



EUROPEAN CENTRAL BANK

EUROSYSTEM

Insights from the Report of
the Price Setting Microdata
Analysis (PRISMA)
Research Network



CNB ROD
Prague, 23 May 2022

Luca Dedola (ECB)

ESCB PRISMA Research Network

- Launched in December 2018 to collect and analyze micro price data
 - Crucial to understand inflation as sum of heterogeneous price setting decisions
 - The ESCB Inflation Persistence Network (IPN) pioneered studies of micro prices in early 2000s
- PRISMA updated and extended IPN work in several dimensions
 - Expanded datasets, not only from official sources (CPI & PPI) but also scanner price data and online prices
 - More comprehensive set of price setting statistics and their evolution over time
 - Macro implications of micro evidence on price setting (state dependence)
 - No firm-level survey though

Outline of PRISMA report (Summer 2022)

1. Understanding price setting in Europe: Is the low inflation period different?

(E. Gautier, C. Conflitti, R. P. Faber, B. Fabo, L. Fadejeva, V. Jouvanceau, J.O. Menz, T. Messner, P. Petroulas, P. Roldan-Blanco, F. Rumler, S. Santoro, E. Wieland, H. Zimmer and P. Karadi)

2. E-commerce and price setting: Evidence from Europe

(G. Strasser, E. Wieland, P. Macias, A. Błażejowska, K. Szafranek, D. Wittekopf, and L. Henkel)

3. Implications of micro price-setting for inflation dynamics and the monetary transmission

(L. Dedola, A. Nakov, S. Santoro)

4. Micro price heterogeneity and optimal inflation

(S. Santoro, H. Weber)

5. Inflation measurement: open questions and how micro data can help

(C. Osbat, C. Conflitti, GP Bellocca, B. Goldhammer, F. Kuik, J-O. Menz, F. Rumler, M. Saez, L. Segers, B. Siliverstovs, A. Touré and E. Wieland)

6. Price setting during the Covid-19 pandemic

(L. Henkel, E. Wieland, J. Jonckheere, L. Fadejeva, C. Conflitti, B. Fabo, P. Macias, A. Błażejowska, K. Szafranek, P. Karadi and P. Seiler)

7. Household inflation heterogeneity

(G. Strasser, T. Messner, F. Rumler)

Overview

- 1 Five facts on individual price changes and monetary policy implications
- 2 New evidence on online inflation and price setting in Europe



1

5 Facts on price changes in the EA

What can 135 million prices tell us about inflation dynamics in EA?

(E. Gautier, C. Conflitti, R. Faber, B. Fabo, L. Fadejeva, V. Jouvanceau, JO. Menz, T. Messner, P. Petroulas, P. Roldan-Blanco, F. Rumler, S. Santoro, E. Wieland, H. Zimmer)

1. Why does micro price adjustment matter?

- Inflation as a sum of individual price decisions
- How often/much do firms change their prices?
- Price stickiness key theoretical rationale of the Phillips curve

2. How to characterize price stickiness?

- **Frequency** of price changes: How fast prices react?
- **Distribution of size of price changes**: Which prices adjust first?
- Need to look at micro price data

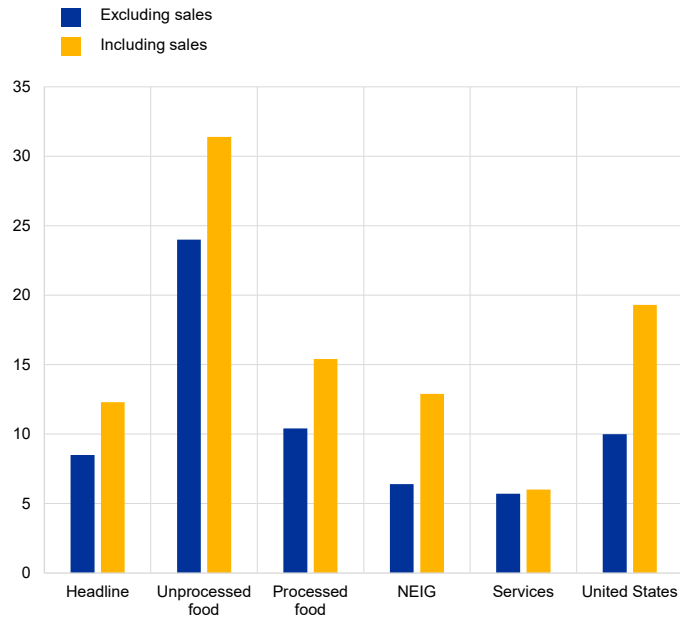
Price quotes underlying euro area HICP

- [135 million of price quotes](#) collected by NSI in 11 countries (AT, BE, DE, FR, GR, IT, LT, LU, LV, SK, SP), for most countries over the period 2010-2019 (longer for AT, FR, GR)
- More than 160 common COICOP-5 level products covering about 60% of the EA HICP (vs. 50 specific items covering about 10% of EA HICP in IPN (Dhyne et al. 2006))
- In all « core » sectors but administered prices, centrally collected prices, scanner data are usually not reported in micro datasets; energy products are excluded.
- Track individual price trajectories + information on sales for most countries and on replacements/quality adjustment

Fact 1: Prices change infrequently in the “core” sectors

Frequency of price changes (in %, euro area, 2010-2019)

Freq. of price changes

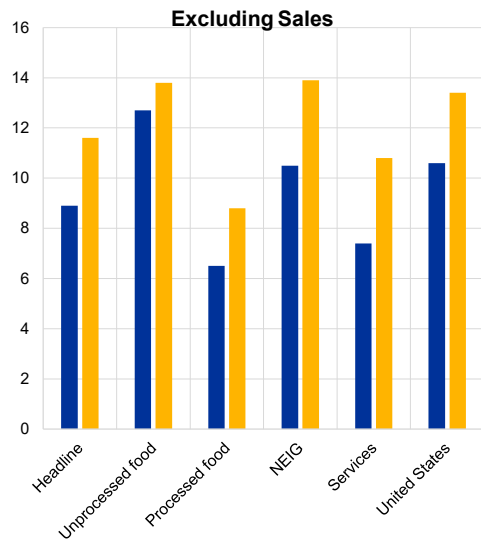


Repricing rates in EA and USA (in %; EA on x-axis, US on y-axis)

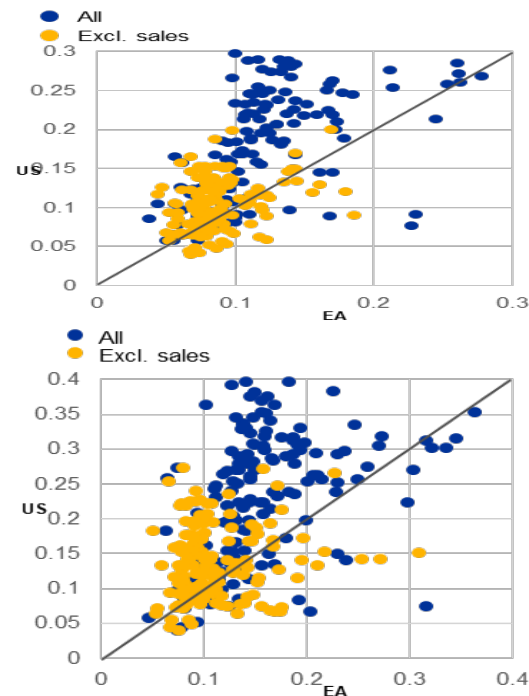


Fact 2: Price changes heterogeneous, many large and small

Size of price changes
(in %, euro area, 2010-2019)

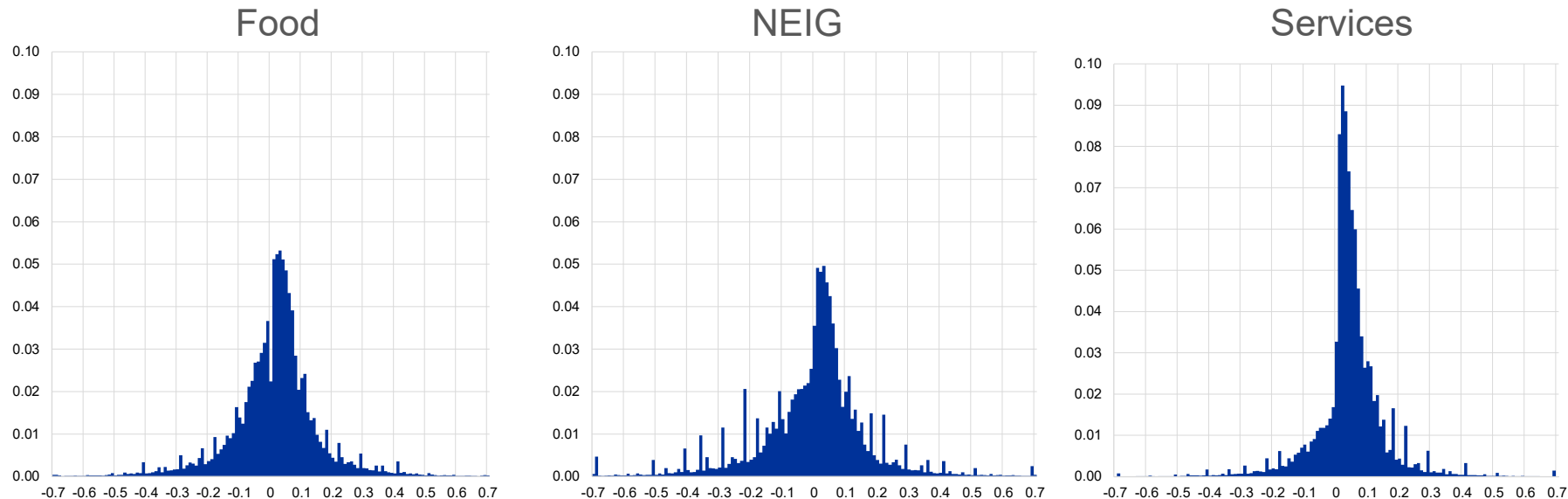


Size of Price Increases/Decreases in EA and USA



Fact 2: Idiosyncratic shocks matter for the size of price changes

Sectoral distributions of size of price changes (ex-sales)

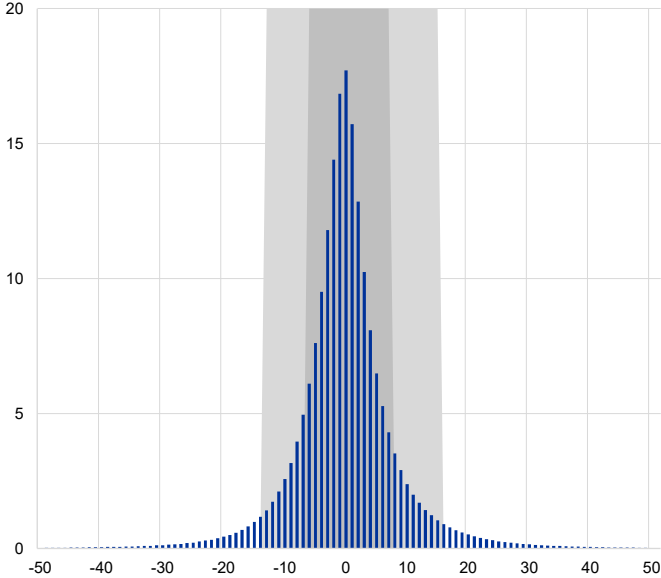


Notes: The histograms plot the distribution of price changes (dlog in %) calculated first at the country level by product for the common sample of products (bins of 0.5 pp), then aggregated at the country level using euro area product weights and then aggregated at the euro area level using HICP country weights.

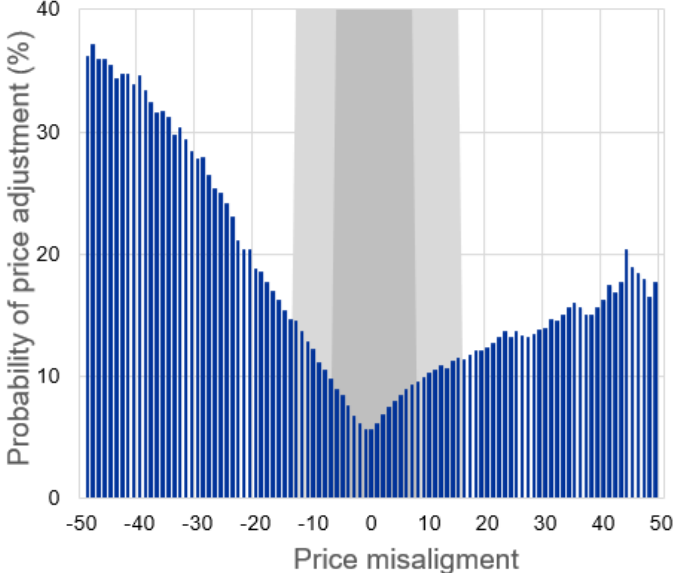
Fact 3: Retail prices more likely to change when most misaligned

(P. Karadi, J. Amann, J.S. Bachiller, J. Wursten)

Distribution of Price Misalignments



Price Adjustment Hazard

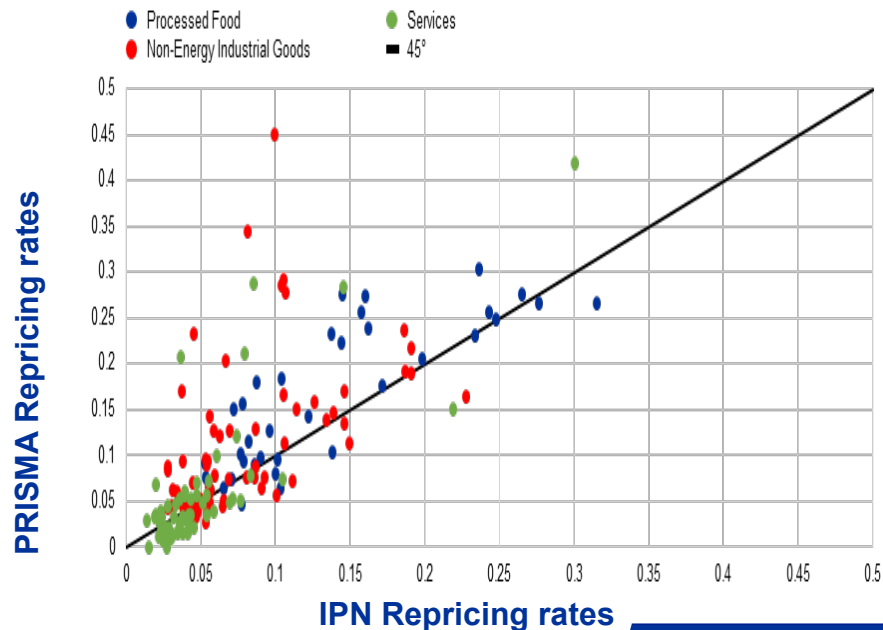


ECB calculations.
Source: IRI supermarket scanner data (Germany, France, Italy, Netherlands, 2013-2017). Shaded areas cover 90% (dark) and 67% (light) mass.

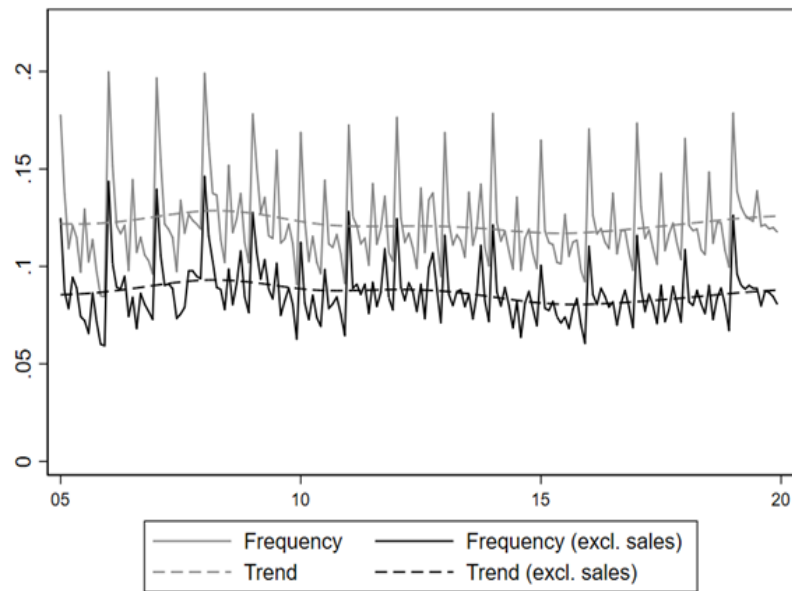
Fact 4: No trend in repricing rate during low inflation period

Repricing rate: IPN (1996-2001) vs

PRISMA (2011-2017)



Repricing rate since 2005

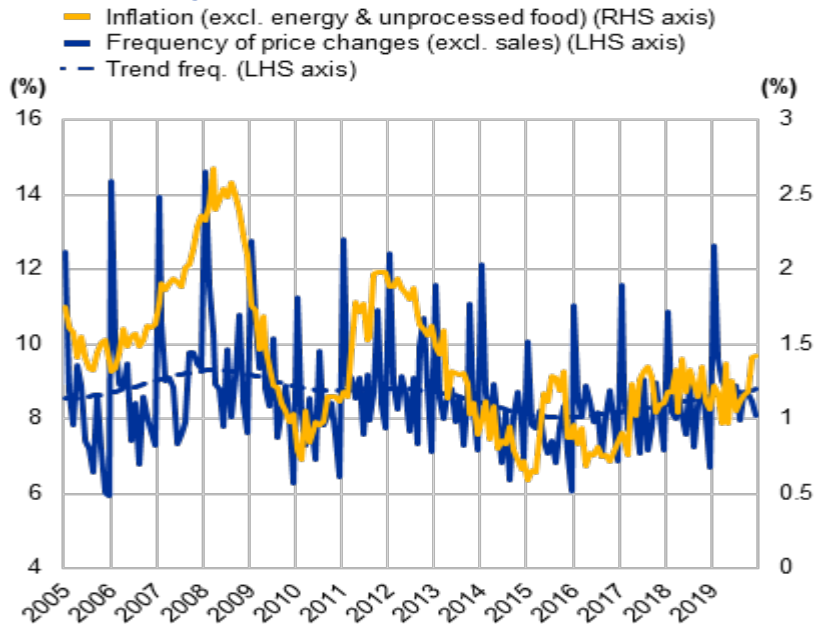


Fact 5: Inflation fluctuations mainly due to size of price changes

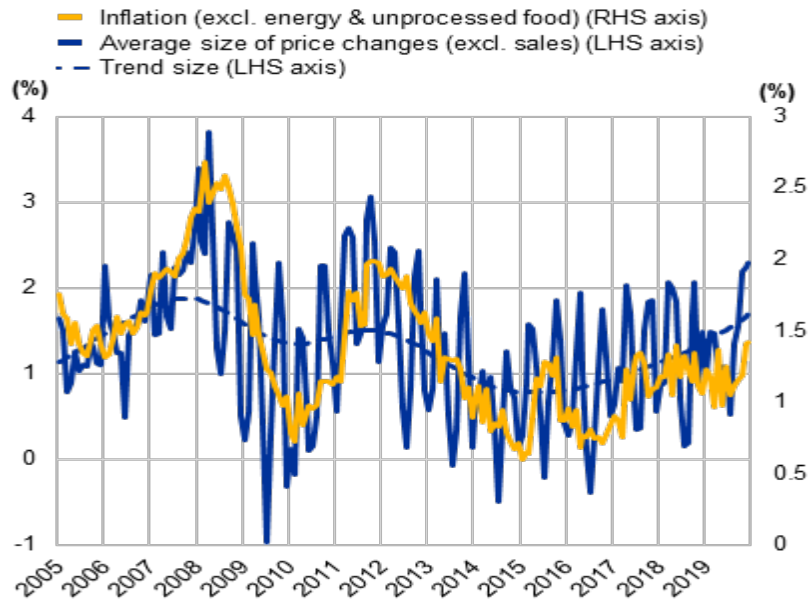
- Inflation equal to average size of (non-zero) price changes times their frequency:

$$\pi_t = f_t \times dp_t$$

Frequency and Inflation

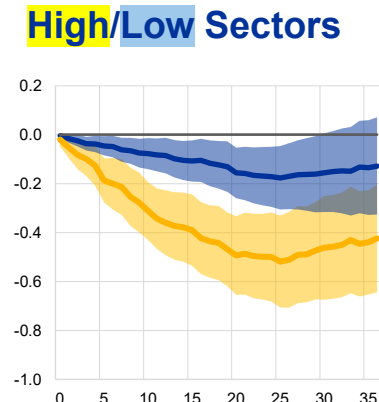
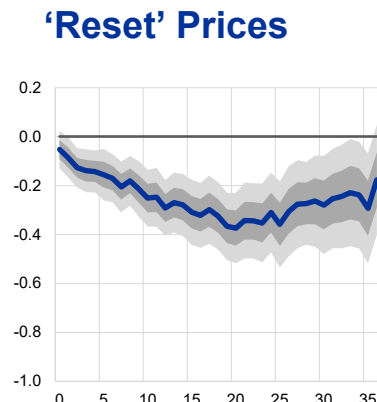
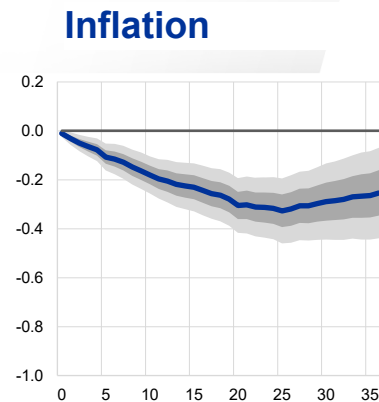


Average Size and Inflation

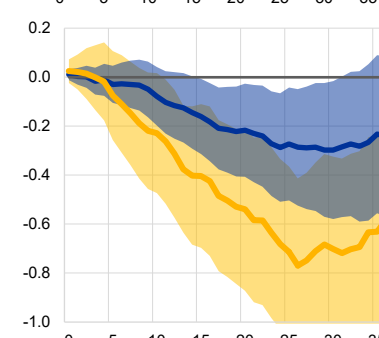
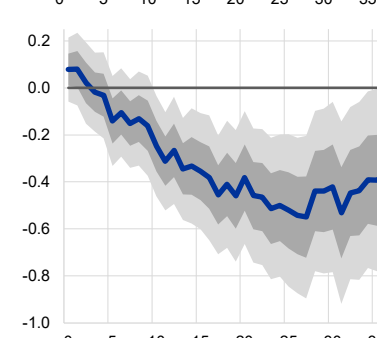
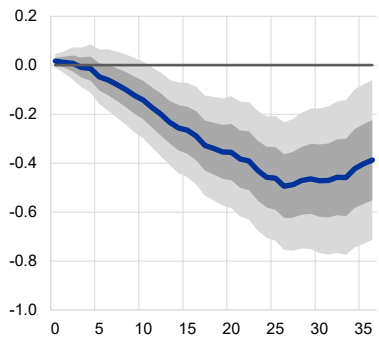


Price adjustment to macro shocks consistent with micro facts in 2005-19 period

Shock Increasing Oil Supply



Shock Reducing Global Demand

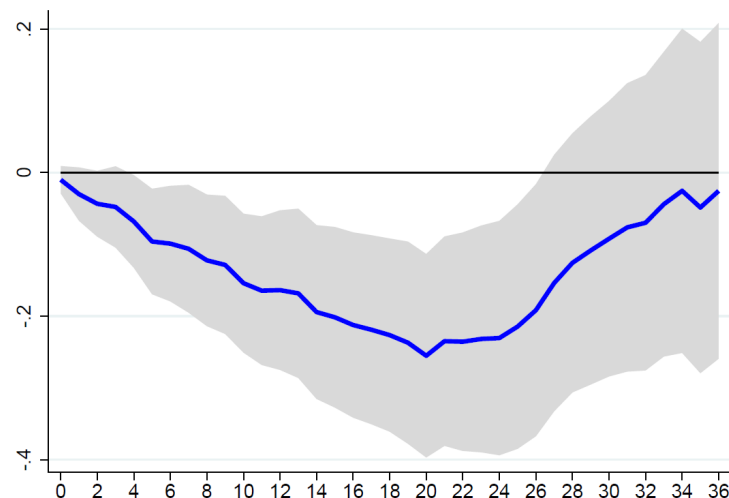
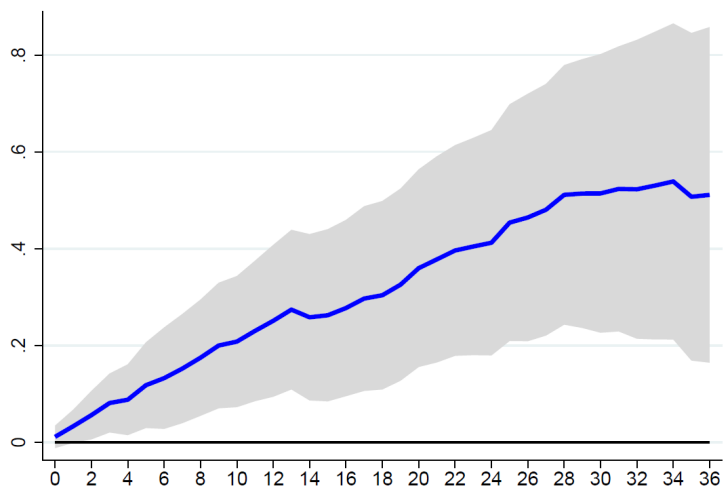


Notes: Impulse response of inflation and reset prices to oil supply and global demand shocks (Baumeister and Hamilton 2019). Months from the shocks on x-axis. Light grey areas: 2 standard deviations confidence interval; dark grey areas: 1 standard deviations confidence interval. In high/low sector graphs, shaded area is the 2 standard deviations confidence interval

Asymmetries to negative vs positive oil supply shocks

- **Reset prices** entirely account for different long-run price response

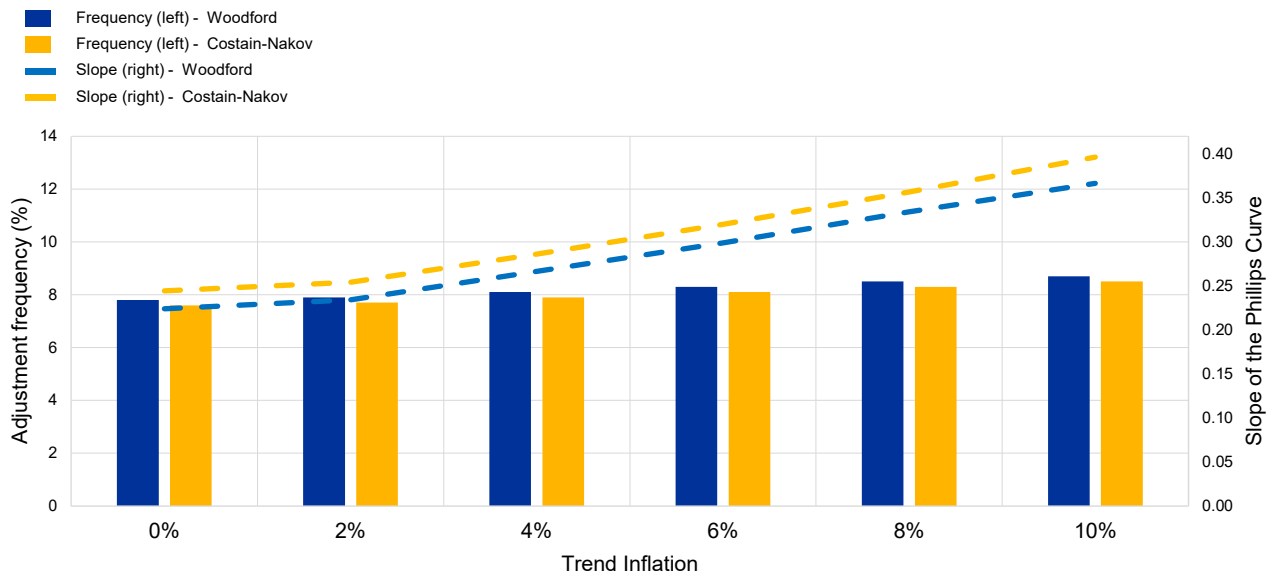
Price adjustment to inflationary(-) and disinflationary(+) oil supply shocks



Model-based analysis of nonlinearities: Trend inflation

Even under moderate state dependence, repricing rate increases with **trend inflation**:
→ steeper Phillips curve

Repricing rate (lhs) and Absolute value of Phillips Multiplier (rhs)



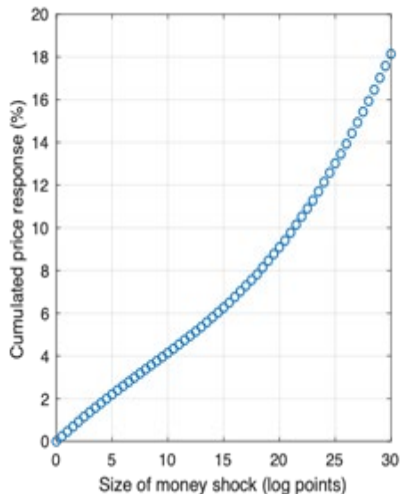
Source: Results from calibrated version of Woodford (2009) and Costain and Nakov (2019).

Model-based analysis of non-linearities: Large nominal shocks

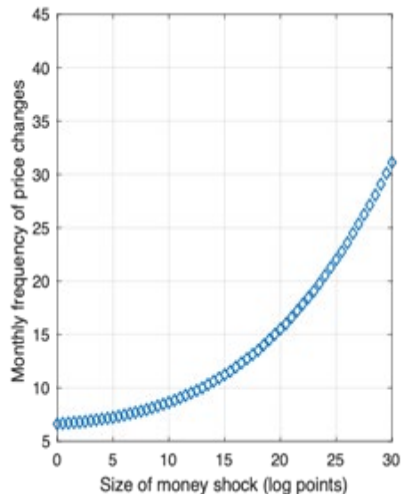
Nonlinear effects of larger nominal shocks across sectors

NEIG

Inflation

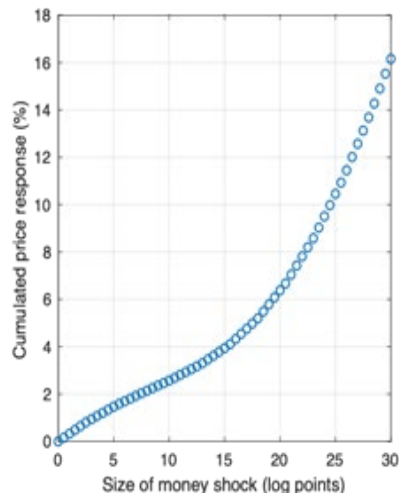


Frequency

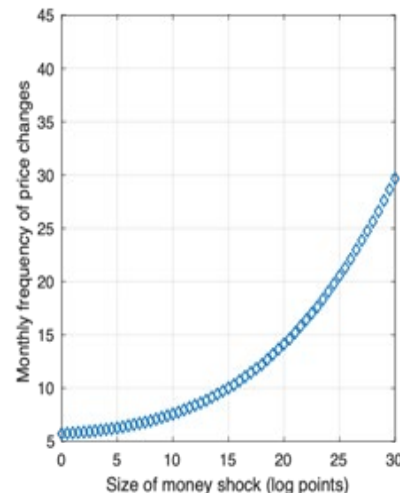


Services

Inflation



Frequency



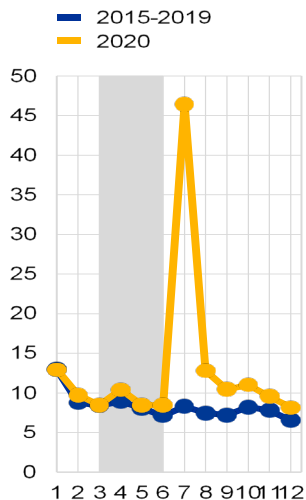
Sources: ECB staff simulations based on model in Woodford (2009) calibrated to euro area micro data.

Large shocks: Price setting in 2020

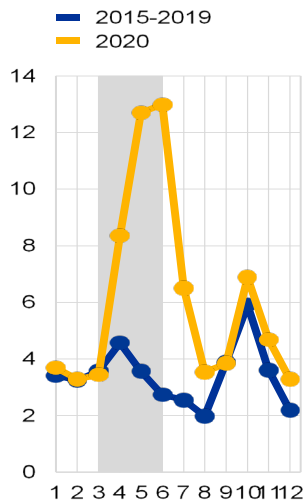
(L. Fadejeva, C. Conflitti, E. Wieland and B. Fabo)

Frequency of price changes by month of year (2015-2019 vs 2020, %)

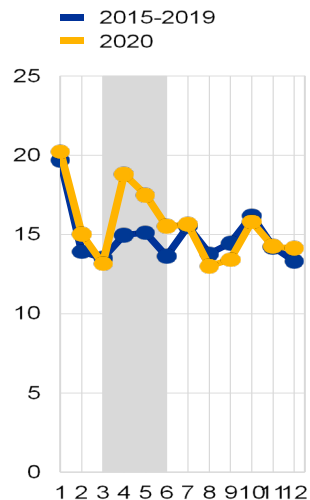
GERMANY
Excl. sales



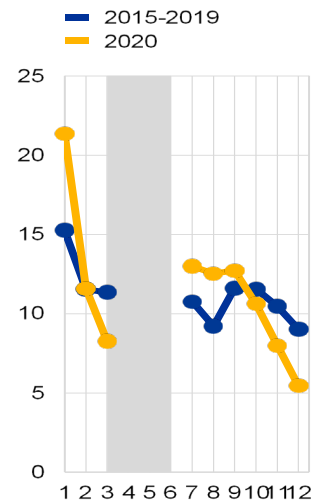
ITALY
Excl. sales



LATVIA
Excl. sales



SLOVAKIA
Excl. sales



Sources: own calculations based on national CPI micro price data.

Notes: Grey shaded area marks the first wave of the COVID pandemic in Europe from March to June 2020. No observations for Slovakia for April-June 2020.

Takeaways: Price setting facts and implications for transmission

1. Prices change infrequently (in the “core” sectors)
2. Idiosyncratic shocks matter for frequency and size/dispersion of price changes
3. Prices more likely to change when more ‘misaligned’
4. Limited cyclical variation in frequency of price changes in 2005-19 period
5. Inflation fluctuations due to average size of price changes (i.e. share of increases)

➤ Implications for monetary policy transmission:

- Both nominal and real rigidities matter for inflation dynamics
- State-dependent price setting should result in nonlinearities in volatile times
- Empirical threshold of nonlinearities, also for real rigidities, still open question

2

Online inflation and price setting in Europe

Some questions

1. Is online inflation different from offline inflation?

- Measurement of inflation with web-scraped prices

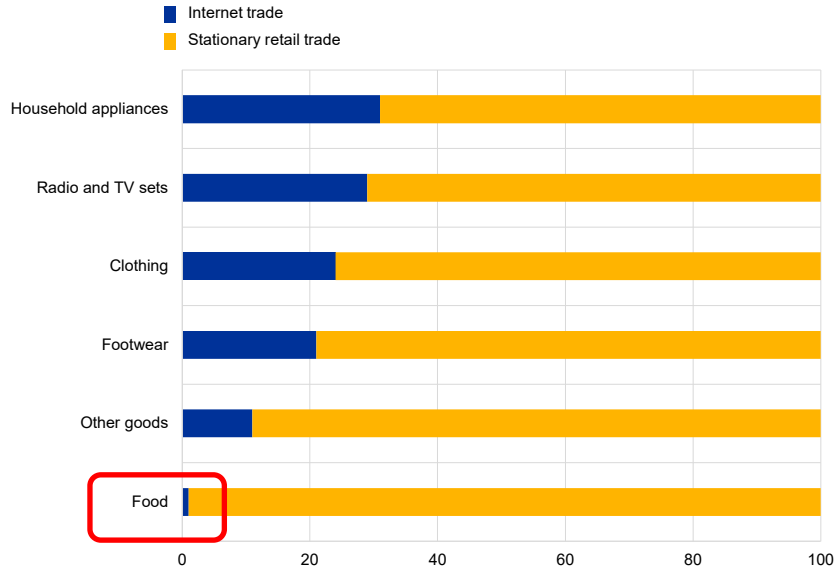
2. Is online and offline price setting different?

- Frequency and size of price changes
- Price dispersion

No comprehensive database of online transactions for the euro area.
Selected evidence from various countries.
(L. Henkel, P. Macias, G. Strasser, E. Wieland and D. Wittekopf)

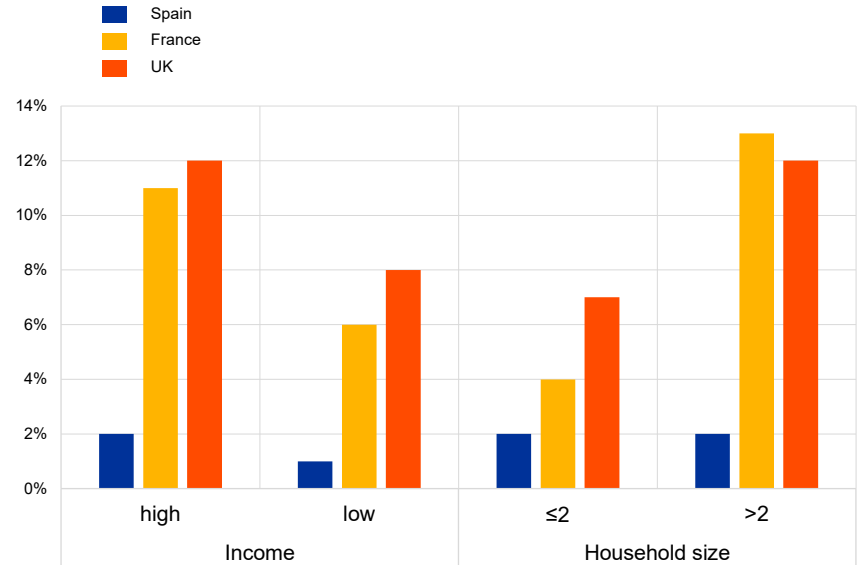
E-commerce at different stages of diffusion in Europe

Internet trade share in German CPI basket (2015)



Source: Destatis (2019)

Online share of grocery expenditure (2018)



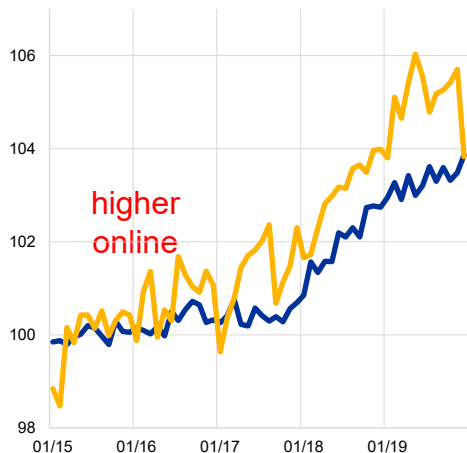
Source: Strasser & Wittekopf (2022) based on GfK household panel
"Supermarket" products refers to fast-moving consumer goods (FMCG).

Online inflation more volatile in most sectors in Germany

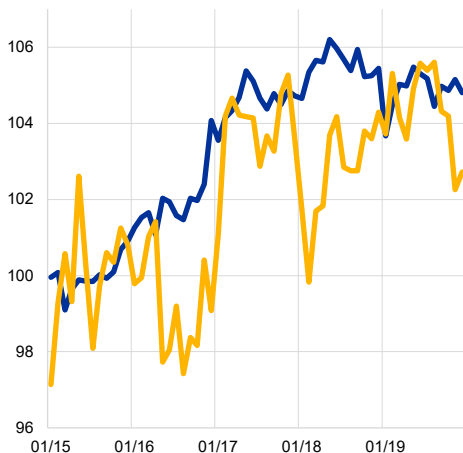
(E. Wieland)

Online and offline price indices in German CPI (2015-2019)

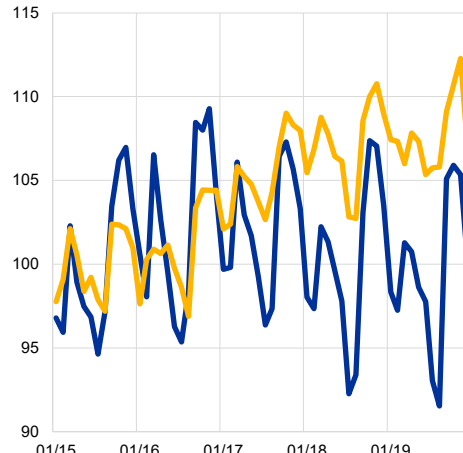
Processed food



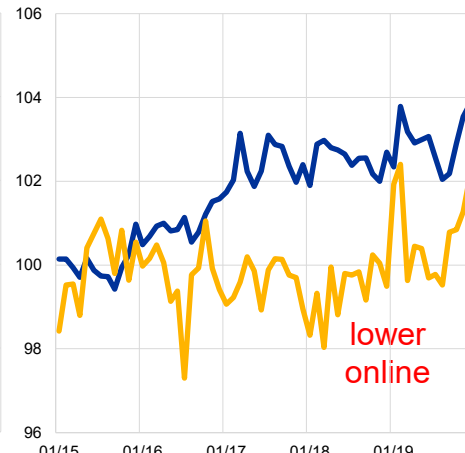
Non-durable NEIG



Semi-durable NEIG



Durable NEIG



■ Offline
■ Online

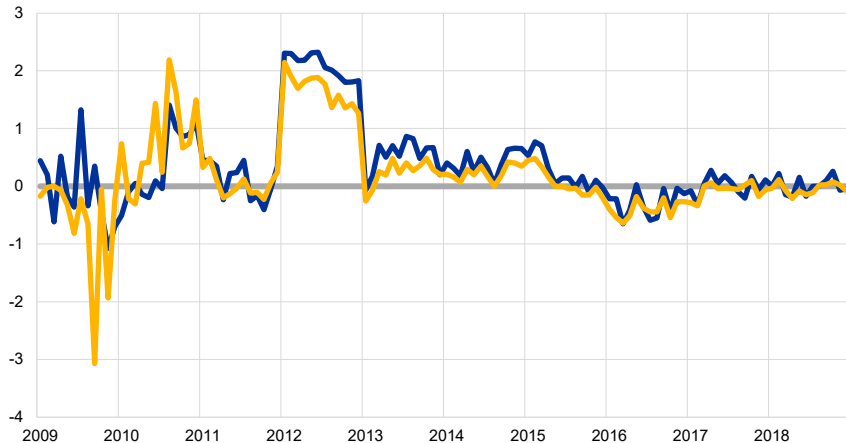
Part 2: Online Prices

Source: Wieland (2022) based on German CPI micro data

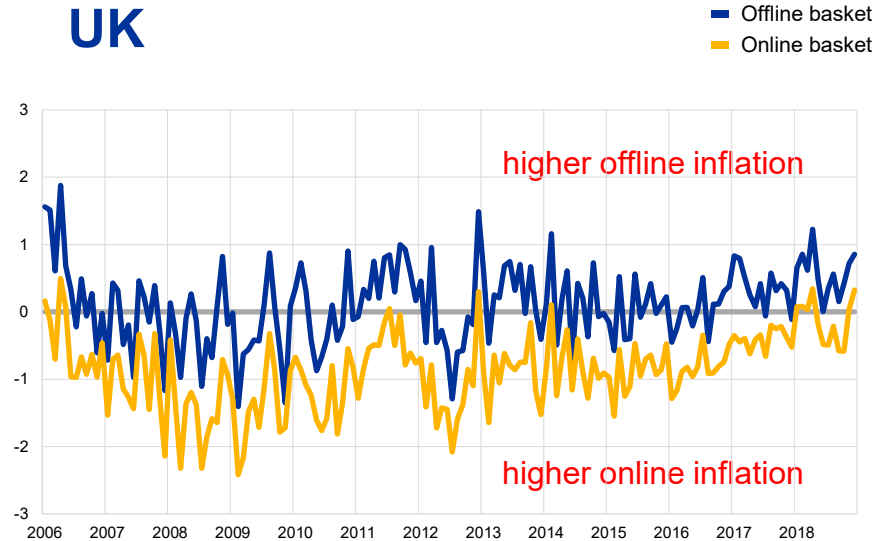
But inflation differences heterogeneous across countries

Inflation differentials in offline-online supermarket products (% p.a.)

France



UK



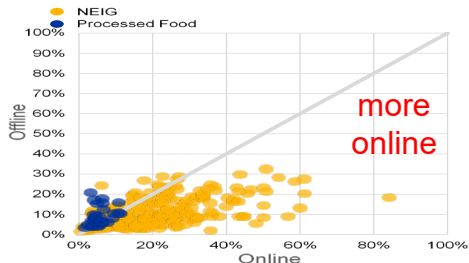
Source: Strasser & Wittekopf (2022) based on GfK household panel data

Online prices change more often in Germany & Poland

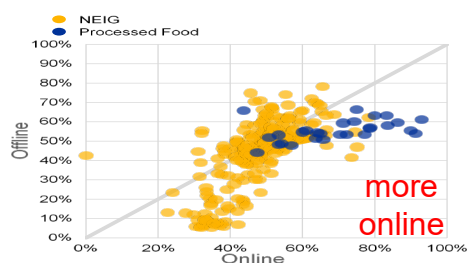
German CPI

- NEIG
- Processed Food

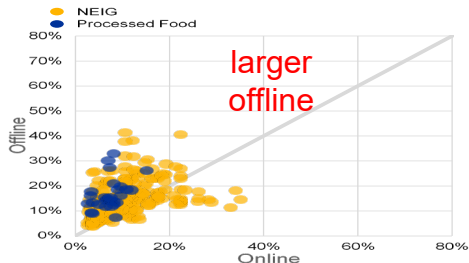
Frequency of price changes



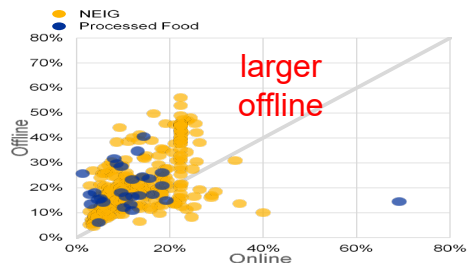
Share of price increases



Median size of price increases



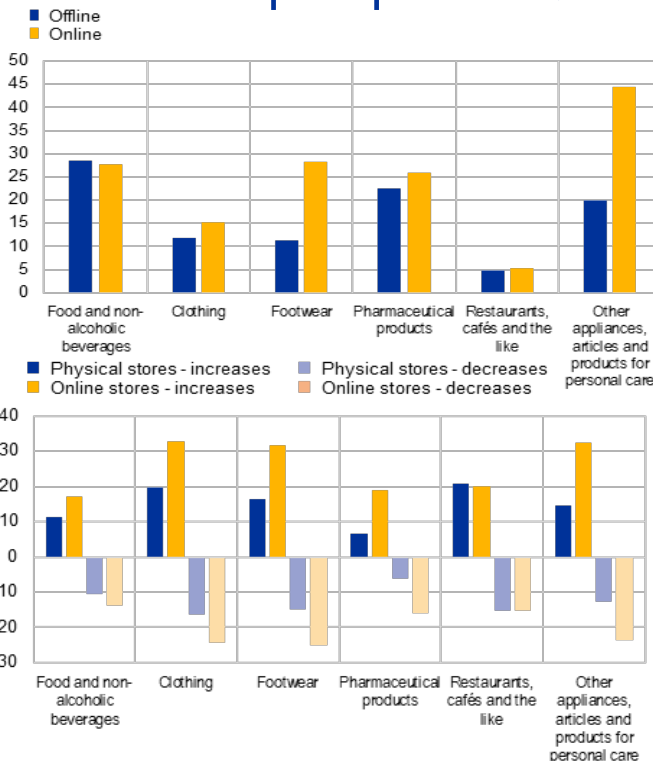
Median size of price decreases



Sources: Bundesbank staff calculations based on German CPI micro data.

Notes: Statistics are derived at the level of 288 online/offline products (COICOP 10-digit level) and aggregated to a given product category based on the corresponding 2015 expenditure share in the German CPI. The sample period covers 2015-2019.

Polish web scraped prices & CPI



Price setting: Online pricing in Europe more or equally uniform than offline

(G. Strasser, D. Wittekopf)

Price dispersion within retailers (supermarket products)

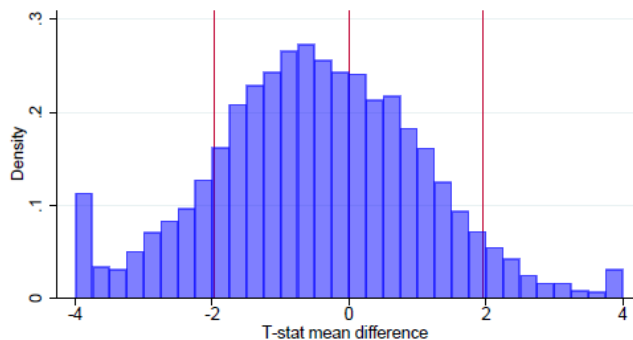
	France		UK		USA	
	Online	Offline	Online	Offline	Online	Offline
Same price (rounded, %)	79	76	89	87	66	78
Price difference (avg., %)	1.8	2.2	2.7	2.9	5.2	3.4
Price difference (med., %)	0.0	0.0	0.0	0.0	0.0	0.0
Price pairs (avg., tsd.)	3	3	44	44	5	40

Source for ES, FR, UK: Strasser & Wittekopf (2022) based on GfK household panel 2018; for USA: Aparicio et al. (2021) based on webscraped and Nielsen retail scanner data

Even direct competitors differ in how they price products online vs. offline.

Mean difference between offline and online prices (France, t-stat)

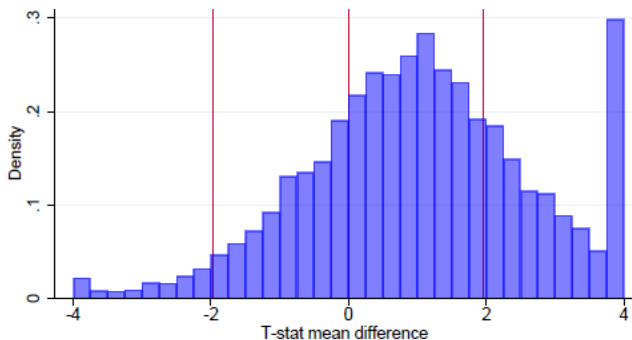
retailer A



offline > online: 6%
offline < online: 16%

(median offline vs. median online price, H_0 : no difference)

retailer B



28%
4%

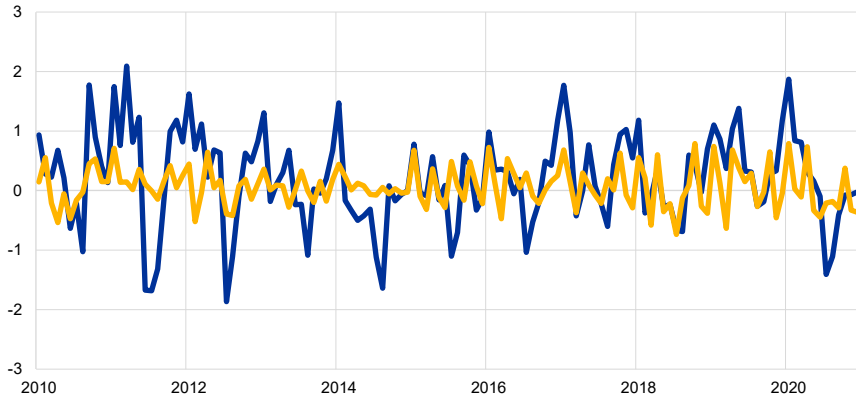
Source: Strasser & Wittekopf (2022) based on GfK household panel data

Online prices useful to track aggregate CPI after alignment

(P. Macias, A. Błażejowska and K. Szafranek, NBP)

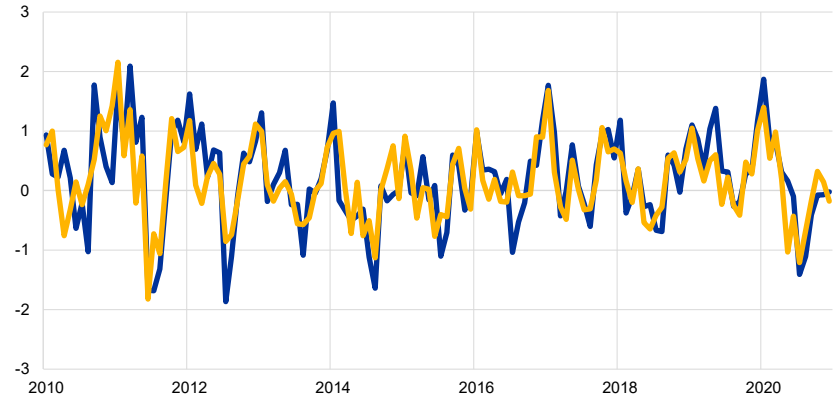
CPI inflation (**Poland**, food and non-alcoholic beverages, m-o-m, % p.a.)

No product alignment



■ Official inflation (food+nalc)
■ E-CPI inflation (food+nalc)

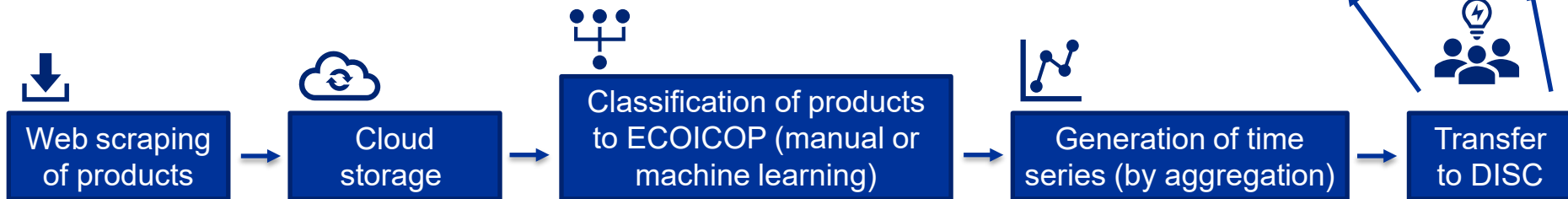
CPI-based product alignment and aggregation



Source: Macias et al. (2022) based on NBP webscraped prices

Coming soon: Daily Price Dataset (DPD)

Sectors	Countries
Supermarket	(BE) DE ES IT NL
Fashion	(AT) (BE) (CH) (CZ) (DE) (ES) (FR) (GB) (IE) (IT) (NL)
Drugstore	(DE)
Food Delivery	DE ES FR IT NL
Electronics	DE ES FR IT NL
Furniture	AT BE CH CZ DE ES FI FR GB IE IT NL PT SE SK



Inflation monitoring: Online data key real time source

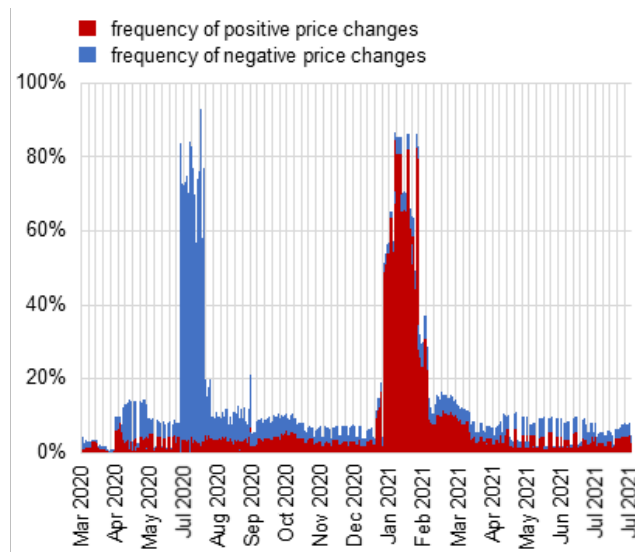
VAT change in Germany: month-on-month average price change



Source: ECB staff calculations.

Notes: Web scraped data from German online supermarkets, containing information mainly on food, beverages and personal care items. Data are collected daily. The chart shows the daily unweighted average of 4-week price changes. 4-week price changes are calculated as the percentage change of the price of a product on a given day compared to the price of the same product on the same weekday four weeks before. Latest observation: 26 July 2021.

VAT change in Germany: frequency of price increases and decreases

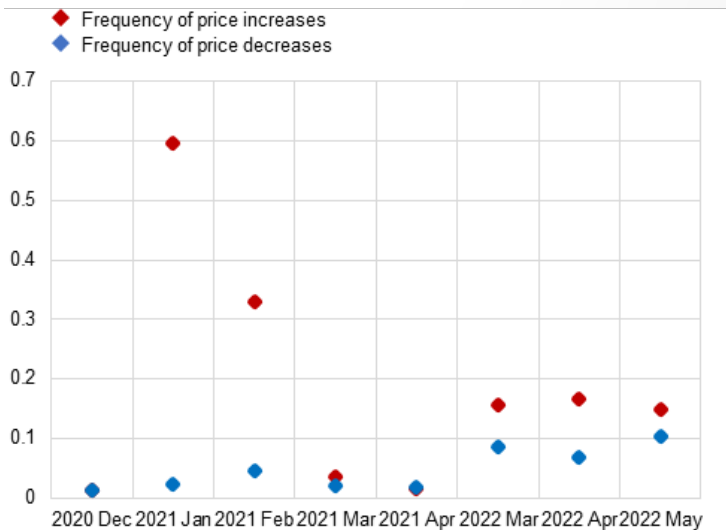


Source: ECB staff calculations.

Notes: Web scraped data from German online supermarkets, containing information mainly on food, beverages and personal care items. Data are collected daily. The chart shows the daily share of products that experienced a price change compared to four weeks before. Latest observation: 26 July 2021.

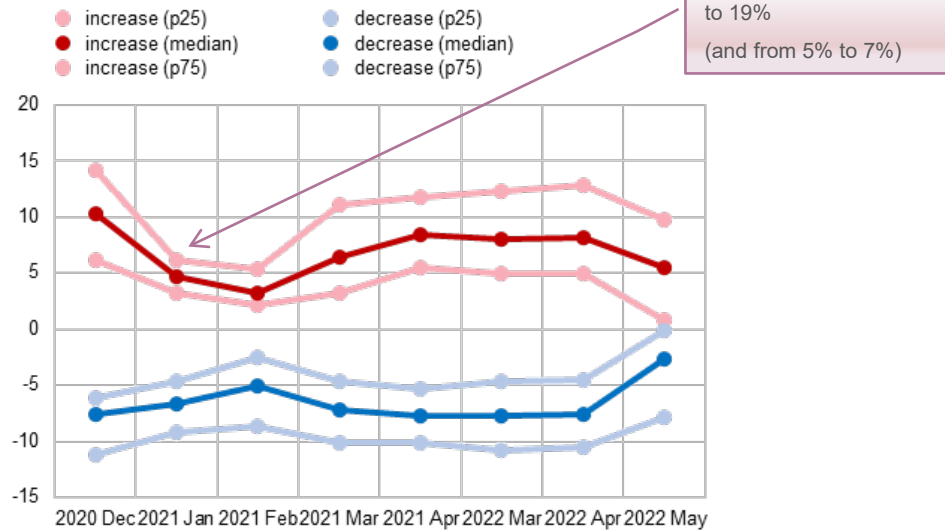
Inflation monitoring: The “return of inflation”

Germany: frequency of price increases and decreases during VAT change and in 2022



Source: ECB staff calculations based on daily online price data.
Notes: Web scraped data from a German online supermarket. Products on sale are excluded. Latest observation: 16 May 2022.

Germany: size of price increases and decreases during VAT change and in 2022



Source: ECB staff calculations based on daily online price data.
Notes: Web scraped data from a German online supermarket. Products on sale are excluded. Latest observation: 16 May 2022.

Summary: Online price setting

1. Online and offline inflation can **differ in terms of volatility and dynamics**, no clear pattern across sectors and countries
 2. **Price adjustment frictions** appear to be lower online
- DPD partly addresses data limitations in analyzing effects of e-commerce on inflation

Summary: Price setting facts and implications for transmission

1. Prices change infrequently (in the “core” sectors)
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4. Limited cyclical variation in frequency of price changes in 2005-19 period
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➤ Implications for monetary policy transmission:

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- State-dependent price setting should result in nonlinearities in volatile times
- Empirical threshold of nonlinearities, also for real rigidities, still open question