

THE HAWAI‘I STATE INPUT-OUTPUT STUDY: 2022 BENCHMARK REPORT



Research and Economic Analysis Division
Department of Business, Economic Development, and Tourism
STATE OF HAWAI‘I

October 2025

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
PREFACE	5
I. INTRODUCTION	6
II. THE INPUT-OUTPUT MODEL	7
Basic Framework	7
Transactions Table	8
Direct Requirements Table	14
Total Requirements Table.....	17
Input-Output Multipliers	17
Output Multipliers.....	20
Earnings Multipliers.....	20
State Tax Multipliers.....	21
Employment Multipliers	21
Type 2 Multipliers.....	22
Trends in Multipliers, 2012–2022.....	25
III. CONSIDERATIONS AND EXAMPLES OF USING I-O MODELS IN IMPACT ANALYSIS	28
Considerations in Using I-O Models in Impact Analysis	28
What I-O models are good at?	28
Limitations of I-O models:.....	29
Best practices:	30
Examples of I-O Models Uses in Impact Analysis:.....	30
Economic Impacts of Visitor Spending	30
Gross Impact vs. Net Impact: Creating a New Business	32
Gross Impact vs. Net Impact: Government Spending	34
Impact of New Construction Jobs.....	35
Increase in Garment Sales to Visitors	36
IV. INDUSTRY CLASSIFICATION, DATA SOURCES, AND ESTIMATION PROCEDURES	38
Industry Classification	38
Output	38
Value Added	38
Final Demand.....	39
Employment and Taxes.....	39

V. INTER-INDUSTRY MATRIX AND BALANCING PROCEDURE.....	41
Inter-Industry Matrix	41
Balancing Procedure	41
VI. MULTIPLIERS FROM THE 2017 DETAILED I-O TABLE FOR HAWAI‘I.....	43
2022 Detailed I-O Table for Hawai‘i.....	43
2022 Detailed I-O Multipliers.....	44
Multipliers.....	44
Interpretation of Multipliers.....	44
Observations from the 2022 Multipliers	45
References.....	58
Appendix A. NAICS Codes for Industries in the 2022 I-O Table for Hawai‘i	61
Appendix B. Mathematics of Input-Output Models	63
Appendix C. Various Retail, Wholesale and Transportation Margins	66
Appendix D. Mathematics of the Modified RAS Procedure	68

LIST OF FIGURES AND TABLES

Figure 2.1. An Overview of an Input-Output Table.....	8
Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i.....	9
Table 2.2. 2022 Condensed Direct Requirements Table for Hawai‘i.....	15
Table 2.3. 2022 Condensed Total Requirements Table (Type 1) for Hawai‘i	18
Table 2.4. 2022 Condensed Output, Earnings, and Employment Multipliers for Hawai‘i.....	23
Table 2.5. 2022 Condensed State Tax Multipliers for Hawai‘i	24
Figure 2.2. Evolution of Output Multipliers for I-O 2012, I-O 2017 and I-O 2022....	25
Figure 2.3. Evolution of Earning Multipliers for I-O 2012, I-O 2017 and I-O 2022....	26
Figure 2.4. Evolution of Total Job Multipliers for I-O 2012, I-O 2017 and I-O 2022.	26
Table 3.1. Economic Impacts of Increasing Visitor Spending by \$7 Million	32
Table 3.2. Economic Impacts of Increasing Private Investment by \$10 Million.....	33
Table 3.3. Economic Impacts of an Increase in Grocery Sales by \$10 Million.....	34
Table 3.4. Net Impact of Government Spending	35
Table 3.5. Impacts of 1,000 New Jobs in Hawai‘i’s Construction Sector	36
Table 3.6. Output Impact of an Increase in Clothing Sales by \$100 Million	37
Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawaii.....	46

EXECUTIVE SUMMARY

This 2022 Benchmark Input-Output (I-O) Study provides an updated and comprehensive picture of Hawai‘i's economy, capturing the inter-industry flows, final demand, value added, and tax structure as of the benchmark year. The model offers multipliers for output, earnings, employment, and state tax revenues across Hawai‘i's industries.

Key findings from the multipliers highlight the structure of Hawai‘i's economy. Labor-intensive service industries - such as health care, education, and certain segments of government - exhibit higher earnings and employment multipliers. Conversely, capital and import-intensive industries - such as petroleum refining and utilities - show lower multiplier effects. Visitor spending continues to play a major role, with significant spillovers across accommodation, food services, transportation, and retail trade. Construction remains another major driver, with strong linkages to a wide array of local industries.

As with any model, it is important to consider the underlying assumptions and limitations built in the I-O framework before drawing conclusions. The I-O framework assumes fixed prices, linear input requirements, and no substitution among input - assumptions that may not hold in practice. Hawai‘i's recent experience underscores these limitations. The COVID-19 pandemic significantly altered productivity and labor dynamics in key sectors, while the 2024 state income tax reform will reshape household disposable income and spending propensities. Because these shifts disproportionately impacted, or are not fully reflected in the 2022 benchmark, multipliers may overstate or understate present-day impacts.

In summary, the 2022 I-O model provides a reference for Hawai‘i's policymakers, researchers, and businesses. It offers a transparent, sector-specific framework for examining how changes in final demand move through industries and households in the economy. At the same time, careful interpretation is required to avoid misuse. Analysts should remain aware of the model's static baseline, restrictive assumptions, and aggregation bias, and should complement results with updated data, and sensitivity checks. Used in this way, the I-O model continues to provide valuable insights for guiding Hawai‘i's economic development strategies.

PREFACE

This report represents the twelfth benchmark input-output (I-O) study of Hawai‘i's economy, prepared by the Department of Business, Economic Development & Tourism (DBEDT). The study continues a tradition that began in 1967 and aligns with the quinquennial U.S. Economic Census, which provides the foundation for benchmarking Hawai‘i's inter-industry relationships.

The input-output framework is a widely used tool in applied economics. It enables policymakers, researchers, businesses, and community organizations to understand how industries interact, how value is created and distributed across the economy, and how external changes - such as shifts in visitor spending, new construction projects, or government program - ripple through Hawai‘i's economic system. As such, this report is intended not only for academics and technical experts, but also for decision-makers across the public and private sectors who need clear and reliable information.

Hawai‘i's economy has undergone significant adjustments in recent years, including the impacts of the COVID-19 pandemic, structural changes in tourism, shifts in energy markets and growing diversification into technology, health care, and education. This report incorporates the latest data from the 2022 Economic Census and other federal, state, and local sources to capture these dynamics. By doing so, it provides a basis for evaluating resilience, assessing growth opportunities, and informing policy priorities.

The updated report was prepared at the Research and Economic Analysis Division (READ) of DBEDT by Dr. Oscar Carvalho Valencia, under the supervision of Dr. Eugene Tian. The final draft benefited from reviews by READ economists, State Chief Economist Dr. Seth Colby, and Branch Chief Dr. Joseph Roos.

I. INTRODUCTION

This report presents the 2022 input–output (I-O) tables for the State of Hawai‘i. I-O analysis provides a comprehensive view of the interrelationships among industries, final users (households, visitors, government, and exports), and factors of production. It helps identify the role and relative importance of each sector in terms of output, value added, income, and employment, as well as the linkages across the broader economy.

By detailing the flows of goods and services among sectors, the I-O tables serve as an essential analytical tool for economists, planners, and policymakers. They are used to:

1. Analyze issues in regional and community economic development.
2. Design and evaluate economic policies and assess their effects on industry output and input patterns.
3. Estimate the impacts of new development initiatives and external shocks (e.g., growth in exports).

More specifically, the tables provide the foundation for calculating multipliers—output, income, employment, and other measures—commonly applied in economic impact studies. The I-O model also supports long-term economic and demographic projections and can be extended into Social Accounting Matrices (SAMs) and Computable General Equilibrium (CGE) models for public policy and scenario analysis.

Two versions of the I-O tables are presented: one with 62 industry sectors and another condensed version with 20 sectors. Appendix A lists the sectors and their corresponding North American Industry Classification System (NAICS) codes. The condensed table illustrates the I-O framework, including inter-industry transactions, direct and total requirements, and multiplier calculations. The detailed table provides multipliers for all 62 sectors. Corresponding transaction and requirements tables are available on the DBEDT website: www.Hawaii.gov/dbedt/.

The report is as follows:

- Section II describes the I-O framework and derivation of requirements tables and multipliers using the condensed 2022 Hawai‘i table.
- Section III provides examples of economic impact analysis using the I-O model and notes on appropriate use of multipliers.
- Section IV outlines the industry classifications, data sources, and estimation procedures.
- Section V explains the construction and balancing of the inter-industry matrix.
- Section VI presents multipliers from the detailed 2022 table.

II. THE INPUT-OUTPUT MODEL

Basic Framework

An input-output (I-O) model provides a comprehensive account of the sales and purchases of goods and services among producing industries, final consumers (households, visitors, government, and exports), and resource owners (labor, capital, and land) within a specific economy or region, usually for one year. The information is summarized on an I-O table.

A simplified overview of an industry-by-industry I-O table is shown in Figure 2.1. A standard input-output table has three main components (blocks or quadrants): inter-industry transactions (Block A), final demand (Block B), and value added (Block C). Each block is organized by rows (selling sectors) and columns (buying sectors).

- Block A (Inter-industry transactions): Records intermediate sales and purchases among producing industries. Reading across a row shows the sales of a sector to other industries, while reading down a column shows its purchases from other sectors.
- Block B (Final demand): Captures sales of goods and services by each industry to final users—households (personal consumption expenditures), government (federal, state, and local), visitors (visitor expenditures), investors (private investment), and exports. These elements represent the final demand for goods and services produced within the economy.
- Block C (Value added): Shows payments to primary factors of production—labor, land, and capital—as well as business taxes, interest on business loans, and payments for imported goods and services used as intermediate inputs.

The I-O model operates under a balancing framework: total receipts of sellers equal total expenditures of buyers. Thus, for each sector, total output (sales, including final demand) equals total input (purchases, including factor payments).

Figure 2.1. An Overview of an Input-Output Table

	Industries (purchases)	Final Demand Sectors	Total
Industries (sales)	Block A Inter-industry Transactions	Block B Final demand (sales to households, visitors, government, investment, and exports)	Total industry output (sales)
Final Payments Sectors	Block C Primary payments (payments for labor, capital, land, loans, taxes, and imported goods)		Total payments
Total	Total industry input (purchases)	Total expenditures	

The derivation of the direct and total requirements tables, along with output, earnings, and employment multipliers, is illustrated using the condensed version of the 2022 Hawai‘i I-O table. The condensed table is used for illustration because it provides a clear and accessible view of the framework, while maintaining consistency with the detailed table. Mathematical details of the I-O model and related procedures are provided in Appendix B.

Transactions Table

For illustration, Table 2.1 presents a condensed version of the 2022 Hawai‘i State I-O transactions table. The condensed table includes 20 industry sectors, seven final demand sectors, and five final payment sectors. It summarizes sales and purchases among the aggregated sectors of Hawai‘i’s economy in 2022. Except for job data, all values are expressed in millions of current dollars. In the I-O framework, industry sales and purchases are recorded at producers’ prices. Accordingly, wholesale and retail transactions are separated into producers’ value, transportation costs, and wholesale and retail margins, which are then assigned to the appropriate producing, transportation, and trade sectors.

In addition to the core I-O data, Table 2.1 also reports wage and salary jobs, proprietor jobs, and total jobs by industry. These measures are used later to calculate job multipliers. Total jobs include both wage and salary positions and self-employed workers, covering full and part-time employment. The table also presents industry earnings and state taxes, which are used to derive earnings and tax multipliers.

Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i (in \$million)

Industry	Agriculture	Mining and Construction	Food processing	Other manufacturing	Transportation
1 Agriculture	71.4	12.1	77.2	3.9	0.1
2 Mining and construction	22.8	23.8	7.9	3.7	141.8
3 Food processing	4.4	0.0	27.4	24.8	3.0
4 Other manufacturing	7.5	20.8	9.0	21.0	98.9
5 Transportation	53.9	362.1	17.2	70.6	581.4
6 Information	1.0	43.6	2.8	8.6	50.9
7 Utilities	12.2	137.5	18.9	45.1	30.1
8 Wholesale trade	24.5	496.3	35.1	58.3	94.5
9 Retail trade	8.7	707.8	12.0	17.7	10.8
10 Finance and insurance	11.1	182.3	3.1	19.3	67.3
11 Real estate and rentals	29.7	699.3	26.1	46.2	173.7
12 Professional services	4.0	848.1	10.2	30.1	154.3
13 Business services	9.7	270.9	82.1	67.8	395.0
14 Educational services	0.0	5.7	0.1	6.1	13.6
15 Health services	0.0	0.0	0.0	0.0	13.6
16 Arts and entertainment	0.8	16.9	2.3	2.9	3.0
17 Accommodation	4.8	252.3	45.6	60.1	49.0
18 Eating and drinking	4.3	249.1	42.3	34.1	238.3
19 Other services	1.1	14.6	4.4	8.9	19.1
20 Government	8.3	37.4	10.8	30.4	622.0
Total intermediate input	280.2	4,380.5	434.4	559.7	2,760.4
Imports	147.5	2,050.4	201.4	2,551.2	804.3
Earnings (Labor income)	374.2	4,651.4	310.6	670.4	2,905.9
Compensation of employees	284.5	3,828.3	311.9	570.9	2,611.3
Proprietor's income	89.7	823.1	-1.3	99.4	294.6
TOPILS	-2.7	137.6	28.7	50.6	1,085.8
Other capital costs	207.9	1,088.3	54.8	680.4	1,488.7
Total Value added	579.4	5,877.3	394.1	1,401.4	5,480.4
Output	1,007.2	12,308.2	1,029.9	4,512.3	9,045.2
Wage and salary jobs	7,332.0	37,982.0	5,862.0	6,667.0	29,582.0
Proprietors' jobs	8,352.0	11,985.0	616.0	3,117.0	14,783.0
Total jobs	15,684.0	49,967.0	6,478.0	9,784.0	44,365.0
Earnings (RIMS II)	322.3	4,042.1	235.6	537.4	2,354.1
State total taxes	30.4	779.0	28.7	78.9	343.6
State individual income tax	17.1	269.7	18.6	43.2	174.8
State GET	5.8	413.5	2.8	4.2	78.8
State TAT	0.0	0.0	0.0	0.0	0.0
State other taxes	7.6	95.8	7.3	31.5	90.0

Note. TOPILS = Taxes on production and imports less subsidies.

Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i - Continued

Industry	Information	Utilities	Wholesale trade	Retail trade	Finance and insurance	Real estate and rentals
1 Agriculture	0.0	0.0	0.2	0.2	0.0	36.4
2 Mining and construction	24.3	194.6	13.7	43.7	45.4	1,168.5
3 Food processing	1.1	0.0	0.8	0.5	0.0	0.0
4 Other manufacturing	1.4	513.7	4.2	7.8	1.4	20.8
5 Transportation	125.6	54.4	71.7	90.5	181.9	162.6
6 Information	449.1	8.1	67.7	71.5	175.9	74.4
7 Utilities	36.6	303.7	31.3	137.6	36.9	112.3
8 Wholesale trade	50.1	27.6	68.4	21.8	7.3	66.2
9 Retail trade	69.8	17.4	36.9	86.6	15.4	220.1
10 Finance and insurance	101.1	53.4	53.0	121.5	1,146.1	961.3
11 Real estate and rentals	296.4	37.1	169.9	691.6	307.7	771.0
12 Professional services	191.4	138.7	82.0	130.2	347.2	260.8
13 Business services	162.2	89.9	179.5	244.5	260.4	383.7
14 Educational services	32.1	59.6	3.1	5.2	70.1	4.0
15 Health services	0.0	0.0	0.0	0.1	0.0	0.0
16 Arts and entertainment	17.2	1.4	0.0	0.0	0.0	0.2
17 Accommodation	103.5	91.7	146.8	209.0	427.4	349.0
18 Eating and drinking	154.9	77.8	87.7	117.2	257.2	114.0
19 Other services	25.7	2.6	13.7	20.7	29.6	562.7
20 Government	53.2	54.5	44.7	207.7	140.0	258.8
Total intermediate input	1,895.6	1,726.2	1,075.4	2,208.0	3,450.0	5,526.6
Imports	1,210.7	252.5	512.2	796.8	855.4	652.3
Earnings (Labor income)	910.1	639.5	1,589.3	3,372.2	1,909.4	2,899.5
Compensation of employees	910.1	625.0	1,521.1	3,199.2	1,853.5	1,012.7
Proprietor's income	0.0	14.6	68.3	173.0	56.0	1,886.8
TOPILS	104.2	400.9	773.5	2,836.8	317.5	2,193.2
Other capital costs	1,438.5	1,335.2	976.3	1,618.4	1,949.9	12,972.8
Total Value added	2,452.8	2,375.6	3,339.2	7,827.3	4,176.9	18,065.5
Output	5,559.1	4,354.3	4,926.8	10,832.1	8,482.3	24,244.5
Wage and salary jobs	8,510.0	3,616.0	17,333.0	64,327.0	16,344.0	12,487.0
Proprietors' jobs	2,509.0	437.0	4,356.0	19,981.0	19,438.0	40,604.0
Total jobs	11,019.0	4,053.0	21,689.0	84,308.0	35,782.0	53,091.0
Earnings (RIMS II)	704.9	452.7	1,348.9	2,822.0	1,622.9	2,758.4
State total taxes	196.8	237.6	254.0	2,002.0	483.6	1,048.8
State individual income tax	53.0	35.5	98.8	186.8	123.7	175.5
State GET	48.6	0.0	117.9	1,732.3	3.2	631.7
State TAT	0.0	0.0	0.0	0.0	0.0	0.0
State other taxes	95.3	202.0	37.3	83.0	356.8	241.7

Note. TOPILS = Taxes on production and imports less subsidies.

Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i - Continued

Industry	Professional services	Business services	Educational services	Health services	Arts and entertainment
1 Agriculture	3.5	0.7	0.0	6.0	0.2
2 Mining and construction	41.3	21.5	11.3	39.9	1.9
3 Food processing	1.6	0.0	0.0	22.8	0.1
4 Other manufacturing	2.0	5.0	0.1	9.3	0.1
5 Transportation	454.7	98.4	8.2	108.9	3.9
6 Information	143.2	49.4	6.1	71.9	2.2
7 Utilities	71.5	51.6	2.7	161.4	5.9
8 Wholesale trade	47.0	24.1	1.4	83.9	1.0
9 Retail trade	111.5	48.7	0.3	46.5	0.3
10 Finance and insurance	86.3	35.8	1.9	60.2	1.5
11 Real estate and rentals	537.7	191.4	24.4	467.4	8.8
12 Professional services	604.3	273.7	6.0	328.0	8.2
13 Business services	138.5	186.0	8.3	463.9	5.4
14 Educational services	13.2	3.1	1.5	58.3	0.66
15 Health services	19.5	1.7	6.5	676.8	2.0
16 Arts and entertainment	0.0	0.0	0.3	0.5	10.6
17 Accommodation	626.7	86.2	7.1	395.3	2.5
18 Eating and drinking	158.6	61.5	14.4	260.7	7.9
19 Other services	29.6	22.7	0.9	21.7	1.4
20 Government	81.3	98.2	2.2	178.1	7.6
Total intermediate input	3,171.8	1,259.7	103.6	3,461.5	72.1
Imports	727.7	201.4	12.1	1,123.2	16.5
Earnings (Labor income)	3,830.8	3,639.2	478.4	5,120.4	903.4
Compensation of employees	2,912.5	3,258.1	419.4	4,516.3	643.1
Proprietor's income	918.3	381.1	59.1	604.1	260.2
TOPILS	264.6	161.8	64.5	233.1	123.1
Other capital costs	540.4	543.6	560.4	2,179.6	270.7
Total Value added	4,635.8	4,344.6	1,103.3	7,533.1	1,297.2
Output	8,535.4	5,805.6	1,218.9	12,117.9	1,385.7
Wage and salary jobs	26,204.0	45,751.0	16,135.0	73,339.0	12,045.0
Proprietors' jobs	23,686.0	15,509.0	4,339.0	12,615.0	9,803.0
Total jobs	49,890.0	61,260.0	20,474.0	85,954.0	21,848.0
Earnings (RIMS II)	3,430.5	3,125.5	421.6	4,309.7	801.6
State total taxes	497.7	401.9	72.8	662.8	88.9
State individual income tax	237.5	224.5	33.7	313.5	48.6
State GET	189.0	127.9	27.5	248.4	29.2
State TAT	0.0	0.0	0.0	0.0	0.0
State other taxes	71.2	49.4	11.6	101.0	11.1

Note. TOPILS = Taxes on production and imports less subsidies.

Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i - Continued

Industry	Accommodation	Eating and drinking	Other services	Government	Total Interindustry demand
1 Agriculture	0.2	70.0	1.4	0.3	283.8
2 Mining and construction	490.1	179.9	17.7	46.5	2,540.3
3 Food processing	5.3	259.6	0.7	1.5	353.6
4 Other manufacturing	10.3	87.6	2.1	2.4	825.5
5 Transportation	283.9	133.7	47.5	85.6	2,996.6
6 Information	124.4	52.3	17.7	9.0	1,429.8
7 Utilities	595.7	212.8	42.8	24.5	2,071.3
8 Wholesale trade	121.1	208.3	13.3	16.2	1,466.4
9 Retail trade	39.4	30.4	19.2	0.2	1,499.7
10 Finance and insurance	344.6	82.6	14.1	7.4	3,353.8
11 Real estate and rentals	481.7	331.3	100.6	16.2	5,408.2
12 Professional services	436.6	242.6	44.6	23.6	4,164.7
13 Business services	998.6	205.0	65.1	32.2	4,248.6
14 Educational services	2.4	0.9	1.4	1.2	282.5
15 Health services	0.0	0.0	6.3	16.4	742.9
16 Arts and entertainment	18.3	32.0	1.1	0.1	107.5
17 Accommodation	366.8	210.0	64.8	27.1	3,525.7
18 Eating and drinking	326.8	236.3	16.0	19.3	2,478.4
19 Other services	45.5	21.3	11.6	4.2	861.9
20 Government	344.0	101.3	18.6	23.3	2,322.3
Total intermediate input	5,036.0	2,698.0	506.7	357.2	40,963.6
Imports	882.3	1,188.5	186.0	128.8	14,501.3
Earnings (Labor income)	3,022.7	2,882.9	1,399.2	17,035.5	58,545.0
Compensation of employees	2,895.6	2,629.7	901.6	17,035.5	51,940.3
Proprietor's income	127.1	253.2	497.6	0.0	6,604.7
TOPILS	1,371.7	200.2	99.5	-270.6	10,174.0
Other capital costs	1,863.2	562.1	1,010.7	3,092.2	34,434.2
Total Value added	6,257.6	3,645.2	2,509.4	19,857.1	103,153.2
Output	12,175.9	7,531.7	3,202.1	20,343.0	158,618.1
Wage and salary jobs	37,127.0	63,783.0	27,053.0	172,482.0	683,961.0
Proprietors' jobs	1,392.0	4,072.0	34,199.6	0.0	231,793.6
Total jobs	38,519.0	67,855.0	61,252.6	172,482.0	915,754.6
Earnings (RIMS II)	2,755.6	2,617.5	1,129.9	12,095.1	47,888.4
State total taxes	1,299.1	384.5	134.8	1,253.4	10,279.5
State individual income tax	150.8	162.5	70.8	1,058.6	3,497.2
State GET	252.1	163.7	40.6	0.0	4,117.0
State TAT	810.0	0.0	0.0	0.0	810.0
State other taxes	86.2	58.4	23.3	194.8	1,855.3

Note. TOPILS = Taxes on production and imports less subsidies.

Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i – Continued

	PCE	Visitor expenditures	Gross private investment*	State and local government
1 Agriculture	265.8	28.3	0.0	8.0
2 Mining and construction	410.5	0.0	6,290.5	2,323.6
3 Food processing	276.0	36.8	0.5	15.7
4 Other manufacturing	1,798.3	72.6	105.7	179.5
5 Transportation	1,589.5	3,642.1	111.6	167.9
6 Information	3,485.8	30.8	0.0	171.4
7 Utilities	1,543.4	0.0	0.0	636.3
8 Wholesale trade	2,459.1	143.5	486.3	171.3
9 Retail trade	5,115.6	3,233.2	726.6	143.0
10 Finance and insurance	3,338.8	0.0	0.0	101.6
11 Real estate and rentals	16,202.6	1,957.1	54.7	242.3
12 Professional services	1,764.2	158.1	815.6	33.7
13 Business services	868.2	436.8	0.0	0.0
14 Educational services	721.7	214.4	0.0	0.0
15 Health services	11,085.0	235.5	0.0	0.0
16 Arts and entertainment	510.6	718.1	0.0	0.0
17 Accommodation	836.9	7,739.1	0.0	30.6
18 Eating and drinking	2,818.4	2,216.4	0.0	0.0
19 Other services	1,926.6	153.9	0.0	253.9
20 Government	5,715.0	178.3	0.0	2,410.9
Total Hawaii produced	62,731.9	21,195.2	8,591.5	6,889.6
Imports	10,288.7	1,450.2	8,499.9	7,027.5
Total	73,020.6	22,645.3	17,091.5	13,917.1

* Includes inventory variation

Table 2.1. 2022 Condensed Input-Output Transactions Table for Hawai‘i - Continued

	Federal government: defense	Federal government: nondefense	Exports	Total Output
1 Agriculture	0.0	0.0	421.3	1,007.2
2 Mining and construction	257.1	59.0	427.1	12,308.2
3 Food processing	4.4	0.4	342.5	1,029.9
4 Other manufacturing	47.4	24.1	1,459.1	4,512.3
5 Transportation	13.9	3.1	520.4	9,045.2
6 Information	5.7	19.8	415.7	5,559.1
7 Utilities	54.7	48.7	0.0	4,354.3
8 Wholesale trade	0.3	0.0	200.0	4,926.8
9 Retail trade	0.5	0.1	113.4	10,832.1
10 Finance and insurance	0.0	0.0	1,688.1	8,482.3
11 Real estate and rentals	0.2	0.3	379.0	24,244.5
12 Professional services	350.6	168.4	1,080.0	8,535.4
13 Business services	92.7	14.4	145.0	5,805.6
14 Educational services	0.3	0.1	0.0	1,218.9
15 Health services	5.9	48.6	0.0	12,117.9
16 Arts and entertainment	0.7	0.0	48.9	1,385.7
17 Accommodation	0.4	43.1	0.0	12,175.9
18 Eating and drinking	0.7	0.0	17.8	7,531.7
19 Other services	2.3	3.5	0.0	3,202.1
20 Government	8,174.3	1,542.2	0.0	20,343.0
Total Hawaii produced	9,012.1	1,975.8	7,258.3	158,618.1
Imports	371.6	247.0	964.7	43,351.0
Total	9,383.7	2,222.8	8,223.0	201,969.0

Reading across a row of the transactions table shows the sales of a row sector to the various column sectors of the economy. For example, in 2022 agriculture's total output was \$1,007.2 million. Of this, inter-industry sales to agriculture itself and other industries totaled \$283.8 million. The largest share went to food processing (\$77.2 million, or 27.2% of inter-industry sales). Sales to final demand sectors totaled \$723.3 million, including \$265.8 million to Hawai'i residents and \$457.6 million to government, visitors, private investment, and exports.

Reading down a column shows the purchases of the column sector from the various row sectors. In 2022, agriculture's purchases included \$280.2 million from Hawai'i industries (with \$71.4 million from agriculture itself and \$208.8 million from other industries), \$374.2 million in payments to households (compensation of employees and proprietors' income), \$205.2 million in other value added (taxes on production and imports less subsidies plus other capital costs), and \$147.5 million in imported inputs.

Hawai'i's agricultural sector also supported 7,332 wage and salary jobs and 8,352 self-employed jobs in 2022. The sector generated \$322.3 million in total earnings and \$30.4 million in state taxes.

Direct Requirements Table

The next step in I-O analysis, following construction of the transactions table, is the derivation of the direct requirements table, also known as the technology coefficient matrix or A matrix. This table provides a comprehensive picture of the interdependence among producing sectors of the economy.

Table 2.2 presents the direct requirements table for 20 producing sectors. Each element in a column is calculated by dividing the corresponding entry in the transactions table by that column's total. These coefficients show the amount of inputs (purchases) each sector requires from other sectors to produce \$1 of output. Each column therefore represents the production function of a sector. Because the technical coefficients are fixed, these production functions exhibit constant returns to scale and reflect the average technology in use within each industry.

The direct requirements table typically includes only producing sectors; final demand sectors are omitted. An exception is personal consumption expenditures (PCEs), which may be treated as an additional producing sector since household earnings are largely spent on goods and services for final consumption. Sectors included in the direct requirements matrix are referred to as "endogenous sectors" or "endogenous to the model."

The agriculture column illustrates how the table works. To produce \$1 of agricultural output in 2022, agriculture required 27.8 cents of inputs per dollar of output from Hawai'i's industries, including 7.1 cents from agriculture itself, 5.3 cents from transportation, 2.9 cents from real estate and rentals, 2.4 cents from wholesale services, and 2.3 cents from mining and construction. The remaining 72.2 cents per dollar of output came from value added and imported inputs.

Table 2.2. 2022 Condensed Direct Requirements Table for Hawai‘i

Industry	Agriculture	Mining and Construction	Food processing	Manufacturing	Transportation
1 Agriculture	0.07090	0.00098	0.07491	0.00086	0.00001
2 Mining and Construction	0.02267	0.00194	0.00762	0.00082	0.01567
3 Food processing	0.00434	0.00000	0.02664	0.00550	0.00033
4 Manufacturing	0.00744	0.00169	0.00872	0.00465	0.01093
5 Transportation	0.05353	0.02942	0.01668	0.01565	0.06427
6 Information	0.00098	0.00354	0.00273	0.00190	0.00563
7 Utilities	0.01214	0.01117	0.01835	0.01000	0.00333
8 Wholesale trade	0.02435	0.04032	0.03406	0.01291	0.01045
9 Retail trade	0.00865	0.05750	0.01169	0.00392	0.00120
10 Finance and insurance	0.01102	0.01481	0.00296	0.00429	0.00744
11 Real estate and rentals	0.02946	0.05681	0.02538	0.01024	0.01920
12 Professional services	0.00396	0.06890	0.00994	0.00668	0.01706
13 Business services	0.00966	0.02201	0.07967	0.01504	0.04367
14 Educational services	0.00000	0.00046	0.00014	0.00136	0.00151
15 Health services	0.00000	0.00000	0.00000	0.00000	0.00150
16 Arts and entertainment	0.00078	0.00137	0.00226	0.00065	0.00033
17 Accommodation	0.00480	0.02050	0.04424	0.01331	0.00541
18 Eating and drinking places	0.00423	0.02024	0.04105	0.00755	0.02635
19 Other services	0.00109	0.00119	0.00431	0.00196	0.00211
20 Government	0.00825	0.00304	0.01046	0.00673	0.06877
Total intermediate input	0.27825	0.35590	0.42182	0.12403	0.30518
Imports	0.14648	0.16659	0.19551	0.56540	0.08893
Value Added	0.57527	0.47751	0.38267	0.31057	0.60589
Total	1.00000	1.00000	1.00000	1.00000	1.00000

Industry	Information	Utilities	Wholesale trade	Retail trade	Finance and insurance
1 Agriculture	0.00000	0.00001	0.00004	0.00002	0.00000
2 Mining and Construction	0.00437	0.04470	0.00278	0.00403	0.00535
3 Food processing	0.00019	0.00000	0.00017	0.00005	0.00000
4 Manufacturing	0.00025	0.11798	0.00086	0.00072	0.00017
5 Transportation	0.02259	0.01250	0.01456	0.00835	0.02144
6 Information	0.08079	0.00186	0.01374	0.00660	0.02074
7 Utilities	0.00659	0.06975	0.00634	0.01271	0.00435
8 Wholesale trade	0.00901	0.00634	0.01389	0.00201	0.00086
9 Retail trade	0.01256	0.00399	0.00750	0.00800	0.00182
10 Finance and insurance	0.01819	0.01225	0.01075	0.01121	0.13511
11 Real estate and rentals	0.05332	0.00853	0.03448	0.06384	0.03628
12 Professional services	0.03444	0.03185	0.01665	0.01202	0.04093
13 Business services	0.02917	0.02064	0.03643	0.02257	0.03070
14 Educational services	0.00577	0.01368	0.00064	0.00048	0.00826
15 Health services	0.00000	0.00000	0.00000	0.00001	0.00001
16 Arts and entertainment	0.00310	0.00031	0.00000	0.00000	0.00000
17 Accommodation	0.01862	0.02105	0.02979	0.01929	0.05039
18 Eating and drinking places	0.02786	0.01788	0.01780	0.01082	0.03032
19 Other services	0.00462	0.00059	0.00279	0.00191	0.00349
20 Government	0.00956	0.01252	0.00907	0.01918	0.01650
Total intermediate input	0.34099	0.39644	0.21827	0.20384	0.40673
Imports	0.21779	0.05799	0.10397	0.07356	0.10085
Value Added	0.44122	0.54557	0.67776	0.72260	0.49243
Total	1.00000	1.00000	1.00000	1.00000	1.00000

Table 2.2. 2022 Condensed Direct Requirements Table for Hawai'i - Continued

Industry	Real estate and rentals	Professional services	Business services	Educational services	Health services
1 Agriculture	0.00150	0.00041	0.00013	0.00003	0.00050
2 Mining and Construction	0.04820	0.00484	0.00371	0.00926	0.00329
3 Food processing	0.00000	0.00019	0.00000	0.00001	0.00188
4 Manufacturing	0.00086	0.00023	0.00086	0.00008	0.00077
5 Transportation	0.00671	0.05327	0.01694	0.00669	0.00899
6 Information	0.00307	0.01677	0.00851	0.00498	0.00593
7 Utilities	0.00463	0.00837	0.00889	0.00225	0.01332
8 Wholesale trade	0.00273	0.00551	0.00415	0.00118	0.00692
9 Retail trade	0.00908	0.01306	0.00838	0.00021	0.00384
10 Finance and insurance	0.03965	0.01011	0.00616	0.00158	0.00496
11 Real estate and rentals	0.03180	0.06300	0.03297	0.01999	0.03857
12 Professional services	0.01076	0.07081	0.04715	0.00489	0.02707
13 Business services	0.01582	0.01622	0.03203	0.00680	0.03828
14 Educational services	0.00016	0.00154	0.00053	0.00126	0.00481
15 Health services	0.00000	0.00229	0.00030	0.00535	0.05585
16 Arts and entertainment	0.00001	0.00000	0.00000	0.00021	0.00004
17 Accommodation	0.01440	0.07342	0.01484	0.00582	0.03263
18 Eating and drinking places	0.00470	0.01859	0.01059	0.01182	0.02152
19 Other services	0.02321	0.00346	0.00391	0.00073	0.00179
20 Government	0.01067	0.00952	0.01691	0.00183	0.01470
Earnings (household sector)	0.11378	0.40192	0.53836	0.34586	0.35565
Total intermediate input	0.22795	0.37161	0.21697	0.08496	0.28566
Imports	0.02691	0.08526	0.03468	0.00991	0.09269
Value Added	0.74514	0.54313	0.74834	0.90513	0.62165
Total	1.00000	1.00000	1.00000	1.00000	1.00000

Industry	Arts, entertainment, and recreation	Accommodation	Eating and drinking places	Other services	Government
1 Agriculture	0.00014	0.00002	0.00930	0.00045	0.00001
2 Mining and Construction	0.00138	0.04025	0.02389	0.00553	0.00229
3 Food processing	0.00005	0.00044	0.03447	0.00022	0.00007
4 Manufacturing	0.00009	0.00085	0.01163	0.00065	0.00012
5 Transportation	0.00279	0.02332	0.01775	0.01484	0.00421
6 Information	0.00156	0.01022	0.00695	0.00553	0.00044
7 Utilities	0.00424	0.04892	0.02825	0.01337	0.00120
8 Wholesale trade	0.00071	0.00995	0.02765	0.00416	0.00080
9 Retail trade	0.00020	0.00323	0.00404	0.00600	0.00001
10 Finance and insurance	0.00110	0.02831	0.01096	0.00441	0.00036
11 Real estate and rentals	0.00636	0.03957	0.04399	0.03141	0.00079
12 Professional services	0.00589	0.03586	0.03221	0.01392	0.00116
13 Business services	0.00392	0.08202	0.02722	0.02035	0.00158
14 Educational services	0.00048	0.00020	0.00012	0.00044	0.00006
15 Health services	0.00144	0.00000	0.00000	0.00197	0.00080
16 Arts and entertainment	0.00764	0.00150	0.00424	0.00035	0.00001
17 Accommodation	0.00183	0.03013	0.02789	0.02023	0.00133
18 Eating and drinking places	0.00571	0.02684	0.03137	0.00499	0.00095
19 Other services	0.00097	0.00373	0.00283	0.00363	0.00021
20 Government	0.00548	0.02826	0.01346	0.00579	0.00114
Total intermediate input	0.05200	0.41360	0.35822	0.15825	0.01756
Imports	0.01187	0.07246	0.15780	0.05809	0.00633
Value Added	0.93613	0.51393	0.48398	0.78366	0.97611
Total	1.00000	1.00000	1.00000	1.00000	1.00000

Total Requirements Table

The direct requirements table (Table 2.2) shows the immediate effects on producing sectors from a \$1 change in final demand. These direct effects trigger successive indirect impacts across industries. For example, accommodation requires 23.3 cents of transportation services for every \$1 of output. To provide this, transportation must purchase inputs from its own suppliers, who in turn must obtain inputs from others. This chain of indirect impacts continues across industries, though each successive round diminishes as some purchasing power leaks out of the economy through imports. Capturing all indirect effects of a \$1 increase in accommodation output therefore requires considering the entire network of supplying sectors.

Calculating these effects directly would be tedious, especially with many sectors. Matrix algebra simplifies the process: subtracting the direct requirements table from an identity matrix and inverting the result yields the total requirements table, also called the Leontief inverse. This table shows both direct and indirect effects of a \$1 change in final demand. Mathematical details of the procedure are provided in Appendix B.

Table 2.3 presents the Type 1 total requirements table for the 20-industry model. Each column shows the combined direct and indirect impacts on producing sectors from a \$1 change in that sector's final demand. The column totals represent the final-demand output multipliers. For example, a \$1 increase in agriculture's final demand raises total economic output by about \$1.39: \$1.07 from agriculture itself (including the initial \$1) and 32 cents from other endogenous sectors.

Input-Output Multipliers

One of the key applications of I-O analysis is assessing the effects of an exogenous (external) change on the economy. In the I-O framework, sectoral outputs are demand-driven, and multipliers derived from the I-O table are used to estimate the impacts of changes in an industry's final demand. The three most commonly used multipliers are output, earnings, and employment (jobs).

Multipliers capture both direct and indirect effects of a demand change. The direct effect is the initial impact on the industry experiencing the change, while the indirect effect reflects subsequent purchases of inputs within and across industries. When earnings and personal consumption expenditures (PCEs) are included as an additional endogenous sector, multipliers also measure the effects of household spending triggered by changes in earnings. These additional effects are referred to as induced effects.

Table 2.3. 2022 Condensed Total Requirements Table (Type 1) for Hawai'i

1	Agriculture	1.07696	0.00162	0.08367	0.00157	0.00058
2	Mining and Construction	0.02946	1.01045	0.01811	0.00382	0.02074
3	Food processing	0.00526	0.00111	1.02968	0.00610	0.00163
4	Manufacturing	0.01110	0.00491	0.01425	1.00669	0.01323
5	Transportation	0.06610	0.04183	0.03175	0.01975	1.07466
6	Information	0.00347	0.00868	0.00713	0.00345	0.00883
7	Utilities	0.01685	0.01801	0.02858	0.01299	0.00733
8	Wholesale trade	0.02971	0.04427	0.04192	0.01462	0.01424
9	Retail trade	0.01247	0.06162	0.01657	0.00512	0.00415
10	Finance and insurance	0.01843	0.02583	0.01216	0.00750	0.01321
11	Real estate and rentals	0.04153	0.07717	0.04501	0.01571	0.03052
12	Professional services	0.01269	0.08461	0.02577	0.01153	0.02780
13	Business services	0.01971	0.03623	0.09844	0.02074	0.05404
14	Educational services	0.00060	0.00128	0.00092	0.00172	0.00202
15	Health services	0.00017	0.00031	0.00018	0.00009	0.00188
16	Arts, entertainment, and recreation	0.00101	0.00163	0.00279	0.00077	0.00059
17	Accommodation	0.01152	0.03525	0.05692	0.01740	0.01281
18	Eating and drinking places	0.01013	0.02867	0.05088	0.01069	0.03274
19	Other services	0.00276	0.00415	0.00679	0.00274	0.00365
20	Government	0.01611	0.01200	0.01988	0.01008	0.07713
Output multipliers (Type 1)		1.39	1.50	1.59	1.17	1.40
		Finance and insurance				
	Industry	Information	Utilities	Wholesale trade	Retail trade	
1	Agriculture	0.00067	0.00066	0.00047	0.00037	0.00072
2	Mining and Construction	0.01236	0.05286	0.00855	0.01046	0.01495
3	Food processing	0.00159	0.00171	0.00105	0.00063	0.00162
4	Manufacturing	0.00280	0.12895	0.00288	0.00323	0.00283
5	Transportation	0.03394	0.02435	0.02145	0.01369	0.03604
6	Information	1.09144	0.00551	0.01757	0.00924	0.02972
7	Utilities	0.01267	1.08105	0.01119	0.01695	0.01265
8	Wholesale trade	0.01315	0.01283	1.01655	0.00408	0.00519
9	Retail trade	0.01680	0.00956	0.00994	1.01032	0.00578
10	Finance and insurance	0.02981	0.02088	0.01794	0.01878	1.16445
11	Real estate and rentals	0.07250	0.02402	0.04567	0.07332	0.05869
12	Professional services	0.04993	0.04823	0.02646	0.01995	0.06242
13	Business services	0.04293	0.03405	0.04628	0.03018	0.05001
14	Educational services	0.00693	0.01537	0.00119	0.00103	0.01021
15	Health services	0.00026	0.00028	0.00014	0.00012	0.00033
16	Arts, entertainment, and recreation	0.00366	0.00070	0.00024	0.00016	0.00043
17	Accommodation	0.03090	0.03381	0.03751	0.02574	0.07011
18	Eating and drinking places	0.03706	0.02653	0.02323	0.01502	0.04325
19	Other services	0.00760	0.00225	0.00463	0.00416	0.00653
20	Government	0.01739	0.01963	0.01449	0.02350	0.02710
Output multipliers (Type 1)		1.48	1.54	1.31	1.28	1.60

Table 2.3. 2022 Condensed Total Requirements Table (Type 1) for Hawai‘i - Continued

Industry		Real estate and rentals	Professional services	Business services	Educational services	Health services
1	Agriculture	0.00191	0.00104	0.00046	0.00027	0.00124
2	Mining and Construction	0.05303	0.01603	0.00888	0.01168	0.01038
3	Food processing	0.00042	0.00133	0.00061	0.00053	0.00312
4	Manufacturing	0.00242	0.00366	0.00303	0.00090	0.00394
5	Transportation	0.01393	0.06847	0.02483	0.00936	0.01709
6	Information	0.00628	0.02306	0.01194	0.00627	0.00966
7	Utilities	0.00881	0.01734	0.01310	0.00402	0.02012
8	Wholesale trade	0.00636	0.01010	0.00647	0.00259	0.01034
9	Retail trade	0.01371	0.01738	0.01098	0.00158	0.00681
10	Finance and insurance	0.05091	0.02211	0.01218	0.00417	0.01224
11	Real estate and rentals	1.04434	0.08351	0.04436	0.02451	0.05297
12	Professional services	0.02228	1.08888	0.05771	0.00876	0.03986
13	Business services	0.02473	0.03443	1.04035	0.01027	0.05106
14	Educational services	0.00088	0.00244	0.00107	1.00147	0.00569
15	Health services	0.00015	0.00281	0.00055	0.00572	1.05935
16	Arts, entertainment, and recreation	0.00020	0.00039	0.00017	0.00032	0.00030
17	Accommodation	0.02310	0.08876	0.02353	0.00870	0.04342
18	Eating and drinking places	0.01030	0.02863	0.01555	0.01398	0.02858
19	Other services	0.02498	0.00672	0.00567	0.00155	0.00395
20	Government	0.01522	0.02088	0.02207	0.00381	0.02110
Output multipliers (Type 1)		1.32	1.54	1.30	1.12	1.40

Industry		Arts, entertainment, and recreation	Accommodation	Eating and drinking places	Other services	Government
1	Agriculture	0.00027	0.00074	0.01359	0.00071	0.00005
2	Mining and Construction	0.00254	0.05035	0.03308	0.01019	0.00267
3	Food processing	0.00031	0.00187	0.03707	0.00059	0.00013
4	Manufacturing	0.00088	0.00907	0.01757	0.00315	0.00039
5	Transportation	0.00422	0.03676	0.02957	0.02000	0.00493
6	Information	0.00217	0.01592	0.01146	0.00775	0.00067
7	Utilities	0.00531	0.05942	0.03722	0.01725	0.00158
8	Wholesale trade	0.00130	0.01577	0.03417	0.00603	0.00109
9	Retail trade	0.00071	0.00939	0.00914	0.00795	0.00028
10	Finance and insurance	0.00225	0.04156	0.02081	0.00928	0.00076
11	Real estate and rentals	0.00850	0.05973	0.06150	0.03919	0.00162
12	Professional services	0.00789	0.05684	0.04769	0.02091	0.00197
13	Business services	0.00554	0.09872	0.04362	0.02719	0.00236
14	Educational services	0.00062	0.00173	0.00111	0.00092	0.00011
15	Health services	0.00158	0.00029	0.00022	0.00220	0.00087
16	Arts, entertainment, and recreation	1.00775	0.00190	0.00473	0.00048	0.00002
17	Accommodation	0.00343	1.04495	0.04149	0.02564	0.00189
18	Eating and drinking places	0.00680	0.03698	1.04099	0.00869	0.00142
19	Other services	0.00131	0.00649	0.00547	1.00504	0.00030
20	Government	0.00647	0.03764	0.02127	0.00988	1.00171
Output multipliers (Type 1)		1.07	1.59	1.51	1.22	1.02

Thus, depending upon whether the household sector is included as an industry in the model or not, there are two types of multipliers, namely Type 1 and Type 2. They are calculated as follows:

$$\text{Type 1 multiplier} = \frac{\text{Direct effect} + \text{Indirect effect}}{\text{Direct effect}}$$

$$\text{Type 2 multiplier} = \frac{\text{Direct effect} + \text{Indirect effect} + \text{Induced effect}}{\text{Direct effect}}$$

Type 2 multipliers are larger than Type 1 multipliers because they include the induced effects of household spending. As they capture these induced effects, Type 2 multipliers are more commonly used in practical applications.

Since multipliers are defined as the ratio of total effects to direct effects, many types of multipliers can be derived. The two most widely used are the final-demand multiplier and the direct-effect multiplier. The final-demand multiplier measures the total change in a variable (such as output, earnings, state taxes, wage and salary jobs, or total jobs) resulting from a change in an industry's final demand. The direct-effect multiplier measures the total change in a variable that results from a one-unit change in the same variable within the industry.

Output Multipliers

Final-demand output multipliers for each sector are obtained by summing the corresponding column entries of the total requirements table (Appendix B). For the 20 endogenous sectors, these multipliers appear in the last row of Table 2.3 and in Table 2.4.

For example, the Type 1 output multiplier for agriculture is 1.39. This means that a \$1 increase in agriculture's final demand generates a \$1.39 increase in total output in the economy. Of this, \$1.00 reflects the direct effect (the initial increase in agriculture's demand), and \$0.39 reflects the indirect effects from inter-industry linkages. Because the household sector is excluded from the calculation, these are referred to as Type 1 output multipliers.

Earnings Multipliers

Final-demand earnings multipliers measure the impact of a change in an industry's final demand on household payments (earnings). Following the RIMS II (Regional Input-Output Modeling System) methodology of the Bureau of Economic Analysis (BEA, 1997), earnings are defined as household income from the production of regional goods and services that are available for spending. They are calculated as:

Earnings = Wage and salary income + Proprietors' income + Directors' fees + Employer contributions to health insurance – Personal contributions to social insurance

This definition excludes components of labor income that cannot be spent, such as social security contributions and employer pension contributions. As a result, earnings are slightly smaller than labor income totals shown in the transactions table (Table 2.1).

Type 1 earnings multipliers are derived by applying earnings-to-output ratios (direct earnings coefficients) to the total requirements table. Multiplying each row of the table by its direct earnings coefficient converts output effects into earnings equivalents. The column totals of the resulting matrix represent the final-demand earnings multipliers. For agriculture, the Type 1 final-demand earnings multiplier is 0.43 (Table 2.4), meaning that a \$1 increase in agricultural final demand increases household earnings in the economy by 43 cents.

The direct-effect earnings multiplier is the ratio of the final-demand earnings multiplier to the direct earnings coefficient. With a direct earnings coefficient of 0.32002, agriculture's Type 1 direct-effect earnings multiplier is 1.34 ($0.43 \div 0.32002$). This means a \$1 increase in household earnings in agriculture raises total earnings in the economy by \$1.34.

State Tax Multipliers

The 2022 I-O study also produces multipliers for total state tax revenues and their major components, since tax impacts are frequently analyzed in policy studies. Final-demand state tax multipliers measure the impact of a change in an industry's final demand on state tax revenues.

The state taxes in the 2022 I-O include the following five categories: (1) general excise and use tax, (2) individual income tax, (3) corporate income tax, (4) transient accommodations tax, (5) other state taxes, which includes: fuel tax, alcohol and tobacco tax, PUC tax, insurance tax, unemployment compensation tax, motor vehicle tax/fees, conveyance tax, bank and other financial institutions tax, and licenses, permits, and others. Excluded from state taxes were property taxes, other city and county taxes, and federal taxes. The calculation mirrors that for earnings multipliers: entries in the total requirements table (Leontief inverse) are converted into tax equivalents by multiplying each row by the sector's state tax-to-output ratio.

Employment Multipliers

Final-demand employment multipliers are calculated similarly to earnings multipliers, except that direct employment coefficients (employment-to-output ratios) are used instead of earnings-to-output ratios. Alternatively, employment multipliers can be derived from earnings multipliers combined with employment-to-earnings ratios.

The employment-to-output ratio is calculated as industry employment divided by output, while the employment-to-earnings ratio is employment divided by earnings. Mathematical details are provided in Appendix B.

A final-demand employment multiplier indicates the number of jobs created by a \$1 million increase in final demand. For example, agriculture's Type 1 final-demand employment multiplier is 18.32. Thus, an additional \$1 million demand for Hawai'i's agricultural products would create about 18.32 jobs in the state.

The direct-effect employment multiplier is the ratio of the final-demand employment multiplier to the direct employment coefficient. With a direct employment coefficient of 15.57 ($15,684 \div 1,007.2$), agriculture's Type 1 direct-effect employment multiplier is 1.18 ($18.32 \div 15.57$).

Employment multipliers generally decline over time due to productivity gains and inflation. The employment multipliers presented in Table 2.4 are for 2022. Because this report is published in 2025, using the 2022 multipliers for later years would overstate employment impacts. To address this, DBEDT has computed adjusted multipliers for 2023–2032, accounting for productivity growth and inflation.¹ These are not included here but are available on the DBEDT website.

Type 2 Multipliers

Type 2 multipliers treat households as both suppliers of labor and consumers of goods and services. A household row and column are added to the direct requirements table to capture the effects of changes in household earnings and spending.

For the 2022 I-O table, Type 2 multipliers are computed using BEA's RIMS II methodology rather than the traditional "textbook" approach. The latter often overstates induced effects because it does not account for leakages from taxes, savings, and household spending financed by transfers.

Under the RIMS II method, entries in the household row are earnings-to-output ratios, while entries in the household column are derived by dividing each industry's PCEs by total PCEs and adjusting for the share of disposable income (personal income less taxes and savings). This procedure parallels IMPLAN's disposable income method.

The conceptual procedures are otherwise the same as for Type 1 multipliers. Using the Type 2 total requirements table, output, earnings, and employment multipliers are calculated in the same way. Due to induced effects, Type 2 multipliers are larger than Type 1 multipliers. For comparison, Type 1 and Type 2 output, earnings, and employment multipliers are shown in Table 2.4, and Type 1 and Type 2 state tax multipliers are presented in Table 2.5.

¹ We accounted for the impact of the COVID era on productivity by estimating sectoral productivity trajectories during that period. To align with previous Input-Output (IO) model versions, we assumed a two-year transition phase (2023–2024), during which productivity gradually returned to its long-term growth path. This baseline was then used to project productivity growth for the 2025–2032 period.

Table 2.4. 2022 Condensed Output, Earnings, and Employment Multipliers for Hawai‘i

Industry	Final-demand multipliers					
	Output multipliers		Earnings multipliers		Total job multipliers	
	Type 1	Type 2	Type 1	Type 2	Type1	Type 2
1 Agriculture	1.39	1.92	0.43	0.58	18.32	21.37
2 Mining and construction	1.50	2.08	0.47	0.63	6.81	10.16
3 Food processing	1.59	2.11	0.42	0.56	10.73	13.68
4 Other manufacturing	1.17	1.38	0.17	0.23	3.16	4.37
5 Transportation	1.40	1.90	0.40	0.54	7.49	10.37
6 Information	1.48	1.80	0.26	0.34	4.54	6.36
7 Utilities	1.54	1.84	0.24	0.32	3.39	5.09
8 Wholesale trade	1.31	1.76	0.37	0.49	6.14	8.73
9 Retail trade	1.28	1.70	0.34	0.45	9.23	11.64
10 Finance and insurance	1.60	2.05	0.36	0.48	7.48	10.03
11 Real estate and rentals	1.32	1.58	0.21	0.28	4.16	5.63
12 Professional services	1.54	2.22	0.55	0.74	8.59	12.52
13 Business services	1.30	2.09	0.63	0.85	12.32	16.83
14 Educational services	1.12	1.59	0.38	0.51	17.46	20.15
15 Health services	1.40	2.00	0.48	0.65	9.51	12.94
16 Arts and entertainment	1.07	1.82	0.60	0.81	16.25	20.54
17 Accommodation	1.59	2.09	0.41	0.55	6.48	9.39
18 Eating and drinking	1.51	2.12	0.49	0.66	11.89	15.40
19 Other services	1.22	1.74	0.42	0.56	20.32	23.28
20 Government	1.02	1.77	0.60	0.81	8.62	12.90
State weighted average 1/	1.36	1.87	0.41	0.55	7.84	10.74
Industry	Final-demand multipliers		Direct-effect multipliers			
	W&S jobs		Earnings multipliers		Total job multipliers	
	Type 1	Type 2	Type 1	Type 2	Type1	Type 2
1 Agriculture	8.94	11.11	1.34	1.80	1.18	1.37
2 Mining and construction	4.99	7.37	1.43	1.92	1.68	2.50
3 Food processing	8.70	10.80	1.82	2.44	1.71	2.18
4 Other manufacturing	2.21	3.07	1.43	1.91	1.46	2.02
5 Transportation	5.30	7.35	1.56	2.09	1.53	2.11
6 Information	3.33	4.62	2.02	2.71	2.29	3.21
7 Utilities	2.65	3.86	2.29	3.08	3.64	5.46
8 Wholesale trade	4.78	6.63	1.33	1.79	1.39	1.98
9 Retail trade	6.96	8.67	1.30	1.74	1.19	1.49
10 Finance and insurance	4.16	5.97	1.87	2.51	1.77	2.38
11 Real estate and rentals	1.76	2.81	1.82	2.44	1.90	2.57
12 Professional services	4.98	7.78	1.38	1.85	1.47	2.14
13 Business services	9.12	12.33	1.18	1.58	1.17	1.60
14 Educational services	13.72	15.64	1.10	1.47	1.04	1.20
15 Health services	7.88	10.32	1.35	1.82	1.34	1.82
16 Arts and entertainment	9.03	12.08	1.04	1.40	1.03	1.30
17 Accommodation	5.47	7.54	1.81	2.43	2.05	2.97
18 Eating and drinking	10.55	13.04	1.42	1.90	1.32	1.71
19 Other services	9.28	11.38	1.18	1.58	1.06	1.22
20 Government	8.58	11.63	1.01	1.36	1.02	1.52
State weighted average 1/	5.77	7.84	1.50	2.01	1.58	2.20

1/ Output as weight.

Table 2.5. 2022 Condensed State Tax Multipliers for Hawai‘i

Final-demand multipliers for state taxes						
Industry	State total tax multipliers		State individual income		State GET multipliers	
	Type 1	Type 2	type 1	type 2	type 1	type 2
1 Agriculture	0.050	0.082	0.024	0.035	0.013	0.027
2 Mining and construction	0.099	0.135	0.032	0.043	0.051	0.067
3 Food processing	0.062	0.094	0.031	0.041	0.014	0.028
4 Other manufacturing	0.028	0.041	0.013	0.017	0.004	0.010
5 Transportation	0.060	0.091	0.030	0.040	0.015	0.028
6 Information	0.063	0.083	0.019	0.025	0.019	0.027
7 Utilities	0.083	0.101	0.018	0.024	0.008	0.016
8 Wholesale trade	0.071	0.099	0.026	0.035	0.031	0.043
9 Retail trade	0.202	0.228	0.023	0.031	0.166	0.177
10 Finance and insurance	0.094	0.121	0.026	0.035	0.009	0.021
11 Real estate and rentals	0.064	0.079	0.014	0.019	0.034	0.040
12 Professional services	0.093	0.135	0.038	0.052	0.034	0.052
13 Business services	0.088	0.136	0.046	0.061	0.029	0.050
14 Educational services	0.067	0.095	0.030	0.039	0.025	0.038
15 Health services	0.079	0.116	0.035	0.047	0.029	0.045
16 Arts and entertainment	0.068	0.114	0.037	0.052	0.022	0.042
17 Accommodation	0.142	0.173	0.025	0.036	0.032	0.045
18 Eating and drinking	0.080	0.117	0.032	0.044	0.031	0.047
19 Other services	0.056	0.088	0.027	0.037	0.018	0.031
20 Government	0.063	0.109	0.053	0.067	0.000	0.020
State weighted average 1/	0.087	0.118	0.030	0.040	0.034	0.047
Industry	State TAT multipliers		State Other Taxes			
	type 1	type 2	type 1	type 2		
1 Agriculture	0.0008	0.0019	0.0121	0.0186		
2 Mining and construction	0.0023	0.0036	0.0136	0.0209		
3 Food processing	0.0038	0.0049	0.0134	0.0198		
4 Other manufacturing	0.0012	0.0016	0.0092	0.0118		
5 Transportation	0.0009	0.0020	0.0143	0.0205		
6 Information	0.0021	0.0028	0.0236	0.0275		
7 Utilities	0.0022	0.0029	0.0546	0.0583		
8 Wholesale trade	0.0025	0.0035	0.0114	0.0170		
9 Retail trade	0.0017	0.0026	0.0115	0.0167		
10 Finance and insurance	0.0047	0.0056	0.0534	0.0589		
11 Real estate and rentals	0.0015	0.0021	0.0148	0.0180		
12 Professional services	0.0059	0.0074	0.0145	0.0230		
13 Business services	0.0016	0.0033	0.0121	0.0219		
14 Educational services	0.0006	0.0016	0.0109	0.0167		
15 Health services	0.0029	0.0042	0.0130	0.0204		
16 Arts and entertainment	0.0002	0.0019	0.0089	0.0182		
17 Accommodation	0.0695	0.0706	0.0158	0.0221		
18 Eating and drinking	0.0028	0.0041	0.0142	0.0218		
19 Other services	0.0017	0.0028	0.0102	0.0166		
20 Government	0.0001	0.0018	0.0099	0.0191		
State weighted average 1/	0.007	0.008	0.017	0.023		

1/ Output as weight.

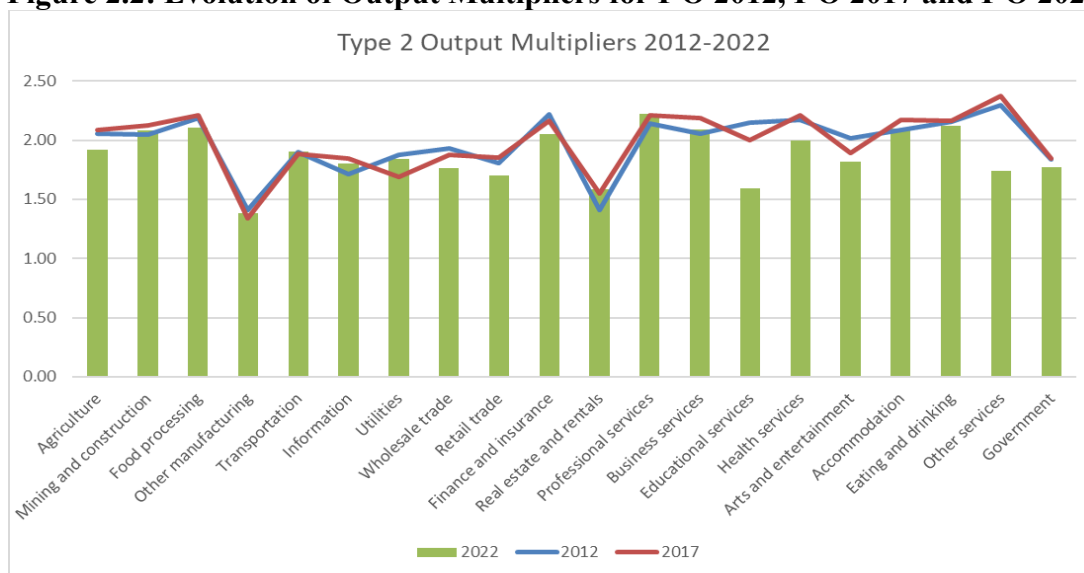
Trends in Multipliers, 2012–2022

To place the 2022 I-O multipliers in perspective, it is useful to examine their evolution over the past decade. For illustration, figures 2.2 through 2.4 present Type II multipliers for output, earnings, and total jobs, comparing results for the 2012, 2017, and 2022 benchmark tables.

Output multiplier trends

Across most industries, output multipliers have remained relatively stable, with modest declines in some sectors. For example, multipliers for agriculture and food processing decreased slightly between 2017 and 2022, while professional services showed a small increase. Service-oriented industries generally continue to exhibit higher output multipliers, reflecting their extensive linkages with other sectors of the economy.²

Figure 2.2: Evolution of Output Multipliers for I-O 2012, I-O 2017 and I-O 2022



Earnings multiplier trends

Earnings multipliers also show gradual changes rather than sharp shifts. Labor-intensive industries such as professional services, and business services continue to generate relatively large earnings effects. By contrast, capital-intensive sectors such as utilities and real estate maintain lower earnings multipliers. The stability of these measures highlights the persistence of structural characteristics in Hawai‘i’s economy.

² The lower multiplier for educational services reflects an updated and more accurate measurement. Meanwhile, the composition of other services explains the consolidated multiplier. Subsectors like Repair and Maintenance and Organizations (nonprofits)—both housed within other services—pulled down the aggregate multiplier (Table 6.1). These lower 2022 output multipliers likely reflect weaker local supply chains, a larger share of spending going to wages or off-island purchases, and post-pandemic shifts toward standardized, remote, or centralized operations.

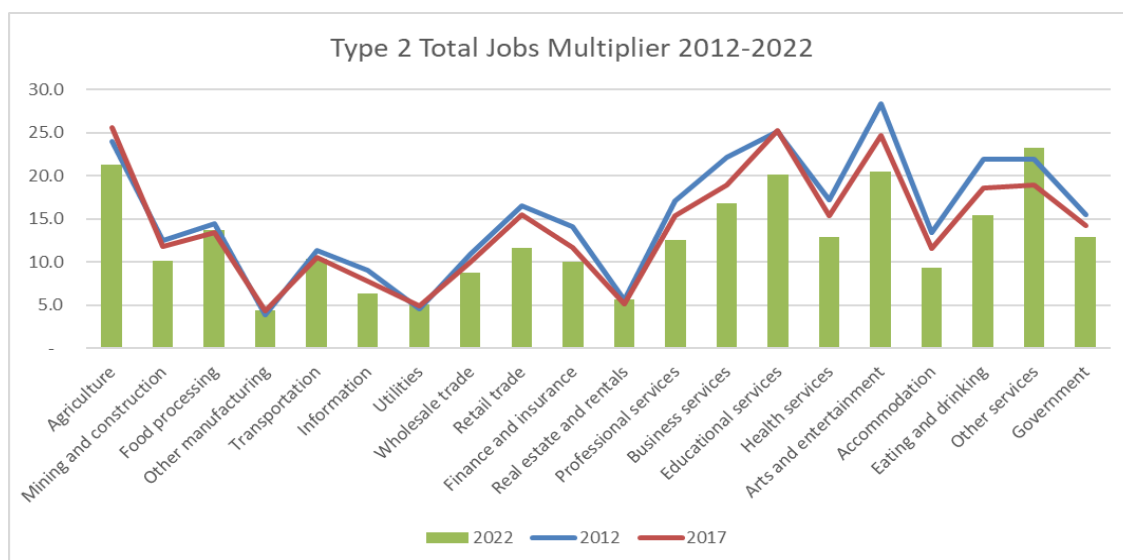
Figure 2.3: Evolution of Earning Multipliers for I-O 2012, I-O 2017 and I-O 2022



Total jobs multiplier trends

Job multipliers show somewhat larger adjustments across periods, consistent with changes in labor productivity. In general, multipliers have declined slightly over time, indicating that each additional dollar of final demand now generates fewer jobs than in earlier years. This trend is most evident in agriculture, retail, and business and educational services, where technology and efficiency improvements have reduced labor intensity.

Figure 2.4: Evolution of Total Job Multipliers for I-O 2012, I-O 2017 and I-O 2022



Taken together, these comparisons show that Hawai‘i’s multiplier structure is relatively stable over time, with gradual shifts reflecting productivity growth, and changes in sectoral composition. The results reinforce the importance of periodic benchmark updates, ensuring that policy analysis and impact assessments are based on the most current representation of the economy.

III. CONSIDERATIONS AND EXAMPLES OF USING I-O MODELS IN IMPACT ANALYSIS

Considerations in Using I-O Models in Impact Analysis

I-O models remain a workhorse for regional impact analysis because they translate a clearly stated final-demand shock into a transparent decomposition of direct, indirect, and induced effects across industries and households. Their usefulness, however, depends on disciplined application and a clear understanding of assumptions and data. This section summarizes key strengths, limitations, and good-practice cautions that guide the use of the 2022 Hawai‘i I-O model.

What I-O models are good at?

1. **Transparent accounting of interindustry linkages.** One of the defining strengths of I-O analysis is its ability to provide a clear and comprehensive map of how industries are connected through purchases and sales of intermediate goods and services. At the core of the framework is the interindustry transaction table, which specifies “who buys what from whom” in monetary terms. By arranging these flows into a system of equations, the I-O model traces how a change in final demand for a sector’s output translates into requirements for upstream suppliers, and further into indirect and induced demand across the economy. This level of transparency is particularly valuable in policy contexts where decision-makers want to know, not just the size of the multiplier, but which industries and households benefit, and along what supply chains.³
2. **Sectoral and effect-type granularity.** I-O analysis allows impacts to be disaggregated by both industry and type of effect. For example, multipliers can be calculated for output (gross sales or margins), value added/earnings (labor income), employment, and government revenues. This makes it possible to evaluate a policy or project along multiple dimensions — jobs created, income generated, tax revenues collected — and to compare effects across industries. Analysts can choose the appropriate measure for the policy question at hand.
3. **Adaptability to regional contexts.** Full survey-based I-O tables are expensive and rare, but regional economies can still construct models by adapting national tables. Methods such as Location Quotients (LQ) and the Flegg Location Quotient (FLQ) approximate regional purchase patterns by scaling national coefficients to reflect local specialization and import propensities.⁴ This is particularly useful in smaller or open economies like Hawai‘i, where imports play a significant role, and full surveys are impractical.
4. **Broad applied ecosystem.** I-O models are widely applied in public agencies, academic research, and consulting. The methodology has become accessible and standardized. Their broad use ensures comparability across studies when properly applied. This also means that policymakers and stakeholders are familiar with the results, which aids in communication and uptake.

³ Leontief, W. (1986). Input-output economics. Oxford University Press. For another classical reference, see Miller, R. E. (1985). Input-output analysis: foundations and extensions. Prentice-Hall.

⁴ Flegg, Anthony T., and Chris D. Webber. "Regional size, regional specialization and the FLQ formula." Regional studies 34.6 (2000): 563-569.

Limitations of I-O models

While input-output (I-O) models are valuable tools for estimating economic impacts, analysts should be mindful of several important limitations:

1. **Fixed-price, fixed-coefficient technology.** I-O assumes that production technologies are constant: firms use the same mix of inputs regardless of relative prices. In reality, firms substitute toward cheaper inputs, adopt new technologies, or adjust factor intensity. Ignoring these behaviors can overstate impacts, especially in the long run or in industries with flexible technologies.
2. **No capacity or supply constraints.** The model assumes that additional inputs — labor, materials, or infrastructure — are available without limit at base-year prices. This is rarely true in practice. For example, Hawai‘i’s construction sector faces labor shortages and land constraints, so a surge in demand may lead to higher wages or rents rather than proportional output expansion.
3. **Static baseline and aggregation bias.** Input–Output models are anchored in the structure of a single benchmark year. All technical coefficients, sectoral flows, and multipliers are estimated from that year’s data, meaning results reflect the economy as it looked at that point in time. The current Hawai‘i I-O model is based on 2022 data, capturing production patterns, tax structures, and household spending behaviors of that year. If significant changes occur afterward—such as major tax reforms, health emergencies, natural disasters, or shifts in key industries—the multipliers may overstate or understate actual impacts. For instance, Hawai‘i’s 2023–2024 income tax reform, which reduced tax liabilities for many households, alters disposable income levels and therefore household spending propensities. Because the 2022 benchmark does not capture this policy change, the induced effects of household income on consumption could be misrepresented in the model. In addition, the Covid-19 pandemic caused profound sectoral disruptions in productivity and cost structures, particularly in tourism, accommodation, food services, healthcare, and construction. Labor shortages, shifts to remote work, supply chain interruptions, and new health protocols permanently changed how certain industries operate. These structural shifts mean that the fixed input coefficients drawn from 2022 may not capture current substitution patterns or productivity dynamics, especially in sectors where recovery has been uneven. For these reasons, results should be interpreted as benchmarked approximations, not forecasts, and whenever possible should be supplemented with updated data, sensitivity checks, or complementary analyses.
4. **High multipliers are not necessarily “good.”** Projects should not be judged solely by multiplier size. A project with a high earnings multiplier might have a low employment multiplier or require high energy inputs. Costs such as capital investment, public subsidies, and tax incentives must also be considered.
5. **Other restrictive assumptions underlying I-O models.** The model assumes: (i) household consumption as a simple linear function of income; and (ii) zero effects from induced government spending or capital investment. When alternative assumptions are needed, other economic tools may be more appropriate.

Best practices

1. **Define the shock precisely.** Policy/project should be mapped into a final-demand change consistent with the I-O accounting convention (e.g., margins for retail, purchaser prices vs producer prices).
2. **No single multiplier for an entire economy.** There is no single “multiplier for Hawai‘i’s economy.” Multipliers vary by type (output, earnings, employment, tax) and by industry. For example, Table 6.1 contains 1,340 multipliers, and many more could be derived.
3. **Do not add output, earnings, and employment impacts together.** These represent different measures of the same effect. Just as we would not add a sector’s sales, earnings, and jobs to get its “size,” the same principle applies to impact results.
4. **Understand how output is measured.** For some industries, output is based on margins (retail, wholesale) or net operating revenues (finance, insurance, real estate), not total sales. For example, a duty-free store with \$100 million in sales contributes only its markup—not the full sales value—as output in I-O analysis.
5. **Government output is measured as value added.** General government sectors (federal, state, local) are included as industries for balance, but their output is defined as value added (compensation plus capital costs). When analyzing government spending, care is needed:
 - If spending is industry-specific, use that industry’s multipliers.
 - If not, allocate spending by the distribution in the base-year model.
 - If the increase is payroll, use the government sector’s multipliers.
6. **Net effects must be considered.** Changes in one sector often trigger opposite changes in others. For instance, a tax cut may reduce government spending while boosting household consumption. The net effect of both changes should be evaluated.

Examples of I-O Models Uses in Impact Analysis

The I-O table and the multipliers generated from it are a major tool used in economic impact analysis. The following are a few hypothetical examples showing practical applications of the I-O model and the correct use of I-O multipliers.⁵

Economic Impacts of Visitor Spending

Visitor spending is a major driver of Hawai‘i’s economy. In 2022, visitors spent about \$21.2 billion on goods and services produced in the state, accounting for roughly 13.4 percent of total output. Understanding the impacts of changes in visitor expenditures - whether from unforeseen events or shifts in visitor market conditions, is therefore essential.

⁵ Additional examples are available in the 1992, 1997, 2002, 2005, 2007, 2012 and 2017 State of Hawai‘i Input-Output Study.

As an illustration, consider a hypothetical special event in Honolulu in 2022 (such as a large convention or sporting event) that attracted 5,000 additional visitors for one week. This generates 35,000 visitor-days ($5,000 \text{ visitors} \times 7 \text{ days}$). Assuming an average daily spending of \$200 per visitor, total additional visitor expenditures would equal \$7 million.

To estimate the broader economic impact, this \$7 million is allocated across industries based on their shares of total visitor expenditures in the 2022 I-O table (unless more precise information is available). The resulting amounts are then multiplied by the Type 2 output, earnings, and job multipliers for each industry, and summed to obtain total effects.

The results, shown in Table 3.1, indicate that this one-week event could increase Hawai'i's total output by \$12.7 million and labor earnings by \$3.5 million. The model also estimates a gain of 72 jobs. However, the employment impact should be interpreted with caution: because the event lasts only seven days, additional labor demand would likely be met by extending hours for existing employees rather than creating new permanent positions. The I-O model framework assumes additional labor demand is met by new jobs, which can overstate short-term employment effects.

This example highlights both the usefulness and limitations of I-O multipliers for short-term, event-driven analyses.

Table 3.1. Economic Impacts of Increasing Visitor Spending by \$7 Million

Industry	Visitor expenditure shares (%)	Increase in visitor expenditure (\$ million)	Type 2 final-demand multipliers (from Table 2.4)			Economic impacts		
			Output	Earnings	Job	Output (\$ million)	Earnings (\$ million)	No. of jobs
Agriculture	0.12	0.01	1.92	0.58	21.4	0.02	0.01	0
Mining and construction	0.00	0.00	2.08	0.63	10.2	0.00	0.00	0
Food processing	0.16	0.01	2.11	0.56	13.7	0.02	0.01	0
Other manufacturing	0.32	0.02	1.38	0.23	4.4	0.03	0.01	0
Transportation	16.08	1.13	1.90	0.54	10.4	2.14	0.61	12
Information	0.14	0.01	1.80	0.34	6.4	0.02	0.00	0
Utilities	0.00	0.00	1.84	0.32	5.1	0.00	0.00	0
Wholesale trade	0.63	0.04	1.76	0.49	8.7	0.08	0.02	0
Retail trade	14.28	1.00	1.70	0.45	11.6	1.70	0.45	12
Finance and insurance	0.00	0.00	2.05	0.48	10.0	0.00	0.00	0
Real estate and rentals	8.64	0.60	1.58	0.28	5.6	0.96	0.17	3
Professional services	0.70	0.05	2.22	0.74	12.5	0.11	0.04	1
Business services	1.93	0.14	2.09	0.85	16.8	0.28	0.11	2
Educational services	0.95	0.07	1.59	0.51	20.2	0.11	0.03	1
Health services	1.04	0.07	2.00	0.65	12.9	0.15	0.05	1
Arts and entertainment	3.17	0.22	1.82	0.81	20.5	0.40	0.18	5
Accommodation	34.18	2.39	2.09	0.55	9.4	5.01	1.31	22
Eating and drinking	9.79	0.69	2.12	0.66	15.4	1.45	0.45	11
Other services	0.68	0.05	1.74	0.56	23.3	0.08	0.03	1
Government	0.79	0.06	1.77	0.81	12.9	0.10	0.04	1
Total Hawaii produced	93.60	6.55				12.7	3.5	72
Imports	6.40	0.45						
Total	100.00	7.00				12.7	3.5	72

Gross Impact vs. Net Impact: Creating a New Business

A new business typically generates two types of economic impacts:

1. One-time impacts from construction and other investment associated with establishing the facility.
2. Ongoing impacts from the continuous operation of the business.

When estimating ongoing impacts, results are often overstated if analysts fail to distinguish between gross and net impacts.

For example, a new retail store, hotel, restaurant, or movie theater does not necessarily increase total demand for goods or services unless existing capacity is insufficient. A new retail store may simply divert sales from existing outlets. Shoppers who use the new store might otherwise have purchased from other retailers, meaning the gross impact exaggerates the true net effect.

By contrast, one-time construction impacts are more straightforward. These can be estimated in the same way as the visitor spending example discussed earlier.

Consider a new grocery retail store with a construction cost of \$10 million and expected annual sales of \$20 million.

Using the 2022 I-O model, the \$10 million construction project could have increased Hawai'i's total output by \$10.2 million, labor earnings by \$3.1 million, and employment by 52 jobs (Table 3.2).

To estimate the long-term operational impact, the net effect on retail sales must first be determined. Assume that half of the store's \$20 million in annual sales represents new demand, while the other half displaces sales from existing retailers. In this case, the net impact is \$10 million, not \$20 million.

To measure the economic effects on output, earnings, and employment, the \$10 million must be allocated among transportation costs, wholesale and retail trade margins, and producers' prices for goods sold. Margin data for groceries are provided in Appendix C. Since all groceries sold are assumed to be imported from the U.S. mainland or abroad, the economic impacts stem solely from increased demand for distribution and trade services, not from local production of goods.

This example demonstrates the need to distinguish gross from net impacts to avoid overstating the benefits of new business operations.

Table 3.2. Economic Impacts of Increasing Private Investment by \$10 Million

Industry	Private investment shares (%)	Increase in private investment (\$ million)	Type 2 final-demand multipliers (from Table 2.4)			Economic impacts		
			Output	Earnings	Job	Output (\$ million)	Earnings (\$ million)	No. of jobs
Agriculture	0.00	0.00	1.92	0.58	21.4	0.0	0.0	0
Mining and construction	36.81	3.68	2.08	0.63	10.2	7.7	2.3	37
Food processing	0.00	0.00	2.11	0.56	13.7	0.0	0.0	0
Other manufacturing	0.62	0.06	1.38	0.23	4.4	0.1	0.0	0
Transportation	0.65	0.07	1.90	0.54	10.4	0.1	0.0	1
Information	0.00	0.00	1.80	0.34	6.4	0.0	0.0	0
Utilities	0.00	0.00	1.84	0.32	5.1	0.0	0.0	0
Wholesale trade	2.85	0.28	1.76	0.49	8.7	0.5	0.1	2
Retail trade	4.25	0.43	1.70	0.45	11.6	0.7	0.2	5
Finance and insurance	0.00	0.00	2.05	0.48	10.0	0.0	0.0	0
Real estate and rentals	0.32	0.03	1.58	0.28	5.6	0.1	0.0	0
Professional services	4.77	0.48	2.22	0.74	12.5	1.1	0.4	6
Business services	0.00	0.00	2.09	0.85	16.8	0.0	0.0	0
Educational services	0.00	0.00	1.59	0.51	20.2	0.0	0.0	0
Health services	0.00	0.00	2.00	0.65	12.9	0.0	0.0	0
Arts and entertainment	0.00	0.00	1.82	0.81	20.5	0.0	0.0	0
Accommodation	0.00	0.00	2.09	0.55	9.4	0.0	0.0	0
Eating and drinking	0.00	0.00	2.12	0.66	15.4	0.0	0.0	0
Other services	0.00	0.00	1.74	0.56	23.3	0.0	0.0	0
Government	0.00	0.00	1.77	0.81	12.9	0.0	0.0	0
Total intermediate input	50.27	5.03				10.2	3.1	52
Imports	49.73	4.97						
Total	100.00	10.00				10.2	3.1	52

As shown in Table 3.3, the \$10 million net increase in retail sales from the new store could raise Hawai‘i's total output by about \$6.6 million, labor earnings by \$1.8 million, and employment by 41 jobs. Unlike the one-time construction impacts, these operational impacts are ongoing for as long as the store remains in business.

It is important to note that these impacts stem from the increase in final demand for groceries, not simply from the opening of a new store. Without additional final demand, a new retail outlet would not generate measurable economic impacts, as sales would merely shift from existing stores. Final demand depends on factors such as personal income, population, prices, and the unemployment rate.

Table 3.3. Economic Impacts of an Increase in Grocery Sales by \$10 Million

	Margin (%)	Allocation (\$ million)	Type 2 final-demand multipliers (from Table 6.1)			Economic impacts		
			Output	Earnings	Job	Output (\$ million)	Earnings (\$ million)	No. of jobs
Margins								
Truck transportation	0.80	0.08	1.78	0.69	11.7	0.1	0.1	1
Air transportation	0.30	0.03	1.76	0.44	7.0	0.1	0.0	0
Water transportation	1.75	0.18	1.57	0.48	6.5	0.3	0.1	1
Wholesale trade	9.00	0.90	1.77	0.49	8.9	1.6	0.4	8
Retail trade	26.40	2.64	1.71	0.46	11.8	4.5	1.2	31
Producers' prices (imports)	61.75	6.18						
Total	100.00	10.00				6.6	1.8	41

Gross Impact vs. Net Impact: Government Spending

I-O analysis is frequently used to assess the effects of government spending. Consider, for example, a hypothetical \$10 million state program to provide early childhood health screening for low-income families. If we apply the Type II output multiplier for government spending (Table 2.4), \$10 million in expenditures would generate about \$17.7 million in total output—\$7.7 million more than the direct program spending. This represents the gross impact of the program.

However, gross impacts alone can be misleading because they ignore the question of how the program is funded. If \$10 million is devoted to this initiative, the money must come from somewhere else. Without the program, those funds might have supported household consumption or other state programs. The net impact therefore depends on the alternative use of funds.

Suppose the program is financed through a small increase in personal income taxes. In this case, households reduce their consumption by the same \$10 million, while savings remain unchanged. The net economic impact is the difference between the effects of reduced household spending and the effects of increased government spending.

Table 3.4 illustrates the calculation. Because the direct spending amount is the same (\$10 million), the difference comes entirely from the multipliers. Since the Type II output multiplier for government spending is larger than that for household spending, the program produces a net positive impact on Hawai‘i's total output.

This example highlights why analysts must consider both the funding source and the displaced use of funds when evaluating government spending programs. If, instead of a tax increase, the program

was financed by reallocating existing General Fund revenues, the net impact would depend on which programs were cut to make room for the new spending.

In practice, the wide range of funding options makes the analysis more complex. Still, the central principle holds: the economic impact of government spending should be measured on a net basis, accounting for both the benefits of the new expenditure and the opportunity cost of the funds.

For federally funded programs, the situation is different. Because the funds come from federal taxes or from reductions in other federal programs, analysts generally do not need to account for offsetting effects such as higher state taxes or cuts to other local programs when estimating the impact of federal spending in Hawai‘i.

Table 3.4. Net Impact of Government Spending

	Direct effect (\$ million)	Type 2 output multiplier*	Total output impact (\$ million)
Government	10.00	1.77	17.7
Households (PCE)	-10.00	1.54	-15.4
Net impact			2.3

* Note that the government multiplier is from Table 2.4 and the household or PCE multiplier is from Table 6.1. The Type 2 PCE output multiplier is derived by post-multiplying the Type 2 total requirements table by the PCE shares and then adding up the results. The PCE earnings and employment multipliers are derived similarly using the final-demand earnings and employment multiplier tables and the PCE shares.

The net impact of government spending depends not only on the multiplier size but also on how the program is financed. The choice of funding source can determine whether a program generates a positive, neutral, or even negative economic effect.

It is important to emphasize that multiplier comparisons should not be interpreted as policy prescriptions. The finding that government spending has a higher multiplier than household spending does not imply that raising tax rates indefinitely would expand economic output. Input–output multipliers are based on a fixed-coefficient accounting framework. They assume constant production technologies, no substitution among inputs, and no behavioral responses to changes in taxes or spending. As such, the model does not capture efficiency costs of taxation, crowding out effects, or long-run adjustments in household and business behavior. The example is intended to illustrate the difference between gross and net impacts within a consistent framework, not to recommend a particular fiscal policy. Multiplier comparisons provide useful insight into relative short-run impacts but should not be interpreted as guidance for setting tax rates or overall government spending levels.

Impact of New Construction Jobs

Tables 2.4 and 6.1 provide both final-demand and direct-effect multipliers for estimating earnings and employment impacts. The choice of multiplier depends on the question being addressed. If the goal is to measure the impacts of a change in an industry’s final demand, final-demand multipliers should be used. If the focus is on changes in income or employment within an industry, direct-effect multipliers are more appropriate.

In the latter case, the initial earnings or employment change is first converted into an output change using the industry's direct earnings coefficient (earnings-to-output ratio) and direct employment coefficient (employment-to-output ratio). The resulting output change is then multiplied by the industry's final-demand output multiplier to capture total effects.

As an example, consider the creation of 1,000 new jobs in Hawai'i's construction sector. The total job impact is obtained by multiplying the initial increase by the Type 2 direct-effect job multiplier for construction. This yields 2,502 jobs ($2.502 \times 1,000$), consisting of the original 1,000 jobs plus 1,502 additional jobs generated through indirect and induced effects.

To estimate earnings and output effects, the 1,000 jobs are converted to earnings and output changes using the construction sector's ratios: 0.081 for earnings-to-job and 0.246 for output-to-job. This produces initial (direct) increases of \$81 million in earnings and \$246 million in output. Applying the construction sector's direct-effect earnings multiplier (1.922) to the direct earnings change gives a total earnings effect of \$155 million (81×2.083). Similarly, applying the final-demand output multiplier to the direct increase in output yields a total output effect of \$513 million.

Alternatively, total job and earnings effects can also be derived by multiplying the direct output change and the final-demand employment and earnings multipliers, respectively. These results are summarized in Table 3.5.

This example illustrates how direct-effect multipliers can be used to estimate the broader economic consequences of observed changes in jobs or earnings.

Table 3.5. Impacts of 1,000 New Jobs in Hawai'i's Construction Sector

	Direct impact	Final-demand multipliers (from Table 2.4)	Direct-effect multipliers (from Table 2.4)	Total impact
Employment (no. of jobs)*	1,000	10.16	2.50	2,502
Earnings (\$ million)	81	0.63	1.92	155
Output (\$ million)	246	2.08		513
Earnings/total job ratio	0.081			
Output/total job ratio	0.246			

* Note that final-demand employment multipliers will change from year to year due to worker productivity growth and inflation-driven wage changes. The base, 2022 multipliers are used in this illustration for simplicity and clarity. For actual impact estimations the current year employment multipliers should be used.

Increase in Garment Sales to Visitors

Consider the impact of a \$100 million increase in clothing sales to visitors (Table 3.6). It would be incorrect to apply retail trade multipliers directly to the \$100 million because, in the I-O framework, retail trade output is measured by margins (markups), not total sales revenue. Transactions are valued at producers' prices rather than consumers' prices. Therefore, the consumer price must be decomposed into its components: the producer's value of the goods,

transportation costs, and wholesale and retail margins. These are then assigned to the respective producing industries.

For clothing, Appendix C provides the following margins: retail 42 percent, wholesale 6 percent, truck transportation 0.8 percent, air transportation 0.3 percent, and water transportation 1.75 percent. Applying these percentages, the \$100 million in visitor clothing expenditures is distributed across the relevant industries, yielding \$49.15 million as the producers' value of the garments, with the balance allocated to trade and transportation services (Table 3.6).

The producers' value of clothing (\$49.15 million) is further divided between local manufacturing and imports. If 6 percent of clothing sales were manufactured in Hawai'i, \$2.95 million could be attributed to Hawai'i's apparel manufacturing and \$46.2 million to imports. If visitors were assumed to purchase primarily Hawaiian-made apparel, the local share would be larger, and the import share smaller. This highlights the importance of carefully specifying the breakdown of direct expenditures to ensure accurate use of multipliers.

Once allocated, the values assigned to trade, transportation, and apparel manufacturing are multiplied by their respective output multipliers. Summing up these results produces the total impact. As shown in Table 3.6, a \$100 million increase in visitor spending on clothing generates about \$92.0 million in new output for Hawai'i's economy, primarily from wholesale and retail margins on imported goods. Earnings and employment impacts can be derived in the same way, using Type 2 final-demand earnings and employment multipliers.

Table 3.6. Output Impact of an Increase in Clothing Sales by \$100 Million

	Margin (%)	Allocation (\$ million)	Type 2 output multipliers (from Table 6.1)	Total output impact (\$ million)
Margins				
Truck transportation	0.80	0.80	1.78	1.4
Air transportation	0.30	0.30	1.76	0.5
Water transportation	1.75	1.75	1.57	2.8
Wholesale trade	6.00	6.00	1.77	10.6
Retail trade	42.00	42.00	1.71	71.8
Cost of garments	49.15	49.15		
Hawaii's apparel manufacturing		2.95	2.09	6.2
Imports (94%)		46.20		
Total	100.00	100.00		93.3

IV. INDUSTRY CLASSIFICATION, DATA SOURCES, AND ESTIMATION PROCEDURES

Industry Classification

The 2022 Hawai‘i I-O table is primarily based on the 2022 North American Industry Classification System (NAICS). Several data sources used for this table reported information in more aggregated formats. These were disaggregated using detailed Economic Modeling Specialists, Inc. (Lightcast) jobs data and estimates from the 2017 I-O table.

Output

The main source for industry outputs in the 2022 I-O table is the 2022 Economic Census of Hawai‘i. Following the U.S. national I-O framework, industry output is measured as:

Output = Revenue of for-profit establishments
+ Expenses of non-profit establishments*
– Cost of merchandise resales*
+ Adjustment for underreporting*
+ Changes in inventory*
+ Sales taxes*
+ Employee tips*

(*Applied only where relevant.)

This definition applies to most manufacturing and service industries.

Value Added

Value added represents the income side of Hawai‘i’s GDP. For the 2022 I-O table, it is divided into:

1. Compensation of employees (COE)
2. Proprietors’ income
3. Taxes on production and imports less subsidies (TOPILS)
4. Other capital costs

The Bureau of Economic Analysis (BEA) provides state GDP data (Table SAGDP2) by NAICS industry, including three components of value added: COE, TOPILS, and gross operating surplus (GOS). GOS was further disaggregated into proprietors’ income and other capital costs for this report.

- Compensation of Employees (COE): Wages and salaries plus supplements (employer contributions to pensions, insurance, and social insurance). Detailed industry-level COE was obtained from BEA table SA06N.
- Proprietors’ Income: Estimated by subtracting COE from total earnings by place of work (BEA table SA05N).

- Taxes on Production and Imports less Subsidies (TOPILS): Includes excise, accommodation, fuel, property, customs duties, and certain non-tax fees, net of subsidies. Industry-level estimates were based on BEA GDP data.
- Other Capital Costs: Includes corporate profits, depreciation (consumption of fixed capital), net interest, rental income, and business transfers. Derived by subtracting proprietors' income from GOS.

Final Demand

Final demand reflects the expenditure side of Hawai'i's GDP. It includes personal consumption expenditures (PCEs), visitor expenditures (VEs), private investment, inventory changes, state and local government consumption and investment, federal government consumption and investment, and exports.

- Personal Consumption Expenditures (PCEs): Based on BEA SAPCE3 by state and product. Electricity consumption was allocated using DBEDT *Monthly Energy Statistics*. Education spending was split between international and domestic students using DBEDT reports.
- Visitor Expenditures (VEs): Derived from DBEDT visitor expenditure surveys, *Data Book* Table 7-31, and the *2022 Annual Visitor Research Report* (Table 71). Airline and cruise expenditures were estimated from BEA SAPCE3.
- Private and Public Investment: Construction investment was based on DBEDT *QSER* Table E-1 (contracting tax base), combined with prime contract data from USAspending.gov, and allocated across private, state, and federal sectors.
- Government Consumption and Investment: Includes compensation, depreciation, and operating costs, net of service charges. Data were drawn from BEA estimates (SAINC7N for wages and salaries), federal contract databases (classified by NAICS for civilian and military), and DBEDT *Data Book* Table 9.19 for state and local capital outlays.
- Exports: Goods and services sold outside Hawai'i, estimated as the balance of output, interindustry demand, and final demand.
- Imports: Goods and services purchased from outside Hawai'i. Intermediate imports were estimated as the residual between income and expenditure sides of GDP and allocated to industries.

Employment and Taxes

Employment includes both wage and salary jobs and proprietors' jobs. The primary source is BEA employment data: total jobs (SA25N) and wage and salary jobs (SA27N) at the 3-digit NAICS level. Proprietors' jobs were derived as the difference between the two.

For industries not aligned with 3-digit NAICS, Lightcast data were used to allocate BEA totals to the 2022 I-O industries. Lightcast also provided 2017 benchmark data on establishments, average employment, and total earnings to support disaggregation.

Since the tax structure did not transform since 2017 to 2022, we use the 2017 tax rates implicit in the 2017 I-O model, to fit reported totals for Individual income tax, GET, TAT and Other state taxes.⁶

⁶ Hawai‘i Department of Taxation Annual Report 2021-2022 [22annrpt.pdf](#).

V. INTER-INDUSTRY MATRIX AND BALANCING PROCEDURE

Inter-Industry Matrix

The core of an I-O model is the inter-industry matrix (or transactions table), which records the flows of goods and services among producing industries. Detailed data on these flows are rarely available, since a full industry survey would be costly and time-consuming. As a result, regional I-O models typically rely on non-survey or partial-survey methods.

The 2022 I-O table takes the 2017 version as the starting reference. For the 2017 Hawai‘i I-O table, the inter-industry matrix was estimated to use multiple data sources. Where reliable estimates were available, they were entered directly drawing from the 2022 Economic Census, industry annual reports, *Statistics of Hawai‘i Agriculture*, and state and county government reports. Remaining cells were estimated using production functions from the U.S. I-O table or the 2007 Hawai‘i I-O table.

- Construction industries: Estimated from the Economic Census of Construction.
- Agriculture: Drawn from *Statistics of Hawai‘i Agriculture* for inter-industry flows.
- Manufacturing: Supplemented by Census data on specific input purchases.
- Services: Based primarily on the U.S. I-O table.
- Government: Based on the U.S. I-O table, Department of Accounting and General Services (DAGS) data, and receipts data from the Economic Census.

Rows and columns of the inter-industry matrix were first adjusted manually to approximate control totals. The matrix was then balanced using a modified bi-proportional (RAS) procedure.

Balancing Procedure

The inter-industry transactions table must be balanced so that each sector’s total sales (row totals) equal its total purchases (column totals). In practice, detailed information on all inter-industry flows is not available. Instead, some values are known with reasonable accuracy, while others must be estimated.

For the 2022 Hawai‘i I-O table, the following known information was used as control totals:

- Total industry output (sales by sector).
- Total industry input (purchases by sector).
- Value added components (compensation of employees, proprietors’ income, taxes on production and imports less subsidies, and other capital costs).
- Total final demand components (personal consumption, visitor spending, investment, government, and exports).
- Selected final-demand flows available from surveys, census reports, and administrative data.

The unknown information consists of the remaining inter-industry flows and imports by sector that are not directly observed in published data.

To reconcile the known control totals with the unknown internal flows, the RAS procedure (bi-proportional balancing) was applied in two steps:

1. Step 1 – Inter-industry balancing: The inter-industry portion of the transactions table was balanced first, ensuring consistency between industry sales and purchases within the production system.
2. Step 2 – Full model balancing: Once the inter-industry block was balanced, the procedure was extended to the rest of the model, aligning the value-added components, imports, and final demand categories with their control totals.

This iterative method begins with a previous input–output matrix as a starting point. Rows are first scaled to match new output totals; then columns are scaled to match new input totals. Because balancing one dimension unbalances the other, the process is repeated many times until all rows and columns converge to their specified totals.

The result is a balanced transactions table that:

1. Preserves the structure of the earlier I-O table as much as possible,
2. Incorporates updated control totals and specific known transactions, and
3. Provides consistent estimates for the unknown flows.

Mathematical details of the procedure are presented in Appendix D.

VI. MULTIPLIERS FROM THE 2017 DETAILED I-O TABLE FOR HAWAI‘I

2022 Detailed I-O Table for Hawai‘i

The 2017 detailed I-O transactions table for the State of Hawai‘i includes the following.⁷

- Sixty-two (62) producing sectors (see Table 6.1 or Appendix A)
- Eleven (11) final demand sectors
 - Personal consumption expenditures (PCEs)
 - Visitor expenditures (VEs)
 - Change in inventories
 - Gross private investment
- Six (6) government sectors
 - State and local government consumption
 - State and local government investment
 - Federal government defense investment
 - Federal government defense consumption
 - Federal government nondefense investment
 - Federal government nondefense consumption
- Exports
- Four (4) final payments sectors
 - Compensation of employees
 - Proprietors’ income
 - Taxes on production and imports less subsidies (TOPILS)
 - Other capital costs
- Imports
- Employment
 - Wage and salary jobs
 - Proprietors’ jobs
 - Total jobs
- Earnings (used in earnings and Type 2 multiplier calculations)
- State tax revenue (used in state tax multiplier calculations)
 - Individual income tax
 - GET
 - TAT
 - Other state taxes

⁷ For details, refer to the 2022 Input-Output Study Tables for Hawai‘i at the DBEDT Web Site. The study presents the 2022 transactions table and various I-O multipliers for each of the 62 industry sectors in the detailed I-O table.

2022 Detailed I-O Multipliers

Multipliers

Using the procedures described in Section 2 and Appendix B, multipliers were derived for each industry in the 2022 detailed I-O table. Results are presented in Table 6.1.

Final-demand multipliers (Type 1 and Type 2):

- Output multipliers
- Earnings multipliers
- Total employment multipliers
- Wage and salary employment multipliers
- State tax multipliers

Direct-effect multipliers (Type 1 and Type 2):

- Earnings multipliers
- Total employment multipliers

The final-demand employment multipliers in this report are for 2022. As discussed earlier, these multipliers change over time with inflation and labor productivity growth. Updated wage and salary and total employment multipliers for 2023–2032 are available on the DBEDT website.

When the household sector is treated as exogenous, multipliers are classified as Type 1. Including the household sector as an endogenous producing sector yields Type 2 multipliers.

Interpretation of Multipliers

1. Final-demand output multipliers: Total dollar change in output across all industries resulting from a \$1 change in final demand in a given industry.
2. Final-demand earnings multipliers: Total change in household earnings across all industries from a \$1 change in an industry's final demand.
3. Final-demand employment multipliers: Change in the number of jobs across all industries from a \$1 million change in an industry's final demand.
4. Final-demand state tax multipliers: Change in state tax revenues from households and industries resulting from a \$1 change in an industry's final demand.
5. Direct-effect earnings multipliers: Total change in household earnings across all industries from a \$1 change in household earnings in the corresponding industry.
6. Direct-effect employment multipliers: Total change in jobs across all industries from a change of one job in the corresponding industry.

Observations from the 2022 Multipliers

- Type 2 vs. Type 1: As expected, Type 2 output multipliers exceed Type 1 multipliers due to induced household spending. The difference is greatest in labor-intensive sectors such as general government, legal services, architecture and engineering, education, construction, hospitals, nursing facilities, and ambulatory health care services. On other hand, sectors with low labor intensity, such as petroleum manufacturing, and telecommunications will have a smaller gap.
- Earnings multipliers: Type 1 final-demand earnings multipliers vary widely, from 0.048 for petroleum manufacturing to 0.668 for administrative and support services. Sectors with relatively low multipliers include owner-occupied dwellings, rental and leasing, and electricity. Labor-intensive sectors - particularly services and government - show higher multipliers. This pattern also applies to Type 2 multipliers.
- Direct-effect earnings multipliers: Type 1 values range from 1.0 for federal defense to 2.73 for telecommunications; Type 2 values range from 1.33 to 3.63 for the same sectors. Labor-intensive industries generally show higher direct-earnings coefficients and earnings multipliers, but relatively lower direct-effect multipliers.
- Employment multipliers: Type 1 final-demand employment multipliers range from 0.72 jobs per \$1 million in petroleum manufacturing to 51.61 jobs in other educational services. Type 2 multipliers range from 1.05 to 55.27 jobs. Agriculture and services tend to have higher multipliers, while manufacturing, communications, and utilities are lower. The reverse holds for direct-effect employment multipliers, reflecting differences in job-to-output ratios.
- State tax multipliers: Table 6.1 also presents final-demand state tax multipliers, which show the change in state tax revenues resulting from a \$1 increase in an industry's final demand.

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i

Industry	Final demand multipliers			
	Output		Earnings	
	type 1	type 2	type 1	type 2
1 Crop production	1.37	1.88	0.413	0.549
2 Animal production	1.33	1.82	0.404	0.538
3 Commercial fishing	1.43	2.06	0.507	0.674
4 Forestry & logging	1.52	2.22	0.566	0.753
5 Support activities for agriculture	1.43	1.96	0.427	0.568
6 Mining	1.50	1.93	0.352	0.468
7 Single family construction	1.47	2.04	0.463	0.616
8 Construction of other buildings	1.52	2.12	0.490	0.651
9 Heavy and civil engineering construction	1.52	2.13	0.494	0.657
10 Maintenance & repairs	1.47	2.05	0.470	0.625
11 Food processing	1.60	2.11	0.421	0.559
12 Beverage manufacturing	1.58	2.00	0.338	0.449
13 Apparel and textile manufacturing	1.42	2.02	0.484	0.644
14 Petroleum manufacturing	1.10	1.16	0.048	0.063
15 Other manufacturing	1.19	1.75	0.451	0.600
16 Air transportation	1.36	1.76	0.327	0.435
17 Water transportation	1.13	1.57	0.362	0.481
18 Truck and rail transportation	1.14	1.78	0.518	0.688
19 Transit and ground passenger transportation	1.32	2.12	0.643	0.855
20 Scenic and support activities for transportation	1.64	2.26	0.505	0.672
21 Couriers and messengers	1.54	2.22	0.551	0.732
22 Warehousing and storage	1.64	2.33	0.559	0.743
23 Publishing (include Internet)	1.64	2.10	0.374	0.497
24 Motion picture and sound recording industries	1.45	1.87	0.339	0.451
25 Broadcasting (Radio, TV, Cable)	1.18	1.47	0.231	0.308
26 Telecommunications	1.52	1.80	0.234	0.311
27 Internet providers, web, and data processing	1.21	1.51	0.241	0.321
28 Other information service	1.20	1.52	0.261	0.347
29 Electricity	1.56	1.85	0.232	0.309
30 Other utilities	1.40	1.65	0.196	0.260
31 Wholesale trade	1.31	1.77	0.372	0.494
32 Retail trade	1.28	1.71	0.347	0.462
33 Credit intermediation and related activities	1.71	2.16	0.362	0.481
34 Insurance carriers and related activities	1.36	1.80	0.352	0.467
35 Other finance and insurance	1.86	2.45	0.478	0.635
36 Owner-occupied dwellings	1.32	1.43	0.089	0.118
37 Real estate	1.33	1.76	0.342	0.454
38 Rental & leasing and others	1.28	1.69	0.339	0.451

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i – Continued

Industry	Final demand multipliers			
	Output		Earnings	
	type 1	type 2	type 1	type 2
39 Legal services	1.68	2.43	0.605	0.805
40 Architectural and engineering services	1.60	2.32	0.585	0.777
41 Computer systems design services	1.09	1.62	0.428	0.569
42 R&D in the physical, engineering, & life sciences	1.47	2.13	0.537	0.714
43 Other professional services	1.62	2.34	0.591	0.785
44 Management of companies and enterprises	1.36	2.15	0.648	0.861
45 Travel arrangement and reservation services	1.23	2.05	0.666	0.885
46 Administrative and support services	1.23	2.05	0.668	0.888
47 Waste management and remediation services	1.56	2.13	0.459	0.610
48 Colleges, universities, and professional schools	1.05	1.46	0.335	0.445
49 Other Educational services	1.31	1.96	0.522	0.694
50 Ambulatory health care services	1.16	1.75	0.479	0.637
51 Hospitals	1.64	2.23	0.484	0.643
52 Nursing and residential care facilities	1.36	2.18	0.662	0.879
53 Social assistance	1.17	1.67	0.405	0.539
54 Arts and entertainment	1.07	1.81	0.604	0.802
55 Accommodation	1.59	2.10	0.417	0.554
56 Eating and drinking	1.52	2.14	0.504	0.670
57 Repair and maintenance	1.12	1.64	0.426	0.566
58 Personal and laundry services	1.36	2.12	0.616	0.819
59 Organizations	1.17	1.42	0.205	0.273
60 Federal government defense	1.00	1.75	0.606	0.805
61 Federal government: nondefense	1.10	1.81	0.576	0.765
62 State and local government	1.02	1.77	0.608	0.808
PCE	1.16	1.54	0.31	0.41
Visitor's expenditures	1.34	1.82	0.39	0.51
State and local government consumption	0.47	0.70	0.19	0.25
Federal defense consumption	1.00	1.71	0.58	0.77
Federal nondefense consumption	1.08	1.72	0.51	0.68

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers			
	W&S jobs		Total jobs	
	type 1	type 2	type 1	type 2
1 Crop production	8.50	10.59	16.81	19.71
2 Animal production	8.54	10.59	16.67	19.51
3 Commercial fishing	10.61	13.18	24.76	28.32
4 Forestry & logging	13.19	16.06	33.16	37.13
5 Support activities for agriculture	8.71	10.88	16.96	19.95
6 Mining	3.71	5.50	7.98	10.45
7 Single family construction	4.93	7.27	6.71	9.96
8 Construction of other buildings	5.08	7.56	7.05	10.49
9 Heavy and civil engineering construction	5.09	7.59	7.13	10.60
10 Maintenance & repairs	5.00	7.38	6.87	10.17
11 Food processing	8.51	10.64	10.45	13.40
12 Beverage manufacturing	5.24	6.96	6.33	8.70
13 Apparel and textile manufacturing	8.81	11.26	19.42	22.82
14 Petroleum manufacturing	0.53	0.78	0.72	1.05
15 Other manufacturing	5.45	7.74	8.13	11.30
16 Air transportation	4.23	5.89	4.71	7.01
17 Water transportation	3.63	5.47	3.95	6.49
18 Truck and rail transportation	7.11	9.73	8.09	11.72
19 Transit and ground passenger transportation	8.49	11.75	22.31	26.82
20 Scenic and support activities for transportation	6.76	9.32	8.26	11.81
21 Couriers and messengers	9.42	12.21	22.77	26.64
22 Warehousing and storage	9.06	11.89	23.18	27.10
23 Publishing (include Internet)	4.22	6.12	6.15	8.77
24 Motion picture and sound recording industries	5.02	6.74	6.50	8.88
25 Broadcasting (Radio, TV, Cable)	2.36	3.53	3.51	5.14
26 Telecommunications	2.83	4.01	3.90	5.54
27 Internet providers, web, and data processing	4.38	5.61	6.99	8.68
28 Other information service	5.85	7.17	7.75	9.58
29 Electricity	2.60	3.78	3.32	4.95
30 Other utilities	2.08	3.07	2.62	4.00
31 Wholesale trade	4.81	6.70	6.25	8.86
32 Retail trade	7.00	8.76	9.38	11.82
33 Credit intermediation and related activities	4.31	6.14	6.43	8.97
34 Insurance carriers and related activities	3.71	5.49	6.94	9.40
35 Other finance and insurance	3.97	6.40	20.60	23.95
36 Owner-occupied dwellings	1.53	1.98	2.08	2.71
37 Real estate	2.29	4.02	6.50	8.89
38 Rental & leasing and others	2.50	4.22	6.40	8.78

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers			
	W&S jobs		Total jobs	
	type 1	type 2	type 1	type 2
39 Legal services	5.50	8.56	9.35	13.59
40 Architectural and engineering services	5.01	7.97	9.14	13.24
41 Computer systems design services	3.43	5.60	6.36	9.36
42 R&D in the physical, engineering, & life sciences	4.66	7.39	8.32	12.08
43 Other professional services	5.60	8.59	9.57	13.72
44 Management of companies and enterprises	5.88	9.17	7.16	11.71
45 Travel arrangement and reservation services	11.41	14.78	16.18	20.85
46 Administrative and support services	11.51	14.89	16.29	20.98
47 Waste management and remediation services	6.13	8.46	7.08	10.30
48 Colleges, universities, and professional schools	4.37	6.07	5.60	7.95
49 Other Educational services	40.48	43.12	51.61	55.27
50 Ambulatory health care services	7.55	9.98	9.68	13.04
51 Hospitals	5.77	8.22	6.91	10.30
52 Nursing and residential care facilities	11.11	14.47	13.48	18.12
53 Social assistance	18.82	20.87	21.43	24.27
54 Arts and entertainment	9.05	12.11	16.29	20.52
55 Accommodation	5.52	7.64	6.62	9.55
56 Eating and drinking	10.58	13.13	12.04	15.57
57 Repair and maintenance	4.95	7.11	21.91	24.90
58 Personal and laundry services	7.60	10.72	22.99	27.31
59 Organizations	14.87	15.91	16.29	17.73
60 Federal government defense	7.82	10.89	7.82	12.07
61 Federal government: nondefense	7.43	10.35	7.55	11.59
62 State and local government	9.64	12.72	9.67	13.93
PCE	4.77	6.34	6.59	8.77
Visitor's expenditures	5.84	7.80	7.73	10.44
State and local government consumption	4.65	6.90	6.51	9.63
Federal defense consumption	7.44	10.38	7.62	11.70
Federal nondefense consumption	6.54	9.15	7.11	10.72

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers			
	Total State Tax		State individual income tax	
	type 1	type 2	type 1	type 2
1 Crop production	0.050	0.080	0.024	0.033
2 Animal production	0.038	0.068	0.019	0.029
3 Commercial fishing	0.059	0.096	0.031	0.043
4 Forestry & logging	0.048	0.089	0.032	0.045
5 Support activities for agriculture	0.065	0.096	0.026	0.036
6 Mining	0.056	0.082	0.026	0.034
7 Single family construction	0.101	0.135	0.031	0.042
8 Construction of other buildings	0.104	0.140	0.033	0.045
9 Heavy and civil engineering construction	0.101	0.137	0.034	0.045
10 Maintenance & repairs	0.104	0.138	0.032	0.043
11 Food processing	0.064	0.095	0.031	0.041
12 Beverage manufacturing	0.057	0.082	0.025	0.033
13 Apparel and textile manufacturing	0.067	0.103	0.038	0.049
14 Petroleum manufacturing	0.015	0.018	0.004	0.005
15 Other manufacturing	0.054	0.087	0.034	0.045
16 Air transportation	0.047	0.071	0.026	0.033
17 Water transportation	0.053	0.080	0.030	0.039
18 Truck and rail transportation	0.073	0.111	0.039	0.051
19 Transit and ground passenger transportation	0.082	0.129	0.041	0.056
20 Scenic and support activities for transportation	0.086	0.123	0.034	0.046
21 Couriers and messengers	0.086	0.127	0.043	0.056
22 Warehousing and storage	0.102	0.143	0.038	0.051
23 Publishing (include Internet)	0.082	0.109	0.027	0.036
24 Motion picture and sound recording industries	0.074	0.099	0.026	0.034
25 Broadcasting (Radio, TV, Cable)	0.051	0.067	0.014	0.019
26 Telecommunications	0.064	0.081	0.017	0.023
27 Internet providers, web, and data processing	0.059	0.076	0.019	0.025
28 Other information service	0.057	0.076	0.018	0.024
29 Electricity	0.089	0.106	0.017	0.023
30 Other utilities	0.049	0.063	0.014	0.019
31 Wholesale trade	0.073	0.100	0.027	0.036
32 Retail trade	0.205	0.231	0.023	0.032
33 Credit intermediation and related activities	0.069	0.095	0.026	0.035
34 Insurance carriers and related activities	0.149	0.175	0.027	0.035
35 Other finance and insurance	0.089	0.124	0.035	0.047
36 Owner-occupied dwellings	0.029	0.036	0.006	0.008
37 Real estate	0.114	0.138	0.022	0.030
38 Rental & leasing and others	0.096	0.121	0.022	0.030

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers			
	Total State Tax		State individual income tax	
	type 1	type 2	type 1	type 2
39 Legal services	0.112	0.156	0.043	0.057
40 Architectural and engineering services	0.100	0.142	0.042	0.055
41 Computer systems design services	0.067	0.098	0.031	0.041
42 R&D in the physical, engineering, & life sciences	0.087	0.126	0.034	0.047
43 Other professional services	0.101	0.144	0.041	0.055
44 Management of companies and enterprises	0.097	0.144	0.050	0.066
45 Travel arrangement and reservation services	0.082	0.131	0.042	0.058
46 Administrative and support services	0.089	0.138	0.047	0.062
47 Waste management and remediation services	0.083	0.117	0.034	0.045
48 Colleges, universities, and professional schools	0.062	0.087	0.028	0.035
49 Other Educational services	0.083	0.121	0.038	0.050
50 Ambulatory health care services	0.070	0.105	0.033	0.045
51 Hospitals	0.096	0.132	0.036	0.048
52 Nursing and residential care facilities	0.070	0.119	0.046	0.062
53 Social assistance	0.065	0.095	0.028	0.038
54 Arts and entertainment	0.069	0.113	0.037	0.051
55 Accommodation	0.145	0.175	0.026	0.036
56 Eating and drinking	0.083	0.120	0.032	0.044
57 Repair and maintenance	0.054	0.085	0.026	0.036
58 Personal and laundry services	0.087	0.132	0.039	0.054
59 Organizations	0.030	0.045	0.014	0.019
60 Federal government defense	0.066	0.110	0.056	0.071
61 Federal government: nondefense	0.066	0.108	0.053	0.067
62 State and local government	0.059	0.103	0.049	0.063
PCE	0.069	0.091	0.022	0.030
Visitor's expenditures	0.112	0.140	0.026	0.035
State and local government consumption	0.027	0.041	0.014	0.019
Federal defense consumption	0.065	0.108	0.053	0.067
Federal nondefense consumption	0.065	0.103	0.045	0.057

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers			
	Total GET		State TAT	
	type 1	type 2	type 1	type 2
1 Crop production	0.012	0.024	0.001	0.002
2 Animal production	0.007	0.019	0.001	0.002
3 Commercial fishing	0.016	0.032	0.001	0.002
4 Forestry & logging	0.005	0.023	0.000	0.002
5 Support activities for agriculture	0.027	0.040	0.000	0.002
6 Mining	0.014	0.025	0.002	0.002
7 Single family construction	0.054	0.068	0.002	0.003
8 Construction of other buildings	0.055	0.070	0.002	0.004
9 Heavy and civil engineering construction	0.050	0.065	0.003	0.004
10 Maintenance & repairs	0.057	0.072	0.002	0.003
11 Food processing	0.016	0.029	0.004	0.005
12 Beverage manufacturing	0.015	0.026	0.003	0.004
13 Apparel and textile manufacturing	0.014	0.029	0.003	0.004
14 Petroleum manufacturing	0.002	0.003	0.001	0.001
15 Other manufacturing	0.008	0.022	0.001	0.002
16 Air transportation	0.006	0.016	0.001	0.002
17 Water transportation	0.002	0.013	0.000	0.001
18 Truck and rail transportation	0.025	0.041	0.000	0.002
19 Transit and ground passenger transportation	0.029	0.049	0.001	0.003
20 Scenic and support activities for transportation	0.036	0.052	0.002	0.003
21 Couriers and messengers	0.029	0.046	0.002	0.003
22 Warehousing and storage	0.044	0.061	0.002	0.003
23 Publishing (include Internet)	0.037	0.048	0.004	0.005
24 Motion picture and sound recording industries	0.034	0.044	0.002	0.003
25 Broadcasting (Radio, TV, Cable)	0.027	0.034	0.001	0.001
26 Telecommunications	0.014	0.021	0.002	0.002
27 Internet providers, web, and data processing	0.027	0.035	0.003	0.003
28 Other information service	0.027	0.035	0.002	0.003
29 Electricity	0.009	0.016	0.002	0.003
30 Other utilities	0.006	0.012	0.002	0.002
31 Wholesale trade	0.032	0.044	0.003	0.004
32 Retail trade	0.168	0.179	0.002	0.003
33 Credit intermediation and related activities	0.014	0.025	0.007	0.008
34 Insurance carriers and related activities	0.006	0.017	0.001	0.002
35 Other finance and insurance	0.019	0.033	0.005	0.006
36 Owner-occupied dwellings	0.009	0.012	0.001	0.001
37 Real estate	0.065	0.075	0.003	0.004
38 Rental & leasing and others	0.062	0.072	0.002	0.003

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers			
	Total GET		State TAT	
	type 1	type 2	type 1	type 2
39 Legal services	0.040	0.059	0.012	0.014
40 Architectural and engineering services	0.040	0.058	0.002	0.004
41 Computer systems design services	0.025	0.038	0.001	0.002
42 R&D in the physical, engineering, & life sciences	0.035	0.051	0.004	0.005
43 Other professional services	0.038	0.056	0.007	0.009
44 Management of companies and enterprises	0.032	0.052	0.001	0.003
45 Travel arrangement and reservation services	0.028	0.048	0.002	0.004
46 Administrative and support services	0.029	0.049	0.002	0.004
47 Waste management and remediation services	0.032	0.046	0.003	0.004
48 Colleges, universities, and professional schools	0.024	0.035	0.000	0.001
49 Other Educational services	0.031	0.047	0.001	0.003
50 Ambulatory health care services	0.026	0.040	0.000	0.002
51 Hospitals	0.038	0.053	0.006	0.007
52 Nursing and residential care facilities	0.008	0.029	0.002	0.004
53 Social assistance	0.026	0.039	0.001	0.002
54 Arts and entertainment	0.023	0.041	0.000	0.002
55 Accommodation	0.034	0.047	0.070	0.071
56 Eating and drinking	0.034	0.049	0.003	0.004
57 Repair and maintenance	0.019	0.032	0.001	0.003
58 Personal and laundry services	0.032	0.051	0.003	0.005
59 Organizations	0.004	0.011	0.001	0.001
60 Federal government defense	-	0.019	-	0.002
61 Federal government: nondefense	0.002	0.020	0.000	0.002
62 State and local government	0.000	0.019	0.000	0.002
PCE	0.029	0.038	0.003	0.003
Visitor's expenditures	0.048	0.060	0.025	0.026
State and local government consumption	0.005	0.011	0.001	0.001
Federal defense consumption	0.002	0.020	0.000	0.002
Federal nondefense consumption	0.006	0.022	0.002	0.004

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers		Direct effect multipliers	
	Other taxes		Earnings	
	type 1	type 2	type 1	type 2
1 Crop production	0.014	0.020	1.343	1.786
2 Animal production	0.011	0.018	1.314	1.747
3 Commercial fishing	0.011	0.019	1.352	1.797
4 Forestry & logging	0.011	0.020	1.509	2.005
5 Support activities for agriculture	0.012	0.019	1.388	1.845
6 Mining	0.015	0.020	1.722	2.290
7 Single family construction	0.014	0.022	1.404	1.866
8 Construction of other buildings	0.014	0.022	1.485	1.974
9 Heavy and civil engineering construction	0.014	0.022	1.498	1.991
10 Maintenance & repairs	0.013	0.021	1.424	1.893
11 Food processing	0.014	0.020	1.839	2.444
12 Beverage manufacturing	0.013	0.019	2.083	2.769
13 Apparel and textile manufacturing	0.013	0.021	1.367	1.817
14 Petroleum manufacturing	0.008	0.009	2.657	3.532
15 Other manufacturing	0.011	0.018	1.158	1.539
16 Air transportation	0.015	0.020	1.858	2.470
17 Water transportation	0.021	0.027	1.156	1.537
18 Truck and rail transportation	0.009	0.018	1.103	1.467
19 Transit and ground passenger transportation	0.011	0.021	1.218	1.619
20 Scenic and support activities for transportation	0.015	0.023	1.686	2.241
21 Couriers and messengers	0.013	0.022	1.515	2.014
22 Warehousing and storage	0.019	0.028	1.537	2.043
23 Publishing (include Internet)	0.014	0.020	2.119	2.817
24 Motion picture and sound recording industries	0.012	0.018	1.582	2.104
25 Broadcasting (Radio, TV, Cable)	0.009	0.013	1.311	1.743
26 Telecommunications	0.031	0.035	2.732	3.632
27 Internet providers, web, and data processing	0.009	0.013	1.367	1.818
28 Other information service	0.009	0.013	1.310	1.741
29 Electricity	0.060	0.063	2.232	2.968
30 Other utilities	0.026	0.029	1.882	2.502
31 Wholesale trade	0.011	0.017	1.357	1.804
32 Retail trade	0.012	0.017	1.334	1.773
33 Credit intermediation and related activities	0.022	0.028	2.411	3.205
34 Insurance carriers and related activities	0.115	0.120	1.418	1.885
35 Other finance and insurance	0.030	0.037	2.109	2.803
36 Owner-occupied dwellings	0.013	0.015	NA	NA
37 Real estate	0.024	0.029	1.407	1.871
38 Rental & leasing and others	0.010	0.015	1.398	1.858

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Final demand multipliers		Direct effect multipliers	
	Other taxes		Earnings	
	type 1	type 2	type 1	type 2
39 Legal services	0.016	0.026	1.506	2.002
40 Architectural and engineering services	0.016	0.025	1.455	1.934
41 Computer systems design services	0.010	0.017	1.065	1.416
42 R&D in the physical, engineering, & life sciences	0.015	0.023	1.336	1.776
43 Other professional services	0.015	0.024	1.469	1.953
44 Management of companies and enterprises	0.014	0.024	1.221	1.623
45 Travel arrangement and reservation services	0.010	0.021	1.119	1.488
46 Administrative and support services	0.012	0.022	1.123	1.493
47 Waste management and remediation services	0.014	0.021	1.728	2.298
48 Colleges, universities, and professional schools	0.010	0.016	1.049	1.394
49 Other Educational services	0.013	0.021	1.238	1.646
50 Ambulatory health care services	0.010	0.018	1.152	1.531
51 Hospitals	0.016	0.024	1.780	2.366
52 Nursing and residential care facilities	0.014	0.024	1.193	1.586
53 Social assistance	0.010	0.017	1.154	1.534
54 Arts and entertainment	0.009	0.019	1.043	1.387
55 Accommodation	0.016	0.022	1.843	2.450
56 Eating and drinking	0.014	0.022	1.450	1.927
57 Repair and maintenance	0.007	0.014	1.090	1.449
58 Personal and laundry services	0.013	0.022	1.215	1.615
59 Organizations	0.010	0.014	1.351	1.796
60 Federal government defense	0.010	0.020	1.000	1.329
61 Federal government: nondefense	0.011	0.020	1.056	1.404
62 State and local government	0.009	0.019	1.011	1.344
PCE	0.015	0.020		
Visitor's expenditures	0.013	0.019		
State and local government consumption	0.007	0.010		
Federal defense consumption	0.010	0.019		
Federal nondefense consumption	0.012	0.020		

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Direct effect multipliers			
	W&S jobs		Total jobs	
	type 1	type 2	type 1	type 2
1 Crop production	1.23	1.53	1.20	1.40
2 Animal production	1.23	1.53	1.19	1.39
3 Commercial fishing	1.20	1.49	1.11	1.27
4 Forestry & logging	1.49	1.82	1.49	1.66
5 Support activities for agriculture	1.26	1.57	1.21	1.42
6 Mining	2.24	3.31	1.76	2.30
7 Single family construction	1.59	2.34	1.66	2.46
8 Construction of other buildings	1.64	2.44	1.74	2.59
9 Heavy and civil engineering construction	1.64	2.45	1.76	2.61
10 Maintenance & repairs	1.61	2.38	1.70	2.51
11 Food processing	1.50	1.87	1.66	2.13
12 Beverage manufacturing	1.94	2.57	2.26	3.11
13 Apparel and textile manufacturing	1.27	1.62	1.18	1.38
14 Petroleum manufacturing	4.11	5.96	4.43	6.48
15 Other manufacturing	1.18	1.68	1.17	1.63
16 Air transportation	2.23	3.10	2.45	3.65
17 Water transportation	1.23	1.86	1.27	2.09
18 Truck and rail transportation	1.10	1.51	1.13	1.64
19 Transit and ground passenger transportation	1.23	1.70	1.12	1.35
20 Scenic and support activities for transportation	1.67	2.31	1.86	2.66
21 Couriers and messengers	1.43	1.85	1.17	1.37
22 Warehousing and storage	1.37	1.80	1.20	1.40
23 Publishing (include Internet)	2.72	3.94	2.64	3.77
24 Motion picture and sound recording industries	1.50	2.01	1.59	2.17
25 Broadcasting (Radio, TV, Cable)	1.52	2.27	1.51	2.21
26 Telecommunications	2.93	4.16	3.48	4.95
27 Internet providers, web, and data processing	1.26	1.62	1.23	1.53
28 Other information service	1.18	1.44	1.19	1.47
29 Electricity	3.13	4.55	3.57	5.32
30 Other utilities	2.51	3.70	2.82	4.29
31 Wholesale trade	1.37	1.90	1.42	2.01
32 Retail trade	1.18	1.47	1.21	1.52
33 Credit intermediation and related activities	2.63	3.75	3.38	4.71
34 Insurance carriers and related activities	1.43	2.12	1.44	1.95
35 Other finance and insurance	2.96	4.76	1.44	1.68
36 Owner-occupied dwellings	NA	NA	NA	NA
37 Real estate	2.08	3.65	1.39	1.90
38 Rental & leasing and others	2.27	3.84	1.37	1.88

Table 6.1. 2022 Detailed Output, Earnings, Employment, and Tax Multipliers for Hawai‘i - Continued

Industry	Direct effect multipliers			
	W&S jobs		Total jobs	
	type 1	type 2	type 1	type 2
39 Legal services	1.79	2.79	1.60	2.33
40 Architectural and engineering services	1.63	2.60	1.56	2.27
41 Computer systems design services	1.12	1.82	1.09	1.60
42 R&D in the physical, engineering, & life sciences	1.52	2.41	1.42	2.07
43 Other professional services	1.82	2.80	1.64	2.35
44 Management of companies and enterprises	1.25	1.94	1.38	2.26
45 Travel arrangement and reservation services	1.09	1.41	1.09	1.40
46 Administrative and support services	1.10	1.42	1.10	1.41
47 Waste management and remediation services	1.83	2.52	1.94	2.82
48 Colleges, universities, and professional schools	1.05	1.46	1.06	1.51
49 Other Educational services	1.04	1.10	1.04	1.11
50 Ambulatory health care services	1.14	1.51	1.15	1.55
51 Hospitals	1.92	2.73	2.29	3.42
52 Nursing and residential care facilities	1.16	1.52	1.19	1.60
53 Social assistance	1.04	1.15	1.05	1.19
54 Arts and entertainment	1.04	1.39	1.03	1.30
55 Accommodation	1.81	2.50	2.09	3.02
56 Eating and drinking	1.25	1.55	1.34	1.73
57 Repair and maintenance	1.10	1.57	1.03	1.17
58 Personal and laundry services	1.21	1.71	1.10	1.30
59 Organizations	1.05	1.12	1.07	1.16
60 Federal government defense	1.00	1.39	1.00	1.54
61 Federal government: nondefense	1.06	1.47	1.07	1.65
62 State and local government	1.01	1.33	1.01	1.46

References

U.S. Bureau of Economic Analysis (BEA)

Bureau of Economic Analysis. (2024–2025). *SAGDP2: Gross domestic product by state (by industry, NAICS)* [Interactive data].

Bureau of Economic Analysis. (2024–2025). *SAPCE3: Personal consumption expenditures by state by type of product* [Interactive data].

Bureau of Economic Analysis. (2024–2025). *SAINC5N/SAINC7N: Personal income and wages & salaries by NAICS industry* [Interactive data and API user guide].

Bureau of Economic Analysis. (2022). *SAEMP25N/SAEMP27N: Total employment and wage & salary employment by industry (state series)* [Archived after 2024].

Bureau of Economic Analysis. (n.d.). *Regional Input–Output Modeling System (RIMS II): User guide and documentation*.

Bureau of Economic Analysis. (n.d.). *Concepts and methods of the U.S. input–output accounts*.

U.S. Census Bureau

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 NAICS codes and titles*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Accommodation and food services – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Administrative and support and waste management and remediation services – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Arts, entertainment, and recreation – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Construction – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Educational services – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Finance and insurance – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Health care and social assistance – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Information – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Manufacturing – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Other services (except public administration) – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Professional, scientific, and technical services – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Real estate and rental and leasing – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Retail trade – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Transportation and warehousing – Geographic area series, Hawai‘i*.

U.S. Census Bureau, U.S. Department of Commerce. (2025). *2022 Economic Census: Wholesale trade – Geographic area series, Hawai‘i*.

State of Hawai‘i (DBEDT / HTA / DAGS)

Department of Business, Economic Development & Tourism (DBEDT). (2022–2024). *State of Hawai‘i Data Book* [Selected tables including visitor spending, CBP extracts, DoD NAICS awards].

Hawai‘i Tourism Authority. (2022). *Annual visitor research report* [Expenditure by type; allocation basis for visitor expenditures].

Department of Business, Economic Development & Tourism (DBEDT). (n.d.). *Monthly energy trends/statistics* [Electricity consumption allocation for PCEs].

Department of Business, Economic Development & Tourism (DBEDT). (n.d.). *International and domestic students: Enrollment and spending reports* [Education PCE allocation].

Department of Business, Economic Development & Tourism (DBEDT). (n.d.). *Quarterly statistical & economic report (QSER), Table E-1 “Contracting tax base”* [Proxy for construction investment allocations].

Hawai‘i Department of Accounting and General Services (DAGS). (n.d.). *Annual financial reports*.

Federal Spending and Contracts

USAspending.gov. (2022). *State profile & advanced search downloads* [Prime awards by NAICS; 2022 filtering].

Federal Procurement Data System (FPDS) / SAM.gov. (2022). *Transition notes: Reports migrated to SAM Data Bank; FPDS search continues*.

Methods and Texts

Appendix D in this report. *Modified RAS procedure mathematics*.

Bureau of Economic Analysis. (n.d.). *Concepts and methods of the U.S. input–output accounts*.

Flegg, Anthony T., and Chris D. Webber. "Regional size, regional specialization and the FLQ formula." *Regional studies* 34.6 (2000): 563-569.

Leontief, W. (1986). *Input-output economics*. Oxford University Press.

Miller, R. E., & Blair, P. D. (2009). *Input–output analysis: Foundations and extensions* (2nd ed.). Cambridge University Press.

Taxation

Hawai‘i Department of Taxation Annual Report 2021-2022 [22annrpt.pdf](#).

Appendix A. NAICS Codes for Industries in the 2022 I-O Table for Hawai‘i

Detailed Table Sector	NAICS Code	Condensed Table Sector
1 Crops	111	1
2 Livestock, poultry, and their products	112	1
3 Commercial fishing	114	1
4 Forestry & logging	113	1
5 Support activities for agriculture	115	1
6 Mining	21	2 Mining and construction
7 Single family construction	part of 23	2
8 Construction of other buildings	part of 23	2
9 Heavy and civil engineering construction	part of 23	2
10 Maintenance & repairs	part of 23	2
11 Food processing	311	3 Food processing
12 Beverage manufacturing	312	4 Other manufacturing
13 Apparel and textile manufacturing	313-315	4
14 Petroleum manufacturing	324	4
15 Other manufacturing	other 31-33	4
16 Air transportation	481	5 Transportation
17 Water transportation	483	5
18 Truck and rail transportation	484	5
19 Transit and ground passenger transportation	485	5
20 Scenic and support activities for transportation	487-488	5
21 Couriers and messengers	492	5
22 Warehousing and storage	493	5
23 Publishing (except Internet)	511	6 Information
24 Motion picture and sound recording industries	512	6
25 Broadcasting (Radio, TV, Cable)	515	6
26 Telecommunications	517	6
27 Internet providers, web, and data processing	518	6
28 Other information services	519	6
29 Electricity	2211	7 Utilities
30 Other utilities	2212-2213	7
31 Wholesale trade	42	8 Wholesale trade
32 Retail trade	44-45	9 Retail trade
33 Credit intermediation and related activities	522	10 Finance and insurance
34 Insurance carriers and related activities	524	10
35 Other finance and insurance	523, 525	10
36 Owner-occupied dwellings		11 Real estate and rentals
37 Real estate	531	11
38 Rental & leasing	532-533	11

Appendix A. NAICS Codes for Industries in the 2022 I-O Table for Hawai‘i

Detailed Table Sector	NAICS Code	Condensed Table Sector
39 Legal services	5411	12 Professional services
40 Architectural and engineering services	5413	12
41 Computer systems design services	5415	12
42 R&D in the physical, engineering, & life sciences	54171	12
43 Other professional services	other 54	12
44 Management of companies and enterprises	55	13 Business services
45 Travel arrangement and reservation services	5615	13
46 Administrative and support services	561 except 5615	13
47 Waste management and remediation services	562	13
48 Colleges, universities, and professional schools	6113	14 Educational services
49 Other educational services	other 611	14
50 Ambulatory health care services	621	15 Health services
51 Hospitals	622	15
52 Nursing and residential care facilities	623	15
53 Social assistance	624	15
54 Arts and entertainment	71	16 Arts and entertainment
55 Accommodation	721	17 Accommodation
56 Eating and drinking	722	18 Eating and drinking
57 Repair and maintenance	811	19 Other services
58 Personal and laundry services	812, 814	19
59 Organizations	813	19
60 Federal government military	part of Federal gov't	20 Government
61 Federal government: civilian	part of Federal gov't	20
62 State and local government	state and local gov't	20

Appendix B. Mathematics of Input-Output Models

The flow of inter-industry sales in the transaction table (Table 2.1) can be expressed as a system of equations, representing the distribution of each industry's total output (sales) to industries and final demand sectors as follows:

$$X_i = \sum_{j=1}^n Z_{ij} + \sum_{k=1}^m Y_{ik} \quad (\text{B.1})$$

where:

$i, j = 1, 2, \dots, n$ industries;

$k = 1, 2, \dots, m$ final demand sectors;

$X_i =$ total output (sales) of the i th industry, including the total inter-industry sales (the first term in the equation) and total final sales (the second term in the equation);

$Z_{ij} =$ i th industry's inter-industry sales to the j th industry; and

$Y_{ik} =$ i th industry's final sales to the k th final demand sector.

Similarly, the flow of inter-industry purchases can be expressed as a system of another set of n equations, showing the distribution of industry j 's total input (purchases) from n industries and imports, and payments to s final payments sectors as follows:

$$X_j = \sum_{i=1}^n Z_{ij} + M_j + \sum_{r=1}^s W_{rj} \quad (\text{B.2})$$

where:

$i, j = 1, 2, \dots, n$ industries;

$r = 1, 2, \dots, s$ final payment sectors, including imports;

$X_j =$ total input (purchases) of the j th industry, including the total inter-industry purchases (the first term in the equation) and total final payments (the second term in the equation);

$Z_{ij} =$ j th industry's inter-industry purchases from the i th industry;

$M_j =$ imports of industry j as intermediate input; and

$W_{rj} =$ j th industry's payments to the r th final payment sector.

The next step in I-O analysis is to derive the direct requirements table. Each coefficient of the direct requirements table, usually designated as a_{ij} , represents the purchase of column sector j from row sector i to produce a dollar of output in sector j . The a_{ij} s are derived by dividing each column entry of the transactions table, Z_{ij} s by the corresponding column total, X_j , i.e.

$$a_{ij} = Z_{ij} / X_j \quad (\text{B.3})$$

Using equation (B.3), the system of inter-industry equations (B.1) can be rewritten as:

$$X_i = \sum_{j=1}^n a_{ij} X_j + \sum_{k=1}^m Y_{ik} \quad (\text{B.4})$$

For notational convenience, let us combine the various final demand sectors to one sector ($Y = \sum_{k=1}^s Y_{ik}$) and rewrite the above system of equations (B.4) in a compact form using matrix algebra as follows:

$$X = AX + Y \quad (\text{B.5})$$

where X represents the n by 1 vector of industry total outputs, A represents the n by n matrix of direct requirements coefficients (also known as the technology matrix), and Y is the n by 1 vector of total final demands.

The last expression of the inter-industry equations (B.5) can be rewritten as:

$$(I - A)X = Y \quad (\text{B.6})$$

where I is the n by n identity matrix, which has ones on its diagonal and zeros elsewhere else. Thus, the vector of total industry outputs can be solved as:

$$X = (I - A)^{-1}Y = BY \quad (\text{B.7})$$

where $(I - A)^{-1} = B$ is the total requirements table, or Leontief inverse matrix. B is also referred to as the final-demand output multiplier table.

If the household sector is exogenous, the Type 1 final-demand output multiplier for the j th sector (O_j) can be obtained by summing down the j th column of the Leontief matrix as:

$$O_j = \sum_{i=1}^n b_{ij} \quad (\text{B.8})$$

where b_{ij} s are the elements of the final-demand output multiplier table, representing the change in output of sector i due to a one dollar change in final demand of sector j .

The final-demand earnings multipliers are obtained using the total requirements table and direct earnings coefficients as:

$$C = L \cdot B \quad (\text{B.9})$$

where C is the final-demand income multiplier table, L is the n by n matrix containing the i th sector's direct earnings coefficient in its i th diagonal and zeros elsewhere. The Type 1 final-demand earnings multiplier for sector j (I_j^{FD}) is computed as:

$$I_j^{FD} = \sum_{i=1}^n c_{ij} \quad (\text{B.10})$$

The Type 1 direct-effect earnings multiplier for sector j (I_j^{DE}) is derived as:

$$I_j^{DE} = I_j^{FD} / l_j \quad (\text{B.11})$$

where l_j is the direct earnings coefficient for the sector j , obtained as the ratio of earnings to total output of the j th sector.

Using the Leontief matrix and employment-to-output ratios, the final-demand employment multiplier table is computed as:

$$D = E \cdot B \quad (\text{B.12})$$

where D is the final-demand employment multiplier table, E is the n by n matrix containing the i th sector's direct employment coefficient in its i th diagonal and zeros elsewhere. The final-demand employment multiplier for sector j (E_j^{FD}) is computed as:

$$E_j^{FD} = \sum_{i=1}^n d_{ij} \quad (\text{B.13})$$

The Type 1 direct-effect employment multiplier for sector j (I_j^{DE}) is derived as:

$$E_j^{DE} = E_j^{FD} / e_j \quad (\text{B.14})$$

where e_j is the employment-to-output ratio for sector j . Type 2 multipliers are obtained in exactly the same fashion except that the household sector is chosen to be endogenous.

Appendix C. Various Retail, Wholesale and Transportation Margins

Retail and Wholesale Margins for PCEs (as a proportion of retail prices)

Commodity	Retail	Wholesale
Groceries	.264	.090
Clothing	.420	.060
Drugs, health aids, and beauty aids	.301	.078
Soaps and detergents	.242	.148
Electrical appliances	.290	.066
Computers	.286	.077
Furniture	.425	.016
Home furnishings	.347	.037
Jewelry	.464	.024
Toys and hobbies	.329	.154
Sporting goods	.350	.123
Hardware and supplies	.409	.070
Lumber	.444	.032
Automobiles	.165	.015
Gasoline	.206	.315
Auto parts	.362	.067
All other merchandise	.331	.063
Average	.353	.076

Wholesale Margins

(as a proportion of wholesale prices)

Commodity	Margin
Durable equipment	.251
Automotive	.225
Furniture	.320
Lumber	.222
Commercial equipment	.260
Metals and minerals	.216
Electrical equipment	.220
Hardware	.260
Machinery	.299
Misc. durable equipment	.259
Non-durable equipment	.181
Paper	.215
Drugs	.148
Apparel	.308
Groceries	.161
Chemicals	.239
Petroleum	.100
Alcohol	.243
Misc. non-durable goods	.239

Transportation Margins for PCEs (as a proportion of retail prices)

Type	Margin
Truck transportation	.0080
Air transportation	.0030
Water transportation	.0175

Note. The wholesale margin for PCEs is the average of all PCE purchases of that type of commodity, which includes purchases made from retailers who did not purchase the goods through Hawai'i wholesalers. That is why some of them are rather low. The transportation margins are estimates for all commodities.

Source: 1992 Benchmark I-O Composition of U.S. NIPA Final Demand

All transactions in an I-O model are valued at producer's prices. In other words, only the margin on merchandise resale is considered the output of the selling industry. Here is an example:

A grocery store sells vegetables to a household for \$100. In the I-O table, the purchase would not show up as a PCE purchase of \$100 from the retail trade sector. The retail markup for groceries is around 26.4 percent of the purchasers' price, so \$26.40 of the \$100 would be a household purchase from the retail trade sector. A wholesaler sells goods to the retail trade sector, and the wholesale margin is around 9 percent of the purchasers' price, so \$9.00 would be a household purchase from the wholesale sector. Transportation costs (air, water, and truck transportation) associated with the shipping of the goods from the producer to the wholesaler and retailer account for about 2.85 percent of the purchasers' cost, so \$2.85 would be a household purchase from the three transportation sectors. The

remaining \$61.75 is the producer's value, the value that the vegetable producer received when he/she sold the good. Thus, there is also a household purchase from the vegetable producing sector of \$61.75, assuming all of the vegetables are produced locally and not imported.

Typical margins are listed in the Appendix C. One needs to be aware that not all retail goods are purchased from wholesalers in Hawai'i. Some are purchased directly from the manufacturer, and others are purchased from mainland wholesalers.

Appendix D. Mathematics of the Modified RAS Procedure

Using equation (B.1), theoretically total intermediate sales of sector i (U_i) is calculated as:

$$U_i = \sum_{j=1}^i Z_{ij} = X_i - Y_i \quad (D.1)$$

and total inter-industry input (including intermediate import (M_j)) for sector j (V_j) is calculated from eqn. (B.2) as:

$$V_j = \sum_{i=1}^n Z_{ij} + M_j = X_j - W_j \quad (D.2)$$

where X_i is total sales or output for industry i , X_j is total purchases or input for industry j , Y_i is total final demand for industry i , W_j is total final payments of industry j , Z_{ij} is industry i 's (j 's) inter-industry sales (purchases) to (from) the industry j (i), and M_j is imports of industry j as intermediate input. Note that $X_i = X_j$ for $i = j$.

The import row for intermediate use is represented as follows:

$$\sum_{j=1}^n M_j = M \quad (D.3)$$

where M is the control total for intermediate imports computed based on relations between the value added and expenditure sides of the GSP account.

Although true theoretically, the last three equations do not hold in practice. Thus, Z_{ij} s and M_j s need to be adjusted until each of the three equations is satisfied simultaneously.

Let

$$U_i^0 = \sum_{j=1}^n Z_{ij}^0, \quad r_i^0 = \frac{U_i^0}{U_i}, \quad M^0 = \sum_{j=1}^n M_j^0, \quad \text{and} \quad r_m^0 = \frac{M^0}{M} \quad (D.4)$$

where Z_{ij}^0 s and M_j^0 s are the elements from the pre-balanced inter-industry matrix. Then we get

$$U_i = \sum_{j=1}^n Z_{ij}^0 \cdot r_i^0 \quad \text{and} \quad M = \sum_{j=1}^n M_j^0 \cdot r_m^0 \quad (D.5)$$

This balances the rows but columns are still unbalanced. To balance the columns, let

$$V_j^1 = \sum_{i=1}^n Z_{ij}^1 + M_j^1 \text{ and } q_j^1 = \frac{V_j^1}{V_j} \quad (\text{D.6})$$

where Z_{ij}^1 and M_j^1 are the elements from the row-balanced inter-industry matrix. Then, we have

$$V_j = \sum_{i=1}^n Z_{ij}^1 \cdot q_j^1 + M_j^1 \cdot q_j^1 \quad (\text{D.7})$$

Once the columns are balanced, the row totals may no longer align. The procedure must then be repeated to rebalance the rows, which in turn can unbalance the columns. This iterative process continues until both rows and columns of the inter-industry transactions table converge to their control totals. The balancing was carried out using customized macros in Microsoft Excel. This iterative adjustment is commonly known as the RAS method, a standard technique for balancing input–output tables.