derived (equation I6).

Table A.9: Equations for domestic non-government institutions

I1	$YI_{i,t} = \sum_{f \in F} YIF_{i,f,t} + trnsfr_{i,gov,t} \cdot \overline{CPI}_t + +trnsfr_{i,row,t} \cdot EXR_t + \sum_{i' \in INSDNG} TRII_{i,i',t}$	$t \in T$ $i \in INSDNG$
I2	$MPS_{i,t} = \overline{mps}_{i,t} \cdot MPSADJ_t$	$t \in T$ $i \in INSDNG$
I3	$SAVINS_{i,t} = \overline{mps}_{i,t} \cdot YI_{i,t}(1 - TY_{i,t})$	$t \in T$ $i \in INSDNG$
I4	$TRII_{i',i,t} = shii_{i',i}(1 - MPS_{i,t})(1 - TY_{i,t})YI_{i,t}$	$t \in T$ $i' \in INS$ $i \in INSDNG$
I5	$CON_{h,t} = \left(1 - \sum_{i \in INS} shii_{i,h}\right)(1 - MPS_{i,t})(1 - TY_{i,t})YI_{i,t}$	$t \in T$ $h \in H$
I6	$QH_{c,h,t} = qhmin_{c,h,t} + \frac{\delta_{c,h}^{les}}{PQ_{c,t}}\left(CON_{h,t} - \sum_{c\prime \in C} PQ_{c\prime,t} \cdot qhmin_{c\prime,t}\right)$	$t \in T$ $c \in C$ $h \in H$

Government

Equation G1 computes the income tax rate, as the product of an exogenous component ($\overline{ty}_{i,t}$) and a scaling factor ($TYADJ_t$). Equation G2 computes government income as the sum of three elements: (1) tax collection, (2) transfers from other institutions, and (3) factor income. Note that transfers from the rest of the world are multiplied by the exchange rate so that they are expressed in domestic currency. Equation G3 computes the government consumption of commodity c. It is assumed that the commodity composition of government consumption is fixed at its initial values. Initially, variable $GADJ_t$ is equal to one. The government uses its

[26] Besides, in this presentation it is assumed that $MPSADJ_t$ is an exogenous variable.

income to provide goods and services and make transfers to other institutions (equation G4). Equation G5 computes government surplus as the difference between current income (YG_t) and total spending, which in turn results from the addition of recurrent (EG_t) and capital spending $GINV_t$. Equation G6 defines government deficit as the negative of government surplus. Equation G7 is the government capital account, which shows how the government finances its deficit. Finally, equation G8 defines real net domestic financing.

Table A.10: Equations for government

G1	$TY_{i,t} = \overline{ty}_{i,t} \cdot TYADJ_t$	$t \in T$ $i \in INSDNG$
G2	$YG_t = \sum_{i \in INSDNG} TY_{i,t} \cdot YI_{a,t} + \sum_{a \in A} ta_{a,t} \cdot PA_{a,t} \cdot QA_{a,t} + \sum_{c \in C} tq_{c,t} \cdot \left(PD_{c,t} \cdot QD_{c,t} + PM_{c,t} \cdot QM_{c,t}\right) + \sum_{c \in C} tm_{c,t} \cdot EXR_t \cdot pwm_{c,t} \cdot QM_{c,t} + \sum_{c \in C} te_{c,t} \cdot EXR_t \cdot pwe_{c,t} \cdot QE_{c,t} + \sum_{f \in F} tf_{f,t} \cdot YF_t + \sum_{f \in F} \sum_{a \in A} tfact_{f,a,t} \cdot WF_{f,t} \cdot WFDIST_{f,a,t} \cdot QF_{f,a,t} + trnsfr_{gov,row,t} \cdot EXR_t + \sum_{i \in INSDNG} TRII_{gov,i,t} \sum_{f \in F} YIF_{gov,f,t}$	$t \in T$
G3	$QG_{c,t} = \overline{qg}_{c,t} \cdot \overline{GADJ}_t$	$t \in T$
G4	$EG_{c,t} = \sum_{c \in C} PQ_{c,t} \cdot QG_{c,t} + \sum_{i \in INSDNG} trnsfr_{i,gov,t} \cdot \overline{CPI}_t + trnsfr_{row,gov,t} \cdot EXR_t$	$t \in T$
G5	$GSURP_t = YG_t - EG_t - GINV_t$	$t \in T$
G6	$-GSURP_t = GDEF_t$	$t \in T$
G7	$GDEF_t = EXR_t \cdot \overline{NFFG}_t + NDF_t$	$t \in T$
G8	$\overline{RNDF}_t = \frac{NDF_t}{\overline{CPI}_t}$	$t \in T$

Tourists

Equations T2 and T2 show alternative demand functions used to model tourism export demand from the rest of the world. In T1, tourism demand is modeled as an exogenous volume. In T2, tourism demand is modeled through a constant elasticity of demand function. In the latter case, Jamaica faces a downward-sloping demand curve for its tourism exports. In both cases, total tourism demand is disaggregated across locally produced commodities using fixed coefficients. In equation T2, foreign tourists' demand is a function of domestic (tourism-related) prices relative to the exchange rate EXR_t.

Table A.11: Equations for tourism demand

T1	$QTRSMROW_{c,t} = qtrsmrocpc_{c,t} \cdot qtrsmrocpop_t$	$t \in T$ $c \in C$
T2	$QTRSMROW_{c,t} = \overline{qtrsmrow}_{c,t} \left(\frac{\frac{PQ_{c,t}}{EXR_t}}{\frac{PQ^0_{c,t}}{EXR^0}} \right)^{\eta^{rowtrsm}}$	$t \in T$ $c \in C$

Equilibrium Conditions

Equation E1 is the wage curve for factor f (see Blanchflower and Oswald (1994)). It is assumed that there is a negative relation between the real wage and the unemployment rate, as the value of the η_f^{wf} parameter is negative. In fact, Blanchflower and Oswald (2005) report a value for the unemployment-elasticity of wage close to -0.1 for a large number of countries, both developed and developing. Note that the wage curve is consistent with several stories to explain the presence of unemployment for the labor market, such as efficiency wages, unions with bargaining power, among others. Equation E2 is the equilibrium condition in the market for factor *f*.

Equation E3 is the equilibrium condition between supply and demand for each commodity. Total supply, composed of domestic and imported varieties, is used for household consumption, intermediate consumption, investment, local and central government consumption, changes in inventories, and consumption by domestic and foreign tourists.

Equation E4 is the savings-investment balance; four are the institutions that contribute to total savings: domestic non-government institutions (i.e., households and enterprises), government, and the rest of the world.

The rest of the world is represented through the current account of the balance of payments, expressed in foreign currency (equation E5). The left (right) hand side shows the inflows (outflows) of foreign exchange. The current account balance of the balance of payments is the negative of foreign savings.

Equation E7 computes the investment demand of commodity c. It is assumed that the commodity composition of investment is exogenous – see parameter $capcomp_{c,inv}$. Thus, if there is an increase in investment, investment demand for all goods and services will increase in the same proportion.[27]

Equation E8 defines the consumer price index as a weighted average of the composite commodity prices; the weights are the shares of each commodity in private (i.e., household) consumption. In this presentation CPI is the model numeraire (see below).

Table A.12: Equilibrium conditions

E1	$\frac{WF_{f,t}}{\overline{CPI}_{c,t}} = \frac{WF_{f,t}^0}{\overline{CPI}^0}\left(\frac{UERAT_f}{UERAT_f^0}\right)^{\eta_f^{wf}}$	$t \in T$ $f \in FUEND$
E2	$QFS_{f,t}\left(1 - UERAT_{f,t}\right) = \sum_{a \in A} QF_{f,a,t,}$	$t \in T$ $f \in F$
E3	$\sum_{h \in H} QH_{c,h,t} + \sum_{a \in A} QINT_{c,a,t} + QINV_{c,t} + QG_{c,t} + QT_{c,t} + qdstk_{c,t} + QTRSMROW_{c,t} = QQ_{c,t}$	$t \in T$ $f \in F$
E4	$\sum_{inv \in INV} PK_{inv,t} \cdot QINVDEST_{c,t} + \sum_{c \in C} PQ_{c,t} \cdot qdstk_{c,t} = \sum_{i \in INSDNG} SAVINS_{i,t} - NDF_t + \sum_{i \in INSDNG} EXR_t \cdot NFFINS_{i,t}$	$t \in T$
	$QINVDEST_{inv,t} = \overline{qinvdest}_{inv,t} \cdot IADJ_t$	$t \in T$ $inv \in INVNG$
	$QINV_{c,t} = \sum_{inv \in INVNG} capcomp_{inv,c} \cdot QINVDEST_{inv,t} + \sum_{inv \in INVG} capcomp_{inv,c} \cdot \overline{QINVDEST}_{inv,t}$	$t \in T$ $c \in C$
E5	$\sum_{c \in C} pwe_{c,t} \cdot QE_{c,t} + \sum_{i \in INSD} trnsfr_{i,row,t} + \sum_{i \in F} trnsfr_{f,row,t} + \frac{\sum_{c \in C} PQ_{c,t} \cdot QTRSMROW_{c,t}}{EXR_t} + SAVROW_t = \sum_{c \in C} pwm_{c,t} \cdot QM_{c,t} + trnsfr_{row,gov,t} + \frac{\sum_{i \in INSDNG} TRII_{row,i,t}}{EXR_t} + \frac{\sum_{f \in F} YIF_{row,f,t}}{EXR_t}$	$t \in T$
	$SAVROW_t = \overline{NFFG}_t + \sum_{i \in INSDNG} NFFINS_{i,t}$	$t \in T$
	$NFFINS_{i,t} = \overline{nffins}_{i,t} \cdot \overline{NFFINSADJ}_{i,t}$	$t \in T$ $i \in INSDNG$

[27] This presentation assumes that investment is considered as an endogenous variable; see below the discussion of macroeconomic closure rule.

E8	$\overline{CPI}_t = \sum_{c \in C} PQ_c \cdot cwts_c$	$t \in T$

Investment by Destination: Dynamics

Lastly, this group of equations presents the model dynamics. Specifically, the mechanisms used to assign each period private and public investment among sectors are presented. As will be shown, a distinction is made between private and public capital stocks; this is particularly relevant given our interest in simulating increases in private investment in the accommodation industry. Naturally, investment in each period increases the capital stock available in the next period. Next, we need to determine how the new capital is distributed among industries. In our model, for private investment (i.e., households and/or enterprises) we assume that the new capital is distributed across activities based on sectoral differences in the rates of return on capital. Thus, sectors with a relatively higher (lower) capital rate of return receive a relatively larger (smaller) share of the new capital.

Equation D1 computes the price of one unit of capital, both private and public; the new capital is assembled using fixed coefficient production function. Equation D2 computes the average capital rate of return, as the ratio between total capital income and total capital stock. Equation D3 computes the share of each activity in the new capital stock, following the explanation on the previous paragraph. The κ parameter, which varies between zero and one, measures the degree of capital mobility among productive sectors. When κ is zero, investment is distributed among sectors only based on the initial share of each sector in the total capital stock. When κ is positive, investment is distributed among sectors also based on the relative capital returns. Equations D4 and D5 show how sectoral private and public capital stocks are updated, respectively. Finally, equation D6 compute the nominal government investment.

Table A.13: Dynamics; investment by destination

D1	$PK_{inv,t} = \sum_{c \in C} capcomp_{inv,c} \cdot PQ_{c,t}$	$t \in T$ $inv \in INV$
D2	$WFAVG_{f,t} = \frac{\sum_{a \in A} \overline{WF}_{f,t} \cdot WFDIST_{f,a,t} \cdot \overline{QF}_{f,a,t}}{\sum_{a \in A} \overline{QF}_{f,a,t}}$	$t \in T$ $f \in FCAP$

D3	$QINVDESTA_{f,a,t} = QINVDEST_{inv,a,t} \cdot \frac{\overline{QF}_{f,a,t}}{\sum_{a' \in A} \overline{QF}_{f,a',t}} \left(1 + \kappa \left(\frac{\overline{WF}_{f,t} \cdot WFDIST_{f,a,t}}{WFAVG_{f,a,t}} - 1\right)\right)$	$t \in T$ $f \in FCAP$ $a \in A$ $inv \in INVNG$
D4	$QF_{f,a,t} = QF_{f,a,t-1}(1 - deprcap_f) + QINVDESTA_{f,a,t-1}$	$t \in T$ $f \in FCAP$ $a \in A$
D5	$KG_{inv,t} = KG_{inv,t-1}(1 - deprcap_{gov}) + \overline{QINVDEST}_{inv,t-1}$	$t \in T$ $inv \in INVG$
D6	$GINV_t = \sum_{inv \in INVG} PK_{inv,t} \cdot \overline{QINVDEST}_{inv,t}$	$t \in T$

Appendix B: Sensitivity Analysis

The results from our Jamaica CGE model are a function of (i) the model structure (including functional forms used to model production and consumption decisions and macroeconomic closures), (ii) the database used for model calibration (including the SAM), and (iii) the values assigned to the model elasticities or, more generally, to the model's free parameters. In other words, the elasticities used in this study implicitly carry an estimation error, as in any similar model. To better understand the implications of this, we performed a systematic sensitivity analysis of the results with respect to the value assigned to the model elasticities. Hence, if the conclusions of the analysis are robust to changes in the set of elasticities used for model calibration, we will have greater confidence in the results presented above.

In 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. The range of variation allowed for each elasticity is +/- 75%, i.e. a fairly wide range of variation for each model elasticity is considered. Our method is a variant of the one originally proposed by Harrison and Vinod (1992). In short, the model is solved iteratively with different sets of elasticities. The resulting distribution of results is used to build confidence intervals for selected model results. The steps for the systematic sensitivity analysis are as follows:

1. The distribution (i.e., lower and upper bound) is computed for each model parameter that will be modified: elasticities of substitution between primary factor of production, trade-related elasticities, expenditure elasticities, and unemployment elasticities for the wage curves.
2. The model is solved repeatedly, each time with a different set of elasticities following a Monte Carlo type procedure. First, the value for all model elasticities is randomly selected. Second, the model is calibrated using the selected elasticities. Third, the same counterfactual (base and non-base) scenarios as previously described are conducted.

These three steps are repeated 1,000 times, with sampling with replacement for the value assigned to the elasticities.

Table B.1 shows the percentage change in private consumption estimated (i) under the central elasticities, and (ii) as the average of the 1000 observations generated by the sensitivity analysis. For the second case, the upper and lower bounds under the normality assumption were also computed. All runs from the Monte Carlo experiment receive the same weight. As can be seen, the results reported in the main text are significant and the estimates presented in Table C.1 are within the confidence intervals reported in Table B.1. For example, it is almost fully certain that, the simulated investment and tourism shock in scenario trsm20+ would have a positive effect on private consumption. In addition, mean-comparison tests show that the increase in private consumption is significantly higher the higher the increase in foreign tourist arrivals.

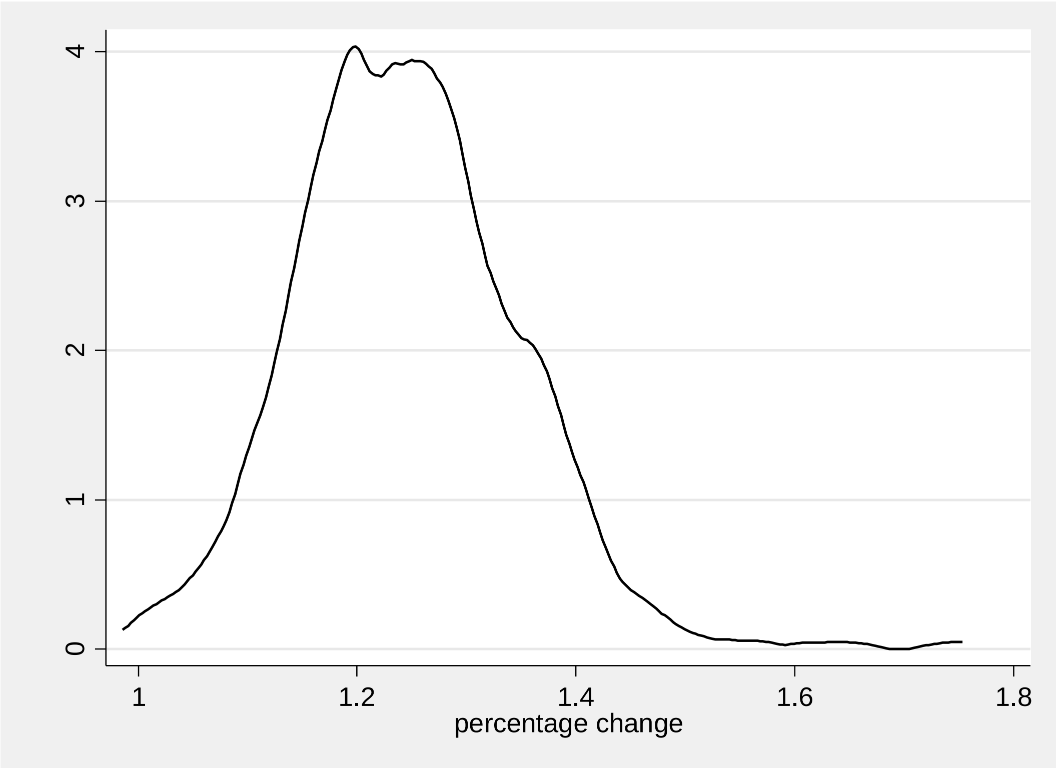
Table B.1: systematic sensitivity analysis; 95% confidence interval for real private consumption under normality assumption (percent deviation from base in 2030)

Item	trsm10+	trsm20+	trsm10-	trsm20-
Mean	0.387	1.246	-0.965	-1.494
Standard deviation	0.118	0.102	0.174	0.191
Lower bound	0.155	1.047	-1.306	-1.868
Upper bound	0.619	1.445	-0.623	-1.121
Central elasticities	0.401	1.231	-0.923	-1.447

Source: Authors' calculations.

Figure C.1 shows non-parametric estimates of the density function for the percentage change in private consumption in the scenario trsm20+ with respect to the base scenario. Again, the sign of the results (i.e., positive) is not changed when model elasticities are allowed to differ by +/- 75% of their “central” values.

Figure C.1: sensitivity analysis, real private consumption scenario trsm20+ (% deviation from base in 2030)



Source: Authors' calculations.

Appendix C: Additional Simulation Results

In Tables C.1-C.3, we show key macroeconomic and sectoral results for the non-base scenarios for the year 2022 (i.e., the first year after the simulated tourism-related investment is completed) and 2030.

Table C.1: Change in real macro indicators, percent deviation from base

		trsm10+		trsm20+		trsm10-		trsm20-	
Item	2015	2022	2030	2022	2030	2022	2030	2022	2030
Absorption	1,923,274	0.2	0.3	0.8	1.0	-0.8	-0.7	-1.2	-1.2
Consumption, private	1,346,283	0.2	0.4	0.9	1.2	-1.0	-0.9	-1.5	-1.4
Investment	345,265	0.3	0.4	0.9	0.9	-0.6	-0.6	-1.0	-0.9
Investment, private	314,516	0.3	0.4	0.9	1.0	-0.7	-0.6	-1.1	-1.0
Exports	255,040	-3.5	-4.7	-9.6	-11.1	8.5	7.8	14.4	13.9
Imports	752,995	1.3	1.6	3.4	3.8	-2.2	-2.1	-3.7	-3.6
Tourism, foreign	241,875	10.0	10.0	20.0	20.0	-10.0	-10.0	-20.0	-20.0
GDP market prices	1,667,194	0.5	0.4	0.8	0.7	-0.1	-0.2	-0.5	-0.6
Net indirect taxes	319,582	1.0	1.0	2.1	2.1	-1.0	-1.0	-1.9	-1.9
GDP factor cost	1,347,612	0.4	0.3	0.6	0.4	0.1	0.0	-0.1	-0.2
Real exchange rate (index)	1	-0.9	-1.3	-3.0	-3.5	3.0	2.5	4.7	4.3
Wage (index)	1	0.6	1.1	2.1	2.8	-1.9	-1.9	-3.0	-3.2
Capital return (index	1	0.3	0.0	0.4	-0.2	0.3	0.6	0.4	0.9
Unemployment rate (%)	13.5	-0.2	-0.2	-0.5	-0.5	0.5	0.3	0.8	0.6

Note: Except for unemployment, the 2015 column shows levels in million J$, while the simulation columns show percent deviations from base in same year. For unemployment, the 2015 and simulation columns show the rates in 2015 and percentage points deviations from base in in same year, respectively.
Source: Authors' calculations based on simulation results.

Table C.2: Change in sectoral employment, percent deviation from base

	base	trsm10+		trsm20+		trsm10-		trsm20-	
Activity	2015	2022	2030	2022	2030	2022	2030	2022	2030
Agriculture, for and fishing	202,600	0.08	0.00	-0.09	-0.11	0.46	0.25	0.65	0.38
Mining	5,815	-1.16	-1.74	-2.95	-4.21	1.94	2.48	3.29	4.30
Food, beverages and tob	25,527	-0.01	-0.40	-0.77	-1.29	1.49	1.31	2.22	2.13
Textiles and wearing app	11,366	-0.70	-1.02	-2.12	-2.43	2.11	1.77	3.49	3.14
Other manufacturing	36,271	-2.10	-2.96	-6.23	-7.02	6.24	5.30	10.43	9.47
Electricity and water	8,723	1.78	0.99	3.43	1.58	-1.45	-0.33	-3.04	-1.05
Construction	82,789	0.60	0.60	1.38	1.29	-0.85	-0.68	-1.52	-1.27
Trade	227,915	-0.19	-0.50	-0.70	-1.32	0.97	1.25	1.60	2.16
Hotels	36,480	-6.86	1.95	6.57	16.76	-31.38	-25.05	-42.45	-37.22
Restaurants	52,000	3.02	2.92	6.27	5.94	-3.34	-3.03	-6.46	-5.97
Transport	59,957	-0.29	-1.24	-2.74	-3.77	4.41	3.66	6.66	6.03
Communications	14,962	-1.20	-1.95	-3.74	-4.77	3.51	3.33	5.71	5.80
Financial services	26,469	-0.22	-0.68	-1.29	-1.93	1.77	1.65	2.70	2.73
Real estate and bus serv	74,393	-0.52	-1.14	-2.30	-3.14	2.66	2.44	4.08	4.05
Gov serv, edu and health	159,964	0.01	-0.01	0.00	-0.04	0.03	0.05	0.04	0.07
Recreation	17,810	4.66	4.24	8.92	8.16	-4.01	-3.86	-8.41	-8.02
Other services	95,734	3.71	3.47	7.29	6.77	-3.52	-3.30	-7.16	-6.75
Total	1,138,775	0.18	0.20	0.59	0.52	-0.56	-0.38	-0.90	-0.65

Note: 2015 column shows levels in number of workers, while the simulation columns show percent deviations from base in same year.
Source: Authors' calculations based on simulation results.

Table C.3: Change in sectoral real value added, exports, and imports, percent deviation from base

Panel a: Value added

	base	trsm10+		trsm20+		trsm10-		trsm20-	
Commodity	2015	2022	2030	2022	2030	2022	2030	2022	2030
Agriculture, for and fishing	101,764	0.05	0.03	-0.04	0.02	0.25	0.09	0.35	0.13
Mining	29,359	-0.68	-1.07	-1.51	-2.56	0.72	1.37	1.31	2.38
Food, beverages and tob	67,014	0.00	-0.10	-0.33	-0.33	0.68	0.37	1.01	0.62
Textiles and wearing app	1,129	-0.54	-0.77	-1.58	-1.76	1.53	1.20	2.54	2.18
Other manufacturing	59,118	-1.43	-2.15	-4.22	-5.09	4.07	3.75	6.78	6.69
Electricity and water	45,242	0.81	0.96	1.61	2.04	-0.72	-1.07	-1.46	-2.02
Construction	103,898	0.62	0.64	1.35	1.38	-0.73	-0.70	-1.36	-1.32
Trade	252,541	0.03	-0.09	-0.15	-0.24	0.50	0.36	0.76	0.64
Hotels	41,899	9.51	9.50	18.99	18.98	-9.45	-9.46	-18.93	-18.94
Restaurants	15,858	2.59	2.69	5.38	5.53	-2.88	-2.89	-5.57	-5.63
Transport	56,866	-0.25	-0.87	-1.92	-2.63	2.93	2.53	4.44	4.17
Communications	50,166	-0.37	-0.67	-0.98	-1.45	0.74	0.78	1.24	1.44
Financial services	116,150	-0.09	-0.28	-0.61	-0.75	0.86	0.62	1.30	1.04
Real estate and bus serv	147,320	-0.19	-0.37	-0.75	-0.95	0.80	0.63	1.22	1.06
Gov serv, edu and health	202,138	0.01	-0.01	0.01	-0.04	0.03	0.04	0.03	0.06
Recreation	29,133	3.84	3.80	7.34	7.41	-3.35	-3.59	-7.02	-7.36
Other services	28,016	3.09	3.14	6.06	6.21	-2.96	-3.11	-6.02	-6.26
Total	1,347,612	0.43	0.30	0.59	0.45	0.11	-0.01	-0.06	-0.17

Panel b: Exports

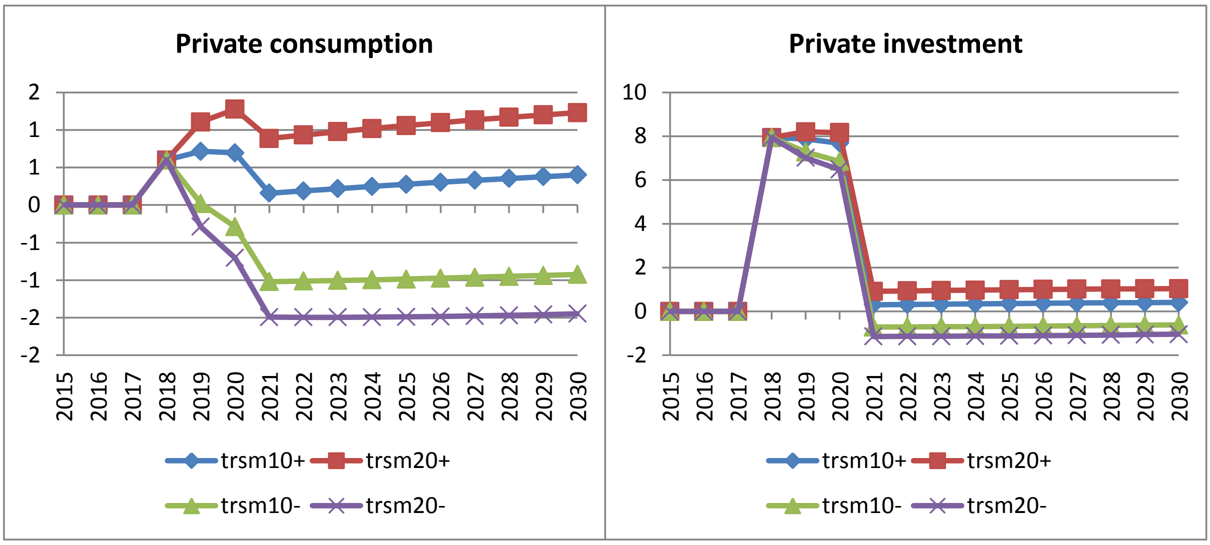
	base	trsm10+		trsm20+		trsm10-		trsm20-	
Commodity	2015	2022	2030	2022	2030	2022	2030	2022	2030
Agriculture, for and fishing	10,037	-6.18	-7.93	-16.38	-18.26	14.26	12.88	24.41	23.25
Mining	72,475	-0.71	-1.11	-1.52	-2.65	0.60	1.35	1.14	2.35
Food, beverages and tob	26,257	-5.25	-6.81	-14.55	-15.81	13.19	11.01	22.29	19.77
Textiles and wearing app	273	-6.49	-8.76	-18.28	-20.23	17.60	14.71	29.77	26.57
Other manufacturing	60,562	-4.96	-7.06	-14.12	-16.49	13.32	12.09	22.38	21.74
Electricity and water	1,831	-4.36	-4.05	-11.70	-9.36	10.02	5.90	17.05	10.56
Trade	12	-4.11	-5.62	-12.21	-13.30	11.75	9.39	19.48	16.68
Transport	40,839	-4.16	-5.79	-11.95	-13.87	11.21	10.30	18.77	18.26
Communications	15,661	-2.81	-3.80	-7.14	-8.53	5.03	4.79	8.60	8.71
Financial services	10,607	-4.52	-5.95	-12.55	-13.85	11.28	9.53	19.02	17.06
Real estate and bus serv	12,642	-4.24	-5.24	-10.86	-11.90	8.57	7.48	14.76	13.55
Gov serv, edu and health	89	-4.85	-6.88	-13.95	-16.36	13.42	12.25	22.53	21.80
Recreation	3,755	-1.54	-2.75	-7.48	-8.30	8.73	6.57	13.02	10.31
Total	255,040	-3.47	-4.75	-9.60	-11.14	8.53	7.77	14.40	13.88

Panel c: Imports

	base	trsm10+		trsm20+		trsm10-		trsm20-	
Commodity	2015	2022	2030	2022	2030	2022	2030	2022	2030
Agriculture, for and fishing	8,556	2.50	3.12	6.68	7.57	-4.49	-4.28	-7.45	-7.39
Mining	58	-0.40	-0.75	-1.45	-1.85	1.74	1.55	2.81	2.73
Food, beverages and tob	55,340	2.35	2.88	6.23	6.87	-4.33	-3.95	-7.23	-6.90
Textiles and wearing app	12,464	0.99	1.30	2.83	3.25	-2.21	-2.04	-3.61	-3.48
Other manufacturing	447,858	0.56	0.67	1.44	1.61	-0.90	-0.87	-1.50	-1.49
Electricity and water	522	3.61	3.67	9.28	8.53	-5.90	-4.52	-9.94	-8.03
Construction	639	2.52	3.38	7.33	8.46	-5.41	-4.92	-8.71	-8.34
Trade	7,053	2.17	2.80	6.48	7.02	-4.70	-3.87	-7.46	-6.53
Hotels, imports	28,574	1.07	1.53	3.45	4.00	-2.89	-2.55	-4.56	-4.24
Restaurants, imports	8,556	1.07	1.53	3.45	4.00	-2.89	-2.55	-4.56	-4.24
Transport	41,872	3.78	4.19	8.82	9.42	-5.04	-4.89	-8.94	-8.89
Communications	12,669	1.68	2.06	4.30	4.85	-2.72	-2.56	-4.58	-4.49
Financial services	25,542	2.55	3.16	6.96	7.64	-4.78	-4.25	-7.87	-7.35
Real estate and bus serv	89,248	2.23	2.58	5.55	6.00	-3.47	-3.19	-5.95	-5.66
Gov serv, edu and health	706	2.54	3.61	7.82	9.29	-6.07	-5.57	-9.63	-9.31
Recreation	9,923	7.00	7.67	16.66	17.32	-9.64	-8.92	-16.90	-16.15
Other services	3,415	6.48	7.23	15.88	16.64	-9.39	-8.61	-16.17	-15.37
Total	752,995	1.34	1.59	3.44	3.77	-2.21	-2.06	-3.73	-3.60

Note: 2015 column shows levels in million J$, while the simulation columns show percent deviations from base in same year.
Source: Authors' calculations based on simulation results.

Figure C.1: Real private consumption and investment by simulation (percent level deviation from base scenario)



Source: Authors' calculations based on simulation results.