Estimating Use Tables

Introduction plus Benchmark and Annual Process

Gabriel Medeiros

International Workshop on Supply and Use Tables

Beijing, Sept 11-13
• Process is guided by the availability of data
  – Benchmark (every five years)
  – Annual
  – Quarterly
Benchmark Sources

Core Data source: Economic Census
- Measures almost the whole universe of establishments with 5 or more employees

Supplemented with data from:
- Business Expense Survey (BES)
- Economic Research Service (ERS)
- Bureau of Transportation Statistics (BTS)
- Census of governments.

Non-employer establishments data supplemented with administrative data.
### Census Sources

Table 1a. Major Sources of Receipts From Customers for Firms Subject to Federal Income Tax for the United States: 1997—Con.

<table>
<thead>
<tr>
<th>NAICS code and RL code</th>
<th>Kind of business and sources of receipts</th>
<th>Establishments (number)</th>
<th>Receipts ($1,000)</th>
<th>Receipts from specified receipt lines as percent of total receipts</th>
<th>Receipts of establishments reporting sources of receipts as percent of total receipts</th>
</tr>
</thead>
<tbody>
<tr>
<td>541219</td>
<td>Other accounting services</td>
<td>28 322</td>
<td>6218 829</td>
<td>100.0</td>
<td>59.3</td>
</tr>
<tr>
<td>541211</td>
<td>Public relations services</td>
<td>15</td>
<td>1 002</td>
<td>29.8</td>
<td>8.4</td>
</tr>
<tr>
<td>541211</td>
<td>Custom computer programming and support services</td>
<td>304</td>
<td>3 156</td>
<td>322.6</td>
<td>33.6</td>
</tr>
<tr>
<td>541211</td>
<td>Computer systems specification and design services</td>
<td>47</td>
<td>2 353</td>
<td>353.6</td>
<td>46.7</td>
</tr>
<tr>
<td>541211</td>
<td>Other computer services, except programming, systems design, and computer facilities management</td>
<td>390</td>
<td>14 584</td>
<td>3673.6</td>
<td>42.2</td>
</tr>
<tr>
<td>541211</td>
<td>Data processing services</td>
<td>248</td>
<td>19 971</td>
<td>80.6</td>
<td>10.2</td>
</tr>
<tr>
<td>541211</td>
<td>Social sciences and humanities research and development</td>
<td>12</td>
<td>3 116</td>
<td>16.0</td>
<td>19.0</td>
</tr>
<tr>
<td>541211</td>
<td>Accounting and auditing services</td>
<td>7 677</td>
<td>995 572</td>
<td>15.0</td>
<td>16.0</td>
</tr>
<tr>
<td>541213</td>
<td>Tax return preparation services</td>
<td>28 004</td>
<td>622 473</td>
<td>90.6</td>
<td>46.2</td>
</tr>
<tr>
<td>541213</td>
<td>Bookkeeping, billing, and payroll services</td>
<td>14 171</td>
<td>603 353</td>
<td>10.2</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Output Total: 3899.1
Other Census Bureau programs:
  - Annual Surveys; examples:
    - Annual Retail Trade Survey (ARTS)
    - Annual Wholesale Trade Survey (AWTS)
    - Service Annual Survey (SAS)
    - Annual Survey of Manufactures (ASM)
    - Annual Survey of Government Finances (ASGF)
  - Value of Construction Put-in-Place (VPIP)
  - Business R&D and Innovation Survey (BRDIS)
  - Special Tabulations

Non Census Bureau programs:
  - ERS, BTS
US Methodology – Computing Supply Tables

Make
• Excludes imports, net taxes, margin columns
• Valued either in basic or producer prices

Use
• Relies on make table accounting identities
• Valued either in basic, producer or purchaser prices

Supply
• Missing Link: Margins
Production Flow: Annual Tables

1. **Prepare Make**
   - Make Tables
     - Extrapolate/Interpolate
     - Load Output
     - Mfg Make Balancing
     - New Make Table

2. **Prepare Use**
   - Use Table
     - Scale Use(pur) Table
     - Allocate Margins and taxes
     - Balancing Controls
     - New Use Table

3. **Prepare Input Controls**
   - Prepare added and final use controls
   - Estimate product margin and taxes
   - Summarize industry and product output
   - Initial Values
   - Balancing Controls
   - New Use Table
Production Flow: Annual Tables

- Make Tables
- Extrapolate/Interpolate
- Load Output
- Mfg Make Balancing
- New Make Table
## Production Flow: Estimating Make Tables

### Make Table

#### Internal structure of MFG Make arrived at through balancing

#### Internal structure elsewhere loaded, extrapolated, interpolated

<table>
<thead>
<tr>
<th>Industries</th>
<th>Agriculture, forestry, fishing, and hunting</th>
<th>Mining</th>
<th>Utilities</th>
<th>Construction</th>
<th>Manufacturing</th>
<th>Wholesale Trade</th>
<th>Retail Trade</th>
<th>Transportation and Warehousing</th>
<th>Information</th>
<th>Finance, insurance, real estate, rental, and leasing</th>
<th>Professional and business services</th>
<th>Educational services, healthcare, and social assistance</th>
<th>Arts, entertainment, recreation, accommodation, and food services</th>
<th>Other services, except government</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMMODITIES</td>
<td>Agriculture, forestry, fishing, and hunting</td>
<td>Mining</td>
<td>Utilities</td>
<td>Construction</td>
<td>Manufacturing</td>
<td>Wholesale Trade</td>
<td>Retail Trade</td>
<td>Transportation and Warehousing</td>
<td>Information</td>
<td>Finance, insurance, real estate, rental, and leasing</td>
<td>Professional and business services</td>
<td>Educational services, healthcare, and social assistance</td>
<td>Arts, entertainment, recreation, accommodation, and food services</td>
<td>Other services, except government</td>
<td>Government</td>
</tr>
<tr>
<td>Total Industry Output</td>
<td>Agriculture, forestry, fishing, and hunting</td>
<td>Mining</td>
<td>Utilities</td>
<td>Construction</td>
<td>Manufacturing</td>
<td>Wholesale Trade</td>
<td>Retail Trade</td>
<td>Transportation and Warehousing</td>
<td>Information</td>
<td>Finance, insurance, real estate, rental, and leasing</td>
<td>Professional and business services</td>
<td>Educational services, healthcare, and social assistance</td>
<td>Arts, entertainment, recreation, accommodation, and food services</td>
<td>Other services, except government</td>
<td>Government</td>
</tr>
</tbody>
</table>
Production Flow: Annual

Prepare Make

Make Tables ➔ Extrapolate Output ➔ Load Output ➔ Mfg Make Balancing ➔ New Make Table ➔ Prepare added and final use controls ➔ Estimate product margin and taxes ➔ Summarize industry and product output

Prepare Use
## Sample Level of Detail for Retail Margin Controls

<table>
<thead>
<tr>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>New autos--PCE</td>
</tr>
<tr>
<td>New trucks--PCE</td>
</tr>
<tr>
<td>Used autos</td>
</tr>
<tr>
<td>Used trucks and vans</td>
</tr>
<tr>
<td>New autos-PDE</td>
</tr>
<tr>
<td>New trucks--PDE</td>
</tr>
<tr>
<td>Mobile homes</td>
</tr>
<tr>
<td>Recreational vehicles, parts, and trailers</td>
</tr>
<tr>
<td>Furniture and fixtures</td>
</tr>
<tr>
<td>Major kitchen &amp; household appliances</td>
</tr>
<tr>
<td>China, giftware, glassware, tableware, utensils, and decorative home furnishings</td>
</tr>
<tr>
<td>Floor coverings</td>
</tr>
<tr>
<td>Telephones and other durable house furnishings, n.e.c.</td>
</tr>
<tr>
<td>Office equipment and writing equipment (excl computer equipment)</td>
</tr>
<tr>
<td>Ophthalmic products and orthopedic appliances</td>
</tr>
</tbody>
</table>
Production Flow: Annual

Make Tables → Extrapolate/Interpolate → Load Output → Mfg Make Balancing → New Make Table

Prepare added value and final use controls → Estimate product margin and taxes → Summarize industry and product output

Prepare Input Controls

Scale Use(pur) Table → Allocate Margins and taxes → Initial Values

Prepare Use
Example: Scaling Use table to Expense Controls

<table>
<thead>
<tr>
<th>Commodities</th>
<th>Industries</th>
<th>Final Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td>95, 95, 50</td>
<td>50</td>
</tr>
<tr>
<td>Basic</td>
<td>875, 800, 500</td>
<td>600</td>
</tr>
<tr>
<td>Value Added</td>
<td>415, 1,300</td>
<td></td>
</tr>
</tbody>
</table>

- Scale to expense controls
  - Expense controls span multiple commodities, and often span multiple industries
  - Expense controls are valued at purchaser prices, and margin cells are scaled jointly with underlying basic value cells to match the controls
  - Source data for intermediate input controls largely based on data from the U.S. Census Bureau.
Prior to scaling use table records to expense controls, use table records were first adjusted as follows:

• Impute a real growth based on the real growth of output for the purchasing industry.
• price growth based on the average price growth of the given commodity/product.

\[ p_t q_t = p_{t-1} q_{t-1} \cdot \Delta q_{GO} \cdot \Delta p \]

This step in the process was abandoned because resulting real value and input-output coefficients were not noticeably different without it.
Example: Allocation of margins and taxes

Purchaser Price Matrix

- Basic Price* Matrix
- Air, Rail, Truck, Water, and Pipe Transportation
- Taxes on Products
- Wholesale Markup
- Retail Markup
Valuation Concepts

Basic Price
- Total amount retained by the producer

Producer Price
- Total amount collected by producer
  - +Taxes less Subsidies

Purchaser Price
- Total amount paid by the purchaser
  - +Margins
Production Flow: Annual Tables

Prepare Make

- Make Table
  - Extrapolate/Interpolate
  - Load Output
  - Mfg Make Balancing
  - New Make Table

Prepare Use

- Use Table
  - Prepare Input Controls
    - Scale Use(pur) Table
    - Allocate Margins and taxes
    - Balancing Controls
      - Initial Values
      - Balancing
  - Prepare value added and final use controls
  - Estimate product margin and taxes
  - Summarize industry and product output
  - New Use Table
### Example: Balancing Controls

#### Prepare balancing controls

- **Total value for transportation, trade margin, and taxes** drawn from the make matrix in the supply table.

- **Total distributed to commodities (or commodity groups)** using various data sources:
  - Air and Water – Ton miles with a “handling multiplier” adjustment from the U.S. Census Commodity Flow Survey.
  - Rail – Revenue by commodity group from the American Association of Railroads Freight Commodity Statistics.
  - Truck – Revenue by commodity group from the U.S. Census' Survey of Annual Services.
  - Pipe – Revenue by commodity from U.S. Census product line detail.
  - Wholesale – Margin output available by type of wholesaler.
  - Retail – Data on nominal sales by product line available from the U.S. Census Bureau Economic Census.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Industries</th>
<th>Final Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td>108</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>Basic</td>
<td>992</td>
<td>903</td>
</tr>
<tr>
<td></td>
<td>462</td>
<td>282</td>
</tr>
<tr>
<td></td>
<td>1,037</td>
<td>994</td>
</tr>
<tr>
<td>Value Added</td>
<td>415</td>
<td>1,300</td>
</tr>
<tr>
<td>control</td>
<td>2,390</td>
<td>4,500</td>
</tr>
</tbody>
</table>
BEA Balancing Algorithm

• Iterative process where values are altered to match sets of constraints

• Multi-dimensional (not simply row/column)

• Allows for two ways of meeting constraints
  – Proportional Scaling
  – Distributive Scaling
Example: Balancing

- Balance using modified RAS balancing technique
  - Scale to industry/final demand controls using standard scaling
  - Scale to value added and basic value commodity controls using standard scaling
  - Scale to margin controls using proportional allocation based on underlying basic value matrix
  - Underlying assumption: All purchasers of a product pay the same margin rates and markups
  - Repeat until table is fully balanced

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Industries</th>
<th>Final Demand</th>
<th>Sum Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Margin</strong></td>
<td>86</td>
<td>130</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>49</td>
<td>50</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td><strong>Basic</strong></td>
<td>763</td>
<td>1,152</td>
<td>484</td>
</tr>
<tr>
<td></td>
<td>438</td>
<td>444</td>
<td>717</td>
</tr>
<tr>
<td></td>
<td>750</td>
<td>1,194</td>
<td>456</td>
</tr>
<tr>
<td><strong>Value Added</strong></td>
<td>380</td>
<td>1,500</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sum Control</th>
<th>2,800</th>
<th>4,800</th>
<th>1,800</th>
</tr>
</thead>
</table>
Redefinitions

<table>
<thead>
<tr>
<th></th>
<th>Industry X Primary</th>
<th>Industry X Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input A</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>Input B</td>
<td>50</td>
<td>3</td>
</tr>
<tr>
<td>Input C</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>Value Added</td>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>OUTPUT</td>
<td>280</td>
<td>11</td>
</tr>
</tbody>
</table>
Changes are mostly cosmetic. The framework outlined above already converts between purchaser prices and producer prices. What remains to convert Use table to basic prices is

• Allocating import matrix
• Allocating duties matrix
• Allocating subsidies matrix
Estimating Supply-Use Tables

Producer Price Matrix

- Basic Price*
- Taxes on Products
Production Flow: Benchmark Tables

Prepare Make
- Load Output
- Mfg Make Balancing
- New Make Table

Initialize Use
- Prepare Final Table with Layers
- Allocate Margins and taxes
- Initialize Use Table
- Basic Price Data
- Purchaser Price Data
- Determine Structure

Reconcile and Finish Use
- Expenditure-based GPD, NIPAs
- Prepare Income Approach by Industry
- Manually Reconcile final Uses
- Reconcile Data Using Linear Optimization
- Initial Values
- Balancing Controls
- Balancing
- New Use Table
Production Flow: Benchmark Tables

Prepare Make
- Load Output
- Mfg Make Balancing
- New Make Table

Initialize Use
- Prepare final uses based on SUTs
- Initialize Use Table
- Allocate Margins and taxes
- Reconcile Data Using Linear Optimization
- Initial Values
- Balancing Controls
- Balance

Reconcile and Finish Use
- Expenditure-based GPD, NIPAs
- Prepare Income Approach by Industry
- Manually Reconcile final Uses
- Initial Use Table with Layers
- Basic Price Data
- Purchaser Price Data
- Determine Structure
- New Use Table
### Creating Benchmark PCE transactions

#### Commodity Flow Fixed Supply Transactions

<table>
<thead>
<tr>
<th>itmCode</th>
<th>itmDescr</th>
<th>BasicVal</th>
<th>ComTax</th>
<th>M (Imports)</th>
<th>X (Exports)</th>
<th>I (Inventory Change)</th>
<th>DS (Domestic Supply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31182M3118214</td>
<td>Cookies, wafers, and ice cream cones and cups (except frozen)</td>
<td>5455</td>
<td>0</td>
<td>100</td>
<td>-100</td>
<td>0</td>
<td>5455</td>
</tr>
</tbody>
</table>

#### Use and Consumption ($mm)

<table>
<thead>
<tr>
<th>indCode</th>
<th>indDescr</th>
<th>itmCode</th>
<th>itmDescr</th>
<th>TransType</th>
<th>DS (Domestic Supply)</th>
<th>II</th>
<th>PCE</th>
<th>PFI (Incl. Inv.)</th>
<th>Gov.</th>
<th>Net Exports (X-M)</th>
<th>UNALLOCATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBAK00</td>
<td>Bakery products</td>
<td>31182M3118214</td>
<td>Cookies, wafers, and ice cream cones and cups (except frozen)</td>
<td>PCE CFS (Commodity Flow of Supply) rate 95% or 0.95.</td>
<td>5455</td>
<td>400</td>
<td>5182</td>
<td>0</td>
<td>145</td>
<td>0</td>
<td>-272</td>
</tr>
</tbody>
</table>
## Final Use Category Transaction Details

<table>
<thead>
<tr>
<th>indCode</th>
<th>itmCode</th>
<th>itmDesc</th>
<th>bas</th>
<th>ctx</th>
<th>Transp. Costs</th>
<th>Wholesale Margin</th>
<th>Wholesale Excise (owt)</th>
<th>Retail Margin</th>
<th>Retail Excise (ort)</th>
<th>TransType/ rule Code</th>
<th>cfPer</th>
<th>PurVal</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBAK00</td>
<td>31181M3118121</td>
<td>Bread (white, wheat, rye, etc.), including frozen</td>
<td>12202.0</td>
<td>0.0</td>
<td>291.5</td>
<td>2084.9</td>
<td>0.0</td>
<td>5949.6</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>20527.9</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31181M3118125</td>
<td>Rolls (bread-type), muffins, bagels, and croissants</td>
<td>8039.6</td>
<td>0.0</td>
<td>192.0</td>
<td>1373.7</td>
<td>0.0</td>
<td>3920.1</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>13525.3</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31181M311813T</td>
<td>Frozen cakes, pies and other pastries</td>
<td>4804.9</td>
<td>0.0</td>
<td>114.8</td>
<td>821.0</td>
<td>0.0</td>
<td>2342.9</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>8083.5</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31182M3118214</td>
<td>Cookies, wafers, and ice cream cones and cups (except frozen)</td>
<td>4910.0</td>
<td>0.0</td>
<td>120.1</td>
<td>820.7</td>
<td>0.0</td>
<td>2344.1</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>8194.8</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31181M3118127</td>
<td>Soft cakes, except frozen</td>
<td>3201.2</td>
<td>0.0</td>
<td>76.5</td>
<td>547.0</td>
<td>0.0</td>
<td>1560.9</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>5385.6</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31181M311812D</td>
<td>Other sweet goods, except frozen</td>
<td>3024.7</td>
<td>0.0</td>
<td>72.3</td>
<td>516.8</td>
<td>0.0</td>
<td>1474.8</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>5088.6</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31182M3118212X</td>
<td>Saltine crackers &amp; all other crackers, biscuits, &amp; related products and nsk</td>
<td>2747.1</td>
<td>0.0</td>
<td>68.7</td>
<td>469.4</td>
<td>0.0</td>
<td>1340.7</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>4625.9</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31181M311812W</td>
<td>Commercial bakeries, nsk, total</td>
<td>2558.4</td>
<td>0.0</td>
<td>61.1</td>
<td>437.1</td>
<td>0.0</td>
<td>1247.4</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>4304.0</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31181M311812A</td>
<td>Pies (fruit, cream, and custard), except frozen</td>
<td>1727.5</td>
<td>0.0</td>
<td>41.3</td>
<td>295.2</td>
<td>0.0</td>
<td>842.3</td>
<td>0.0</td>
<td>CFR</td>
<td>1</td>
<td>2906.3</td>
</tr>
<tr>
<td>CBAK00</td>
<td>31182M311821W</td>
<td>Cookie and cracker manufacturing, nsk, total</td>
<td>243.7</td>
<td>0.0</td>
<td>6.1</td>
<td>41.6</td>
<td>0.0</td>
<td>118.9</td>
<td>0.0</td>
<td>OUT_EXTRAP</td>
<td>0</td>
<td>410.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>CBAK00</strong></td>
<td><strong>Total</strong></td>
<td>43459.1</td>
<td>0.0</td>
<td>1044.2</td>
<td>7407.3</td>
<td>0.0</td>
<td>21141.8</td>
<td>0.0</td>
<td><strong>73052.4</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>