Internet Rising, Prices Falling: Measuring Inflation in a World of E-Commerce

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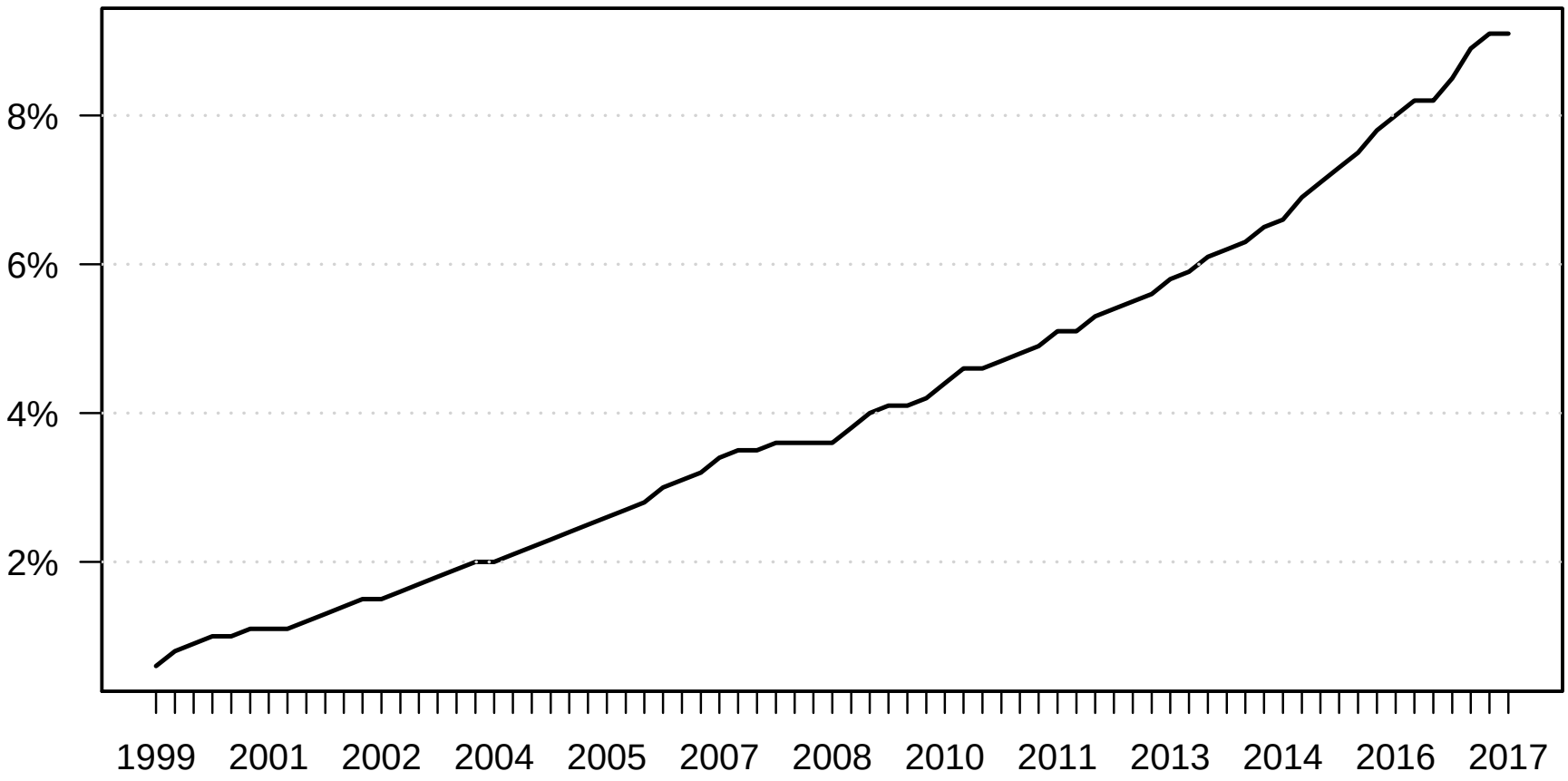
NY Fed Discussion

E-Commerce share of retail sales



Source: U.S. Census Bureau (2018)

Motivation

- Does inflation online differ from inflation offline?
- How does quantity data alter the inflation picture?
- How rapid is online product turnover?
- How big are the gains from e-commerce product turnover?

Preview

- Through **Adobe, Inc.** we have a massive dataset of online transaction prices and quantities
- Online inflation $\sim$ 1 % point per year lower from 2014–2017 than in the same CPI categories
- Product turnover is much higher in most Adobe categories than for (much-studied) grocery items
- Increased variety online $\Rightarrow$ an additional $\sim$ 2 % points per year lower inflation than in matched model / CPI-style indices

Related literature

Gains from e-commerce and the internet

- Brynjolffson and collaborators (2003, 2012, 2017)
- Einav, Klenow, Klopack, Levin, Levin, and Best (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

Adobe Analytics data

- Adobe clients currently cover
  - 20 of the top 30 U.S. employers
  - 80% of Fortune 500 retailers
- Adobe categories we use span 19% 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 granularity

DAILY INFLATION RATE FOR TELEVISIONS, 2015
SOURCE: ADOBE DPI

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.

DPI vs. the CPI and the *Billion Prices Project*

	DPI	CPI	BPP
Quantities	Yes	No	No
# of items	2.1 M	140 K	500 K
Offline prices	No	Yes	No
Long history	No	Yes	No
All categories	No	Yes	No
Merchant Identities	No	No	Yes

Adobe's coverage by CPI Major Group

	# of Products	% CPI Coverage
Headline	**2.1 M**	**19**
Food and beverages	1 M	49
Education and communication	404 K	9
Recreation	202 K	32
Apparel	130 K	100
Transportation	125 K	3
Housing	92 K	7
Other goods and services	92 K	42
Medical care	23 K	9

% of revenue by category in Adobe data

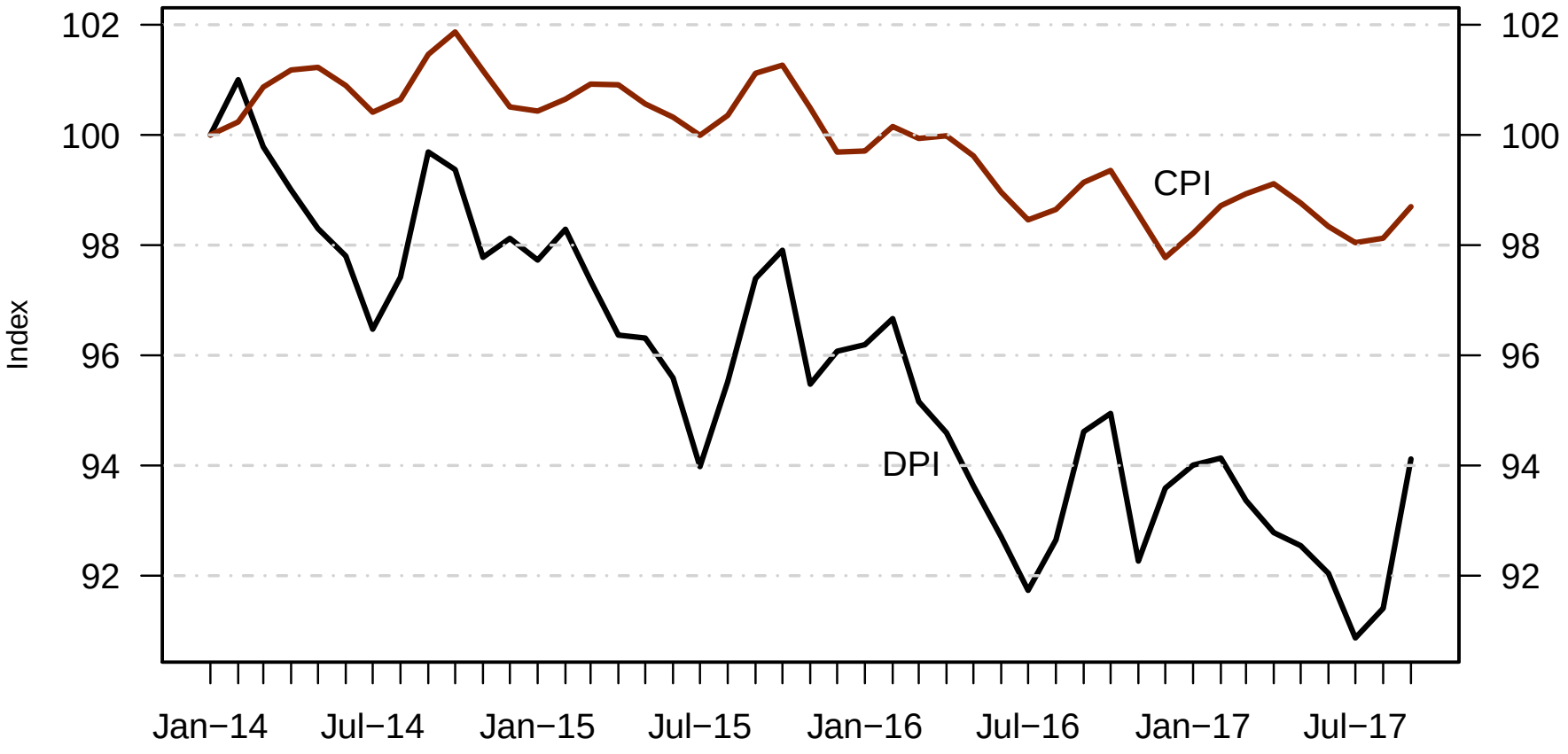
Household goods	27%
Apparel	27%
ICT	19%
Recreation goods	14%
Food and beverages	7%
Other goods and services	3%
Transportation accessories and parts	2%
Medicines and medical supplies	1%

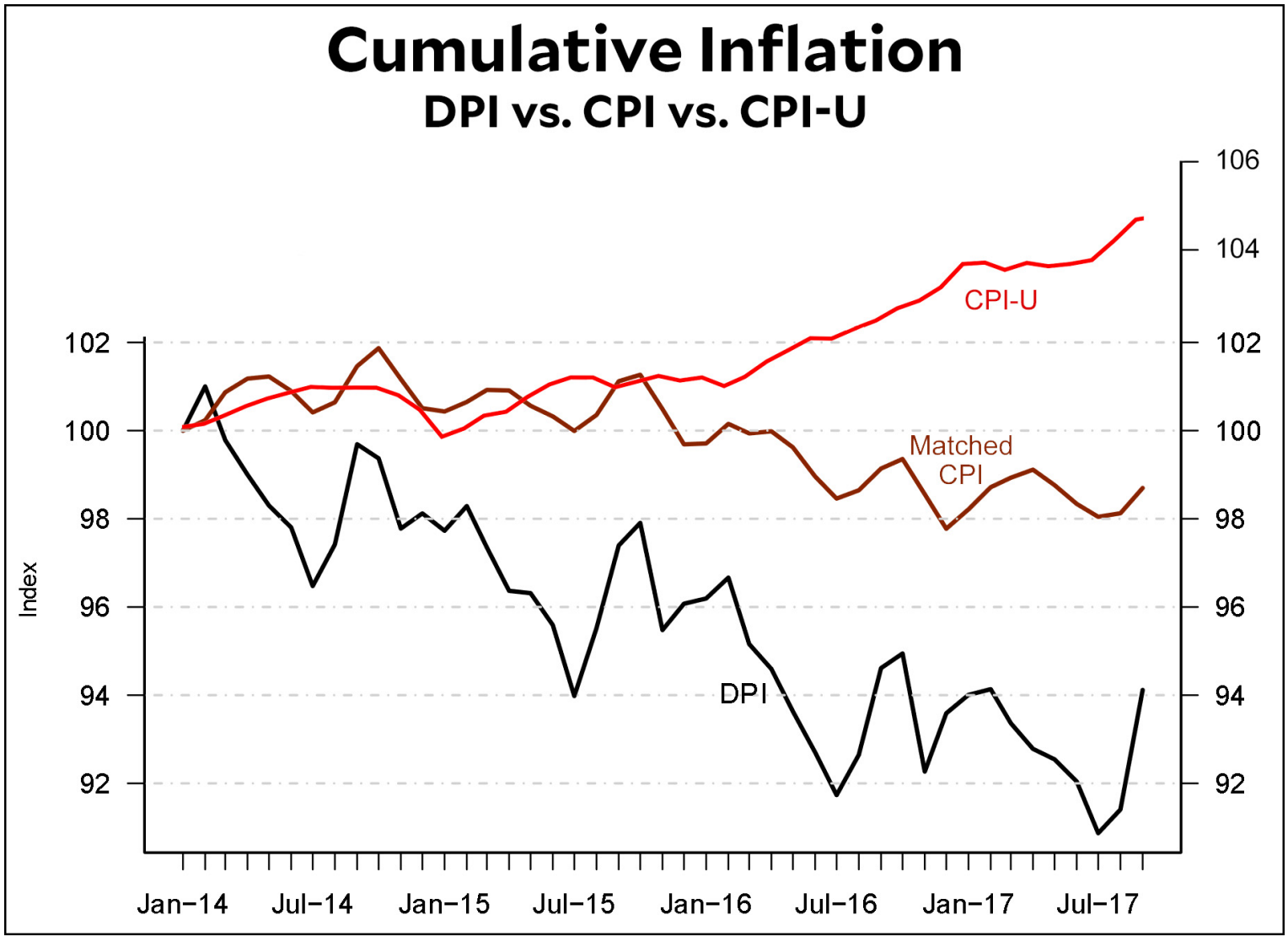
Outline

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 65 CPI categories (Entry Level Items, or ELI's)
- CPI relative importance weights across categories

Cumulative inflation, DPI vs. CPI



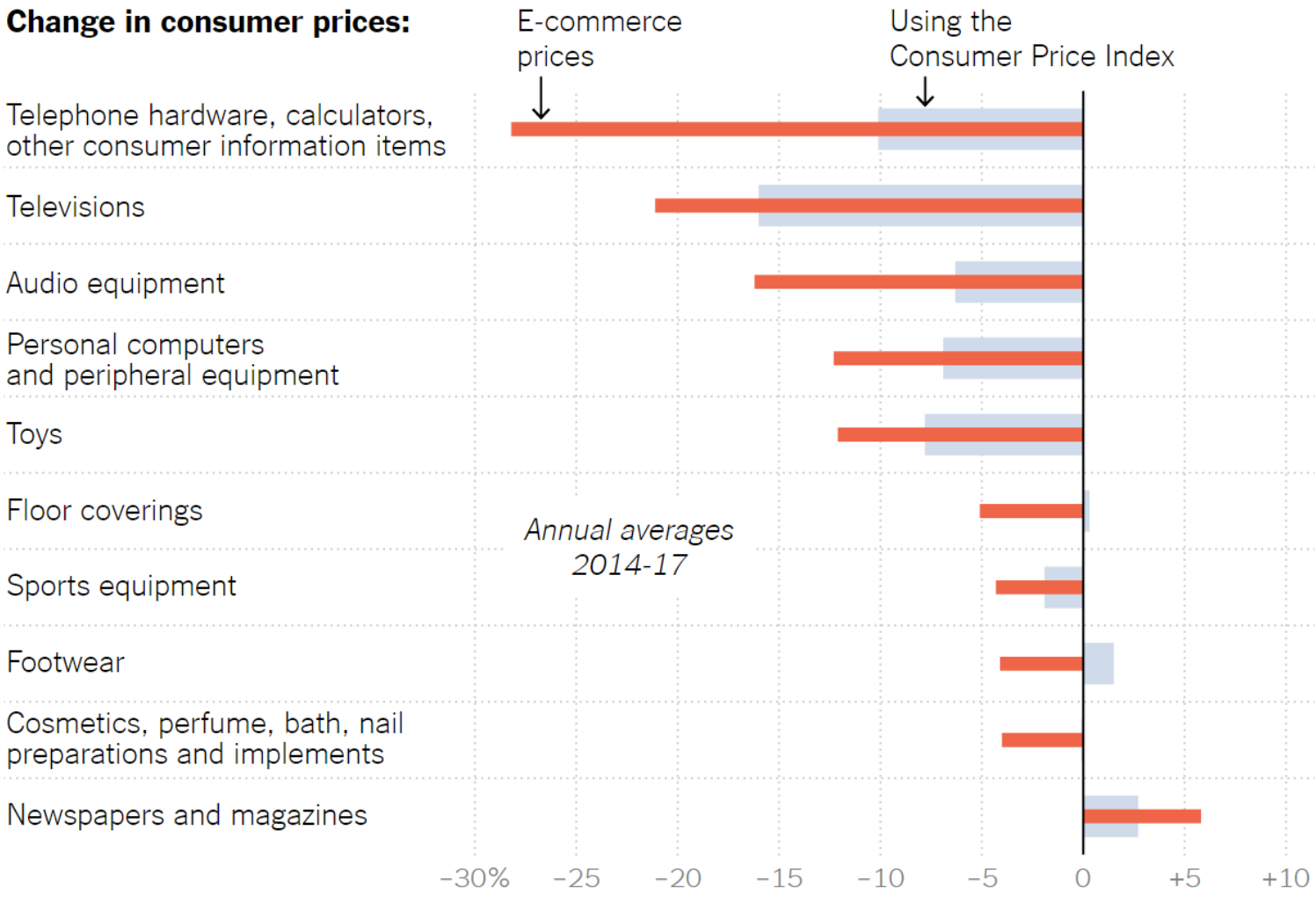

Cumulative Inflation
DPI vs. CPI vs. CPI-U
Index
106
104
102
100
98
96
94
92
CPI-U
Matched
CPI
DPI
Jan−14
Jul−14
Jan−15
Jul−15
Jan−16
Jul−16
Jan−17
Jul−17

2014–2017 Annual Inflation, DPI vs. CPI

	DPI	CPI
Headline	**–1.6**	**–0.3**
Recreation goods	–6.1	–3.0
Household goods	–4.8	–1.9
ICT	–6.6	–3.7
Food and beverages	–0.9	0.3
Apparel	–0.1	0.8
Other goods and services	0.8	1.7
Transportation accessories and parts	–1.2	–0.4
Medicines and medical supplies	1.3	–0.2

Inflation vs. Inflation

Inflation has been very low in recent years, with prices of some goods falling. Analysis of online transactions suggests prices for some products have fallen more than in the Consumer Price Index.



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

Product Turnover

	Entry	Exit
Headline	51.4%	24.3%
Headline excluding Apparel	43.7%	21.9%

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

Product Turnover: Food vs. Headline

	Entry	Exit
Headline	51.4%	24.3%
Food and beverages	15.7%	9.2%

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

Product Entry and Exit by Major Group

	Entry	Exit
Apparel	70.8	30.3
Recreation goods	61.1	20.7
ICT	60.8	31.7
Other goods and services	49.9	13.4
Household goods	30.5	19.0
Transportation accessories and parts	24.6	16.9
Food and beverages	15.7	9.2
Medicines and medical supplies	11.1	7.6

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Inflation bias from variety growth (% points per year)

	$\sigma = 4$	$\sigma = 6$
Headline	3.5	2.1
Headline excluding Apparel	**2.5**	**1.5**

Using CPI category weights.

This variety bias is *on top of* the matched-model differences.

Variety bias by Major Group (% points per year)

	$\sigma = 4$	$\sigma = 6$
Apparel	7.3	4.4
Other goods and services	5.9	3.9
Recreation goods	5.4	3.2
ICT	4.1	2.5
Household goods	0.9	0.5
Transportation accessories and parts	0.7	0.4
Food and beverages	0.4	0.2
Medicines and medical supplies	0.0	0.0

Conclusions

- Online inflation was about 1 % point per year lower than in the CPI for the same categories from 2014–2017
- Increased variety online implies an additional 2 % points per year lower inflation than in matched model / CPI-style indices
- **Question**: Is e-commerce holding down offline inflation?