Working with Chain-type Aggregates: A Few Tricks

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What Is “Real” about Real GDP?

• Real GDP is intended to remove the effects of inflation in comparing GDP across time.
• The fundamental problem
  – There is not a single “inflation” number
  – Changes in relative prices
• Prior to 1996, BEA dealt with this problem by picking prices of a single base year - “constant dollars”
What Are Chain-type Measures?

• For each pair of periods (e.g., 2001 and 2002, or 2002-IV and 2003-I), calculate a Fisher index, which uses prices of both periods as weights.

• The quantity index is formed by “chaining together” these Fisher indexes – for example: $100 \times F_{1996,1997} \times F_{1997,1998} \times \ldots$

• To calculate chained-dollars, multiply quantity index times reference year current-dollar value, divided by 100.
What Were the Problems with Fixed-weight Constant Dollars?

• “Substitution effect” caused upward bias in recent periods as prices differ greatly from base-year prices.

• Example: 2003Q1 GDP growth was 1.9% with current prices as weights (chained dollars), but was 3.5% with 1996 prices as fixed weights (constant dollars).

• Revisions due to updating base period -- “rewrite” of economic history.
Problems with Fixed-weight Constant Dollars

• For periods far from the base year, base-year prices of little relevance.

• Examples:
  – Should we measure real GDP for 1940s using prices of defense equipment in 1996?
  – Should we measure growth in info processing equipment investment in 2003 using 1996 computer prices?
Common Errors in Using Chains

- Use of chained dollar values to measure “share” or contribution of component to GDP growth.
- Generally, the appropriate share of a component is its current-dollar share.
- = Measure of importance of the component relative to other components at prices of the period.
Measuring contributions

• Because chain-type measures use current-period prices as weights, the chained dollars (based on prices of the reference year) do not measure contribution to change.

• Solutions
  – Use BEA’s contributions to percent change, or
  – Use approximation such as one described below.
Other problems

• Similar problems in measuring contribution or relative importance in chain-type price indexes.

• Issues arise from other calculations that implicitly assume additivity. For more examples, see Karl Whelan, *Review of Income and Wealth*, 2002.
Forecasting with Chains

- Often forecaster may forecast several components and wish to forecast their aggregate.
- Alternatively, could make a forecast of aggregates and wish to split it among components.
- Recommendation – Don’t forecast chained-dollar residual. There are better methods.
Example

• Assume forecaster “knows” (or has accurate forecasts of) 5 components – structures, IP equipment & software, industrial equipment, transportation equipment, and other equipment.
• How bad will simple addition be?
<table>
<thead>
<tr>
<th></th>
<th>2002-IV</th>
<th>2003-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresidential fixed investment</td>
<td>1,185.3</td>
<td>1,170.8</td>
</tr>
<tr>
<td>Pct change (annual rate)</td>
<td>2.3%</td>
<td>-4.8%</td>
</tr>
<tr>
<td>Structures</td>
<td>212.6</td>
<td>212.7</td>
</tr>
<tr>
<td>Info processing eq &amp; software</td>
<td>579.7</td>
<td>590.1</td>
</tr>
<tr>
<td>Industrial equipment</td>
<td>145.9</td>
<td>144.4</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>151.4</td>
<td>135.0</td>
</tr>
<tr>
<td>Other equipment</td>
<td>142.3</td>
<td>139.5</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>1,231.9</strong></td>
<td><strong>1,221.7</strong></td>
</tr>
<tr>
<td>Pct change (annual rate)</td>
<td>2.8%</td>
<td>-3.3%</td>
</tr>
</tbody>
</table>
Method 1 – Fisher of Fishers

• Requires forecasts of price and quantity of each component. (Other methods will only require forecast of quantity)
• Emulates BEA’s method.
• Step 1: Calculate Laspeyres index:
  – Denominator: Last period current $ value
  – Numerator: Sum of this period’s quantities valued at last period’s prices.
<table>
<thead>
<tr>
<th>Current dollars</th>
<th>2002-IV</th>
<th>2003-I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresidential fixed investment</td>
<td>1,117.1</td>
<td>1,105.1</td>
</tr>
<tr>
<td>Structures</td>
<td>254.2</td>
<td>256.9</td>
</tr>
<tr>
<td>Info processing eq &amp; software</td>
<td>406.3</td>
<td>411.5</td>
</tr>
<tr>
<td>Industrial equipment</td>
<td>151.5</td>
<td>150.4</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>154.5</td>
<td>138.1</td>
</tr>
<tr>
<td>Other equipment</td>
<td>150.8</td>
<td>148.3</td>
</tr>
</tbody>
</table>
Laspeyres

- Denominator = 2002-IV current $ total = $1,117.1
- Numerator, 2002-IV prices times 2003-I quantities:
  - Structures: $1.196 \times 212.7 = 254.3$
  - IP eq. & soft: $0.701 \times 590.1 = 413.6$
  - Sum = $254.3 + 413.6 + 149.9 + 137.8 + 147.8 = 1,103.4$
- Laspeyres = $1,103.4 / 1,117.1 = 0.9878$
Paasche

• Numerator is this period’s current $ value (sum of this period’s prices times quantities).

• Denominator is sum of last period’s quantities times this period’s prices.
  – Structures = 212.6 × 1.208 = 256.8
  – Sum = 256.8 + 404.2 + 152.0 + 154.9 + 151.3 = 1,119.1

• Paasche = 1,105.1 / 1,119.1 = 0.9875
Fisher

- Fisher is square root of Laspeyres times Paasche. (geometric mean)
- Fisher = \((0.9878 \times 0.9875)^{1/2} = 0.9876\)
- Multiply Fisher times last period’s quantity to obtain (approximately) this period’s chain-type quantity value.
- Forecast value of real nonresidential fixed investment = \(1,185.3 \times 0.9876 = 1,170.6\) (vs. 1,170.8 published)
What if you don’t have prices?

• Can usually do well by just calculating the Laspeyres part of the example (relying on previous period’s prices).

• Method 2 - Steps:
  – Rebase quantities to 2002-IV prices
  – Add 2003-I component values in chained (2002-IV) dollars
  – Rebase total back to 1996 dollars.
Method 2

• Convert component quantities to last period’s prices:
  • Structures: $1.196 \times 212.7 = 254.3$
  • IP eq. & software: $0.701 \times 590.1 = 413.6$
  • Sum the components: $254.3 + 413.6 + 149.9 + 137.8 + 147.8 = 1,103.4$
  • Convert back to 1996 dollars: $1,103.4 / 0.943 = 1,170.6$
Method 3

- Calculate current-dollar share of each component for last period.
- Multiply share times percent change to get “contribution”
- Sum contributions to get aggregate percent change.
- Apply percent change to total.
Method 3 – example

- Structures: $0.2276 \times 0.0005 = 0.0001$
- IP eq. & software: $0.3637 \times 0.0179 = 0.0065$
- Sum = $0.0001 + 0.0065 - 0.0014 - 0.0150 - 0.0027 = -0.012$
- That is, real nonresidential fixed investment is forecast to decline 1.2 percent (qtrly rate) = $1,185.3 \times 0.988 = 1,170.6$
Summary

• It is possible to forecast chain-type aggregates with only a couple of additional steps over what was required for fixed-weight constant-dollar aggregates.
• Fisher of Fishers approach can be used to form user-defined aggregates (e.g., GDP less medical care)
• Not necessary to forecast residual
• For shares, use current dollars. For contributions, use BEA estimates or approximations shown here.
Extensions

• Chain-type price calculations are the same as shown above, except reverse quantities, prices.

• Special aggregates that don’t use a chain-type Fisher calculation:
  – Change in private inventories
  – Net exports
  – Net investment, etc.

• Methods shown in “A Guide to the NIPA’s”