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Abstract

Ex-ante economic impact analyses are required to demonstrate the development impact and economic viability of loans and grants extended by multi-lateral development banks. These assessments are performed under tight time constraints and often in data poor environments. This paper develops a framework for assessing development interventions in data poor environments and applies it to the analysis of the Sustainable Tourism Program, a US$15 million loan from the Inter-American Development Bank to the Government of Belize to foster tourism development in emerging destinations and enhance participation of low income people in the tourism value chain. This paper contributes to the literature in two critical ways: (i) the paper develops a generalizable approach to building dynamic computable general equilibrium models for development policy analysis in data poor environments; (ii) realistic expectations of agent behavioral responses to development interventions are required to calibrate model simulations. To estimate business as usual tourism arrivals and expenditure, auto-regressive integrated moving average methods were used. To estimate agent response to the development intervention, a survey-based quasi-contingent valuation approach was employed. These projections and information on investment structuring and costs were used to calibrate the model shocks. Results of this analysis show that the proposed investment will have positive impacts on Belize's economy by hastening economic growth. Gross domestic product increases 3% by 2040 and unemployment falls from 12% to 10%. Cross validating with a break-even scenario confirms that the Government of Belize would recover all investment costs even if actual agent demand response were considerably less than forecast. The model developed here may be applied to the ex-ante economic analysis of other sectoral development interventions ranging from agricultural policy to fiscal policy, from integration and trade, to health and education.

Keywords: ex-ante economic impact analysis; tourism development; economy-wide model; auto-regressive integrated moving average; contingent valuation; data poor environment.

1.0 Introduction

As a requisite to the preparation of loans and grants extended by multi-lateral development banks, an ex-ante economic impact assessment is required to evaluate the potential development impact of the loan and whether or not the returns from the investment exceed the costs. Ex-ante economic impact assessments are performed within tight time frames to respect the overall project approval cycle, which limits the amount of primary data that may be collected. Further compounding the challenge is that these data intensive assessments are undertaken in the data poor environments characteristic of many developing countries.

This paper develops a framework for assessing development interventions in data poor environments and applies this framework to the analysis of the Sustainable Tourism Program (STP II). STP II is a US$15 million loan from the Inter-American Development Bank to the Government of Belize, approved October 21, 2015, to foster tourism development in emerging destinations and enhance participation of low income people in the tourism value chain. Building on the framework developed in Banerjee et al. (2015), this paper contributes to the literature in two critical ways: (i) the paper develops a generalizable approach to building dynamic computable general equilibrium models for development policy analysis in data poor environments; (ii) realistic expectations of agent behavioral responses to development interventions are required to calibrate model simulations. To estimate business as usual tourism arrivals and expenditure, auto-regressive integrated moving average methods were used. To estimate agent response to the intervention, a survey-based quasi-contingent valuation approach was employed. These projections and information on investment structuring and costs were used to calibrate the model shocks.

The goal of STP II is to increase the tourism sector's contribution to socioeconomic development while maintaining and enhancing natural and cultural capital with special consideration for Belize's vulnerability to natural disasters and climate change (Lemay et al., 2015). The predecessor to STP II is the Sustainable Tourism Program I, a US$13.2 million IDB loan executed between 2008 and 2013. The emphasis of STP I was on consolidating the overnight foreign leisure visitor market through investment in the key destinations of Ambergris Caye, Placencia, Cayo and Belize City.

An important strategic divergence from STP I is STP II's focus on emerging destinations. Consistent with the priorities set forth in Belize's National Sustainable Tourism Masterplan, the destinations selected for investment are Corozal District, Toledo District, the Mountain Pine Ridge, Chiquibul, Caracol Complex in Cayo District, and Caye Caulker. While Caye Caulker is not so much an emerging destination, its current level of development and vulnerability to natural disasters and climate change warrant investments in terms of urban planning and disaster risk management. The specific objectives of STP II are to: (i) increase tourism employment and tourism sector-based income and revenues through enhancement of the tourism product; (ii) promote disaster and climate resilience and environmental sustainability, and; (iii) improve tourism sector governance and create an enabling environment for private investment through institutional strengthening and capacity building (Lemay et al., 2015).

The tourism sector is composed of many sub-sectors including hotels, restaurants, food and beverages, transportation, and tours. Tourism development interventions themselves target diverse sectors such as the construction sector, basic public services (water and sanitation and energy), capacity building and education. Given the strong inter-related nature of the tourism sector and other sectors, tourism interventions generate significant spillovers (Banerjee, Cicowiez, & Gachot, 2015a, 2015b; Vanhove, 2005). DCGE models are considered a powerful analytical framework to represent the intersectoral linkages characteristic of the tourism sector and capture the direct, indirect and induced impacts of investment interventions (Banerjee et al., 2015a, 2015b; Taylor, 2010).

DCGE models are, however, data-intense, which in the case of data poor Belize, presents a challenge addressed by this paper. Potential applications of the approach developed here span the sectoral spectrum from agricultural policy to fiscal policy, from integration and trade, to health and education. This paper is structured as follows: following this introduction, the basic structure of a DCGE model and the approach to constructing its underlying database, the social accounting matrix (SAM), are discussed. A snapshot of Belize's economy, as understood through the SAM, is then provided. Next, the approach to estimating tourism demand with auto-regressive integrated moving average (ARIMA) methods is described. The estimation of *with program* tourism demand through a quasi-contingent valuation experiment is then discussed. Section 4 presents the investment structuring and the estimation of break-even demand. A preliminary cost-benefit analysis is undertaken considering only direct benefits and the cost of the investment, in the absence of factor and other supply constraints, and second-round indirect and induced impacts. Section 5 describes the calibration of the model shocks, results and analysis. The final section offers concluding remarks and discusses the methodological frontier of ex-ante economic analyses of development interventions.

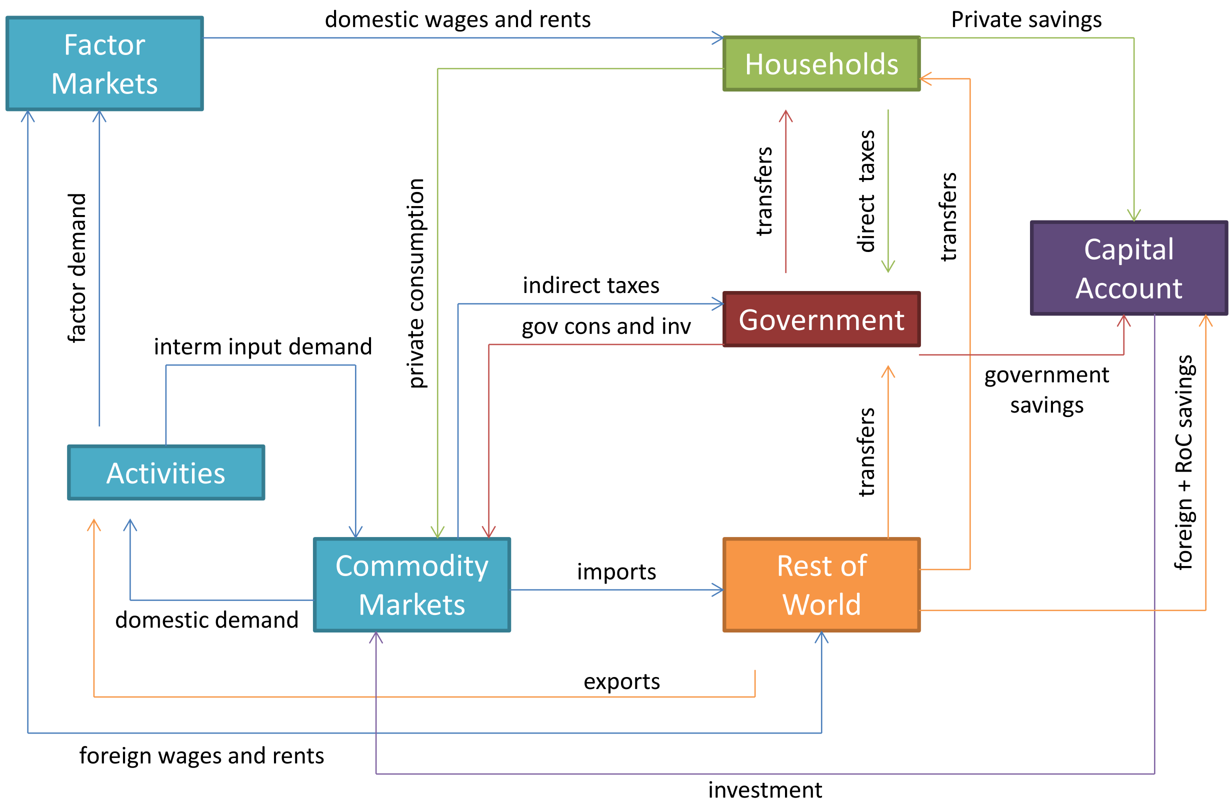
2. Methodology: A National Dynamic Computable General Equilibrium Model for Belize

2.1. The Model

This study employs the single country small open recursive dynamic Computable General Equilibrium modelling framework developed in Banerjee, Cicowiez and Gachot (2015b) to evaluate the economic impact of STP II. A detailed description of the model and a manual for its calibration and operation may be found in the IDB Working Paper (Banerjee et al., 2015a). The model integrates a relatively standard recursive DCGE model with additional equations and variables that single out: (a) domestic and foreign tourism demand, and; (b) the impact of public capital investment in infrastructure on sectoral productivity. This DCGE model offers a combination of policy-relevant features for the study of tourism investment and tourism policy scenarios in a national economy. Provided disaggregated supply and use data, the model may be regionalized to evaluate district-level investment and policies.

Figure 1 depicts the circular flow of income within the economy and between the economy and the rest of the world as represented by the DCGE model. Activities are industries that both demand, as intermediate inputs, and supply, goods and services. Goods and services are consumed by households and governments, and supplied to export markets and foreign tourists. Activities also demand factors of production (labor, capital, land, natural resources) for their productive processes and make payments to these factors. These payments are transferred to households in the form of wages and rents. Households may also receive income from transfers from the government and transfers from the rest of the country or world (migrant labor, remittances, government subsidies, gifts, etc.). Households pay taxes, consume and save.

Figure 1. Circular flow of income in the DCGE.



Source: Authors' own elaboration.

The DCGE model mathematically describes the optimizing behavior of agents in their economic environment; it is a system of equations describing the utility maximizing behavior of consumers, profit maximizing behavior of producers, and the equilibrium conditions and constraints imposed by the macroeconomic environment. Agent behavior is represented by linear and non-linear first order optimality conditions and the economic environment is described as a series of equilibrium constraints for factors, commodities, savings and investment, the government, and rest of the world accounts (Lofgren, Harris, Robinson, Thomas, & El-Said, 2002).

2.2. Belize's Data Deficit

Belize is one of the data poorest countries in Latin America and the Caribbean. The compilation of Belize's National Accounts, which adhere to the now outdated concepts and definitions of the 1993 System of National Accounts (SNA) are hampered due to a paucity of data (International Monetary Fund, 2015). The scope of Belize's national accounts includes Gross Domestic

Product (GDP) by activity and GDP by expenditure. Balance of payments data and some fiscal data are available from the Central Bank of Belize. The national accounts and other required data sources for building a DCGE are in general highly aggregated, particularly with regard to sectoral detail for activities, expenditure and taxation.

Routine data collection in Belize includes its Labor Force Survey (undertaken twice per year in April and September), the Visitor Expenditure and Motivation Survey (monthly), the Population and Housing Census (every 10 years, the most recent dated 2010), and the Multiple Indicator Cluster Survey (MICS; 2011 and 2015). Belize lacks publically available household survey data and agricultural survey data, while government account, taxation and transfer data are highly aggregated. Supply and use tables and input output (I-O) tables, which are constructed based on supply and use tables, are not available for Belize.

Efforts have been initiated to improve Belize's data collection and management systems. In 2012, the Statistical Institute of Belize and the Partnership in Statics for Development in the 21^{st} Century launched a workshop to establish a national committee to develop a roadmap for designing and implementing a National Strategy for the Development of Statistics. Unfortunately, since then, progress has been slow in working toward a National Statistical System.

The lack of I-O tables and sectoral detail pose a significant challenge for the construction of a DCGE. The absence of supply and use and I-O tables limits the scope for evaluating development interventions with potentially significant intersectoral linkages. How this challenge was overcome is discussed in the sections that follow.

2.3. The Social Accounting Matrix for Belize

The basic accounting structure and much of the underlying data required to implement a DCGE model is derived from a Social Accounting Matrix (SAM). A SAM is a comprehensive, economy-wide statistical representation of an economy for a specific year. 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. The accounting identity applies to a SAM in that column totals are equal to row totals for each corresponding account. Major accounts in a standard SAM are: activities that carry out production; commodities (goods and services) which are produced and/or imported and sold domestically and/or exported; factors used in production which include labor, capital, land and other natural resources; institutions such as households, government, and the rest of the country and the rest of the world.

The lack of an I-O table or supply and use tables for Belize presents a challenge for developing a SAM. An I-O table provides information on the inputs (factor and intermediate inputs) used in the production process of economic sectors, the magnitude of output from each sector, and the income generated through production. While Belize's national accounts provide basic information on aggregate output, what is missing is information on the quantities of factor and intermediate inputs used in producing sectoral output, and; data on final consumption by households, government and investment. To overcome this challenge, the approach taken in this paper is to build on the method developed in Horridge's (2002, 2006) estimation of an I-O table for Albania (Horridge, 2002, 2006).

The first step in constructing a SAM is to begin by constructing an aggregate SAM or MACROSAM. A stylized MACROSAM is presented in Table 1.

Table 1. A stylized MACROSAM.

	act	com	f-lab	f-cap	tax-act	tax-com	sub-com	tax-imp	tax-dir	hhd	gov	row	sav	inv	invg	dstk	total
act		4															
com	1									9a	9b	9c		19a	19b	19c	
f-lab	2a											16a					
f-cap	2b											16b					
tax-act	3																
tax-com		5a															
sub-com		5b															
tax-imp		5c															
tax-dir										10							
hhd			7a	7c							14a	14b					
gov					8a	8b	8c	8d	8e	11		17					
row		6	7b	7d						12	15						
sav										13a	13b	13c					
inv													18a				
invg													18b				
dstk													18c				
total																	

Source: Authors' own elaboration. Definitions: act = activities; com = commodities; f-lab = labor; f-cap = capital; tax-act = activity tax; tax-com = commodity tax; sub-com = subsidies; tax-imp = import tax; tax-dir = direct tax; hhd = household; gov = government; row = rest of the world; sav = savings; inv = private investment; invg = public investment; dstk = changes in stocks.

The reference numbers in the MACROSAM in Table 1 explain typical transfers found in a standard SAM. Table **2** presents the type of transfer each reference number represents and, in a best case scenario where a country has full national accounts including supply and use tables and integrated economic accounts, where the data may be sourced from (in italics). Similarly, Table **3** presents typical transfers in a SAM, and where data may be sourced from when national accounts and data availability are limited and/or aggregated.

Table 2. Description of SAM transfers; data sources in data-unconstrained case.

1. Intermediate consumption. *Use table.*	6. Imports. *Supply table.*	13a. Household savings. *Integrated economic accounts.* 13b. Government savings. *Integrated economic accounts.*
2a. Value added, labor. *Use table.* 2b. Value added, capital. *Use table.*	7a. Labor income transfer to domestic households. *Integrated economic accounts.* 7b. Labor income transfer abroad. *Integrated economic accounts.* 7c. Capital income transfer to domestic households. *Integrated economic accounts.* 7d. Capital income transfer abroad. *Integrated economic accounts.*	14a. Government transfer to households (social security, etc.). *Integrated economic accounts.* 14b. Transfers to households from abroad. *Integrated economic accounts.*
3. Tax on production. *Use table.*	8a. Activity tax transfer to government. *Central Bank.* 8b. Commodity tax transfer to government. *Central Bank.* 8c. Commodity subsidy transfer from government. *Central Bank.* 8d. Import tax transfer to government. *Central Bank.* 8e. Direct tax transfer to government. *Central Bank.*	15. Government transfer abroad. *Integrated economic accounts*.
4. Output at basic prices. *Make matrix.*	9a. Household final demand. *Use table.* 9b. Government final demand. *Use table.* 9c. Export final demand. *Use table.*	16a. Payments to labor from abroad. *Integrated economic accounts.* 16b. Payments to capital from abroad. *Integrated economic accounts.*
5a. Tax on commodities. *Supply table.* 5b. Subsidies on commodities. *Supply table.*	10. Household income tax. *Integrated economic accounts.*	17. Transfers to government from abroad (foreign aid, etc.). *Integrated economic accounts.*

5c. Taxes on imports. *Supply table.*	11. Other household transfers to government. *Integrated economic accounts.*	18a. Non-government investment (note: includes public enterprises). *Fiscal data.* 18b. Government investment. *Fiscal data.* 18c. Changes in stocks.
	12. Household transfers abroad. *Integrated economic accounts.*	19a. Private investment. *Use table.* 19b. Government investment. *Use table.* 19c. Changes in stocks. *Use table*.

Source: Authors' own elaboration.

Full national accounts including supply and use tables and integrated economic accounts provide sufficient information to construct a MACROSAM. In the case of Belize's limited national accounts, and similarly for other countries with rudimentary national accounts, the first step in constructing a MACROSAM is to populate as many of the cells representing transactions in Table 1 as is possible based on the available data. A country's national statistical body and Central Bank usually hold what national account and balance of payments data that are available. In the case of Belize, data on GDP by activity and by expenditure were drawn from the Statistical Institute of Belize (SIB, 2015). This was sufficient to complete the data requirements for cells 4, 9(a,b,c), at an aggregate sectoral level. Balance of payments data from Belize's Central Bank allowed cells 6 and 9c to be populated. Some data on taxes levied and tax revenues were obtained from the Central Bank (Central bank of Belize, 2015a) though the data available was limited and required some assumptions to be made.

Table 3. Description of SAM transfers; data sources in data-constrained case.

1. Intermediate consumption. *National accounts for total and Use table from similar country for sectoral data.*	6. Imports. *National source typically available; COMTRADE.*	13a. Household savings. *May be calculated as residual to balance the household account.* 13b. Government savings. *Fiscal data (calculated as total current income minus total current spending).*
2a. Value added, labor. *National accounts for total and Use table from similar country for sectoral data.* 2b. Value added, capital. *National accounts for total and Use table from similar country for sectoral data.*	7a. Labor income transfer to domestic households. *Total labor income – [lab,row].* 7b. Labor income transfer abroad. *Balance of payments.* 7c. Capital income transfer to domestic households. *Total capital income minus [cap,row] – [cap,gov].* 7d. Capital income transfer abroad. *Balance of payments.*	14a. Government transfer to households (social security, etc.). *May be calculated as a residual to balance the government account.* 14b. Transfers to households from abroad. *Balance of payments.*
3. Tax on production. *Tax rates and corresponding total tax collected.*	8a. Activity tax transfer to government. *Central Bank.* 8b. Commodity tax transfer to government. *Central Bank.* 8c. Commodity subsidy transfer from government. *Central Bank.* 8d. Import tax transfer to government. *Central Bank.* 8e. Direct tax transfer to government. *Central Bank.*	15. Government transfer abroad. *Balance of payments.*
4. Output at basic prices. *National accounts for total output and Use table from similar country for sectoral data.*	9a. Household final demand. *National accounts for total and household survey or Use table from similar country.* 9b. Government final demand. *National accounts for total and fiscal data or use table from similar country.* 9c. Export final demand. *National source typically available; also COMTRADE.*	16a. Payments to labor from abroad. *Balance of payments.* 16b. Payments to capital from abroad. *Balance of payments.*

5a. Tax on commodities. *Tax rates and corresponding total tax collection.* 5b. Subsidies on commodities. *Subsidy rates and corresponding total subsidies collected.* 5c. Taxes on imports. *Import tariff rates and corresponding total tax collected.*	10. Household income tax. *Fiscal data.*	17. Transfers to government from abroad (foreign aid, etc.). *Balance of payments.*
	11. Other household transfers to government. *Integrated economic accounts.*	18a. Non-government investment (note: includes public enterprises). 18b. Government investment. *Fiscal data.*
	12. Household transfers abroad. *Balance of payments.*	18c. Changes in stocks. 19a. Private investment. National accounts for total and Use table from similar country for sectoral data. 19b. Government investment. Fiscal data for total and Use table from similar country for sectoral data. 19c. Changes in stocks. *National accounts for total; aggregate with gross fix capital formation.*

Source: Authors' own elaboration.

Secondary data sources were required to complete much of the remaining information as well disaggregate the activity and commodity accounts of the MACROSAM. For additional information on exports and imports, data were obtained from the United Nations Comtrade Database (UN, 2015a) and the International Trade Center's Market Access Map (International Trade Commission, 2015). Some data on macroeconomic aggregates were drawn from the World Bank Development Indicators (World Bank, 2015) and the International Monetary Fund Balance of Payments and International Investment Position Statistics (IMF, 2015a, 2015b).

An important ingredient to the MACROSAM is an estimation of the proportion of labor, capital and intermediate inputs that are used in the overall production process. While these data, known as I-O coefficients, are typically derived from supply and use or I-O tables, at the aggregate level these may be estimated based on information on payments to labor and capital with the share of intermediate inputs calculated as a residual. In the case of Belize, these I-O coefficients were extracted from the GTAP Version 9 global database developed at Purdue University (Narayanan, Aguiar, & McDougall, 2015). In Table **3**, most of the transactions sourced from "Use table from similar country" were extracted from this database. GTAP 9 is a fully documented, publically available database used world-wide by thousands of quantitative policy modelers. The reference year for GTAP 9 is 2011 and it represents 140 countries/regions of the world and 57 economic activities in each country/region. The GTAP database includes I-O tables for 109 of the 140 regions represented. For those countries that have not contributed I-O tables, GTAP follows Horridge's (2002, 2006) approach to produce representations of composite regions or countries as described in detail in Narayanan et al. (2015).

In Horridge (2002, 2006) and GTAP's approach, countries lacking I-O tables are matched with other countries in the region based on similarity in GDP per capita. GDP per capita is recognized as a core indicator of a country's level of economic development, economic performance and average living standards (OECD, 2010). On the basis of GDP per capita, in development of the GTAP database, Belize was associated with the I-O structure of Ecuador. In 2011, the reference year of GTAP 9 and the DCGE model developed herein, Ecuador had a GDP per capita of US$4,870 compared to Belize's GDP per capita which was US$4,310. In Latin America and the Caribbean in 2011, Belize and Ecuador were indeed two of the most similar countries in terms of GDP per capita (World Bank, 2015).

While the countries of Ecuador and Belize may seem very different in terms of the size of their respective economies and populations, applying Ecuador's I-O structure to Belize makes the assumption that the two countries use similar technologies in the production of goods and services. The interpretation of this technological assumption is that, for example, to produce a ton of sugarcane, both Belize and Ecuador use similar proportions of factor inputs (capital, labor and land) and intermediate inputs such as pesticides and fertilizers. The same logic applies to all sectors of the economy. While an I-O table represents the magnitudes of factors and intermediate inputs that are used to produce a country's output of each good, what is borrowed from Ecuador are the I-O technical coefficients representing the proportions of inputs that are used in productive processes. Therefore, in borrowing I-O data from Ecuador, magnitudes are not important, only the proportions are.

With a MACROSAM for Belize constructed and structured to fit the DCGE model developed in Banerjee et al. (2015), economic sectors were disaggregated based on Belize's national accounts sector aggregation reported by the Statistical Institute of Belize (SIB, 2015). The resulting SAM sectoral aggregation follows a conservative approach which reduces the variation in production technology between sectors, where each individual sector is closer to the average production technology. This is a sensible approach, particularly when assumptions on production technology are borrowed from another country. In finalizing the SAM, it was re-balanced using cross-entropy methods (Robinson, Cattaneo, & El-Said, 2001; Robinson & El-Said, 2000).[1]

Table 4 shows the accounts in the SAM, comprised of 9 sectors, each sector producing 1 commodity type. The factors of production are skilled and unskilled labor, private capital stock, land, and a mining resource. The SAM identifies current accounts for institutions (household, government, and tourists from the rest of world), private and public investment, and various tax accounts.

[1] It is important to emphasize that the SAM extracted and customized here is an estimation of the structure of Belize's economy. When I-O or supply and use tables become available for Belize, these may be used in reconstructing the SAM so that Belize-specific technology is represented in the SAM. In addition, disaggregated government accounts and balance of payments data would enable a much better representation of Belize's taxation system and Belize's transactions with the rest of the world in the form of trade and investment.

Table 4. Accounts in the Belize SAM.

Category	Item	Category	Item
Sectors	Agriculture, forestry and fishing	**Institutions**	Households
(9)	Processed food	**(4)**	Government
	Manufacturing		Rest of the world
	Communications		Tourism demand
	Travel, transport and retail		
	Communications	**Taxes**	Land factor tax
	Business services	**(10)**	Unskilled labor factor tax
	Recreational services		Skilled labor factor tax
	Government services		Capital factor tax
Factors	Land		Natural resources factor tax
(5)	Unskilled labor		Activity tax
	Skilled labor		Commodity tax
	Capital		Import tax
	Natural resources		Export tax
Investment	Private investment		Factor tax
(3)	Government investment		
	Savings		

Source: Authors' own elaboration; Belize SAM.

2.4. A Snapshot of Belize in the Base Year of 2011

According to estimates from the SAM, Belize's Gross Domestic Product (GDP) reached 2,978,502 thousand BZD in fiscal year (FY) 2011 Table 5. Belize exported only slightly more than it imported, while foreign tourism demand was equivalent to almost 10% of GDP.

Table 5. Belize total supply and demand.

Item		Thousands BZD
Demand		
Private consumption	$	1,730,687
Government consumption	$	386,246
Fixed investment	$	332,501
Exports	$	1,853,720
Tourism demand	$	449,974
Total demand	$	4,753,128
Supply		
GDP	$	2,978,502
Imports	$	1,774,626
Total supply	$	4,753,128

Source: Authors' own elaboration; Belize SAM.

The production and trade structure of Belize is reflected in Table 6. Travel, transport and retail is the most important value-added sector and responsible for 24.4% of economic output and 38.2% of employment. The export share of this sector was 20.0%. Manufacturing was responsible for 20.9% of total economic output and contributed 28.2% of exports; manufactured goods represented the greatest share of imports (68.7%). Agriculture, forestry and fishing constituted the third most important sector in terms of production with a production share of 18.6%, an employment share of 10.8%, an export share of 21.6% and an import share of 2.3%. Not surprisingly, processed foods accounted for the second highest share of imports at 14.3%. Business and government services were also strong sectors accounting for 12.5% and 15.5% of value added, respectively. These two sectors are also significant employers in Belize, responsible for 11.3% and 21.7% of employment, respectively.

Table 6. Sectoral production and trade structure in FY 2011 (percent share of total).

Sector	Value added	Production	Employment	Export	Import
Agriculture, forestry and fishing	13.1	18.6	10.8	21.6	2.3
Processed food	7.7	11.9	4.9	15.3	14.3
Manufacturing	7.9	20.9	6.8	28.2	68.7
Communications	3.5	3.6	3.5	0.3	0.1
Travel, transport and retail	35.5	24.4	38.2	20.0	3.4
Communications	2.6	1.8	0.4	1.7	0.5
Business services	12.5	7.6	11.3	6.8	7.4
Recreational services	1.7	0.9	2.3	1.6	1.0
Government services	15.5	10.4	21.7	4.5	2.3
Total	100	100	100	100	100

Source: Authors' own elaboration; Belize SAM.

2.5. Model Calibration

The model is a dynamic model where dynamic calibration is performed under the assumption that, in the baseline, the economy is on a path of balanced growth. In this case, a growth rate is specified and is applied to all model quantities. Relative prices however remain unchanged. In the simulations, the GDP growth rate is always endogenous. Projections of economic growth were derived from the IMF's World Economic Outlook (IMF, 2015b). Population projections were drawn from the United Nations Projections, 2012 Revision (UN, 2015b), using the medium variant.

Beyond the SAM, depreciation rates for private and public capital and various elasticities are also used to calibrate the model. These elasticities include those used in production, trade, consumption, and in the wage/rental rate curve. Estimates of these parameters were obtained from the best available estimates in the relevant literature including GTAP (Narayanan et al., 2015). To test the robustness of the model and its results with regard to variation in these parameters, a systematic sensitivity analysis was conducted.

3. Benefits: Forecasting Foreign Tourism Demand

3.1. Foreign Overnight Tourist Arrivals and Expenditure *without Program*

Tourist arrivals and expenditure projections with and *without* the STP II program investment are required to calibrate the model shocks implemented in the DCGE. The first step in developing these projections is to develop a forecasting model for *without program* expenditure and arrivals. The *without program* projections were based on time series data (1998 to 2014) of foreign tourist overnight arrivals and expenditure at the national level on a monthly basis, excluding cruise ship arrivals (Belize Tourism Board, 2015; Central Bank of Belize, 2015b).

The time series model developed is an Autoregressive Integrated Moving Average (ARIMA) model which is one of the more widely used approaches to time series forecasting. An ARIMA model is an auto regression model where the variable of interest is forecast using a linear combination of past values of that variable; in other words, the regression is of the variable against itself. This contrasts with multiple regression models where a variable of interest is forecast as a linear combination of predictive or independent variables. A moving average model uses past forecast errors in a regression. The dependent variable is a weighted moving average of a past predetermined number of forecast errors.

To develop an ARIMA model, time series data must exhibit stationarity. Data are stationary when their properties do not depend on the time at which the series was observed. Data exhibiting seasonality, such as tourist arrivals, or other time trends, are considered non-stationary. Three tests were performed to check for stationarity. A simple test for stationarity is a line plot of the data. The data are stationary if the data series is approximately horizontal with constant variance (Becketti, 2013). Second, autocorrelation function (ACF) plots was used (Nau, 2015). When data are stationary, the ACF drops to zero relatively quickly and the Ljung-Box Q statistic has a small p-value, suggesting that the next period change in the variable of interest is uncorrelated with previous periods. Third, and in addition to graphical methods, a unit root test was performed, the most common of which is the Augmented Dicky-Fuller test (Hyndman & Athanasopoulos, 2013).

In order to transform non-stationary data into stationary data, differencing is performed, which is the computation of the difference between consecutive observations in order to eliminate trend and seasonality effects. Seasonal differencing is the difference between an observation and the corresponding observation from the previous year, quarter, month or other time period. When time series data exhibits a high variance, a logarithmic transformation may be undertaken, though this was not necessary in the case of the models estimated here.

A non-seasonal ARIMA model is specified as:

$$y't = c + \phi_1 y_{t-1} + \cdots + \phi_p y_{t-p} + \theta_1 e_{t-1} + \cdots + \theta_q e_{t-q} + e_t \qquad \text{(eqn' 2)}$$

The predictors on the right hand side are the lagged values of y at time t, and lagged errors, e. This form is commonly referred to as an ARIMA (p,d,q) model, where:

$y't$ = the differenced series;

p = order of the autoregressive;

d = degree of first differencing, and;

q = order of the moving average.

Following differencing, the model orders of p and q are identified through graphical ACF plots and Partial Correlation Function (PCF) plots. The log likelihood of the data (which is the logarithm of the probability of the observed data being generated from the model), Akaike's Information Criterion (AIC) and the Bayesian Information Criterion may be used to choose the best fitting model. Better models minimize AIC and BIC (Hyndman & Athanasopoulos, 2013). Once identified, the parameters of the model are estimated, most commonly with the maximum likelihood estimation approach.

The Hyndman-Khandakar algorithm for ARIMA modelling is an automated function in the R statistical package, but it may also be performed manually in other statistical packages such as Stata. The algorithm suggested by Hyndman and Athanasopoulos (2013) was used to estimate the best fitting ARIMA model for Belize's arrival and expenditure data:

1. The number of differences *d* is determined using repeated Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests.

2. The values of *p* and *q* are chosen by minimizing the AIC after differencing the data *d* times. In a step-wise approach:

(a) The model with the smallest AIC is selected from one of the following:

ARIMA(2,d,2),

ARIMA(0,d,0),

ARIMA(1,d,0),

ARIMA(0,d,1).

If d=0 then the constant c is included; if $d \geq 1$ then the constant c is set to zero. This model is then called the "current model".

(b) Variations on the current model are then considered by varying p and/or q from the current model by ±1, and c is included/excluded from the current model.

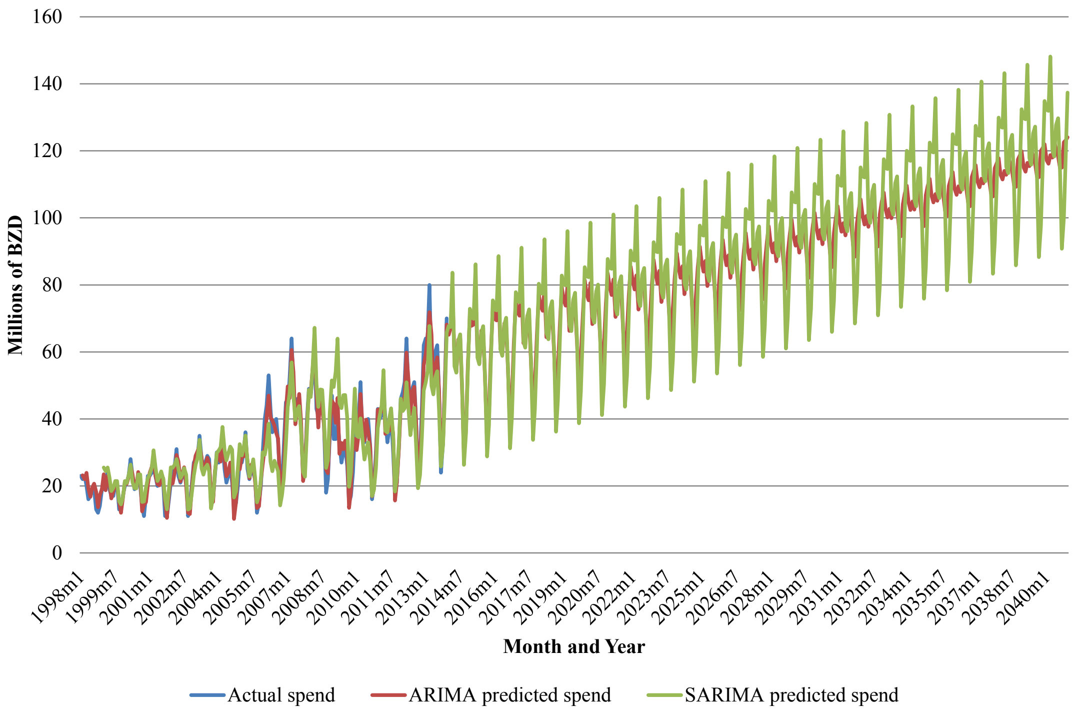
The lowest AIC is again used to select the best and new current model.

3. Step 2(b) is repeated until no lower AIC can be estimated.

4. Model residuals are checked by plotting the ACF of the residuals, and undertaking a portmanteau test of the residuals. If the residuals do not resemble white noise, a different model is tested. Once the residuals resemble white noise, the model is considered to be well calibrated to the data and it may be used for forecasting (Hyndman & Athanasopoulos, 2013).

Figure 2 shows the actual and predicted tourist expenditure for Belize; in this chart, both an ARIMA and a Seasonal ARIMA model were estimated. Since monthly data were used, the seasonal fluctuations characteristic of tourism demand are evident. The closeness of fit between predicted and actual expenditure reflects the fact that the model is well calibrated and reproducing the historical data with a reasonable degree of accuracy.

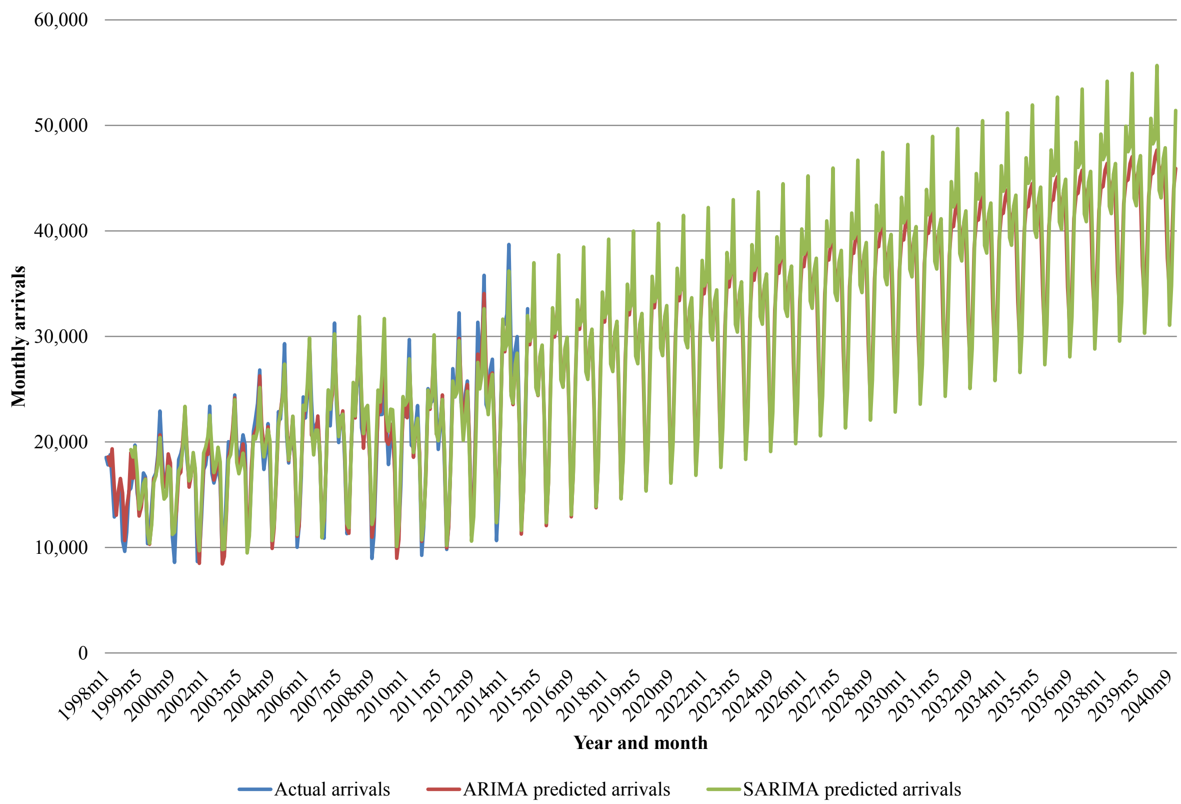
Figure 2. Actual and predicted tourist expenditure for Belize.



Source: Authors' own elaboration.

Figure 3 depicts ARIMA and SARIMA predictions of monthly foreign overnight tourist arrivals to Belize.

Figure 3. Actual and predicted foreign overnight tourist for Belize.



Source: Authors' own elaboration.

3.2. Foreign Overnight Tourist Arrivals and Expenditure *with Program*

The next step in demand forecasting is to estimate tourist arrivals and expenditure *with program*. To estimate demand *with program*, tourist exit surveys were undertaken during the months of April and May 2015. During this period 1,011 surveys of international tourists were conducted at Belize's Western border of Benque Viejo del Carmen (126 surveys), the Northern border of Santa Elena (125 surveys), and the Philip Goldson International Airport (760 surveys), Belize's main international airport[2].

The sample of 1,011 tourists was subdivided into 8 subsamples. For each of the four destinations (Caye Caulker, Cayo San Ignacio, Corozal, Toledo/Punta Gorda), both tourists that had and had not visited the destination were interviewed. For respondents that had visited the destination, the

[2] Summary tables of the tourist exit survey results may be found in: Knight, M. (2015). Tourism Market Study and Identification of Investments for the Sustainable Tourism Program II in Belize (BL-L1020). Washington DC: KnightConsult LLC.

survey assessed motivation for visiting the destination; activities undertaken (see Table 4 for some of the distinguishing features of the destinations); quality of services, and; quality of experience. Respondents were also asked to rate the quality of features and if they needed improvement, for example, with regard to access, general maintenance, environmental quality, signage, safety, quality and diversity of tourism opportunities. Finally, in a quasi-contingent valuation question, respondents were asked if the features that they identified were improved, and the opportunities they identified were available, whether they would be willing to visit the destination in the future, and how much in addition to what they had spent on their current trip, would they be willing to spend. In this stated preference approach, the critical assumption is made that STP II will address the concerns voiced by respondents as well as improve the tourism product on offer along the lines of the enhancements desired by the respondents[3].

For those tourists that had not visited the destination, respondents were asked if certain types of sites (e.g. Table 7; archaeological sites and national parks) and opportunities to take part in specific activities such as diving and caving for example were available, if this would persuade them to visit the destination on a future visit. For those that responded in the affirmative, the respondents were asked the quasi-contingent valuation question of how much they would be willing to spend in a future visit.

[3] Ideally, if time and resources permitted, a choice modelling study would be undertaken to assess tourists' willingness to pay for the main attributes of STP II.

Table 7. Distinguishing features of the STP II emerging destinations.

Site	Distinguishing features and activities
Caye Caulker	Forest and marine reserves, wildlife sanctuary, beach activities and water sports, sport fishing, barrier reef, blue hole, islands, caves, mangrove, cultural events
Cayo San Ignacio	National Parks and Reserves, waterfalls, archaeological sites, caves, bird watching horseback riding, cultural activities
Corozal	Wildlife Sanctuary, nature reserve, archaeological sites, beach activities and water sports, sport fishing, bird watching, cultural activities
Toledo/Punta Gorda	Marine and ecological reserves, National Parks, caves, archaeological sites, bird watching, cultural activities

Source: Authors' own elaboration.

Considering first those tourists who visited the destination they were queried about, across all four destinations, 90% of respondents said they would return to the destination on a future trip to Belize (8). Based on general improvements and increased tourism opportunities proposed under the investment program, tourists reported they would spend on average, across the four sites, USD $141 per day and USD $1,217 per trip in addition to what they had already spent on the current trip.

Table 8. For those that have visited the destination: willingness to return and willingness to spend (BZD).

	Caye Caulker		**Cayo San Ignacio**		**Corozal**		**Toledo/ Punta Gorda**		**Average across sites**	
	mean	**N**	**mean**	**N**	**mean**	**N**	**mean**	**N**	**mean**	**N**
Would you return to this site on your next trip to Belize?	90%	172	87%	159	92%	62	90%	51	90%	444
How much would you be willing to spend per trip if you visit this site in the future?	$993	155	$1,571	137	$932	52	$1,373	44	$1,217	388
How much would you be willing to spend per day if you visit this site in the future?	$129	158	$217	142	$119	53	$99	47	$141	400
Estimated number of days willing to spend in site	7.7	n/a	7.2	n/a	7.8	n/a	13.9	n/a	8.6	n/a

Source: Authors' own elaboration.

Among respondents who did not visit the destination they were queried about, when asked if they would be interested in visiting on a future trip to Belize provided certain tourist activities were available, 86%, 75%, 64%, and 73% affirmed that they would visit Caye Caulker, Cayo San Ignacio, Corozal, and Toledo/Punta Gorda, respectively (Table 9). For this group, they reported they would spend, on average, USD $276 per day and USD $554 per trip. The fact that this group of tourists reported a lower willingness to pay than those that had visited the destination is aligned with expectations as they did not visit the first time, and they have less knowledge of the characteristics of the destinations and of the utility they might derive from visiting them.

Table 9. For those that have not visited the destination: willingness to visit in the future and willingness to spend (BZD).

	Caye Caulker		Cayo San Ignacio		Corozal		Toledo/ Punta Gorda		Average across sites	
	mean	N	mean	N	mean	N	mean	N	mean	N
Would you return to this site on your next trip to Belize?	90%	172	87%	159	92%	62	90%	51	90%	444
How much would you be willing to spend (BZD) per trip if you visit this site in the future?	$502	155	$793	137	$471	52	$693	44	$615	388
How much would you be willing to spend (BZD) per day if you visit this site in the future?	$65	158	$110	142	$60	53	$50	47	$71	400
Estimated number of days willing to spend in site	7.7	n/a	7.2	n/a	7.8	n/a	13.9	n/a	8.6	n/a

Source: Authors' own elaboration.

The next step in estimating the *with program* expenditure was to scale up the values obtained through the survey data to the population. In the case of those that had visited the destination, the total additional expenditure across all destinations was calculated as in equation 3:

$$TAE_a = \sum_{n=1}^{4}(RR_n \cdot PV_n \cdot WR_n \cdot AS_n \cdot AV) \qquad \text{(eqn' 3)}$$

Where:

- TAE_a is total additional expenditure for those that have visited the destination;
- N is destination 1 through 4 representing Caye Caulker, Cayo San Ignacio, Corozal and Toledo/Punta Gorda, respectively;
- RR is visitor return rate;
- PV is percent of total annual visitors to Belize that visit the destination;
- WR is percent of those surveyed that would return to the destination in the future;
- AS is additional spend on future trip, and;
- AV is the total annual foreign overnight holiday/leisure visitors to Belize in 2013.

In the case of those tourists that had not visited the destination they were queried about, their willingness to spend on a subsequent trip was calculated slightly differently as in equation 4.

$$TAE_b = \sum_{n=1}^{4}(VRR_d \cdot (1 - PV_d) \cdot WR_d \cdot AS_d \cdot YS \cdot AV) \qquad \text{(eqn' 4)}$$

Where:

- TAE_b is total additional expenditure for those that have not visited the destination;
- N is destination 1 through 4 representing Caye Caulker, Cayo San Ignacio, Corozal and Toledo/Punta Gorda, respectively;
- VRR is visitor return rate estimated from the BTB's Visitor Expenditure and Motivation Survey (VEMS);
- PV is percent of total annual visitors to Belize that visit the destination;
- WR is percent of those surveyed that would visit the destination in the future;
- AS is additional spend on future trip;
- YS is a 'yea-sayer' factor (a conservative 0.05 in this paper) which takes into account the reality that although many respondents may say they will visit in the future, the actual likelihood that they will is much lower, and;
- AV is the total annual foreign overnight holiday/leisure visitors to Belize in 2013.

Table 10. *With program* tourism expenditure calculations; all dollars are BZD.

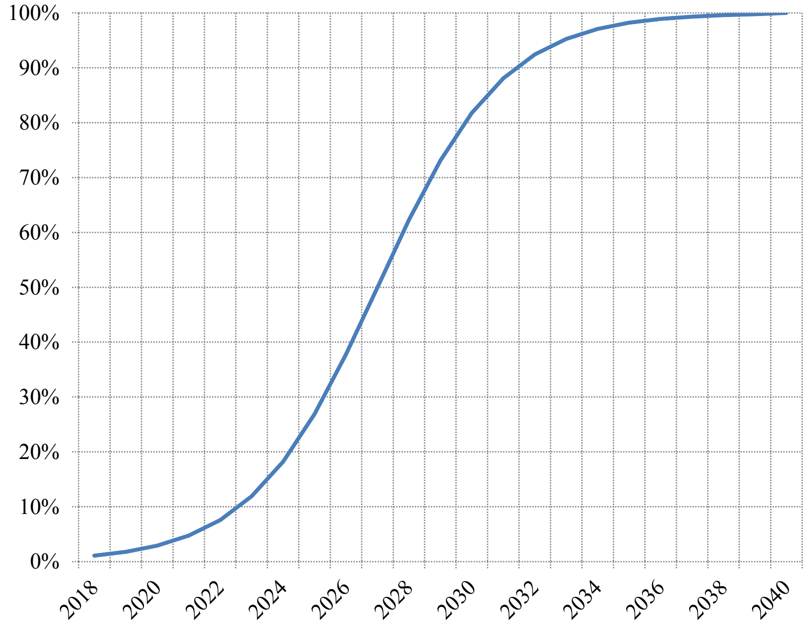
	Caye Caulker (1)	Cayo (2)	Corozal (3)	Toledo (4)	Total
Those that visited the destination					
Percent total overnight, visited (PV)	27%	25%	5%	4%	
Visited before = return rate (RR)	15%	17%	12%	12%	
Would return (WR)	90%	87%	92%	90%	
Additional spend (AS)	$ 1,965	$ 3,110	$ 1,846	$ 2,718	
Total Additional Spend (TAE_a)	$ 19,085,689	$ 30,855,420	$ 2,419,387	$ 3,263,182	$ 55,623,678
Those that have not visited the destination					
Percent total overnight, not visited (1-PV)	73.1%	74.8%	95.5%	95.9%	
Visit next trip (WR)	86%	75%	64%	67%	
VEMS return rate (VRR)	26%	26%	26%	26%	
"Yea sayer" factor (YS)	5%	5%	5%	5%	
Additional spend (AS)	$ 1,319	$ 800	$ 1,279	$ 993	
Total Additional Spend (TAE_a)	$ 2,840,060	$ 1,524,849	$ 2,660,152	$ 2,189,455	$ 9,214,516
TAE_a plus TAE_b	**$ 21,925,749**	**$ 32,380,269**	**$ 5,079,539**	**$ 5,452,637**	**$ 64,838,194**

Source: Authors' own elaboration; calculations based directly on tourist exit survey data.

The sum of $TAE_a + TAE_b$ is the estimated total additional *with program* expenditure. Table 10 summarizes the additional *with program* expenditure calculations. The table shows that the total additional spend for those that have visited the destination is over BZ$55 million while that of those who have not visited the destination is over BZ$9.2 million. The total additional estimated *with program* expenditure is BZ$64,838,194. This figure is a key input into the DCGE model for estimation of indirect and induced benefits, as well as for the cost-benefit analysis. Since the DCGE model is an annual model, the monthly expenditure data presented in Figure 2 was aggregated on an annual basis.

Given the DCGE model is an annual model, the distribution of the additional expenditure over time must be determined. In the absence of data to inform this distribution, an assumption needs to be made; the additional expenditure may for example be distributed linearly, or according to another functional form. In this paper, benefits were distributed according to a logistical function as shown in Figure 4. According to this functional form, benefits begin accruing in 2018 allowing 2 years following STP II's first disbursement. By the year 2025, almost 27% of the benefits will have materialized, while by 2030, almost 82% of the benefits will be realized. By 2032, 92% of the benefits will be realized; 100% of the benefits will have materialized by 2040.

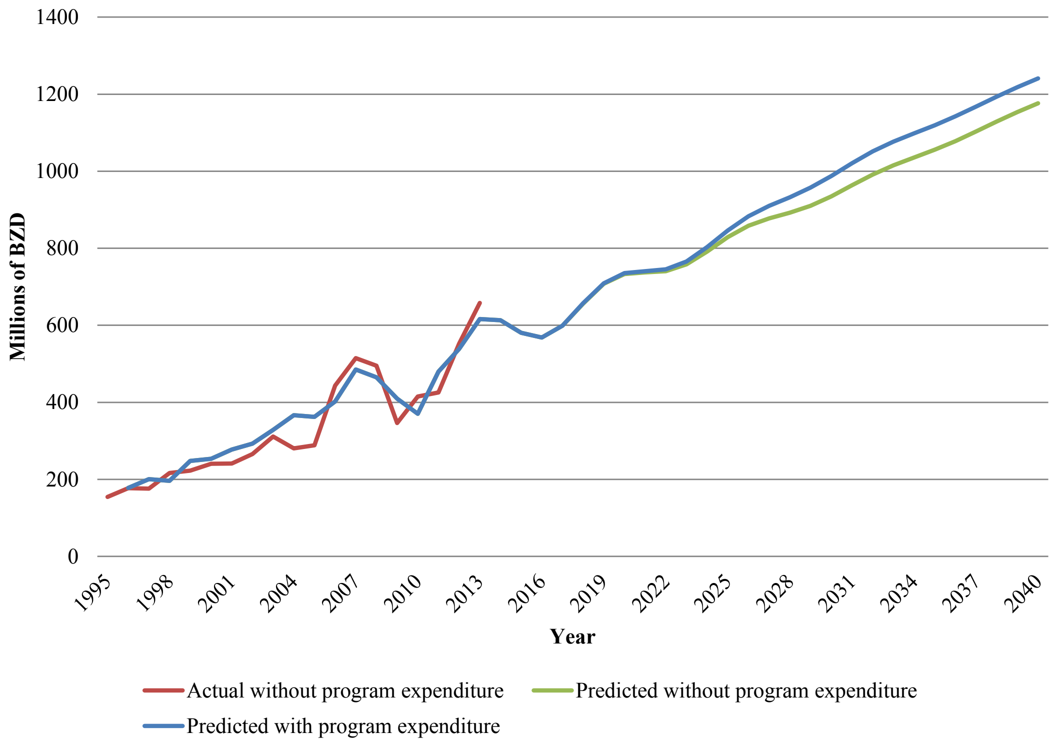
Figure 4. Logistical function distribution of *with program* additional expenditure.



Source: Authors' own elaboration.

Figure 5 presents with and *without program* forecasted tourist expenditure. In year 2040, the difference between the predicted with and *without program* tourist expenditure is equal to BZ$64,838,194.

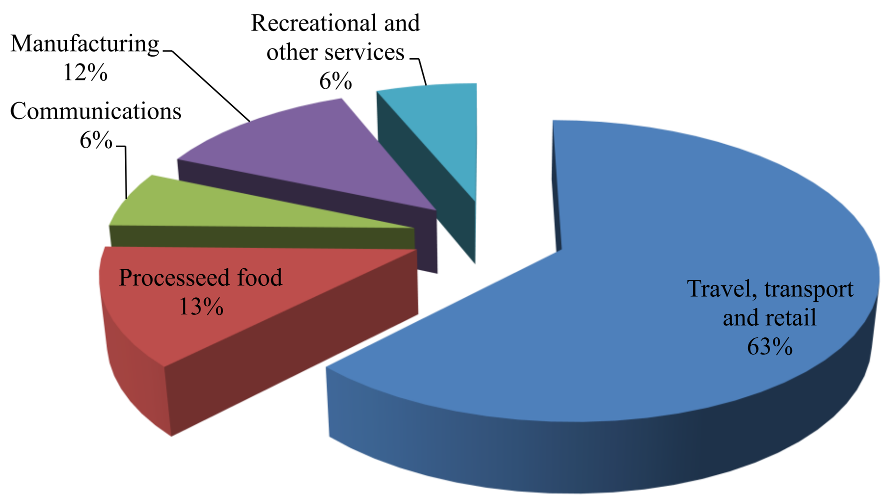
Figure 5. Actual tourist expenditure, and; predicted without and *with program* tourist expenditure.



Source: Authors' own elaboration.

In addition to the temporal distribution of the additional expenditure, it is also necessary to know the approximate distribution of this BZ$64.8 million across commodities in the SAM. The composition of tourism expenditure was derived from the tourist exit surveys which was further validated through verification with the only other earlier reliable source on tourist expenditure patterns released by the Central Bank in 1992 (Lindberg & Enriquez, 1994; Morgan & Campbell, 1992). The resulting composition of tourism expenditure at the national level was estimated as 40% accommodations, 26% food and beverage, 25% gifts and other purchases, and 10% transportation. Across SAM accounts, this expenditure is allocated as in Figure 6.

Figure 6. Additional *with program* tourist expenditure across SAM accounts.



Source: Authors' own elaboration.

4.0 Costs and Break-Even Demand

4.1. Investment Structure and Sequencing

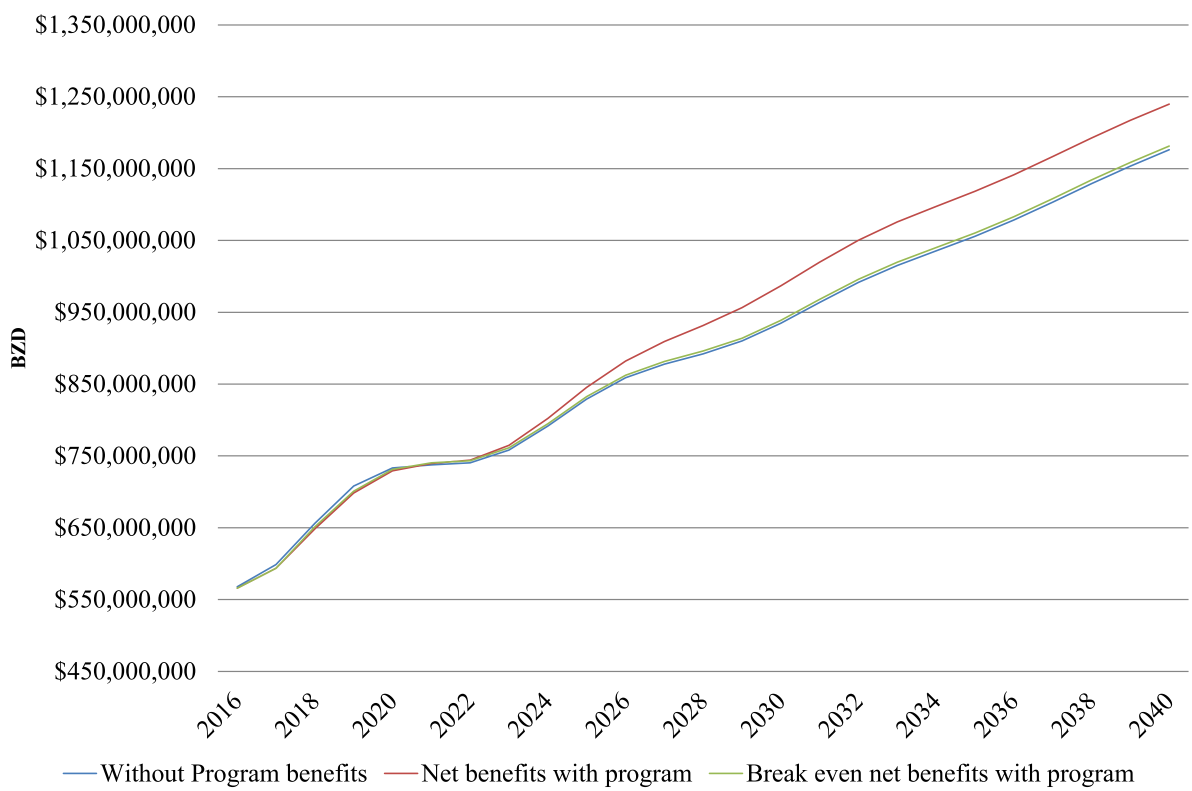
The total STP II investment is BZ$30 million, BZ$21 million of which is destined for investment in infrastructure. According to the loan proposal, disbursements are to begin gradually in 2016 with the last disbursement in 2020. The disbursement schedule is 6.67% in the first year, 16.67% in the second year, 26.67% in the third year, 33.33% in the fourth year and 16.67% in the final year. Operations and maintenance costs are estimated as 5% of the cost of the infrastructure investment on an annual basis for the entire period of analysis.

Details of the specific investment components may be found in the Pluri-annual Execution and Procurement Plan for the program (Lemay et al., 2015). In summary, in terms of infrastructure, the program will invest in the restoration and enhancement of archeological, cultural and natural attractions, basic infrastructure, and key services to create an enabling environment for private investment. In addition to infrastructure, other program components will finance the development of management and other plans such as a disaster and climate resilience plan, protected areas management plans, and various feasibility studies. Finally, the program will invest in institutional strengthening, capacity building and improving tourism-sector data systems.

4.2. Break-even Demand

An optimization routine was programmed in MS Excel to estimate the minimum increase in tourism demand required for the STP II to be economically viable. This optimization routine solves for a scaling factor which is multiplied with the *without program* benefits. The optimization routine identifies the scaling factor for which the net present value (NPV) of the difference between the scaled benefits net of the program investment costs and the net *with program* benefits is equal to zero using a discount rate of 12%.

Figure 7. Break-even analysis; *without program*, net *with program* and break-even net *with program* benefits.



Source: Authors' own elaboration.

Based on the optimization routine, it was calculated that the minimum increase in tourism expenditure for the program to be economically viable was significantly lower than the expected increase in tourism demand estimated in section III. To put this into perspective, in year 2040, the difference in *without program* benefits and break even *with program* benefits is BZ$6.3 million, whereas the difference in the *without program* benefits and net *with program* benefits estimated based on tourism demand projections is equal to BZ$63.8 million. The proximity of the break-even net benefits *with program* graphed line in Figure 7 and the *without program* benefits line is illustrative of this.

4.3. Preliminary Cost-benefit Analysis

Based on the analysis and projections developed thus far, it is possible to conduct a cost-benefit analysis of the program using only the estimates of direct benefits and costs. If time or resources were not available for a DCGE to be developed, this preliminary analysis would provide an indication of the net returns to the investment. Using the IDB's discount rate of 12%, the NPV of the investment was estimated at BZ$100.156 million with an internal rate of return (IRR) of 31%. Thus, assuming resources are in abundant supply (no labor, capital or other factor constraints), the program is likely to do much better than just break-even.

5.0 Estimating Economic Returns

5.1. CGE Scenario Design

This section presents the simulations and analyzes the results from the DCGE model. The following five scenarios were conducted: (a) the baseline scenario, which is the *without program* scenario; (b) a government investment in tourism infrastructure, institutional strengthening, capacity building and baseline studies; (c) an increase in foreign overnight leisure tourism expenditure; (d) scenarios *(b)* and *(c)* implemented jointly, and; (e) a break-even scenario which uses the minimum increase in tourism expenditure required for the program to be economically viable at a 12% discount rate. Details of each scenario follow:

Baseline scenario: this first simulation assumes that average past trends will continue from FY 2011 to FY 2040. In the absence of better projections, it is assumed that Belize is on a balanced growth path, which means that real variables (i.e. volume) grow at the same rate while relative prices do not change. The non-base simulations that follow only deviate from the base beginning in FY 2016 to FY 2040; 2016 is the first year of STP II loan disbursements, while benefits begin to accrue beginning in 2018.

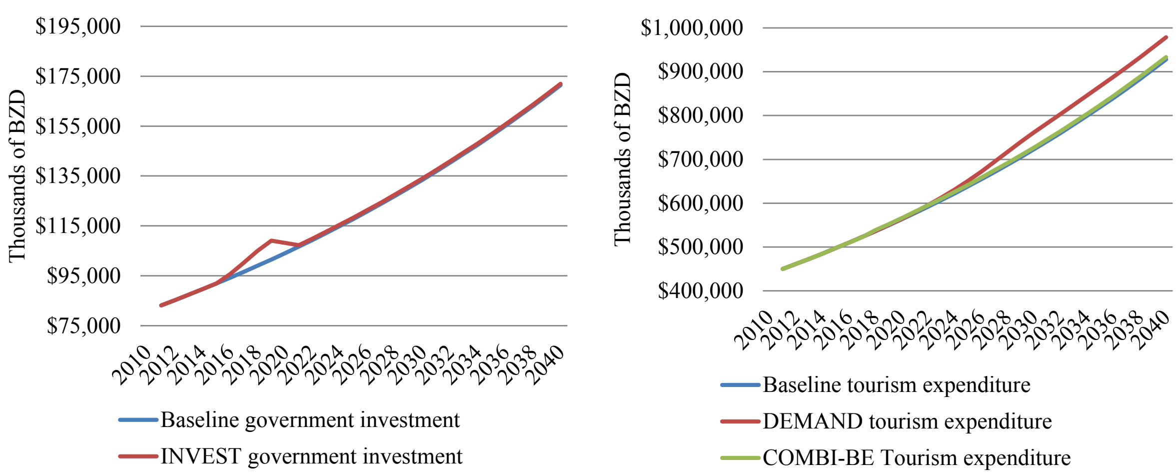
Invest scenario: this simulation imposes increased government investment in tourism infrastructure, institutional strengthening, capacity building and baseline studies financed with the IDB loan. Details of the structure and sequencing of the investment were provided in section 4.1 of this paper. Figure 8 shows how this investment is distributed with respect to the baseline.

Demand scenario: in this simulation, foreign leisure tourist overnight arrivals and expenditure increase. This scenario is based on the *with program* demand projections developed in section 3.2 of this paper. It is assumed that this increase in demand begins in 2018 and is distributed according to a logistical function, reaching 100% of the increase in demand in the final year of the period of analysis (Figure 8).

Combi scenario: this scenario models the invest and demand scenarios combined.

Combi-BE scenario: this scenario is similar to the previous scenario, but uses the estimated minimum increase in foreign overnight leisure tourism demand required for the program to break even at a 12% discount rate (Figure 8).

Figure 8. Definition of scenarios invest and demand (% deviation from base).



Source: Authors' own elaboration.

At the macro level, a DCGE model requires the specification of the equilibrating mechanism for three macroeconomic balances. For the non-base scenarios: (a) the government fiscal account is balanced via adjustments in transfers to and from the rest of the world; (b) private investment in Belize follows an exogenously imposed path, and; (c) the real exchange rate equilibrates inflows and outflows of foreign exchange by influencing export and import quantities. The non-trade-related payments of the balance of payments (transfers and foreign investment) are non-clearing and follow exogenously imposed paths.

The base year of the model is FY 2011. For the base scenario, which serves as a benchmark for comparisons, an average growth of 2.5 percent is imposed, based on projections from the 2015 IMF World Economic Outlook (IMF, 2015b). In addition, due to the assumption of a balanced growth path, the following assumptions are also imposed: (a) macro aggregates are kept fixed as a share of regional GDP at base year values; (b) transfers to and from the government and the rest of the world to households are also kept fixed as a fixed share of GDP; and (c) tax rates are fixed over time.

5.2. Model Results

5.2.1. Aggregate Results

Figure 9 shows that as a result of the investment shock (INVEST), there is a small spike in private consumption during the 5 year disbursement period. Private consumption then returns to close to baseline levels, though growing slightly more quickly. The DEMAND scenario shows the gradual increase in tourism demand while the COMBI and COMBI-BE both show the initial spike in consumption due to the investment shock and the subsequent demand response which increases gradually after 2018, and at a faster rate sometime after 2028. This figure also shows a significant difference in private consumption between the COMBI and the breakeven COMBI scenarios. Figure 10 shows similar trends for gross domestic product.

Figure 9. Change in real private consumption 2016-2040.

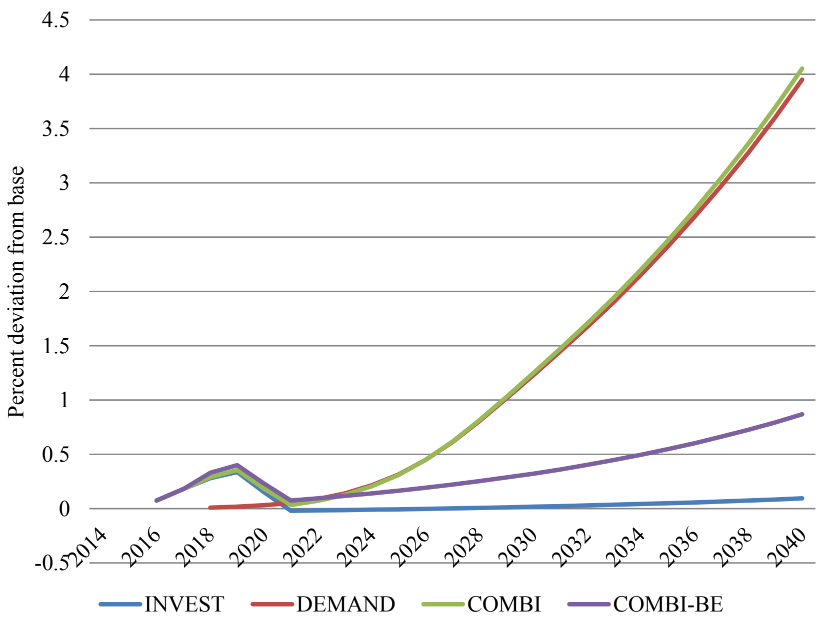
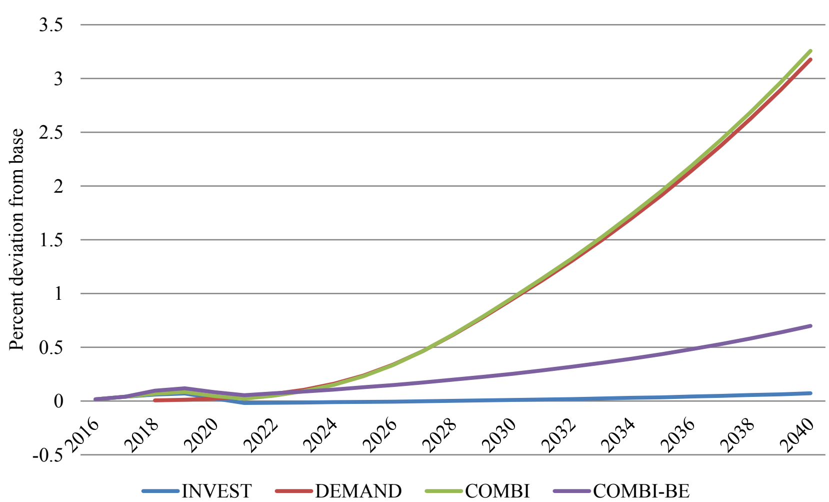


Figure 10. Change in real gross domestic product 2016-2040.



Source: Authors' own elaboration.

11 shows how macro indicators respond to the various shocks. Considering the INVEST scenario, following the spike in government investment due to the program investment, investment begins to return to close to baseline levels by 2025 and even closer by 2040. Private

investment grows slightly slower by 2025 due to a small crowding out effect resulting from the large government investment, however, it recovers shortly afterwards. To some extent, this response changes when labor and capital are in greater supply. In other words, if wage increases are constrained and extra labor used would otherwise have been unemployed, these types of crowding out effects may be less substantial.

Stimulated by the enabling environment, private investment begins to grow more quickly and reaches 0.13% by 2040. Considering the demand shock, while there is a small contraction in exports by 2025, exports fully recover and grow more quickly (2.42%) by 2040. The large demand shock also has a large impact on all other indicators, especially private investment growing over 10% above the baseline by 2040. Private consumption is also stimulated and the unemployment rate drops from 12% to 10.32% by 2040.

Table 11. Change in real macro indicators (percent deviation from base).

	BASE '000 BZD	INVEST		DEMAND		COMBI		COMBI-BE	
	2011	2025	2040	2025	2040	2025	2040	2025	2040
Absorption	$ 2,899,408	0.01	0.09	0.59	4.13	0.61	4.23	0.24	0.81
Private consumption	$ 1,730,687	-0.01	0.09	0.32	3.95	0.31	4.05	0.17	0.87
Private investment	$ 249,376	-0.18	0.13	1.15	10.81	0.97	10.95	0.34	2.16
Government investment	$ 83,125	0.46	0.31	0.00	0.00	0.46	0.31	0.46	0.31
Exports	$ 1,853,720	-0.04	0.06	-0.16	2.42	-0.21	2.48	0.00	0.65
Imports	$ 1,774,626	-0.01	0.08	0.40	3.94	0.39	4.03	0.17	0.83
Foreign tourism demand	$ 449,974	0.03	0.02	1.96	5.44	2.00	5.46	0.55	0.58
GDP	$ 2,978,502	-0.01	0.07	0.24	3.18	0.23	3.26	0.13	0.70
Real exchange rate	1	0.02	0.01	-0.28	-0.41	-0.26	-0.40	-0.04	0.00
Unemployment rate	12	11.99	11.95	11.81	10.32	11.80	10.26	11.91	11.62

Source: Authors' own elaboration.

Considering the COMBI shock, all indicators are positive by 2025 except again for exports which is a result of the large increase in domestic demand due to both the investment and tourism demand shock. The increase in foreign tourism demand in this scenario is also slightly greater than when the demand shock is imposed alone. The impact on GDP is the greatest in this scenario, as would be expected from the joint impact of the public investment and concomitant increase in foreign tourism demand. By 2040, GDP is 3.26% greater than in the baseline. The employment generating impact of this scenario is also the greatest among scenarios, with unemployment falling to 10.26% by 2040.

Finally, the COMBI-BE shock represents the economic impact that would result from tourism demand expanding just enough to cover the direct and indirect costs of the public investment. Results for this scenario show that even in this somewhat pessimistic scenario, the public investment results in positive indirect and inducted effects as exhibited through the increase in GDP, 0.70% above the baseline in 2040. Exports and (0.65%) private investment (2.16%) also grow faster while unemployment falls to 11.62% by 2040.

5.2.2. Sectoral Results

12 shows impacts on value added. Considering the INVEST scenario, impacts in the early years are slightly negative for those sectors not receiving program investment which represents a reallocation of resources to those sectors most closely linked to the investment such as travel, transport and retail, as well as business and recreational services. There is a slight decline in export value-added of the larger exporting sectors due to the increase in domestic demand for goods and services. By 2040, export value added for almost all sectors is positive.

Table 12. Change in sectoral real value added, exports, and imports (percent deviation from base).

Commodity	BASE '000 BZD	NVEST		DEMAND		COMBI		COMBI-BE	
	2011	2025	2040	2025	2040	2025	2040	2025	2040
Value Added									
Agriculture, forestry and fishing	$ 334,265	-0.09	0.02	-0.03	1.33	-0.11	1.35	-0.05	0.33
Processed food	$ 197,078	-0.15	0.01	0.09	3.47	-0.06	3.48	-0.03	0.74
Manufacturing	$ 200,301	-0.02	0.09	-0.08	3.58	-0.11	3.67	0.06	0.91
Communications	$ 89,792	-0.02	0.15	0.68	6.87	0.66	7.03	0.30	1.46
Travel, transport and retail	$ 902,883	0.03	0.08	0.41	3.62	0.44	3.71	0.21	0.75
Communications	$ 64,987	-0.06	0.07	0.28	5.18	0.22	5.26	0.15	1.04
Business services	$ 319,053	0.13	0.19	0.02	3.48	0.15	3.69	0.23	0.97
Recreational services	$ 43,754	0.01	0.05	0.76	4.03	0.78	4.09	0.27	0.68
Government services	$ 393,937	-0.03	0.01	-0.02	0.97	-0.05	0.97	-0.01	0.23
Export value added									
Agriculture, forestry and fishing	$ 496,483	-0.09	0.00	-0.14	0.26	-0.23	0.26	-0.11	0.12
Processed food	$ 294,489	-0.21	-0.03	-0.12	3.24	-0.33	3.22	-0.14	0.72
Manufacturing	$ 593,902	-0.03	0.09	-0.27	3.36	-0.29	3.46	0.02	0.93
Import value added									
Processed food	$ 253,640	-0.01	0.08	0.51	3.92	0.50	4.00	0.20	0.78
Manufacturing	$ 1,219,886	-0.02	0.09	0.36	4.10	0.34	4.19	0.17	0.88
Business services	$ 132,200	0.09	0.14	0.33	3.42	0.41	3.57	0.24	0.79

Source: Authors' own elaboration.

In the DEMAND scenario, there is a positive impact on those sectors producing goods and services most highly demanded by tourists. Imports are also stimulated while exports contract early on. All indicators are positive soon after 2025, again with the largest positive impacts experienced by those sectors servicing the tourism and related sectors. With greater foreign exchange earnings, imports of key sectors also rise by 2025 and to a greater extent by 2040.

Considering the COMBI scenario, while there is some reallocation of resources toward tourism-related sectors in the early years, with some levels of non-tourism related activities declining slightly, the activities of these sectors increase shortly after 2025 and by 2040, all sectors are growing more quickly than in the baseline with exports and import value added for key trading sectors also growing more quickly than in the baseline. The COMBI-BE scenario generates results similar to those of COMBI, though percent deviations are generally less pronounced, as would be expected. Certainly, the key mechanisms which determine the size of the economic impacts across sectors resulting from increased tourism demand include: factor supply constraints, exchange rate appreciation, and current government economic policy (Banerjee et al., 2015b; Dwyer, Forsyth, Madden, & Spurr, 2000).

5.3. Cost-Benefit Analysis

The results of the COMBI scenario represent the direct, indirect and induced economic impacts of government investment in STP II combined with an increase in inbound overnight leisure tourism demand, given the model assumptions. Thus, given that the project cost is part of the simulations, the cost-benefit analysis can be conducted by simply analyzing the DCGE results for the indicator of interest, which in this national model is GDP. In other words, the simulated impacts using the DCGE model provide the benefit and cost estimates for this calculation. Notice, however, that conventional cost-benefit accounting does not capture all of the indirect and induced benefits captured by simulations using DCGE models.

Using model results and nomenclature to calculate NPV, equation 5 is first solved:

$$INVNETINC_{(sim,t)} = SIMGDP_{(sim,t)} - BASEGDP_{(sim,t)} - \sum RGFCBAR2SIM_{(\text{"inv", inv,t})} - \sum QGBAR2SIM_{(\text{"inv",c,t})} \qquad \text{(eqn' 5)}$$

Equation 5 uses model variables for calculating the net returns from each simulation, where:

- Sim is a set of model simulations which include the investment (INVEST, COMBI, COMBI-BE);
- T is the time period from t = 0 to t = 24;
- INVNETINC is the net return ;
- SIMGDP is simulated GDP estimated by the DCGE model;
- BASEGDP is the base forecast GDP estimated by the DCGE model;
- RGFCBAR2SIM is the government capital investment in STP II, and;
- QGBAR2SIM is the component of the STP II government investment allocated to the purchase of goods and services.

The series of results arising from equation 5 are then used in equation 6 to calculate NPV.

Analytically:

$$NPV = \sum_{t=0}^{24} \frac{Y_t - Y_t^0}{(1+r)^t} \qquad \text{(eqn' 6)}$$

Where:

NPV = net present value;

$t = 0$ is 2016;

$t = 24$ is 2040;

Y_t = indicator of interest (GDP in this case) in year t;

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

r = discount rate (12%).

Table 13 shows that NPV is the highest in the COMBI scenario, reaching BZ$127.88 million; for the DEMAND scenario, the NPV is slightly less at BZ$121.222. The COMBI-BE scenario shows that there is considerable room for tourism demand to respond in a manner below expectations, with the COMBI-BE NPV equal to BZ$23.4 million. The internal rates of return for each of the three scenarios are all reasonably high, from 21% in COMBI-BE to 31% in the COMBI scenario.

Table 13. Net Present Value (NPV) and Internal Rate of Return (IRR), BZD.

Scenario	NPV	IRR
DEMAND	$ 121,221,552	28%
COMBI	$ 127,884,159	31%
COMBI-BE	$ 23,436,288	21%

Source: Authors' own elaboration.

While it may seem curious that the breakeven NPV is greater than zero, this is due to the fact that the break-even minimum increase in tourism demand was calculated outside the model. This is a reflection of the strength of the DCGE analytical framework, which enables estimation of second and third round benefit streams in the form of indirect and induced benefits.

6.0. Concluding Remarks

Ex-ante economic impact assessments are required to demonstrate development impacts and economic feasibility of multilateral development bank loans and grants. These assessments are often undertaken under tight timelines and in data poor environments. This paper develops an approach to ex-ante economic analyses, innovating on previous quantitative assessment frameworks by: (i) developing a generalizable approach to building DCGE models for development policy analysis in data poor environments; (ii) generating realistic expectations of agent behavioral responses to development interventions to calibrate model simulations with ARIMA and quasi-contingent valuation methods. Applied to the analysis of Belize's STP II, results show that the investment will have positive impacts on Belize's economy by stimulating GDP to grow 3% more by 2040 compared to the *without program* baseline, and reducing unemployment from 12% to 10%. Cross validating with a break-even scenario shows that even if the actual increase in tourism demand were considerably less than the *with program* forecast, the Government of Belize would still recover all costs of investment.

The model developed here is considered a starting point for future analysis of development and policy interventions in Belize. As data improves, the model's representation of Belize's economy may also be improved. Having an I-O table for the country of interest would be a significant improvement in providing a more precise representation of the country's technologies of production. Other marginal improvements are also possible, for example, with more accurate and disaggregated national accounts data, the SAM could be constructed relying less on the GTAP database and more on data reported by the country. Finally, government accounts and balance of payments data, at a disaggregated level, would enable a much better representation of Belize's taxation system as well as its transactions with the rest of the world in the form of trade and investment.

The approach developed in this paper may be applied to the ex-ante economic analysis of other sectoral development interventions ranging from agricultural policy to fiscal policy, from integration and trade, to health and education. Where development interventions are anticipated to have strong inter-sectoral impacts, and indirect and induced benefits are important, the DCGE analytical approach is a powerful one. In the case where the country of interest lacks I-O tables and is relatively data poor, the approach to DCGE model construction introduced here offers a solution.

For ex-ante economic analysis, a baseline is required which forms the reference scenario to which all development intervention scenarios are compared. Lack of data often limits the prediction power and robustness of multiple regression models that are often used to estimate a baseline. ARIMA methods offer a strategy to overcome this limitation if it is reasonable to expect historical trends to continue in the future.

Finally, expected agent response to development interventions is a critical input to model calibration. As in the case of estimating a baseline, data limitations are a significant obstacle to the development of a reliable model. The quasi-contingent valuation approach developed in this paper has proven to be an effective method for eliciting behavioral responses to development interventions, with a limited amount of primary data collection. Together, the DCGE, ARIMA and quasi-contingent valuation approach to development intervention analysis overcomes many of the data limitations found in developing countries and can help bring countries closer to the goal of evidence-based policy and decision making.

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