Outlet Substitution Bias and Price Indexes for Retail Services

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Price Deflators for Retail Services

- Recent shift of purchases from brick and mortar establishments to non-store retailers poses measurement challenges for price measurement

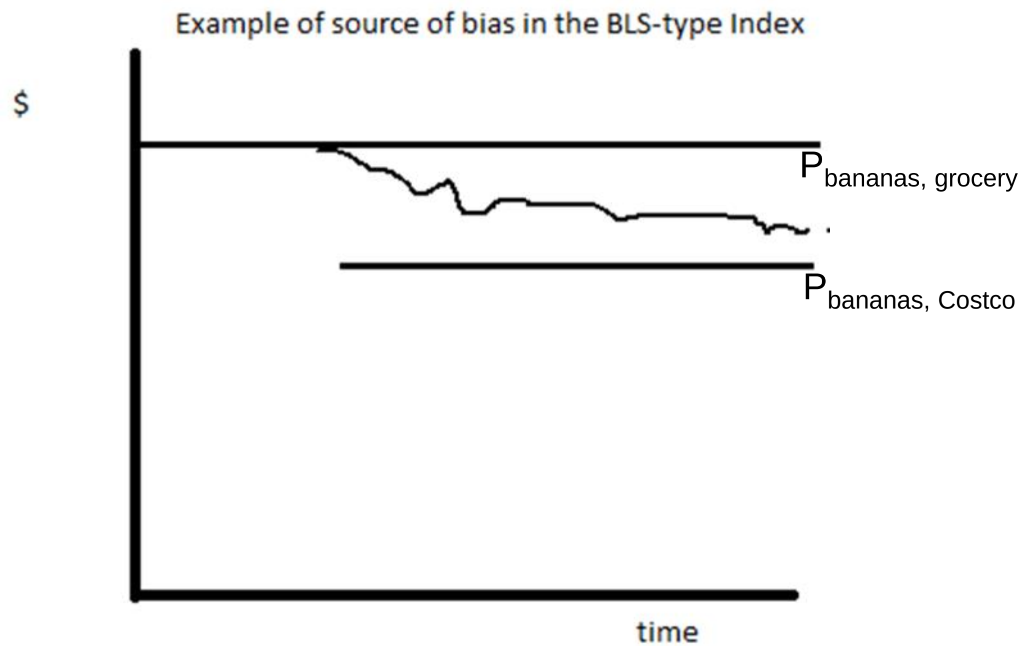
- Conceptually, these problems are not entirely new:
  - Define the good—do you want to price just the good you purchased or services provided at the store?
  - Quality adjustment – accounting for improvements over time in cars and phones…..
  - Outlet substitution bias – Originally studied in the context of the arrival of big discount stores like Costco and how that affects the CPI for goods.

- Today: high-level discussion of outlet substitution bias:
  - What is the outlet substitution bias problem?
  - How would one eliminate the bias?
  - How big is the bias likely to be?

Illustration of the problem for CPI goods: Perfect substitutes

Assume

- Bananas at grocery stores are identical to bananas at Costco
- Prices of bananas are unchanged but bananas at Costco cost less
- 100 bananas are sold per week
- As people switch to buying bananas at Costco, spending on bananas falls.



A superlative index of the two types of bananas:

- Shows no price change
- Deflated spending falls

A Unit value index that treats the two types of bananas as perfect substitutes:

- Shows price decline, reflecting the fact that bananas are getting cheaper
- Deflated spending remains at 100

If different goods, track changes in a Fisher Index.
If perfect substitutes, track changes in the unit value:

$$UV_{\text{bananas}} = \frac{REV_{\text{bananas, grocery}} + REV_{\text{bananas, Costco}}}{Q_{\text{bananas, grocery}} + Q_{\text{bananas, Costco}}}$$

What if goods are not perfect substitutes?

What if consumers, instead, view the two types of bananas as “broadly comparable items” or as differentiated goods?

In that case, the target index is a unit value index that tracks the change in a *quality-adjusted* unit value: (DeHaan):

$$QAUV_{\text{bananas}} = \frac{REV_{\text{bananas, grocery}} + REV_{\text{bananas, Costco}}}{\lambda_{\text{bananas, grocery}}\, Q_{\text{bananas, grocery}} + \lambda_{\text{bananas,costco}}\, Q_{\text{bananas,Costco}}}$$

where the λ’s control for differences in the quality of bananas across outlets.

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About quality adjustment....

- Possible methods:
  - Hedonic regression, for example Silver (2011), deHaan and Diewert (2017)
  - Model-based equilibrium condition, as in Byrne, Kovak and Michaels (2017)
- Pragmatic question: Adjusting for quality is difficult. How much of the bias could be removed by a quality-*unadjusted* unit value approach? Under what conditions would it provide an upper bound to true price change?

Apart from the quality adjustment problem, can external data help?

	B&M	Online
Transactions associated with Brick and Mortar retailers		
POS (scanner)		
Nielsen	X	X
IRI	X	X
NPD	X	X
Credit card		
Affinity	X	X
Palentir	X	X
Transactions for non-store retailers		
Adobe		X
Amazon		X

Coverage: Scanner and credit card data do not contain transactions for non-store retailers, but could be used to study the Walmart type of bias in earlier time periods

Practical points:

- POS data typically provide revenues and units aggregated over retailers but often don't include all types of outlets. For some time, Nielsen didn't include Walmart Not clear that any of them include Costco and other discount stores
- Not clear that Adobe and Amazon data could be merged with other sources to correct outlet substitution bias.

What do we know about the bias?

"Like with new goods bias, most studies *seem to agree* on the direction of bias as upward. The extent of the new outlet bias depends on

- the components of the CPI basket that are likely to be affected,
- the change in market share of new outlets for these items, and
- the percentage difference in quality adjusted prices between new outlets and old outlets."

Source: ILO/IMF/OECD/UNECE/Eurostat/The World Bank (2004)

Analytical examinations of bias show:

1. Numerically, the bias can be positive or negative.
2. Bias arises only when new outlets are gaining market share and quality-adjusted prices differ (potentially a temporary phenomenon)

Nakamura, A., Diewert, W.E., Greenlees, J.S., Nakamura, L.I., Reinsdorf, M. B. (2015)

What do we know about the bias?

- Empirical studies in other contexts typically find an upward bias
  - Prices at new outlet are typically lower, and
  - Their market share is increasing

- Informed opinion:
  - Moulton (2018): Based on research into the arrival of big box stores (like Walmart) in the 1990s, outlet substitution problems likely caused the PCE deflator to overstate true price growth by about .08 per year.
  - Hatzius (2017): Studied the recent growth of Amazon and other non-store retailers and argues that the bias is likely much smaller than bias over the 1990s.

Problem in the context of retail services

- Shift of focus to a producer price index (PPI) for the retail *services*
- Output of the retail trade sector is quantified as margins (revenues less acquisition cost) rather than revenues.
- So, the “price” used in the PPI is margin per unit, rather than revenue per unit.

Example of the problem for retail services with only one good sold (bananas)

Simple example:

- Two ways to obtain bananas: Brick and mortar stores (s) and non-store retailers (o)
- The quality of services provided can differ across outlets is λ_j
- They earn a gross margin of $MARGIN_s$ per banana that is specific to the retailer type

The quality adjusted unit value for retail services from selling bananas is:

$$QAUV^{alloutlets} = \frac{MARGIN_s + MARGIN_o}{\lambda_s Q_s + \lambda_o Q_o}$$

Note:

- $MARGIN_j$ is the margin at retailer type j
- λ_j is the quality of services provided by retailer type j

Unlike the CPI goods case, the quality adjustment factors are not about the goods per se and only about the quality of services

What happens when there is more than one type of good?

1. Find groups of goods where the associated services are similar:
   - Suppose outlets have two departments.
     - IT goods
     - tires
   - Services provided by the IT department are different than those provided by the tires department

2. For each department, form the quality-adjusted unit value (e.g., $QAUV_t^{IT}$) *across outlets* using data on margins and an estimate of the quality of service (λ_s^{IT})

3. Calculate changes in those unit values over time (e.g., $I_{t,0}^{IT}$):

$$I_{t,0}^{IT} = QAUV_t^{IT} \; / \; QAUV_0^{IT}$$

4. Aggregate over the two departments using a superlative index:

$$\ln I_{t,0}^{ALLOUTLETS} = (w_t^{IT} + w_0^{IT})/2 \, (\ln I_{t,0}^{IT}) + (w_t^{TIRES} + w_0^{TIRES})/2 \, (\ln I_{t,0}^{TIRES})$$

Data requirements

- Data on margins by department and outlet are typically not publicly available
  - Need department to control for department-specific services
  - Need outlet to control for quality differences across outlets
- Need:
  - Margins and *quantities* by department *for all types of outlets*
    - So that you can form unit values summing over all outlet types
  - A way to control for quality difference across outlets
    - Maybe obtain information for outlet-specific attributes

How big is bias likely to be?

- Not much empirical evidence of the potential magnitude of bias in a PPI for retail services
- Wild guess:
  - If Amazon’s share of retail margins is as small as its share of retail sales (4% in 2018), the impact of any bias on retail sector output is still likely to be small.
  - In 2018, output of the retail sector was $1.3 trillion, or about 6% of GDP.

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Thank you

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