

## **Chapter 2**

### **The 2007 Washington Input-Output Table: Methodology and Data**

The 2007 Washington Input-Output (I-O) Study was based on a combination of data sources. The first step involved defining the sectors to be used in model development. The second step was development of a survey of establishments; the survey was conducted under contract from OFM by the Washington State Department of Employment Security. Simultaneously, output, value added, and employment were estimated for each sector. Also estimated were personal consumption expenditures, private investment, and government expenditures. Data sources for the estimation are: the 2007 Economic Census, the Bureau of Economic Analysis state employment, income, and gross domestic product by state data series, and other miscellaneous reports from trade associations and government.

The benchmark 2007 U.S. Input-Output Table was not available at the time the 2007 Washington input-output model was estimated. The 2002 Washington input-output table utilized an aggregated version of the 2002 U.S. benchmark input-output table as a part of the process of estimating the interindustry transactions matrix. Therefore, in the development of the current model, we utilized the bioproportional matrix adjustment technique to develop an initial interindustry transactions matrix. Careful analyses of sales and purchases distributions obtained from the survey were undertaken, comparing the survey-based distributions with the benchmark 2002 national input-output model, U.S. Bureau of Economic Analysis (BEA) estimates, and with prior Washington State Input-Output Models.

#### **Step 1: Define target-year industrial sectors**

Over time, new industries evolve or old industries decline in the state economy. Furthermore, existing establishments may change their production processes to adapt to new technologies or to shifting markets. These changes required re-definition of industrial sectors in the new I-O table, because in the I-O concept every industrial sector is assumed to be homogeneous, meaning all establishments in the sector have a similar production process or input/purchasing pattern. Empirically, limitations in data availability may force adoption of more aggregate industrial sectors. After all these considerations the sectoring plan for the 2007 table was defined, as shown in Table 2-1. In the 2007 table, we disaggregated two of the sectors in the 2002 table into more detailed sectors. Construction was divided into Highway, Street and Bridge Construction, and all other Construction. Retail trade was divided into non-store retailers, and all other retail trade.

#### **Step 2: Survey of Industrial sectors**

A sampling plan was developed jointly by OFM, the Washington State Department of Revenue, the Employment Security Department, and other members of the study team. The Employment Security Department distributed questionnaires to 6,010 establishments, and obtained 2,531 valid responses, a response rate of 42.1%. The gross business volume of this sample was \$269.1 billion, or 54.2% of the recorded gross business income (GBI) of all establishments in Washington state in 2007. Coverage was good in about 40 of the

50 sectors in the I-O model. The cover letter and questionnaire used for this study are available at the links below.

[Washington I-O Study cover letter](#)  
[Washington I-O Study questionnaire](#)

**Table 2-1  
2007 Washington Input-Output Study  
Sectoring Plan**

| <b>Industry Name</b>   | <b>NAICS Code</b>                            |
|--|--|
| 1. Crop Production   | 111  |
| 2. Animal Production   | 112  |
| 3. Forestry and Logging  | 113 (Incl. state forests, etc.)              |
| 4. Fishing, Hunting, and Trapping  | 114  |
| 5. Mining  | 21   |
| 6. Electric Utilities  | 2211 (Incl. public, BPA, etc.)               |
| 7. Gas Utilities   | 2212 (Incl. public)                          |
| 8. Other Utilities   | 2213 (Incl. public)                          |
| 9. Highway, Street and Bridge Construction                               | 2373   |
| 10. Other Construction   | 236-238 except 2373                          |
| 11. Food, Beverage and Tobacco Manufacturing                             | 311, 312                                     |
| 12. Textiles and Apparel Mills   | 313, 314, 315                                |
| 13. Wood Product Manufacturing   | 321  |
| 14. Paper Manufacturing  | 322  |
| 15. Printing and Related Activities                                      | 323  |
| 16. Petroleum and Coal Products Manufacturing                            | 324  |
| 17. Chemical Manufacturing   | 325  |
| 18. Nonmetallic Mineral Products Manufacturing                           | 327  |
| 19. Primary Metal Manufacturing  | 331  |
| 20. Fabricated Metals Manufacturing                                      | 332  |
| 21. Machinery Manufacturing  | 333  |
| 22. Computer and Electronic Product Manufacturing                        | 334  |
| 23. Electrical Equipment Manufacturing                                   | 335  |
| 24. Aircraft and Parts Manufacturing                                     | 3364   |
| 25. Ship and Boat Building   | 3366 (Incl. federal/PSNS)                    |
| 26. Other Transportation Equipment Manufacturing                         | 3361, 3362, 3363, 3365, 3369                 |
| 27. Furniture Product Manufacturing                                      | 337  |
| 28. Other Manufacturing  | 316, 326, 339                                |
| 29. Wholesale  | 423-425                                      |
| 30. Non-Store Retail   | 454  |
| 31. Retail   | 44-45 except 454 (Incl. state liquor stores) |
| 32. Air Transportation   | 481  |
| 33. Water Transportation   | 483 (Incl. Ferry)                            |
| 34. Truck Transportation   | 484  |
| 35. Other Transportation/Postal Offices                                  | 482, 485, 486, 487, 491, 492 (Incl. transit) |
| 36. Support Activities for Storage, Transportation and Warehousing       | 488, 493 (Incl. public ports)                |
| 37. Software Publishers & Data Processing, Hosting, and Related Services | 5112, 5182                                   |
| 38. Telecommunications   | 517  |

**Table 2-1 (Continued)**  
**2007 Washington Input-Output Study**  
**Sectoring Plan**

| <b>Industry Name</b>   | <b>NAICS Code</b>                |
|--|----------------------------------|
| 39. Other Information  | 5111, 512, 515, 516, 519         |
| 40. Credit Intermediation and Related Activities               | 521, 522                         |
| 41. Other Finance and Insurance                                | 523, 524, 525                    |
| 42. Real Estate and Rental and Leasing                         | 53                               |
| 43. Legal /Accounting and Bookkeeping / Management Services    | 5411, 5412, 5416, 5418, 5419, 55 |
| 44. Architectural, Engineering, and Computing Services         | 5413, 5414, 5415, 5417           |
| 45. Educational Services                                       | 61                               |
| 46. Ambulatory Health Care Services                            | 621                              |
| 47. Hospitals  | 622                              |
| 48. Nursing and Residential Care Facilities, Social Assistance | 623, 624                         |
| 49. Arts, Recreation, and Accommodation                        | 71, 721                          |
| 50. Food Services and Drinking Places                          | 722                              |
| 51. Administrative/Employment Support Services                 | 561                              |
| 52. Waste Management/Others, and Agriculture Services          | 562, 81, 115                     |

**Step 3: Compile the target-year data and information on Washington industries**

Data on 2007 industrial output, value-added, government expenditures, consumption by Washington residents, capital (investment) spending, and external trade (exports and imports) were compiled. Sometimes industrial details can only be derived through inferring, interpolating or extrapolating from available, but more aggregate estimates. Table 2-2 shows the data categories and the respective data sources.

**Step 4: Analysis of survey results**

In the development of the 2007 Washington Input-Output survey, it was decided that establishments participating in the survey would not be asked to provide detailed interindustry sales and purchases estimates, but rather total interindustry sales and purchases made in Washington state. Data from the survey were analyzed, sector by sector.

Distributions of sales and purchases proportions for each sector were calculated, and compared to the 1997 and 2002 Washington Input-Output tables. In many cases the survey yielded reasonable estimates of these distributions. However, there were some sectors with very few respondents, and in which the patterns of sales and purchases were not consistent with other data sources. In some instances it was necessary to “triangulate” sales and purchases distributions based on prior or alternative estimates, and judgments.

**Table 2-2  
Input Data for the Target Year (2007)**

| <b>Data Categories</b>            | <b>Data Sources</b>   |
|-----------------------------------|---|
| Industrial Output                 | 2007 Economic Census – Industrial Shipment \$<br>Washington State Dept. of Agriculture – annual agricultural production by crop type<br>Washington Dept. of Revenue – Gross Business Income database<br>Bureau of Economic Analysis – 2002 U.S. Input-Output (Use) Table<br>Washington Insurance Commissioner – Revenue and margins of insurance businesses |
| Value Added                       | Bureau of Economic Analysis – Gross State Product<br>Bureau of Economic Analysis – labor earnings series<br>Washington Employment Security Department – ES202 Wage and Salary series  |
| Personal Consumption Expenditures | Bureau of Economic Analysis – National Income and Product Accounts<br>Bureau of Economic Analysis – State personal income Series<br>Bureau of Labor Statistics – 2007 Consumer Expenditure Survey   |
| Government Spending               | Census Bureau -- State and Local Government Expenditures series<br>Census Bureau -- Federal Government Expenditures reports<br>Washington Office of Financial Management – State government expenditures accounting records   |
| Investment                        | Bureau of Economic Analysis – National Income and Product Accounts<br>Census Bureau - Building Permit report<br>Washington Dept. of Revenue – taxable sales database<br>Bureau of Economic Analysis – 2007 Annual U.S. Input- Output (Use) Table  |
| Exports and Imports               | The World Institute for Strategic Economic Research (WISER) export database<br>Census Bureau – The 2007 Commodity Flow Survey<br>Washington Department of Commerce – studies of the impact of foreign exports and imports on the state economy  |

**Step 5: Development of new transactions table**

The survey provided sales estimates by Washington industries, as well as estimates of purchases by Washington industries. The survey instrument provided a much clearer definition of sales by Washington industries on intermediate account than was the case for purchases. The purchases questions asked recipients to distinguish between purchases made from wholesalers and retailers, as well as from manufacturers and other service industries. National data on trade and transportation margins were used to reduce reported purchases from wholesalers and retailers to the margin value, and it was presumed to most sales made by these businesses were of goods imported to Washington state. The purchases survey did not ask respondents to estimate their value added. Purchases percentage distributions from the survey were adjusted downward, given the estimates of value added developed for each sector. Even after these adjustments, the purchases survey resulted in a higher estimate of regional purchases than the sales survey. Good alternative estimates of imports from the rest of the US or from foreign sources were not available. Comparisons of these import propensities were made with the 1997 and 2002 Washington input-output models. The result of this initial process of developing a new transactions table was estimation of total intermediate sales and purchases by sector, with the sales and purchases levels summing to the same total.

The intermediate sales and purchases totals were used with the 2002 transactions matrix to develop an estimated 2007 transactions matrix through the use of the biproportional method of matrix adjustment. This is an interactive process, in which row and column distributions are estimated repeatedly, until the row and column sums converge to the desired totals. Weights are developed in each iteration of the procedure. Initially, ratios of actual versus desired row sums by sector are calculated, and the row values are multiplied by these weights to force rows to total the desired value. This resulting matrix is then used as input to the adjustment of column values, with column sums compared to desired totals, and weights calculated that force column sums to the desired total. Then the process is repeated, adjusting row values with the matrix just described. This procedure of row and column adjustment proceeds until the difference between the row and column sums approaches zero. In the current modeling process, this iterative procedure was undertaken 12 times for both rows and columns.

It was necessary to introduce initial values into the beginning matrix for the two sectors included in this model, which were not specified in the 2002 model.

The initial regional transactions matrix underwent a number of adjustments. For example, the Washington State ferry system was included in the water transportation sector, but it did not participate in the survey. The Bremerton Naval Yard was also included in shipbuilding, but was not surveyed. Data were introduced into the transactions matrix for cases of this type, with their most likely markets and sources of supply defined. After these adjustments were made, comparisons were made with the 2002 and 1997 Washington transactions matrices to identify cases needing further evaluation and adjustment. The resulting matrix of interindustry transactions has a slightly higher estimated regional purchases as a share of sales (25.2%) than the 2002 Washington input-output model (24.3%). However, the share of intermediate purchases closely tracks the history of Washington State Input-Output Models.

**Intermediate Purchases as a Share of Washington Total Industrial Input  
1963-2007**

