

Accounting for Innovation in Consumer Digital Services: Implications for economic growth and consumer welfare

David Byrne, Federal Reserve Board

Carol Corrado, The Conference Board and Center for Business and
Public Policy, McDonough School of Business, Georgetown University

Fifth World KLEMS Conference

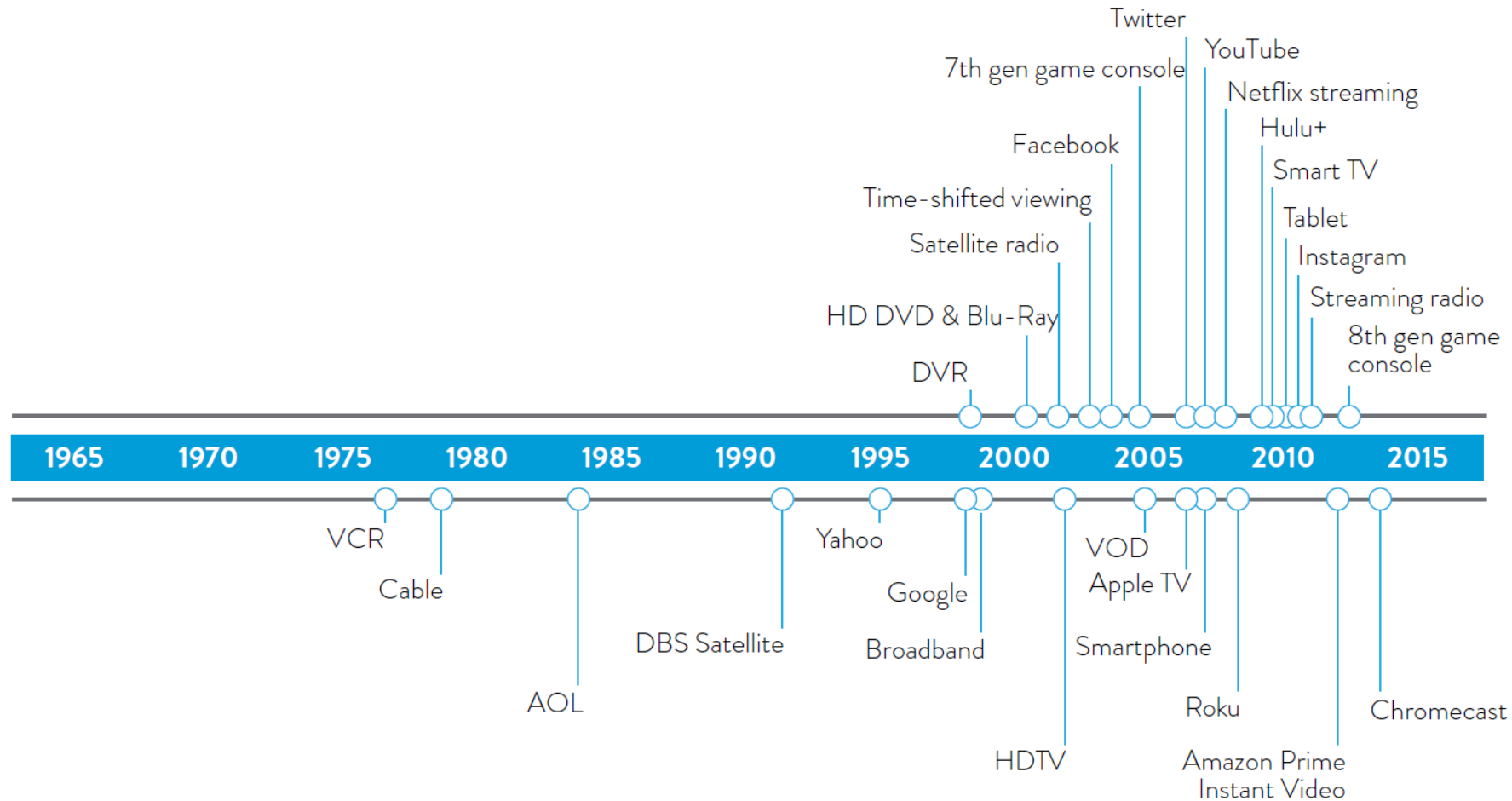
Cambridge, MA

June 4-5, 2018

Consumer durables have digitized...

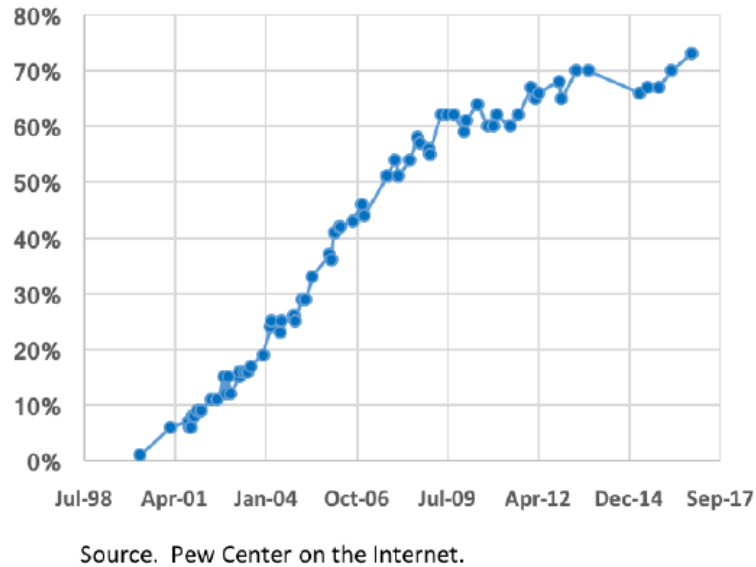


...spawning new consumer services...

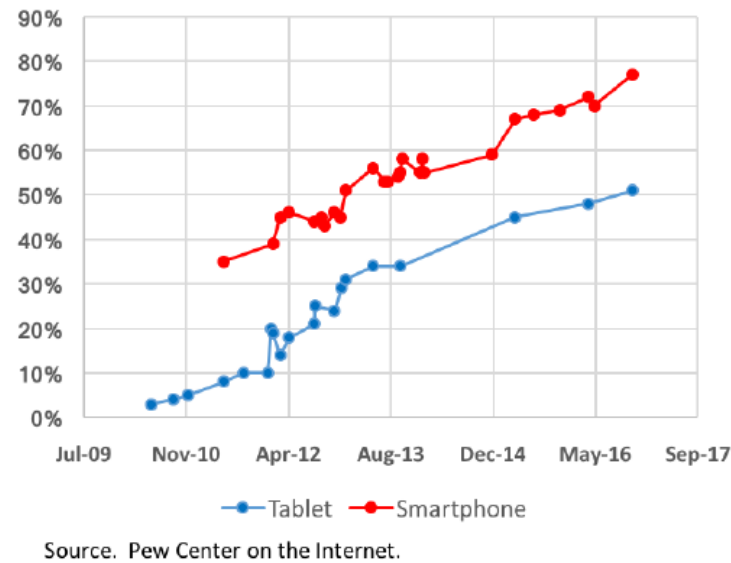


... and boosting use intensity.

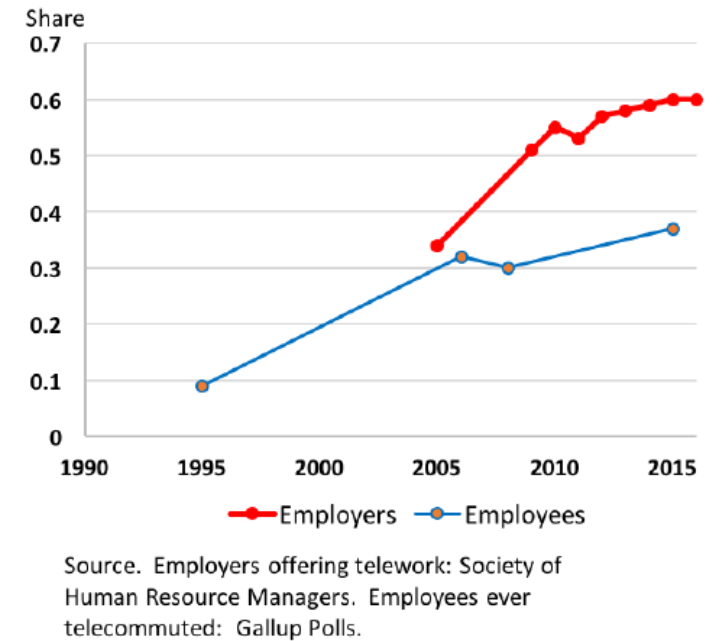
Indicators of U.S. Consumer Digital Capital Use



(a) Broadband Use



(b) Mobile Device Use



(c) Prevalence of Telework

Challenges for national accounts

- Quality change
- New goods
- “Free” goods
- Border between household and business activity
- Use intensity

Should we adjust the national accounts?

- Research question:

Will capitalizing consumer digital goods and imputing a service flow to them capture consumer digital innovation in national accounts?

- Key moves

- Quality-adjusted prices for digital goods

- Quality-adjusted prices for digital services *accounting for use intensity*

Approach: Demand Complementarity

- Consumer digital services reflect household use of digital devices and their take up of network access services.
 - Digital device services and internet access service work together to deliver consumer content
 - How to account for quality change in these services?
- Demand complementarity between the use of devices and use of access services suggests the quality of digital services is related to
 - The quality of the devices and equipment used to access/consume content delivered via the network
 - The use intensity of these devices via the use intensity of network services

Approach: Digital Capital Services

- Measure household digital service flows w/ user cost expression
 - $P_T^{S^H} S_T^H$: HH digital service flow
 - $(\bar{\rho} + \delta_T^H) P_T^{I^H} K_T^H$: User cost
 - λ : Factor of proportionality representing average use intensity of stocks
 - $\dot{P}_T^{S^H} = \dot{P}_T^{I^H} - \dot{\lambda}$: Price change for digital capital services
- Household use rates affect willingness to pay for digital access equipment

Approach: Digital Access Services

- Consumer perspective: payment for subscription plans are $P^{C_T^B} C_T^B$, where C_T^B is the quantity of services *consumed*.
- The use intensity of consumer digital capital is thus $\lambda = \frac{C_T^B}{N}$
- Producer perspective: total services Offered is $P^{O_T^B} O_T^B$ and $\frac{P^{O_T^B} O_T^B}{N}$ is the price of a plan.
- To arrive at $P^{C_T^B}$, we adjust for the service quantity from the consumer's perspective.

Approach: Digital Access Services

- Controlling for IP traffic is a simple approach

$$P^{C_T^B} = \frac{P^{O_T^B} O_T^B}{IP}$$

- Which we refine by distinguishing by types of service and aggregating
- The combined changes in the various margins of use is the difference between the price index for access services and the average price paid:

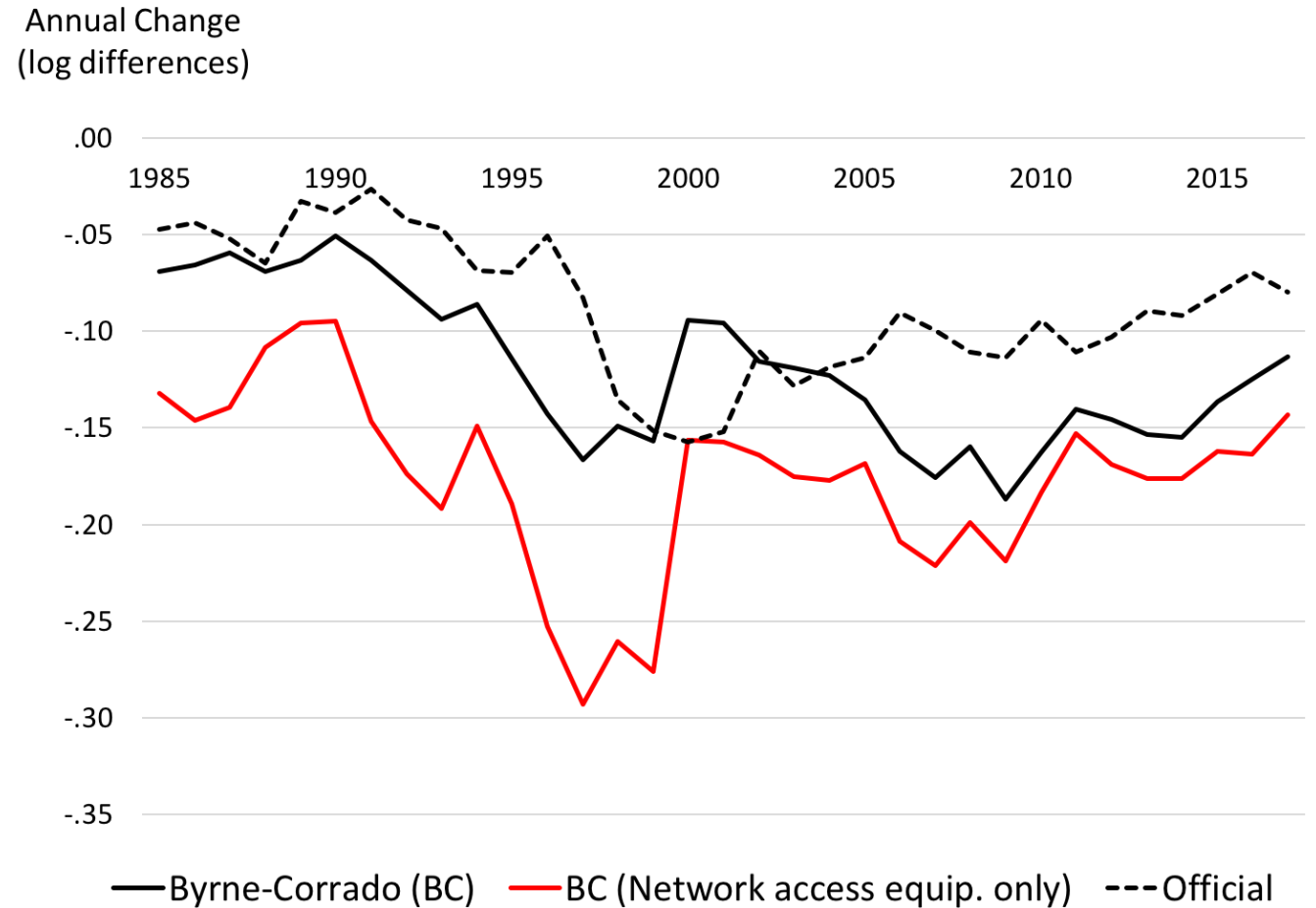
$$\dot{\lambda} = P^{\dot{C}_T^B} - \left(\frac{P^{O_T^B} O_T^B}{N} \right)$$

Implementation

- We capitalize 14 detailed product classes of consumer digital goods (TVs, computers, cameras, etc.) and estimate quality-adjusted asset prices (based in part on Byrne and Corrado, 2015, 2017)
- Capital services prices for a subset, termed “network access equipment”, are adjusted for use intensity.
- 5 categories of service: internet access, smartphone, subscription video-on-demand, conventional cellular phone, cable TV
- IP data traffic internet, smartphone, and SVOD
- Hours for cable TV
- No use adjustment for conventional cellular phone

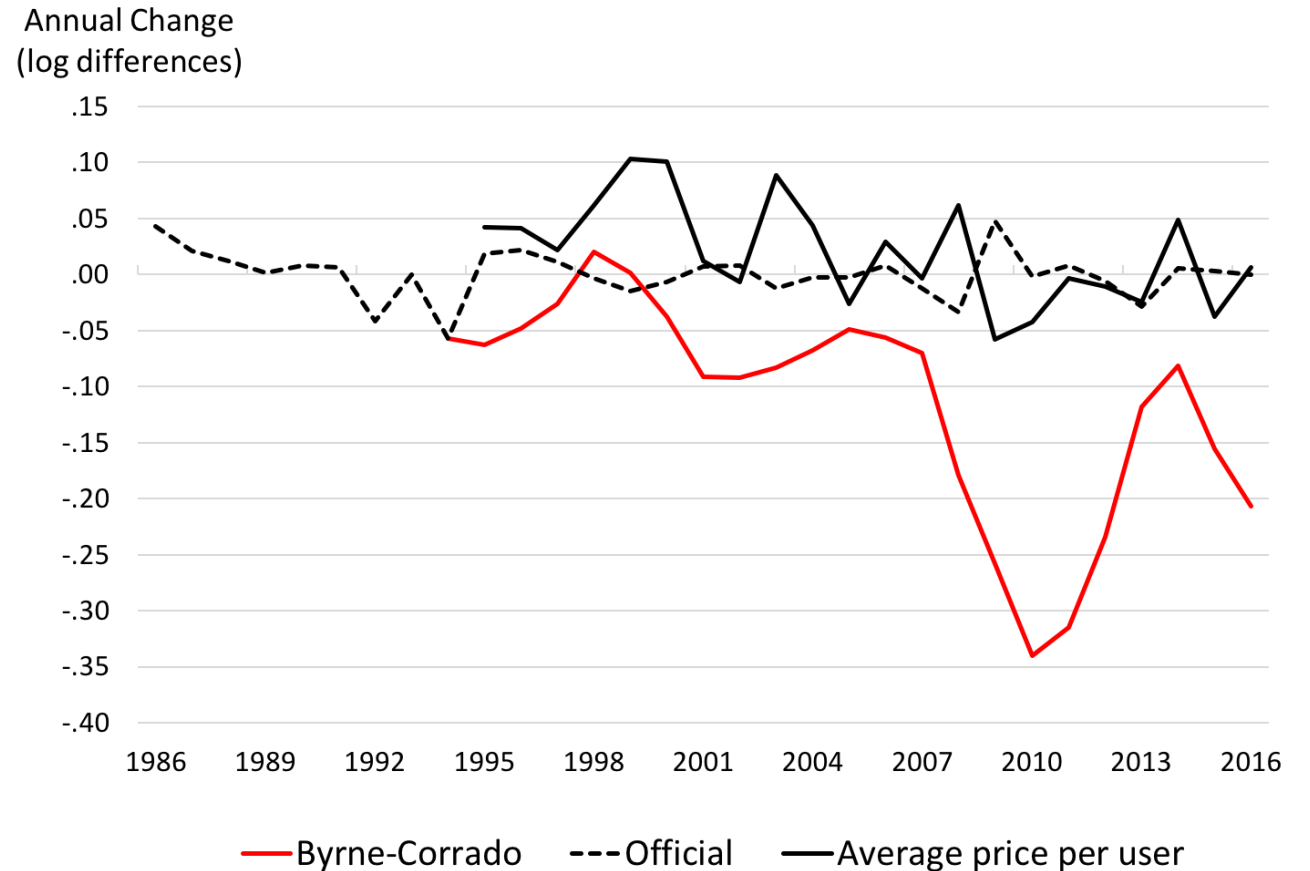
Results: Price Indexes for Goods

Declines in official price index are understated, especially after 2005...



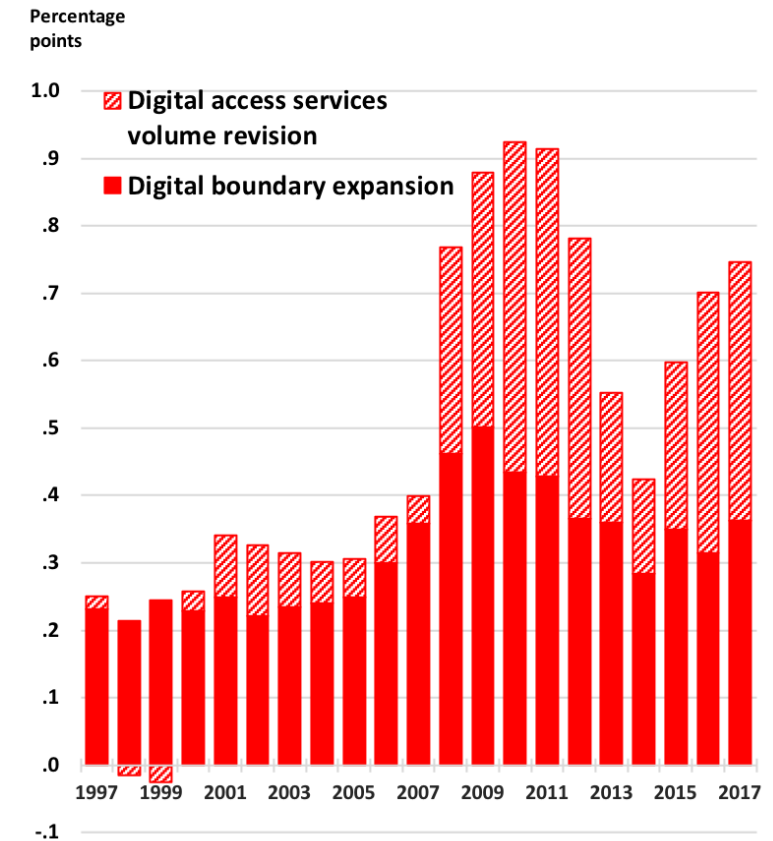
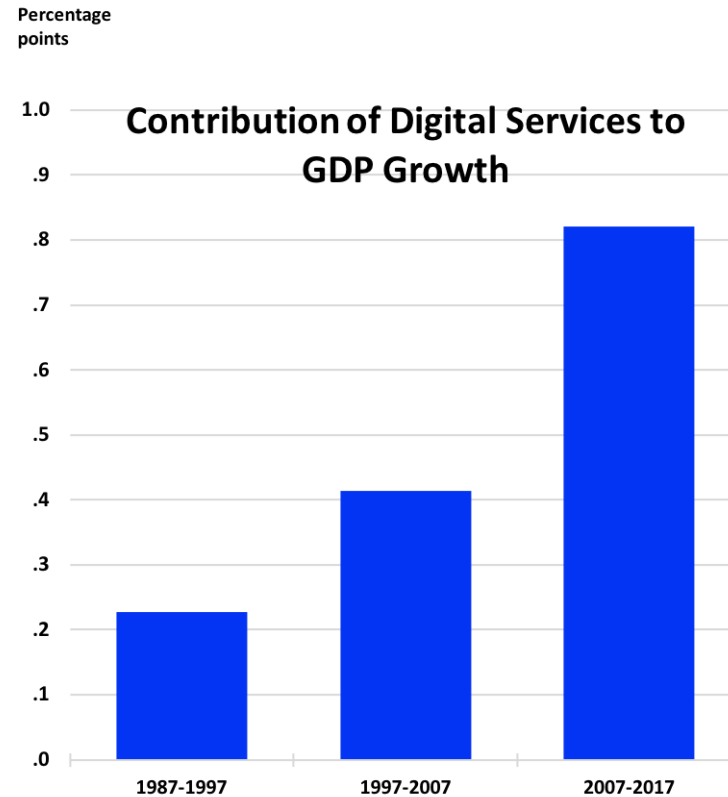
Results: Price Indexes for Services

- Massive difference relative to official index after 2005 (16 ppts)
- Utilization (λ) contributes additional -8 ppts to consumer capital services price change after 2005



Results: GDP

- New consumer digital services measures (both series) add .8 ppts per year since 2007
- Swing in post-2005 growth is .4 ppts per year

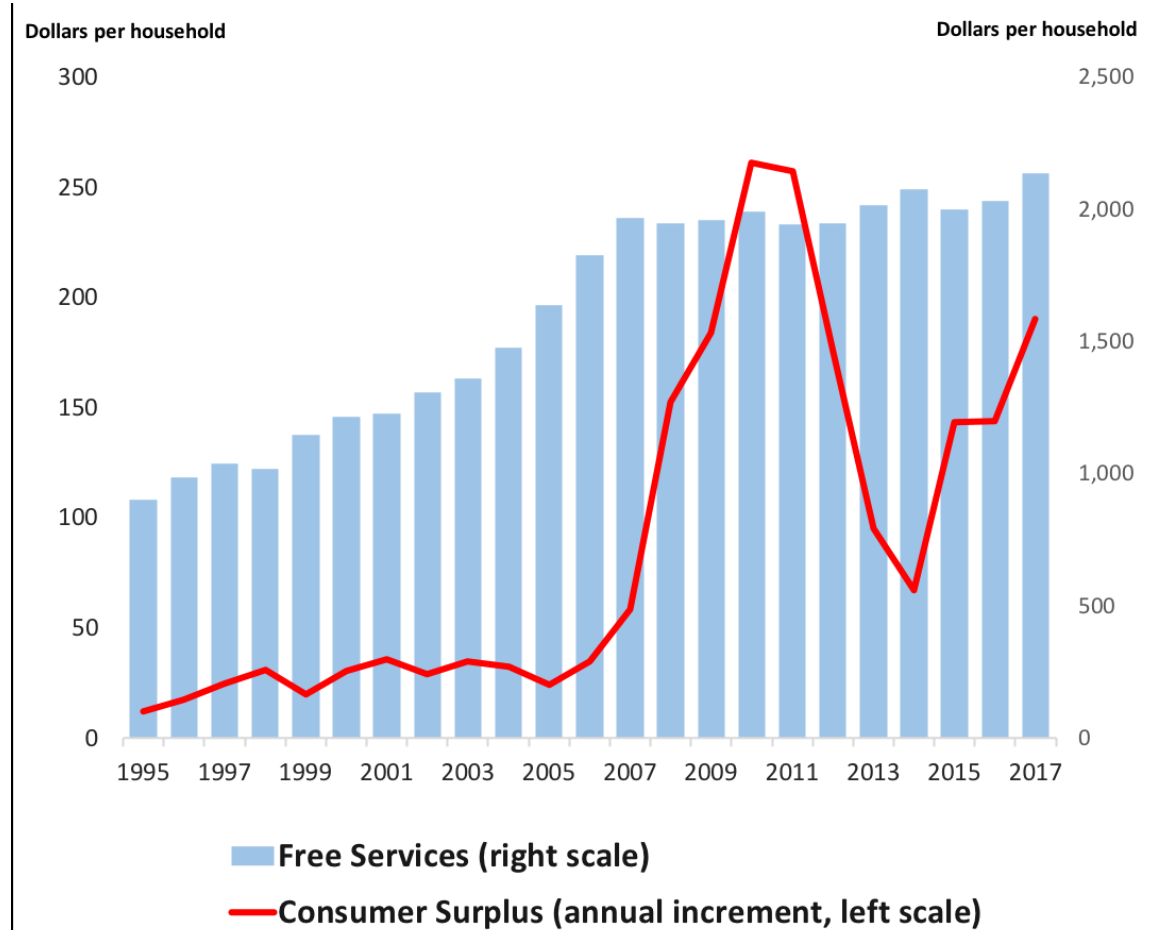


Results: Consumer Surplus

- Consumer surplus from continuing commodities:

$$.5(\Delta P_T^{S^H} \Delta S_T^H) +$$
$$.5(\Delta P_T^{C^B} \Delta C_T^B)$$

- Change from 2007 to 2017: \$26,985 per internet-using household.



Conclusions

- Nagging concerns that the national accounts are missing massive innovations in digital consumer goods and services seem justified.
- Substantial progress can be made by:
 - Capitalizing consumer digital goods
 - Accounting for their increased use as content delivery devices
 - Capturing quality change in prices for digital goods and services
- Significant implications for gauging welfare gains and measuring productivity.