The impact of weight shifts on inflation
Evidence for the euro area HICP

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Outline

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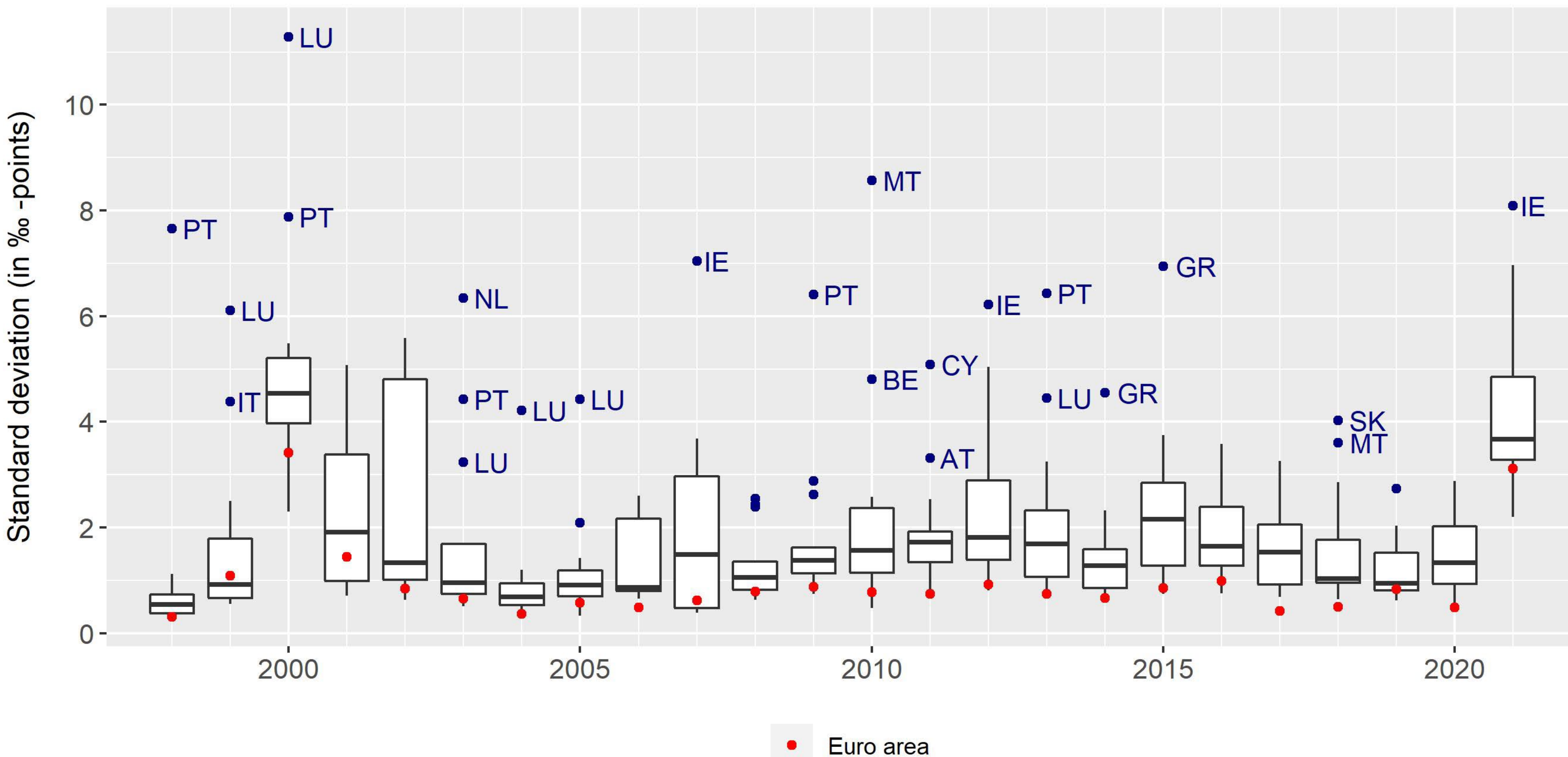
Knetsch T. A., Schwind, P. and Weinand S. (2022), The impact of weight shifts on inflation: Evidence for the euro area HICP, Discussion Paper, Deutsche Bundesbank, *forthcoming*.

Chapter 1

Introduction

Motivation
Large weight changes in euro area HICPs due to Covid-19



Contribution

- Can we quantify the aggregate impact of changing weights or quantities on inflation?

- We propose two formal decompositions of the inflation rate into

  1. Price change and weighting effects

  2. Pure price change and quantity effects

Chapter 2

Methodology

HICP inflation

- Annual price change of the Harmonised Index of Consumer Prices (HICP) in month m of year y denoted as inflation rate $\pi^{y|m}$

- HICP weights in year y represent expenditure patterns of the previous year

- It can be shown that $\pi^{y|m}$…
  - contains both current and previous period weights in months $m = 1, \dots, 11$
    - ➢ Weighting and quantity effects possible
  - but relies solely on current period weights in December ($m = 12$)
    - ➢ No weighting and quantity effects

Decomposition 1: Price change and weighting effects

− Introducing official weights applied in HICP compilation in year $y-1$ yields:

$$\pi^{y|m} = \text{Price change effect} + \text{Weighting effect}\,, \tag{1}$$

where the…

- ***price change effect*** measures the aggregate price change when HICP weights are kept constant at previous year's level
- ***weighting effect*** captures the total impact of HICP weight changes on the inflation rate

− But: Expenditure shares underlying the weights contain both prices and quantities

➢ Weighting effects may arise even if quantities do not change

How to disentangle quantity changes?

- Disentangling quantity effects from inflation can be achieved by introducing a new set of weights into the decomposition
- These weights…
  - are not publicly available, but can be derived from official weights, taking into account country-specific compilation methods over time
  - rely on quantities dating back one year further, compared to official weights
  - are accurate for countries which applied the (optional) price-updating of the expenditure shares

Decomposition 2: Pure price change and quantity effects

− Introducing the (newly derived) weights into the decomposition of $\pi^{y|m}$ yields:

$$\pi^{y|m} = \text{Pure price change effect} + \text{Quantity effect}\,, \qquad (2)$$

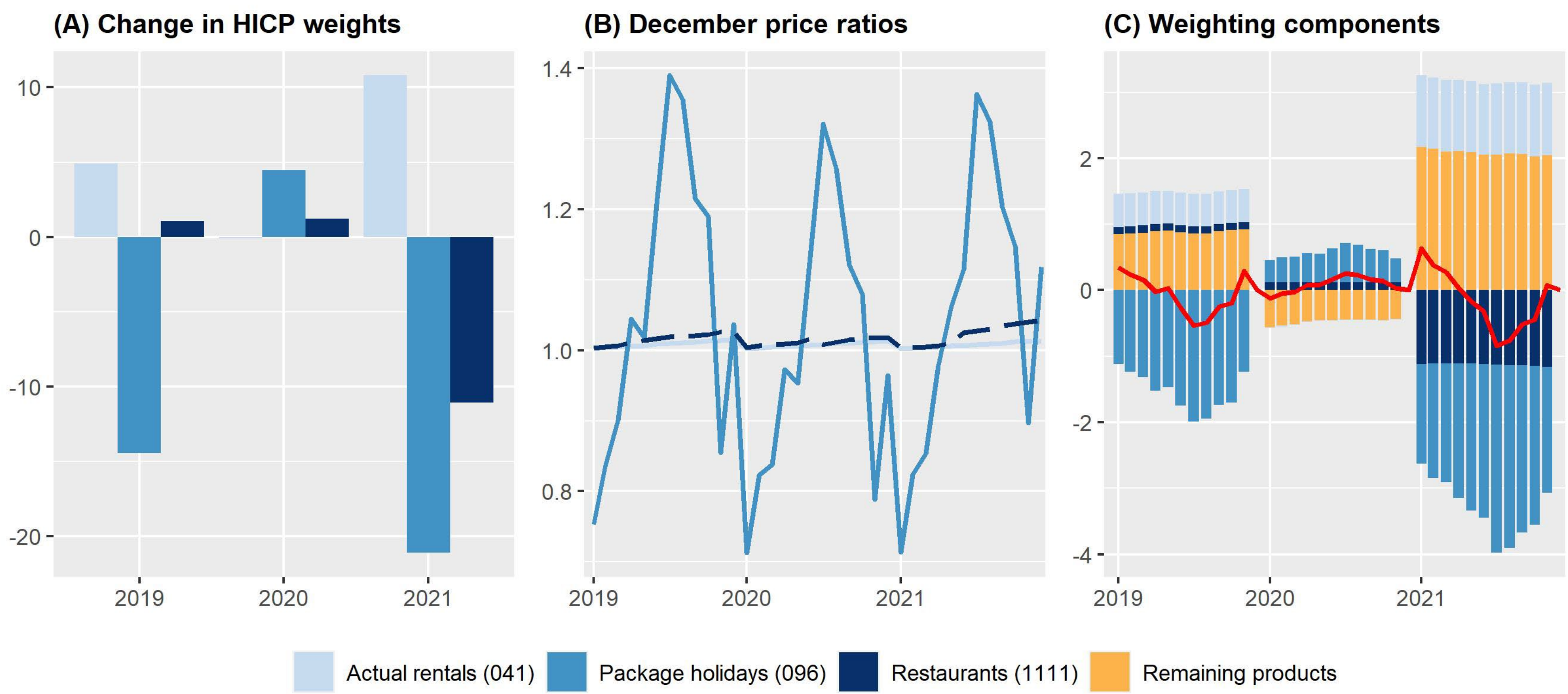
where the…

- ***pure price change effect*** measures the aggregate price change when quantities are kept constant at previous year's level
  - ➢ Conceptually, defined by a Lowe index
- ***quantity effect*** measures the total impact of a change in quantities on the inflation rate

Chapter 3

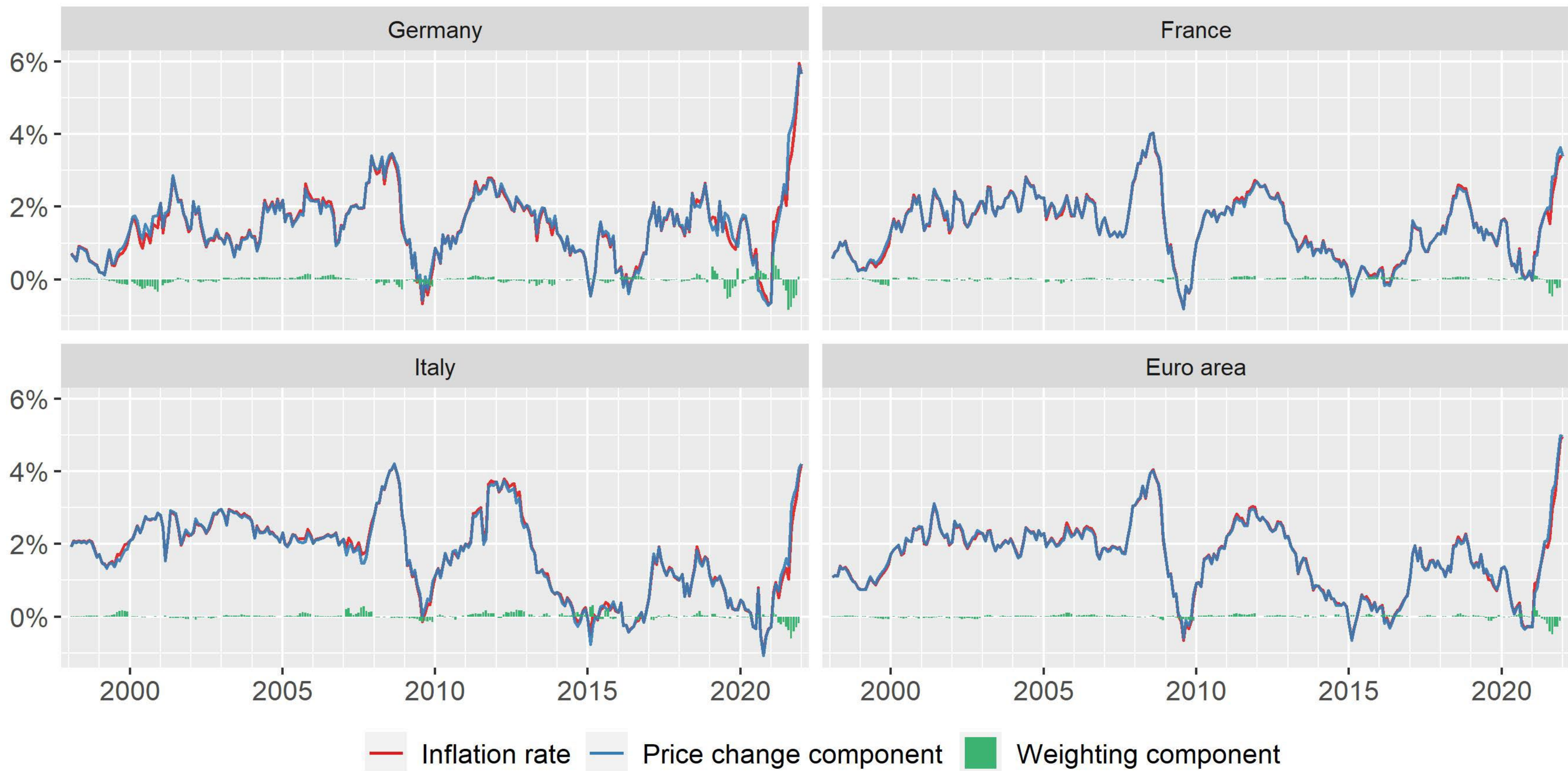
Empirical results

Dynamics of the weighting effect in the German HICP

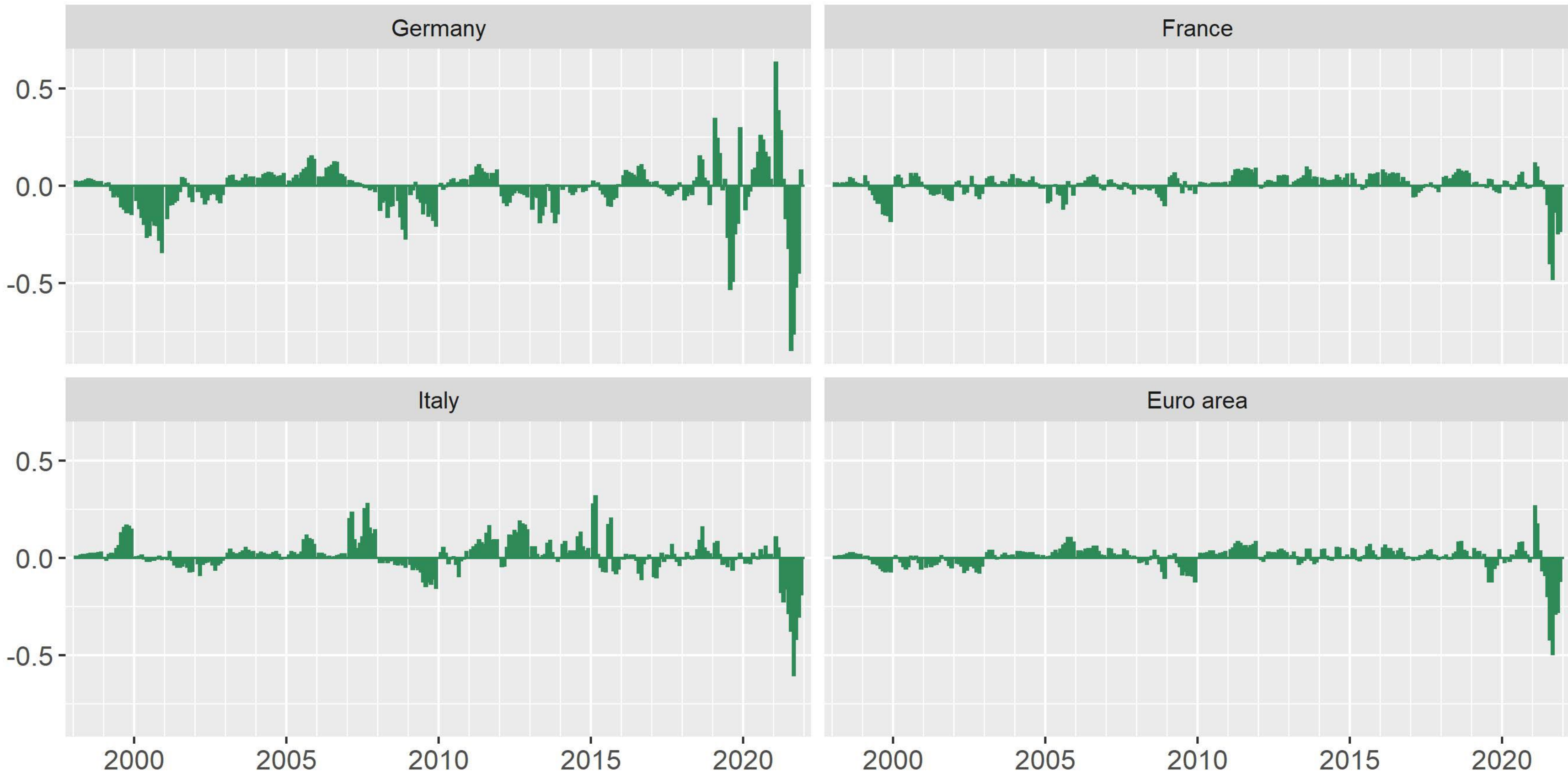


Note: The weighting component (in pp, red line) sums up the contributions of all products three of which are shown explicitly as stacked bars together with the aggregate contributions of the remaining products.

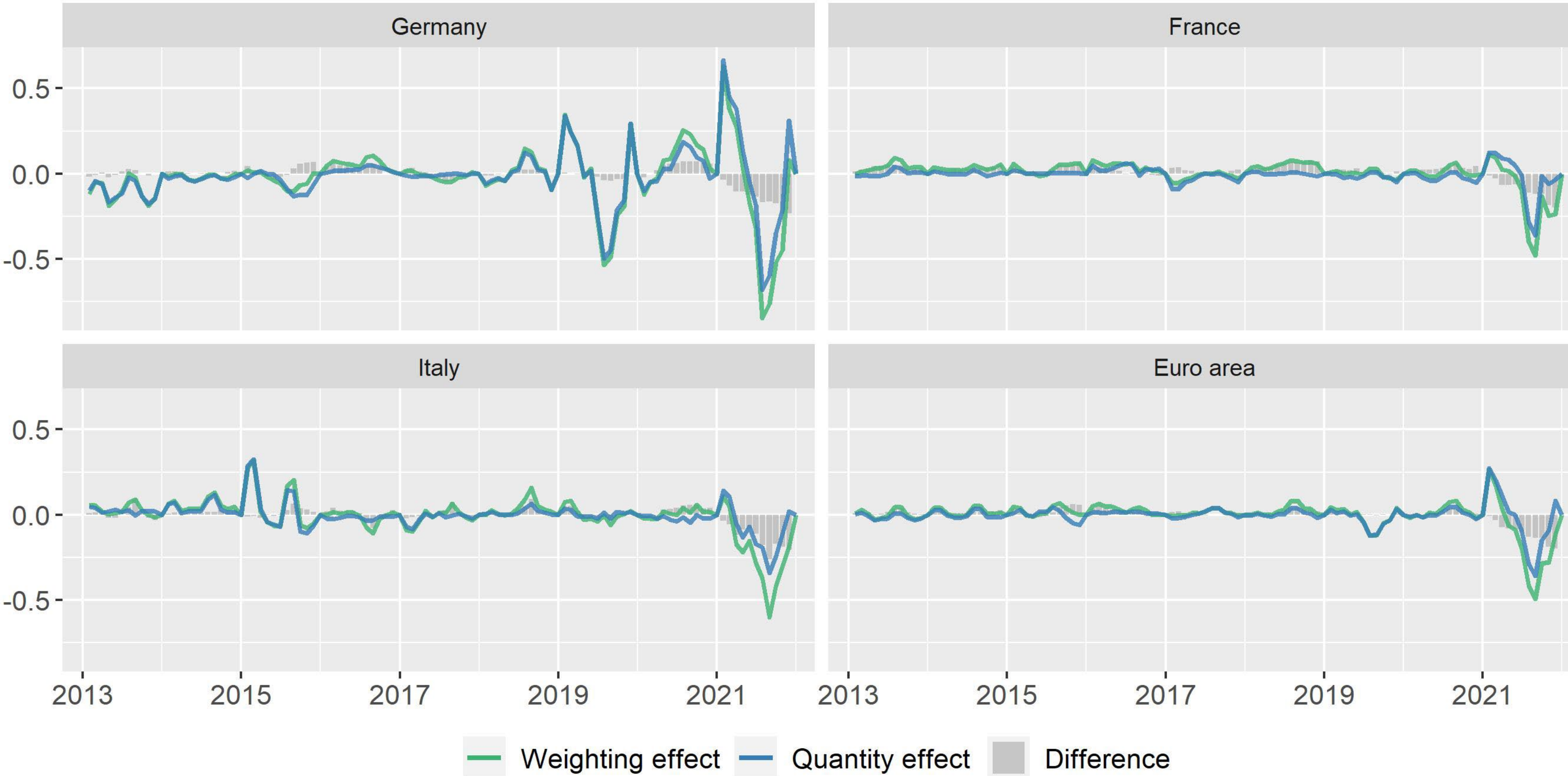
Price change component closely follows inflation rate, but…



… large weighting effects in some periods



Weighting and quantity effects similar before 2021



Chapter 4

Concluding remarks

Conclusions

- Covid-19 pandemic induced large weight shifts
  - Euro area inflation impacted by large weighting and quantity effects in 2021
- Before 2021, larger weighting effects observable in individual country HICPs from time to time
- Reporting of weighting and quantity effects on a regular basis if certain thresholds are exceeded
  - Decomposition 1: easy to implement and easy to communicate
  - Decomposition 2: advantageous from an index theoretical perspective

Appendix

Mathematical derivations

General decomposition of HICP inflation (I)

− In formal terms, the inflation rate $\pi^{y|m}$ can be expressed by

$$\pi^{y|m} = \frac{P^{y|m}}{P^{y-1|m}} - 1\,, \tag{A.1}$$

where $P^{y|m}$ is the HICP index value in month *m* ($m = 1, \dots, 12$) of year *y*.

− The HICP $P^{y|m}$ is calculated as a Laspeyres-type index and chained over December:

$$P^{y|m} = \sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} w_i^{y-1} \cdot \prod_{l=0}^{y-y^0} \delta^{y-l}\,, \tag{A.2}$$

where δ^{y-l} is a chaining factor in year $y - l$.

General decomposition of HICP inflation (II)

- Inserting Eq. (A.2) into (A.1) gives

$$\pi^{y|m} = \delta^{y} \cdot \frac{\sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} w_i^{y-1}}{\sum_{i=1}^{N} \frac{p_i^{y-1|m}}{p_i^{y-2|12}} w_i^{y-2}} - 1, \tag{A.3}$$

- Defining the scaling factor $\gamma^{y|m}$ by

$$\gamma^{y|m} = \delta^{y} \cdot \left(\sum_{i=1}^{N} \frac{p_i^{y-1|m}}{p_i^{y-2|12}} w_i^{y-2} \right)^{-1} = \frac{P^{y-1|12}}{P^{y-1|m}}\ , \tag{A.4}$$

gives the general decomposition of the inflation rate:

$$\pi^{y|m} = \gamma^{y|m} \cdot \left(\sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} \left(w_i^{y-1} - x_i \right) + \sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} x_i \right) - 1 \tag{A.5}$$

Derivation of weights $\widetilde{w}_i^{y-1}$

- If a price update is applied, official weights w_i^{y-1} applied to HICP compilation in calendar year y can be written as

$$w_i^{y-1} = \frac{p_i^{y-1|12}\, q_i^{y-1-l}}{\sum_{j=1}^{N} p_j^{y-1|12}\, q_j^{y-1-l}} \text{ with } l = \begin{cases} 1 & \text{if } 2012 \le y \le 2020 \\ 0 & \text{if } y > 2020 \end{cases} \qquad \text{(A.6)}$$

- Weights $\widetilde{w}_i^{y-1}$ can be derived from official weights w_i^{y-2} and are defined by:

$$\widetilde{w}_i^{y-1} = \frac{p_i^{y-1|12}\, q_i^{y-2-l}}{\sum_{j=1}^{N} p_j^{y-1|12}\, q_j^{y-2-l}} \text{ with } l = \begin{cases} 1 & \text{if } 2012 \le y \le 2020 \\ 0 & \text{if } y > 2020 \end{cases} \qquad \text{(A.7)}$$

where q_i^{y-1-l} denotes the quantity of product i in year $y-1-l$.

Decomposition 1: Price change and weighting effects

− Replacing x_i in (A.5) by official weights applied in HICP compilation in year *y-1*, w_i^{y-2}, yields:

$$\textit{Price change component} = \begin{cases} \gamma^{y|m} \cdot \sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} w_i^{y-2} - 1 & \text{if } m = 1, \dots, 11 \\ \pi^{y|12} & \text{if } m = 12 \end{cases}$$

$$\textit{Weighting effect} = \begin{cases} \gamma^{y|m} \cdot \sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} \left(w_i^{y-1} - w_i^{y-2}\right) & \text{if } m = 1, \dots, 11 \\ 0 & \text{if } m = 12 \end{cases} \tag{A.8}$$

Decomposition 2: Pure price change and quantity effects

- Replacing x_i in (A.5) by the weights $\widetilde{w}_i^{y-1}$ yields:

$$\textit{Pure price change component} = \begin{cases} \frac{\sum_{i=1}^{N} p_i^{y|m} q_i^{y-2-l}}{\sum_{i=1}^{N} p_i^{y-1|m} q_i^{y-2-l}} - 1 & \text{if } m = 1, \dots, 11 \\ \pi^{y|12} & \text{if } m = 12 \end{cases}$$

$$\textit{Quantity effect} = \begin{cases} \gamma^{y|m} \cdot \sum_{i=1}^{N} \frac{p_i^{y|m}}{p_i^{y-1|12}} \left(w_i^{y-1} - \widetilde{w}_i^{y-1} \right) & \text{if } m = 1, \dots, 11 \\ 0 & \text{if } m = 12 \end{cases} \tag{A.9}$$