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

IMF Statistical Forum, 16 November 2017

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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 price and output measures

BLS mission

- … principal Federal agency responsible for measuring
  - labor market activity
  - working conditions
  - price changes in the economy
- … collect, analyze, and disseminate essential economic information
- … support public and private decision making.

Journal of Economic Perspectives symposium -- "Are Measures of Economic Growth Biased?"

Underestimating the Real Growth of GDP, Personal Income, and Productivity - *Martin Feldstein*

- Asserts there's a huge 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 - *Groshen, Moyer, Aizcorbe, Bradley & Friedman*

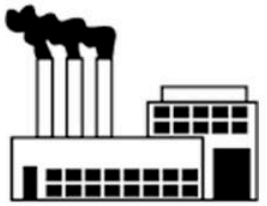
- Current processes, issues, adjustment strategies, bias estimates, measurement strengths

BLS price indexes

Most of the price indexes used for real GDP

- **Consumer Price Index** (CPI)—prices paid by urban consumers

- **Producer Price Index** (PPI)—prices received by domestic producers



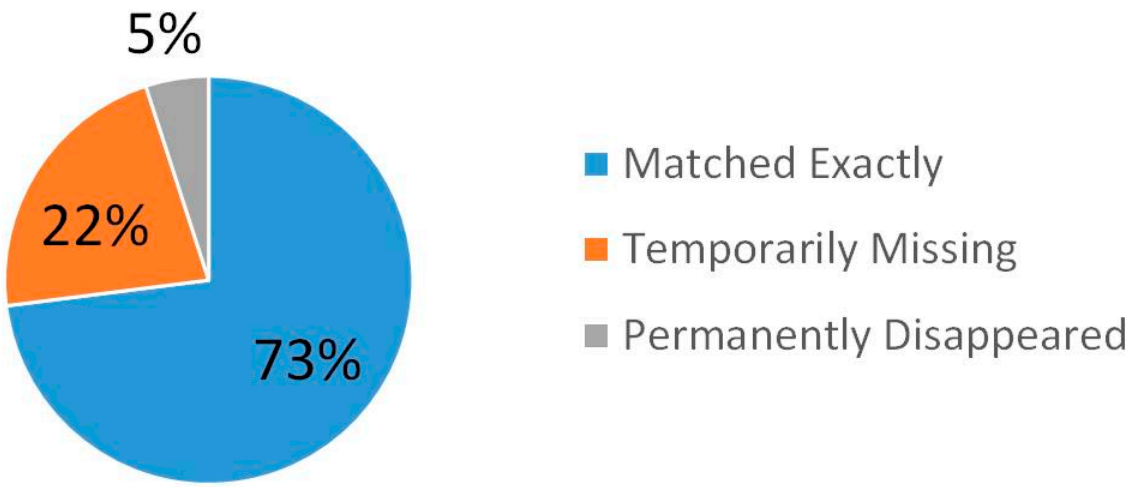
- **Import and Export Prices** (MXP)—prices related to trade between US & rest of world

Price indexes in the trenches

- Goal
  - Best possible monthly indexes of price changes
- Constraints on methodology
  - Compatible with resources
  - Computable and reviewable in 20 days
  - Preserve respondent confidentiality
  - Avoid undue burden on respondents
  - Make changes only if reduce bias certainly & significantly

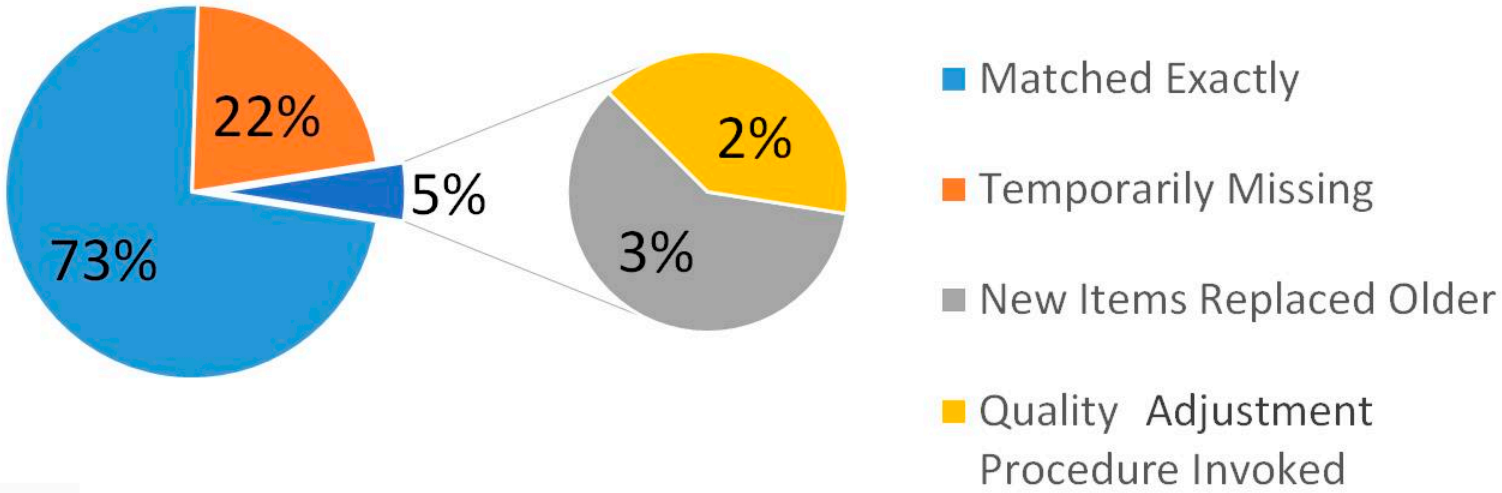
How BLS accounts for innovation in price indexes

- Issue as old as price indexes; innovation is old
  - Note: Not 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



How BLS accounts for innovation in price indexes, contd.

- As items disappear (5% of items), "replacement" identified
  - If very similar (3% of items), new item replaces older
  - For remaining 2% of items, quality adjustment procedure invoked—see Table



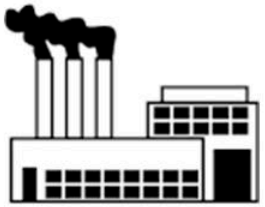
Methods to account for new and improved goods and services

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

* See 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.
****PPI is experimenting with this method for microprocessors.

Three BLS quality adjustment approaches for price indexes

1. Producer-provided quality adjustment
   - Producers supply monetary value (generally cost-based) for quality change or info about replacement model
     - E.g., autos, machinery, goods with model changes
   - Most prevalent for PPI and MXP
   - Appropriate for adjusting output (not welfare) price indexes
     - See Triplett [1982] and IMF [2004]



2. Input from other surveys, e.g.
   - DHHS Hospital Compare and Nursing Home Compare database
   - Insurance Services Office

Three BLS quality adjustment approaches, contd.

3. 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

Key approach not in production, sort of…

- Disease-based price indexes
  - Healthcare spending **17.5% of GDP**
  - Medical price indexes (service-based) upwardly biased when many new treatments replace costlier services
  - Disease-based indexes account for price impact of substituting or dropping services
  - BLS and BEA both developed new disease-based indexes (6/2017 BLS "*Beyond the Numbers*")
    - Still experimental
    - Outcomes not accounted for

How large might be bias in measured real GDP growth?

- Goal: Judge degree of **quality-adjustment** and **new goods** bias remaining
- Apply and add up best external empirical estimates
  - Lebow & Rudd (2003); Byrne, Fernald & Reinsdorf (2016); Cutler, Rosen & Vijan (2006); Greenstein & McDevitt (2011)
- Value (despite subjectivity and uncertainty)
  - Direct improvement efforts
  - Inform users of data limitations
  - Potentially rule out hypotheses

Impact of possible biases to Personal Consumption Expenditures deflators on measured real GDP growth, 2000-2015

Expenditure Category	Contributions to real GDP growth (percentage points per year)			
Selected PCE categories	2000	2005	2010	2015
Medical care:				
Prescription drugs	-0.02	-0.02	-0.02	-0.03
Nonprescription drugs	0.00	0.00	0.00	0.00
Medical care services	-0.07	-0.08	-0.09	-0.09
PC services (incl. internet)	-0.01	-0.01	-0.03	-0.04
All other PCE categories	-0.10	-0.10	-0.10	-0.09
All PCE categories	**-0.20**	**-0.22**	**-0.24**	**-0.26**
NOTE: Total for All PCE categories may not add exactly due to rounding.				

Impact of possible biases to Private Fixed Investment deflators on measured real GDP growth, 2000-2015

Equipment type	Contributions to real GDP growth (percentage points per year)			
	2000	2005	2010	2015
Communication equipment	-0.07	-0.04	-0.03	-0.03
Computers and peripherals	-0.08	-0.05	-0.04	-0.03
Other info. systems equipment	-0.05	-0.06	-0.06	-0.06
Software	-0.03	-0.02	-0.02	-0.03
All PFI categories	**-0.23**	**-0.17**	**-0.16**	**-0.15**

Note: Total for All PFI categories may not add exactly due to rounding.

Bottom line on biases

- **GDP impact on PCE + PFI: -0.4 percentage point**
  - Reduction in measured real GDP growth from biases (2015)
    - PCE: -0.26 percentage point
    - PFI: -0.15 percentage point
  - Little change over time
  - Looms larger when growth is slow

- BLS & BEA perspective
  - Not alarmed, nor satisfied
  - Helps focus improvement efforts
  - Next, explore potential biases in trade and government spending

Challenges for BEA in measuring nominal GDP in the digital age

- 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
  - Misallocations across GDP categories (Uber, Airbnb)
  - Distortions likely small now, but growing rapidly
  - Traded intellectual property needs further attention

Improving quality adjustments in prices and output—BLS & BEA together

- **Cell phones, CPI**
  - Using datasets from BEA, BLS built a new QA hedonic model—**in production starting in January**
  - Directed substitutions 2x/year, as major new models are released
  - QA models will be updated twice yearly to correspond with release dates

- **Wireless telephone services, CPI**
  - BLS refined QA practices **last spring**
  - Exploring JD Household data for item selections and substitution frequency next year
  - Exploring another source from BEA to replace surveys
  - BEA using source to estimate historical biases

Improving measurement—BLS

- Scanner data
- Outcome measures for medical services
- Hedonics
  - Scrape prices and characteristics
  - Corporate transactions data
  - Add/improve models and products (next slide)

BLS

Quality adjustment improvements—BLS

- **Microprocessors, PPI**
  - New hedonic methods deal with changed pricing practices
    - Responds to and expands on Byrne, Oliner & Sichel framework
    - Looks at all products (new and old), updates models frequently, etc.
  - Template for quality adjustment in other industries with rapid technological change, using
    - Statistical learning methods for model specification
    - Time dummy variables approach
- **Broadband services, PPI**
  - Hedonic regression model in production
  - First QA model for a service

Improving measurement of prices and output—BEA

- Tracking ad-supported media
- Coverage of intellectual property transactions, here and abroad
- Value created in production chains

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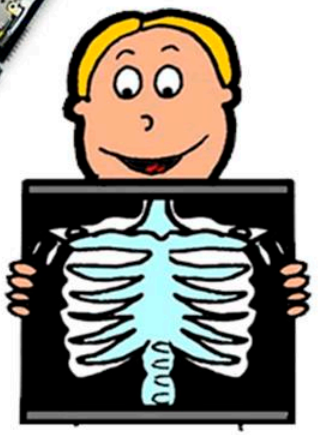
Tapping external data sources—BEA

- Constructing historical price indexes from new sources
  - Goal: Assess any potential biases in rapidly innovating sectors with substantial GDP shares
  - Sectors
    - Custom & own-account software
    - Electro-medical equipment
    - Residential Communication Services
      - Wireless services, including devices
      - Wireline services (broadband, cable, telephone)



Conclusion

- **Price index measurement → understated real output growth**
  - From rapid innovation and globalization
  - Affects healthcare, possibly areas using IT/comms technology
  - Stable over time
- **Producing official stats: not for the rigid or fainthearted**
  - Put out timely monthly data, within budget
  - Biases will be addressed over time
- **Official statistics**
  - Imperfect, like all statistics
  - Uniquely accurate, objective, relevant, timely and accessible
  - Infrastructure supporting efficient markets, helping policymakers and citizens make decisions
  - Need active support in today's environment

You can help the work in the trenches

Approaches not in production

- Discrete choice
  - 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

Impact of estimated biases to Private Fixed Investment deflators on measured real GDP growth, 2000-2015

Equipment type	Share of GDP				Byrne, Fernald, and Reinsdorf estimated bias	
	2000	2005	2010	2015	1995–2004	2004–2014
Communication equipment	1.2%	0.7%	0.6%	0.6%	*5.8%*	*7.6%*
Computers and peripherals	1.0%	0.6%	0.5%	0.4%	*8.0%*	*12.0%*
Other info. systems equipment	0.7%	0.7%	0.7%	0.8%	*8.3%*	*5.4%*
Software	1.8%	1.7%	1.7%	1.8%	*1.4%*	*0.9%*
	Contributions to real GDP growth (percentage points/year)					
Communication equipment	-0.07	-0.04	-0.03	-0.03		
Computers and peripherals	-0.08	-0.05	-0.04	-0.03		
Other info. systems equipment	-0.05	-0.06	-0.06	-0.06		
Software	-0.03	-0.02	-0.02	-0.03		
All PFI categories	**-0.23**	**-0.17**	**-0.16**	**-0.15**		

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.

Impact of estimated biases to Personal Consumption Expenditures deflators on measured real GDP growth, 2000-2015

Expenditure Category	Share of GDP				Lebow-Rudd est. bias
Selected PCE categories	2000	2005	2010	2015	2003
Medical care:					
Prescription drugs	1.3%	1.6%	1.9%	2.3%	*1.20%*
Nonprescription drugs	0.2%	0.2%	0.3%	0.3%	*0.50%*
Medical care services*	9.8%	10.9%	12.2%	12.5%	*0.76%*
PC services (incl. internet)**	0.2%	0.2%	0.4%	0.6%	*6.50%*
Medical care:	Contributions to real GDP growth (percentage points per year)				
Prescription drugs	-0.02	-0.02	-0.02	-0.03	
Nonprescription drugs	0.00	0.00	0.00	0.00	
Medical care services	-0.07	-0.08	-0.09	-0.09	
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All other PCE categories	-0.10	-0.10	-0.10	-0.09	
All PCE categories	**-0.20**	**-0.22**	**-0.24**	**-0.26**	

*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.