EUROPEAN CENTRAL BANK

EUROSYSTEM

Is There a Measurement bias from quality adjustment in Austria and Italy?

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Bernhard Goldhammer, ECB
Cristina Conflitti, Banca d'Italia
Fabio Rumler, OeNB
Michaela Maier, Statistik AT

Overview

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Introduction

Introduction

- Price Index demands constant quality => adjustment for quality when products change
- Fully missing quality adjustment (QA) would lead to a biased index
- What about a bias if QA is done in an „incorrect way“? What is „correct“ quality adjustment?
- No common sense on how to evaluate quality => Better: define corridor for meaningful quality adjustment
- Bias: QA result outside the corridor
- Presentation elaborates this idea and presents results for Austria and Italy based on microdata

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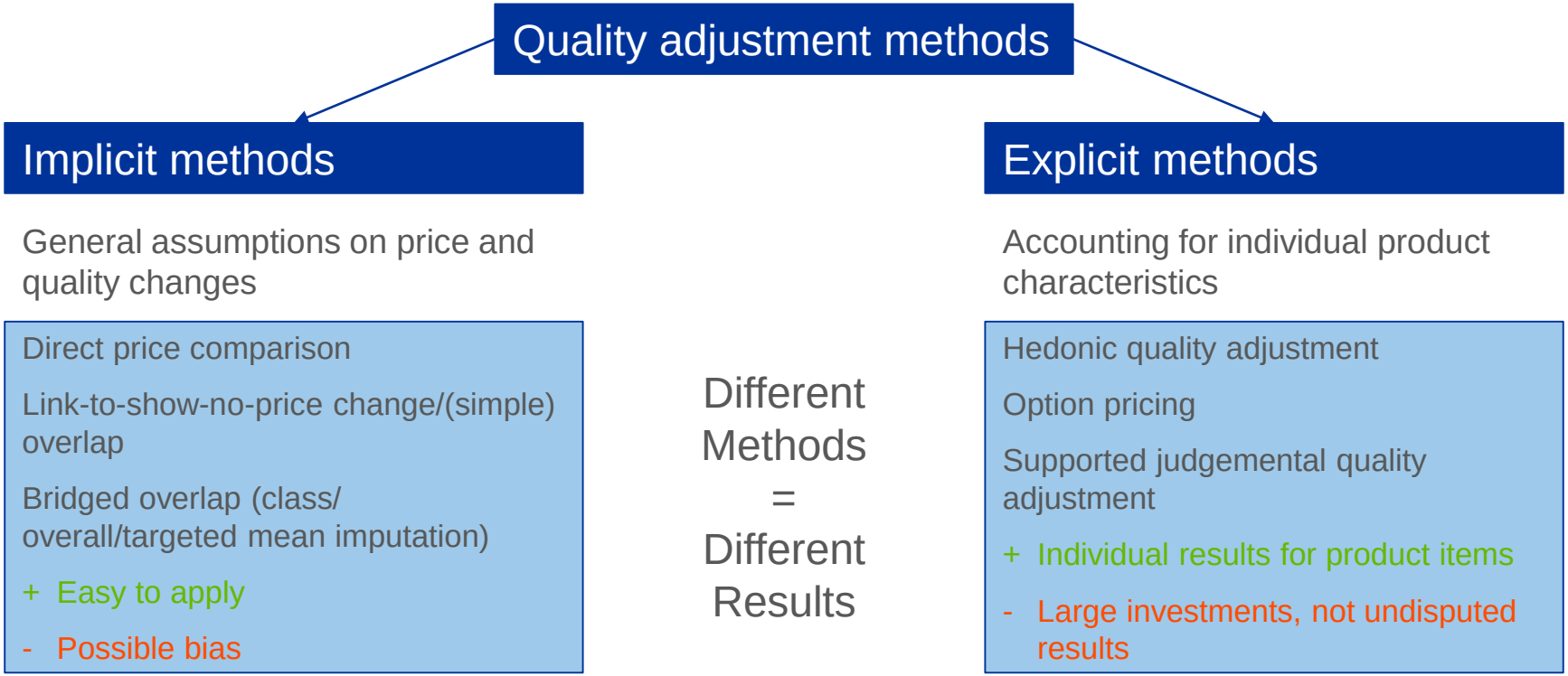
Quality adjustment in theory and practice

Quality adjustment methodology



Quality adjustment bias

- Boskin commission (1996) established framework for CPI measurement bias including a „quality adjustment bias“
- Bias as difference between benchmark and actual quality adjustment
- However, no undisputed benchmark for quality adjustment

⇒ Neubauer (1999): bias determination impossible; Schultze report (2002, p. 113):

> „…solutions to quality change and new good bias problems must be the fruit at the top of the tree…“

- But what about a corridor of meaningful results for QA?
- Corridor proposed recently on the level of single price quotations by Eurostat (2021)

Eurostat‘s quality adjustment corridor (1)

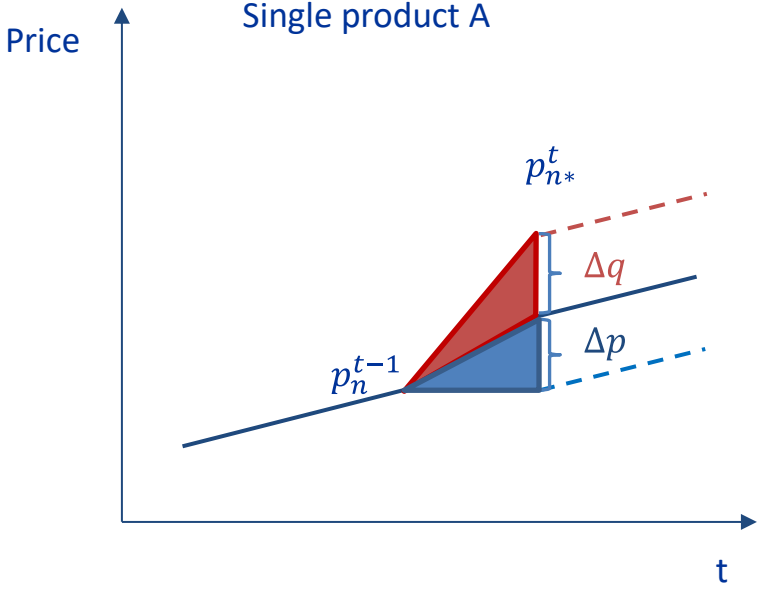
- Eurostat (2021): HICP recommendation on bridged overlap
- Central assumption: quality adjusted price should lie in the corridor between two critical values, the extreme cases of quality adjustment:
  - Link-to-show-no price change (LNP): total nominal price change equals quality difference => $\Delta p = 0$
  - Direct price comparison (DPC): assumption of no quality difference => $\Delta p = p_{n^*}^t - p_n^{t-1}$
- Quality adjustment calculation framework – relation of prices and quality:

$$p_{n,qa}^t \equiv \frac{p_{n^*}^t}{\hat{\alpha}_n} = p_n^{t-1} \cdot r_n^t$$

$\hat{\alpha}_n$ Quality adjustment factor of product n; r_n^t „bridge“/real price change factor;

n^* Replacement product

Eurostat‘s quality adjustment corridor (2)



$$1 < \hat{\alpha}_n < \frac{p_{n*}^t}{p_n^{t-1}}$$

$$\frac{p_{n*}^t}{p_n^{t-1}} > r_n^t > 1$$

$$p_{n,qa}^t \equiv p_n^{t-1} \cdot r_n^t = \frac{p_{n*}^t}{\widehat{\alpha_n}}$$

- Upper boundary: DPC
- Lower boundary: LNP

⇒ Plausiblity check for quality adjustment in replacement situations

Can this be used for estimating index bias?

Source: Eurostat (2021). Formulae adapted to the notations in this paper.

Logical boundaries to quality-adjusted price indices

Single price quotation: logical boundary DPC and LNP

Price index: logical boundary DPC index and LNP index

$$if\ \forall i \in n: p_i^{t-1} < p_{i^*}^T:\ I_n^{DPC,t} \geq I_n^{QA,t} \geq I_n^{LNP,t}$$
$$if\ \forall i \in n: p_i^{t-1} > p_{i^*}^T:\ I_n^{DPC,t} \leq I_n^{QA,t} \leq I_n^{LNP,t}$$

- Index outside boundaries => bias is difference of average annual change rate to next boundary
- Main assumption: relationship holds for **ALL** replacement situations

Quality adjustment practice in Austria and Italy

Austria

Focus on explicit quality adjustment

Direct price comparison

Price/quality split 25/50/75%

Link-to-show-no price change

Individual pricing of quality dependent on characteristics (all explicit methods including hedonics)

Italy

Implicit quality adjustment

Direct price comparison

Bridged overlap (class/ overall/targeted mean imputation)

Link-to-show-no price change („overlap“)

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Methodology for assessing a possible measurement bias related to QA

Assessing a possible quality adjustment bias

- Recalculation of inflation rates based on microdata for a number of selected products
- Calculation of three different indices:
  - LNP index: use of LNP in all replacement situations
  - QA index: use of actual quality adjustment practice in all replacement situations
  - DPC index: use of DPC in all replacement situations
- QA index should move inside the DPC-LNP corridor, otherwise bias cannot be ruled out
- Exceptions from the rule can occur in single cases => increasing robustness:
  - Observe average annual rates of change
  - Observation over long time periods: 6 years (AT)/7 years (IT)

4 Data

Data

Austria

- Dataset covers >1000 product groups
- January 2011 – December 2017
- Focus on Non-Energy Industrial Goods (highest prevalence of QA)
- Product choice: many QA cases; large weight or representativeness

Bedroom furniture	Sofa set
Dishwasher	Electrical razor
Toothbrush	Washing machine
Lawn mower	Sink
Laundry detergent	Notebook/tablet
PC	Men‘s jeans

Italy

- Dataset covers 267 8-digit-level COICOP categories from local price collection
- >3.5 mill. price quotations
- January 2011 – December 2018
- Product choice considerations as with AT

Bedroom furniture	Fridge/freezer
Wash. machine/dryer/dishw.	Small electr. devices (razor/ toothbrush)
Jewellery and clocks	TV
Laundry detergent	Appliances f. heating/AC
Women‘s pullovers	Men‘s trousers

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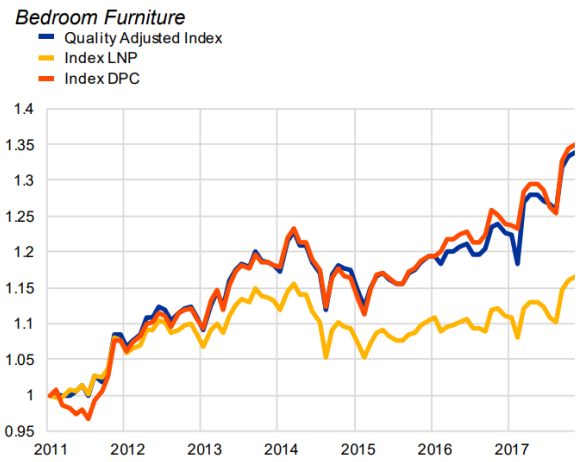
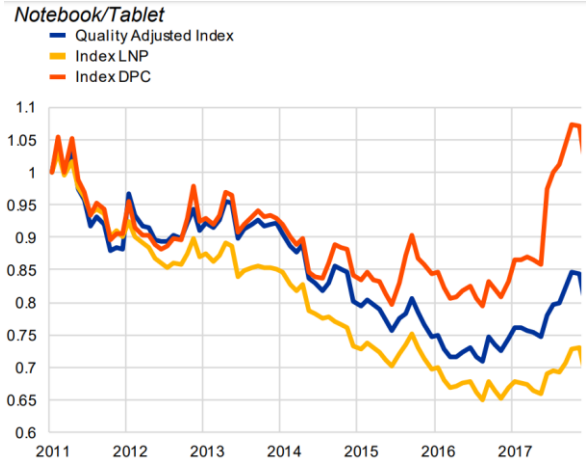
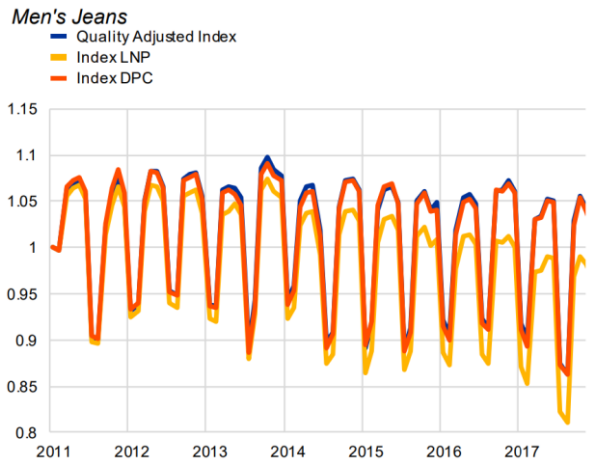
Results

Results: Austria - Indices (1)

Most cases are fine…



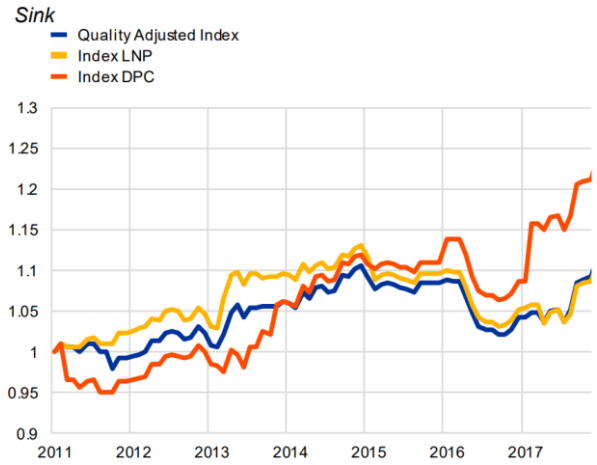


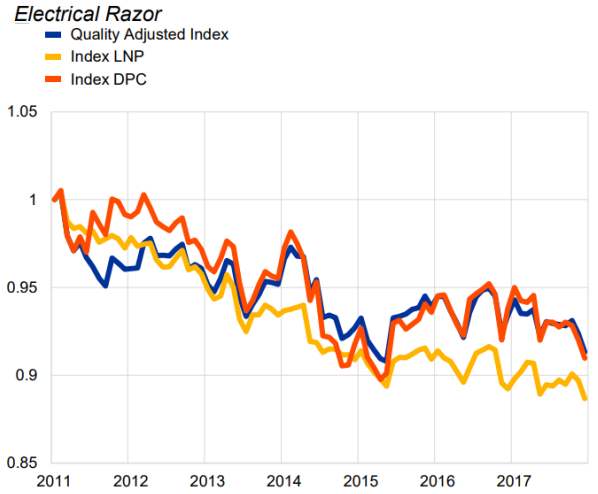


Source: OeNB calculations with Statistik Austria data.

Results: Austria - Indices (2)

… but others problematic





Source: OeNB calculations with Statistik Austria data.

Results: Austria – Average annual change rates

Products	DPC	QA	LNP
Bedroom furniture	4.3	3.8	1.7
Sofa set	2.9	1.8	1.2
Dishwasher	0.4	0.2	0.2
Electrical razor	-0.9	-0.7	-1.5
Toothbrush	0.6	0.3	-0.3
Washing machine	0.2	0.1	-0.6
Lawn mower	0.7	0.4	-0.2
Sink	3.2	1.0	0.8
Laundry detergent	-1.2	-5.3	-6.0
Notebook/tablet	-0.1	-3.1	-5.3
PC	1.3	0.6	-1.7
Men's jeans	-0.6	-0.5	-1.4

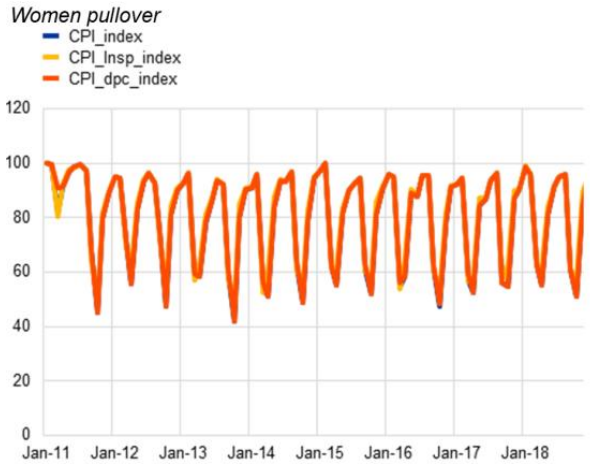
- Average annual inflation rate for 2011 to 2017
- QA inflation rate on average between DPC and LNP
- Exceptions:
  - Electrical razor: +0.2 p.p.
  - Men‘s jeans: +0.1 p.p.
- Size of corridor fully dependent on product
  - Notebook/tablet: 5.2 p.p.
  - Dishwasher 0.2 p.p.

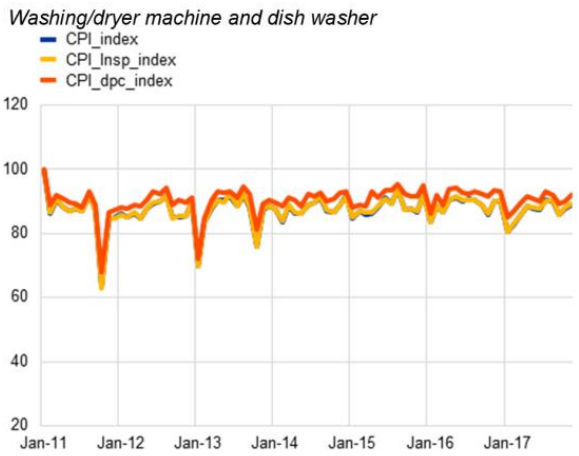
⇒ On average, QA in the middle of corridor; no evidence of bias

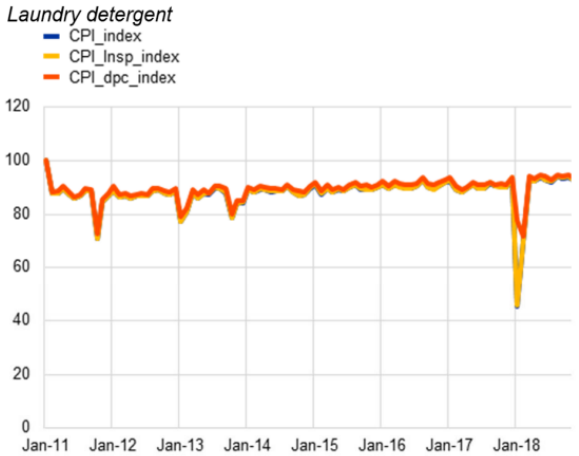
Source: OeNB calculations with Statistik Austria data.

Results: Italy - Indices (1)

Small corridors…



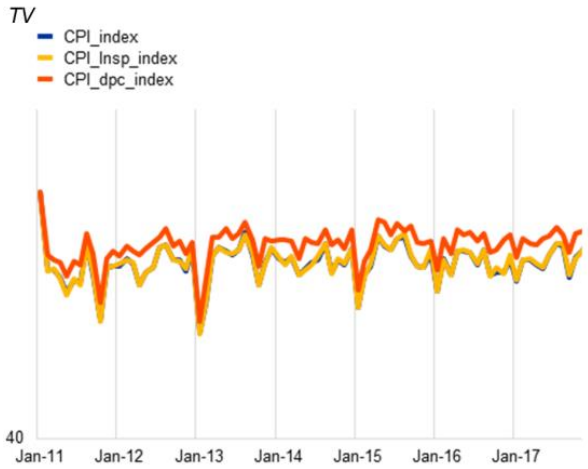


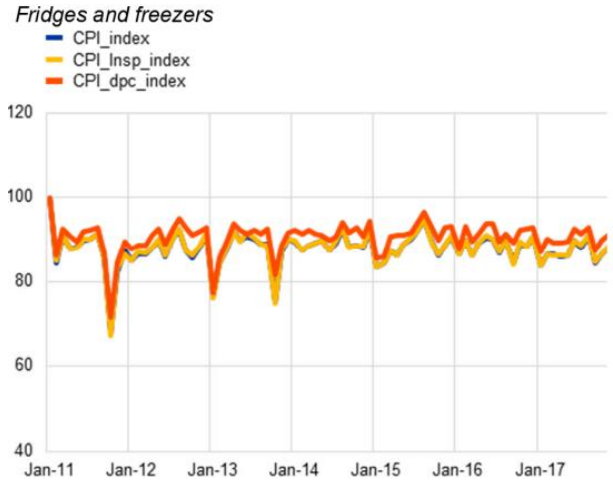


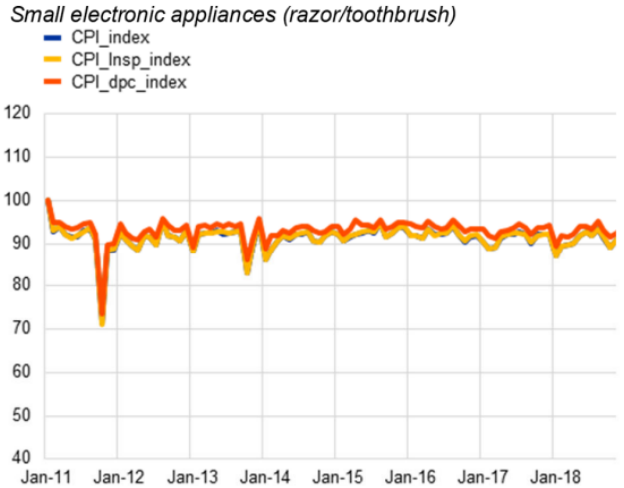
Source: BdI calculations with ISTAT data.

Results: Italy - Indices (2)

… with QA index at the lower bound







Source: BdI calculations with ISTAT data.

Results: Italy – Average annual change rates

Products	DPC	QA	LNP
Men-pants	-0.016	-0.017	0.07
Womens pullovers	-0.22	-0.22	-0.09
Washing/dryer Mashine and dish washer	-0.003	-0.013	-0.01
Bedroom Furniture	0.164	0.225	0.199
Laundry detergent	0.375	-0.067	-0.066
Fridge/frezeer	-0.932	-1.337	-1.322
Appliances for heating and air conditioners	0.608	0.705	0.689
TV	-0.383	-0.631	-0.638
Small electronic appliances (razer, toothbrush)	-0.063	-0.081	-0.093
Jewel and clock	0.312	0.264	0.265

- Average annual inflation rate for 2011 to 2018
- QA inflation rate outside corridor for 7 out of ten products (five cases: below lower bound)
- Largest differences:
  - Bedroom furniture: +0.061 p.p.
  - Appliances for heating/AC: +0.016 p.p.
- QA index represents lower bound
- Different QA/sampling/replacement strategy

$\Rightarrow$ Possible bias very small

Source: OeNB calculations with Statistik Austria data.

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Discussion

Discussion and limitations

- Corridor for meaningful QA price indices may be of substantially different size
  - Different strategies for sampling, replacement, quality adjustment:
    - AT: wide product descriptions, random replacements, explicit QA; also smaller sample
    - IT: narrow product descriptions or strata, implicit QA
- Method does not point to substantial QA biases in Austria and Italy
  - Small differences to the corridor, if at all
- Even within the corridor, QA methods can drive inflation rates (AT: laundry detergent)
- Limitations:
  - No bias within the corridor does not mean bias outside the corridor (propositional logic)
  - Method needs stable market conditions, i.e. order of LNP and DPC indices
  - Method needs long time range for meaningful results (use of indices and long-term averages)

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Conclusion

Conclusion

- New approach for QA bias determination
  - Corridor – no unambigous definition of quality value, subjective decisions by statistician needed
  - Micro-data driven approach – this is where QA is applied
- No evidence of systematic and sizeable QA biases for Italy and Austria
- Italy: index close to lower bound => Italian CPI close to a minimum of reasonable quality-adjusted indices
- Differences in explicit and implicit methods calls for more harmonisation of quality adjustment, sampling and replacement strategies for the HICP
- Studies on QA should be conducted on microdata level

Source: https://londonplus.org/blog/agm-and-autumn-networking-event/thank-you-bar-chart

Bernhard Goldhammer
European Central Bank
Directorate General Statistics
bernhard.goldhammer@ecb.europa.eu