Internet Rising, Prices Falling

Austan Goolsbee, University of Chicago and NBER

Pete Klenow, Stanford and NBER

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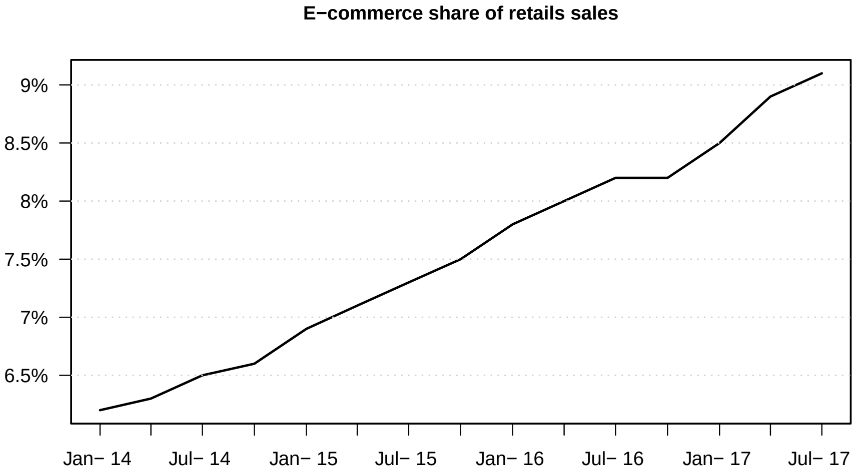
Summary

- Through Adobe, we have a massive data set of online transaction prices and quantities to compute price indices
- Online inflation was about 100 bps lower than in the CPI for the same categories from 2014–2017
- Entry and exit of new product varieties is extremely important in most categories (but less so in food and grocery)
- Data on quantities is particularly valuable for measurement because entry and exit rates vary with product sales
- The increased variety sold online implies an additional 90-150 bps lower inflation than in the matched model/CPI-style indices

The rising importance of e-commerce



Motivation

- Adobe Analtyics data on e-commerce prices *and* quantities
- How does quantity data alter the inflation picture?
- How does it affect our estimates of product turnover?
- How big are the gains from e-commerce product turnover?

Related literature

Gains from e-commerce and the internet

- Brynjolffson and collaborators (2003, 2012, 2017)
- Einav et al. (2017)
- Syverson (2016)
- Varian (2013)
- Goolsbee and Klenow (2006)

Consumer surplus from new products

- Redding and Weinstein (2017)
- Broda and Weinstein (2006, 2010)
- Hausman (1997, 1999)
- Feenstra (1994)

Outline

1. **Adobe Analytics data**
2. A Digital Price Index (DPI) vs. the CPI
3. Rates of product entry and exit online
4. Gains from product turnover online

Adobe Analytics data

- Adobe clients currently cover:
  - 20 of the top 30 U.S. employers
  - 80% of Fortune 500 retailers
- Adobe categories currently span 22% of CPI weight
- Data on individual transactions from 2014–2017
  - IP address, day, product, seller, dollars, quantities

Our focus right now:

- Data at the product-seller-month level
- Prices, quantities, products – not identifying sellers or buyers
- Subset of clients authorizing data use ($\sim$ 15% of e-commerce)

Adobe data confidentiality

All results have been reviewed to ensure that no confidential information about Adobe clients or individuals have been disclosed.

Transactions are anonymized, and we report no data on individuals.

We report no data on specific sellers.

Adobe's coverage by major CPI group

	CPI Coverage (% of ELI's)	# of Products
Headline	**22%**	**1.7 M**
Food and beverages	49%	1000 K
Housing	7%	50 K
Apparel	100%	100 K
Education and communication	33%	300 K
Medical care	9%	20 K
Transportation	3%	100 K
Recreation	32%	100 K
Other goods and services	42%	40 K

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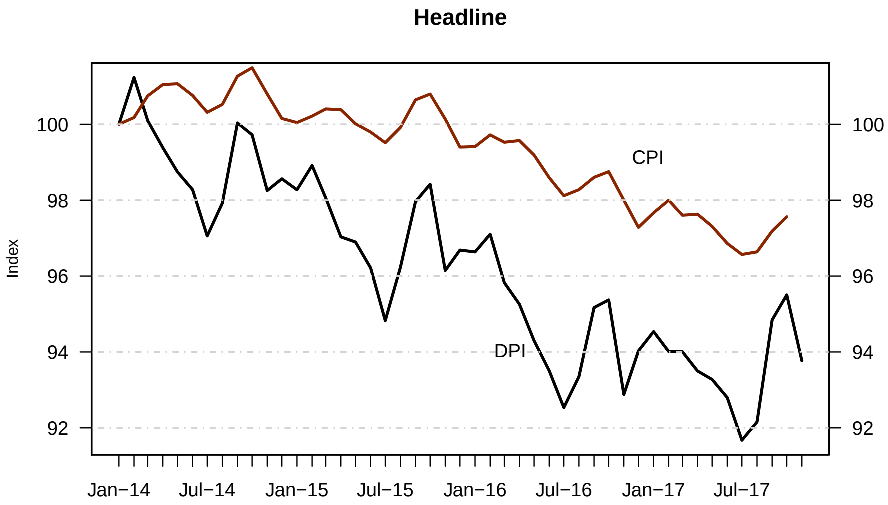
DPI vs. the CPI and the *Billion Prices Project* (BPP)

	DPI	CPI	BPP
Quantities	Yes	No	No
# of items	1.7 M	120 K	500 K
Offline prices	No	Yes	No
Long history	No	Yes	No
All categories	No	Yes	No
Merchant Identities	No	No	Yes

Adobe DPI methodology

- Matched model index (overlapping products) within categories
  - Weighted average of log first differences within categories
  - Weights are Tornqvist spending shares in the category
- Laspeyres across 68 CPI categories (Entry Level Items, or ELI's)
- CPI or DPI weights across categories

DPI vs. CPI trend



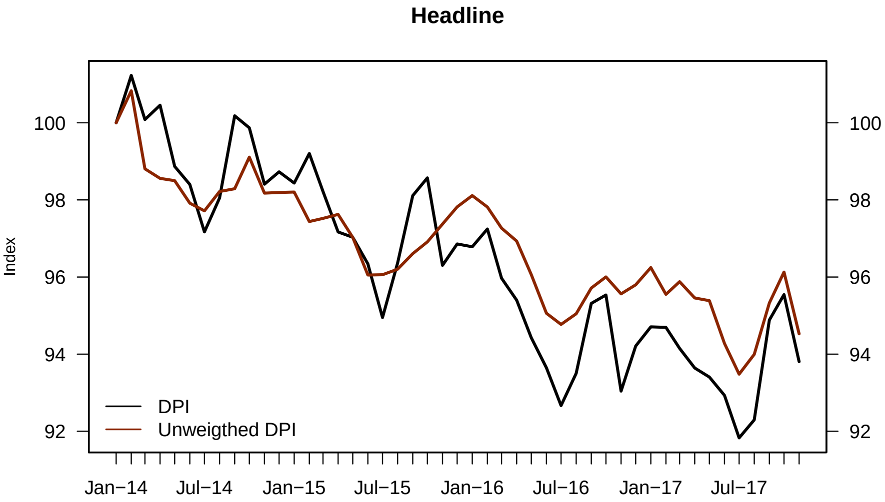
Note: Using CPI category weights. Excluding Apparel.

2014–2017 Annual Inflation, DPI vs. CPI

	DPI	CPI
Headline	**-1.6%**	**-0.6%**
Food and beverages	-0.8	0.4
Household goods	-5.3	-1.8
Apparel	0.0	1.1
ICT*	-1.6	-4.5
Medicines and medical supplies	1.3	-0.2
Transportation accessories and parts	-1.7	-0.6
Recreation goods	-7.2	-2.9
Other goods and services	0.4	1.9

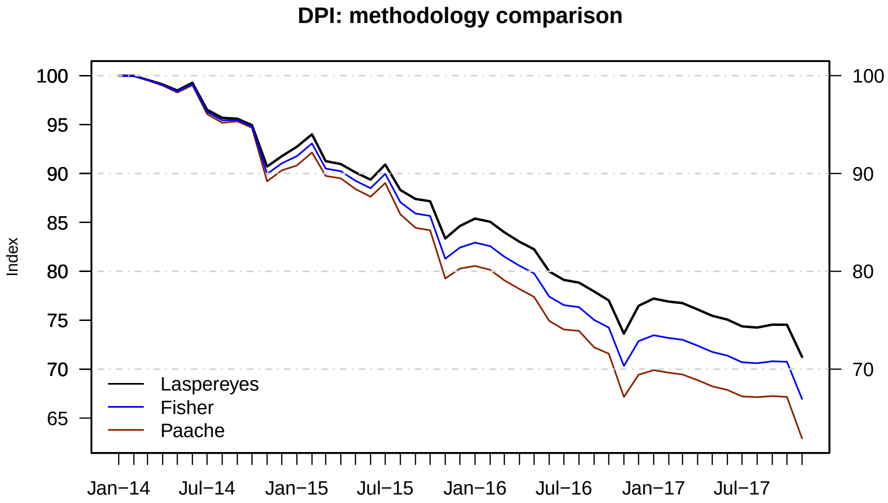
* ICT = Information and communication technology

DPI vs. unweighted DPI



Note: "Unweighted" uses CPI category weights, but weights all items equally within categories (vs. Tornqvist shares within categories).

Weighting across categories



Note: Using DPI category weights.

Chain Drift

"Chain drift" refers to when a chained price index fails to revert to 1 even when all prices/quantities revert to their starting levels.

In the Adobe data, we find *positive* chain drift when we add an artificial 13th month to each year with 1st month p's and q's:

	2014	2015	2016	Average
Headline	1.0%	1.1%	1.2%	1.1%

This contrasts with the sharply negative drift seen in weekly supermarket scanner data (e.g. de Haan and van der Grient, 2011).

Chain Drift: Major categories

	Average
Food and beverages	0.8%
Household goods	-0.8%
Apparel	2.4%
Communication and ICT	1.5%
Medicines and medical supplies	-0.3%
Transportation accessories and parts	0.2%
Recreation goods	0.2%
Other goods and services	0.3%

Note: Average annual chain drift, 2014–2016.

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Product Exit and Entry

	Entry	Exit
Based on # of products	52.2%	47.8%
Based on market share of products	50.6%	23.8%

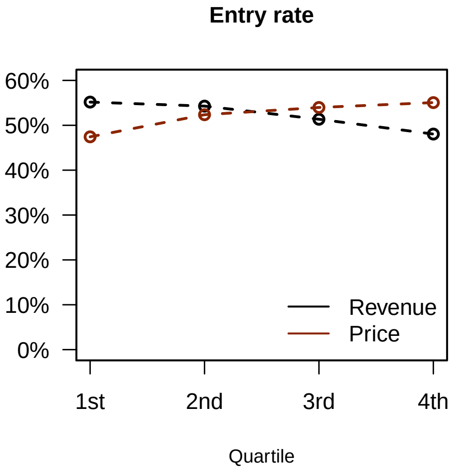
Based on entering products in 2016 and exiting products in 2015.

Product Exit and Entry: Food vs. Headline

	Entry	Exit
Headline	50.6%	23.8%
Food and beverages	19.5%	8.5%

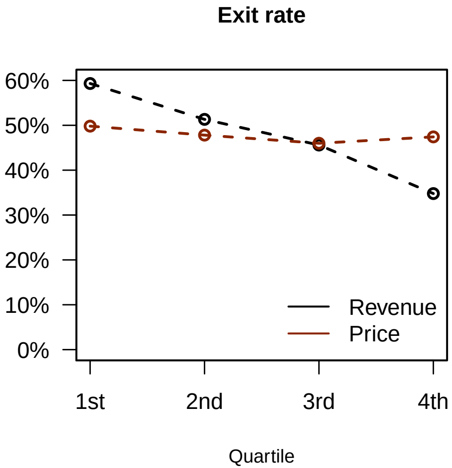
Based on market shares of entering (exiting) products in 2016 (2015).

Entry rate heterogeneity



Note: Entry rate in 2016 of products sorted by revenues or prices from the lowest (1st quartile) to the highest (4th quartile).

Exit rate heterogeneity



Note: Entry rate in 2016 of products sorted by revenues or prices from the lowest (1st quartile) to the highest (4th quartile).

Product Entry and Exit by Major Group

	Entry	Exit
Apparel	69.8	29.5
Other goods and services	63.2	12.1
ICT	61.5	31.3
Recreation goods	58.7	21.3
Household goods	28.7	19.1
Transportation accessories and parts	22.4	17.1
Food and beverages	19.5	8.5
Medicines and medical supplies	13.2	7.9

Note: Percentages based on market shares in 2016 (2015).

% growth in variety (sales-weighted)

	Average	2015	2016	2017
Headline	6.7	6.1	9.7	4.3
Headline ex. Apparel	4.3	3.4	6.8	2.7
Food and beverages	1.2	0.5	1.8	1.4
Household goods	2.0	2.9	2.4	0.7
Apparel	18.3	22.7	21.4	10.7
Communication and ICT	10.6	12.6	11.9	7.2
Medicines and medical supplies	-0.8	-0.9	1.1	-2.5
Transportation accessories and parts	1.5	2.5	1.4	0.7
Recreation	5.0	1.3	9.8	3.9
Other goods and services	12.2	5.3	30.4	1.0

Total spending growth minus spending growth for *recurring* products (as in the Feenstra Ratio).

Inflation bias from variety growth (% points per year)

σ	Average	2015	2016	2017
4	1.4	1.1	2.3	0.9
6	0.9	0.7	1.4	0.5

Based on headline excluding apparel.

We will estimate category-specific σ's down the road.

This inflation bias from new products is in addition to the matched-model online price index differences shown above.