

IMPLAN¹ Methodology for the Study of the Impact of Tourism on the Vermont Economy

Prepared for

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¹ For more information on the IMPLAN modeling please access <http://www.implan.com>

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The objectives of this study are to evaluate the annual and seasonal economic impacts of Vermont tourists' expenditure, to build the major tourism-related industry profiles, and evaluate their impact on the Vermont economy. This study evaluated the economic impact of tourism on Vermont's economy in terms of changes in industrial output, employment, income, and taxes. The IMPLAN (IMpact analysis for PLANning) economic impact model was used to measure both direct and secondary impacts of the tourism industry. Data used for this study were collected through visitor surveys, business surveys and the IMPLAN database.

This study adopted input-output analysis to estimate the status and importance of the tourism industry on the Vermont economy because of the following reasons:

1. An input-output model is ideally suited to measure both the relative sizes of sectors that make up the economy and the linkages among them. I/O modeling produces a structural model that illuminates the interactions among many sectors and measures impacts as they reverberate through the economy. Understanding which types of economic activities generate higher returns can direct decision makers toward enterprises that will stimulate economic development within a region.
2. Input-output modeling is the most commonly used method to assess the economic impact of tourism by many other states as well as at the national level. So it is expected to provide comparable results to other states' research, national data, and previous Vermont studies.
3. The advantage of an input-output model is that it provides impact estimates in a general equilibrium framework instead of single-market analysis (referred to as "partial equilibrium"). The input-output model captures not only the direct impact of

tourist expenditures but also the indirect and induced impacts that occur when tourist dollars work their way through the economy.

Vermont Input-Output IMPLAN Model

An input-output (I/O) analysis uses an economic model that traces the flow of goods and services, income, and employment among related sectors of the economy. The I/O approach triggers the flow of activities as follows: When final demand for a good changes, the sector producing the good (output) purchases inputs from other industrial sectors, which in turn purchase inputs from other industries. Moreover, all of these industrial sectors purchase additional labor input. The employees use their compensation to purchase goods and services from the economy. Linkages among industries in a region create a ripple effect as a result of change in demand for a product. Strong linkages can lead to healthier economies, as capital flows through the economy rather than out of it.

An input-output model is a snapshot of an economy in equilibrium, where the gross output of each industry is equal to the gross inputs to the industry. The gross output of an industry includes both inter-industry sales and sales to final demand. The gross input of an industry includes the purchase of goods and services, labor, investment, and profit. The I/O model provides a means of examining relationships within an economy both among different sectors and between sectors and final consumers such as households and government. The model allows one to examine the impact on the entire economy of a change in one or several economic activities.

This study uses the IMPLAN software to evaluate the economic impact of the tourism sector. IMPLAN (IMpact analysis for PLANning) is the most widely used software for I/O analysis. The USDA Forest Service originally developed IMPLAN in 1979. It is a sophisticated

software package that makes regional input-output models and forecasts regional economic impact based on those models. It is widely used by government agencies to make regional economic forecasts (Miller and Blair, 1985).

The I/O model works with a transaction table diagramming the flows among sectors (see Table 32). Rows and columns are the producing and purchasing sectors in the economy, respectively. The columns are buyers and the rows are sellers. The more sectors in the model, the more rows and columns there are, and the more inter-linkages the model has. The conventional seven-sector model of the United States economy includes agriculture, mining, construction, manufacturing, transportation, and services sectors; all economic activity that does not fall within one of these six sectors is placed in the “other” sector (Miller and Blair, 1985; Taylor et al., 1992). IMPLAN has 528 sectors, of which 344 sectors exist in Vermont.

To interpret a transaction table, let’s examine the agricultural sector. In Table 27, the agricultural sector is shown in the first column and the first row. Column one shows that the agriculture sector buys $\$Z_{11}$ from the agriculture sector itself (row 1), $\$Z_{i1}$ from manufacturing (row i), $\$H_1$ from households for their labor, and so forth. Total input expenditure by the agriculture sector ($\$X_1$, found in the last row) is the sum of the first column.

To examine what sectors agriculture sells to, look at the first row in the I/O transaction table: the agriculture sector (row one) sells $\$Z_{11}$ to the agriculture sector itself (column one), $\$Z_{1j}$ to the manufacturing sector (column j), $\$C_1$ to households, $\$G_1$ to government, and so on. Total output of the agriculture sector ($\$X_1$, found in the last column of the first row) is the sum of the first row. For each sector, total expenditures (input) always equal total earnings (output).

Table 27. Input-Output Transaction Table: An Example

		Purchasing Sectors (Buyers)				
		Intermediate Demand		Final Demand		Total Gross Output
		Agriculture Forestry 1.....j.....n	Manufacturing Trade Finance Services	Household Consumption	Govt. Expenditures Capital Formation Exports	
		I Intermediate Production and Consumption		II Final Outputs		
(Sellers)	Sectors	Intermediate Inputs	Agriculture Forestry Trade Manufacturing Finance Services 1 : : i : n	$Z_{11} \dots Z_{1j} \dots Z_{1n}$: : $Z_{i1} \dots Z_{ij} \dots Z_{in}$: : $Z_{n1} \dots Z_{nj} \dots Z_{nn}$	$C_1 \quad G_1 \quad I_1 \quad E_1$: : : $C_i \quad G_i \quad I_i \quad E_i$: : $C_n \quad G_n \quad I_n \quad E_n$	X_1 : : X_i : X_n
	Producing		III Primary Inputs to Production		IV Primary Inputs to Final Demand	
	Inputs	Payments to Households Government Depreciation Imports	$H_1 \dots H_j \dots H_n$ $T_1 \dots T_j \dots T_n$ $D_1 \dots D_j \dots D_n$ $M_1 \dots M_j \dots M_n$	$H_C \quad H_G \quad H_I \quad H_E$ $T_C \quad T_G \quad T_I \quad T_E$ $D_C \quad D_G \quad D_I \quad D_E$ $M_C \quad M_G \quad M_I \quad M_E$	H T D M	
		Total Gross Outlays	$X_1 \dots X_i \dots X_n$		$C \quad G \quad I \quad E$	

The input-output transaction table (Table 32) is always balanced at any given time. Any change in this table will trigger changes throughout the economy that will achieve a new balance. For example, suppose the household demand for agricultural goods (C_1) increases due to increased product promotion. As a result there is a change in the demand for (C_1). The change will increase the total earnings of the agriculture sector (X_1), and row one changes. In order to meet the increase in demand for agricultural goods, the agriculture sector has to buy more intermediate input (e.g., machinery) and hire more people---everything in column one will change. Then the affected manufacturing sector has more earnings (output) because the

agriculture sector buys more machines, and in turn the manufacturing sector will buy more inputs from other sectors. The ripple (multiplier) effect due to an initial increase in the demand for agricultural goods will ripple through the economy, until the economy reaches a new balance.

The I/O model provides a means to capture and measure these effects. It uses three effects to measure economic impact: direct effect, indirect effect and induced effect.

- *Direct effect* refers to production change associated with a change in demand for the good itself. It is the initial impact to the economy, which is exogenous to the model.
- *Indirect effect* refers to the secondary impact caused by changing input needs of directly affected industries (e.g., additional input purchases to produce additional output).
- *Induced effect* is caused by changes in household spending due to the additional employment generated by direct and indirect effects.

Multiplier

Generally, economic multipliers estimate the economy-wide impact on related variables of changing one variable in the specified economy, such as a state (Tanjuakio, Hastings and Tytus, 1996). There are several multipliers calculated by the IMPLAN model:

- **Output Multiplier:** An output multiplier for a sector is defined as the total production in all sectors of the economy that is necessary to satisfy a dollar's worth of final demand for that sector's output (Miller and Blair, 1985). In other words, every dollar change in final-demand spending (direct output) changes in the total value of output in all sectors.
- **Personal Income Multiplier:** For every dollar change in final-demand spending (direct output), the change in income received by households.
- **Employment Multiplier:** For every million-dollar change in final-demand spending (direct output) in a sector, the change in number of jobs in the economy.

- Indirect Business Taxes Multiplier: For every dollar change in final-demand spending (direct output), the change in indirect business taxes.²

Limitations of the Input-Output Model and Potential Sources of Error in the IMPLAN Model

Input-output models incorporate several important assumptions (Miller and Blair, 1985; Minnesota IMPLAN Group, 1996) that place limitations on their interpretation:

- The I/O model assumes a linear production function, which means constant returns to scale and constant production functions for each firm within an industry. For example, the model assumes that a small sawmill would use the same inputs, in the same proportion, as a large sawmill. Furthermore, the model assumes that the percentage of those inputs that are purchased locally is constant from one firm to the next.
- Output is also assumed to be homogenous. In other words, the assumption is that the two sawmills would produce the same percentage of lumber, wood chips, and other outputs.
- It assumes that there are no constraints on the supply of any commodity.
- It assumes that increases or decreases in employment cause in- or out-migration from the state modeled, so that “full employment” is maintained.

The IMPLAN model combines the national average data and location-specific data. In the Vermont model, final-demand data and value-added data (such as employee compensation, proprietary income, property income and indirect business taxes) are collected specifically for Vermont. Production functions for the 344 sectors in the model are derived from national averages.

² Indirect business taxes consist primarily of excise and sales taxes paid by individuals to businesses. These taxes occur during the normal operation of these businesses but do not include taxes on profit and income (IMPLAN Manual, 1996)

Potential sources of error in the IMPLAN model, based on national averages, include production functions (what industries purchase to produce their output), byproducts (the mix of products that industries actually produce), and regional purchase coefficients, or RPC's (the percentage of a commodity that is purchased from local suppliers). The greatest source of error in the base model data is the RPC's (Stevens, 1987).

Glossary Economic Impact Terms

- *Direct effect*: production changes associated with changes in demand for the good itself; it is an initial impact on the economy
- *Employee compensation*: wage and salary payments as well as benefits, including health and life insurance, retirement payments and other non-cash compensation.
- *Employment multiplier*: for every million dollar change in final-demand spending (direct output), the change in employment (jobs).
- *Indirect business tax multiplier*: for every dollar change in final-demand spending (direct output), the change in indirect business taxes.
- *Indirect effect*: the secondary impact caused by changing input needs of directly affected industries (e.g., additional input purchases to produce additional output).
- *Induced effect*: caused by changes in household spending due to the additional employment generated by direct and indirect effects.
- *Indirect business taxes*: consist primarily of excise and sales taxes paid by individuals to businesses; these taxes occur during the normal operation of the businesses but do not include taxes on profit and income.
- *Output*: industry output is a measure of the value of goods and services produced in the study area.
- *Output multiplier*: An output multiplier for a sector is defined as the total production in all sectors of the economy that is necessary to satisfy a dollar's worth of final demand for that sector's output (Miller and Blair, 1985). In other words, every dollar change in final-demand spending (direct output) changes the total value of output in all sectors.
- *Personal income*: consists of employee compensation and proprietary income.
- *Personal income multiplier*: for every dollar change in final-demand spending (direct output), the change in income received by households.
- *Proprietary income*: consists of payments received by self-employed individuals as income. This includes income received by private business owners, doctors, lawyers and so forth.