Some Thoughts on Digital Products, Consumer Prices and GDP

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Overview

1. A longstanding debate: measuring productivity and welfare
2. Which welfare effects may go amiss?
3. Capturing welfare effects
    - 3a. Inside price indices & inside GDP
    - 3b. Outside price indices & inside GDP
    - 3c. Outside GDP
4. Conclusions

1. A longstanding debate: productivity and welfare

A longstanding debate

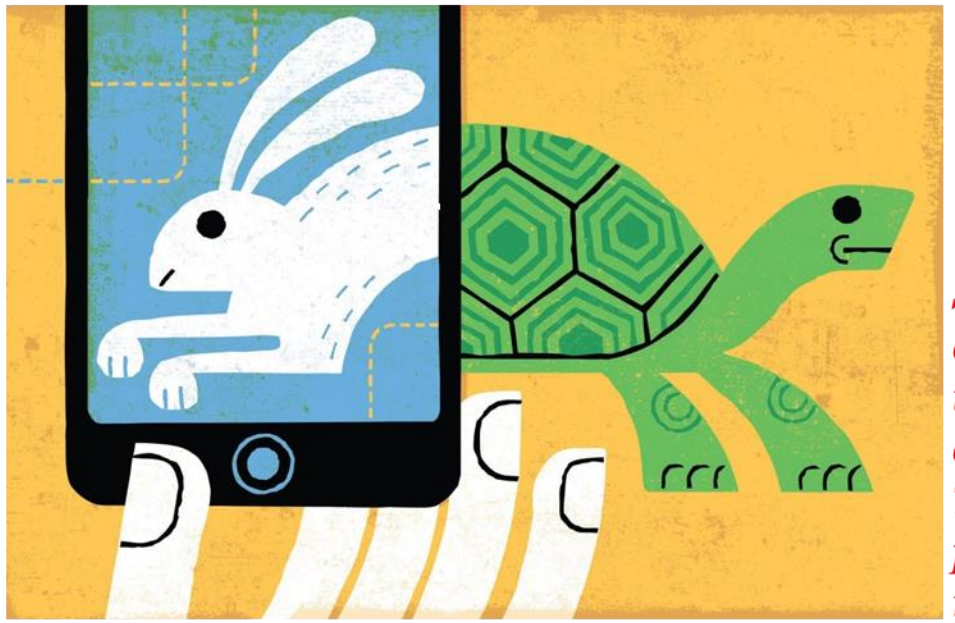
- Weak productivity growth
- Shortage of ideas, innovation slowdown
- Break-down of the diffusion machine
- The **Mismeasurement Hypothesis**: inflation is overstated
- Although, other issues around inflation have recently moved centre-stage

Presence in the public debate

THE WALL STREET JOURNAL.

Silicon Valley Doesn't Believe U.S. Productivity

The U.S. Underestimates Growth



FINANCIAL TIMES

The internet and the productivity slump

Charlie Bean: "statistics have failed to keep pace with the impact of digital technology"

Diane Coyle: The pace of change in OECD countries is making the existing statistical framework decreasingly appropriate for measuring the economy

Why we're measuring the digital economy in the wrong way

The Economist

Some optimists argue instead that the problem is one of measurement. Technological progress often raises productivity in ways that statistical agencies struggle to detect

2. Which productivity/welfare effects may go amiss?

Possible welfare effects

1. Quality change in existing product types	2. Appearance of truly novel products	3. Appearance and use of free products
(a) Quality change in existing digital products through evolving characteristics embodied in new varieties of digital products (e.g. computers)	e.g., smartphones	e.g., free communication services through apps
(b) Digital replacement of non-digital products (e.g., streaming services replacing CDs)		
(c) Improved variety selection among products, digital and other (e.g., clothing, books)		

Source: Reinsdorf and Schreyer (2019)

Quality change in existing product types

- Appearance of new models/varieties of existing products and new products

- Digital replacements

- Improved variety selection

Truly novel products

- Smartphone, DVD players, streaming services,…

- Captured once they are on the market, but introductory welfare gain (or loss) is lost

Free products

- Transaction price = 0
- Excluded from price index
- Shadow price:
- Marginal consumer surplus > 0, valuation:
  - Implicit transaction (advertising, user data)
  - Value of time (opportunity cost)
  - Willingness to pay/accept can be observed
  - Almost certainly, different results

3. Capturing welfare effects

3a. Inside the price index & inside GDP

Established approaches to deal with quality change for existing products include:

- Direct price comparison (price difference = pure price change, no quality change)
- Link-to-show-no-price change (price difference = quality difference)
- Linking with aggregate price change
- Hedonics (well developed area, also with new sources - see eg Nyborg Hov & Nygaard on consumer electronics, this meeting)
- Proxies

A few issues with established approaches to quality-adjust (1)…

- Outlet effects for digital products – online versus physical stores – unclear

- Much less investigated: quality decline:
  Programmed obsolescence
  Purely machine based after sales services
  No backward compatibility of new software
  Digitally-enabled products with reduced convenience (eg self –checkout)

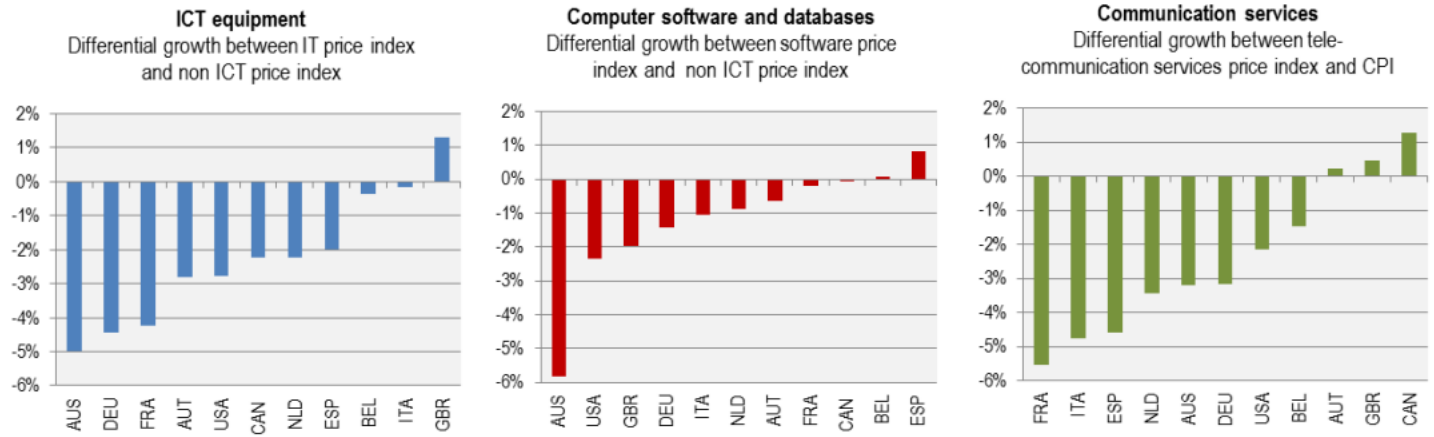
- Proxies
  E.g., Byrne and Corrado (2020): direct measures of volume (data transmitted, talk time, and hours of programming) for quality adjustment of consumer digital access services
  U.S. (1988-2018): -12% adjusted vs +1.2% official for digital access services -> 0.5 pp overestimation of PCE prices

- General: knowledge gap on effects of quality adjustment on price indices (ECB 2021)

…also international comparability…

Price indices across countries, adjusted for overall inflation

Difference in average annual % rate of change, 2010-15



Notes: Data reported for Spain for ICT equipment and Computer software and database correspond to the period 2010-2014. Data reported for Austria for Communication services correspond to the period 2011-2015.

Source: OECD National Accounts Statistics, OECD Productivity Database, OECD Prices and Purchasing Power Parities database, Australian Bureau of Statistics (ABS), Bureau of Economic Analyses (BEA) and Statistics Canada, February 2017.

Source: Ahmad, Reinsdorf, Ribarsky (2017)

- Menz, Wieland and Merhoff (this meeting) estimate effects of differences in quality adjustment methods more generally and find non-negligable effects on HICP

…although, GDP effects depend on imports and intermediate inputs…

GDP growth, aggregate impact of ICT assets and communication services using lower bound price indices

Average annual growth rate in%, 2010-2015 (or latest available year)

Country	GDP growth, unadjusted	Adjusted GDP growth minus Unadjusted GDP growth		
		Scenario I: M=0	Scenario II: FD=0	Scenario III: FD and M from SUT
Australia	2.761%	0.023%	-0.001%	0.022%
Austria	1.047%	0.294%	-0.103%	0.191%
Belgium	0.996%	0.400%	-0.184%	0.216%
Canada	2.148%	0.286%	-0.093%	0.194%
France	0.943%	0.157%	-0.034%	0.123%
Germany	1.572%	0.122%	-0.044%	0.077%
Italy	-0.641%	0.200%	-0.091%	0.109%
Netherlands	0.748%	0.367%	-0.118%	0.250%
Spain	-0.235%	0.176%	-0.058%	0.117%
UK	1.978%	0.365%	-0.193%	0.172%
US	2.072%	0.208%	-0.046%	0.162%

Notes: Data reported for Austria (communications) correspond to 2011-2015 and Spain (ICT goods and software) correspond to 2010-2014.

Source: OECD calculations based on OECD National Accounts Statistics, OECD Prices and Purchasing Power Parities database, OECD Supply and Use Tables database, Australian Bureau of Statistics (ABS), Bureau of Economic Analysis (BEA), Statistics Canada, Office for National Statistics (UK), February 2017.

Source: Ahmad, Reinsdorf, Ribarsky (2017)

…and expenditure weights in PCE of digital products are declining

	2005 Weight (average across 34 OECD countries) (%)	2015 Weight (average across 34 OECD countries) (%)
Significant potential for under adjustment for quality change (‘affected products’) except communication services	0.8	0.1
Communication services	2.7	2.4
Some potential for under adjustment for quality change (‘potentially affected prods.’)	7.4	6.2
Significant replacement by digital products (‘affected products’)	2.4	1.0
Some replacement by digital products (‘potentially affected products’)	5.8	5.7
Total	19.1	15.4

Source: Reinsdorf and Schreyer (2019)

Turning to novel and free products – insider the price index

- Reservation price (Hicks 1940)
  - Pre-entry price that drives demand to zero (Hicks 1940)
  - How to get it?
  - Econometrics (e.g., Diewert & Feenstra, 2019)
  - Experimental economics (Brynjolfsson, Collis, Diewert, Eggers and Fox 2018)

- Issues
  - Estimation costs, data availability
  - No reservation price if product hasn't been invented yet
  - COLI perspective required and economic approach to indices
  - Acceptance as tool in official statistics

- Capturing welfare effects of novel/disappearing and free products - a lost cause?

- Not quite: outside the price index may be a better space to capture welfare effects

3b. Outside the price index & inside GDP

Outside the price index & inside GDP

- Capturing welfare effects of free products through nominal income effects
- Use of results on willingness to pay/forego through choice experiments (Brynjolfsson, Collis, Diewert, Eggers and Fox 2018)
- Facebook: around 500$/year: shadow price (marginal consumer surplus)
- Added on to nominal GDP
- BCDEF: U.S. GDP ‘B’ growth

Still some problems

- Who produces?
- Who gets attribution of productivity gain/loss?
- Possibly conflicting valuation – case of Facebook
  - Financing via advertisements or data sales
  - Facebook's measured value-added = income generated in the advertising or data sales business
  - Problem: measured value-added ≠ shadow price*#of users
  - 25$/user/year (approximative advertising revenues) < 500$/user/year (willingness to forego)

The broader issue

- How far do we want to go with imputations to GDP or household income/consumption to reflect welfare gains or losses?

- A possible way forward – quantification outside GDP, as own account household production

3c. Outside GDP

Free digital products as *inputs* to own-account HH production

- Production process by households who use:
  - time
  - capital services (hardware, software) including freely provided
  - to produce (typically, leisure) services

- Unit values and quantities need not coincide with advertising or data sales revenues of digital service provider
- Choice experiments inform about the value of own account production to HHs

Computations for the Facebook case (1)

Variable		Unit	Acronym	Year	
				2004	2017
Time spent on Facebook	1	Minutes per day		20	40
	2	Hours/year	t_F	122	243
WTA (BCDEF[8])	3	\$/year		–	506
User costs					
—all ICT capital services	4	\$/hour		0.01	0.03
—Facebook ICT capital services	5=4*2	\$/year	$u_F K_F$	1.46	6.58
Implied wage rate	6	\$/hour	w_F	1.58	2.05
Value of leisure time per person	7=6*2	\$/year	$w_F t_F$	192	499
Value of leisure services per person	8=7+5	\$/year	$p_F q_F$	194	506

Source: Schreyer (2022)

Computations for the Facebook case (2)

Variable		Unit	Acronym	Year	
				2004	2017
Change of wage rate for leisure services		Index	w_F^1/w_F^0	1.00	1.30
Price change of ICT capital services		Index	u_K^1/u_K^0	1.00	0.3604
U.S. Facebook users		Million persons	Z	0.10	200
Törnqvist unit cost index of leisure services		Index	p_F^1/p_F^0		
—no quality adjustment	$\epsilon = 0$			1.000	1.2493364
—quality adjustment	$\epsilon = 0.5$			1.000	0.0279360
—quality adjustment	$\epsilon = 1.0$			1.000	0.0006247
—quality adjustment	$\epsilon = 1.5$			1.000	0.0000140

- Extended measure of activity (EMA) would rise between 0.04 and 0.3 ppt /year faster than U.S. GDP
- EMA-based labour productivity would always be less than official number

Source: Schreyer (2022)

Outside GDP, yes, but not in isolation

- Big tickets in home production (25%-60% of GDP)
  - Childcare, care for infirm and elderly, cooking, cleaning,…
- Important gender issues
- Digitally-enabled leisure services best considered in conjunction with other forms of household production

2016 ALZHEIMER'S DISEASE FACTS AND FIGURES

Conclusions

- Digital economy makes price measurement harder and raises questions about possibly neglected welfare effects (positive and negative)
- No silver bullet – case by case approach
- Consider methods both within and outside price index and within and outside GDP boundaries
- No clear conclusion how far welfare effects should be imputed into GDP – theoretical and practical issues
- No progress without research, though, and much is to be done to better understand the digital transformation

THANK YOU

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