How Govt. Stats Adjust for Potential Biases from Quality Change and New Goods in an Age of Digital Technologies: A View from the Trenches

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Agenda

• Background
• Challenges in measuring price indexes
  – Adjustment methods
• Estimated quality-adjustment and new goods biases in measuring real GDP
• Challenges in measuring nominal GDP
• Improving measurement of prices and output
JEP symposium -- “Are Measures of Economic Growth Biased?”

- **Underestimating the Real Growth of GDP, Personal Income, and Productivity** Martin Feldstein
  - Asserts there’s a measurement problem

- **Challenges to Mismeasurement Explanations for the US Productivity Slowdown** Chad Syverson
  - Refutes many mismeasurement explanations

- **How Government Statistics Adjust for Potential Biases from Quality Change and New Goods in an Age of Digital Technologies: A View from the Trenches** Erica L. Groshen, Brian C. Moyer, Ana M. Aizcorbe, Ralph Bradley and David M. Friedman
  - Reviews issues, adjustment strategies, bias estimates and work in progress
Challenges in measuring price indexes

• BLS produces most price indexes used for real GDP
  – Consumer Price Index (CPI) — prices paid by urban consumers
  – Producer Price Index (PPI) — prices received by domestic producers
  – Import and Export Prices (MXP) — prices related to trade between US and rest of world
Price indexes in the trenches

• Goal: Best possible monthly indexes of price changes, subject to binding practical constraints

• Methodology changes must
  – Be compatible with budget and staff skills
  – Be computable and reviewable in 20 days
  – Preserve respondent confidentiality
  – Not unduly burden respondents
  – Reduce bias certainly and significantly
How BLS accounts for innovation in price indexes

• Issue as old as price indexes, since innovation is not new
  – Note: Not the same as substitution bias

• Matched model = cornerstone of price measurement
  – Compare prices for identical products over time
  – Attribute any price change to inflation
  – In CPI, from 12/2013 to 11/2014
    • 73% of items matched exactly
    • 22% missing temporarily, priced in later months
    • 5% disappeared permanently
How BLS accounts for innovation in price indexes, contd.

• When items disappeared (5% of items), “replacement good” identified
  – When very similar (3% of items), new item replaced older
  – For remaining items (2% of items), quality adjustment procedure invoked—see Table
### Methods to account for new and improved goods and services

<table>
<thead>
<tr>
<th>Method</th>
<th>Requires demand estimation</th>
<th>Based on characteristics, product or other</th>
<th>Example of studies</th>
<th>In production</th>
<th>Reason not in production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality adjustment from producer</td>
<td>No</td>
<td>Characteristics</td>
<td>Yes; PPI, MXP, CPI***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input from other surveys</td>
<td>No</td>
<td>Characteristics</td>
<td>Yes; primarily PPI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explicit hedonic quality adjustment</td>
<td>No</td>
<td>Characteristics</td>
<td>Yes; CPI*, PPI**, MXP**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time dummy hedonic index</td>
<td>No</td>
<td>Characteristics</td>
<td>No</td>
<td>Restrictive assumptions</td>
<td></td>
</tr>
<tr>
<td>Imputed hedonic index</td>
<td>No</td>
<td>Characteristics</td>
<td>No</td>
<td>Requires larger sample sizes</td>
<td></td>
</tr>
<tr>
<td>Discrete choice</td>
<td>Yes</td>
<td>Characteristics</td>
<td>No</td>
<td>High computational intensity and cost; poor timeliness</td>
<td></td>
</tr>
<tr>
<td>Consumer surplus</td>
<td>Yes</td>
<td>Product</td>
<td>No</td>
<td>Endogeneity problems (under investigation); high cost</td>
<td></td>
</tr>
<tr>
<td>Disease-based price indexes</td>
<td>No</td>
<td>Treated disease</td>
<td>Partial; BEA and BLS experimental indexes</td>
<td>Do not yet adjust for differences in outcomes</td>
<td></td>
</tr>
</tbody>
</table>

* See [http://www.bls.gov/cpi/cpihqablsbib.pdf](http://www.bls.gov/cpi/cpihqablsbib.pdf) for CPI items that are quality adjusted.

** PPI and MXP do explicit hedonic quality adjustment for computers.

*** For example, this is done for new vehicles in the CPI and PPI.
BLS quality adjustment approaches for price indexes

• Producer-provided quality adjustment
  – Producers supply monetary value (generally cost-based) for quality change
    • Frequent examples: autos, machinery, goods with model changes
  – Most prevalent in PPI and MXP
  – Appropriate for adjusting output (not welfare) price indexes (see Triplett [1982] and IMF [2004])

• Input from other surveys, e.g.
  • DHHS Hospital Compare and Nursing Home Compare database
  • Insurance Services Office
BLS quality adjustment approaches for price indexes, contd.

• Hedonic adjustments
  – Estimates what each product characteristic adds to value
  – CPI goods eligible for hedonics account for 33% of market basket (includes housing)
  – PPI and MXP use hedonics for computers
  – Requires
    • Adequate sample size
    • Data on characteristics, all observable
    • Stable characteristics
    • Competitive market
Models not in production

• Discrete choice model
  – More general than traditional hedonics
  – Currently logistically impossible (needs more data, computational power, monthly item-area estimates)

• Consumer surplus
  – Estimated demand functions solved for virtual prices
  – Original versions subject to large biases
  – Newer versions may hold promise
Disease-based price indexes

- Healthcare spending 17.5% of GDP
- Medical price indexes upwardly biased because many new treatments replace costlier services
  - Disease-based (not service-based) indexes account for price impact of substituting services
- BLS and BEA have both developed new disease-based indexes
  - Still experimental
  - Outcomes not accounted for
Estimated quality-adjustment and new goods biases and measured real GDP growth

• Goal: Judge degree of bias remaining
• Apply and add up best external empirical estimates
  – Lebow & Rudd (2003); Byrne, Fernald & Reinsdorf (2016); Cutler, Rosen & Vijan (2006); Greenstein & McDevitt (2011)
• Valuable, despite subjectivity and uncertainty
  – Direct improvement efforts
  – Inform users of data limitations
  – Potentially rule out hypotheses
# Impact of estimated biases to Personal Consumption Expenditures deflators on measured real GDP growth, 2000-2015

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>2000</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>Lebow-Rudd est. bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected PCE categories</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical care:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescription drugs</td>
<td>1.3%</td>
<td>1.6%</td>
<td>1.9%</td>
<td>2.3%</td>
<td>1.20%</td>
</tr>
<tr>
<td>Nonprescription drugs</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.3%</td>
<td>0.3%</td>
<td>0.50%</td>
</tr>
<tr>
<td>Medical care services*</td>
<td>9.8%</td>
<td>10.9%</td>
<td>12.2%</td>
<td>12.5%</td>
<td>0.76%</td>
</tr>
<tr>
<td>PC services (incl. internet)**</td>
<td>0.2%</td>
<td>0.2%</td>
<td>0.4%</td>
<td>0.6%</td>
<td>6.50%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenditure Category</th>
<th>Contributions to real GDP growth (percentage points per year)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescription drugs</td>
<td>-0.02 -0.02 -0.02 -0.03</td>
<td></td>
</tr>
<tr>
<td>Nonprescription drugs</td>
<td>0.00 0.00 0.00 0.00</td>
<td></td>
</tr>
<tr>
<td>Medical care services</td>
<td>-0.07 -0.08 -0.09 -0.09</td>
<td></td>
</tr>
<tr>
<td>PC services (incl. internet)</td>
<td>-0.01 -0.01 -0.03 -0.04</td>
<td></td>
</tr>
<tr>
<td>All other PCE categories</td>
<td>-0.10 -0.10 -0.10 -0.09</td>
<td></td>
</tr>
<tr>
<td>All PCE categories</td>
<td>-0.20 -0.22 -0.24 -0.26</td>
<td></td>
</tr>
</tbody>
</table>

*Bias estimate for medical care services has been adjusted based on data from AHRQ (2017).

**Bias estimate for PC services (including internet) is based on Greenstein and McDevitt (2011).

NOTE: Total for All PCE categories may not add exactly to the sub-components shown in the columns due to rounding.
## Impact of estimated biases to Private Fixed Investment deflators on measured real GDP growth, 2000-2015

<table>
<thead>
<tr>
<th>Equipment type</th>
<th>Share of GDP</th>
<th>Byrne, Fernald, and Reinsdorf estimated bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication equipment</td>
<td>1.2%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Computers and peripherals</td>
<td>1.0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Other info. systems equipment</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Software</td>
<td>1.8%</td>
<td>1.7%</td>
</tr>
</tbody>
</table>

**Contributions to real GDP growth (percentage points/year)**

<table>
<thead>
<tr>
<th>Equipment type</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication equipment</td>
<td>-0.07 -0.04 -0.03 -0.03</td>
</tr>
<tr>
<td>Computers and peripherals</td>
<td>-0.08 -0.05 -0.04 -0.03</td>
</tr>
<tr>
<td>Other info. systems equipment</td>
<td>-0.05 -0.06 -0.06 -0.06</td>
</tr>
<tr>
<td>Software</td>
<td>-0.03 -0.02 -0.02 -0.03</td>
</tr>
</tbody>
</table>

**All PFI categories**

<table>
<thead>
<tr>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.23 -0.17 -0.16 <strong>-0.15</strong></td>
</tr>
</tbody>
</table>

Note: The contributions to GDP growth for 2000 and 2005 are calculated using the bias estimates for 1995–2004; the contributions for 2010 and 2015 use the bias estimates for 2004–2014. Total for All PFI categories may not add exactly to sub-components shown in columns due to rounding.
Bottom line on biases

- Reduction in measured real GDP growth from biases (2015)
  - PCE: -0.26 percentage point
  - PFI: -0.15 percentage point

  **GDP impact on PCE + PFI: -0.4 percentage point**
  - Little change over time
  - Looms larger when growth is slow

- How we think about it
  - Neither alarmed nor satisfied
  - Helps focus improvement efforts
  - Should explore potential biases in government spending and trade
Challenges in measuring nominal GDP in the digital age

• Issue: GDP may omit valuable new goods and services that are not sold (e.g., searches, Wikipedia)

• GDP tracks market activity, not welfare
  – BEA’s satellite accounts track some non-market activity, like household work

• “Free” digital services supported by ads appear in GDP (Google and many more)
  – Wikipedia, many blogs & photo archives are nonmarket
Challenges in measuring nominal GDP in the digital age, contd.

• Movement between market and household production (e.g., travel arrangements)
  – Appropriately tracked, but may be of interest
• Business investments in intellectual property—likely undercounted
• Purchased cloud services—not directly problematic
• Bottom line
  – Most marketed digital products appear in GDP
  – May be misallocated across GDP categories (Uber and Airbnb)
  – Distortions likely still small due to low volumes, but growing rapidly
  – Traded intellectual property needs further attention
Improving measurement of prices and output--BLS

• Improving/expanding hedonics
  – Scraping prices and characteristics
  – Corporate transactions data
  – Continue adding/improving models and products
    • Broadband services (PPI) added recently
    • Wireless services (CPI) improved recently
  – New methodologies

• Scanner data

• Outcome measures for medical services
Improving measurement of prices and output--BEA

• Improve tracking of ad-supported media
• Improve measures of contribution of digital technologies and commerce to growth
• Expand coverage of intellectual property transactions, here and abroad
• Improve measures of value created in production chains
• Improve tracking high-tech product prices by leveraging alternative data sources
Conclusion

• Price index measurement → understated real output growth
  – From rapid innovation and globalization
  – Affects healthcare and possibly areas using IT and communications technology
  – Stable over time

• Producing official stats: not for the rigid or fainthearted
  – Put out timely monthly data, within budget
  – Over time, biases will be addressed, as have previous problems

• Official statistics
  – Imperfect estimates, like all statistics
  – Yet uniquely accurate, objective, relevant, timely and accessible
  – Infrastructure to support efficient markets and help policymakers and citizens make decisions