Working with Chain-type Aggregates: A Few Tricks

Brent R. Moulton

Bureau of Economic Analysis

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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 from 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

- Goal: Forecast real nonresidential fixed investment for 2003:Q1.
- 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?

Chained (1996) dollars	2002-IV	2003-I
Nonresidential fixed investment	1,185.3	1,170.8
Pct change (annual rate)	2.3%	-4.8%
Structures	212.6	212.7
Info processing eq & software	579.7	590.1
Industrial equipment	145.9	144.4
Transportation equipment	151.4	135.0
Other equipment	142.3	139.5
Sum	1,231.9	1,221.7
Pct change (annual rate)	2.8%	-3.3%

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.

Current dollars	2002-IV	2003-I
Nonresidential fixed investment	1,117.1	1,105.1
Structures	254.2	256.9
Info processing eq & software	406.3	411.5
Industrial equipment	151.5	150.4
Transportation equipment	154.5	138.1
Other equipment	150.8	148.3

Laspeyres

- Denominator = 2002-IV current $ total = $1,117.1
- Numerator, 2002-IV prices times 2003-I quantities:
  - Structures: 1.196 × 212.7 = 254.3
  - IP eq. & soft: 0.701 × 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 × 212.7 = 254.3
- IP eq. & software: 0.701 × 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 × 0.0005 = 0.0001
- IP eq. & software: 0.3637 × 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 × 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"