

New Facts on Consumer Price Rigidity in the Euro Area

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Why Do Micro Price Adjustments Matter for Inflation?

Micro Data to Better Understand Macro Dynamics

- ▶ Inflation as a sum of individual price decisions: timing and size of the price change
- ▶ Price stickiness is a key rationale for the existence of the Phillips curve: in response to a shock, it takes some time for prices to adjust, leading to short-run real effects of monetary policy

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How to Characterize Price Stickiness?

- ▶ Frequency of price changes: How fast prices react?
- ▶ Distribution of size of price changes: Which prices adjust first?
- ▶ Do non-linearities matter?
- ▶ Need to look at micro price data

New Facts on Euro Area Micro Price Rigidity

What Can 135 Million Prices Tell Us About EA inflation?

- ▶ Provide new evidence on price rigidity at the euro area level
 - ▶ Micro data underlying the construction of country level inflation
 - ▶ 11 countries and 60% of the EA HICP
 - ▶ Over the period 2010-2019 (for most countries)
- ▶ Document how micro prices react to economic shocks (MP, demand, VAT...)

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The Return of Inflation and Price Adjustment

- ▶ Can high trend inflation lead to a steeper Phillips curve?
- ▶ Can large shocks lead to non-linear price dynamics?
- ▶ Preliminary empirical findings using most recent available data (2020-2022)

What Can 135 Million Prices Tell Us About EA Inflation?

Price quotes underlying the HICP construction

- ▶ 135 million of price quotes collected by NSIs in 11 EA countries (AT, BE, DE, FR, GR, IT, LT, LV, LU, SK, SP) [▶ Data](#)
- ▶ Over the period 2010-2019 (more for AT, FR, GR)
- ▶ In all “core” sectors but administered prices, centrally collected prices, scanner data are usually not reported in available micro data sets. We also exclude energy prices.
- ▶ More than 160 COICOP5 common products covering 60% of HICP [▶ Common Sample](#)
- ▶ Track item-specific price trajectories + information on prices on sales and product substitutions

What Can 135 Million Prices Tell Us About EA inflation?

Harmonized Methodology

- ▶ Clean data in the same way in each country (e.g., remove outliers, remove imputed prices (where possible), use quantity and quality adjusted prices (where possible))
- ▶ Define a common sample of COICOP5 products (at least 3 of the 4 largest countries (DE, FR, IT, SP))
- ▶ Calculate at a decentralized national level the same statistics for each country/5-digit COICOP combination
- ▶ Aggregation of country–product results using euro area product weights at the COICOP-5 level (2017-2020 average) and country weights in euro area HICP (2017-2020 average)
- ▶ Baseline results: excluding product replacements, country-specific sample period, common sample of products
- ▶ Sales: sales flag when available; ad hoc sales filter if not available

Our contributions:

- ▶ Providing new evidence on price rigidity at the **euro area** level
 - ▶ More countries and largest product coverage of the EA HICP than Dhyne et al. (2006)
 - ▶ Over the period 2010-2019 (for most countries)
- ▶ Precise and harmonized measures of sales (flag, filter) and new evidence on the distribution of size
- ▶ Document how micro prices react to economic shocks (MP, demand, VAT...)

Fact 1: Prices are sticky in the EA

Euro Area Price Rigidity: Frequency of Price Changes (in %)

	Including sales		Excluding sales (NSI sales flag if available)		Excluding sales (Sales filter)		% of sales	
	Freq. price changes	% price increases	Freq. price changes	% price increases	Freq. price changes	% price increases	NSI Flag	Sales Filter
EURO AREA	12.3	64.0	8.5	68.8	8.0	66.4	4.4	4.9
by Sector								
Unprocessed Food	31.4	54.5	24.0	57.6	20.6	58.3	7.4	10.1
Processed Food	15.4	57.0	10.4	61.8	9.2	62.0	4.3	5.7
NEIG	12.9	48.2	6.4	59.8	6.8	54.8	8.6	7.5
Services	6.0	82.5	5.7	82.4	5.5	80.4	0.5	1.2
<i>United States</i>	<i>19.3</i>	<i>62.0</i>	<i>10.0</i>	<i>71.1</i>			-	

Notes: Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand. Results excluding sales are based on NSI sales flag (if available, and sales filter otherwise). Statistics are weighted using EA HICP weights.

- ▶ 12.3% of prices are updated in a given month on average
 - ▶ When excluding sales, the frequency of price changes is 8.5% in the EA
 - ▶ About the same frequency as in the US once we exclude sales
 - ▶ Frequency is somewhat higher than in previous IPN evidence obtained for the period 1996-2001 but for a more limited number of products
- ▶ Sectoral heterogeneity is more pronounced than country heterogeneity
 - ▶ Energy prices change very frequently and would imply a higher aggregate frequency (about +8 pp) but mainly coming from a quick reaction to exogenous oil shocks
 - ▶ Small country heterogeneity in particular when excl. sales
 - ▶ Labour/input shares explain some cross sectoral differences

▶ US vs EA

▶ Dhyne et al.

▶ Country

▶ Correlations

Fact 2(a): Idiosyncratic shocks matter for the average size of price changes

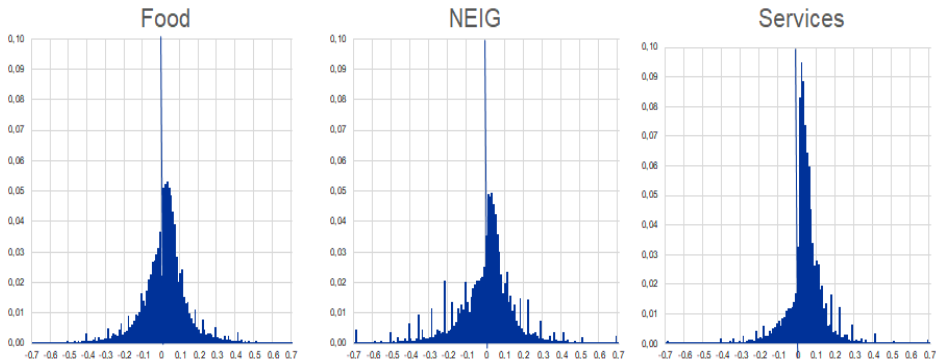
Euro Area Price Rigidity: Size of Price Changes (in %)

	Including sales				Excluding sales			
	Median		Average		Median		Average	
	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease
EURO AREA	9.6	13.0	12.3	16.2	6.7	8.7	8.9	11.6
by Sector								
Unprocessed Food	12.6	15.0	16.8	18.9	10.1	11.0	12.7	13.8
Processed Food	9.2	12.0	12.3	14.6	5.8	7.8	6.5	8.8
NEIG	13.9	19.2	17.1	22.1	7.9	10.7	10.5	13.9
Services	5.6	8.2	7.5	11.8	5.5	7.9	7.4	10.8
<i>United States</i>			<i>17.8</i>	<i>21.6</i>			<i>10.6</i>	<i>13.4</i>

Notes: Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand. Results excluding sales are based on NSI sales flag (if available, and sales filter otherwise). Statistics are weighted using EA HICP weights.

- ▶ Price changes are on average much larger than inflation: local-/firm-specific shocks + sales are more relevant than aggregate shocks for price changes
- ▶ More country heterogeneity for size than for freq. (even once sales excluded) ▶ Country
- ▶ Price changes are a little larger in the US than in the EA ▶ US vs EA
- ▶ Price changes are about the same size as in previous EA evidence ▶ Dhyne

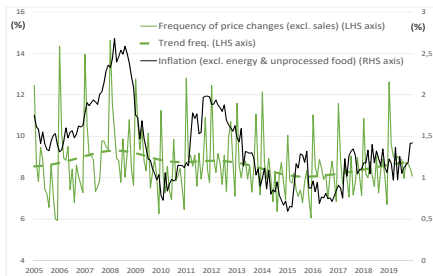
Fact 2(b): Idiosyncratic shocks matter for the dispersion of price changes



Notes: Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Results excluding sales are based on NSI sales flag (if available, and sales filter otherwise). Statistics are weighted using EA HICP weights.

- ▶ 11% of price changes are smaller than 2% in absolute values and 14% when we exclude sales ▶ Sales
- ▶ Large price increases and decreases are quite frequent: once excl. sales, 10% of price changes are above +15.9% and 10% of price changes are below -13.5%
- ▶ Country heterogeneity: more dispersion in AT and DE than in IT/FR/SP ▶ By country

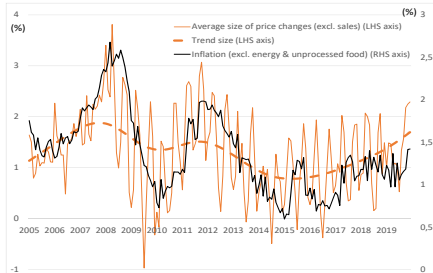
Fact 3: The EA frequency of price changes is stable over the last 15 years



- ▶ Inflation is the product of the average size of non-zero price changes by the frequency of price changes

$$\pi_{jt} = f_{jt} \times dp_{jt} \quad (1)$$

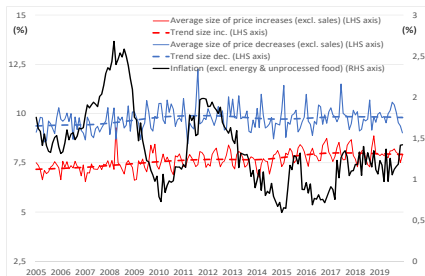
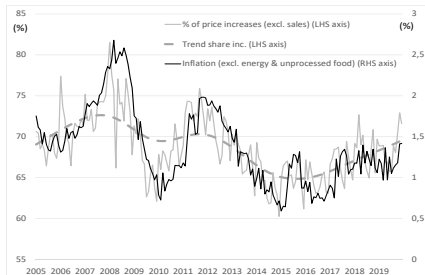
- ▶ No trend in the frequency of price changes over the last 15 years
- ▶ Yet the repricing rate does vary over time



- ▶ Small cyclical variations and small correlation with aggregate inflation [▶ Estimates](#)
- ▶ Prices are more frequent in January even once we control for sales (+6 pp for changes, +5pp for increases) (in particular in services (+11 pp)) [▶ Jan. effects](#)

- ▶ Average size of non-zero price changes co-moves with inflation (correlation coef. higher than 0.9)

Fact 4: Inflation is mainly driven by the relative share of price increases/decreases



- Inflation can be written as:

$$\pi_{jt} = f_{jt}^+ \times dp_{jt}^+ - f_{jt}^- \times dp_{jt}^- \quad (2)$$

- Time variation in inflation comes variation in the share of price increases / decreases (correlation coef close to 0.9)
- Size of price increases and size of price decreases are quite stable (correlation coef lower than 0.3)
- Overall, aggregate inflation moves with changes in the relative fraction of price increases and decreases (which translate into changes in the average size of price changes) and less with the average size of price increases and decreases

► Estimates

► Counterfactual

How Does Inflation Adjust to Macro Shocks?

- ▶ Run local projection exercises on recomposed and counterfactual inflation rates:

$$\pi_{j,t-1,t+h}^* = \alpha_{j,h} + \alpha_{m,h} + \beta_h S_t + \gamma_h X_{c,t} + \epsilon_{j,t,h} \quad (3)$$

with $\pi_{j,t-1,t+h}^*$ being the cumulated inflation rate for product j (product- and country-specific) between period $t-1$ and $t+h$.

- ▶ Different macro shocks:
 - ▶ MP shock (Jarocinski and Karadi, 2020)
 - ▶ Oil shocks (Baumeister and Hamilton, 2019).
 - ▶ Global demand shock (Baumeister and Hamilton, 2019).
 - ▶ VAT (either country information by COICOP5 or by difference between HICP and the HICP at constant taxes)
- ▶ We estimate this model for recomposed inflation, and the 4 counterfactual inflation rates and report β_h
- ▶ Counterfactual inflation rates assuming constant frequency, size,...

$$\pi_{jt}^{\bar{f}} = f_j \times dp_{jt} \quad (4)$$

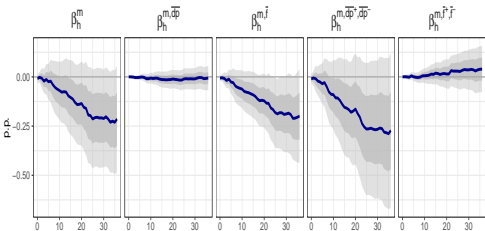
$$\pi_{jt}^{\bar{d}p} = f_{jt} \times dp_j. \quad (5)$$

$$\pi_{jt}^{\bar{d}p^-, \bar{d}p^+} = f_{jt}^+ \times dp_{t.}^+ - f_{jt}^- \times dp_{j.}^- \quad (6)$$

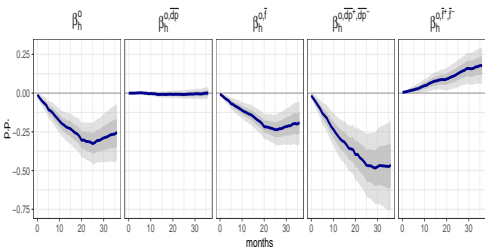
$$\pi_{jt}^{\bar{f}^+, \bar{f}^-} = f_{j.}^+ \times dp_{jt}^+ - f_{j.}^- \times dp_{jt}^- \quad (7)$$

Fact 5: The frequency of price changes does not react to macro shocks

A: Monetary policy shocks



B: Oil supply shocks

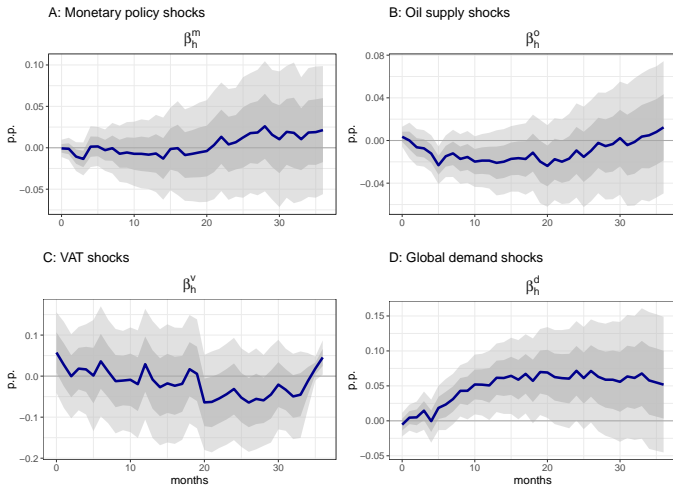


Notes: Superscripts $x \in \{m, o\}$ represent the MP and oil supply shocks respectively. The light and dark gray areas correspond to one and two standard error bands, assuming calendar-based clusters

- ▶ Delayed price reaction consistent with price stickiness (col. 1)
- ▶ Outlets adjust the size of price changes (col. 3) and not the freq. (col. 2) after shock
- ▶ Size responds via movements in the freq. of price increases and freq. of price decreases (col. 4)
- ▶ Sluggish response of size (col. 3): real rigidities also matter
- ▶ Larger responses for high-frequency products
 - ▶ Hetero
- ▶ Excluding sales does not alter the results
 - ▶ Excl. sales
- ▶ Same patterns for other shocks: demand, unemployment, VAT
 - ▶ Other shocks
 - ▶ Unemployment

How Do Sales React to Shocks?

Conditional responses of sales inflation to positive aggregate shocks



Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece). Superscripts $x \in \{v, d\}$ represent the VAT and global demand shocks respectively. The models are specified in equation (3). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x , counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{\alpha}p}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{\alpha}p^+,\bar{\alpha}p^-}$ and counterfactual inflation assuming constant frequencies of price increases and decreases $\beta_h^{x,\bar{f}^+,\bar{f}^-}$. The light and dark gray areas correspond to one and two standard error bands, assuming calendar-based clusters.

The Return of Inflation and Price Adjustment

Most recent available EA micro price data

- ▶ Firm survey data on their own prices (qualitative information)
- ▶ HICP data until 2021 for some EA countries + UK evidence until recent months of 2022
- ▶ Web scraped data (supermarkets)
- ▶ Comparison with other country experiences (Argentina, US...)

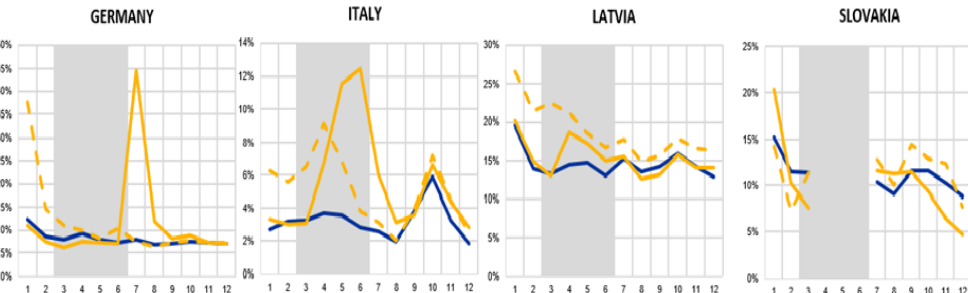
Main questions

- ▶ Can high trend inflation lead to a steeper Phillips curve?
- ▶ Can large shocks lead to non-linear price dynamics?
- ▶ Covid period + higher-inflation context

COVID period 2020-2021

Large shocks: Price setting in 2020-21 (L. Fadejeva, C. Conflitti, E. Wieland and B. Fabo)

— 2015-2019 — 2020 - - 2021



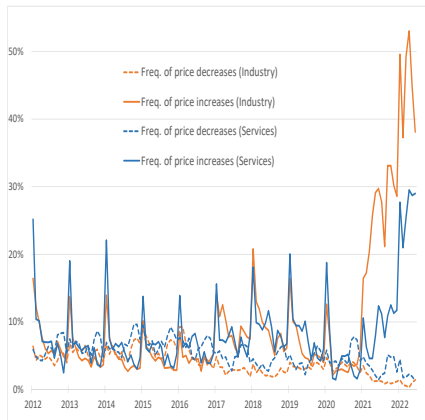
Source: Country HICP micro data.

- ▶ Covid period is not systematically related to an increase in the frequency of price changes
- ▶ VAT shocks in Germany lead to a quick and sharp rise in the frequency of price decreases then increases
- ▶ Non-linearities more relevant as predicted by state-dependent models in a higher volatile environment

▶ More

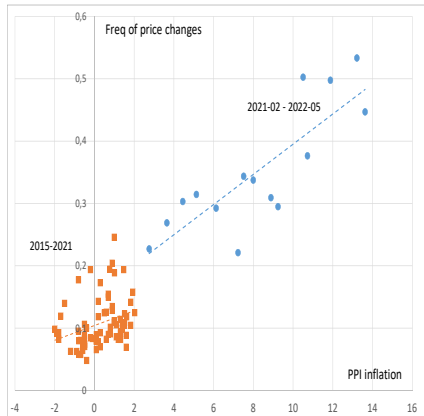
Price Adjustment When Inflation is Higher

France: Frequency of Producer Price Changes - BDF survey data



Source: BDF monthly business survey.

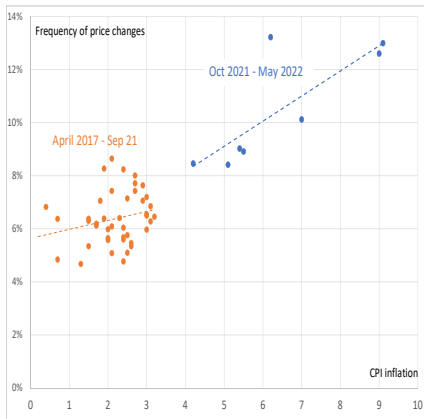
France: Frequency of Price Changes and PPI inflation



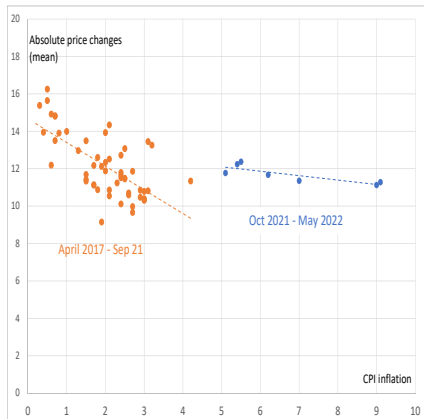
Source: BDF monthly business survey.

Price Adjustment When Inflation is Higher

UK: Frequency of Price Change and Inflation



UK: Size of Price Change and Inflation

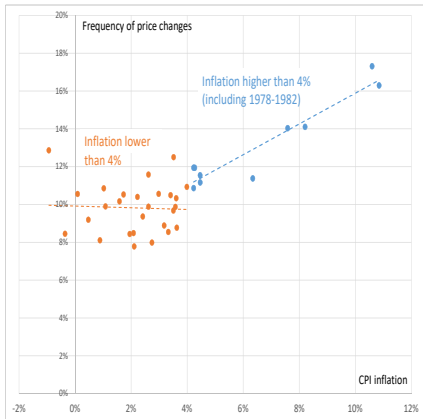


Source: UK ONS micro price data, ECB calculations

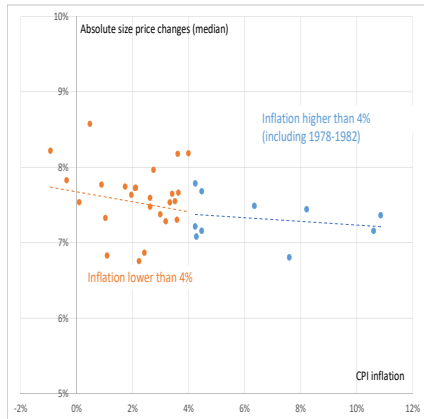
Source: UK ONS micro price data, ECB calculations

Price Adjustment When Inflation is Higher

US: Frequency of Price Change and Inflation



US: Size of Price Change and Inflation



Source: Nakamura et al. 2018

Source: Nakamura et al. 2018

Price Adjustment When Inflation is Higher: Literature Review

Argentina - Alvarez et al. 2019

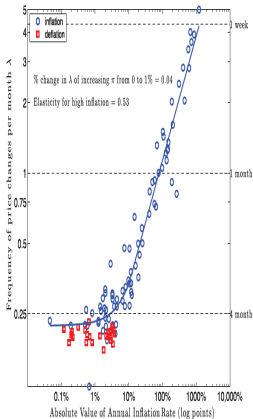
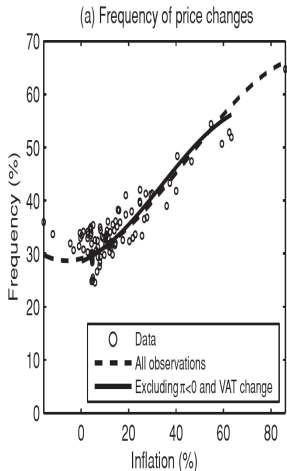


FIGURE V

The Frequency of Price Changes (λ) and Expected Inflation

Mexico - Gagnon 2009



United States - Nakamura et al. 2019

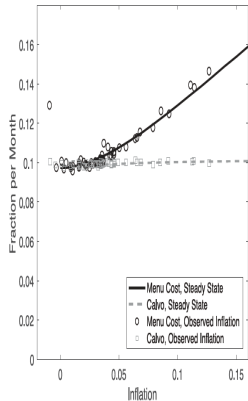


FIGURE XIII

Frequency of Price Change in Sticky-Price Models

Conclusion and Policy Implications

Low and Stable Inflation 2010-2019

- ▶ Prices in the “core sectors” are sticky in the euro area: excl. sales, 8.5% of price changes in a given month
- ▶ Frequency of price changes has not increased over time: no steepening in the slope of the Phillips curve
- ▶ Frequency does not react to shocks, implying potentially larger real effects of monetary policy shocks

- ▶ Large average price changes and dispersion in the price change distribution: micro price changes are mostly driven by large idiosyncratic shocks rather than by aggregate shocks
- ▶ Size of price changes do react to aggregate shocks but sluggish response implies some degree of real rigidity (marginal cost stickiness, strategic complementarities...)
- ▶ Inflation slowly moves with the share of price increases/decreases as opposed to the size of price increases/decreases: idiosyncratic shocks swamp inflation as a motive for changing prices

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More volatile environment 2020-2022

- ▶ Frequency of price changes starts to move for aggregate inflation higher than 4 to 5%
- ▶ State-dependence in pricing decisions would lead to non-linearities in inflation response
- ▶ Higher trend inflation would also lead to more frequent price changes and a steeper Phillips curve

Appendix SLIDES

CPI Micro Database with country-specific periods

Country	Source	Period	% of EA products ¹	% of EA HICP ²	Sales flag	OBS
AT	Statistik Austria	2000M1-2017M12	89.2	3.4	yes	10.98M
BE	Statbel	2007M1-2015M12	42.6	3.8	yes	8.50M
DE	Statistisches Bundesamt (Destatis)	2010M1-2019M12	87.3	27.9	yes	49.60M
ES	Instituto Nacional de Estadística (INE)	2008M1-2018M2	52.4	11.5	no	1.36M
FR	Institut National de la Statistique et des Études Économiques (Insee)	2003M4-2019M9	83.2	20.3	yes	17.05M
GR	Ελληνική Στατιστική Αρχή	2002M1-2019M12	64.0	2.2	no	7.68M
IT	Istituto Nazionale di Statistica (ISTAT)	2011M1-2018M12	61.1	17.3	yes	22.74M
LT	Lietuvos Statistikos Departamentas	2010M1-2018M12	82.3	0.5	yes	5.35M
LU	Institut national de la statistique et des études économiques (Le Statec)	2005M1-2017M12	97.0	0.3	no	1.15M
LV	Centrālā Statistika Parvalde	2017M1-2019M12	92.5	0.3	yes	0.66M
SK	Statistický úrad Slovenskej Republiky	2011M1-2019M12	94.1	0.8	no	9.02M
Total		2000M1-2019M12	58.9	88.3		134.03M

Notes: **1)** In terms of euro area product weights at the COICOP-5 level (2017-2020 average). **2)** Country weight in euro area HICP (2017-2020 average). OBS denotes the total number of monthly observations (in millions).

CPI Coverage of the Common Product Sample

Special aggregate (SA)	HICP total share in % (EA 2017-2020)	Share not covered in %	Share covered in %	No. of COICOP-5s covered
Food	19.3	2.5	16.8	59
Processed food	4.5	0.0	4.5	49
Unprocessed food	14.8	2.5	12.3	10
NEIG	26.4	8.0	18.4	66
Durables	9.2	5.1	4.1	23
Semi-durables	10.4	0.7	9.7	30
Non-durables	6.8	2.1	4.6	13
Energy	9.8	9.8	0.0	0
Services	44.6	20.8	23.7	41
Housing services	10.8	9.7	1.1	5
Transport services	7.3	1.5	5.8	9
Communication services	2.7	2.7	0.0	0
Recreational services rel. to accommodation	3.6	2.0	1.6	2
Recreational services (others)	11.7	0.6	11.1	14
Miscellaneous services	8.4	4.3	4.2	11
Total	100.0	41.1	58.9	166

Notes: The micro data set covers the country-specific periods and is set up such that 166 COICOP-5 products are available at least in 3 out of the 4 largest countries Germany, France, Italy and Spain.

Frequency of price change: country heterogeneity

Euro Area Price Rigidity: Frequency of Price Changes (in %)

	Including sales		Excluding sales		% of sales	
	Freq. price changes	% price increases	Freq. price changes	% price increases	NSI Flag	Sales Filter
EURO AREA	12.3	64.0	8.5	68.8	4.4	4.9
COUNTRY						
Austria	11.1	64.5	7.2	72.0	5.1	4.2
Belgium	14.5	69.0	13.3	69.7	1.1	3.8
France	12.7	60.8	9.8	66.9	5.5	5.1
Germany	12.7	61.9	9.2	67.2	4.1	4.7
Greece	11.3	61.3	7.3	63.9	.	3.8
Italy	10.3	69.9	4.8	75.6	4.3	5.4
Latvia	18.6	60.0	7.9	71.1	10.7	7.5
Lithuania	12.8	62.3	9.7	68.4	2.3	5.3
Luxembourg	14.1	73.4	8.8	78.4	.	4.6
Slovakia	14.3	64.8	9.3	66.6	.	4.9
Spain	13.5	64.0	9.0	65.3	.	5.1

Notes: Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece). Results excluding sales are based on NSI sales flag (if available, and sales filter otherwise). Statistics are weighted using EA HICP weights.

Comparison with Dhyne et al.

▶ Back - freq

▶ Back - size

	Dhyne et al. (1996-2001): core items (43 products)				2011-2017: core items of available products			
Average frequency of price changes								
	Proc. Food	NEIG	Services	Total Core	Proc. Food	NEIG	Services	Total Core
Euro area-5	13.6	9.4	5.0	7.8	15.6	12.8	7.0	10.2
Austria*	17.0	8.5	8.8	9.7	21.1	19.7	11.8	15.7
Belgium**	18.3	3.5	2.6	5.5	22.1	6.6	4.1	8.0
France*	20.2	16.8	6.4	12.0	24.6	18.6	5.3	12.7
Germany**	9.7	7.1	4.8	6.2	11.0	12.6	9.1	10.5
Italy**	10.6	5.9	3.6	5.4	9.9	6.4	5.5	6.5
Median size of price increases								
	Proc. Food	NEIG	Services	Total Core	Proc. Food	NEIG	Services	Total Core
Euro area-5	6.6	8.5	6.3	7.1	8.1	8.7	5.3	6.8
Austria*	12.1	10.2	5.9	8.2	17.3	11.8	5.2	9.0
Belgium**	6.7	6.4	7.0	6.8	4.6	11.3	4.6	6.9
France*	3.9	8.7	4.3	5.7	2.8	15.6	4.4	7.8
Germany**	7.7	9.4	5.1	6.8	14.1	5.5	4.8	6.3
Italy**	6.8	7.1	10.5	8.8	4.3	4.7	7.1	5.9
Median size of price decreases								
	Proc. Food	NEIG	Services	Total Core	Proc. Food	NEIG	Services	Total Core
Euro area-5	7.4	11.7	10.4	10.4	9.6	14.9	9.3	11.2
Austria*	12.7	13.2	9.0	10.9	20.6	15.8	7.2	11.8
Belgium**	7.0	8.0	6.7	7.2	3.9	14.3	4.7	7.8
France*	4.5	14.3	6.3	8.7	2.7	21.1	8.0	11.5
Germany**	9.4	12.7	13.5	12.7	17.1	14.9	11.6	13.4
Italy**	6.6	7.6	11.3	9.4	5.1	7.7	8.7	7.8

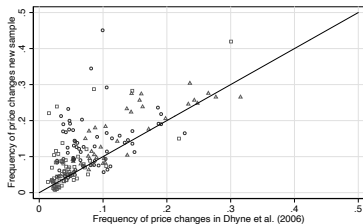
Notes: *: Price changes including sales; **: Price changes excluding sales (except for Processed Food in Germany). Price changes include substitutions (except for Belgium). Euro area-5 refers to Austria, Belgium, Germany, France and Italy. Only products available in both sample periods are included in the comparison and results are aggregated using country-specific product weights to product groups and then product-group weights (average of 2011-17) to the "Total core".

Comparison with Dhyne et al.

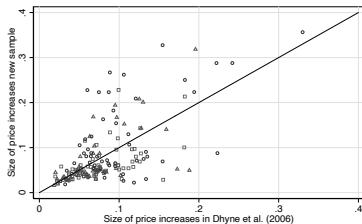
▶ Back - freq

▶ Back - size

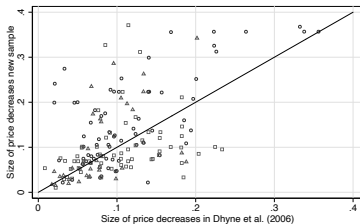
Frequency and size of price changes at the product level – Period 2011-2017 vs. Dhyne et al.



▲ Processed Food ○ Non-Energy Industrial Goods
□ Services — 45°



▲ Processed Food ○ Non-Energy Industrial Goods
□ Services — 45°



▲ Processed Food ○ Non-Energy Industrial Goods
□ Services — 45°

Notes: Frequencies and size of price changes at the product level for Processed Food, NEIG and Services items (at most 43 products depending on availability). Countries covered are Austria, Belgium, France, Germany and Italy.

Size of price change: country heterogeneity

Euro Area Price Rigidity: Median Size of Price Changes (in %)

	Including sales		Excluding sales	
	Median		Median	
	Increase	Decrease	Increase	Decrease
EURO AREA	9.6	13.0	6.7	8.7
COUNTRY				
Austria	10.4	14.6	6.9	8.7
Belgium	7.0	8.2	6.6	7.5
France	7.8	11.9	5.1	7.3
Germany	11.6	16.1	8.4	11.0
Greece	9.6	12.8	8.0	11.4
Italy	9.1	11.4	4.4	5.5
Latvia	15.9	14.8	7.9	6.2
Lithuania	13.5	17.2	11.8	12.8
Luxembourg	7.5	10.7	5.5	7.8
Slovakia	10.5	11.1	9.2	8.5
Spain	8.9	11.1	8.1	10.4

Notes: Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece). Results excluding sales are based on NSI sales flag (if available, and sales filter otherwise). Statistics are weighted using EA HICP weights.

Are prices more flexible in the United States than in the EA?

[▶ Back1](#)[▶ Back2](#)

Note: US product results are taken from Nakamura and Steinsson (2008). Euro area statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries and calculated using euro area product weights at the COICOP-5 level (2017-2020 average) and country weights in euro area HICP (2017-2020 average). Total COICOP-5 categories: 164. Price changes due to replacement are excluded beforehand (except Greece). Results excluding sales are based on NSI sales flag if available.

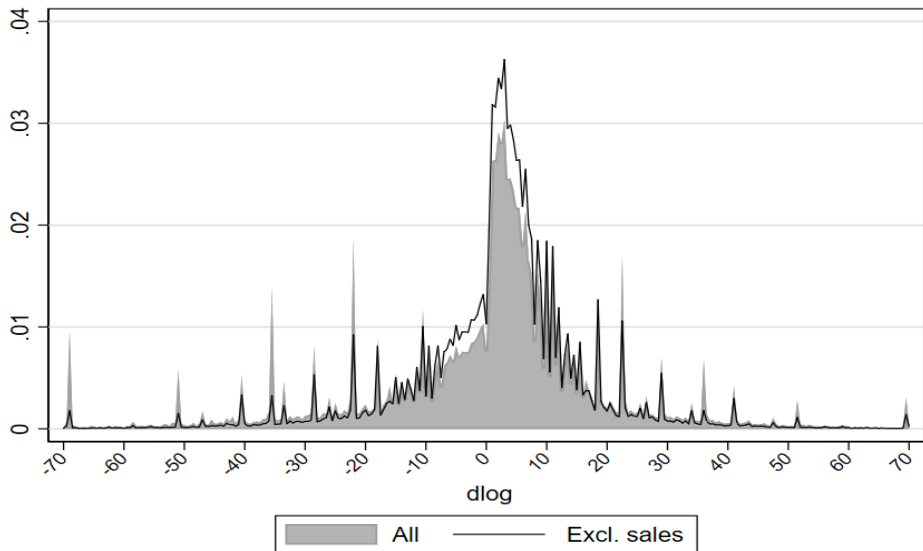
Are prices more flexible in the United States than in the EA?

[▶ Back1](#)
[▶ Back2](#)

	Frequency		Share of increases		Average size price changes			
	Incl. sales	Excl. sales ¹	Incl. sales	Excl. sales ¹	Incl. sales	Excl. sales ¹	Incl. sales	Excl. sales ¹
Aggregate								
United States	19.3	10.0	62.0	71.1	17.8	10.6	21.6	13.4
Euro Area	12.3	8.5	64.0	68.8	12.3	8.9	16.2	11.6
by Sector								
Unprocessed Food								
United States	42.8	29.3	53.1	58.4	27.5	18.9	30.0	20.6
Euro Area	31.4	24.0	54.5	57.6	16.8	12.7	18.9	13.8
Processed Food								
United States	26.3	12.0	55.3	66.3	24.4	11.5	28.1	15.8
Euro Area	15.4	10.4	57.0	61.8	12.3	7.8	14.6	8.8
NEIG								
United States	22.0	5.7	46.9	66.0	21.6	9.8	26.4	12.1
Euro Area	12.9	6.4	48.2	59.8	17.1	10.5	22.1	13.9
Services								
United States	8.9	8.6	78.9	80.1	9.5	9.1	12.8	11.7
Euro Area	6.0	5.7	82.5	82.4	7.5	7.4	11.8	10.8

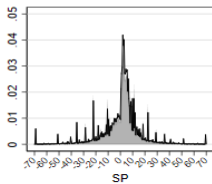
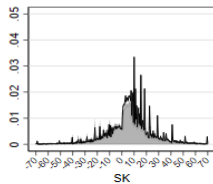
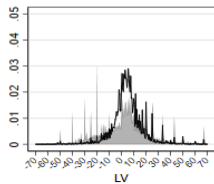
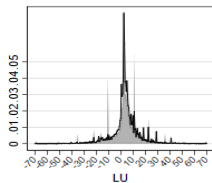
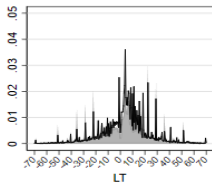
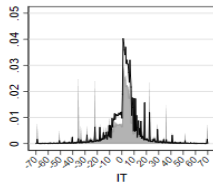
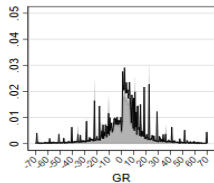
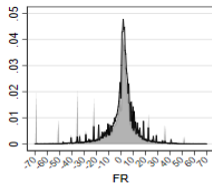
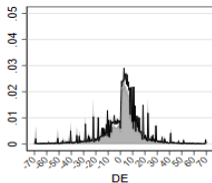
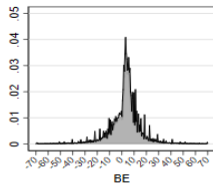
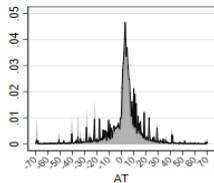
Distribution of Price Changes

▶ Back



Distribution of Price Changes by Country

▶ Back



"January effect" on the Frequency of Price Changes

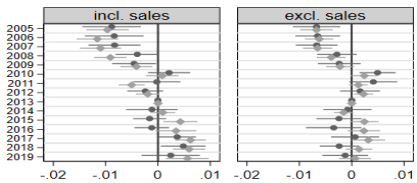
	Including sales			Excluding sales		
	Average effect	Products with a significant Jan effect N	% HICP	Average effect	Products with a significant Jan effect N	% HICP
<i>All sectors</i>						
F_{jt}	0.085	104	74.0	0.063	121	84.4
F_{jt}^m	0.036	90	64.3	0.012	76	57.1
F_{jt}^p	0.049	102	71.2	0.051	108	72.7
<i>By Sector</i>						
F_{jt}^{FOOD}	0.018	19	35.5	0.023	38	67.1
F_{jt}^{NEIG}	0.105	47	82.5	0.029	44	84.6
F_{jt}^{SERV}	0.117	38	95.1	0.118	39	96.4

Notes: The table shows, the (weighted) average size of significant January-dummy coefficients of the COICOP-specific month-year regressions on the frequency of price changes (cols 1 and 4), the absolute number (cols 2 and 5) and weighted share of COICOP-5 groups for which the coefficient is positive and significant (cols 3 and 6). Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries and calculated using euro area product weights at the COICOP-5 level (2017-2020 average) and country weights in euro area HICP (2017-2020 average).

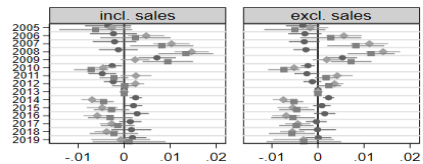
Estimations Month and Year Effects

▶ Back1

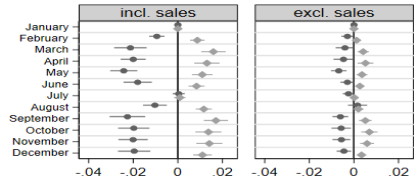
▶ Back2



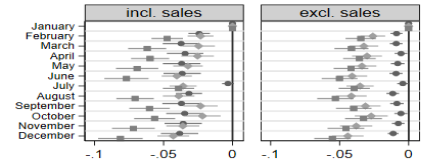
● Size of price decreases ◆ Size of price increases



● Freq. of price decreases ◆ Freq. of price increases
■ Freq.



● Size of price decreases ◆ Size of price increases

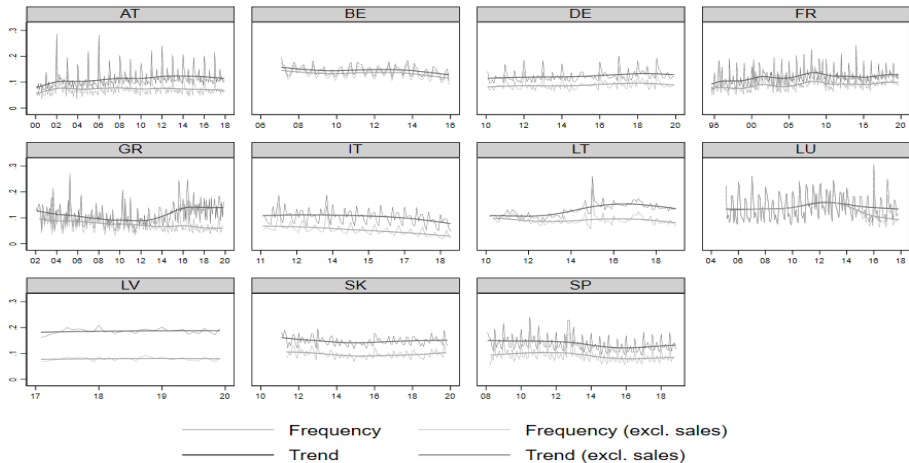


● Freq. of price decreases ◆ Freq. of price increases
■ Freq.

Notes: Coefficient plots from weighted panel regressions with COICOP, country, and time fixed effects and dummy for VAT changes in France (04/00, 01/12, 01/14), Italy (09/11), Slovakia (01/11), and Spain (09/12, 07-09/10), with country weights in euro area HICP (2017-2020 average) and robust standard errors. Dependent variables are frequency and size of price adjustment. Regressions are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Displayed are only the years 2005-2019, with the base year 2013, and base month January.

Frequency of Price Changes Over Time by Country

▶ Back1

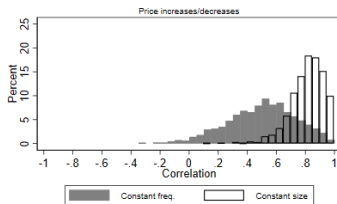
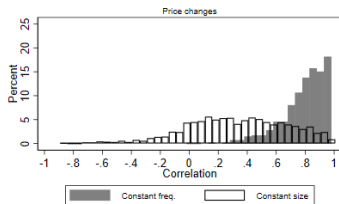


Notes: Statistics are based on products that are common to at least 3 of the 4 largest countries and calculated using euro area product weights at the COICOP-5 level (2017-2020 average). Price changes due to replacement are excluded beforehand. Outliers adjusted beforehand.

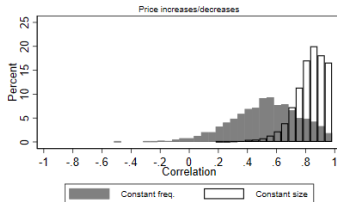
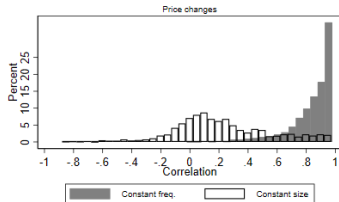
Distribution of Correlation Coef. Btw "recomposed" and "counterfactual" inflation

▶ Back

Including sales



Excluding sales

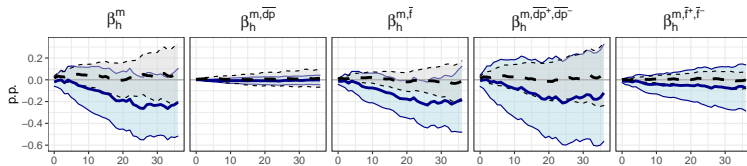


Notes: The figure plots the distribution of correlation coefficients between recomposed inflation, as in Equation 9 and counterfactual inflation as in Equation 4 and 5, 7 and 6. These correlation coefficients are calculated at the product(COICOP5)-country level (more than 1,500 product-country pairs). Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries.

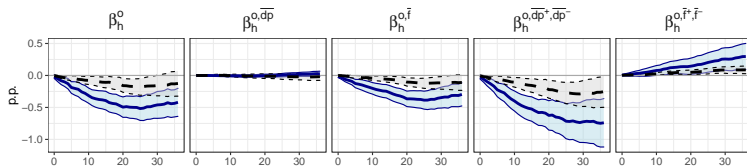
Sectoral Heterogeneity

▶ Back

A: Monetary policy shocks



B: Oil supply shocks



High Low

Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece). Superscripts $x \in \{v, d\}$ represent the VAT and global demand shocks respectively. The models are specified in equation (3). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x , counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{d}p}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{i}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{d}p^+,\bar{d}p^-}$ and counterfactual inflation assuming constant frequencies of price increases and decreases $\beta_h^{x,\bar{i}^+,\bar{i}^-}$. The light and dark gray areas correspond to one and two standard error bands, assuming calendar-based clusters

Following Klenow and Kryvtsov (2008), we decompose:

$$\pi_{jt} = f_{jt} \times dp_{jt} \quad (8)$$

with COICOP5 product-category j ,

f_{jt} : frequency of price changes at date t ,

dp_{jt} : average of non-zero price changes of group j at date t .

Distinguishing between prices increases (+) and price decreases (-), we have

$$\pi_{jt} = f_{jt}^+ \times dp_{jt}^+ - f_{jt}^- \times dp_{jt}^- \quad (9)$$

with f_{jt}^+ : frequency of price increases,

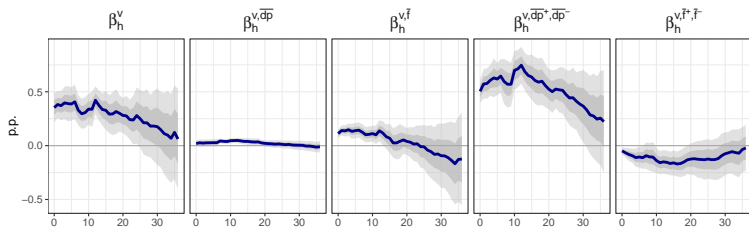
f_{jt}^- : frequency of price decreases,

dp_{jt}^+ : average of non-zero price increases,

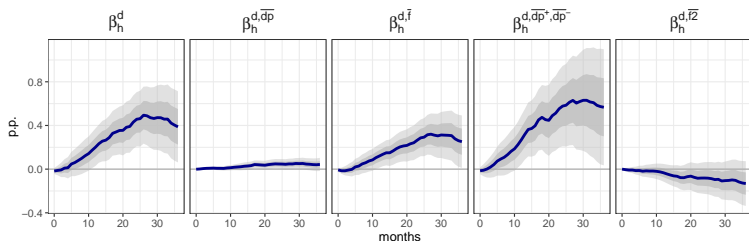
dp_{jt}^- : average of non-zero price decreases (in absolute values) of group j at date t .

How Do Freq. and Size React to VAT / Demand Shock?

A: VAT shocks



B: Global demand shocks

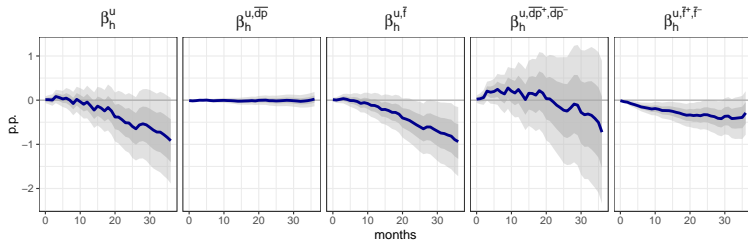


Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece). Superscripts $x \in \{v, d\}$ represent the VAT and global demand shocks respectively. The models are specified in equation (3). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x , counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\overline{dp}}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\overline{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\overline{dp^+},\overline{dp^-}}$ and counterfactual inflation assuming constant frequencies of price increases and decreases $\beta_h^{x,\overline{f^+},\overline{f^-}}$. The light and dark gray areas correspond to one and two standard error bands, assuming calendar-based clusters

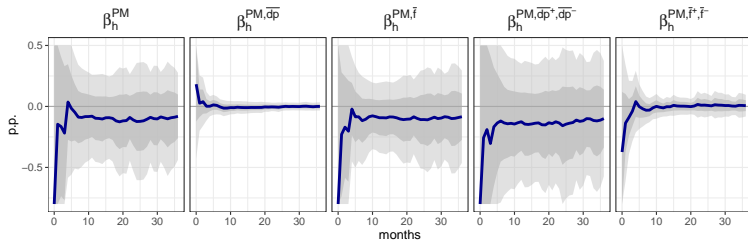
How Do Freq. and Size React to Unemployment?

Conditional Responses to Unemployment - Local Projections and Phillips Multipliers

A: Unemployment



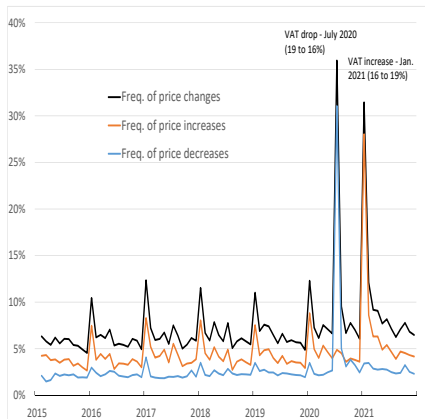
B: Phillips multipliers



Germany 2020-2021: More Evidence

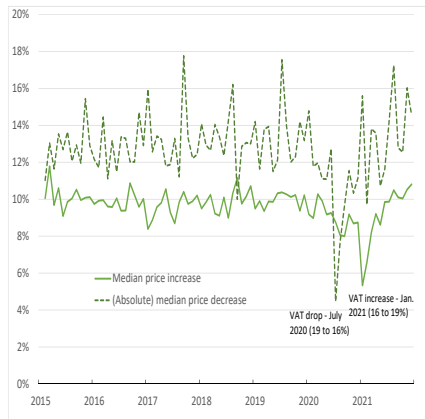
[▶ Back](#)

Germany: Frequency of Price Changes



Source: Bundesbank staff calculations using national CPI micro data (2015-2021)

Germany: Size of Price Changes



Source: Bundesbank staff calculations using national CPI micro data (2015-2021)