Discussant Comments

Accounting for Growth in the Age of the Internet: The Importance of Output-Saving Technical Change

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Conference on Research in Income and Wealth, Summer Institute

July 18, 2017

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Puzzle addressed by this paper

- Slowdown in U.S. productivity, real GDP per capita, real consumption per capita
- Strong perception that the consumption slowdown is artificial because benefits of Internet to consumers are understated.

Measure	1995–2004	2004–2016
Labor productivity	3.1%	1.3%
Multifactor productivity	1.6%	0.4%
Real GDP/capita	2.3%	0.8%
Real personal consumption/capita	2.8%	1.1%

Hypothesis: Innovation directly affects consumer welfare

- What if recent innovation is targeted directly at consumer welfare rather than at producers?
  - Slowing GDP growth could still be consistent with rapid growth in standard of living
- Paper uses Lancaster (1966) model
  - "Consumer technology" transforms goods acquired by consumers into "commodities" that are inputs into utility function
  - Shifts in consumer technology allow consumers to get more utility from a given expenditure
  - First part of paper assumes that these shifts come through costless improvements in product quality
  - Described as "output saving" technical change

How free is the Internet?

- Schmidt and Rosenberg (2014): “the internet has made information free, copious, and ubiquitous” to the consumer.

- But consumers pay a lot to access the Internet:

Personal consumption expenditures category	Total (2016 - billions)	Per household (2016)
Internet access	106.2	909
Cellular telephone services	124.7	1,066
Personal computers & peripheral equipment	61.2	524
Computer software & accessories	52.0	445
Telephone equipment	18.3	156

Closed vs open economy

- Paper frames issue in terms of a closed economy
- "World" is closed, but most data are national statistics—open

Economy	GDP: 1995–2004	GDP: 2004–2016
Advanced economies	2.8%	1.5%
World	3.8%	3.8%

- No slowdown in World GDP
- Over last 20 years, ICT increasingly imported
- Gains from trade may allow ↑ Consumption > ↑ GDP
- Offshoring bias (Houseman, et al., 2011; Reinsdorf and Yuskavage, 2014) in conjunction with traditional CPI bias suggests that U.S. official statistics understate gains to consumers from trade

Model of consumer technology – Lancaster? or Becker?

- Traditionally, Lancaster model has been used to take advantage of working in characteristics space
  - Hulten and Nakamura don't really emphasize characteristics; focus on shifting consumption technology as information and product quality increase.
- Might consider another approach to consumption technology from Becker's (1965) theory of the allocation of time.
  - Utility a function of "commodities" which are produced from market goods and time: $U = U(Z_1, \ldots, Z_m)$, where $Z_i = f_i(x_i, T_i)$
- Would permit analysis of effects of technology on time use

E-Commerce and time use

- **Michael Mandel** (*Progressive Policy Institute blog, July 10, 2017)*:
  - "According to the American Time Use Survey from the Bureau of Labor Statistics, in 2015-2016 Americans spent .645 hours per day on average shopping for consumer goods or traveling to shopping, or 4.5 hours per week."
  - "By comparison, in 2006-2007 Americans spent 4.75 hours per week shopping for consumer goods or traveling to shopping, or 0.25 more. That extra quarter hour corresponds to 64 million extra hours per week (260 million x .25)."
  - "Some of these jobs are being moved into the market sector: The fulfillment center workers do the aisle-cruising that shoppers used to do themselves, the truck drivers take the place of the consumers driving back and forth to the mall.
  - **"This also implies that retail productivity is being [under-]measured, since we're not counting the reduction of household hours."**

Growth accounting framework

- **Conventional** (Solow):

$$R = \dot{q} - s_L\eta - s_K\kappa$$

- Hulten and Nakamura's **Lancaster-model** based growth account:

$$\dot{u} = \omega + \mu\beta + \mu\lambda + \mu\eta$$

- where ω is information, β product quality, and λ technical efficiency.

- **Price Dual** version:

$$CV = e(p_1, u_1) - e(p_1, u_0)$$

- But, compensating variation still based on price/quantity data.
  - This model includes (unpriced) information parameter
  - Isn't clear that the information parameter can be identified

Other thoughts

- "…the paper is largely illustrative and…aimed at providing an intuitive foundation for thinking about the way innovation affects the economy and the welfare of the population."

- Paper has much more and deserves to be read. Discussions of:
  - Absence of observable prices
  - Public good aspects
  - Contingent goods
  - Capital formation
  - Technical innovation with a resource cost
  - Role of GDP when it doesn't fully capture innovation

Some questions

- To what extent do traditional (e.g., Boskin Commission) measurement problems affect interpretation of consumer welfare?
- Price indices have fallen, but do they fully capture quality change?
  - CPI for cellular telephone services averaged −1.9% per year.
  - CPI for telephone hardward averaged −6.4% per year.
- How does Internet technology compare to past technologies that have affected household production/consumption? (clothes washers & dryers, vacuum cleaners, refrigerators, etc.) What's unique about information?
- Is it essential to think of this technical change as output saving? Becker time-allocation approach might suggest resource saving technology.