Annals of Tourism Research 60 (2016) 115–138

Contents lists available at ScienceDirect

Annals of Tourism Research

journal homepage: www.elsevier.com/locate/atoures

Economics of tourism investment in data scarce countries

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ARTICLE INFO

Article history:
Received 9 November 2015
Revised 10 June 2016
Accepted 24 June 2016
Available online 25 July 2016

Coordinating Editor: J. Tribe

Keywords:
Ex-ante economic impact analysis
Tourism development
Economy-wide model
Computable general equilibrium
Auto-regressive integrated moving average
Stated preference

ABSTRACT

Ex-ante economic impact analyses are required to demonstrate the development impact and viability of multilateral loans. These assessments are often performed under tight timelines, in data scarce environments and with limited opportunity for primary data collection. This paper develops a framework for assessing tourism interventions under these challenging conditions and evaluates a US$15 million tourism investment in Belize. This paper contributes to the literature by: (i) developing a generalizable approach to building economy-wide models in data scarce environments; (ii) generating realistic expectations of agent responses with quasi-contingent valuation and auto-regressive integrated moving average methods. Applying the first economy-wide model for Belize, results show that the investment would stimulate GDP by 3% and reduce unemployment from 12% to 10% by 2040.

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 and economic viability of the investment. These 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 intensive assessments are

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http://dx.doi.org/10.1016/j.annals.2016.06.001

undertaken in the data scarce environments characteristic of many developing countries. This paper develops a framework for assessing development interventions in data scarce environments and illustrates its application to Belize's Sustainable Tourism Program (STP II). STP II is a US$15 million loan from the Inter-American Development Bank (IDB) to the Government of Belize 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, Cicowiez, and Gachot (2015a, 2015b), this paper contributes to the literature in two important ways: (i) the paper develops a generalizable approach to building dynamic computable general equilibrium (DCGE) models for development impact and policy analysis in data scarce 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 (ARIMA) methods were used. To estimate agent response to the intervention, a survey-based quasi-contingent valuation approach was developed and implemented. These projections and information on investment structuring and costs were used to calibrate the model shocks. In addition to the methodological contributions, this paper develops the first social accounting matrix and DCGE for Belize which will facilitate future development impact and policy analysis for generating evidence-based advice for the country.

Approved in October 2015, the goal of STP II is to increase the tourism sector's contribution to socioeconomic development while maintaining and enhancing natural and cultural capital (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 income 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 (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, capacity building and education. Given the strong inter-related nature of the tourism sector and other sectors, tourism interventions generate significant spillovers (Banerjee et al., 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 and their use in development impact and policy analysis are data-intense, which in the case of data scarce Belize, presents the core challenge addressed by this paper. This paper is structured as follows: section two presents the basic structure of a DCGE model and the approach to constructing its underlying database, the SAM. Next, the approach to estimating tourism demand with auto-regressive integrated moving average (ARIMA) methods is described followed by the estimation of *with program* tourism demand through a quasi-contingent valuation experiment. The Section "Costs and break-even demand" presents the investment structuring and the estimation of break-even demand, and a preliminary cost-benefit analysis considering only direct benefits and costs. The Section "Estimating economic returns" describes the calibration of the model shocks, results and analysis. The final section discusses the methodological frontier of ex-ante economic analyses of development impact and policy analysis.

Methodology: A national dynamic computable general equilibrium model for Belize

The model

This study develops a DCGE model for Belize to evaluate the economic impact of STP II.[1] 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 modelling framework 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.

Following the description in Banerjee et al. (2015a). Fig. 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 represent industries that use goods and services as inputs and through productive processes, produce other goods and services. Final demanders of goods and services are households and governments, export markets and foreign tourists. Activities use and make payments to factors of production (labor, capital, land, natural resources). Income earned by these factors is transferred to households in the form of wages, capital rents and natural resource rents. Households also receive transfers from the government and transfers from the rest of the country or world, which arise from migrant labor, remittances, government subsidies, gifts, etc. With their income, households pay taxes, consume and save.

A DCGE model mathematically describes the optimizing behavior of producers, households, government and other institutions and is represented by a system of equations. Agent behavior is represented by linear and non-linear first order optimality conditions. Equilibrium conditions and constraints are imposed on the system by the macroeconomic environment. This economic environment is described as a series of equilibrium constraints for factors, commodities, savings and investment, the government, and rest of the world accounts (Lofgren et al., 2002).

Belize's data deficit

Belize is one of the more data scarce 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 highly aggregated, particularly with regard to sectoral detail for activities, expenditure and taxation.

Routine data collection in Belize includes its Labor Force Survey, the Visitor Expenditure and Motivation Survey, the Population and Housing Census, and the Multiple Indicator Cluster Survey. Belize lacks agricultural survey data, while government account, taxation and transfer data are highly aggregated. Supply and use tables are not available for Belize which poses a significant challenge for the construction of a DCGE.

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 SAM which is a comprehensive, economy-wide statistical representation of an economy for a reference 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.

[1] A detailed description of the general DCGE modelling framework and a manual for its calibration and operation may be found in the IDB Working Paper (Banerjee et al., 2015a). To understand in depth the mechanics of CGE models, their microeconomic and macroeconomic foundations and the type of information they generate, please see: (Dixon, Parmenter, Powell, & Wilcoxen, 1992; Shoven & Whalley, 1992; Lofgren, Harris, Robinson, Thomas, & El-Said, 2002; Burfisher, 2011; Dixon & Jorgenson, 2013).

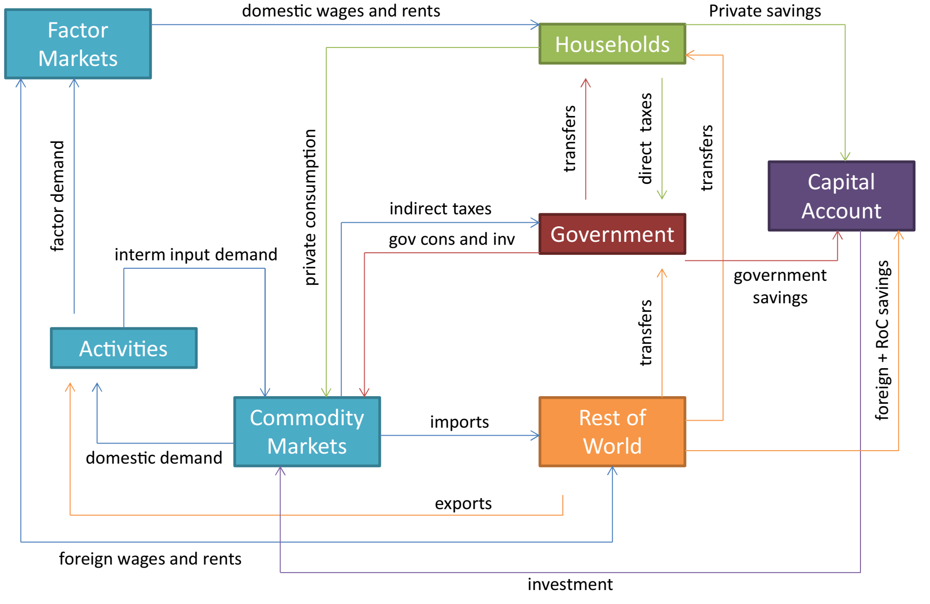

Fig. 1. Circular flow of income in the DCGE. Source: Authors' own elaboration.

The primary input into the development of a SAM is the supply and use or I-O table, which is constructed based on a supply and use table. An I-O table provides information on the inputs used in the production processes of economic activities, 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, this paper builds 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 construct an aggregate SAM or MACROSAM. A stylized MACROSAM is presented in Table 1.

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.

Full national accounts including supply and use tables and integrated economic accounts provide sufficient information to construct a MACROSAM. In the case of Belize and of other countries with limited 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.

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

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.

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*	7a. Labor income transfer to domestic households. *Integrated economic accounts*	14a. Government transfer to households (social security, etc.). *Integrated economic accounts*
2b. Value added, capital. *Use table*	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*	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* 5c. Taxes on imports. *Supply table*	10. Household income tax. *Integrated economic accounts*	17. Transfers to government from abroad (foreign aid, etc.). *Integrated economic accounts*
	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.

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.* 18c. Changes in stocks
	12. Household transfers abroad. *Balance of payments*	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.

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.

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 GTAP. 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 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). In development of the GTAP database, Belize was associated with the I-O structure of Ecuador. In 2011, 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 other economic activities. 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

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.

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.

representing the proportions of inputs that are used in productive processes. Therefore, in borrowing I-O coefficients from Ecuador, magnitudes are not important, only the proportions are.

With a MACROSAM for Belize constructed, economic activities were then disaggregated based on Belize's national accounts (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. In finalizing the SAM, it was re-balanced using cross-entropy methods (Robinson, Cattaneo, & El-Said, 2001; Robinson & El-Said, 2000). Table 4 shows the disaggregated SAM accounts.[2]

A snapshot of Belize from the SAM in the base year of 2011

According to the SAM, Belize's 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 directly contributed to almost 10% of GDP.

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. Manufacturing was responsible for 20.9% of total economic output and contributed

[2] 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.

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%. 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.

Model calibration and closure rules

The DCGE model is primarily calibrated based on data contained in the SAM. In addition, since the model is dynamic, assumptions need to be made with regard to future growth and as such the DCGE is calibrated under the assumption that the economy is on a path of balanced (GDP) growth in the baseline. A growth rate is therefore specified and applied to all model quantities with relative prices remaining unchanged. In the simulations however, the growth rate is always endogenous. Projections of economic growth were derived from the IMF's World Economic Outlook (IMF, 2015b) and the rate of 2.5% was used.

With the assumption of balanced growth, 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. Population growth projections also required for calibration were drawn from the United Nations Projections (UN, 2015b) using the medium variant.

Finally, depreciation rates for private and public capital and various elasticities are used to calibrate the model. These elasticities include those used in the functional forms describing production, trade, consumption, and in the wage/rental rate curve. The best available estimates of these parameters were obtained from 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.

At the macro level, a DCGE model requires the specification of the equilibrating mechanism or closure rules for three macroeconomic balances. In the DCGE model simulations: (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.

Benefits: forecasting foreign tourism demand

Foreign overnight tourist arrivals and expenditure without Program

Tourist arrivals and expenditure projections *with* and *without* the STP II investment are required to calibrate the DCGE model shocks. 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 (1998–2014) 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 forecasting. An ARIMA model is an auto regression model where the variable of interest is forecast using a linear combination of the past values of that variable (i.e., 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 and 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 were 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 undertaken, 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:

$$y't = c + \phi_1 y_{t-1} + \ldots + \phi_p y_{t-p} + \theta_1 e_{t-1} + \ldots + \theta_q e_{t-q} + e_t \tag{1}$$

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 $d \geqslant 1$ 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).

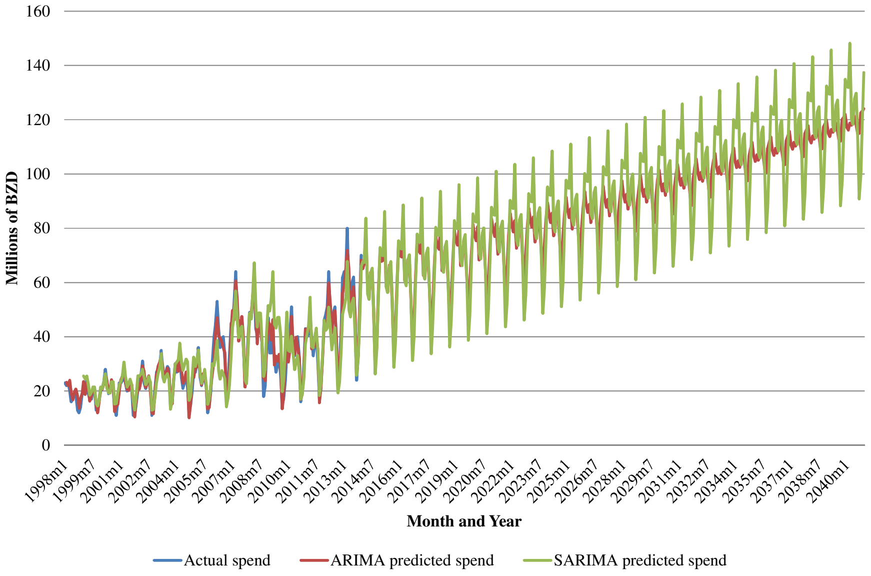

Fig. 2. Actual and predicted tourist expenditure for Belize. Source: Authors' own elaboration.

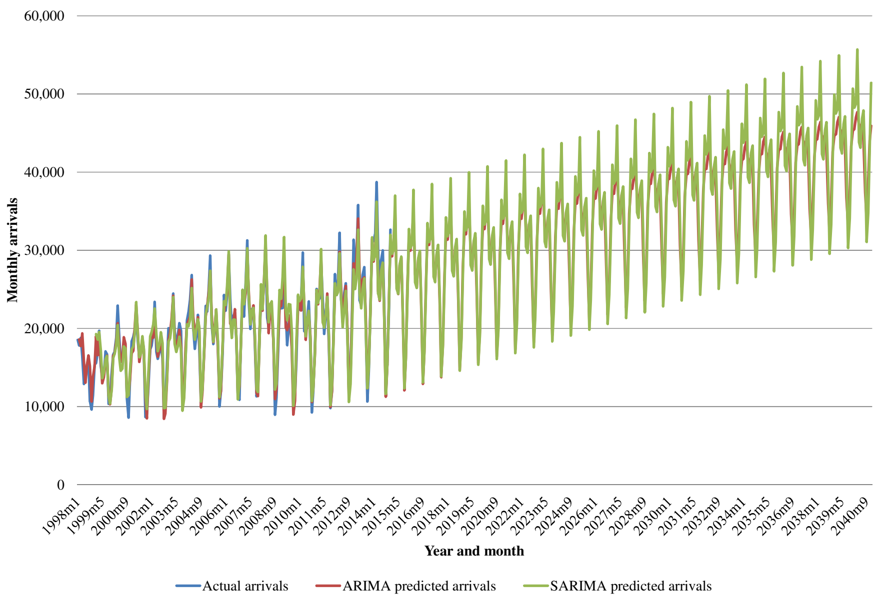

Fig. 3. Actual and predicted foreign overnight tourist arrivals for Belize. Source: Authors' own elaboration.

Fig. 2 shows the actual and predicted tourist expenditure for Belize; in this chart, both an ARIMA and a Seasonal ARIMA (SARIMA) 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.

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

Foreign overnight tourist arrivals and expenditure with program

While the previous section generated a forecast of tourist arrival and expenditure *without program*, to calibrate model shocks, expectations on *with program* arrivals and expenditure are generated. Most previous exante impact analysis of tourism inventions have simply assumed a *with program* projected tourism growth path (e.g. 10% or 20% increase). We have found this to be unsatisfactory for substantiating large investments in development interventions such as STP II. In this paper, we use our ARIMA forecasts as a basis for our *with program* forecast supplemented by a quasi-contingent valuation estimation. Tourist exit surveys were undertaken between April and May 2015, completing 1011 surveys of international tourists 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.[3]

The sample of 1011 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 survey assessed motivation for visiting the destination; activities undertaken; 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.

In a quasi-contingent valuation question, respondents were then 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 they would they be willing to spend, in addition to their current trip expenditure. In this stated preference approach, we assume 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.[4] This is a realistic assumption since the survey was prepared to inform STP II's destination-specific interventions.

For those tourists that had not visited the destination, they were asked if certain types of opportunities and 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 then asked the quasi-contingent valuation question of how much they would be willing to spend on a future visit.

Considering first those tourists who visited the destination, across all four destinations, 90% of respondents said they would return to the destination on a future trip to Belize (Table 7). Based on general improvements and increased tourism opportunities proposed under STP II, tourists reported they would spend on average across the four sites, USD $141 per day and USD $1217 per trip.

Among respondents who did not visit the destination, when asked if they would be interested in visiting the destinations 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 8). 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 our 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.

[3] 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.

[4] 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
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 (BZD) per trip if you visit this site in the future?	$993	155	$1571	137	$932	52	$1373	44	$1217	388
How much would you be willing to spend (BZD) 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 at 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.

Table 8
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 be willing to visit this site on your next trip to Belize?	86%	123	75%	134	64%	149	67%	162	73%	568
How much would you be willing to spend (BZD) per trip if you visit this site in the future?	$666	114	$404	118	$646	140	$502	143	$554	515
How much would you be willing to spend (BZD) per day if you visit this site in the future?	$230	119	$291	122	$314	140	$269	143	$276	524
Estimated number of days willing to spend at site.	2.9	n/a	1.4	n/a	2.1	n/a	1.9	n/a	2.0	n/a

Source: Authors' own elaboration.

Once the *with program* expenditure was generated, it was scaled up to the visitor population. In the case of those that had visited the destination, the total additional expenditure across all destinations was calculated as in Eq. (2):

$$\mathrm{TAE_a} = \sum_{n=1}^{4}(\mathrm{RR}_n \cdot \mathrm{PV}_n \cdot \mathrm{WR}_n \cdot \mathrm{AS}_n \cdot \mathrm{AV}) \tag{2}$$

where:

- $\mathrm{TAE_a}$ 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, their willingness to spend on a subsequent trip was calculated slightly differently as in Eq. (3).

$$\mathrm{TAE_b} = \sum_{n=1}^{4}(\mathrm{VRR}_d \cdot (1 - \mathrm{PV}_d) \cdot \mathrm{WR}_d \cdot \mathrm{AS}_d \cdot \mathrm{YS} \cdot AV) \tag{3}$$

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 Belize Tourism Board'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.

The sum of $TAE_a + TAE_b$ is the estimated total additional *with program* expenditure. Table 9 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 critical input into the calibration of the DCGE model shock for estimation of indirect and induced benefits, as well as for the cost-benefit analysis.

Given that the 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, it was assumed that benefits were distributed according to a logistical. 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.

Fig. 4 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.

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

Table 9
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)	$1965	$3110	$1846	$2718	
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%	75%	96%	96%	
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)	$1319	$800	$1279	$993	
Total additional spend (TAE_b)	$2,840,060	$1,524,849	$2,660,152	$2,189,455	$9,214,516
TAE_a plus TAE_b	$2,19,25,749	$3,23,80,269	$50,79,539	$54,52,637	$6,48,38,194

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

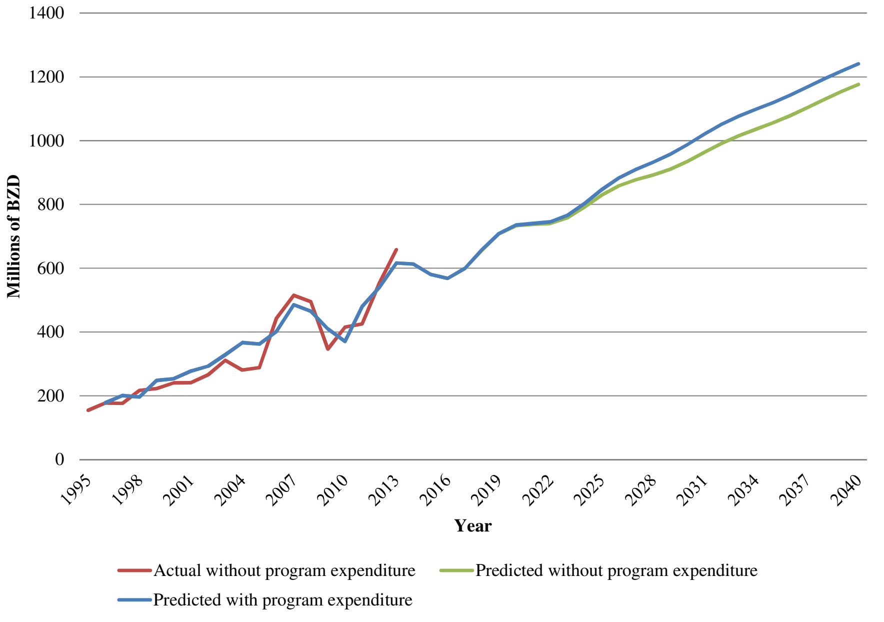

Fig. 4. Actual tourist expenditure, and; predicted without and *with program* tourist expenditure. Source: Authors' own elaboration.

described in Table 4, this expenditure is allocated as follows: 63% in travel, transport and retail; 13% in processed food; 12% in manufacturing; 6% in communications, and; 6% in recreational and other related services.

Costs and break-even demand

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 STP II's design, 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 STP II's Pluri-annual Execution and Procurement Plan (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.

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. The optimization solves for the scaling

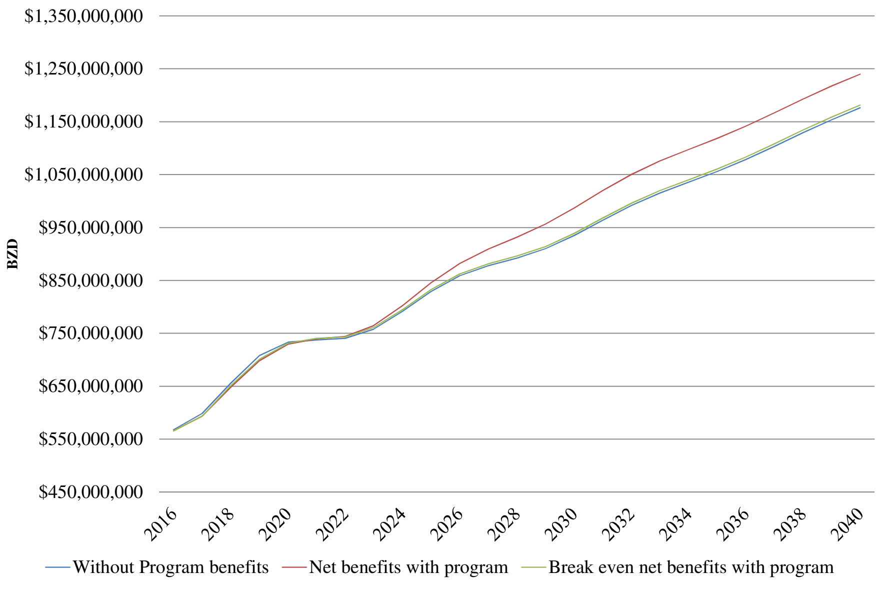

Fig. 5. Break-even analysis; *without program*, net *with program* and break-even net *with program* benefits. Source: Authors' own elaboration.

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%.[5]

Based on the optimization, it was estimated 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 "Benefits: forecasting foreign tourism demand". 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 (Fig. 5).

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. At a 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 generate returns above the cost of capital.

Estimating economic returns

DCGE scenario design

This section presents the simulations and analyzes the results from the DCGE model. The following five scenarios were conducted: (i) the baseline scenario, which is the *without program* scenario; (ii) a

[5] This is the standard discount rate used by the Inter-American Development Bank in its economic analyses.

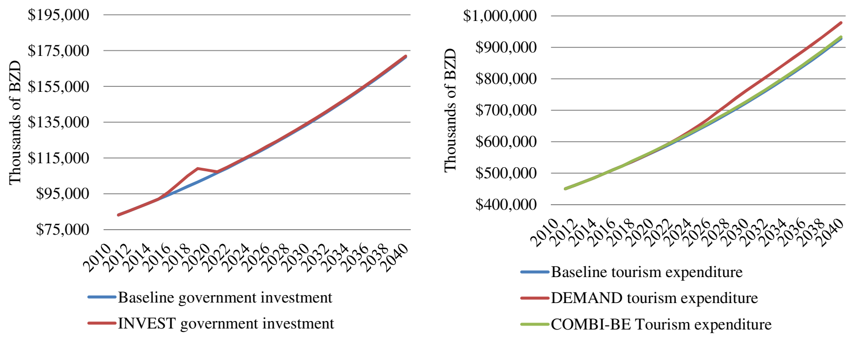

Fig. 6. Definition of scenarios invest and demand (% deviation from base). Source: Authors' own elaboration.

government investment in tourism infrastructure, institutional strengthening, capacity building and baseline studies; (iii) an increase in foreign overnight leisure tourism expenditure; (iv) scenarios *(ii)* and *(iii)* implemented jointly, and; (iv) 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. 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 expenditures, 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 through STP II. Details of the structure and sequencing of the investment were provided in Section "Investment structure and sequencing" of this paper. Fig. 6 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 "Foreign overnight tourist arrivals and expenditure with program" 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.

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.

Model results

Aggregate results

Fig. 7 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. Impacts on GDP are similar to the trends of private consumption (Fig. 8).

Table 10 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 more so 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

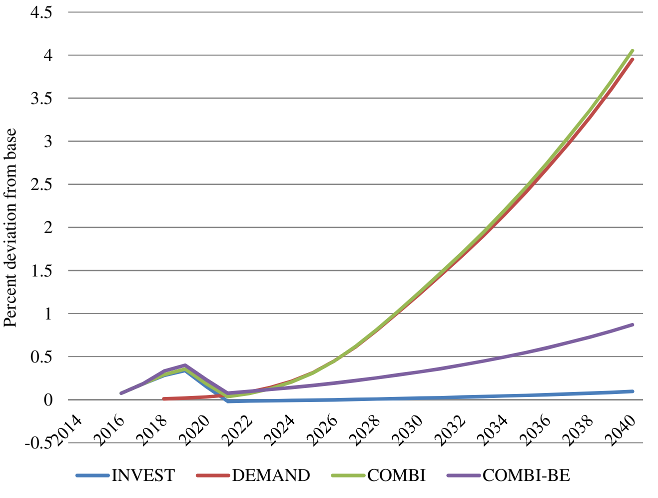

Fig. 7. Change in real private consumption 2016–2040.

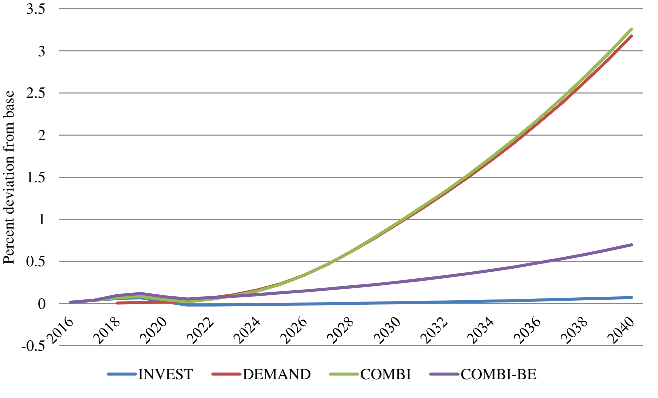

Fig. 8. Change in real gross domestic product 2016–2040. Source: Authors' own elaboration.

Table 10
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	$28,99,408	0.01	0.09	0.59	4.13	0.61	4.23	0.24	0.81
Private consumption	$17,30,687	−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	$18,53,720	−0.04	0.06	−0.16	2.42	−0.21	2.48	0.00	0.65
Imports	$17,74,626	−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	$29,78,502	−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.

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 just over 10% by 2040.

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 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 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 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.

Sectoral results

Table 11 shows impacts on value added. Considering the INVEST scenario, impacts in the early years are slightly negative for those sectors not receiving STP II 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 11
Change in sectoral real value added, exports, and imports (percent deviation from base).

	BASE '000 BZD	INVEST		DEMAND		COMBI		COMBI-BE	
Commodity	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 initially negatively impacted increase shortly after 2025. 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).

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 foreign tourism demand. 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 case 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, Eq. (4) is first solved:

$$INVNETINC_{(\mathrm{sim},t)} = SIMGDP_{(\mathrm{sim},t)} - BASEGDP_{(\mathrm{sim},t)} - \sum RGFCBAR2SIM_{(''inv'',\mathrm{inv},t)} - \sum QGBAR2SIM_{(''\mathrm{inv}'',c,t)} \quad (4)$$

Eq. (4) 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 Eq. (4) are then used in Eq. (5) to calculate NPV.

Analytically:

$$NPV = \sum_{t=0}^{24} \frac{Y_t - Y_t^0}{(1+r)^t} \quad (5)$$

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%).

The NPV is the highest in the COMBI scenario, reaching BZ$127.88 million (IRR of 31%); for the DEMAND scenario, the NPV is slightly less at BZ$121.222 (28% IRR). 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 (21%). 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.

Concluding remarks

Ex-ante economic impact analyses are required to demonstrate the development impact and viability of multilateral development loans. These assessments are often performed under tight timelines, in data scarce environments and with limited opportunity for primary data collection. This paper develops an approach to development impact and policy analysis, building on the framework developed in Banerjee et al. (2015) by: (i) developing a generalizable approach to building a DCGE in data scarce environments; (ii) generating realistic expectations of agent responses using a quasi-contingent valuation approach and auto-regressive integrated moving average methods. In addition to the methodological contributions, this paper develops the first SAM and DCGE for Belize which will facilitate future development impact and policy analysis for generating evidence-based advice for the country.

Applying the framework 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 results of this analysis have informed both the Government of Belize and the Inter-American Development Bank's decision to move forward with the investment.

The approach developed in this paper may be applied to the ex-ante economic analysis of other 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 and has long been considered the 'workhorse of policy analysis' (Jones, 1965).

Expected agent response to development and policy interventions is a critical input to DCGE model scenario calibration. As in the case of estimating a baseline, data limitations are a significant obstacle to the development of a reliable model. Where estimating economy-wide impacts of tourism interventions are concerned, the status quo in the literature has been to simply assume a *with intervention* rate of growth in tourist demand. The development of an ARIMA model and the coupling of this methodology with the quasi-contingent valuation approach developed in this paper has proven to be an effective strategy to elicit and forecast behavioral responses with a limited amount of primary data collection. Together, the DCGE, ARIMA and quasi-contingent valuation approach overcomes the challenges of data scarce contexts characteristic of many developing countries and brings countries closer to the goal of evidence-based policy and decision making.

In tourism applications, the frontier of tourism impact analysis lies in three areas. First, DCGE models are usually national in scope. Regional models at the level of state/province/district can be developed should certain data be available such as household income and expenditure survey data at a minimum. Improving the spatial resolution of the models can show spatially differentiated impacts in the case of multiregional models. Tourism expenditure data collected at the level of destination is also necessary for the accurate calibration of the model and simulations. Regionally disaggregated models can better inform investment and policy design, where particular groups such as the more marginalized or those excluded from current tourism value chains may be targeted.

Second, building on the quasi-contingent valuation approach developed in this paper, choice modelling can provide a more robust estimation of tourist preferences. Where detailed information on a tourism investment is available at the time of analysis, choice modelling enables the valuation of multiple attributes of an intervention. These data are useful for refining estimates of tourist demand as well for investment design. Knowledge of tourist valuations for different attributes of an intervention can be used to prioritize investment components where resources are scarce from competing demands.

Lastly, tourism demand in a receiving country is highly dependent on country of origin conditions. This dependence can be particularly acute in some geographies and countries that rely heavily on one or two sources of international tourism demand. Multi-country DCGE models are required to capture these dynamics of tourism demand and while there has been some work conducted in this area, it still represents fertile ground for research. Simulations with multi-country models can be used to inform the design of interventions that seek to diversify inbound tourist demand. Distinguishing between the preferences of different source markets for scenario calibration can provide valuable insights for the formulation of national tourism development strategies. The GTAP database discussed earlier provides a strong starting point for the development of multi-country models with future efforts focused on disaggregating a tourism sector in the GTAP database and model. Advancing the frontiers as proposed here can have measurable impacts on how tourism investment and policy is not only evaluated but designed.

Acknowledgements

This work was funded by the Inter-American Development Bank – United States. Sincere thanks to the STP II Team, with special thanks to Michele Lemay and Sybille Nuenninghoff, STP II Team Leaders for their support and encouragement.

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