

# **The 2007 Hawaii Inter-County Input-Output Study**



**Revised May 2014**

**Research and Economic Analysis Division  
Department of Business, Economic Development and Tourism  
STATE OF HAWAII**

## TABLE OF CONTENTS

LIST OF FIGURES AND TABLES	iii
LIST OF APPENDIX TABLES	iv
PREFACE	v
I. INTRODUCTION	1
II. RESULTS AND DISCUSSION	4
The Inter-County Transactions Table	4
<i>Output, Labor Income and Employment</i>	4
<i>Inter-industry Purchases and Sales</i>	5
<i>Final Demand</i>	5
Multipliers	6
III. EXAMPLES OF USING THE INTER-COUNTY I-O MODEL	9
Economic Impacts of Decreased Visitors Expenditures in Maui County in 2008	9
TABLES	12
APPENDIX A. MATHEMATICAL FRAMEWORK FOR THE INTER-COUNTY I-O MODEL	41
APPENDIX B. INDUSTRY CLASSIFICATION, DATA SOURCES, AND ESTIMATION PROCEDURES	47
APPENDIX C. INTER-COUNTY INTER-INDUSTRY TRANSACTIONS TABLE AND BALANCING PROCEDURES	52
REFERENCES	55
APPENDIX TABLES	60

## LIST OF FIGURES AND TABLES

Figure 1.	Spillover and Feedback Effects in a 3-region Model	2
Table 1.	Output, Income and Total Employment by Industry and by County – County Shares, 2007	12
Table 1a.	Output, Income and Total Employment by Industry and by County – Sector Shares, 2007	13
Table 2.	Inter-County Transactions Table (\$ millions), 2007	14
Table 3.	Inter-County Transactions Table (percent of total input), 2007	16
Table 4.	Composition of Total Final Demand by County, 2007	18
Table 5.	Final Demand Output, Earnings and Total Job Multipliers in State, Inter-County, and County I-O Models, 2007	19
Table 6.	Counties’ Percentage Contributions to Output Multiplier in Inter-County I-O Model, 2007	20
Table 7.	Type I State and Weighted Inter-County Multipliers, 2007	21
Table 8.	Final Demand Output Multipliers for the State, Inter-County and County I-O Models, 2007	22
Table 9.	Final Demand Earnings Multipliers for the State, Inter-County and County I-O Models, 2007	23
Table 10.	Final Demand Total Job Multipliers for the State, Inter-County and County I-O Models, 2007	24
Table 11.	Final Demand State Tax Multipliers for the State, Inter-County and County I-O Models, 2007	25
Table 12.	Direct Effect Earnings Multipliers for the State, Inter-County and County I-O Models, 2007	26
Table 13.	Direct Effect Total Job Multipliers for the State, Inter-County and County I-O Models, 2007	27
Table 14.	Detailed Inter-County Final Demand Output and Earnings Multipliers for Honolulu, 2007	28
Table 15.	Detailed Inter-County Final Demand Total Job and State Tax Multipliers for Honolulu, 2007	30
Table 16.	Detailed Inter-County Direct Effect Earnings and Total Job Multipliers for Honolulu, 2007	32
Table 17.	Total Visitor Expenditures by County: August Year-To-Date (\$ millions)	34
Table 18.	Direct Spending of Decreased Visitor Expenditures in Maui County in 2008	35
Table 19.	Direct Output Impact of Decreased Visitor Expenditures in Maui County in 2008	36
Table 20.	Direct Labor Income Impact of Decreased Visitor Expenditures in Maui County in 2008	37
Table 21.	Direct Employment Impact of Decreased Visitor Expenditures in Maui County in 2008	38
Table 22.	Economic Impacts of Decreased Visitor Expenditures in Maui County in 2008	39
Table 23.	Impacts of Decreased Visitor Expenditures in Maui County in 2008 by Industry	40

## LIST OF APPENDIX TABLES

Table A-1. Output Shares by Sector and by County, 2007	60
Table A-2. Earnings Shares by Sector and by County, 2007	61
Table A-3. Value Added Shares by Sector and by County, 2007	62
Table A-4. Total Job Shares by Sector and by County, 2007	63
Table A-5. Personal Consumption Expenditures (PCE) Shares by Sector and by County, 2007	64
Table A-6. Visitor Expenditures (VE) Shares by Sector and by County, 2007	65
Table A-7. Total Intermediate Demand as a Percent of Total Output by Sector and by County, 2007	66
Table A-8. Total Intermediate Input as a Percent of Total Output by Sector and by County, 2007	67
Table A-9. Total Labor Income as a Percent of Total Output by Sector and by County, 2007	68
Table A-10. Total Value Added as a Percent of Total Output by Sector and by County, 2007	69
Table A-11. Total Jobs Per \$Million of Total Output by Sector and by County, 2007	70

## **PREFACE**

This report is the second update of the 2002 benchmark report of Hawaii inter-county input-output (I-O) study prepared by the Department of Business, Economic Development & Tourism (DBEDT). This update is based on both available and estimated 2007 data. The report was prepared at the Research and Economic Analysis Division (READ) of DBEDT by Dr. Binsheng Li, under the supervision of Dr. Eugene Tian, Division Administrator.

The report is available on the DBEDT Web site, <http://www.hawaii.gov/dbedt/>.

## I. INTRODUCTION

This report presents the inter-county input-output (I-O) model for the State of Hawaii. The 2007 inter-county I-O model updates the 2005 inter-county I-O model by including the latest available county-level data on jobs, earnings, final demand, state taxes, components of value added, and outputs of a few industries. There is no structure change between the 2005 and the 2007 inter-county I-O model.

I-O models are accounting representations of the structure of an economy, which allow analysts to examine the possible impacts of changes in the demand for a region's goods and services. The technique was developed by Wassily Leontief in the 1930s for which he was awarded the Nobel Prize in Economics in 1973.<sup>1</sup>

The inter-regional I-O accounting framework, first developed by Isard (1951), and later elaborated by Isard et al. (1960), Richardson (1972), Miller and Blair (1985), and Yamano and Ahmad (2006) provides the basic framework for building the inter-county I-O model for Hawaii. In an inter-regional I-O model, linkages between regions (in this case inter-county linkages) are made sector specific both in the supplying region and in the receiving region.

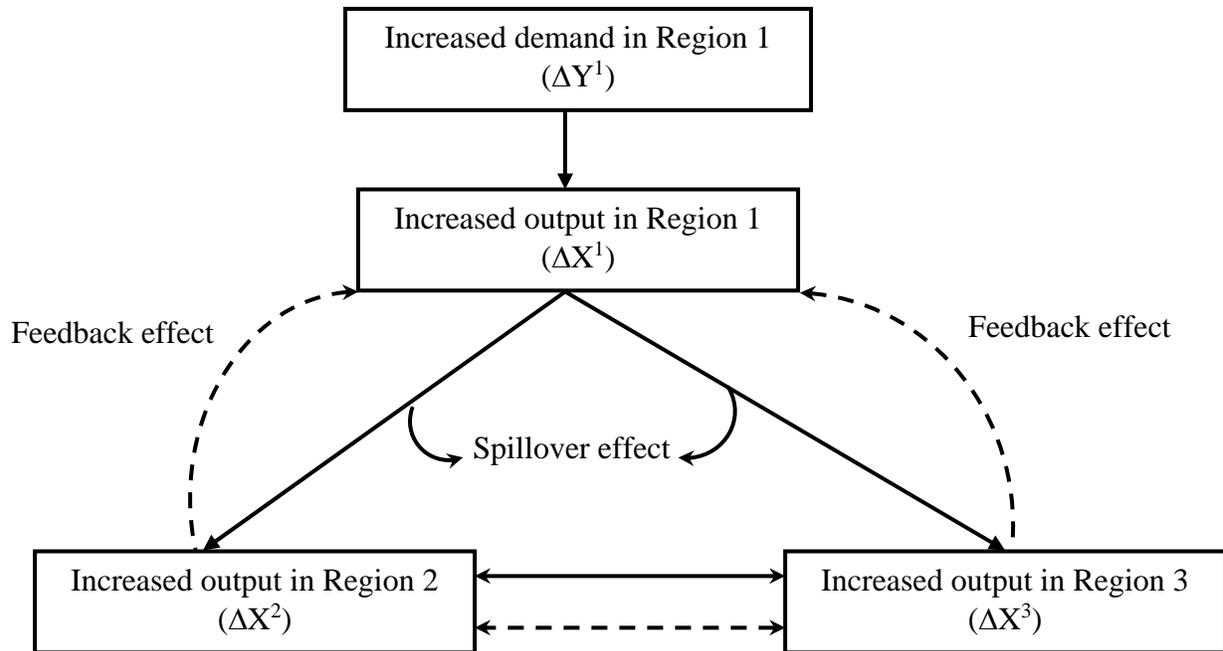
The inter-county I-O model presented in this report is an extension of the 2007 I-O model for the state, published by DBEDT in July 2011. The state I-O model provides detailed information on sales and purchases of goods and services among industries, final consumers (households, visitors, government, and exports) and factors of production in the entire state. In addition to county-specific information not contained in the state I-O model, the inter-county I-O model also shows the value of goods and services flowing among the various economic sectors *within each county*, and it also accounts for flows that occur among the various sectors *between counties*. This characteristic of detailing the flows between counties is what differentiates an inter-county model from a set of single-county models and the state model and provides a valuable analytical advantage over a state or single-county model.

When an inter-county I-O model is used for economic impact analysis, the specification of the flows between counties permits the estimation of impacts that are not explicit in a state-level or a single-county model. These effects are described in Figure 1 below.

For example, if a new economic activity has been created which increases an industry's final demand in Region 1, the increased demand in Region 1 will create increased output in that region. This increased output in Region 1 will also necessitate new flows of goods and services from Region 2 and Region 3, resulting in increased output in those regions. These effects are referred to as the *spillover effects*. In order to meet Region 1's new demand of goods and services, industries in Regions 2 and 3 will have to expand their production. This may, in turn, create new demand for goods and services produced in Region 1. As a result, output in Region 1 may increase again as a result of increased activity in the first place. These additional effects are known as the *feedback effects*.

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<sup>1</sup> Leading texts on input-out analysis are by Chenery and Clark (1959), Miernyk (1965), and Miller and Blair (1985).



**Figure 1. Spillover and Feedback Effects in a 3-region Model**

As can be seen in the discussion in the next section, production and consumption patterns in a particular county can differ significantly from the state average patterns recorded in the state I-O table. Besides movements of goods and services between counties, inter-regional flows of factors, factor incomes, and transfers of all kinds can occur in both directions. This suggests that there are benefits in creating an accounting framework that captures interactions and linkages between counties within the context of the state as whole. Since Hawaii’s counties are geographically isolated, the potential problem of workers with different counties of residence and workplace is less important than it would be with adjoining counties.

There are several beneficial uses of the inter-county I-O model over the state model or the single-county model. First, it can be used to better assess impacts of county-specific economic activities. Individual I-O models of each of the counties are included within the larger inter-county I-O structure. The separate representation of each county's intermediate and final demand structure allows the user to account for the differences underlying production and consumption structures among counties.

Second, the inter-county model can provide a useful tool in assessing rural-urban linkages in the state economy. State government policy is sometimes focused on directing economic impacts to less-developed areas. In cases, such as the State of Hawaii, where much of the urban activity is geographically localized, an inter-regional I-O model permits observation and quantification of some urban-rural connections. The effects quantified by the model are the inter-regional spillover and feedback effects, as depicted in Figure 1.

Third, the inter-county I-O model provides a more appropriate modeling framework for producing long-range economic and population forecasts for counties compared to the state I-O model. The inter-county model eliminated the need for an additional mechanism to allocate state forecasts to the individual counties.

Despite the advantages of the inter-county model just described, there exist some drawbacks in building an inter-county I-O table. There are some institutions or activities of institutions, which are not easily attributable to a particular county, for instance, activities of the state or federal governments to provide public services. Another problem is posed by firms that have plants or offices in several counties, but their main office is located in one county. If company data are reported out of the main office, attributing the shares of the enterprise to different counties is problematic. Compared to the state I-O table, the inter-county table requires much more detailed data on flows of goods and services between sectors and between counties. The problem is that such data, especially bilateral flows of services and commodities across counties and institutional transfers, are not readily available or do not exist. The lack of sufficient data to produce this Hawaii inter-county I-O model was overcome by using various mathematical approaches to estimate inter-regional commodity and service flows.

Inter-regional I-O models have been applied in many empirical studies to address a wide range of policy issues and to analyze their impacts on other regions. For example, Brian *et al.* (2006) described current uses of inter-country I-O models and their applications to understanding a range of policy issues, such as global value chains and production fragmentation, technology flows, productivity and determinants of growth, industrial ecology and sustainable development. Fernando and Urena (2006) introduced a new method of regionalization and disaggregation which takes into account the gross value added of each sector in every region and the transport infrastructure used by these regions.

To analyze the inter-regional feedback effects and the degree to which change originating in one region has capacity to influence activity levels in another region, Bui *et al.* (2000) applied an inter-regional I-O model on a case study of HoChiMinh City and the rest of Vietnam. Harries *et al.* (1998) separated the Lincoln County into the Caliente area and the rest of Lincoln County. Following procedures outlined by Robinson (1997), Holland (1991), and Robinson and Lark (1993), Harries *et al.* (1998) used an inter-regional model to give local decision makers an idea of potential socio-economic and fiscal impacts from changes in local economic activity.

Inter-regional I-O models are also used to estimate the damages and losses by unscheduled events, such as earthquakes, flood, and other major natural disasters. Okuyama *et al.* (2002) applied a sequential inter-industry model to assess the impacts of the Great Hanshin earthquake in such a way to enable transportation into the I-O framework. Other recent studies using the inter-regional I-O model include Allan *et al.* (2004), Zhang (2007), Patrick and Wang (2007), and Rey (1999).

Section II of this report describes the inter-county I-O table in terms of the inter-industry transactions table and different multipliers. Section III illustrates the use of the inter-county I-O table using an example. Mathematical details of constructing an inter-regional I-O model are provided in Appendix A. Industry classification, data sources, and estimation procedures of different components of the I-O table are discussed in Appendix B. The estimation of inter-county transactions table and the balancing procedures are described in Appendix C.

## II. RESULTS AND DISCUSSION

This section highlights differences among counties in terms of their production and consumption patterns as shown by the inter-county transactions table, followed by a description of various I-O multipliers derived from that table. For simplicity, an aggregated 5-sector 4-county table is presented here. More detailed county-specific data are provided in a series of Appendix Tables. Two versions of detailed inter-county I-O models are developed in this study: the first is a 20-sector 4-county model, and the second includes 68 sectors for Honolulu (similar to the 2007 State I-O table) and 20 sectors for each of the neighbor island counties. Data limitations made more detailed analysis of the neighbor islands counties impractical. The complete 20 sector 4-county and more detailed (68 sectors for Honolulu and 20 sectors for other counties) transactions tables, direct requirements tables, and total requirements tables are available along with this report at the DBEDT Web site.

Various types of multipliers are provided for both 5-sector and more detailed models. For comparison, these multipliers are computed for three different types of I-O models: the single region state I-O model, the inter-county (inter-regional) I-O model, and four single region I-O models for each of the four counties. The multipliers derived from the State I-O table can be larger or smaller than those derived from the inter-county and single region county I-O tables. The size of the multiplier will depend on differences in patterns of production and consumption between individual counties and the state as a whole. However, the multipliers obtained from the single region county I-O tables will always be smaller than those obtained from the inter-county I-O table. The reason is that the inter-county table accounts for both inter-regional spill-over and feedback effects, while the single region county table does not account for such inter-regional effects.

### **The Inter-County Transactions Table**

#### ***Output, Labor Income and Employment***

Output, labor income and total employment for the five aggregated sectors by county are summarized in Table 1. Accordingly, in 2007, Honolulu accounted for 74.2 percent of total output, 76.7 percent of total labor income, and 71.5 percent of total jobs in the State. Maui and Hawaii counties accounted for about 9-12 percent each and Kauai about 4-5 percent of the State total output, labor income and employment.

Except for agriculture for which Hawaii County had the most jobs and output, Honolulu accounted for the largest shares of total output, total income and total jobs in the State for all of the aggregated sectors in Table 1. For the government sector, Honolulu's share was 84-86 percent of the State total. Honolulu also accounted for significant shares of total agricultural (including commercial fishery and agricultural and fishery services) output (33.6 percent), labor income (33.5 percent), and employment (21.4 percent), although these shares were much smaller compared to those for the other industries.

As expected, other counties' shares of total agriculture's contributions to the State economy were substantially higher than those for other industries. For instance, Hawaii County accounted for 34.3 percent of total output, 33.4 percent of labor income, and 47.6 percent of total jobs in agriculture in the

State. Kauai accounted for 10.0 percent and Maui accounted for 22.2 percent of total agricultural output in the State.

Counties also differed significantly in terms of their sectoral composition of total output, labor income, and employment. For example, as shown in Table 1a, agriculture contributed to 2.3 percent of total output, 2.6 percent of total labor income, and 7.5 percent of total jobs in Hawaii County, compared to less than 1 percent of total output, labor income, and total jobs in Honolulu. The government is another sector in which counties differed significantly. The government sector accounted for 17.0 percent of total output, 35.6 percent of labor income, and 23.8 percent of total jobs in Honolulu, compared to 7–9 percent of total output, 16–22 percent of labor income, and 10–14 percent of total jobs in other three counties. More detailed industries' contributions to total output, labor income, and value added and jobs are presented in Appendix Tables A-1 through A-4.

### ***Inter-Industry Purchases and Sales***

As can be seen in Tables 2 and 3, Honolulu made a sizable portion of total sales to industries located in the other three counties. For instance, Honolulu accounted for about 12–23 percent of total input purchases (mostly materials and services) by the construction industry and the manufacturing industry in other counties. For other private industries, the share purchased from Honolulu was about 6–10 percent in most cases. Except for some inputs to the manufacturing (food processing) industry, the flows of industries' inputs among Hawaii, Kauai and Maui counties were quite small.

In terms of the 5-sector model shown in Table 3, the shares of manufacturing intermediate input in total input purchases were generally higher in other counties than in Honolulu. This is largely a function of local sugar, pineapple, macadamia nuts and other agricultural products used as inputs to food processing on the neighbor islands. Shares of both intermediate input and value added in total purchases of manufacturing were lower in Honolulu, mainly because of a higher share of imported inputs from outside Hawaii. For example, imports from outside the state accounted for more than half (68.9 percent) of total manufacturing input purchases in Honolulu, compared to about 30 percent in the other three counties. The shares of intermediate input, intermediate sales, labor income, and value added in total input purchases for 20 industries are provided in Appendix Tables A-7 to A-10.

For some industries, Honolulu purchased sizable amounts of intermediate sales from other counties. For example, Honolulu purchases accounted for 12.6 percent of total intermediate sales of agriculture (Table 2, first row, \$15.0 million) and 39.8 percent of intermediate manufacturing sales in Hawaii County (Table 2, third row, \$92.6 million).

### ***Final Demand***

Table 4 summarizes total final demand provided by Hawaii producers (excluding imported final demand) and their major components by county. Of the \$77.3 billion total final demand provided by Hawaii producers in 2007, Honolulu accounted for 73.0 percent, Maui 12.1 percent, Hawaii County 10.2 percent, and Kauai 4.7 percent. Personal consumption expenditures (PCE) had the highest share in total final demand in all counties, especially in Honolulu and Hawaii County. Visitor expenditures (VE) had the second highest share in total final demand in all counties, especially in Kauai and Maui County. Another notable difference among counties was a significantly larger share of federal government expenditures in the City and County of Honolulu than in other counties (about 15 percent vs. 1 – 3

percent), primarily because of the military bases on Oahu. While the share of out-of-state export in total final demand was similar in Honolulu compared with that of the neighbor island counties, the out-of-county but within-state export share was slightly larger for neighbor island counties than for Honolulu (4.3-5.2 percent vs. 4.0 percent).

Of the total \$32.2 billion PCE for the state in 2007 provided by local producers (i.e., excluding imported goods and services from out-of-state producers), Honolulu accounted for 75.7 percent, Maui 9.6 percent, Hawaii County 10.7 percent, and Kauai 4.1 percent. In 2007, of total visitor expenditures of \$12.9 billion provided by local producers, Honolulu accounted for 52.4 percent, Maui 25.3 percent, Hawaii County 12.8 percent, and Kauai 9.6 percent.

Industries' shares in total PCE and those for visitor expenditures including imports from out-of-state producers are presented in Appendix Tables A-5 and A-6, respectively. As shown in Appendix Table A-5, except for considerably higher shares of within-state imports and real estate and rentals and somewhat lower shares of finance and insurance, health services, and other services in other counties, industries' shares in total PCE were fairly similar across counties. For all counties, as well as the state as a whole, real estate and rentals accounted for the largest share of total PCE, followed by health services, retail trade, and finance and insurance. Out-of-state imported goods and services made about 17 percent of total PCE.

As can be seen in Appendix Table A-6, in terms of industries' proportions, visitor expenditure patterns were significantly different across counties. The hotel sector accounted for the largest share of total visitor expenditures in all counties; however, the hotel sector's share for Honolulu was smaller than that for other counties. The second largest sector was retail trade for Hawaii, Maui and Kauai counties, while it was transportation for Honolulu, which accounted for about 19.4 percent of total visitor expenditures. The retail trade sector ranked third for Honolulu, followed by eating and drinking. The next largest contributors to the visitor expenditure in other counties included eating and drinking, real estate and rentals, and transportation.

## **Multipliers**

Type I and Type II final demand multipliers for output, earnings<sup>2</sup> and total jobs calculated from the 5-sector state, inter-county, and single-region county I-O models are given in Table 5. As explained more fully in Appendix A, final demand multipliers measure the volume of economic activity related to a dollar change in final demand. A Type I multiplier shows the economic activity produced by the initial final demand change (called the direct effect) and the purchases of inputs from local industries necessary to supply the final demand change (called the indirect effect). A Type II multiplier accounts for the direct effect, the indirect effect, plus the economic activity produced by the consumption spending related to the earnings induced by the direct and indirect effects of the final demand change (called the induced effect).

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<sup>2</sup> Following BEA's RIMS II methodology (BEA, 1997), earnings is calculated as the sum of wages and salaries, proprietors' income, directors' fees, employer contribution to health insurance less personal contribution to social insurance. Earnings are typically about 17 percent smaller than the sum of employee compensation and proprietors' income, which is traditionally known as labor income.

Everything else being equal, multipliers are larger when the economic activity that is generated remains within the economy. Economic activities that promote more wages for residents rather than more imports generally have higher multipliers. In all cases, multipliers obtained from the single-region county models are smaller than those obtained from the inter-county model. An economic activity is likely to require more imports of labor and goods in a single-region. Except for a few cases (agriculture earnings and output multipliers for Honolulu, manufacturing earnings multipliers for Hawaii, Kauai and Maui, manufacturing output multipliers for Hawaii and Maui counties, and government earnings and output multipliers for Hawaii and Kauai), single-region county output and earnings multipliers are also generally lower than the corresponding state output and earnings multipliers. However, no particular pattern could be observed for job multipliers.

As can be seen in Table 5, the differences between the inter-county multipliers and the single-county multipliers are much larger for other counties than for Honolulu. This is because industries in other counties are more dependent on their inputs from Honolulu than the other way around. As a result, not accounting for inter-county flows in single-region county I-O models would have bigger impacts in other counties than in Honolulu.

Type II multipliers are larger than Type I multipliers in all cases because the former also account for induced effects in addition to the direct and indirect effects.

A notable advantage of an inter-regional I-O model over a single-region model is its ability to estimate impacts of a demand change not only in a particular region where demand change has occurred, but also the impacts on other regions supplying inputs to that region. The Type I inter-county output multiplier of agriculture for Hawaii County is 1.38, meaning that every dollar increases in final demand in agriculture in Hawaii County would increase the total output in the State by \$1.38. Table 6 shows that, of the \$1.38 additional output, \$1.21 (88.1 percent) is output of Hawaii County, \$0.16 (11.5 percent) of Honolulu output, and \$0.004 (0.3 percent) of Maui output. Note that Type I single-county output multiplier of agriculture in Hawaii County is 1.21, about the same as that county's contribution to the output multiplier in the inter-county model. The same relationship would hold for other multipliers, as well as other industries.

Table 7 shows the relationships between multipliers obtained from the inter-county I-O table and the state I-O table for the 5-sector model. When the inter-county multipliers are weighted by counties' output shares, inter-county weighted output multipliers are almost identical to the state output multipliers for all sectors, except the government sector. Earnings and employment multipliers are also very close, although not identical, when they are weighed by earnings and employment shares of counties.

The various final-demand and direct-effect multipliers obtained from the 20-sector state, inter-county and single region county I-O models are presented in Tables 8-13. The multipliers for a more detailed inter-county I-O model (68 sectors for Honolulu and 20 sectors each for other counties) are presented in Tables 14-16. Important points from these tables are summarized below.

Both Type I and Type II output multipliers from the single region county models are not only smaller than those obtained from the inter-county model, but they are mostly smaller than those from the

state I-O model, especially for Maui, Kauai and Hawaii counties. In many cases, this is also true for final demand earnings multipliers.

Final demand job multipliers for most of the industries are lower in Honolulu than in other counties in both inter-county and single region county I-O models. Across all counties, the more labor intensive industries, such as arts and entertainment, agriculture, educational services, eating and drinking, business services, and other services have higher final demand job multipliers and more capital intensive industries, such as utilities, other manufacturing, information, and real estate and rentals have lower final demand job multipliers.

### III. EXAMPLES OF USING THE INTER-COUNTY I-O MODEL

The usefulness of the inter-county I-O model is illustrated below using an example. The example involves estimating the economic impacts of increased visitor spending in Maui County in 2011. In determining whether or not the use of a multiplier is relevant, the single most important factor is whether the economic activity brings in money not currently in the economy. Visitor expenditures are a particularly good example. For example, a rock concert attended only by residents would have virtually no feed back or multiplier effects, as it would substitute for other entertainment such as a movie and dinner out. But a rock concert which draws in a large number of fans from across the world may have a multiplier impact, but the import content (e.g. payment to the out-of-state performer) must be subtracted. A multiplier analysis may also be relevant if there is a shift from an activity which is highly import based to one which draws more on local resources. Additional examples of applying the inter-county I-O model are available in the 1997, 2002, and 2005 Hawaii Inter-County Input-Output studies.

#### **Economic Impacts of Increased Visitors Expenditures in Maui County in 2011**

Visitor expenditures increased substantially in Hawaii in 2011. As shown in Table 17, for the whole year of 2011, total visitor expenditures by air for the state increased \$1,689.4 million or 15.6 percent compared to the previous year. Honolulu experienced the largest increase in visitor expenditures by air in 2011, increased \$1,027.3 million or 18.7 percent, compared with the previous year, followed by Maui County (\$380.1 million or 13.2 percent), Kauai County (\$210.4 million or 18.9 percent), and Hawaii County (\$71.6 million or 5.3 percent).

Increases in visitor expenditures have positive impacts on the economy. Using the I-O model, the direct, indirect, and induced impacts of increased visitor expenditures on output, labor income (earnings), total jobs, wage and salary jobs, and state tax revenues can be estimated. Due to differences in economic structures, the economic impacts of a given change in visitor expenditures would be different for each county. In this example, we estimate the impacts of increased visitor expenditures in Maui County in 2011 on output, labor income, and total jobs.<sup>3</sup> The economic impacts of increased visitor expenditures in other counties can be estimated in a similar way.

To estimate the economic impacts of increased visitor expenditures in Maui County in 2011, one has to go through three basic steps: (1) allocate the \$380.1 million increased visitor spending in Maui County in 2011 to industries in each county that produced the goods and services purchased by Maui visitors, thereby generating a vector of visitor spending by county and by industry,<sup>4</sup> (2) estimate the direct impacts on output, labor income, and total jobs in each industry and each county, and (3) multiply the vector of visitor spending generated in step (1) by the appropriate multipliers or the total requirements matrix to estimate the total economic impacts on output, earnings, and total jobs. Using

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<sup>3</sup> The impacts on state tax revenues and wage and salary jobs can be estimated similarly.

<sup>4</sup> Since the visitor demand in Maui includes goods and services produced by industries in all counties in the State of Hawaii and out-of-state producers, the \$380.1 million increased visitor expenditures in Maui County in 2011 should be allocated to individual industries in all counties in Hawaii and imports. We assume imports do not affect the output of Hawaii, so that only the impacts on Hawaii produced goods and services are analyzed.

the Type I multipliers, the total direct and indirect impacts can be estimated; using the Type II multipliers, the total direct, indirect, and induced impacts can be estimated. In this example, we apply the Type II multipliers to estimate the total economic impacts.

Step (1) first allocates the \$380.1 million additional Maui County visitor expenditures to Maui County producers, other Hawaii producers (producers in Honolulu, Hawaii, and Kauai County), and out-of-state imports. Based on the 2007 inter-county transaction table, about 84.5 percent of total (including Hawaii produced and imported goods and services) Maui County visitor expenditures were provided by Maui industries; about 9.1 percent of total Maui County visitor expenditures were provided by Hawaii industries of other counties; and about 6.4 percent of total Maui County visitor expenditures were imported from out-of-state producers. Based on the same percentages calculated from the 2007 inter-county transaction table, it is estimated that Maui County visitor expenditures provided by Maui producers, other Hawaii producers, and out-of-state imports increased \$321.2 million, \$34.4 million, and \$24.5 million, respectively, in the 2011.<sup>5</sup>

To allocate the Maui visitor expenditure increases from each county's producers to the industries (sectors) of each county, the sector's shares of visitor expenditures in total county visitor expenditures must be estimated. Such shares were also estimated based on the 2007 inter-county transaction table. As shown in Table 18, the Maui hotel sector received most of visitor spending in Maui, accounting for 43.6 percent of total visitor spending provided by Maui producers in 2007, followed by retail trade (16.2 percent), eating and drinking (12.5 percent), real estate and rentals (10.2 percent), and transportation (5.3 percent). Among the industries in other counties, transportation was the most dominant sector, followed by wholesale trade and manufacturing. The vector of direct visitor spending is calculated by multiplying the total visitor expenditure increase from each county's producer by the industry percentages provided in Table 18.

Step (2) estimates the direct impacts on output, labor income, and total jobs in each industry and each county. The vector of direct visitor spending calculated in Step (1) reflects the direct impacts on output of Hawaii industries and excludes the goods and services imported from out-of-state producers. The direct output impact is provided in Table 19. The direct labor income and total job impacts by industry can be computed by multiplying the direct output vector estimated in Step (1) by earnings-to-output and total job-to-output ratio vectors calculated from the transactions table of the 2007 inter-county I-O model. The sums of the resultant vectors are the total state direct earnings and jobs impacts. The direct labor income and total job impacts by industry are provided in Table 20 and Table 21, respectively.

Step (3) computes the estimated impacts on total output by county and by industry and is performed by multiplying the visitor expenditures vector generated in Step (1) by the Type II inter-county total requirements table. This calculation can easily be performed by copying the total requirements matrix from the DBEDT Web site into a file where the visitor expenditure vector is stored as a row. The total

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<sup>5</sup> Ideally, if the actual data of increased visitor expenditures by industry and by county in 2011 were available, such data should have been used as the visitor expenditure vector. However, such data are not available; therefore, we must estimate the vector using the 2007 inter-county I-O table. Dividing each element in the Maui County visitor expenditure vector by its total produces a vector of industry and import shares. Multiplying each element in this share vector by \$380.1 million allocates the total visitor spending to industries on each county as well as imports.

output impacts by industry are then produced by multiplying each element in the visitor expenditure vector by the corresponding element in each industry row of the total requirements matrix. Total output impact estimates can also be calculated using the appropriate multiplier vector shown in Table 8. By stacking together four Type II inter-county multiplier columns into a 80 x 1 single vector corresponding to the county order in the visitor expenditure vector and multiplying the two vectors would also yield the same total impact estimate. However, the individual products do not represent the output in each industry, but the total output in the economy attributable to each industry's direct effect.

The total earnings and total job impacts can be computed similarly to the total output impacts by county and by industry, as described above. In calculating the total earnings and total job impacts, however, the Type II total requirements matrix (also called output multipliers matrix) in estimating output impacts is replaced by the Type II earning multipliers matrix and the Type II total job multipliers matrix, respectively. The results of these operations are summarized in Table 22.

As can be seen in Table 22, the \$355.6 million increased visitor spending in Maui County produced by Hawaii producers throughout the state in 2011 is estimated to have increased \$707.7 million output, \$224.4 million labor income, and 5,955 jobs in the state economy. About 73.2 percent of total output, 74.9 percent of total labor income, and 77.8 percent of total jobs generated from the increased visitor spending are estimated to remain in Maui County. Honolulu is expected to account for 24.5 percent of total output, 22.9 percent of labor income, and 19.5 percent of total job impacts. The Maui's shares in total impacts were smaller than its shares in direct impacts, suggesting some dependence of Maui industries in meeting visitor demand on their counterparts from other counties, especially from Honolulu.

The direct and total impacts of increased Maui visitor expenditures in 2011 by industry are provided in Table 23. With the exception of the real estate and rentals sector, the same sectors with the highest share in total direct impacts also have the highest shares in total output impacts, but their shares are considerably smaller. This is because some sectors with no or very small direct visitor spending captured large indirect and induced effects, including finance and insurance, other manufacturing, utilities, professional and business services, and health services.

## TABLES

**Table 1. Output, Income and Total Employment by Industry and by County - County Shares, 2007**

	Hawaii County		Honolulu County		Kauai County		Maui County		State Total	
	Value	%	Value	%	Value	%	Value	%	Value	%
<b>Output (\$ mil.)</b>										
Agriculture	245.9	34.3	240.9	33.6	71.6	10.0	159.3	22.2	717.8	100.0
Construction	1,382.2	13.7	7,060.1	69.9	431.9	4.3	1,228.9	12.2	10,103.0	100.0
Manufacturing	632.6	7.4	7,059.6	82.5	200.0	2.3	667.5	7.8	8,559.8	100.0
Services	7,331.3	10.3	50,872.6	71.6	3,707.2	5.2	9,122.5	12.8	71,033.5	100.0
Government	877.3	5.7	13,334.2	86.4	410.4	2.7	815.5	5.3	15,437.4	100.0
<b>Total</b>	<b>10,469.3</b>	<b>9.9</b>	<b>78,567.4</b>	<b>74.2</b>	<b>4,821.1</b>	<b>4.6</b>	<b>11,993.7</b>	<b>11.3</b>	<b>105,851.5</b>	<b>100.0</b>
<b>Earnings (\$ mil.)</b>										
Agriculture	94.4	33.4	94.8	33.5	13.7	4.8	79.9	28.3	282.9	100.0
Construction	468.8	13.6	2,352.6	68.4	171.1	5.0	446.0	13.0	3,438.4	100.0
Manufacturing	70.5	8.3	630.5	74.3	23.0	2.7	124.2	14.6	848.2	100.0
Services	2,229.1	9.7	16,891.3	73.2	1,200.7	5.2	2,763.3	12.0	23,084.4	100.0
Government	811.9	6.3	11,050.0	86.4	306.6	2.4	625.6	4.9	12,794.0	100.0
<b>Total</b>	<b>3,674.6</b>	<b>9.1</b>	<b>31,019.2</b>	<b>76.7</b>	<b>1,715.1</b>	<b>4.2</b>	<b>4,039.0</b>	<b>10.0</b>	<b>40,447.9</b>	<b>100.0</b>
<b>Total jobs* (no.)</b>										
Agriculture	7,595	47.6	3,411	21.4	1,558	9.8	3,377	21.2	15,941	100.0
Construction	8,859	16.9	33,389	63.7	2,966	5.7	7,163	13.7	52,377	100.0
Manufacturing	2,030	10.7	14,151	74.3	774	4.1	2,103	11.0	19,058	100.0
Services	69,004	11.4	421,959	69.8	33,568	5.6	79,624	13.2	604,155	100.0
Government	13,566	7.7	147,425	83.6	4,967	2.8	10,382	5.9	176,340	100.0
<b>Total</b>	<b>101,053</b>	<b>11.6</b>	<b>620,335</b>	<b>71.5</b>	<b>43,833</b>	<b>5.1</b>	<b>102,650</b>	<b>11.8</b>	<b>867,871</b>	<b>100.0</b>

\*Includes wage/salary and proprietors' jobs.

**Table 1a. Output, Income and Total Employment by Industry and by County - Sector Shares, 2007**

	Hawaii County		Honolulu County		Kauai County		Maui County		State Total	
	Value	%	Value	%	Value	%	Value	%	Value	%
<b>Output (\$ mil.)</b>										
Agriculture	245.9	2.3	240.9	0.3	71.6	1.5	159.3	1.3	717.8	0.7
Construction	1,382.2	13.2	7,060.1	9.0	431.9	9.0	1,228.9	10.2	10,103.0	9.5
Manufacturing	632.6	6.0	7,059.6	9.0	200.0	4.1	667.5	5.6	8,559.8	8.1
Services	7,331.3	70.0	50,872.6	64.8	3,707.2	76.9	9,122.5	76.1	71,033.5	67.1
Government	877.3	8.4	13,334.2	17.0	410.4	8.5	815.5	6.8	15,437.4	14.6
<b>Total</b>	<b>10,469.3</b>	<b>100.0</b>	<b>78,567.4</b>	<b>100.0</b>	<b>4,821.1</b>	<b>100.0</b>	<b>11,993.7</b>	<b>100.0</b>	<b>105,851.5</b>	<b>100.0</b>
<b>Earnings (\$ mil.)</b>										
Agriculture	94.4	2.6	94.8	0.3	13.7	0.8	79.9	2.0	282.9	0.7
Construction	468.8	12.8	2,352.6	7.6	171.1	10.0	446.0	11.0	3,438.4	8.5
Manufacturing	70.5	1.9	630.5	2.0	23.0	1.3	124.2	3.1	848.2	2.1
Services	2,229.1	60.7	16,891.3	54.5	1,200.7	70.0	2,763.3	68.4	23,084.4	57.1
Government	811.9	22.1	11,050.0	35.6	306.6	17.9	625.6	15.5	12,794.0	31.6
<b>Total</b>	<b>3,674.6</b>	<b>100.0</b>	<b>31,019.2</b>	<b>100.0</b>	<b>1,715.1</b>	<b>100.0</b>	<b>4,039.0</b>	<b>100.0</b>	<b>40,447.9</b>	<b>100.0</b>
<b>Total jobs* (no.)</b>										
Agriculture	7,595	7.5	3,411	0.5	1,558	3.6	3,377	3.3	15,941	1.8
Construction	8,859	8.8	33,389	5.4	2,966	6.8	7,163	7.0	52,377	6.0
Manufacturing	2,030	2.0	14,151	2.3	774	1.8	2,103	2.0	19,058	2.2
Services	69,004	68.3	421,959	68.0	33,568	76.6	79,624	77.6	604,155	69.6
Government	13,566	13.4	147,425	23.8	4,967	11.3	10,382	10.1	176,340	20.3
<b>Total</b>	<b>101,053</b>	<b>100.0</b>	<b>620,335</b>	<b>100.0</b>	<b>43,833</b>	<b>100.0</b>	<b>102,650</b>	<b>100.0</b>	<b>867,871</b>	<b>100.0</b>

**Table 2. Inter-County Transactions Table (in million of dollars except number of jobs in the last row), 2007**

		Hawaii County					Honolulu County				
		Agri- culture	Const- ruction	Manufac- turing	Services	Govern- ment	Agri- culture	Const- ructon	Manufac- turing	Services	Govern- ment
Hawaii County	Agriculture	21.7	2.6	55.9	11.3	0.1	0.4	0.0	7.9	6.7	0.0
	Construction	0.9	3.8	4.8	88.5	3.7	0.0	0.0	0.0	0.0	0.0
	Manufacturing	2.1	9.8	35.7	40.6	0.4	1.3	16.7	10.8	61.5	2.4
	Services	15.4	275.5	130.7	1,297.9	15.1	0.3	42.0	8.1	77.0	5.0
	Government	1.9	54.5	4.4	119.3	1.1	0.0	0.0	0.0	0.0	0.0
Honolulu County	Agriculture	0.0	0.0	3.9	0.0	0.0	15.5	4.1	8.7	36.5	0.5
	Construction	0.0	0.0	0.0	0.0	0.1	3.6	14.9	9.8	600.5	119.0
	Manufacturing	22.2	97.1	64.5	328.2	2.7	35.2	636.5	425.7	1,683.9	85.1
	Services	3.6	66.8	26.1	287.9	3.6	43.2	1,959.8	719.7	11,596.6	561.2
	Government	0.0	0.0	0.0	0.0	0.0	5.1	37.6	61.5	672.4	43.0
Kauai County	Agriculture	0.0	0.0	0.4	0.0	0.0	0.1	0.0	0.1	0.2	0.0
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Manufacturing	0.1	0.7	0.7	5.5	0.0	0.1	1.4	0.9	12.8	1.1
	Services	0.1	3.0	1.3	10.8	0.2	0.2	8.9	3.8	50.1	3.2
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maui County	Agriculture	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.2	0.3	0.0
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Manufacturing	0.3	2.9	1.7	8.7	0.0	0.3	7.5	5.5	36.5	2.9
	Services	0.2	2.8	2.1	15.6	0.3	0.4	17.6	10.4	97.5	7.5
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Intermed. input	68.4	519.4	332.5	2,214.4	27.2	105.9	2,747.0	1,273.0	14,932.4	830.8
	Value added	149.7	612.8	101.5	4,576.4	839.8	93.2	3,005.8	919.6	32,047.0	12,212.0
	Income	94.4	468.8	70.5	2,229.1	811.9	94.8	2,352.6	630.5	16,891.3	11,050.0
	Others	55.3	144.1	30.9	2,347.3	27.9	-1.6	653.2	289.1	15,155.7	1,162.0
	Imports	27.8	249.9	198.6	540.6	10.3	41.8	1,307.3	4,867.0	3,893.2	291.4
	Total input	245.9	1,382.2	632.6	7,331.3	877.3	240.9	7,060.1	7,059.6	50,872.6	13,334.2
	Total jobs	7,595	8,859	2,030	69,004	13,566	3,411	33,389	14,151	421,959	147,425

**Table 2. Inter-County Transactions Table (in million of dollars except number of jobs in the last row), 2007 - Contd.**

		Kauai County					Maui County					Total	Total	Total
		Agri- culture	Const- ruction	Manuf- acturing	Services	Govern- ment	Agri- culture	Const- ructon	Manuf- acturing	Services	Govern- ment	intermed. demand	final demand	output (sales)
Hawaii County	Agriculture	0.0	0.0	0.2	0.2	0.0	0.0	0.0	9.4	2.4	0.0	118.9	127.0	245.9
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.7	1,280.5	1,382.2
	Manufacturing	0.0	1.0	5.9	11.0	0.3	0.5	6.0	4.6	21.6	0.7	232.8	399.9	632.6
	Services	0.0	0.7	3.4	8.9	0.8	0.1	10.7	6.0	32.4	1.2	1,931.4	5,400.0	7,331.3
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	181.2	696.1	877.3
Honolulu County	Agriculture	0.0	0.0	13.2	1.1	0.0	0.0	0.0	20.6	3.9	0.0	107.9	133.1	240.9
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	747.9	6,312.1	7,060.1
	Manufacturing	7.3	49.0	4.3	183.3	7.5	10.2	151.2	87.4	463.5	16.1	4,360.8	2,698.8	7,059.6
	Services	3.0	37.9	9.4	201.7	7.2	3.7	88.9	47.1	426.8	14.2	16,108.3	34,764.2	50,872.6
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	819.6	12,514.6	13,334.2
Kauai County	Agriculture	1.1	0.2	27.3	2.2	0.1	0.0	0.0	2.0	0.2	0.0	33.8	37.8	71.6
	Construction	1.4	1.8	0.3	70.2	12.0	0.0	0.0	0.0	0.0	0.0	85.8	346.2	431.9
	Manufacturing	0.7	0.7	13.0	29.4	0.1	0.0	0.4	1.8	7.6	0.0	76.9	123.1	200.0
	Services	8.7	66.8	36.8	648.4	40.7	0.1	3.4	1.3	17.3	0.9	905.9	2,801.3	3,707.2
	Government	0.4	1.2	1.5	65.1	2.4	0.0	0.0	0.0	0.0	0.0	70.6	339.8	410.4
Maui County	Agriculture	0.0	0.0	6.8	0.4	0.0	6.9	1.0	54.7	7.8	0.2	78.9	80.4	159.3
	Construction	0.0	0.0	0.0	0.0	0.0	2.3	5.1	3.5	183.5	23.8	218.2	1,010.7	1,228.9
	Manufacturing	0.1	0.6	0.4	2.5	0.1	0.5	6.0	17.5	73.8	0.5	168.4	499.1	667.5
	Services	0.1	1.1	0.9	16.9	0.7	12.1	180.3	103.2	1,585.4	58.0	2,112.9	7,009.5	9,122.5
	Government	0.0	0.0	0.0	0.0	0.0	0.5	1.5	2.6	63.9	2.4	71.0	744.5	815.5
	Intermed. input	22.9	160.9	123.3	1,241.5	71.8	37.0	454.5	361.8	2,889.9	118.2	28,532.8	77,318.7	105,851.5
	Value added	38.5	193.9	17.6	2,166.5	313.7	109.6	557.4	104.4	5,496.1	656.5	64,212.0		
	Income	13.7	171.1	23.0	1,200.7	306.6	79.9	446.0	124.2	2,763.3	625.6	40,447.9		
	Others	24.8	22.8	-5.4	965.8	7.1	29.6	111.5	-19.8	2,732.8	30.9	23,764.1		
	Imports	10.3	77.1	59.1	299.2	24.9	12.8	216.9	201.3	736.4	40.8	13,106.7	14,211.7	27,318.4
	Total input	71.6	431.9	200.0	3,707.2	410.4	159.3	1,228.9	667.5	9,122.5	815.5	105,851.5	91,530.4	
	Total jobs	1,558	2,966	774	33,568	4,967	3,377	7,163	2,103	79,624	10,382	867,871		

**Table 3. Inter-County Transactions Table (percent of total input), 2007**

		Hawaii County					Honolulu County				
		Agri- culture	Const- ruction	Manufac- turing	Services	Govern- ment	Agri- culture	Const- ructon	Manufac- turing	Services	Govern- ment
Hawaii County	Agriculture	8.8	0.2	8.8	0.2	0.0	0.2	0.0	0.1	0.0	0.0
	Construction	0.4	0.3	0.8	1.2	0.4	0.0	0.0	0.0	0.0	0.0
	Manufacturing	0.8	0.7	5.6	0.6	0.0	0.5	0.2	0.2	0.1	0.0
	Services	6.3	19.9	20.7	17.7	1.7	0.1	0.6	0.1	0.2	0.0
	Government	0.8	3.9	0.7	1.6	0.1	0.0	0.0	0.0	0.0	0.0
Honolulu County	Agriculture	0.0	0.0	0.6	0.0	0.0	6.4	0.1	0.1	0.1	0.0
	Construction	0.0	0.0	0.0	0.0	0.0	1.5	0.2	0.1	1.2	0.9
	Manufacturing	9.0	7.0	10.2	4.5	0.3	14.6	9.0	6.0	3.3	0.6
	Services	1.5	4.8	4.1	3.9	0.4	17.9	27.8	10.2	22.8	4.2
	Government	0.0	0.0	0.0	0.0	0.0	2.1	0.5	0.9	1.3	0.3
Kauai County	Agriculture	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Manufacturing	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	Services	0.0	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.0
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maui County	Agriculture	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Manufacturing	0.1	0.2	0.3	0.1	0.0	0.1	0.1	0.1	0.1	0.0
	Services	0.1	0.2	0.3	0.2	0.0	0.2	0.2	0.1	0.2	0.1
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Intermed. input	27.8	37.6	52.6	30.2	3.1	43.9	38.9	18.0	29.4	6.2
	Value added	60.9	44.3	16.0	62.4	95.7	38.7	42.6	13.0	63.0	91.6
	Income	38.4	33.9	11.1	30.4	92.5	39.4	33.3	8.9	33.2	82.9
	Others	22.5	10.4	4.9	32.0	3.2	-0.7	9.3	4.1	29.8	8.7
	Imports	11.3	18.1	31.4	7.4	1.2	17.4	18.5	68.9	7.7	2.2
	Total input	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Table 3. Inter-County Transactions Table (percent of total input), 2007 - Contd.**

		Kauai County					Maui County					Total	Total	Total
		Agri-culture	Const-ruktion	Manuf-acturing	Servi-ces	Govern-ment	Agri-culture	Const-ruktion	Manuf-acturing	Services	Govern-ment	intermed. demand	final demand	output (sales)
Hawaii County	Agriculture	0.0	0.0	0.1	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.1	0.1	0.2
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4	1.3
	Manufacturing	0.0	0.2	3.0	0.3	0.1	0.3	0.5	0.7	0.2	0.1	0.2	0.4	0.6
	Services	0.0	0.2	1.7	0.2	0.2	0.1	0.9	0.9	0.4	0.1	1.8	5.9	6.9
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.8
Honolulu County	Agriculture	0.0	0.0	6.6	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.1	0.1	0.2
	Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	6.9	6.7
	Manufacturing	10.2	11.3	2.1	4.9	1.8	6.4	12.3	13.1	5.1	2.0	4.1	2.9	6.7
	Services	4.3	8.8	4.7	5.4	1.7	2.3	7.2	7.1	4.7	1.7	15.2	38.0	48.1
	Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	13.7	12.6
Kauai County	Agriculture	1.6	0.0	13.6	0.1	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.1
	Construction	2.0	0.4	0.2	1.9	2.9	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.4
	Manufacturing	1.0	0.2	6.5	0.8	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.1	0.2
	Services	12.2	15.5	18.4	17.5	9.9	0.0	0.3	0.2	0.2	0.1	0.9	3.1	3.5
	Government	0.5	0.3	0.8	1.8	0.6	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.4
Maui County	Agriculture	0.0	0.0	3.4	0.0	0.0	4.3	0.1	8.2	0.1	0.0	0.1	0.1	0.2
	Construction	0.0	0.0	0.0	0.0	0.0	1.4	0.4	0.5	2.0	2.9	0.2	1.1	1.2
	Manufacturing	0.1	0.1	0.2	0.1	0.0	0.3	0.5	2.6	0.8	0.1	0.2	0.5	0.6
	Services	0.1	0.2	0.4	0.5	0.2	7.6	14.7	15.5	17.4	7.1	2.0	7.7	8.6
	Government	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.4	0.7	0.3	0.1	0.8	0.8
	Intermed. input	31.9	37.2	61.6	33.5	17.5	23.2	37.0	54.2	31.7	14.5	27.0	84.5	
	Value added	53.8	44.9	8.8	58.4	76.4	68.8	45.4	15.6	60.2	80.5	60.7		
	Income	19.1	39.6	11.5	32.4	74.7	50.2	36.3	18.6	30.3	76.7	38.2		
	Others	34.6	5.3	-2.7	26.1	1.7	18.6	9.1	-3.0	30.0	3.8	22.5		
	Imports	14.3	17.9	29.5	8.1	6.1	8.0	17.7	30.2	8.1	5.0	12.4	15.5	
	Total input	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

**Table 4. Composition of Total Final Demand by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total final demand (\$ million)	7,903.4	56,422.9	3,648.1	9,344.3	77,318.7
Components of final demand					
Personal consumption expenditures	3,436.6	24,381.2	1,311.6	3,080.9	32,210.2
Visitor expenditures	1,654.1	6,770.3	1,234.8	3,269.2	12,928.5
GPI and inventories change	1,349.0	5,998.7	373.2	1,118.2	8,839.0
State and local government	545.5	5,573.9	314.6	741.1	7,175.1
Federal government	202.4	8,600.1	56.5	105.8	8,964.7
Exports - within state	350.8	2,273.6	155.9	489.0	3,269.3
Exports - out of state	365.1	2,825.1	201.5	540.1	3,931.8

GPI = gross private investment

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total final demand (\$ million)	7,903.4	56,422.9	3,648.1	9,344.3	77,318.7
Share in county final demand (%)					
Personal consumption expenditures	43.5	43.2	36.0	33.0	41.7
Visitor expenditures	20.9	12.0	33.8	35.0	16.7
GPI and inventories change	17.1	10.6	10.2	12.0	11.4
State and local government	6.9	9.9	8.6	7.9	9.3
Federal government	2.6	15.2	1.5	1.1	11.6
Exports - within state	4.4	4.0	4.3	5.2	4.2
Exports - out of state	4.6	5.0	5.5	5.8	5.1

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total final demand (% in state total)	10.2	73.0	4.7	12.1	100.0
Share in state total (% of state total)					
Personal consumption expenditures	10.7	75.7	4.1	9.6	100.0
Visitor expenditures	12.8	52.4	9.6	25.3	100.0
GPI and inventories change	15.3	67.9	4.2	12.7	100.0
State and local government	7.6	77.7	4.4	10.3	100.0
Federal government	2.3	95.9	0.6	1.2	100.0
Exports - within state	10.7	69.5	4.8	15.0	100.0
Exports - out of state	9.3	71.9	5.1	13.7	100.0

**Table 5. Final Demand Output, Earnings and Total Job Multipliers in State, Inter-County, and County I-O Models, 2007**

	Agriculture		Construction		Manufacturing		Services		Government	
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Output multipliers										
State model	1.46	2.04	1.54	2.10	1.34	1.55	1.42	1.93	1.10	1.87
Inter-county model										
Hawaii	1.38	1.92	1.51	2.08	1.74	2.22	1.42	1.91	1.04	1.96
Honolulu	1.60	2.20	1.53	2.08	1.24	1.40	1.41	1.92	1.09	1.84
Kauai	1.45	1.86	1.52	2.14	1.94	2.49	1.48	1.99	1.25	2.09
Maui	1.32	2.00	1.51	2.08	1.76	2.21	1.45	1.95	1.21	2.03
County model										
Hawaii	1.21	1.58	1.31	1.69	1.47	1.77	1.27	1.60	1.03	1.69
Honolulu	1.58	2.13	1.51	2.02	1.23	1.37	1.39	1.88	1.08	1.80
Kauai	1.22	1.45	1.21	1.56	1.51	1.77	1.28	1.57	1.17	1.69
Maui	1.17	1.61	1.20	1.53	1.34	1.57	1.26	1.57	1.13	1.67
Earnings multiplier										
State model	0.46	0.63	0.44	0.61	0.17	0.23	0.41	0.55	0.61	0.83
Inter-county model										
Hawaii	0.42	0.58	0.45	0.61	0.37	0.51	0.39	0.53	0.72	0.98
Honolulu	0.47	0.64	0.43	0.59	0.12	0.17	0.41	0.56	0.60	0.82
Kauai	0.31	0.43	0.47	0.64	0.43	0.58	0.38	0.52	0.63	0.86
Maui	0.53	0.71	0.44	0.60	0.35	0.48	0.39	0.53	0.64	0.87
County model										
Hawaii	0.40	0.51	0.41	0.52	0.33	0.41	0.36	0.45	0.72	0.91
Honolulu	0.46	0.63	0.43	0.58	0.12	0.16	0.41	0.55	0.60	0.81
Kauai	0.27	0.34	0.41	0.51	0.31	0.39	0.31	0.42	0.62	0.76
Maui	0.50	0.63	0.38	0.48	0.27	0.33	0.35	0.44	0.63	0.78
Job multiplier										
State model	26.5	31.3	9.2	13.8	4.9	6.6	11.7	15.9	12.1	18.4
Inter-county model										
Hawaii	35.6	40.4	10.7	15.7	10.9	15.1	12.9	17.2	15.8	24.0
Honolulu	18.5	23.2	8.5	12.8	3.6	4.8	11.4	15.5	11.7	17.7
Kauai	25.0	28.5	10.5	15.7	13.9	18.6	12.8	17.0	14.1	21.1
Maui	23.9	29.5	9.2	13.8	10.0	13.7	12.0	16.2	14.2	21.0
County model										
Hawaii	35.0	38.5	9.6	13.2	9.5	12.4	12.0	15.2	15.7	22.1
Honolulu	18.2	22.6	8.3	12.3	3.5	4.6	11.2	15.1	11.7	17.3
Kauai	23.9	26.0	8.8	11.9	10.0	12.4	11.6	14.2	13.6	17.7
Maui	23.2	27.0	7.5	10.4	7.0	9.1	11.0	13.7	13.8	18.5

**Table 6. Counties' Percentage Contributions to Output Multiplier in Inter-County I-O Model, 2007**

	Agriculture		Construction		Manufacturing		Services		Government	
	Multiplier	%	Multiplier	%	Multiplier	%	Multiplier	%	Multiplier	%
Type I										
Hawaii	1.38	100.0	1.51	100.0	1.74	100.0	1.42	100.0	1.04	100.0
Hawaii	1.21	88.1	1.31	86.9	1.47	84.4	1.27	89.4	1.03	98.7
Honolulu	0.16	11.5	0.19	12.4	0.25	14.6	0.14	9.9	0.01	1.2
Kauai	0.001	0.1	0.00	0.3	0.01	0.4	0.00	0.3	0.00	0.0
Maui	0.004	0.3	0.01	0.5	0.01	0.7	0.01	0.4	0.00	0.1
Honolulu	1.60	100.0	1.53	100.0	1.24	100.0	1.41	100.0	1.09	100.0
Hawaii	0.01	0.9	0.01	0.9	0.01	0.5	0.01	0.4	0.00	0.1
Honolulu	1.58	98.5	1.51	98.5	1.23	99.1	1.39	99.1	1.08	99.7
Kauai	0.00	0.2	0.00	0.2	0.00	0.1	0.00	0.2	0.00	0.1
Maui	0.01	0.4	0.01	0.4	0.00	0.3	0.00	0.3	0.00	0.1
Kauai	1.45	100.0	1.52	100.0	1.94	100.0	1.48	100.0	1.25	100.0
Hawaii	0.00	0.2	0.01	0.6	0.08	3.9	0.01	0.7	0.01	0.4
Honolulu	0.22	15.2	0.29	19.3	0.30	15.3	0.18	12.2	0.07	5.9
Kauai	1.22	84.2	1.21	79.6	1.51	78.0	1.28	86.5	1.17	93.3
Maui	0.01	0.4	0.01	0.5	0.06	2.8	0.01	0.6	0.00	0.3
Maui	1.32	100.0	1.51	100.0	1.76	100.0	1.45	100.0	1.21	100.0
Hawaii	0.01	0.6	0.02	1.4	0.04	2.5	0.01	0.8	0.00	0.4
Honolulu	0.14	10.3	0.28	18.8	0.36	20.7	0.17	11.6	0.07	5.8
Kauai	0.00	0.1	0.01	0.3	0.01	0.7	0.00	0.3	0.00	0.2
Maui	1.17	88.9	1.20	79.5	1.34	76.1	1.26	87.2	1.13	93.6
Type II										
Hawaii	1.92	100.0	2.08	100.0	2.22	100.0	1.91	100.0	1.96	100.0
Hawaii	1.58	82.7	1.69	81.3	1.77	79.9	1.60	83.6	1.69	86.2
Honolulu	0.31	16.4	0.36	17.4	0.41	18.6	0.29	15.1	0.25	12.7
Kauai	0.01	0.3	0.01	0.4	0.01	0.5	0.01	0.4	0.01	0.3
Maui	0.01	0.7	0.02	0.9	0.02	1.0	0.02	0.8	0.02	0.8
Honolulu	2.20	100.0	2.08	100.0	1.40	100.0	1.92	100.0	1.84	100.0
Hawaii	0.03	1.3	0.03	1.2	0.01	0.7	0.02	0.8	0.01	0.7
Honolulu	2.14	97.5	2.03	97.6	1.37	98.6	1.89	98.0	1.80	98.0
Kauai	0.01	0.3	0.01	0.3	0.00	0.2	0.01	0.3	0.01	0.3
Maui	0.02	0.9	0.02	0.9	0.01	0.5	0.02	0.9	0.02	0.9
Kauai	1.86	100.0	2.14	100.0	2.49	100.0	1.99	100.0	2.09	100.0
Hawaii	0.01	0.6	0.02	1.0	0.10	4.1	0.02	1.1	0.02	1.0
Honolulu	0.38	20.6	0.54	25.2	0.53	21.3	0.37	18.8	0.36	17.1
Kauai	1.45	78.0	1.56	72.8	1.78	71.2	1.57	79.0	1.69	80.8
Maui	0.02	0.8	0.02	1.1	0.09	3.4	0.02	1.2	0.02	1.1
Maui	2.00	100.0	2.08	100.0	2.21	100.0	1.95	100.0	2.03	100.0
Hawaii	0.02	1.1	0.04	1.8	0.06	2.9	0.02	1.2	0.02	1.0
Honolulu	0.36	18.0	0.50	23.9	0.56	25.2	0.35	17.9	0.33	16.3
Kauai	0.01	0.3	0.01	0.5	0.02	0.8	0.01	0.5	0.01	0.4
Maui	1.61	80.6	1.53	73.9	1.57	71.2	1.57	80.5	1.67	82.3

**Table 7. Type I State and Weighted Inter-County Multipliers, 2007**

	Agriculture	Construction	Manufacturing	Services	Government
Output					
State	1.46	1.54	1.34	1.42	1.10
Weighted inter-county	1.45	1.53	1.34	1.42	1.14
Earnings					
State	0.46	0.44	0.17	0.41	0.61
Weighted inter-county	0.46	0.44	0.18	0.41	0.61
Total jobs					
State	26.5	9.2	4.9	11.7	12.1
Weighted inter-county	28.4	9.0	5.5	11.7	12.2

**Table 8. Final Demand Output Multipliers for the State, Inter-County and County I-O Models, 2007**

	State model	Inter-county model 1/				County model 2/			
		Hawaii	Oahu	Kauai	Maui	Hawaii	Oahu	Kauai	Maui
<b>Type I</b>									
Agriculture	1.45	1.37	1.60	1.45	1.31	1.21	1.57	1.22	1.17
Mining and construction	1.52	1.50	1.51	1.52	1.51	1.31	1.49	1.21	1.20
Food processing	1.75	1.89	1.40	1.99	1.85	1.64	1.33	1.56	1.40
Other manufacturing	1.28	1.66	1.23	1.55	1.69	1.35	1.22	1.13	1.28
Transportation	1.49	1.49	1.49	1.49	1.53	1.20	1.47	1.20	1.18
Information	1.31	1.23	1.32	1.25	1.27	1.15	1.31	1.17	1.16
Utilities	1.56	1.54	1.54	1.54	1.59	1.08	1.52	1.09	1.09
Wholesale trade	1.32	1.26	1.32	1.47	1.27	1.16	1.31	1.22	1.14
Retail trade	1.36	1.42	1.27	1.54	1.53	1.29	1.26	1.35	1.34
Finance and insurance	1.62	1.61	1.62	1.71	1.66	1.36	1.60	1.41	1.34
Real estate and rentals	1.35	1.32	1.36	1.50	1.26	1.24	1.35	1.30	1.17
Professional services	1.32	1.50	1.24	1.83	1.67	1.33	1.24	1.41	1.38
Business services	1.36	1.60	1.31	1.22	1.57	1.38	1.29	1.12	1.32
Educational services	1.35	1.39	1.33	1.15	1.52	1.26	1.32	1.07	1.33
Health services	1.45	1.53	1.43	1.61	1.49	1.35	1.41	1.39	1.28
Arts and entertainment	1.33	1.07	1.49	1.03	1.09	1.05	1.48	1.02	1.06
Hotels	1.43	1.40	1.46	1.32	1.44	1.29	1.45	1.21	1.30
Eating and drinking	1.51	1.54	1.49	1.53	1.58	1.34	1.45	1.35	1.34
Other services	1.49	1.43	1.49	1.57	1.54	1.29	1.48	1.37	1.33
Government	1.09	1.04	1.09	1.26	1.21	1.03	1.08	1.17	1.13
<b>Type II</b>									
Agriculture	2.01	1.90	2.17	1.85	1.96	1.56	2.10	1.43	1.57
Mining and construction	2.08	2.06	2.06	2.14	2.08	1.67	2.00	1.55	1.52
Food processing	2.24	2.44	1.89	2.51	2.29	1.99	1.77	1.79	1.61
Other manufacturing	1.46	2.07	1.37	2.44	2.16	1.60	1.35	1.61	1.52
Transportation	1.95	2.05	1.95	2.05	2.07	1.56	1.90	1.51	1.48
Information	1.73	1.58	1.73	1.72	1.81	1.38	1.69	1.44	1.49
Utilities	1.76	1.75	1.77	1.77	1.80	1.18	1.73	1.19	1.18
Wholesale trade	1.88	1.82	1.88	1.89	1.87	1.54	1.83	1.45	1.51
Retail trade	1.86	1.89	1.80	2.02	1.99	1.60	1.76	1.62	1.60
Finance and insurance	2.14	2.10	2.12	2.35	2.20	1.65	2.07	1.74	1.63
Real estate and rentals	1.54	1.53	1.53	1.74	1.42	1.37	1.51	1.40	1.25
Professional services	2.10	2.23	2.04	2.34	2.45	1.80	1.99	1.64	1.83
Business services	2.14	2.30	2.10	2.06	2.34	1.83	2.04	1.62	1.78
Educational services	2.17	2.18	2.15	2.07	2.32	1.81	2.09	1.63	1.82
Health services	2.17	2.27	2.15	2.26	2.16	1.83	2.09	1.75	1.67
Arts and entertainment	2.09	1.86	2.19	1.84	1.95	1.61	2.13	1.52	1.62
Hotels	2.03	2.01	2.06	1.97	2.03	1.70	2.01	1.59	1.66
Eating and drinking	2.12	2.15	2.08	2.18	2.16	1.74	2.00	1.72	1.67
Other services	2.23	2.18	2.23	2.36	2.25	1.80	2.17	1.83	1.77
Government	1.86	1.94	1.83	2.09	2.01	1.67	1.79	1.67	1.64

Note: Output multiplier shows the total dollar change in output in all row industries that results from a \$1 change in final demand in the corresponding row industry.

1/ A multiplier in the Inter-County Model is used to calculate the statewide impact of all industries when a change occurs in the final demand of the industry listed on the left of the table in the county listed above the table.

2/ A multiplier in the County Model is used to calculate the county specific impact of all industries for the county listed above the table for a change in the final demand of the industry listed on the left of the table.

**Table 9. Final Demand Earnings Multipliers for the State, Inter-County and County Models, 2007**

	State model	Inter-county model 1/				County model 2/			
		Hawaii	Oahu	Kauai	Maui	Hawaii	Oahu	Kauai	Maui
Type I									
Agriculture	0.45	0.42	0.46	0.30	0.52	0.40	0.45	0.26	0.50
Mining and construction	0.45	0.45	0.44	0.48	0.46	0.41	0.44	0.41	0.39
Food processing	0.40	0.44	0.39	0.40	0.36	0.39	0.37	0.28	0.26
Other manufacturing	0.14	0.33	0.11	0.69	0.38	0.28	0.11	0.59	0.30
Transportation	0.37	0.45	0.37	0.43	0.44	0.40	0.37	0.38	0.38
Information	0.33	0.28	0.33	0.36	0.43	0.26	0.33	0.34	0.40
Utilities	0.17	0.17	0.18	0.18	0.17	0.12	0.17	0.13	0.12
Wholesale trade	0.44	0.45	0.44	0.33	0.49	0.42	0.44	0.27	0.46
Retail trade	0.40	0.38	0.42	0.37	0.37	0.35	0.42	0.33	0.32
Finance and insurance	0.41	0.39	0.40	0.49	0.43	0.32	0.40	0.41	0.34
Real estate and rentals	0.15	0.17	0.14	0.18	0.13	0.15	0.14	0.13	0.10
Professional services	0.63	0.58	0.64	0.40	0.63	0.53	0.64	0.29	0.55
Business services	0.63	0.57	0.64	0.65	0.63	0.51	0.63	0.62	0.56
Educational services	0.66	0.64	0.66	0.70	0.64	0.61	0.66	0.68	0.59
Health services	0.58	0.59	0.58	0.50	0.54	0.54	0.58	0.44	0.48
Arts and entertainment	0.61	0.63	0.56	0.62	0.69	0.63	0.56	0.61	0.69
Hotels	0.48	0.49	0.48	0.50	0.48	0.45	0.47	0.47	0.44
Eating and drinking	0.48	0.49	0.48	0.50	0.47	0.45	0.46	0.45	0.41
Other services	0.59	0.60	0.59	0.61	0.58	0.56	0.59	0.56	0.53
Government	0.61	0.72	0.60	0.63	0.65	0.72	0.60	0.61	0.63
Type II									
Agriculture	0.60	0.56	0.62	0.40	0.68	0.49	0.60	0.31	0.60
Mining and construction	0.60	0.60	0.60	0.62	0.60	0.50	0.58	0.48	0.47
Food processing	0.54	0.59	0.53	0.53	0.47	0.48	0.49	0.33	0.31
Other manufacturing	0.19	0.44	0.15	0.90	0.50	0.34	0.15	0.69	0.36
Transportation	0.50	0.60	0.51	0.56	0.58	0.50	0.49	0.45	0.45
Information	0.45	0.37	0.45	0.47	0.57	0.32	0.44	0.40	0.48
Utilities	0.22	0.22	0.24	0.23	0.23	0.14	0.23	0.15	0.14
Wholesale trade	0.60	0.60	0.60	0.43	0.64	0.52	0.59	0.32	0.55
Retail trade	0.54	0.50	0.57	0.49	0.48	0.43	0.56	0.38	0.39
Finance and insurance	0.56	0.52	0.55	0.64	0.57	0.40	0.53	0.48	0.41
Real estate and rentals	0.20	0.23	0.19	0.24	0.17	0.18	0.18	0.15	0.13
Professional services	0.84	0.78	0.87	0.53	0.83	0.66	0.85	0.33	0.66
Business services	0.85	0.76	0.86	0.84	0.83	0.63	0.84	0.73	0.68
Educational services	0.89	0.85	0.89	0.91	0.84	0.75	0.88	0.80	0.72
Health services	0.78	0.78	0.79	0.65	0.71	0.67	0.77	0.51	0.58
Arts and entertainment	0.82	0.85	0.76	0.80	0.91	0.78	0.75	0.72	0.83
Hotels	0.65	0.65	0.65	0.65	0.63	0.56	0.63	0.55	0.53
Eating and drinking	0.65	0.66	0.64	0.65	0.61	0.55	0.62	0.53	0.49
Other services	0.79	0.80	0.80	0.79	0.76	0.70	0.78	0.66	0.63
Government	0.82	0.96	0.81	0.83	0.85	0.88	0.80	0.72	0.76

Note: Final demand earnings multiplier shows the total change in earnings received by households from all row industries that results from a \$1 change in final demand in the corresponding row industry.

1/ A multiplier in the Inter-County Model is used to calculate the statewide impact of all industries when a change occurs in the final demand of the industry listed on the left of the table in the county listed above the table.

2/ A multiplier in the County Model is used to calculate the county specific impact of all industries for the county listed above the table for a change in the final demand of the industry listed on the left of the table.

**Table 10. Final Demand Total Job Multipliers for the State, Inter-County and County Models, 2007**

	State model	Inter-county model 1/				County model 2/			
		Hawaii	Oahu	Kauai	Maui	Hawaii	Oahu	Kauai	Maui
<b>Type I</b>									
Agriculture	26.0	35.4	17.9	24.6	23.6	34.8	17.7	23.6	23.0
Mining and construction	9.0	10.6	8.4	10.5	9.6	9.5	8.2	8.8	7.9
Food processing	14.8	16.4	18.7	13.9	13.7	14.7	17.4	9.6	9.8
Other manufacturing	3.6	7.5	3.0	20.3	7.6	6.1	3.0	17.0	5.4
Transportation	9.5	13.1	9.3	13.2	13.1	11.9	9.1	11.9	11.5
Information	7.2	8.0	6.7	10.5	11.1	7.5	6.7	9.9	10.2
Utilities	3.1	3.2	3.5	3.6	3.5	1.9	3.3	2.2	2.0
Wholesale trade	9.8	11.2	9.4	13.4	11.9	10.5	9.3	12.0	11.1
Retail trade	14.9	15.0	15.8	13.9	12.9	14.2	15.8	12.7	11.6
Finance and insurance	10.1	12.2	9.4	13.8	13.2	10.5	9.2	11.8	11.1
Real estate and rentals	5.2	6.0	4.7	6.8	5.7	5.5	4.7	5.5	5.1
Professional services	13.0	17.6	12.0	15.1	19.6	16.3	11.9	12.3	17.5
Business services	19.4	22.9	18.4	23.9	21.6	21.4	18.3	23.2	19.9
Educational services	23.1	26.5	22.9	25.7	20.8	25.6	22.9	25.1	19.5
Health services	14.1	15.7	13.6	16.0	14.7	14.4	13.4	14.4	13.2
Arts and entertainment	26.6	24.5	26.0	40.1	25.1	24.3	25.9	40.1	24.8
Hotels	10.6	13.5	9.8	10.8	11.0	12.7	9.6	10.0	10.0
Eating and drinking	20.4	21.4	20.9	19.4	17.1	20.2	20.5	18.0	15.3
Other services	19.2	23.4	18.4	23.4	19.0	22.5	18.3	22.2	17.7
Government	12.1	15.8	11.7	14.1	14.3	15.7	11.6	13.6	13.9
<b>Type II</b>									
Agriculture	30.5	39.8	22.5	27.7	28.7	37.8	21.8	25.2	26.3
Mining and construction	13.5	15.3	12.9	15.3	14.1	12.7	12.3	11.3	10.5
Food processing	18.8	21.0	22.6	18.0	17.3	17.7	20.9	11.4	11.5
Other manufacturing	5.1	10.9	4.2	27.2	11.4	8.2	4.0	20.7	7.4
Transportation	13.2	17.8	13.0	17.6	17.4	15.0	12.6	14.3	14.1
Information	10.5	10.9	10.0	14.2	15.3	9.5	9.7	12.0	12.8
Utilities	4.8	4.9	5.3	5.3	5.2	2.8	4.9	3.0	2.7
Wholesale trade	14.3	15.9	13.8	16.7	16.7	13.8	13.4	13.7	14.1
Retail trade	19.0	18.9	20.1	17.6	16.5	16.9	19.7	14.8	13.8
Finance and insurance	14.3	16.2	13.4	18.7	17.4	12.9	13.0	14.3	13.4
Real estate and rentals	6.7	7.8	6.1	8.6	6.9	6.7	5.9	6.3	5.8
Professional services	19.4	23.6	18.4	19.2	25.7	20.4	17.9	14.1	21.2
Business services	25.8	28.8	24.8	30.4	27.7	25.3	24.2	27.1	23.7
Educational services	29.8	33.1	29.5	32.8	27.1	30.3	29.0	29.4	23.5
Health services	19.9	21.8	19.4	21.0	19.9	18.6	18.8	17.1	16.4
Arts and entertainment	32.8	31.1	31.7	46.3	31.8	29.2	31.1	43.9	29.4
Hotels	15.5	18.6	14.5	15.8	15.6	16.2	14.0	12.9	12.9
Eating and drinking	25.3	26.5	25.7	24.5	21.6	23.7	24.9	20.8	18.0
Other services	25.1	29.7	24.3	29.5	24.6	26.9	23.8	25.7	21.2
Government	18.2	23.3	17.6	20.5	20.7	21.2	17.2	17.4	18.1

Note: Final-demand total job multiplier shows the total change in number of total jobs in all row industries that results from a \$1 million change in final demand in the corresponding row industry.

1/ A multiplier in the Inter-County Model is used to calculate the statewide impact of all industries when a change occurs in the final demand of the industry listed on the left of the table in the county listed above the table.

2/ A multiplier in the County Model is used to calculate the county specific impact of all industries for the county listed above the table for a change in the final demand of the industry listed on the left of the table.

**Table 11. Final Demand State Tax Multipliers for the State, Inter-County and County Models, 2007**

	State model	Inter-county model 1/				County model 2/			
		Hawaii	Oahu	Kauai	Maui	Hawaii	Oahu	Kauai	Maui
Type I									
Agriculture	0.04	0.03	0.05	0.03	0.03	0.03	0.05	0.02	0.03
Mining and construction	0.09	0.07	0.09	0.07	0.07	0.06	0.09	0.06	0.06
Food processing	0.05	0.04	0.05	0.04	0.04	0.03	0.05	0.02	0.02
Other manufacturing	0.02	0.03	0.02	0.04	0.04	0.02	0.02	0.03	0.02
Transportation	0.05	0.06	0.05	0.06	0.06	0.06	0.05	0.05	0.05
Information	0.06	0.06	0.06	0.07	0.07	0.05	0.06	0.07	0.06
Utilities	0.05	0.04	0.06	0.04	0.04	0.03	0.06	0.03	0.03
Wholesale trade	0.04	0.13	0.15	0.11	0.15	0.12	0.14	0.10	0.15
Retail trade	0.09	0.07	0.09	0.06	0.06	0.06	0.09	0.05	0.05
Finance and insurance	0.07	0.07	0.06	0.08	0.08	0.06	0.06	0.06	0.07
Real estate and rentals	0.05	0.04	0.06	0.05	0.04	0.04	0.06	0.04	0.04
Professional services	0.09	0.08	0.10	0.09	0.08	0.07	0.10	0.06	0.07
Business services	0.10	0.08	0.10	0.07	0.08	0.07	0.10	0.06	0.07
Educational services	0.10	0.08	0.10	0.08	0.08	0.07	0.10	0.08	0.07
Health services	0.10	0.08	0.10	0.08	0.07	0.07	0.10	0.06	0.06
Arts and entertainment	0.09	0.06	0.10	0.07	0.06	0.06	0.10	0.07	0.06
Hotels	0.13	0.10	0.15	0.09	0.10	0.10	0.15	0.09	0.09
Eating and drinking	0.09	0.08	0.10	0.07	0.07	0.07	0.09	0.06	0.06
Other services	0.07	0.06	0.08	0.06	0.06	0.05	0.08	0.05	0.05
Government	0.04	0.03	0.04	0.03	0.03	0.03	0.04	0.03	0.03
Type II									
Agriculture	0.07	0.05	0.08	0.05	0.06	0.04	0.07	0.03	0.05
Mining and construction	0.11	0.10	0.12	0.10	0.09	0.08	0.12	0.07	0.07
Food processing	0.07	0.07	0.08	0.06	0.06	0.05	0.07	0.03	0.03
Other manufacturing	0.03	0.05	0.02	0.08	0.06	0.03	0.02	0.04	0.03
Transportation	0.08	0.09	0.08	0.08	0.08	0.07	0.08	0.06	0.06
Information	0.08	0.07	0.08	0.09	0.09	0.06	0.08	0.08	0.08
Utilities	0.06	0.05	0.07	0.05	0.05	0.03	0.07	0.03	0.03
Wholesale trade	0.07	0.15	0.18	0.13	0.18	0.14	0.17	0.11	0.16
Retail trade	0.11	0.09	0.12	0.08	0.08	0.08	0.12	0.06	0.06
Finance and insurance	0.10	0.09	0.09	0.11	0.10	0.07	0.09	0.08	0.08
Real estate and rentals	0.06	0.05	0.07	0.06	0.05	0.04	0.07	0.04	0.04
Professional services	0.13	0.11	0.14	0.11	0.12	0.09	0.14	0.07	0.09
Business services	0.14	0.12	0.14	0.10	0.11	0.09	0.14	0.08	0.09
Educational services	0.14	0.12	0.15	0.12	0.11	0.10	0.15	0.10	0.09
Health services	0.13	0.11	0.14	0.10	0.10	0.09	0.14	0.08	0.08
Arts and entertainment	0.13	0.10	0.14	0.11	0.10	0.09	0.14	0.09	0.08
Hotels	0.16	0.13	0.18	0.12	0.13	0.11	0.18	0.10	0.11
Eating and drinking	0.12	0.10	0.13	0.10	0.10	0.09	0.13	0.08	0.07
Other services	0.11	0.09	0.12	0.09	0.09	0.08	0.11	0.07	0.07
Government	0.08	0.07	0.09	0.07	0.07	0.06	0.08	0.05	0.05

Note: Final-demand state tax multiplier shows the total change in state tax revenues from households and all row industries that results from a \$1 change in final demand in the corresponding row industry.

1/ A multiplier in the Inter-County Model is used to calculate the statewide impact of all industries when a change occurs in the final demand of the industry listed on the left of the table in the county listed above the table.

2/ A multiplier in the County Model is used to calculate the county specific impact of all industries for the county listed above the table for a change in the final demand of the industry listed on the left of the table.

**Table 12. Direct Effect Earnings Multipliers for the State, Inter-County and County Models, 2007**

	State model	Inter-county model 1/				County model 2/			
		Hawaii	Oahu	Kauai	Maui	Hawaii	Oahu	Kauai	Maui
<b>Type I</b>									
Agriculture	1.30	1.25	1.40	1.42	1.17	1.19	1.38	1.23	1.11
Mining and construction	1.46	1.47	1.48	1.33	1.39	1.33	1.46	1.14	1.19
Food processing	2.19	2.22	1.37	3.10	3.32	1.93	1.30	2.15	2.38
Other manufacturing	2.03	1.81	2.09	1.23	1.82	1.53	2.03	1.06	1.42
Transportation	1.49	1.38	1.59	1.41	1.40	1.24	1.57	1.25	1.21
Information	1.37	1.32	1.38	1.23	1.26	1.22	1.37	1.15	1.16
Utilities	1.77	1.80	1.90	1.82	1.94	1.26	1.84	1.30	1.31
Wholesale trade	1.28	1.19	1.29	1.62	1.20	1.12	1.28	1.34	1.12
Retail trade	1.26	1.32	1.17	1.50	1.54	1.22	1.16	1.32	1.35
Finance and insurance	1.76	1.77	1.74	1.67	1.81	1.45	1.72	1.39	1.44
Real estate and rentals	2.83	2.25	2.84	4.25	2.43	1.97	2.78	3.06	2.01
Professional services	1.16	1.35	1.11	2.19	1.44	1.23	1.11	1.56	1.25
Business services	1.21	1.46	1.17	1.10	1.36	1.30	1.16	1.05	1.22
Educational services	1.15	1.18	1.13	1.06	1.27	1.12	1.13	1.03	1.18
Health services	1.30	1.31	1.27	1.51	1.34	1.21	1.26	1.32	1.20
Arts and entertainment	1.20	1.03	1.35	1.02	1.04	1.03	1.34	1.01	1.03
Hotels	1.38	1.31	1.43	1.22	1.39	1.22	1.42	1.15	1.28
Eating and drinking	1.38	1.41	1.34	1.33	1.44	1.29	1.31	1.20	1.26
Other services	1.28	1.22	1.28	1.31	1.32	1.14	1.27	1.21	1.21
Government	1.05	1.02	1.04	1.12	1.10	1.01	1.04	1.08	1.07
<b>Type II</b>									
Agriculture	1.75	1.67	1.90	1.86	1.53	1.47	1.84	1.44	1.34
Mining and construction	1.97	1.96	2.00	1.75	1.84	1.65	1.94	1.34	1.44
Food processing	2.95	2.96	1.86	4.08	4.38	2.39	1.74	2.53	2.86
Other manufacturing	2.74	2.42	2.83	1.61	2.41	1.88	2.71	1.25	1.71
Transportation	2.00	1.84	2.15	1.85	1.85	1.53	2.09	1.46	1.46
Information	1.84	1.76	1.87	1.61	1.65	1.51	1.83	1.35	1.39
Utilities	2.39	2.41	2.57	2.40	2.57	1.55	2.46	1.52	1.57
Wholesale trade	1.72	1.59	1.75	2.12	1.58	1.38	1.71	1.57	1.35
Retail trade	1.70	1.76	1.58	1.97	2.03	1.50	1.55	1.55	1.62
Finance and insurance	2.37	2.37	2.36	2.19	2.39	1.79	2.29	1.63	1.74
Real estate and rentals	3.81	3.01	3.84	5.59	3.20	2.44	3.72	3.60	2.42
Professional services	1.56	1.80	1.51	2.88	1.89	1.51	1.48	1.83	1.51
Business services	1.62	1.94	1.58	1.44	1.80	1.60	1.55	1.24	1.47
Educational services	1.55	1.57	1.53	1.39	1.67	1.39	1.51	1.21	1.41
Health services	1.75	1.75	1.72	1.98	1.76	1.49	1.68	1.55	1.44
Arts and entertainment	1.61	1.38	1.83	1.32	1.36	1.27	1.79	1.19	1.23
Hotels	1.85	1.74	1.94	1.60	1.83	1.51	1.89	1.34	1.54
Eating and drinking	1.85	1.88	1.82	1.74	1.89	1.59	1.75	1.41	1.51
Other services	1.72	1.62	1.73	1.71	1.73	1.41	1.69	1.42	1.45
Government	1.41	1.35	1.41	1.46	1.44	1.25	1.39	1.27	1.28

Note: Direct-effect earnings multiplier shows the total change in earnings received by households from all row industries that results from a \$1 change in earnings received by households directly from the corresponding row industry.

1/ A multiplier in the Inter-County Model is used to calculate the statewide impact of all industries when a change occurs in the final demand of the industry listed on the left of the table in the county listed above the table.

2/ A multiplier in the County Model is used to calculate the county specific impact of all industries for the county listed above the table for a change in the final demand of the industry listed on the left of the table.

**Table 13. Direct Effect Total Job Multipliers for the State, Inter-County and County Models, 2007**

	State model	Inter-county model 1/				County model 2/			
		Hawaii	Oahu	Kauai	Maui	Hawaii	Oahu	Kauai	Maui
Type I									
Agriculture	1.17	1.15	1.27	1.13	1.12	1.13	1.25	1.08	1.09
Mining and construction	1.73	1.65	1.78	1.53	1.65	1.49	1.74	1.28	1.35
Food processing	2.26	4.06	1.24	6.98	3.67	3.64	1.16	4.81	2.60
Other manufacturing	2.23	2.85	2.06	1.28	2.95	2.31	2.01	1.08	2.08
Transportation	1.49	1.37	1.63	1.35	1.36	1.24	1.60	1.22	1.19
Information	1.49	1.33	1.51	1.28	1.31	1.25	1.49	1.20	1.20
Utilities	2.42	2.62	2.64	2.53	2.72	1.55	2.53	1.58	1.54
Wholesale trade	1.37	1.25	1.39	1.40	1.26	1.17	1.37	1.26	1.16
Retail trade	1.19	1.23	1.12	1.37	1.45	1.17	1.11	1.26	1.31
Finance and insurance	1.85	1.70	1.82	1.75	1.72	1.47	1.78	1.49	1.44
Real estate and rentals	2.05	2.03	2.06	2.56	1.63	1.86	2.03	2.09	1.47
Professional services	1.22	1.33	1.16	1.76	1.40	1.23	1.15	1.44	1.25
Business services	1.17	1.31	1.15	1.08	1.30	1.22	1.14	1.05	1.20
Educational services	1.12	1.13	1.10	1.05	1.24	1.10	1.10	1.03	1.16
Health services	1.35	1.37	1.33	1.49	1.38	1.26	1.31	1.34	1.24
Arts and entertainment	1.12	1.03	1.19	1.01	1.03	1.02	1.18	1.01	1.02
Hotels	1.50	1.36	1.61	1.33	1.56	1.27	1.59	1.24	1.42
Eating and drinking	1.23	1.26	1.19	1.27	1.36	1.19	1.16	1.18	1.22
Other services	1.23	1.16	1.23	1.24	1.28	1.12	1.22	1.18	1.20
Government	1.06	1.02	1.05	1.17	1.13	1.02	1.05	1.12	1.09
Type II									
Agriculture	1.37	1.29	1.59	1.27	1.35	1.22	1.54	1.16	1.24
Mining and construction	2.60	2.38	2.72	2.23	2.41	1.98	2.60	1.65	1.80
Food processing	2.87	5.21	1.50	9.01	4.60	4.38	1.39	5.68	3.06
Other manufacturing	3.10	4.15	2.83	1.72	4.39	3.12	2.71	1.31	2.85
Transportation	2.08	1.86	2.28	1.79	1.80	1.57	2.20	1.46	1.46
Information	2.18	1.82	2.25	1.72	1.81	1.58	2.18	1.46	1.52
Utilities	3.71	4.02	4.01	3.80	4.06	2.27	3.77	2.13	2.15
Wholesale trade	1.99	1.77	2.05	1.75	1.76	1.54	1.98	1.44	1.49
Retail trade	1.51	1.56	1.42	1.74	1.86	1.39	1.39	1.46	1.56
Finance and insurance	2.61	2.27	2.60	2.38	2.27	1.81	2.50	1.82	1.74
Real estate and rentals	2.63	2.62	2.67	3.25	1.98	2.24	2.58	2.39	1.67
Professional services	1.81	1.79	1.78	2.23	1.84	1.54	1.73	1.64	1.52
Business services	1.56	1.64	1.54	1.38	1.67	1.44	1.51	1.23	1.42
Educational services	1.44	1.42	1.42	1.34	1.61	1.30	1.39	1.20	1.40
Health services	1.91	1.90	1.90	1.96	1.87	1.62	1.84	1.60	1.54
Arts and entertainment	1.38	1.31	1.45	1.17	1.31	1.23	1.42	1.10	1.21
Hotels	2.18	1.87	2.40	1.95	2.23	1.63	2.32	1.59	1.84
Eating and drinking	1.53	1.56	1.46	1.60	1.72	1.39	1.41	1.36	1.44
Other services	1.60	1.47	1.62	1.57	1.66	1.33	1.58	1.36	1.44
Government	1.60	1.51	1.60	1.69	1.62	1.37	1.56	1.44	1.42

Note: Direct-effect total job multiplier shows the total change in number of jobs (wage and salary plus proprietors' jobs) in all row industries that results from a change of one job in the corresponding row industry.

1/ A multiplier in the Inter-County Model is used to calculate the statewide impact of all industries when a change occurs in the final demand of the industry listed on the left of the table in the county listed above the table.

2/ A multiplier in the County Model is used to calculate the county specific impact of all industries for the county listed above the table for a change in the final demand of the industry listed on the left of the table.

**Table 14. Detailed Inter-County Final Demand Output and Earnings Multipliers for Honolulu, 2007**

Industry	Final-demand multipliers			
	Output (dollars)		Earnings (dollars)	
	Type I	Type II	Type I	Type II
1 Sugarcane	1.76	2.32	0.43	0.59
2 Vegetables	1.61	2.22	0.47	0.65
3 Macadamia nuts, coffee, and other fruits	1.64	2.14	0.39	0.53
4 Pineapples	1.75	2.29	0.41	0.56
5 Flowers and nursery products	1.64	2.18	0.42	0.57
6 Other crops	1.49	1.91	0.32	0.44
7 Animal production	1.47	1.94	0.36	0.50
8 Aquaculture	1.60	2.06	0.36	0.49
9 Commercial fishing	1.59	2.37	0.60	0.82
10 Forestry & logging	1.68	2.53	0.65	0.89
11 Support activities for agriculture	1.63	2.10	0.36	0.49
12 Mining	1.90	2.94	0.80	1.09
13 Single family construction	1.51	2.09	0.44	0.61
14 Construction of other buildings	1.54	2.13	0.46	0.63
15 Heavy and civil engineering construction	1.54	2.15	0.47	0.64
16 Maintenance & repairs	1.49	2.08	0.45	0.62
17 Food processing	1.39	1.90	0.39	0.53
18 Beverage manufacturing	1.44	2.11	0.52	0.71
19 Apparel and textile manufacturing	1.65	2.09	0.35	0.47
20 Petroleum manufacturing	1.10	1.15	0.04	0.05
21 Other manufacturing	1.51	1.85	0.27	0.37
22 Air transportation	1.52	1.89	0.29	0.39
23 Water transportation	1.46	2.01	0.43	0.59
24 Truck and rail transportation	1.48	2.13	0.50	0.68
25 Transit and ground passenger transportation	1.53	2.13	0.47	0.64
26 Scenic and support activities for transportation	1.29	2.01	0.56	0.76
27 Couriers and messengers	1.27	1.98	0.55	0.75
28 Warehousing and storage	1.32	2.12	0.62	0.84
29 Publishing (include Internet)	1.14	1.77	0.49	0.67
30 Motion picture and sound recording industries	1.36	1.76	0.31	0.43
31 Broadcasting (Radio, TV, Cable)	1.26	1.71	0.35	0.48
32 Telecommunications	1.35	1.71	0.28	0.39
33 Internet providers, web, and data processing	1.37	1.89	0.40	0.55
34 Other information services	1.46	1.97	0.40	0.55
35 Electricity	1.54	1.76	0.17	0.23
36 Gas production & distribution	1.26	1.44	0.14	0.19
37 Wholesale trade	1.33	1.90	0.45	0.61
38 Retail trade	1.27	1.83	0.43	0.58
39 Credit intermediation and related activities	1.60	2.10	0.39	0.53
40 Insurance carriers and related activities	1.66	2.21	0.43	0.58
41 Other finance and insurance	1.49	2.23	0.57	0.78
42 Owner-occupied dwellings	1.33	1.47	0.10	0.14
43 Real estate	1.40	1.62	0.17	0.23
44 Rental & leasing	1.16	1.36	0.16	0.22

**Table 14. Detailed Inter-County Final Demand Output and Earnings Multipliers for Honolulu, 2007 - Contd.**

Industry	Final-demand multipliers			
	Output (dollars)		Earnings (dollars)	
	Type I	Type II	Type I	Type II
45 Legal services	1.22	2.07	0.66	0.90
46 Architectural and engineering services	1.19	2.03	0.65	0.88
47 Computer systems design services	1.42	2.28	0.66	0.91
48 R&D in the physical, engineering, & life sciences	1.20	2.07	0.67	0.92
49 Other professional services	1.21	2.01	0.62	0.84
50 Management of companies and enterprises	1.33	2.10	0.60	0.81
51 Travel arrangement and reservation services	1.37	2.01	0.50	0.68
52 Administrative and support services	1.25	2.20	0.73	1.00
53 Waste management and remediation services	1.45	2.07	0.48	0.66
54 Colleges, universities, and professional schools	1.32	2.18	0.67	0.91
55 Other educational services	1.34	2.20	0.67	0.91
56 Ambulatory health care services	1.25	2.16	0.70	0.96
57 Hospitals	1.61	2.24	0.49	0.67
58 Nursing and residential care facilities	1.44	2.16	0.56	0.76
59 Social assistance	1.29	2.13	0.65	0.89
60 Arts and entertainment	1.49	2.23	0.57	0.78
61 Accommodation	1.46	2.09	0.48	0.66
62 Eating and drinking	1.49	2.11	0.48	0.65
63 Repair and maintenance	1.40	2.07	0.52	0.71
64 Personal and laundry services	1.61	2.36	0.58	0.80
65 Organizations	1.47	2.30	0.64	0.87
66 Federal government military	1.00	1.75	0.58	0.80
67 Federal government: civilian	1.18	1.87	0.53	0.73
68 State and local government	1.16	2.00	0.65	0.89
PCE - Hawaii	1.16	1.56	0.31	0.42
PCE - Honolulu	1.14	1.56	0.32	0.44
PCE - Kauai	1.26	1.65	0.29	0.39
PCE - Maui	1.17	1.55	0.29	0.39
VE - Hawaii	1.33	1.85	0.40	0.54
VE - Honolulu	1.33	1.84	0.39	0.53
VE - Kauai	1.33	1.87	0.40	0.53
VE - Maui	1.36	1.88	0.40	0.54
State and local government consumption	1.12	1.84	0.55	0.75
Federal military consumption	0.97	1.66	0.53	0.73
Federal civilian consumption	1.17	1.87	0.54	0.74

**Table 15. Detailed Inter-County Final Demand Total Job and State Tax Multipliers for Honolulu, 2007**

Industry	Final-demand multipliers			
	Employment (total jobs)		State Tax (dollars)	
	Type I	Type II	Type I	Type II
1 Sugarcane	10.5	15.0	0.05	0.08
2 Vegetables	15.1	20.0	0.06	0.09
3 Macadamia nuts, coffee, and other fruits	12.5	16.5	0.06	0.08
4 Pineapples	34.2	38.5	0.06	0.08
5 Flowers and nursery products	16.5	20.9	0.05	0.08
6 Other crops	16.4	19.8	0.03	0.06
7 Animal production	17.0	20.8	0.04	0.07
8 Aquaculture	19.4	23.1	0.04	0.06
9 Commercial fishing	15.6	21.9	0.04	0.08
10 Forestry & logging	34.9	41.7	0.04	0.08
11 Support activities for agriculture	50.8	54.5	0.11	0.14
12 Mining	17.6	25.9	0.09	0.15
13 Single family construction	7.1	11.7	0.10	0.13
14 Construction of other buildings	8.1	12.9	0.10	0.14
15 Heavy and civil engineering construction	13.4	18.3	0.05	0.08
16 Maintenance & repairs	10.0	14.8	0.11	0.14
17 Food processing	18.6	22.6	0.05	0.08
18 Beverage manufacturing	11.4	16.7	0.05	0.09
19 Apparel and textile manufacturing	17.0	20.6	0.05	0.07
20 Petroleum manufacturing	0.7	1.1	0.01	0.01
21 Other manufacturing	7.5	10.3	0.04	0.06
22 Air transportation	6.7	9.6	0.04	0.05
23 Water transportation	10.0	14.4	0.05	0.08
24 Truck and rail transportation	12.5	17.7	0.10	0.14
25 Transit and ground passenger transportation	26.5	31.4	0.10	0.13
26 Scenic and support activities for transportation	11.7	17.5	0.10	0.14
27 Couriers and messengers	13.8	19.5	0.09	0.13
28 Warehousing and storage	17.8	24.2	0.10	0.14
29 Publishing (include Internet)	9.1	14.2	0.09	0.12
30 Motion picture and sound recording industries	10.9	14.2	0.09	0.11
31 Broadcasting (Radio, TV, Cable)	7.8	11.4	0.09	0.11
32 Telecommunications	5.1	8.0	0.04	0.06
33 Internet providers, web, and data processing	8.5	12.6	0.09	0.12
34 Other information services	10.8	14.9	0.10	0.13
35 Electricity	2.9	4.7	0.06	0.07
36 Gas production & distribution	3.0	4.5	0.04	0.05
37 Wholesale trade	9.7	14.3	0.15	0.18
38 Retail trade	16.0	20.5	0.09	0.12
39 Credit intermediation and related activities	9.6	13.6	0.05	0.08
40 Insurance carriers and related activities	8.9	13.4	0.09	0.12
41 Other finance and insurance	22.6	28.5	0.06	0.10
42 Owner-occupied dwellings	2.5	3.5	0.02	0.02
43 Real estate	6.1	7.8	0.08	0.10
44 Rental & leasing	5.7	7.4	0.19	0.20

**Table 15. Detailed Inter-County Final Demand Total Job and State Tax Multipliers for Honolulu, 2007 - Contd.**

Industry	Final-demand multipliers			
	Employment (total jobs)		State Tax (dollars)	
	Type I	Type II	Type I	Type II
45 Legal services	8.1	14.9	0.09	0.14
46 Architectural and engineering services	7.7	14.5	0.09	0.14
47 Computer systems design services	12.6	19.5	0.12	0.17
48 R&D in the physical, engineering, & life sciences	7.5	14.4	0.10	0.14
49 Other professional services	20.1	26.6	0.09	0.14
50 Management of companies and enterprises	9.0	15.2	0.10	0.15
51 Travel arrangement and reservation services	15.5	20.7	0.10	0.13
52 Administrative and support services	27.7	35.3	0.10	0.15
53 Waste management and remediation services	10.1	15.1	0.10	0.13
54 Colleges, universities, and professional schools	24.0	31.0	0.10	0.15
55 Other educational services	23.1	30.0	0.11	0.15
56 Ambulatory health care services	13.6	20.9	0.10	0.15
57 Hospitals	10.6	15.7	0.11	0.14
58 Nursing and residential care facilities	19.7	25.5	0.05	0.09
59 Social assistance	26.7	33.4	0.10	0.15
60 Arts and entertainment	26.2	32.1	0.10	0.14
61 Accommodation	10.1	15.1	0.15	0.19
62 Eating and drinking	20.8	25.8	0.10	0.13
63 Repair and maintenance	18.7	24.1	0.11	0.14
64 Personal and laundry services	26.0	32.0	0.12	0.16
65 Organizations	14.5	21.1	0.05	0.09
66 Federal government military	9.3	15.4	0.04	0.08
67 Federal government: civilian	11.0	16.6	0.05	0.09
68 State and local government	15.1	21.8	0.05	0.09
PCE - Hawaii	9.8	13.1	0.05	0.07
PCE - Honolulu	9.1	12.5	0.06	0.08
PCE - Kauai	9.8	12.8	0.05	0.07
PCE - Maui	9.3	12.3	0.05	0.07
VE - Hawaii	12.9	17.2	0.07	0.09
VE - Honolulu	11.3	15.3	0.10	0.12
VE - Kauai	12.2	16.5	0.07	0.09
VE - Maui	11.7	15.8	0.07	0.09
State and local government consumption	12.8	18.5	0.04	0.08
Federal military consumption	8.9	14.4	0.04	0.08
Federal civilian consumption	11.7	17.4	0.05	0.09

**Table 16. Detailed Inter-County Direct Effect Earnings and Total Job Multipliers for Honolulu, 2007**

Industry	Direct-effect multipliers			
	Earnings (dollars)		Employment (total jobs)	
	Type I	Type II	Type I	Type II
1 Sugarcane	1.69	2.31	1.85	2.64
2 Vegetables	1.46	2.00	1.45	1.92
3 Macadamia nuts, coffee, and other fruits	1.51	2.07	1.64	2.16
4 Pineapples	1.61	2.20	1.20	1.35
5 Flowers and nursery products	1.62	2.22	1.41	1.77
6 Other crops	1.26	1.72	1.19	1.43
7 Animal production	1.42	1.93	1.28	1.56
8 Aquaculture	1.41	1.93	1.31	1.57
9 Commercial fishing	1.32	1.81	1.34	1.88
10 Forestry & logging	1.31	1.79	1.35	1.62
11 Support activities for agriculture	1.60	2.19	1.10	1.18
12 Mining	1.44	1.96	1.50	2.20
13 Single family construction	1.50	2.04	2.32	3.81
14 Construction of other buildings	1.55	2.11	1.93	3.07
15 Heavy and civil engineering construction	1.58	2.16	1.43	1.95
16 Maintenance & repairs	1.48	2.02	1.63	2.40
17 Food processing	1.36	1.86	1.23	1.50
18 Beverage manufacturing	1.32	1.80	1.42	2.09
19 Apparel and textile manufacturing	1.79	2.44	1.41	1.70
20 Petroleum manufacturing	2.64	3.61	6.88	10.63
21 Other manufacturing	2.08	2.84	1.96	2.69
22 Air transportation	1.95	2.66	2.15	3.11
23 Water transportation	1.73	2.36	1.74	2.51
24 Truck and rail transportation	1.42	1.93	1.42	2.00
25 Transit and ground passenger transportation	1.51	2.06	1.18	1.40
26 Scenic and support activities for transportation	1.21	1.65	1.25	1.86
27 Couriers and messengers	1.22	1.67	1.22	1.72
28 Warehousing and storage	1.20	1.64	1.17	1.60
29 Publishing (include Internet)	1.11	1.52	1.17	1.83
30 Motion picture and sound recording industries	1.46	2.00	1.36	1.76
31 Broadcasting (Radio, TV, Cable)	1.28	1.75	1.40	2.05
32 Telecommunications	1.50	2.05	1.81	2.85
33 Internet providers, web, and data processing	1.45	1.98	1.73	2.59
34 Other information services	1.62	2.21	1.81	2.51
35 Electricity	1.79	2.45	2.40	3.84
36 Gas production & distribution	1.33	1.81	1.36	2.01
37 Wholesale trade	1.30	1.78	1.43	2.12
38 Retail trade	1.18	1.61	1.13	1.44
39 Credit intermediation and related activities	2.02	2.75	2.49	3.53
40 Insurance carriers and related activities	1.74	2.37	1.96	2.94
41 Other finance and insurance	1.35	1.84	1.21	1.53
42 Owner-occupied dwellings	NA	NA	NA	NA
43 Real estate	2.29	3.13	1.73	2.22
44 Rental & leasing	1.38	1.88	1.27	1.63

**Table 16. Detailed Inter-County Direct Effect Earnings and Total Job Multipliers for Honolulu, 2007 - Contd.**

Industry	Direct-effect multipliers			
	Earnings (dollars)		Employment (total jobs)	
	Type I	Type II	Type I	Type II
45 Legal services	1.10	1.50	1.23	2.27
46 Architectural and engineering services	1.09	1.49	1.21	2.27
47 Computer systems design services	1.21	1.65	1.32	2.04
48 R&D in the physical, engineering, & life sciences	1.09	1.49	1.22	2.35
49 Other professional services	1.11	1.52	1.10	1.45
50 Management of companies and enterprises	1.20	1.64	1.34	2.26
51 Travel arrangement and reservation services	1.28	1.75	1.22	1.62
52 Administrative and support services	1.12	1.53	1.09	1.39
53 Waste management and remediation services	1.42	1.94	1.54	2.30
54 Colleges, universities, and professional schools	1.12	1.53	1.10	1.41
55 Other educational services	1.16	1.58	1.13	1.47
56 Ambulatory health care services	1.13	1.55	1.19	1.84
57 Hospitals	1.57	2.15	1.88	2.79
58 Nursing and residential care facilities	1.24	1.70	1.21	1.56
59 Social assistance	1.17	1.59	1.12	1.41
60 Arts and entertainment	1.36	1.86	1.20	1.47
61 Accommodation	1.44	1.96	1.67	2.49
62 Eating and drinking	1.35	1.84	1.18	1.46
63 Repair and maintenance	1.25	1.71	1.17	1.51
64 Personal and laundry services	1.39	1.90	1.20	1.48
65 Organizations	1.26	1.72	1.36	1.98
66 Federal government military	1.00	1.37	1.00	1.65
67 Federal government: civilian	1.11	1.52	1.14	1.71
68 State and local government	1.08	1.47	1.08	1.56

**Table 17. Total Visitor Expenditures by Air by County: 2010-2011 (\$ million)**

	2011	2010	Change	(%) Change
State total	12,546.9	10,857.5	1689.4	15.6
Honolulu County	6,527.8	5,500.6	1027.3	18.7
Maui County	3,269.3	2,889.2	380.1	13.2
Hawaii County	1,426.5	1,354.8	71.6	5.3
Kauai County	1,323.3	1,112.9	210.4	18.9
County share (%)				
Honolulu County	52.0	50.7	60.8	
Maui County	26.1	26.6	22.5	
Hawaii County	11.4	12.5	4.2	
Kauai County	10.5	10.3	12.5	

Source: Hawai'i Tourism Authority

**Table 18. Direct Spending of Increased Visitor Expenditures in Maui County in 2011**

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total direct spending (\$ million)	1.6	31.7	1.1	321.2	355.6
Sector's shares (% in county total)					
Agriculture	16.9	0.6	3.3	0.0	0.2
Mining and construction	0.0	0.0	0.0	0.0	0.0
Food processing	30.7	2.6	1.9	0.0	0.4
Other manufacturing	1.4	4.1	0.5	0.0	0.4
Transportation	50.3	89.5	93.5	5.3	13.2
Information	0.0	0.0	0.0	0.1	0.1
Utilities	0.0	0.0	0.0	0.0	0.0
Wholesale trade	0.8	3.2	0.9	0.5	0.8
Retail trade	0.0	0.0	0.0	16.2	14.6
Finance and insurance	0.0	0.0	0.0	0.0	0.0
Real estate and rentals	0.0	0.0	0.0	10.2	9.2
Professional services	0.0	0.0	0.0	1.0	0.9
Business services	0.0	0.0	0.0	2.5	2.3
Educational services	0.0	0.0	0.0	1.1	1.0
Health services	0.0	0.0	0.0	1.2	1.1
Arts and entertainment	0.0	0.0	0.0	4.1	3.7
Hotels	0.0	0.0	0.0	43.6	39.4
Eating and drinking	0.0	0.0	0.0	12.5	11.3
Other services	0.0	0.0	0.0	1.0	0.9
Government	0.0	0.0	0.0	0.7	0.6

**Table 19. Direct Output Impact of Increased Visitor Expenditures in Maui County in 2011**

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total direct impact (\$M)	1.6	31.7	1.1	321.2	355.6
Direct impact by industry (\$M)					
Agriculture	0.3	0.2	0.0	0.0	0.6
Mining and construction	0.0	0.0	0.0	0.0	0.0
Food processing	0.5	0.8	0.0	0.0	1.4
Other manufacturing	0.0	1.3	0.0	0.1	1.4
Transportation	0.8	28.4	1.0	16.9	47.1
Information	0.0	0.0	0.0	0.5	0.5
Utilities	0.0	0.0	0.0	0.0	0.0
Wholesale trade	0.0	1.0	0.0	1.7	2.7
Retail trade	0.0	0.0	0.0	52.0	52.0
Finance and insurance	0.0	0.0	0.0	0.0	0.0
Real estate and rentals	0.0	0.0	0.0	32.6	32.6
Professional services	0.0	0.0	0.0	3.1	3.1
Business services	0.0	0.0	0.0	8.1	8.1
Educational services	0.0	0.0	0.0	3.5	3.5
Health services	0.0	0.0	0.0	3.7	3.7
Arts and entertainment	0.0	0.0	0.0	13.1	13.1
Hotels	0.0	0.0	0.0	140.2	140.2
Eating and drinking	0.0	0.0	0.0	40.2	40.2
Other services	0.0	0.0	0.0	3.3	3.3
Government	0.0	0.0	0.0	2.1	2.1

**Table 20. Direct Labor Income Impact of Increased Visitor Expenditures in Maui County in 2011**

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total direct labor income (\$M)	0.5	8.9	0.4	109.6	119.5
Direct impact by industry					
Agriculture	0.1	0.1	0.0	0.0	0.2
Mining and construction	0.0	0.0	0.0	0.0	0.0
Food processing	0.1	0.5	0.0	0.0	0.5
Other manufacturing	0.0	0.1	0.0	0.0	0.1
Transportation	0.3	7.9	0.4	6.0	14.6
Information	0.0	0.0	0.0	0.2	0.2
Utilities	0.0	0.0	0.0	0.0	0.0
Wholesale trade	0.0	0.4	0.0	0.8	1.1
Retail trade	0.0	0.0	0.0	14.1	14.1
Finance and insurance	0.0	0.0	0.0	0.0	0.0
Real estate and rentals	0.0	0.0	0.0	1.8	1.8
Professional services	0.0	0.0	0.0	1.5	1.5
Business services	0.0	0.0	0.0	4.1	4.1
Educational services	0.0	0.0	0.0	1.7	1.7
Health services	0.0	0.0	0.0	1.7	1.7
Arts and entertainment	0.0	0.0	0.0	8.4	8.4
Hotels	0.0	0.0	0.0	51.9	51.9
Eating and drinking	0.0	0.0	0.0	14.4	14.4
Other services	0.0	0.0	0.0	1.4	1.4
Government	0.0	0.0	0.0	1.6	1.6

**Table 21. Direct Employment Impact of Increased Visitor Expenditures in Maui County in 2011**

	Hawaii County	Honolulu County	Kauai County	Maui County	State Total
Total direct jobs (no.)	19	187	11	2,917	3,133
Direct impact by industry					
Agriculture	9	3	1	1	13
Mining and construction	0	0	0	0	0
Food processing	2	13	0	0	15
Other manufacturing	0	2	0	0	2
Transportation	8	163	10	163	344
Information	0	0	0	4	4
Utilities	0	0	0	0	0
Wholesale trade	0	7	0	16	23
Retail trade	0	0	0	461	461
Finance and insurance	0	0	0	0	0
Real estate and rentals	0	0	0	114	114
Professional services	0	0	0	43	43
Business services	0	0	0	134	134
Educational services	0	0	0	59	59
Health services	0	0	0	40	40
Arts and entertainment	0	0	0	318	318
Hotels	0	0	0	983	983
Eating and drinking	0	0	0	505	505
Other services	0	0	0	49	49
Government	0	0	0	27	27

**Table 22. Economic Impacts of Increased Visitor Expenditures in Maui County in 2011**

	Visitor expenditures (\$ million)	Output (\$ million)		Earnings (\$ million)		Total jobs (no.)	
		Direct	Total	Direct	Total	Direct	Total
State total	355.6	355.6	707.7	119.5	224.4	3,133	5,955
Hawaii County	1.6	1.6	11.5	0.5	3.5	19	127
Honolulu County	31.7	31.7	173.4	8.9	51.3	187	1,163
Kauai County	1.1	1.1	5.0	0.4	1.6	11	49
Maui County	321.2	321.2	517.8	109.6	168.0	2,917	4,617
County share (%)							
Hawaii County	0.5	0.5	1.6	0.4	1.6	0.6	2.1
Honolulu County	8.9	8.9	24.5	7.5	22.9	6.0	19.5
Kauai County	0.3	0.3	0.7	0.3	0.7	0.3	0.8
Maui County	90.3	90.3	73.2	91.8	74.9	93.1	77.5

**Table 23. Impacts of Increased Visitor Expenditures in Maui County in 2011 by Industry**

	Output (\$ million)		Income (\$ million)		Total jobs (no.)	
	Direct	Total	Direct	Total	Direct	Total
Total	355.6	707.7	119.5	224.4	3,133	5,955
Agriculture	0.6	4.0	0.2	1.7	13	88
Mining and construction	0.0	12.9	0.0	4.6	0	74
Food processing	1.4	7.7	0.5	1.7	15	49
Other manufacturing	1.4	41.9	0.1	3.3	2	66
Transportation	47.1	60.2	14.6	18.6	344	433
Information	0.5	12.5	0.2	4.1	4	79
Utilities	0.0	16.0	0.0	1.8	0	20
Wholesale trade	2.7	13.4	1.1	5.4	23	106
Retail trade	52.0	79.8	14.1	22.6	461	745
Finance and insurance	0.0	19.2	0.0	5.0	0	118
Real estate and rentals	32.6	99.9	1.8	5.5	114	330
Professional services	3.1	22.0	1.5	11.5	43	274
Business services	8.1	38.9	4.1	20.9	134	645
Educational services	3.5	6.2	1.7	3.2	59	109
Health services	3.7	27.8	1.7	13.3	40	292
Arts and entertainment	13.1	15.1	8.4	9.6	318	364
Hotels	140.2	144.0	51.9	53.4	983	1,011
Eating and drinking	40.2	51.7	14.4	18.7	505	673
Other services	3.3	21.5	1.4	9.2	49	321
Government	2.1	13.0	1.6	10.3	27	159
Sector's shares (%)						
Agriculture	0.2	0.6	0.2	0.7	0.4	1.5
Mining and construction	0.0	1.8	0.0	2.1	0.0	1.2
Food processing	0.4	1.1	0.4	0.7	0.5	0.8
Other manufacturing	0.4	5.9	0.1	1.5	0.1	1.1
Transportation	13.2	8.5	12.3	8.3	11.0	7.3
Information	0.1	1.8	0.2	1.8	0.1	1.3
Utilities	0.0	2.3	0.0	0.8	0.0	0.3
Wholesale trade	0.8	1.9	1.0	2.4	0.7	1.8
Retail trade	14.6	11.3	11.8	10.1	14.7	12.5
Finance and insurance	0.0	2.7	0.0	2.2	0.0	2.0
Real estate and rentals	9.2	14.1	1.5	2.5	3.6	5.5
Professional services	0.9	3.1	1.2	5.1	1.4	4.6
Business services	2.3	5.5	3.5	9.3	4.3	10.8
Educational services	1.0	0.9	1.4	1.4	1.9	1.8
Health services	1.1	3.9	1.4	5.9	1.3	4.9
Arts and entertainment	3.7	2.1	7.1	4.3	10.2	6.1
Hotels	39.4	20.4	43.5	23.8	31.4	17.0
Eating and drinking	11.3	7.3	12.1	8.3	16.1	11.3
Other services	0.9	3.0	1.1	4.1	1.6	5.4
Government	0.6	1.8	1.3	4.6	0.9	2.7

Note: sector totals are totals for all four counties.

## APPENDIX A

### MATHEMATICAL FRAMEWORK FOR THE INTER-COUNTY I-O MODEL

The flow of inter-industry sales in the inter-regional transaction table can be expressed as a system of  $n \times l$  equations, representing the distribution of each industry's total output (sales) in each of  $l$  regions to  $n$  industries and  $m$  final demand sectors in that region as well as other regions in the economy as<sup>6</sup>

$$X_i^r = \sum_{s=1}^l \sum_{j=1}^n Z_{ij}^{rs} + \sum_{s=1}^l \sum_{k=1}^m Y_{ik}^{rs} \quad (\text{A.1})$$

where

$r, s = 1, 2, \dots, l$  row and column regions;

$i, j = 1, 2, \dots, n$  selling and purchasing sectors;

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

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

$Z_{ij}^{rs} =$   $i$ th industry's inter-industry sales from row region  $r$  to the  $j$ th industry in column region  $s$ ; and

$Y_{ik}^{rs} =$   $i$ th industry's final sales from region  $r$  to the  $k$ th final demand sector in region  $s$ .<sup>7</sup>

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

$$X_j^s = \sum_{r=1}^l \sum_{i=1}^n Z_{ji}^{sr} + M_j^s + \sum_{q=1}^p W_{qj}^s \quad (\text{A.2})$$

where

$r, s = 1, 2, \dots, l$  regions;

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

$q = 1, 2, \dots, p$  final payment sectors;

$X_j^s =$  total input (purchases) of the  $j$ th industry in column region  $s$ , including the total inter-industry purchases (the first term in the equation), imports as production inputs to industries (the second term in the equation) and total final payments (the third term in the equation);

$Z_{ji}^{sr} =$  inter-industry purchases by  $j$ th industry in region  $s$  from the  $i$ th industry in region  $r$ ;

$M_j^s =$  imports of  $r$ th region's industry  $j$  as intermediate input; and

---

<sup>6</sup> Most of the mathematical expressions presented are adopted from Miller and Blair (1985) with some modifications.

<sup>7</sup> Only personal consumption expenditures (PCE) and visitor expenditure components of industry's final demand have been allocated to each of the four counties in this study, given the lack of information to do the same for other final demand.

$W_{qj}^s =$   $j$ th industry's payments to the  $q$ th final payment sector in region  $s$ .<sup>8</sup>

Continuing with the above notations, a matrix of inter-industry flows of goods and services within region  $r$  may be represented as

$$Z^{rr} = [Z_{ij}^{rr}]_{n \times n} \quad (\text{A.3})$$

where  $Z_{ij}^{rr}$  shows  $i$ th sector's sales of goods and services in region  $r$  to the  $j$ th sector in that region.

Similarly, the matrix of inter-industry flows of goods and services between regions  $r$  and  $s$  (for  $r \neq s$ ) is<sup>9</sup>

$$Z^{rs} = [Z_{ij}^{rs}]_{n \times n} \quad (\text{A.4})$$

where  $Z_{ij}^{rs}$  represents the  $i$ th sector's sales of goods and services in region  $r$  to the  $j$ th sector in region  $s$ .

With these notations, the complete inter-regional inter-industry transactions table for an  $n$ -sector,  $l$ -region economy can be represented as

$$Z = \begin{bmatrix} Z^{11} & Z^{12} & \dots & Z^{1l} \\ Z^{21} & Z^{22} & \dots & Z^{2l} \\ \vdots & \vdots & \vdots & \vdots \\ Z^{l1} & Z^{l2} & \dots & Z^{ll} \end{bmatrix}_{nl \times nl} \quad (\text{A.5})$$

The diagonal matrices are intra-regional inter-industry flows (i.e., within regions) and off-diagonal matrices are inter-regional flows of goods and services (i.e., between regions). Specifying  $Z$  would require detailed data on shipments (flows) of goods and services across sectors and between regions. When such data are not available, various mathematical approaches are employed to estimate inter-regional commodity and service flows.

In this study, given the lack of detailed information on intra- and inter-county flows of goods and services across industries, elements in  $Z$  are estimated using the direct-requirements or technology matrix (usually denoted as matrix ' $A$ ') from the 68-sector state I-O model and industry outputs (sales) for counties. This is done in two stages.

- i) Derive the preliminary estimates of diagonal elements of matrix  $Z$  as

$$\hat{Z}^{rr} = A \cdot X^r \quad (\text{A.6})$$

where  $\hat{Z}^{rr}$  is the preliminary estimate of  $Z^{rr}$ ,  $A$  is the technical coefficients matrix for the state I-O model, and  $X^r$  is a diagonal matrix with its diagonal elements being industry outputs for region  $r$ . The resultant 68 x 68 industry matrix for each county was then aggregated to a 20 x 20 industry matrix. This procedure was repeated four times for each of the four counties. The resulting matrices account for all Hawaii intermediate inputs purchased in each county regardless of which county they came from.

<sup>8</sup> Conceptually, one could also regionalize final payments components, but it is not done so in this study due to data limitations.

<sup>9</sup> In the literature this is also referred to as inter-regional trade flow.

ii)  $\hat{Z}^{rr}$  was adjusted to account for inter-county trade flows of goods and services as

$$\begin{aligned} Z^{rr} &= \hat{Z}^{rr} \cdot \alpha_r \\ Z^{sr} &= \hat{Z}^{sr} \cdot \alpha_s \\ \alpha_r + \sum_{r \neq s=1}^l \alpha_s &= I \text{ for all } i \end{aligned} \tag{A.7}$$

where the first expression shows the intra- and inter-industry input purchases within the region, second expression denotes the region  $r$ 's inter-industry purchases from other regions,  $\alpha_r$  denotes the proportion of total inter-industry purchases from within the region and  $\alpha_s$  denotes the proportions supplied from other regions.

Like information on inter-regional flows of goods and services, information on proportions ( $\alpha$ s) of total regional inter-industry purchases supplied by different regions was not readily available. These proportions for manufacturing and agricultural sectors were based on inter-island waterborne commerce data obtained from the US Army Corps of Engineers and data on plane and ship arrivals of various agricultural products from neighbor islands to Honolulu market obtained from the State of Hawaii Department of Agriculture (DOA). Hawaii's inputs to certain industries, such as agriculture, construction, utilities, arts/entertainment, other services and government enterprises were assumed to come mostly from the purchasing county. For financial, professional and business service sectors, Oahu was assumed to supply some intermediate inputs to other three counties. For other manufacturing and hotel sectors, Oahu was assumed to supply most of the intermediate inputs to other counties.

The next step is to derive the inter-regional direct requirements table. In the case of an inter-regional I-O model, each column of the direct requirements table contains purchases within the region ( $a_{ij}^{rr}$ ) and purchases from other regions ( $a_{ij}^{rs}$  where  $r \neq s$ ).  $a_{ij}^{rr}$  represents the purchase of column sector  $j$  in region  $r$  from the  $i$ th sector in that region to produce a dollar of sector  $j$ 's output in region  $r$ .  $a_{ij}^{rs}$  represents the purchase of column sector  $j$  in region  $r$  from the  $i$ th sector in other regions ( $r \neq s$ ) to produce a dollar of sector  $j$ 's output in region  $r$ . These coefficients are derived by dividing each column entry of the inter-regional transactions table,  $Z_{ij}^{rr}$  and  $Z_{ij}^{rs}$  ( $r \neq s$ ) by the corresponding column total,  $X_j^s$  as

$$a_{ij}^{rr} = Z_{ij}^{rr} / X_j^s \quad a_{ij}^{rs} = Z_{ij}^{rs} / X_j^s \tag{A.8}$$

Using equation (A.8), the system of inter-industry equations (A.1) can be rewritten as

$$X_i^r = \sum_{s=1}^l \sum_{j=1}^n a_{ij}^{rs} X_j^s + \sum_{s=1}^l \sum_{k=1}^m Y_{ik}^{rs} \tag{A.9}$$

The sets of matrices showing the direct requirement coefficients among industries within the region is represented as

$$A^{rr} = [a_{ij}^{rr}]_{n \times n} \tag{A.10}$$

Similarly the set of matrices showing the direct requirement coefficients among industries between regions  $r$  and  $s$  ( $r \neq s$ ) is represented as

$$A^{rs} = [a_{ij}^{rs}]_{n \times n} \quad (\text{A.11})$$

For a  $l$ -region model, the complete direct coefficient matrix will be

$$A = \begin{bmatrix} A^{11} & A^{12} & \dots & A^{1l} \\ A^{21} & A^{22} & \dots & A^{2l} \\ \vdots & \vdots & \vdots & \vdots \\ A^{l1} & A^{l2} & \dots & A^{ll} \end{bmatrix}_{nl \times nl} \quad (\text{A.12})$$

For notational convenience, let us combine the various final demand sectors to form one aggregate final demand sector ( $Y^r = \sum_{s=1}^l \sum_{k=1}^m Y_{ik}^{rs}$ ). Also let  $X^r = [X^1 \ X^2 \ \dots \ X^l]$  and  $Y^r = [Y^1 \ Y^2 \ \dots \ Y^l]$  be the vectors of industry outputs and final demand sectors, respectively, where  $X^l$  is an  $n \times 1$  vector of outputs and  $Y^l$  is a  $n \times 1$  vector of final demand in region  $l$ . With these notations, the system of equations (A.9) can be written in a compact form as

$$X = AX + Y \quad (\text{A.13})$$

where  $X$  represents a  $nl \times 1$  vector of industry total outputs,  $A$  represents an  $nl \times nl$  matrix of direct requirements coefficients (also known as the technology matrix), and  $Y$  is an  $nl \times 1$  vector of total final demand.

The expression of the inter-industry equations (A.13) can be rewritten as

$$X(I - A) = Y \quad (\text{A.14})$$

representing a set of  $l$  matrix equations

$$\begin{aligned} (I - A^{11})X^1 & - A^{12}X^2 - \dots & - A^{1l}X^l & = Y^1 \\ - A^{21}X^1 + (I - A^{22})X^2 & - \dots & - A^{2l}X^l & = Y^2 \\ \vdots & \vdots & \vdots & \vdots \\ - A^{l1}X^1 & - A^{l2}X^2 - \dots + (I - A^{ll})X^l & & = Y^l \end{aligned} \quad (\text{A.15})$$

where  $I$  is an identity matrix, which has ones on its diagonal and zeros elsewhere.

Thus, the vector of total industry outputs can be solved as:

$$X = (I - A)^{-1}Y = BY \quad (\text{A.16})$$

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 I final-demand output multiplier for the  $j$ th sector in region  $s$  ( $O_s^j$ ) can be obtained by summing down the  $j$ th column of the Leontief matrix as

$$O_s^j = \sum_{r=1}^l \sum_{i=1}^n b_{ij}^{rs} \quad (\text{A.17})$$

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

A direct earnings coefficient (earnings to output ratio) matrix for region  $r$  ( $L^r$ ) is represented as<sup>10</sup>

$$L^r = \begin{bmatrix} L_1^r & 0 & \cdots & 0 \\ 0 & L_2^r & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & L_n^r \end{bmatrix} \quad (\text{A.18})$$

where  $L_i^r$  represents the earnings to output ratio for sector  $i$  in region  $r$ . Then, the complete earnings to output coefficient matrix may be written as

$$L = \begin{bmatrix} L^1 & 0 & \cdots & 0 \\ 0 & L^2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & L^l \end{bmatrix} \quad (\text{A.19})$$

The final-demand earnings multiplier matrix ( $C$ ) is obtained using the direct earnings coefficient matrix and the total requirements or Leontief matrix as

$$C = L \cdot B \quad (\text{A.20})$$

The Type I final-demand earnings multiplier for sector  $j$  in region  $s$  ( $I_j^s(FD)$ ) is computed as:

$$I_j^s(FD) = \sum_{r=1}^l \sum_{i=1}^n c_{ij}^{rs} \quad (\text{A.21})$$

The Type I direct-effect earnings multiplier for sector  $j$  in region  $s$  ( $I_j^s(DE)$ ) is derived as:

$$I_j^s(DE) = I_j^s(FD) / L_j^s \quad (\text{A.22})$$

A matrix of employment to output ratios or direct employment coefficients for region  $r$  ( $E^r$ ) can be represented as

$$E^r = \begin{bmatrix} e_1^r & 0 & \cdots & 0 \\ 0 & e_2^r & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & e_n^r \end{bmatrix} \quad (\text{A.23})$$

where  $e_i^r$  represents the employment to output ratio for sector  $i$  in region  $r$ . Then, the complete direct employments coefficients matrix can be written as

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<sup>10</sup> See footnote 3.

$$E = \begin{bmatrix} E^1 & 0 & \dots & 0 \\ 0 & E^2 & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & E^l \end{bmatrix} \quad (\text{A.24})$$

The final-demand employment multiplier matrix (D) is derived using the direct employment coefficients matrix (E) and total requirements or Leontief matrix (B) as

$$D = E \cdot B \quad (\text{A.25})$$

The Type I final-demand employment multiplier for sector  $j$  in region  $s$  ( $E_j^s(FD)$ ) is computed as

$$E_j^s(FD) = \sum_{r=1}^l \sum_{i=1}^n d_{ij}^{rs} \quad (\text{A.26})$$

The Type I direct-effect employment multiplier for sector  $j$  in region  $s$  ( $E_j^s(DE)$ ) is derived as:

$$E_j^s(DE) = E_j^s(FD) / e_j^s \quad (\text{A.27})$$

Type II multipliers are obtained in exactly the same fashion as Type I multipliers except that households in each county are treated as an additional industry (i.e., as both suppliers of labor inputs to industries and purchasers of industries' outputs) to account for the effects of changes in household earnings and expenditures. Mathematically, this is done by adding both a household row and a household column to the inter-regional direct requirements matrix (A) in equation (A.13). Entries in the household row are the earnings to output ratios, and entries in the household column are industries' shares of total personal consumption expenditures, multiplied by the ratio of personal income less taxes and savings to personal income in order to account for the dampening effects of taxes and savings on expenditures. In computing output and employment multipliers, the entries in the household row of the resulting total requirements table are not included in the summation. Each entry in the household row of the total requirements matrix also happens to be the type II final-demand earnings multiplier of the column industry corresponding to the entry.

## APPENDIX B

### INDUSTRY CLASSIFICATION, DATA SOURCES, AND ESTIMATION PROCEDURE

#### Industry Classification

As in the state I-O model, the North American Industry Classification System (NAICS) was adopted in classifying industry sectors for the inter-county I-O model. However, several data sources used in the 2007 I-O table were reported in a more aggregate format and therefore were disaggregated using the detailed Hawaii's Department of Labor and Industrial Relations (DLIR) ES-202 jobs and income data.

Two different detailed levels are provided in this study. In the less detailed level, industries in the inter-county model were aggregated to 20 sectors as in the condensed version of the state I-O model. In the more detailed level, industries in Honolulu were aggregated to 68 sectors as in the detailed version of the state I-O model, while industries in other counties were aggregated to 20 sectors as in the less detailed version of the inter-county model. A more detailed table would be difficult to build using the inter-regional accounting framework due to lack of data for the neighbor island counties and the geometric increase in the number of sectors. For example, an inter-regional inter-industry transactions table for a 20-sector 4-county model will have a total of 80 rows and 80 columns.

#### Output

The main data source for industries' outputs for the 2007 inter-county I-O table was the 2007 Economic Census (EC) of Hawaii's industries. The Economic Censuses disclose output estimates for most of the industries included in the inter-county I-O table. Following the 2007 U.S. national I-O table, industry's output is generally measured as follows:

$$\begin{aligned} \text{Output} &= \text{Revenue of for-profit establishments} \\ &+ \text{Expenses of non-profit establishments*} \\ &- \text{Cost of merchandise resales*} \\ &+ \text{Adjustment for underreporting*} \\ &+ \text{Changes in inventory*} \\ &+ \text{Sales taxes*} \\ &+ \text{Employee tips*} \end{aligned}$$

\* If applicable (some industry may only have some of the components).

The above definition applies to most of the manufacturing and service industries. However, as described below, there are several industries for which output measures and sources were different from the 2007 Economic Census.

#### Agriculture, Aquaculture, and Commercial Fishing

The output for the agriculture (crops and livestock) and aquaculture sectors was based on the values of agricultural and aquaculture sales published in the Hawaii Department of Agriculture Statistics of Hawaii Agriculture, with adjustments made for changes in inventories and inter-farm sales based on information obtained from the Bureau of Economic Analysis (BEA). The total state output of

commercial fishing was based on information from the National Marine Fisheries Services (NMFS) Web site and it was allocated to counties based on counties' shares in nonemployer receipts from the 2007 Economic Census.

### **Forestry & Logging and Support Activities for Agriculture**

The forestry & logging and support activities for agriculture are not covered in either the Statistics for Hawaii's Agriculture or the Economic Census. Thus, their outputs were estimated by applying the value added to output ratios for these sectors obtained from Statistics of Hawaii Agriculture to their corresponding valued added obtained from the Bureau of Economic Analysis (BEA).

### **Mining and Construction**

Construction output equals the net revenue of construction (total value of construction less subcontracting) plus the value of architectural and engineering services involved in the construction activity. Mining and construction outputs in the state I-O came from the 2007 Economic Census of mining and construction, respectively. Mining and construction outputs for counties were estimated by allocating mining and construction outputs in the state I-O table using wage and salary employment in mining and construction related activities by county.

### **Manufacturing**

Manufacturing outputs at the state level were mostly based on the 2007 Economic Census of manufacturing except for the output of petroleum processing, which was not disclosed in the Economic Census. Petroleum processing output was estimated based on the information contained in the 2007 Hawaii Foreign Trade Zone (FTZ) Annual Report. At the county level, outputs for Honolulu were based on either the 2007 Economic Census or the FTZ Annual Report 2007. For other counties, the Economic Census does not disclose detailed manufacturing sales by county. Therefore, manufacturing outputs for other counties were estimated by allocating the difference between Honolulu output and state total output for these industries in the state I-O table based on other counties shares in wage and salary income.

### **Transportation**

Output of all transportation sectors for counties was obtained by allocating total output of transportation sectors in the 2007 state I-O table using respective transportation wage and salary income by county. The definition of air and water transportation output and its estimation procedure can be found in the 2007 benchmark I-O report for the state.

### **Utilities**

Output of electricity and gas production by county was obtained from the Hawaii Data Book.

### **Trade**

Output of wholesale and retail trade services was estimated based on wholesale and retail gross sales by county from the 2007 Economic Census and appropriate wholesale and retail margins. Because of the lack of information, the margins for counties were assumed to be the same as those for the 2007 state I-O table. Trade margins are described in the 2007 state I-O report.

### **Finance and Insurance**

Output of finance and insurance industries for counties was obtained by allocating the finance and insurance output in the 2007 state I-O table using respective wage and salary income or job by county. The definition of finance and insurance output and estimation procedures are provided in the 2007 state I-O report.

## **Real Estate and Rental**

Real estate and rental output was defined as the revenue of all rental activity in the state (regardless of which industry earned the revenue), plus the revenue of real estate brokers and agents, plus the imputed rental value of buildings owned by non-profit establishments serving individuals, plus the imputed value of new home sales by the construction industry. In the 2007 state I-O table, this sector includes three industries: (1) owner-occupied dwellings, (2) real estate, and (3) rental & leasing and others. Owner-occupied housing output was computed as the revenue that would be generated if all of the owner-occupied housing units were rented. This was estimated based on the number of owner-occupied housing units and average rent paid to comparable rental units by county. This information was obtained from the Housing Policy Study for Hawaii. Real estate output and rental & leasing outputs by county were computed based on the 2007 Economic Census.

## **Services**

### *Business Services*

In the 2007 state I-O table, the business services sector includes four industries: (1) management of companies and enterprises, (2) travel arrangement and reservation services, (3) administrative and support services, and (4) waste management and remediation services. The county level output of the management of companies and enterprises industry was obtained by allocating the state output of this industry using respective wage and salary income or job by county. For the remaining three industries in this sector, county level outputs were based on the Economic Census.

### *Educational Services*

In the 2007 state I-O table, the educational services sector includes two industries: (1) colleges, universities, and professional schools, and (2) other educational services. Output of the total educational services sector by county was estimated based on the 2007 Economic Census and adjusted by the BEA/EC job ratios. The allocation of total educational services output to the two industries included was based on wage and salary income from ES202 data from the State of Hawaii Department of Labor and Industrial Relations (DLIR).

### *Hospitals*

Hospitals output was based on their expenses instead of their revenues, since they are considered non-profit institutions serving individuals. Government-run hospitals were included in the Economic Census, but were removed from the output estimate, since the hospitals industry by I-O definition includes private hospitals only. Government hospitals are part of government expenditures in final demand.

### *Accommodation and Food Services*

Accommodation and food services outputs for counties were estimated based on the 2007 Economic Census, plus estimated tips.

### ***Government and Government Enterprises***

In the 2007 state I-O table, the government sector includes three sub-sectors: (1) Federal government military, (2) Federal government civilian, and (3) state and local government. The outputs of government enterprises were combined with the outputs of the general government sub-sectors. State and local government enterprises' output was estimated in terms of three categories, namely water and sewer, public transit, and other government enterprises (airports, harbors, housing, parking, etc.). There are two federal government enterprises, namely postal service and others (e.g., military exchanges, commissaries, restaurants, and hotels). Government enterprise output was defined as operating revenue, except for military exchanges and commissaries for which output was defined as their operating margins. Output of the government sector for counties was obtained by allocating the government sector output in the 2007 state I-O table using respective value added by county.

### **Value Added**

Value added is the income side of the Hawaii gross domestic product (GDP) account. For the 2007 I-O table, value added was divided into four components: (1) compensation of employees (COE), (2) proprietors' income, (3) taxes on production and imports less subsidies (TOPILS), and (4) other capital costs. The main data source for the components of value added was the Bureau of Economic Analysis (BEA).

The BEA provided the following three components of GDP data at the state level (64 industries by NAICS): (1) COE, (2) TOPILS, and (3) gross operating surplus (including proprietor's income and other capital costs). The BEA GDP data can be used to determine the control total at the state level for the following two components: (1) COE, and (2) TOPILS. The gross operating surplus (GOS) needs to be separated between proprietor's income and other capital costs.

In its personal income data, BEA also provides the earnings by place of work data for the state (SA05N) and by county (CA05N) and COE data for the state (SA06N) and by county (CA06N). Earnings by place of work = Compensation of employees + Proprietors' income. Therefore, COE and proprietors' income by industry for the state and by county can be calculated using BEA personal income data.

Other capital costs by industry for the state were calculated by subtracting the proprietors' income from the GOS. Please note that the BEA GDP data contains less detailed industry level data than the BEA income data. While the BEA GDP data can be grouped into 20 sectors similar to the 2-digit NAICS code, it is not detailed enough to generate the more detailed 68-sector industry level data applied in the 2007 state I-O table. The BEA income data, however, is more detailed and can be grouped into the required 68 sectors.

### ***Compensation of Employees***

Compensation of employees consists of wage and salary disbursements plus supplements to wages and salaries. The supplements to wages and salaries include employer contributions for employee pension and insurance funds, and employer contributions for government social insurance. In the 2007

inter-county I-O table, county level COE data by detailed industries (68 sectors) were obtained from BEA's estimate of COE by county (CA06N).

### ***Proprietors' Income***

In its personal income data, BEA also provides the county level earnings by place of work by industry (CA05N). The county level proprietors' income was determined by subtracting the county level COE from the county level total earnings by place of work.

### ***Taxes on Production and Imports less Subsidies***

Taxes on production and imports less subsidies (TOPILS) consist of tax liabilities, such as general sales and property taxes that are chargeable to business expense in the calculation of profit-type incomes. Also included are special assessments. TOPILS is the sum of business taxes and fees paid to the federal, state, and local governments. Components of TOPILS include general excise taxes (GET), transient accommodations taxes (TAT), fuel taxes, property taxes, customs duties, and certain types of non-tax fees. Subsidies consist of the monetary grants paid by government agencies to private business or to government enterprises at another level of government. The county level TOPILS data in the 2007 inter-county I-O table were estimated by allocating the state total TOPILS to counties using counties' shares in total earnings.

### ***Other Capital Costs***

Other capital costs consist of several components, including corporate profits, consumption of fixed capital (i.e., depreciation), net interest paid, net rental income of individuals, and business transfers. Other capital costs for the state were computed by subtracting proprietors' income from gross operating surplus. Since information on other capital costs by industry and by county was not available, total other capital costs for the state was allocated to counties using counties share in 2007 outputs.

### ***The Control Total of Honolulu Total Value Added***

The county level total value added by industry can be calculated initially by adding the four components of value added estimated above; however, since BEA also provided 2007 Honolulu industry level total value added, the estimated county level GDP components above need to be adjusted such that the Honolulu total value added by industry data are consistent with the BEA provided data.

### **Final Demand**

Final demand reflects the expenditure side of the state GDP account. It consists of personal consumption expenditures (PCEs), visitor's expenditures (VEs), gross private investment, change in inventories, state and local government consumption and investment, federal government consumption and investment, and exports.

### ***Pers onal Consumption Expenditures***

The PCEs for counties were estimated based on income, population, retail sales and industry outputs by county. The process involved several iterations. The total PCE of each industry in each county was broken down to four components, representing the spending on that industry's final goods and services by households in each of the four counties. Exports to other counties and spending by Hawaii residents from other counties were included in PCEs. As in the state I-O model, PCEs were estimated in producers' prices with trade and transportation margins being assigned to relevant trade and transportation sectors.

### ***Visitor Expenditures***

Visitor expenditures for counties were computed based on total visitor days and total retail sales by county. Like PCEs, total expenditures by visitors on each industry's goods and services were broken down to four components, showing visitors' spending on that industry's goods and services in each of the four counties. Visitor expenditures were also valued at producers' prices with trade and distribution margins being assigned to relevant distribution sectors.

### ***Gross Private Investment***

Gross private investment consists of private sector spending on construction and producers' durable equipment (PDE). The value of private construction was estimated as total value of new construction (excluding repairs and maintenance construction) minus the value of government construction. The construction portion of private investment was obtained in estimating the construction output by county. The PDE portion was estimated by allocating total private spending on PDE in the 2007 state I-O table to counties using counties' shares in industry outputs.

### ***Changes in Inventories***

Changes in inventories by county were computed by allocating total changes in inventories in the 2007 state I-O table using industry outputs by county.

### ***State and Local Government Consumption and Investment***

State and local government consumption consists of compensation of employees, consumption of fixed capital, and operating expenses. Employee compensation was based on ES202 income and BEA wages and salaries and other labor income, adjusted to account for state and local government enterprises. Information on consumption of fixed capital by county was not available. Total fixed capital in the 2007 state I-O table, estimated based on BEA, was allocated to counties based on compensation of state and local government employees by county. Similarly, information on detailed government operating expenses by industry was not available for counties. Thus, the total operating expenses of state and local government (excluding operating expenses of the various government enterprises) in the 2007 state I-O table, estimated based on the special DAGS report and Census of Governments, was allocated to counties using industry outputs by county.

State and local government investment consists of the value of new state and local government construction and spending on durable equipment. The value of state and local government construction by county was estimated based on county financial reports and supplemental detail to the state financial reports, with adjustments made to conform to the state I-O model. The spending on durable equipment in the 2007 state I-O table was allocated to counties using industry outputs.

### ***Federal Government Investment and Consumption: Military***

Federal government military expenditures include investment and consumption expenditures. Investment comprises new construction spending and spending on producers' durable equipment. Construction spending was based on federal defense procurement data by county, while spending on durable equipment was estimated by allocating the total federal military durable spending in the 2007 state I-O table using industry outputs by county. Federal military consumption consists of purchases of goods and services from various industries, compensation of federal employees and consumption of fixed capital. Federal purchases of goods and services by industry were based on federal military procurement data by county and employees' compensation and capital consumption was obtained by adding the compensation of federal military employees and other capital costs of the federal military.

### ***Federal Government Investment and Consumption: Civilian***

Federal civilian investment and consumption were computed in the same way as the federal military investment and consumption, except for that it involved federal civilian procurement data and compensation of federal civilian employees and other nonmilitary capital costs of federal government.

### ***Exports***

Given the lack of data on industries' exports by county, exports were estimated by allocating total exports in the 2007 state I-O table to counties based on industry outputs by county.

### ***Imports***

Imports consist of out-of-state purchases of services and commodities by industries as inputs to production and by final users for consumption and investment. The value of total industries' imports was computed as a residual between total final demand and total value added, and allocated to industries in balancing the inter-regional inter-industry transactions table. The value of imports for each final demand sector was estimated as that sector's total expenditures on final goods and services at producers' prices less total final sales of goods and services to that sector by local industries. Given the lack of information, industries' imports by county were estimated by allocating total industries' imports in the 2007 state I-O table using counties' shares in industries' outputs. Allocation of imports of goods and services by final demand sectors was done based on counties' total expenditures on each final demand.

### ***Employment***

Total employment, wage and salary employment, and proprietors' employment numbers are mainly based on BEA employment data by industry and by county. The county level total employment at less detailed industry level (20 sectors) was obtained from the BEA's total employment data by county at 2-digit NAICS level (CA25N). The county level total employment at less detailed industry level was allocated to more detailed industry level (20 sectors for the neighbor island counties and 68 sectors for Honolulu) based on shares in wage and salary jobs. Since the state level total employment at more detailed industry level (68 sectors) can be calculated based on BEA SA25N data, adjustments were made such that the county total at detailed industry level equals the state total jobs at detailed industry level. The county level wage and salary jobs at detailed industry level (68 sectors) were estimated based on BEA CA27N data. The proprietors' jobs were determined by the difference between total jobs and wage and salary jobs.

In addition, the State of Hawaii Department of Labor and Industrial Relations (DLIR) maintains a detailed data set (ES202) that provides tabulations of the 2007 number of reporting units, average annual employment, and total wages by industry and by county. For the industries in the 2007 I-O table that were not consistent with the 3-digit NAICS, the 2007 ES202 data were used to allocate the BEA data to the 2007 I-O industries.

## APPENDIX C

### INTER-COUNTY INTER-INDUSTRY TRANSACTIONS TABLE AND BALANCING PROCEDURE

#### Inter-county Inter-industry Transactions Table

An inter-industry transactions table in an inter-regional context depicts the flow of goods and services across industries both within region and between regions. This information is not readily available, especially the flow of services. Here, an attempt was made to derive an inter-county transactions table using the existing state inter-industry table and limited information on inter-industry flows of goods and services between counties.

Inter-island water-borne commerce data obtained from the U.S. Army Corps of Engineers provide information on tonnages received by and shipped out from each county for major commodity types. However, the available data do not contain information on the various port-to-port movements due to disclosure restrictions. In order to better estimate the flow of commodities between counties, such data on bilateral flows by port would be necessary for each commodity type. Moreover, the values of the shipments are not reported. However, looking at total tonnages received in and shipped out of each county by commodity type provided some insights into the flows of commodities between counties. Besides water-borne commerce, data on plane and ship arrivals of various agricultural products to Honolulu from neighbor islands were obtained from the Hawaii State Department of Agriculture (DOA). These data provided a basis for determining proportions of industries' commodity inputs supplied by various industries in different counties. There are significant flows of services between counties, but very little or no information exists on flows of services. Because of the lack of data to estimate the inter-county transactions table directly, as in other inter-regional I-O studies, an indirect approach is used to derive the inter-county transactions table.

As outlined in the mathematical section, the inter-county inter-industry transactions table was derived in two stages. First, for each county, a 68 by 68 inter-industry table was estimated using the detailed direct requirements matrix from the 2007 state I-O table and 68 industry outputs for that county. These 68 industries were then aggregated to 20 sectors for the neighbor island counties (Honolulu remained 68 industries in the more detailed version of the 2007 inter-county I-O table). Each column of the resultant matrix represented the total inputs supplied by each of the row industries to produce the total column sector's output in each county. If all inputs were supplied from industries within a particular county, the resultant table would serve as the inter-industry transactions table for a single region I-O model for that county. However, when industries purchase inputs not only from industries within the county, but also from those in other counties, the resultant inter-industry table needs to be adjusted. This adjustment was done during the second stage. Total input purchases from a particular row industry were allocated to that industry in each of the four counties. The allocation of industries' total commodity inputs to different counties was done based on waterborne commerce data and DOA data on arrival of agricultural produce to Honolulu from outer islands. The allocation of services was based on a judgment of the proportions of services supplied within the county and those supplied by other counties depending upon the types of industries. Inter-industry supplies of inputs from certain industries, such as construction, real estate and rentals, utilities, arts/entertainment, other services and government enterprises were assumed to be mostly local.

## Balancing Procedure

By definition, total output (sales) should equal total input (purchases) for each industry in each county. Because of the lack of information on inter-county inter-industry transactions, industries' sales (row totals) usually do not initially add up to their total purchases (column totals). Therefore, row and column elements of the transactions table need to be adjusted using a balancing procedure such that the row and the column corresponding to a particular industry add up to the same value. The inter-county model needs an additional adjustment such that relevant cells in the inter-county transactions table add up to the corresponding cell in the state I-O table.

One of the most popular techniques in balancing an I-O transactions table is the bi-proportional balancing procedure, which is also known as the RAS procedure. Traditionally, RAS is used to balance the direct requirements table. This study uses a modified tri-proportional RAS procedure to balance the inter-industry portion of the transactions table. None of the final demand and final payment sectors is changed in the balancing process.

Using equation (A.1), the control total for intermediate sales of sector  $i$  in region  $r$  ( $U_i^r$ ) is calculated as

$$U_i^r = \sum_{s=1}^l \sum_{j=1}^n Z_{ij}^{rs} = X_i^r - \sum_{s=1}^l \sum_{k=1}^m Y_{ik}^{rs} \quad (C.1)$$

and the control total for inter-industry input (including intermediate import ( $M_j^s$ )) for sector  $j$  in region  $s$  ( $V_j^s$ ) is calculated from equation (A.2) as

$$V_j^s = \sum_{r=1}^l \sum_{i=1}^n Z_{ji}^{sr} + M_j^s = X_j^s - \sum_{q=1}^p W_{qj}^s \quad (C.2)$$

where  $X_i^r$  is total sales or output for industry  $i$  in region  $r$ ,  $X_j^s$  is total purchases or input for industry  $j$  in region  $s$ ,  $Z_{ij}^{rs}$  is  $i$ th industry's inter-industry sales from row region  $r$  to the  $j$ th industry in column region  $s$ ;  $Y_{ik}^{rs}$  is  $i$ th industry's final sales from region  $r$  to the  $k$ th final demand sector in region  $s$ ;  $Z_{ji}^{sr}$  is inter-industry purchases by  $j$ th industry in region  $s$  from the  $i$ th industry in region  $r$ ;  $M_j^s$  is imports of  $s$ th region's industry  $j$  as intermediate input; and  $W_{qj}^s$  is  $j$ th industry's payments to the  $q$ th final payment sector in region  $s$

The import row for intermediate use is represented as follows:

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

where  $M$  is the control total for intermediate imports computed based on relations between the value added and expenditure sides of the GDP account (i.e. total final demand less total value added gives total imports for intermediate use).

Initially none of the last three conditions hold. Thus, entries in each row and column need to be adjusted so that each row and each column add up to their corresponding control totals. The fourth balancing condition is that, for consistency, the sum of  $j$ th industry's purchases from  $i$ th industry in all

regions should add up to  $j$ th industry's purchases from  $i$ th industry in the state I-O model. Mathematically it can be expressed as

$$\sum_{s=1}^l \sum_{r=1}^l Z_{ij}^{rs} = \sum_{r=1}^l \sum_{s=1}^l Z_{ji}^{sr} = Z_{ij} \quad (\text{C.4})$$

Although, necessary for the construction of an I-O model, the last four equations (equations C.1 – C.4) are unlikely to be met by initial estimates. Thus,  $Z_{ij}^{rs}$ s and  $M_j^s$  need to be adjusted until each of the four equations is satisfied simultaneously. The balancing procedure was implemented using specifically designed macros in Microsoft Excel.

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**APPENDIX TABLES**

**Table A-1. Output Shares by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Total output (\$ million)	10,469.3	78,567.4	4,821.1	11,993.7	105,851.5
Sector share (%)					
Agriculture	2.3	0.3	1.5	1.3	0.7
Mining and construction	13.2	9.0	9.0	10.2	9.5
Food processing	2.5	0.3	3.6	2.7	1.0
Other manufacturing	3.5	8.6	0.6	2.9	7.1
Transportation	2.9	5.8	3.6	3.2	5.1
Information	1.6	2.9	1.1	1.1	2.5
Utilities	3.9	2.0	3.8	3.3	2.4
Wholesale trade	2.5	3.3	1.5	1.7	2.9
Retail trade	9.3	5.4	10.7	11.3	6.7
Finance and insurance	2.7	5.5	2.5	2.0	4.7
Real estate and rentals	18.7	14.2	19.3	15.7	15.0
Professional services	3.0	4.3	4.0	2.5	4.0
Business services	3.2	3.7	3.8	4.1	3.7
Educational services	0.6	0.9	0.4	0.7	0.8
Health services	6.6	6.7	5.5	4.8	6.4
Arts and entertainment	1.2	0.7	1.2	1.6	0.9
Hotels	7.4	3.2	12.3	14.8	5.4
Eating and drinking	3.4	3.2	4.3	5.4	3.5
Other services	3.1	3.0	2.8	3.7	3.1
Government	8.4	17.0	8.5	6.8	14.6

**Table A-2. Earnings Shares by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Total earnings (\$ million)	3,674.7	31,020.6	1,714.3	4,038.3	40,447.9
Sector share (%)					
Agriculture	2.6	0.3	0.8	2.0	0.7
Mining and construction	12.8	7.6	10.0	11.0	8.5
Food processing	0.7	0.5	0.3	1.0	0.6
Other manufacturing	1.2	1.6	1.0	2.1	1.5
Transportation	3.1	4.1	3.8	3.4	3.9
Information	1.1	2.0	1.0	1.3	1.8
Utilities	1.3	0.6	1.3	1.1	0.8
Wholesale trade	2.9	3.1	1.0	2.3	2.9
Retail trade	8.6	5.6	8.5	9.1	6.4
Finance and insurance	1.9	3.6	2.3	1.6	3.2
Real estate and rentals	4.3	1.9	2.5	2.6	2.2
Professional services	4.0	6.8	2.2	3.5	6.0
Business services	3.9	5.8	6.9	6.3	5.7
Educational services	1.0	1.5	1.3	1.0	1.4
Health services	9.5	8.8	6.4	6.6	8.6
Arts and entertainment	2.0	0.9	3.7	3.1	1.3
Hotels	8.5	3.0	15.2	16.3	5.3
Eating and drinking	3.7	3.2	5.0	5.8	3.6
Other services	4.8	3.6	8.9	4.6	4.0
Government	22.1	35.6	17.9	15.5	31.6

**Table A-3. Value Added Shares by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Total value added (\$ million)	6,280.2	48,277.6	2,730.2	6,924.0	64,212.0
Sector share (%)					
Agriculture	2.4	0.2	1.4	1.6	0.6
Mining and construction	9.8	6.2	7.1	8.1	6.8
Food processing	0.4	0.3	0.2	0.6	0.4
Other manufacturing	1.2	1.6	0.4	0.9	1.4
Transportation	2.5	4.7	3.4	2.7	4.2
Information	1.9	2.9	1.3	1.3	2.5
Utilities	3.4	1.7	3.6	2.8	2.1
Wholesale trade	3.0	3.4	1.4	2.1	3.1
Retail trade	9.0	6.4	9.3	9.4	7.1
Finance and insurance	2.2	4.3	1.9	1.6	3.7
Real estate and rentals	23.3	16.6	20.9	21.6	18.0
Professional services	2.9	5.5	2.3	1.9	4.7
Business services	2.6	4.5	5.5	3.9	4.3
Educational services	0.7	1.1	0.6	0.7	1.0
Health services	5.5	6.3	4.3	4.6	5.9
Arts and entertainment	1.9	0.7	2.1	2.6	1.1
Hotels	8.3	3.2	16.1	16.6	5.7
Eating and drinking	2.7	2.7	4.2	4.5	3.0
Other services	3.0	2.5	2.3	3.1	2.6
Government	13.4	25.3	11.5	9.5	21.8

**Table A-4. Total Job Shares by Sector and by County, 2007**

	Hawaiï County	Honolulu County	Kauai County	Maui County	State total
Total jobs	101,034	620,365	43,830	102,641	867,871
Sector share (%)					
Agriculture	7.5	0.5	3.6	3.3	1.8
Mining and construction	8.8	5.4	6.8	7.0	6.0
Food processing	1.0	0.7	0.8	1.2	0.8
Other manufacturing	1.0	1.6	1.0	0.9	1.4
Transportation	2.9	4.2	3.9	3.7	4.0
Information	1.0	1.6	1.0	1.1	1.5
Utilities	0.5	0.3	0.6	0.5	0.4
Wholesale trade	2.3	2.8	1.6	1.9	2.6
Retail trade	11.7	9.7	11.9	11.7	10.3
Finance and insurance	2.0	3.6	2.2	1.8	3.1
Real estate and rentals	5.8	4.1	5.6	6.4	4.7
Professional services	4.2	5.7	3.7	4.0	5.2
Business services	5.7	7.6	9.2	8.0	7.5
Educational services	1.4	2.4	1.0	1.4	2.1
Health services	7.8	8.6	6.5	6.0	8.1
Arts and entertainment	2.9	2.1	5.3	4.6	2.6
Hotels	7.6	2.5	11.0	12.1	4.6
Eating and drinking	5.9	7.2	7.2	8.0	7.2
Other services	6.5	5.6	5.8	6.4	5.8
Government	13.4	23.8	11.3	10.1	20.3

**Table A-5. Personal Consumption Expenditures (PCE) Shares by Sector and by County, 2007**

	Hawaiï County	Honolulu County	Kauai County	Mauï County	State total
Total PCE (\$ million)	4,816.2	30,562.8	1,975.8	4,523.7	41,878.5
Sector share (%)					
Agriculture	0.22	0.16	0.06	0.13	0.16
Mining and construction	0.00	0.00	0.00	0.00	0.00
Food processing	0.21	0.38	0.00	0.01	0.30
Other manufacturing	1.22	3.44	0.01	0.02	2.65
Transportation	1.04	2.75	0.76	0.88	2.26
Information	1.61	2.53	0.60	0.93	2.16
Utilities	3.62	1.88	3.48	3.24	2.30
Wholesale trade	1.50	3.17	0.77	1.21	2.65
Retail trade	9.74	7.35	11.64	13.70	8.51
Finance and insurance	3.29	5.15	2.16	1.89	4.44
Real estate and rentals	25.44	19.69	28.53	22.67	21.09
Professional services	0.83	1.46	0.38	0.27	1.21
Business services	0.44	0.65	0.18	0.24	0.56
Educational services	0.53	1.64	0.11	0.67	1.34
Health services	13.33	15.80	11.40	11.41	14.83
Arts and entertainment	0.92	0.90	0.12	0.96	0.87
Hotels	0.12	0.19	0.02	0.84	0.24
Eating and drinking	2.27	4.18	1.11	3.27	3.72
Other services	2.80	4.45	2.55	3.63	4.08
Government	2.24	3.99	2.52	2.12	3.52
Imports -within state	11.61	2.30	17.54	14.87	5.45
Imports -out of state	17.03	17.93	16.07	17.03	17.64

**Table A-6. Visitor Expenditures (VE) Shares by Sector and by County, 2007**

	Hawaiï County	Honolulu County	Kauai County	Maui County	State total
Total VE (\$ million)	2,073.2	7,340.4	1,619.2	3,869.0	14,901.8
Sector share (%)					
Agriculture	0.07	0.05	0.02	0.01	0.04
Mining and construction	0.00	0.00	0.00	0.00	0.00
Food processing	0.12	0.20	0.00	0.01	0.12
Other manufacturing	0.08	0.30	0.00	0.01	0.16
Transportation	6.37	19.43	3.42	4.45	11.99
Information	0.11	0.11	0.11	0.12	0.11
Utilities	0.00	0.00	0.00	0.00	0.00
Wholesale trade	0.60	0.60	0.35	0.44	0.53
Retail trade	12.26	12.09	12.38	13.68	12.56
Finance and insurance	0.00	0.00	0.00	0.00	0.00
Real estate and rentals	8.95	8.89	8.18	8.59	8.74
Professional services	0.73	0.72	0.74	0.82	0.75
Business services	1.90	1.88	1.92	2.12	1.95
Educational services	0.83	0.82	0.84	0.93	0.85
Health services	0.88	0.87	0.89	0.98	0.90
Arts and entertainment	3.09	3.05	3.13	3.45	3.17
Hotels	33.04	32.61	33.39	36.88	33.86
Eating and drinking	9.48	9.36	9.58	10.58	9.72
Other services	0.78	0.77	0.79	0.87	0.80
Government	0.50	0.49	0.50	0.55	0.51
Imports -within state	13.61	1.05	17.21	9.06	6.63
Imports -out of state	6.61	6.72	6.53	6.44	6.61

**Table A-7. Total Intermediate Demand as a Percent of Total Output by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Agriculture	48.4	44.8	47.2	49.5	47.3
Mining and construction	7.4	10.6	19.9	17.8	11.4
Food processing	31.5	5.4	35.4	26.7	23.7
Other manufacturing	40.6	64.1	57.9	23.9	61.0
Transportation	16.6	20.7	18.4	19.9	20.3
Information	48.0	48.2	73.8	62.2	49.4
Utilities	54.2	46.8	44.9	44.7	47.5
Wholesale trade	40.6	43.5	39.2	31.8	42.4
Retail trade	13.2	16.6	7.4	8.5	13.9
Finance and insurance	32.2	43.5	41.2	40.0	42.6
Real estate and rentals	26.6	35.2	23.9	24.5	32.2
Professional services	62.2	52.2	80.3	80.6	56.2
Business services	81.5	84.5	74.2	78.0	83.0
Educational services	12.5	14.7	12.3	13.7	14.4
Health services	1.8	1.1	6.4	1.1	1.4
Arts and entertainment	3.4	6.2	5.0	1.7	4.8
Hotels	4.6	1.8	2.6	6.4	3.7
Eating and drinking	11.1	18.6	10.7	9.9	15.9
Other services	51.3	32.3	46.7	48.4	37.0
Government	20.7	6.1	17.2	8.7	7.4

**Table A-8. Total Intermediate Input as a Percent of Total Output by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Agriculture	26.9	42.7	30.5	21.6	31.4
Mining and construction	36.7	39.8	37.1	37.7	39.0
Food processing	62.1	30.1	67.3	60.4	53.9
Other manufacturing	48.5	18.9	28.1	52.4	22.0
Transportation	33.1	38.8	31.3	33.9	37.9
Information	22.8	22.8	35.5	26.4	23.2
Utilities	35.7	34.9	34.0	37.5	35.4
Wholesale trade	19.6	24.2	32.6	19.5	23.7
Retail trade	31.2	28.2	22.1	19.2	26.5
Finance and insurance	38.6	43.0	40.9	39.4	42.5
Real estate and rentals	12.8	29.0	21.0	16.2	25.1
Professional services	35.0	18.4	55.1	45.9	23.3
Business services	41.5	23.3	14.4	37.7	26.2
Educational services	29.0	23.6	12.5	38.3	25.2
Health services	37.9	31.8	44.9	33.0	33.1
Arts and entertainment	6.5	34.9	4.9	7.2	23.9
Hotels	28.6	20.8	22.9	47.7	30.5
Eating and drinking	37.5	35.4	31.8	38.1	35.9
Other services	29.7	36.6	38.4	37.3	36.1
Government	14.2	5.9	11.5	11.5	6.8

**Table A-9. Total Labor Income as a Percent of Total Output by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Agriculture	38.4	39.4	19.1	50.2	39.4
Mining and construction	33.9	33.3	39.6	36.3	34.0
Food processing	10.3	54.7	3.1	12.8	21.7
Other manufacturing	11.8	7.1	65.0	24.1	8.3
Transportation	37.4	28.0	37.7	35.7	29.4
Information	24.5	27.6	31.1	39.8	28.1
Utilities	11.9	12.2	12.4	11.4	12.1
Wholesale trade	41.3	37.6	22.3	44.7	38.0
Retail trade	32.5	41.3	28.1	27.1	36.4
Finance and insurance	24.8	25.9	32.3	26.5	26.0
Real estate and rentals	8.1	5.2	4.6	5.6	5.6
Professional services	46.4	62.1	19.7	47.4	58.0
Business services	43.3	60.9	65.1	51.2	58.4
Educational services	61.3	66.0	117.7	48.2	65.0
Health services	50.7	52.4	41.6	45.6	51.2
Arts and entertainment	57.5	45.1	109.9	64.3	54.5
Hotels	40.3	36.2	43.9	37.0	37.8
Eating and drinking	38.5	39.1	41.6	35.9	38.6
Other services	53.7	47.4	112.1	41.2	49.9
Government	92.5	82.9	74.7	76.7	82.9

**Table A-10. Total Value Added as a Percent of Total Output by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Agriculture	60.9	38.7	53.8	68.8	54.5
Mining and construction	44.3	42.6	44.9	45.4	43.3
Food processing	10.6	57.3	3.2	12.9	22.5
Other manufacturing	19.9	11.2	44.8	18.2	12.1
Transportation	52.1	50.3	52.8	48.8	50.4
Information	71.7	61.1	69.8	68.0	62.3
Utilities	52.1	52.8	53.6	49.4	52.2
Wholesale trade	72.3	64.2	52.9	72.4	65.2
Retail trade	58.2	72.9	49.3	47.9	64.4
Finance and insurance	48.3	48.3	41.6	44.8	48.0
Real estate and rentals	74.9	72.0	61.4	79.5	72.6
Professional services	57.0	78.0	33.4	43.5	72.0
Business services	50.2	73.4	82.1	54.0	69.4
Educational services	69.0	73.3	88.3	58.2	71.8
Health services	50.6	57.9	44.8	55.1	56.4
Arts and entertainment	93.7	55.8	97.5	92.4	70.5
Hotels	67.1	60.5	73.9	64.9	64.2
Eating and drinking	47.9	51.4	55.8	47.2	50.6
Other services	57.1	51.5	46.7	48.8	51.5
Government	95.7	91.6	76.4	80.5	90.8

**Table A-11. Total Jobs Per \$Million of Total Output by Sector and by County, 2007**

	Hawaii County	Honolulu County	Kauai County	Maui County	State total
Agriculture	30.9	14.2	21.8	21.2	22.2
Mining and construction	6.4	4.7	6.9	5.8	5.2
Food processing	4.0	15.1	2.0	3.7	6.5
Other manufacturing	2.6	1.5	15.8	2.6	1.6
Transportation	9.6	5.7	9.8	9.7	6.4
Information	6.0	4.5	8.2	8.5	4.8
Utilities	1.2	1.3	1.4	1.3	1.3
Wholesale trade	9.0	6.8	9.5	9.5	7.2
Retail trade	12.1	14.2	10.1	8.9	12.6
Finance and insurance	7.1	5.2	7.9	7.7	5.5
Real estate and rentals	3.0	2.3	2.6	3.5	2.5
Professional services	13.2	10.3	8.6	14.0	10.7
Business services	17.5	16.1	22.1	16.6	16.6
Educational services	23.4	20.8	24.4	16.8	20.7
Health services	11.5	10.2	10.7	10.6	10.4
Arts and entertainment	23.8	21.9	39.7	24.3	23.7
Hotels	9.9	6.0	8.1	7.0	7.1
Eating and drinking	17.0	17.6	15.3	12.6	16.5
Other services	20.1	15.0	18.8	14.8	15.7
Government	15.4	11.1	12.1	12.7	11.4