# Using Massive Online Choice Experiments to Measure Changes in Well-being

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# How Are We Doing?

SEARCH

The New York Times

ECONOMY

*U.S. Economy Grew at 3.2% Rate in 3rd Quarter*

By THE ASSOCIATED PRESS NOV. 29, 2016

The United States economy in the third quarter grew at the fastest pace in two years, according to a revised report that showed stronger consumer spending than first estimated.

Sections

The Washington Post

*Democracy Dies in Darkness*

Wonkblog

U.S. economy grew at sluggish 0.7 percent in first quarter of 2017

By Ana Swanson and Max Ehrenfreund April 28

"...a measure for **standard of living**: average real **gross domestic product (GDP)** per capita" – Boston Fed

"**Productivity** is the most important determinant of the **standard of living**" – Forbes

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**“The welfare of a nation can scarcely be inferred from a measurement of national income as defined [by the GDP.]”**

***- Simon Kuznets, 1934***

**GDP is a measure of production, not well-being**

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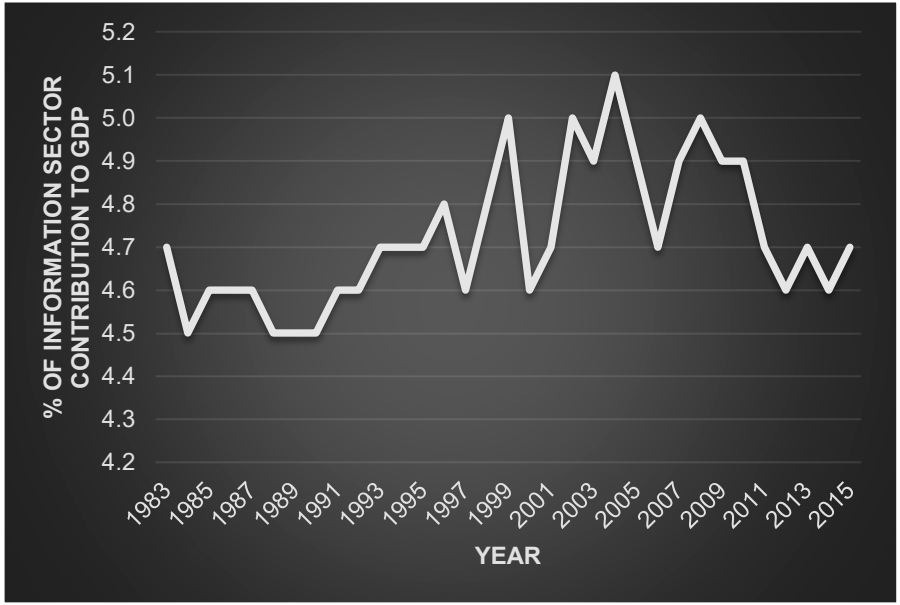
# IT & GDP

## Explosion of free digital goods

## Information goods as a share of GDP

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# Our Approach

- **Estimate Consumer Welfare Directly**

- **Key techniques: Online Choice Experiments and Lotteries**
  1. Single Binary Discrete Choice Experiments
  2. Becker-DeGroot-Marschak Lotteries
  3. Best-Worst Scaling

- **Both with and without incentive compatibility**

- **At Massive scale**

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# Key Findings

1. **Choice experiments generate plausible demand curves**
   - Valuations are consistent across BDM lotteries, best-worst scaling and SBDC experiments
   - But incentive compatible experiments often imply higher valuations
2. **Median valuations**

   Search > email > maps > video > e-commerce > social media > messaging > music
3. **Consumer surplus from Facebook in USA:**

   $450/year for median consumer
4. **This approach could be scaled up to numerous goods and services**

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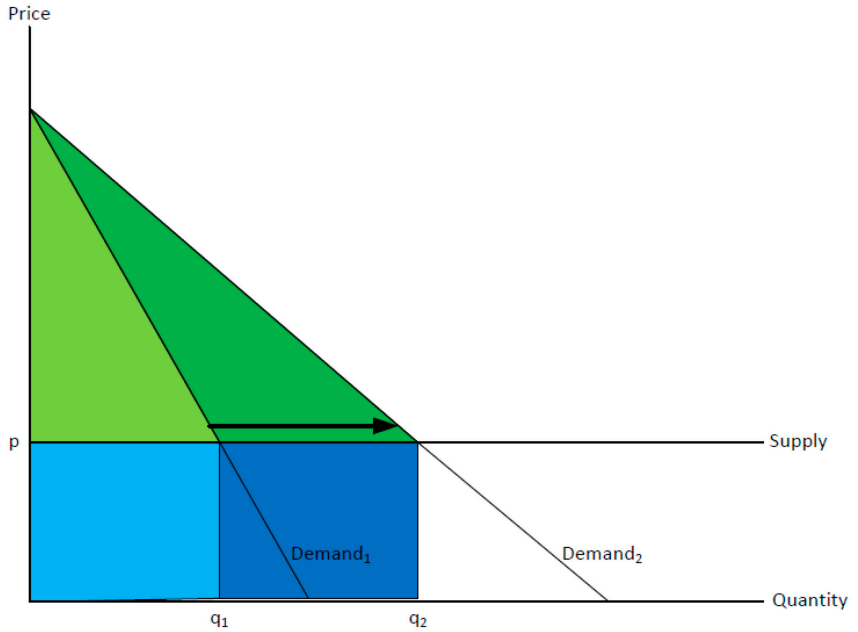
# GDP vs. Consumer Welfare

# ΔProduction vs. ΔConsumer Surplus

**Case 1: Classic Goods**

E.g. Automobiles, haircuts, food

GDP ↑, Consumer Surplus ↑

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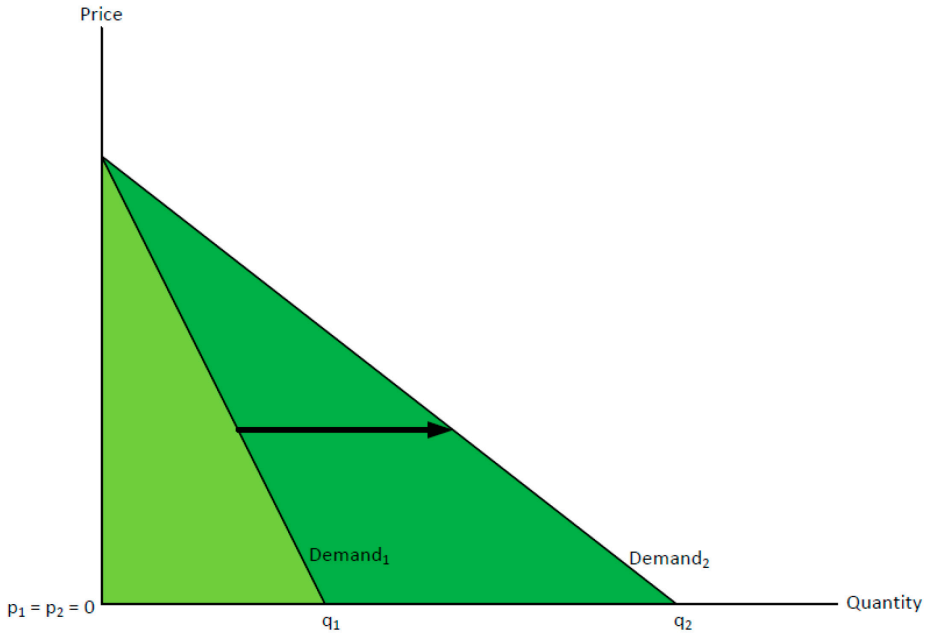
# ΔProduction vs. ΔConsumer Surplus

## Case 2: Digital Goods

E.g. Increased use of free maps on smart phones or more digital photos;
Special case: Free digital apps that never existed before

GDP no change,
Consumer Surplus ↑

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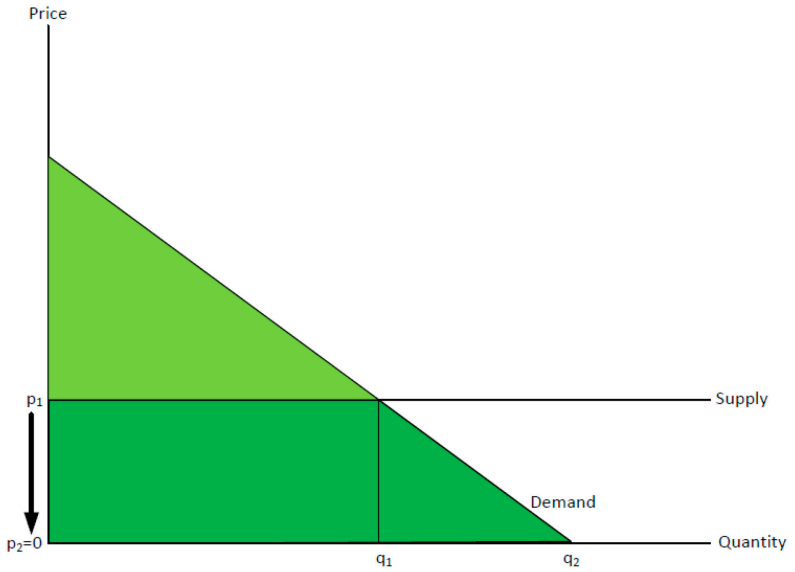
# ΔProduction vs. ΔConsumer Surplus

**Case 3: Transition Goods**

E.g. Encyclopedia
(Wikipedia vs. Britannica)
Chemical photography to digital photography

GDP ↓, Consumer Surplus ↑

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# Example: Smartphones

Smartphones substituted

- Camera
- Alarm Clock
- Music Player
- Calculator
- Computer
- Land Line
- Game Machine
- Movie Player
- Recording Device
- Video Camera

Plus:

- Data plan
- GPS Map and directions
- Web Browser
- E-book reader
- Fitness monitor
- Instant messaging

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# What about producer surplus?

- **Nordhaus (2005): Innovators able to capture only 3.7% of social returns to innovation between 1948-2001**
  - If the share of producer surplus contribution to the total social surplus remains relatively stable, then consumer surplus would have to be scaled up by a small fraction
  - However, measuring simply the consumer surplus might be a concern if the producer surplus changes rapidly relative to the consumer surplus
    - Higher profit share recently?

# What about advertising revenue?

1. **Advertising is an intermediate good, not included in GDP.**
   - Nakamura, Samuels and Soloveichik (2017) show how to account for advertising within GDP framework, find 0.07% increase in GDP/year

2. **Advertising revenues are generally not proportional to consumer surplus and may reflect only a small share of it. (Spence and Owen 1977)**

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# Approach & Results

# Discrete Choice Experiments

- **Common in marketing, transportation, price-setting, damages calculations, etc.**
  - Widely used in industry for new product introductions and pricings
  - Accepted as evidence in legal cases
    - BP oil spill (Carson, List et al, *Science* 2017)
    - Samsung vs. Apple (Hauser vs McFadden), etc.

- **Three variants**
  1. Single Binary Discrete Choice Experiments
  2. Best-worst scaling
  3. Becker-DeGroot-Marschak (BDM) lotteries
  - Each can be done with or without incentive compatibility

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# Our Platforms for Choice Experiments

1. **Lab in a University**
   - Includes incentive compatible studies (where we enforce choices)
   - N = 500

2. **Professional Survey Panel (Peanut Labs)**
   - 3 million active verified panelists, user quotas selected to represent internet users in US, good for longer surveys (BWS)
   - N = 5000

3. **Google Consumer Surveys**
   - Market research platform, good for short surveys (SBDC)
   - N = 200,000

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# Single Binary Discrete Choice (SBDC) Experiments

- **Ask consumers to make a single choice among two options:**
  - ❑ **Keeping the good**
  - ❑ **Give up the good and receive $W in return**
  - Prices $W systematically varied between consumers
  - Seek to reduce error by increasing quantity of responses
    - Aggregation of data leads to demand curves
    - Can be done with or without incentive compatible design

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# Incentive Compatible SBDC Experiments

- **Randomly pick some respondents and fulfill their selection**
  - E.g. for Facebook
    - If user chose to keep Facebook, do nothing
    - If user chose to give up Facebook, then
      1. Ask them to give it up for 1 month
      2. After 1 month, verify whether they have used Facebook in the past month and reward them with $W
  - This can be done remotely: Facebook reports when user was last online
  - Random application to 1 in 200 users suffices for Incentive compatibility

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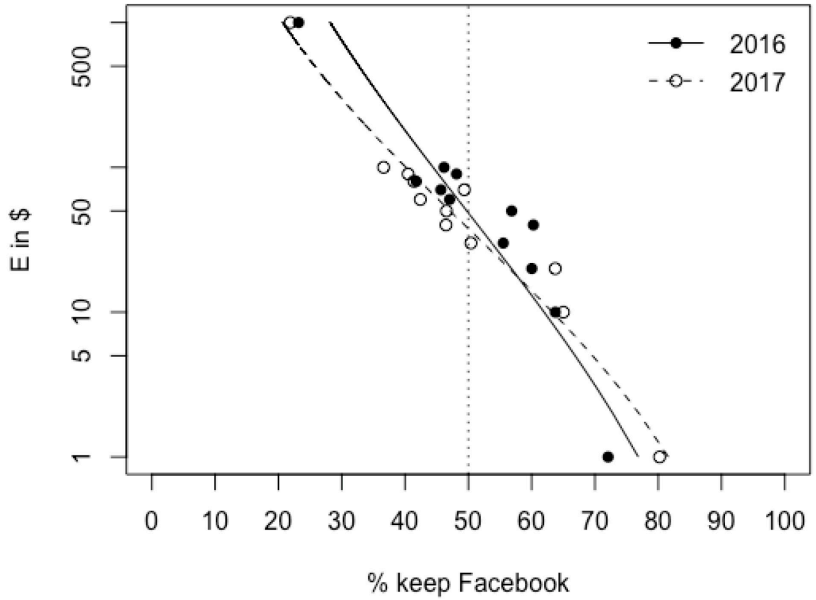
# Facebook study with Incentive Compatibility

$n_{2016} = 1497$, $n_{2017} = 1388$

Median WTA: 2017 $37.76 / month

[$27.19, $51.97]




**Heterogeneity in valuation**

Higher valuations for people with

- More time spent on Facebook
- More friends they have
- More frequent posting
- More videos watched
- Female
- Older
- Less use of Instagram or Youtube

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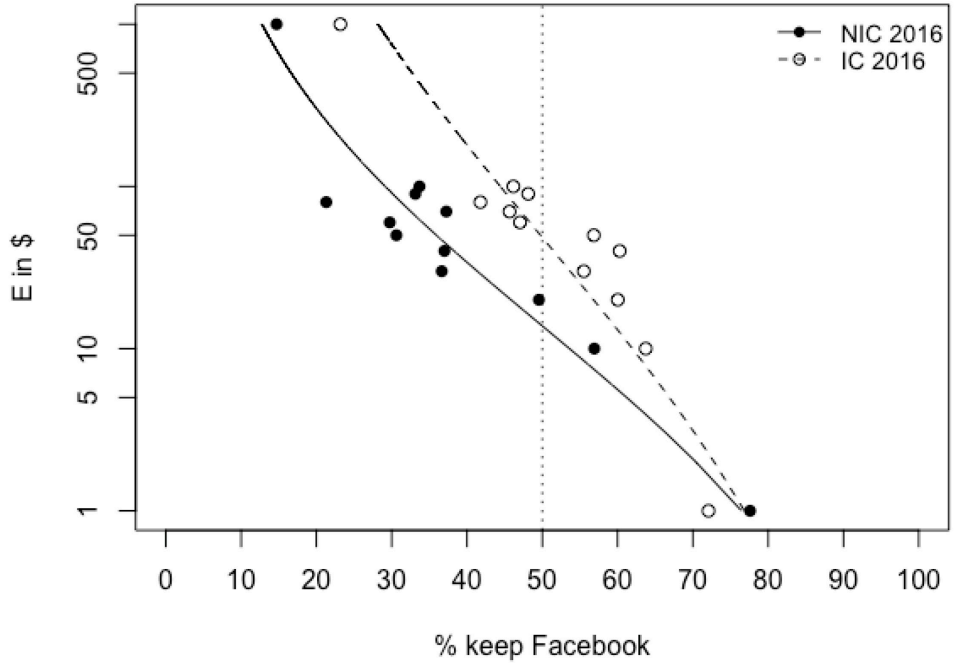
# Relaxing Incentive Compatibility




Values are *lower* for NIC condition => NIC is an underestimate

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# BDM Lottery

## Use Approach of Becker, DeGroot, and Marschak 1964

1. We ask minimum amount of money they would accept to give up Facebook for 1 month

2. After the survey, a random price is drawn from a uniform distribution of values.
    - If the random price is lower than the bid, the respondent will receive no money but can keep the access to Facebook.
    - If the random price is higher than the bid, the respondent will be paid the random price when giving up Facebook for 1 month.
        - We can remotely monitor whether they access Facebook for that month

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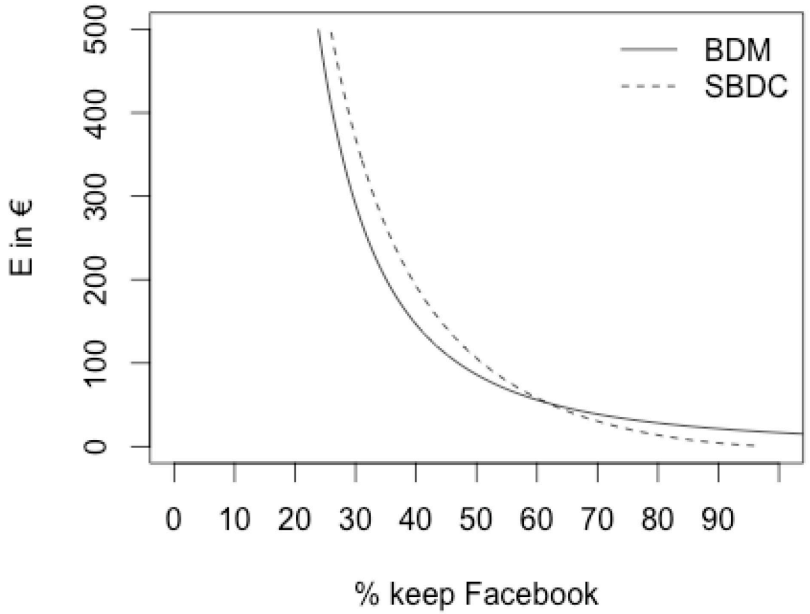
# SBDC vs. BDM




N = 139 (BDM) and 356 (SBDC)

Observed shares between SBDC and BDM correlate strongly (Correl. = 0.891)

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# Scale up using Google Consumer Surveys (NIC)

The Daily Globe | Top Stories | World | US | Business

## Fair Use Digital Circulation Strategy Information Overload

*The Work of Art in the Age of Mechanical Reproduction*

*Matthew Dodd* from the January 16, 2013 issue

Jurgen Habermas R&D Android cops beat The Weekender mathewi Tim Carmody attracting young readers tweets, collaboration tags the medium is the message blog plagiarism horse-race coverage advertising the other longer Book Review....

Privacy put the paper to bed Fuego news.me photo source: proimos/flickr

Please complete the following survey to access this premium content.

Would you prefer to keep access to Facebook or go without access to Facebook for one month and get paid $5?

- ○ Give up Facebook and get paid $5
- ○ Keep access to Facebook

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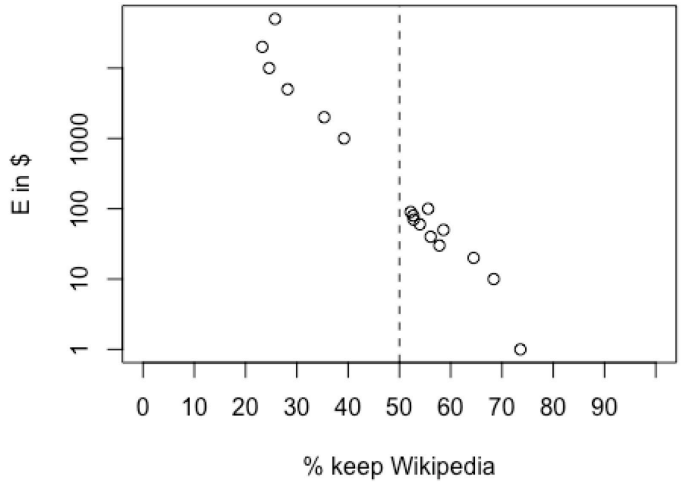
# Some Implied Demand Curves and WTA

**Wikipedia: $WTA_{median}$ = $150/year**

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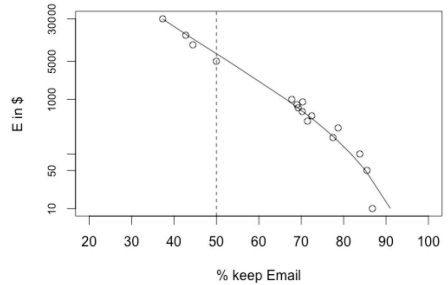
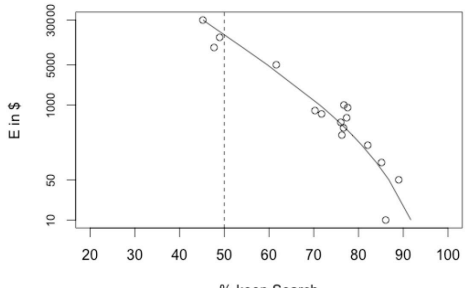
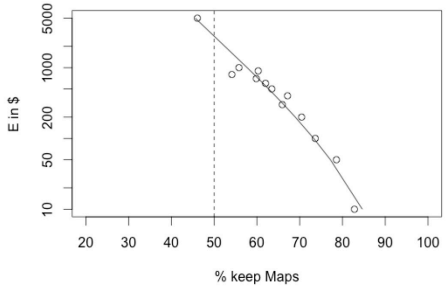
# Most widely used categories of digital goods



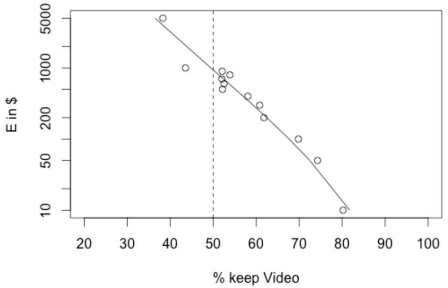

**Email**




**Search**




**Maps**




**Video**

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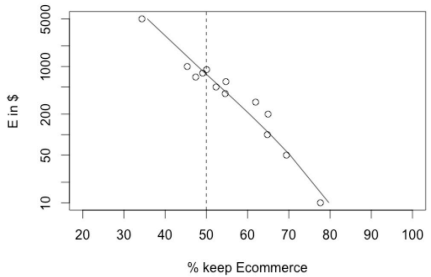
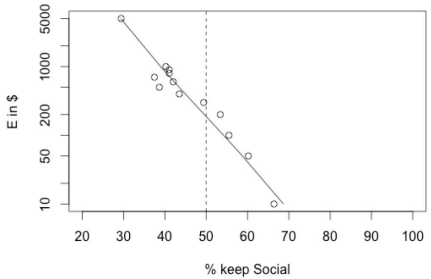
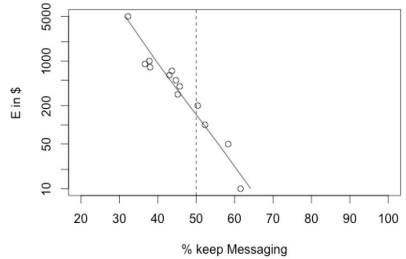
# Most widely used categories of digital goods



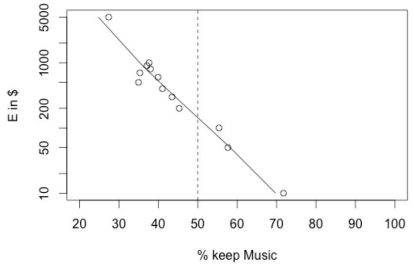

**E-Commerce**




**Social Media**




**Messaging**




**Music**

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# Most widely used categories of digital goods

| Category | Median WTA/year 2016 | Median WTA/year 2017 | 95% CI 2016 | | 95% CI 2017 | | n |
|---|---|---|---|---|---|---|---|
| | | | lower | upper | lower | upper | |
| **All Search Engines** | $14,760 | $17,530 | $11,211 | $19,332 | $13,947 | $22,080 | 8,074 |
| **All Email** | $6,139 | $8,414 | $4,844 | $7,898 | $6,886 | $10,218 | 9,102 |
| **All Maps** | $2,693 | $3,648 | $1,897 | $3,930 | $2,687 | $5,051 | 7,515 |
| **All Video** | $991 | $1,173 | $813 | $1,203 | $940 | $1,490 | 11,092 |
| **All E-Commerce** | $634 | $842 | $540 | $751 | $700 | $1,020 | 11,051 |
| **All Social Media** | $205 | $322 | $156 | $272 | $240 | $432 | 6,023 |
| **All Messaging** | $135 | $155 | $98 | $186 | $114 | $210 | 6,076 |
| **All Music** | $140 | $168 | $112 | $173 | $129 | $217 | 6,007 |

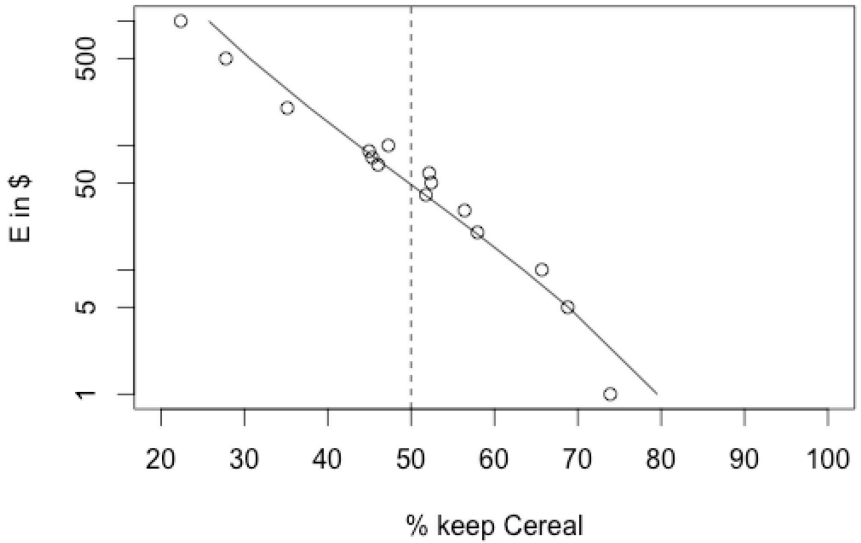
# Non-digital goods: Breakfast Cereal

$WTA_{median}$ = $48.46/year

[$42.01, $55.60]

**Implied Consumer Surplus = $15 billion**

**Compare: US Cereal Revenue = $10 billion**

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# Another approach: Best-Worst Scaling

E-Commerce

vs.

Music Streaming

| Maps + Earn $100 less/ year | vs. | No Maps + Earn same as now |
|---|---|---|

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# Another approach: Best-Worst Scaling

- All Internet
- Smartphone
- Email
- Search Engines
- E-Commerce
- Music
- Video
- Social Media
- Maps

- Facebook
- Twitter
- Instagram
- LinkedIn
- Skype
- Snapchat
- Uber
- WhatsApp
- Wikipedia

- Toilets at home
- TV
- Meeting friends in person
- Breakfast cereal
- Airline Travel
- Public Transport

- Earn $10 less /yr
- Earn $100 less /yr
- Earn $500 less /yr
- Earn $1000 less /yr
- Earn $5000 less /yr
- Earn $10,000 less /yr

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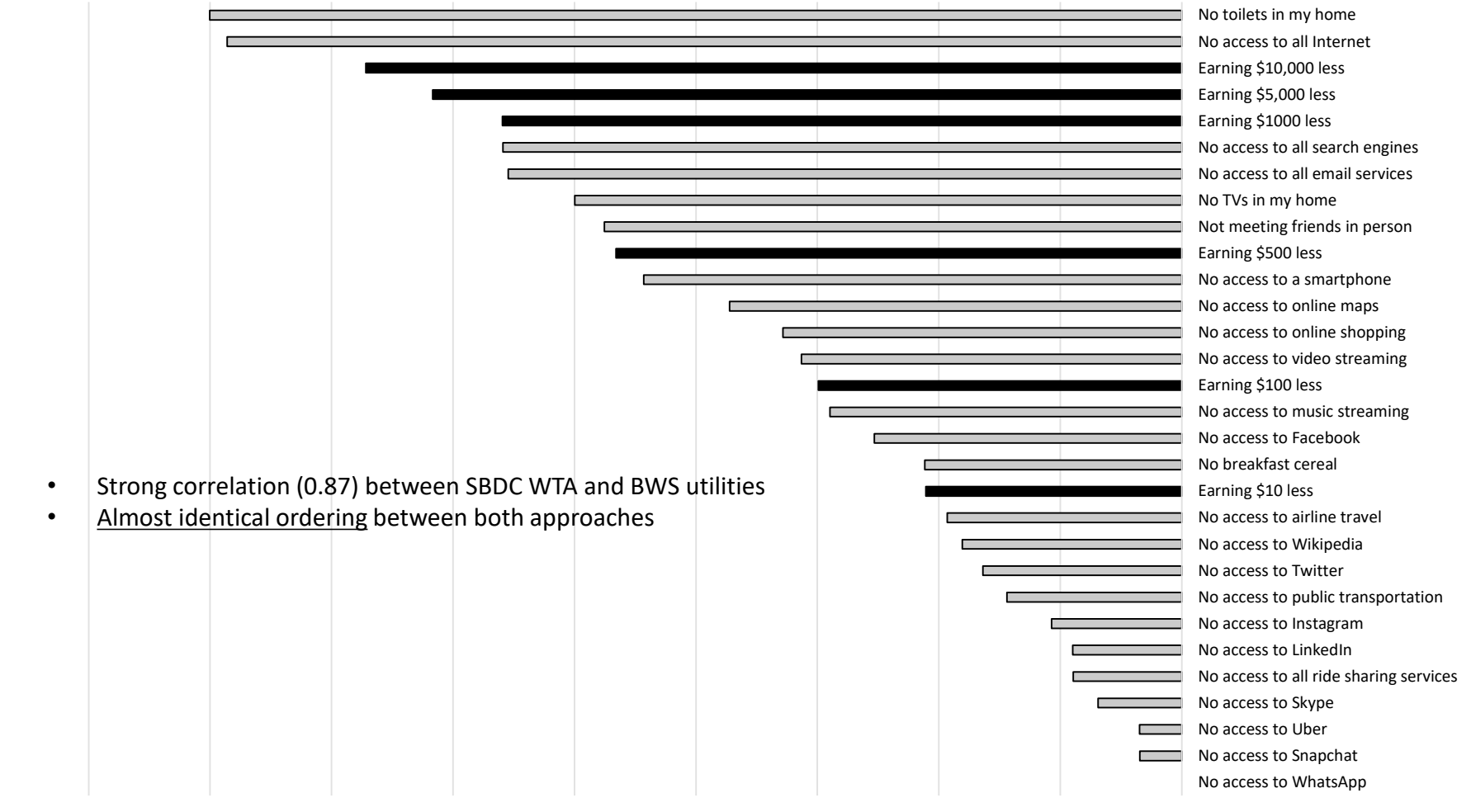
# BWS Results: Disutility from losing access to goods for 1 year




- Strong correlation (0.87) between SBDC WTA and BWS utilities
- Almost identical ordering between both approaches

# Integrating GDP growth accounting for free goods

**Brynjolfsson, Diewert, Eggers, Fox & Gannamaneni (2017):**

- Derive an explicit term to measure the value of a free good on welfare change
  - Provide adjustments to national accounts to infer welfare from GDP
- Combine this framework with our choice experiments to empirically estimate adjustments to national accounts to include free digital goods

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# GDP growth accounting for new and free goods

$$Q_{Full}^{A} = Q^{F}$$

$$+ (p_0^{0*} - p_0^{1})q_0^{1}/[p^0 \cdot q^0 (1+P^F)]$$ → adjustment for new goods

$$+ (w_0^{0*} - w_0^{1})z_0^{1}/[p^0 \cdot q^0 (1+P^F)]$$ → adjustment for new free goods

$$+ [2w^0 \cdot (z^1 - z^0) + (w^1 - w^0) \cdot (z^1 - z^0) + 2w_0^{1}z_0^{1}] /[p^0 \cdot q^0 (1+P^F)]$$ → adjustment for continuing free goods

Where

**$w^0$ = WTA of continuing free goods in period 0**
**$w^1$ = WTA of continuing free goods in period 1**
**$z^0$ = Quantity of continuing free goods in period 0**
**$z^1$ = Quantity of continuing free goods in period 1**
**$w_0^{0*}$ = Shadow WTA of new free good in period 0**
**$w_0^{1}$ = WTA of new free good in period 1**
**$z_0^{1}$ = Quantity of new free good in period 1**
**$p^0$ = Prices of non-free continuing goods in period 0**
**$q^0$ = Quantities of non-free continuing goods in period 0**
**$P^F$ = Fisher price index = $[(p^1 \cdot q^0/p^0 \cdot q^0)(p^1 \cdot q^1/p^0 \cdot q^1)]^{1/2}$**

$w^t$, $z^t$ = WTA and quantity of free goods in period t → Estimated through choice experiments

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# Conclusion

1. GDP, developed in 1930s, remains the de facto metric of economic growth.
2. Conceptually, consumer surplus is a better metric of well-being.
3. Massive online surveys have the potential to reinvent and significantly supplement the measurement of economic welfare.
   - Can be used for goods whether they have zero price or positive price
   - Highly scalable
   - Can be run in near real time to track changes in well-being
4. This approach can be incorporated into the national accounts

# References


1. Brynjolfsson, Eggers & Gannamaneni (2017). *Using Massive Online Choice Experiments to measure changes in Well-being*. Working Paper.
2. Brynjolfsson, Diewert, Eggers, Fox & Gannamaneni (2017). *The digital economy, GDP and Consumer Welfare*. Working paper (available in Dec 2017).
3. Brynjolfsson, Eggers & Gannamaneni (2017). *Hypothetical bias in choice experiments*. Working paper (available in Jan 2018).


**Please Join us at 2:30pm on Jan 5 2018 at the AEA annual meetings (Philadelphia) for our session on "New Measures of the Economy"**

1. Erik Brynjolfsson, Felix Eggers and Avi Gannamaneni
2. Michael Porter and Scott Stern
3. Austan Goolsbee and Peter Klenow
4. Alberto Cavallo, Erwin Diewert, Robert Feenstra, Robert Inklaar, Marcel Timmer

# Can We Incorporate This Into the National Accounts?

- **For goods which have a price:**
  - We can often infer welfare from national accounts
    - Consider effects of changes in prices and quantities on welfare
  - E.g. Hulten 1978, Diewert 1983, Jorgenson and Slesnick 2014, and others.

- **For new goods:**
  - Try to estimate virtual price (aka shadow or reference price) in pre-launch period which would imply 0 units of consumption
    - Then infer welfare using similar methods
  - E.g. Hicks 1920, Diewert 1980, Hausman 1994, Feenstra 1994

- **Other issues to consider:**
  - Intangibles, quality adjustments, household production etc.

- **Many alternative indexes for happiness, subjective well-being etc.**

***Challenge*: Integrate free goods**

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