

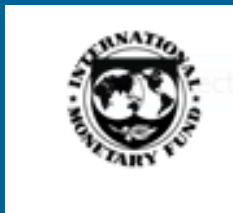


# MEASURING CONSUMER INFLATION IN A DIGITALISED ECONOMY

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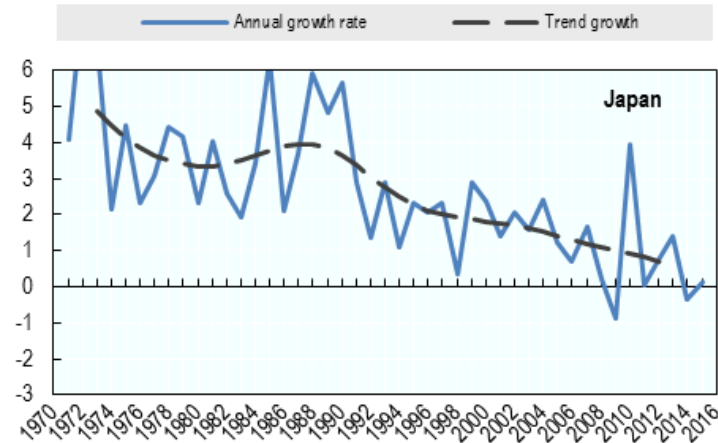
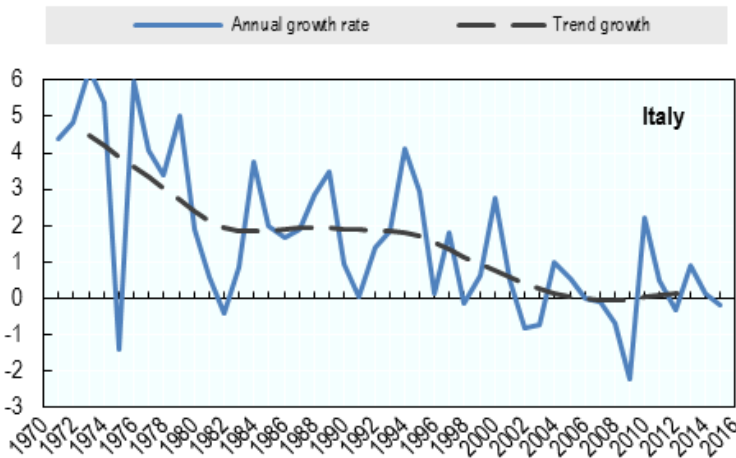
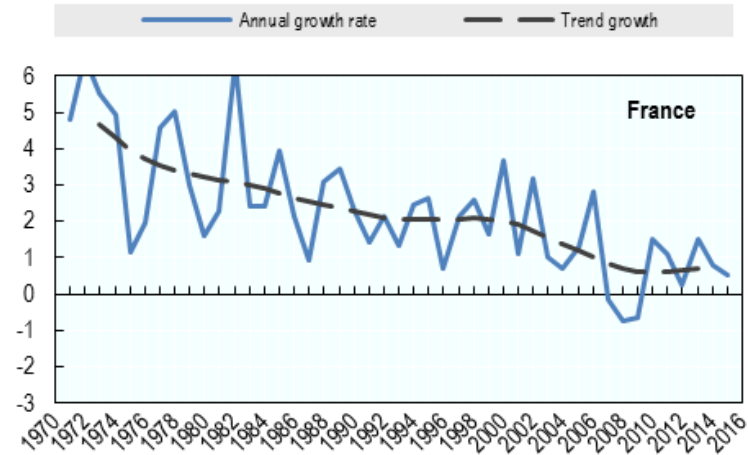
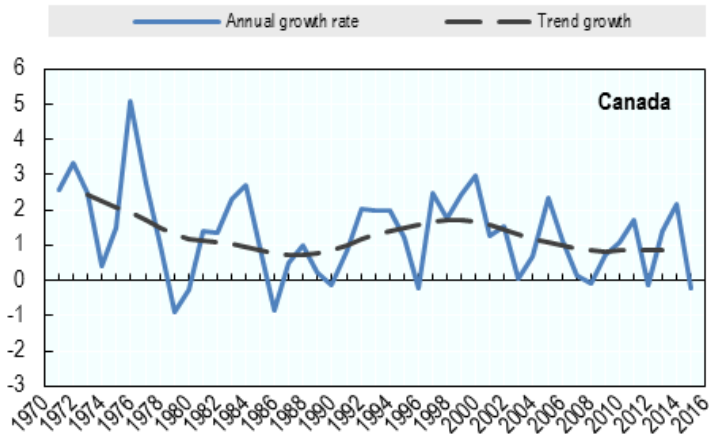
The debate...





# Pervasive long-term slowing of labour productivity growth

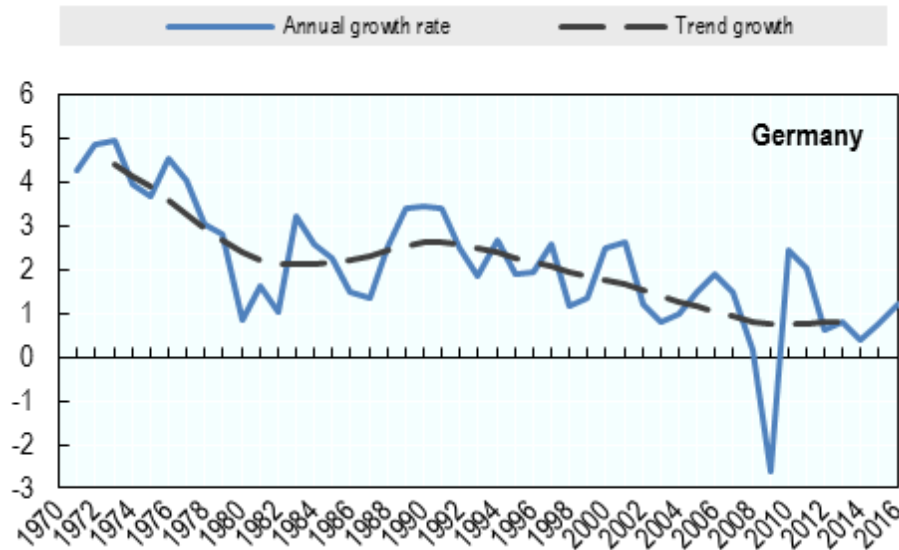
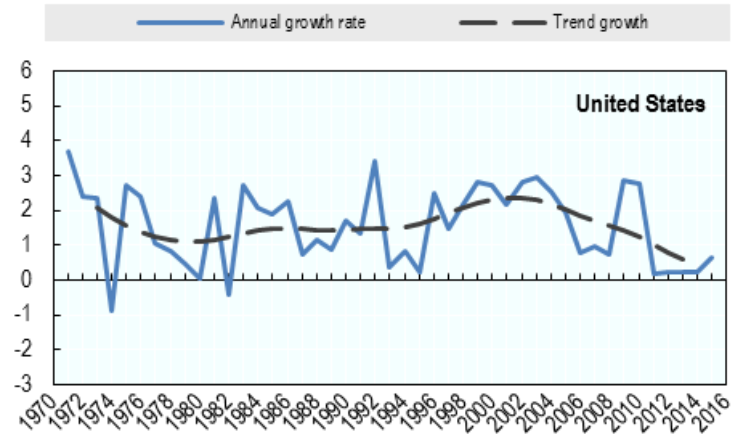
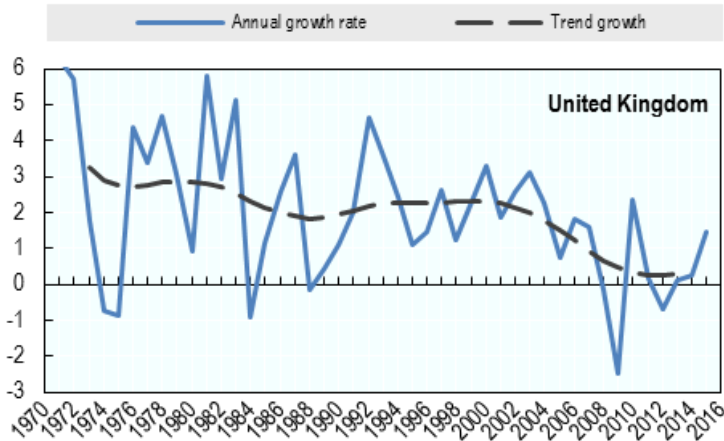
Total economy, average annual rates of change in %





# Pervasive long-term slowing of labour productivity growth

Total economy, average annual rates of change in %



Source: OECD Productivity Compendium 2017



## Some explanations

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- Shortage of ideas, **innovation slowdown**
- Break-down of the **diffusion** machine
- Digital economy not picked up in GDP and productivity figures:
  - **The Mismeasurement Hypothesis**



# Presence in the public debate

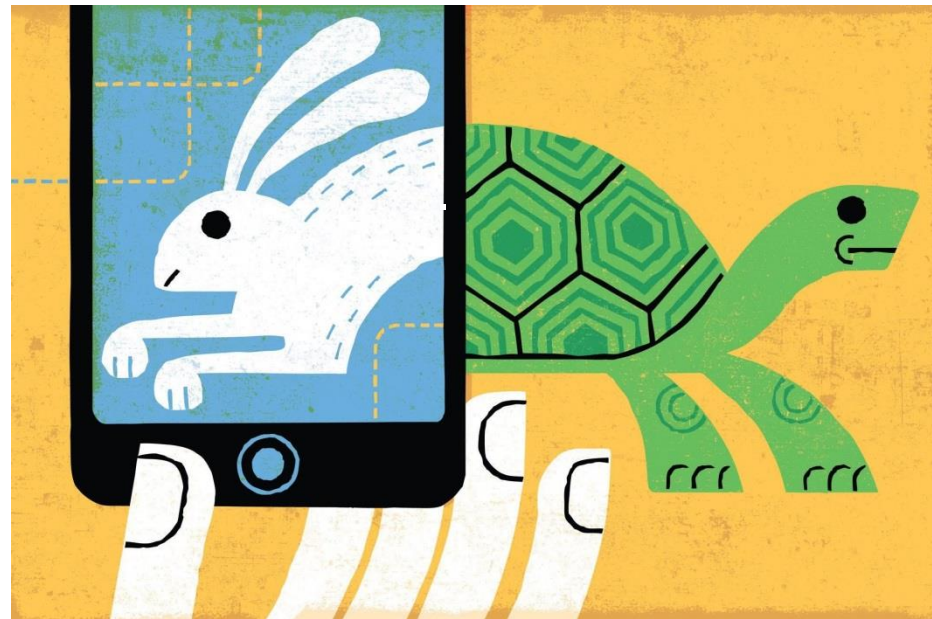
*Marty Feldstein: “I have concluded that, despite the various improvements to statistical methods that have been made through the years, the official data understate the changes of real output and productivity.”*

*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*

**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**

**ComputerWeekly.com**  
**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*



## ...the ill-defined nature of the issue has not helped

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- Conceptual vs. Empirical issues
- **Production vs. Welfare**
- **Volumes vs. Prices**
- Discussion of consumer inflation measures captures many of these issues



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# Consumer prices and welfare effects of digitalisation





# 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)		



# Quality change in existing product types

- Appearance of new models/varieties of existing products and new products
  - Free/low cost digital replacements
  - Improved variety selection
  - How should new varieties be linked in?
  - To preserve representativeness of sample, when should they be linked in,?
- 'Worst case' scenarios





## Truly novel products

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- When do they enter the price index?
- Theory: estimate a **reservation price** to capture welfare change from invention
- **Problems:**
  - Estimation of reservation prices in practice
  - Communication/user acceptance
- **Conclusion:** of interest for welfare research, but hard to see in official price index
- **Note:** reservation price of digital replacements should be included





# Free products (1)

- Transaction price = 0  $\Rightarrow$  excluded from price index
- Shadow price  $> 0$ 
  - Implicit transaction (advertising, user data)
  - Value of time (opportunity cost)
- **Imputation?**
  - Price index still fit for use?
  - Consistency with treatment of other nonmarket consumption (child care, cooking,...)
  - Estimating shadow price in practice





## Free products (2)

- COLI is always conditional on *some* environmental variable
- No clear theoretical basis where to draw a line
- Possible: consider free products at point of entry
- Systematic inclusion of free products of interest for **welfare research**, but hard to see in official price index
- *How to measure missing welfare effects*



Diewert and Fox (2017)





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# Simulating effects



## (a) Quality adjustments in deflators of existing digital products

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- Digital products where *advances in technology* are causing rapid quality improvement
- ***Affected:***
  - Example: computers and software
  - Assumption: ***5 percentage points*** per year over-estimation of the price change (Byrne and Corrado 2017)
- ***Possibly affected:***
  - Example: motor vehicles
  - Assumption: ***2 percentage points*** per year over-estimation of the price change





## (b) Digital replacements

- Free or cheaper *replacement* for a more expensive item that used to be the only alternative
- **Affected:**
  - Example: passenger transport
  - Assumption: **5 percentage points** per year over-estimation of the price change
- **Possibly affected:**
  - Example: books
  - Assumption: **2 percentage points** per year over-estimation of the price change







## (c) Better selection of varieties

- Expanded access to *varieties* + reduced search costs for finding the best match for one's individual needs and tastes.
- ***Affected:***
  - Many products, e.g., clothing, furniture, even restaurant choices
  - Assumption: ***0.3 percentage points*** per year over-estimation of the price change (Byrne, Fernald and Reinsdorf, 2017)





# Upper Bounds for Potential Effects on Price Index for Household Consumption

	Assumed Error in Growth Rate of Prices (% points per year)	2005 Weight (average across 34 OECD countries) (%)	2015 Weight (average across 34 OECD countries) (%)	Adjustment to Growth Rate of Consumption Deflator, 2005 Weights (% points)	Adjustment to Growth Rate of Consumption Deflator, 2015 Weights (% points)
Significant potential for under adjustment for quality change ('affected products')	5	3.5	3.1	-0.18	-0.16
Some potential for under adjustment for quality change ('potentially affected prods.')	2	7.4	6.2	-0.15	-0.12
<b>Potential effect of under adjustment for quality change</b>				<b>-0.32</b>	<b>-0.28</b>
Significant replacement by digital products ('affected products')	5	2.4	1.0	-0.12	-0.05
Some replacement by digital products ('potentially affected products')	1	5.8	5.7	-0.06	-0.06
<b>Potential effect of digital replacements</b>				<b>-0.18</b>	<b>-0.11</b>
Potential for improved variety selection (affected & potentially affected prods.)	0.3	16.8	15.6	-0.06	-0.06
<b>All potential effects on aggregate deflator</b>		<b>35.9</b>	<b>31.5</b>	<b>-0.56</b>	<b>-0.45</b>



# Affected or Potentially Affected by Under Adjustment for Quality

	2005 Weights (% points)	2015 Weights (% points)
<b>Affected:</b>		
Telecommunication equipment	0.21	0.41
Telecommunication services*	2.71	2.38
Information processing equipment and software	0.45	0.49
Photographic/cinematographic equipment*	0.13	0.09
<b>Potentially Affected:</b>		
Major and small HH appliances	1.12	0.95
Equipment for the reception and recording of sound and vision*	0.70	0.53
Motor vehicles and parts	5.08	4.26
Games, toys and hobbies	0.48	0.42

\* Includes effects of digital replacement



# Affected or Potentially Affected by Low-Cost Digital Replacement

	2005 Weights (% points)	2015 Weights (% points)
Taxi or hired car with driver	0.31	0.30
Pre-recorded recording media	0.22	0.12
Unrecorded recording media	0.11	0.04
Newspapers and periodicals	0.68	0.45
Film developing and printing	1.04	0.07
<b>Potentially Affected:</b>		
Books	0.47	0.33
Passenger transport by air	0.68	0.89
Package holidays	0.81	0.93
Accommodation services	1.41	1.56
Maintenance and repair of dwelling	0.46	0.41
Postal services	0.11	0.09
Jewellery, clocks and watches	0.43	0.39
FISIM	1.42	1.46



# Improved Variety Selection due to Expanded Access or Better Information

	2005 Weights (% points)	2015 Weights (% points)
<b>Cloth and clothing</b>	<b>5.16</b>	<b>4.45</b>
<b>Furniture, floor coverings, HH textiles, and repairs thereof</b>	<b>2.50</b>	<b>1.98</b>
<b>Games, toys and hobbies</b>	<b>0.48</b>	<b>0.42</b>
<b>Newspapers and periodicals</b>	<b>0.68</b>	<b>0.45</b>
<b>Books</b>	<b>0.47</b>	<b>0.33</b>
<b>Other durable and nondurable HH goods</b>	<b>1.83</b>	<b>1.69</b>
<b>Restaurants, cafes and dancing establishments</b>	<b>3.84</b>	<b>4.26</b>
<b>Accommodation services</b>	<b>1.41</b>	<b>1.56</b>
<b>Maintenance and repair of dwelling</b>	<b>0.46</b>	<b>0.41</b>



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# Two Unorthodox Points



# How plausible is *persistent* under-measurement?

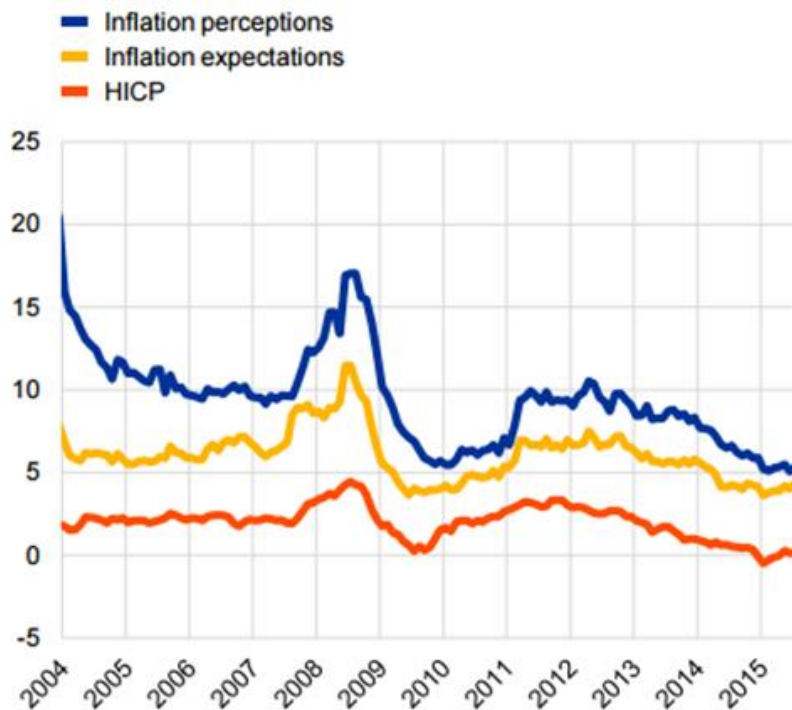
## Median Income Per Household, United States

Year	Price basis	USD
2016	2016	59039
1959	1959	5400
1959	2016 with official PCE deflator	34636
1959	2016 prices with assumed bias 1%	19588
1960	2016 prices with assumed bias 2%	11077
Poverty threshold		
2016	2016, for HH size 2	15,569
2016	2016, for HH size 3	19,105
Source: US Bureau of Economic Analysis and US Census Bureau		
Real income change 2016/1959		70.5%
Real income change 2016/1959, 1% bias		201.4%
Real income change 2016/1959, 2% bias		433.0%



# How do people *feel* about inflation?

## EU consumers' quantitative estimates of inflation perceptions and expectations



- Perceived inflation nearly always above CPI
- If CPI is overstated, gap will widen
- Issue of credibility
- At variance with consumer theory?

Arioli et al (2017);





## Conclusion

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- Digital economy makes price measurement harder and raises questions about possibly neglected welfare effects
- Not every welfare change belongs in official consumer price index although there is no clear theoretical boundary – *fitness for use* criterion
- For 2015, we simulate a ‘worst case’ adjustment that amounts to -0.45 % points/year, down from -0.56% points in 2005
- Though not insignificant, it can’t explain slowing GDP and productivity growth



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**Thank you!**

