Online Appendix for "New Facts on Consumer Price Rigidity in the Euro Area"

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A Data and Methods

A.1 National CPI Micro Datasets

In this section we provide basic information about each one of the country micro datasets underlying the analysis in our study. Further information can be found in the country-specific read-me files included in the replication materials: Gautier et al. (2023).

Austria. Data source: Statistik Austria (2017).

The dataset has been released by Statistics Austria to the Oesterreichische Nationalbank (OeNB) on the grounds of a confidentiality agreement and can thus not be shared with researches outside of the OeNB. Prices have been collected in 20 major cities of Austria, over the time period from 1996M1 to 2017M12. Overall, the dataset contains about 11 million price observations for 1,051 product categories (e.g. milk or men's t-shirt, no brand information), representing 96% of the Austrian CPI. Over the period 1996-2000, individual products could not be assigned to the ECOICOP5 classification used in the paper and overall, the total number of observations used to produce the results is 8.3 million price observations. The dataset also includes products with centrally collected prices, but some of them had to be removed as they already contain aggregate information from other data sources (e.g. rents taken from the Austrian rent price index). Furthermore, the dataset contains flags indicating price reductions due to temporary promotions and sales as well as for different quality adjustments and product replacement. The price quotes have been transformed to prices per unit in order to account for changes in quantity. The sample period covers the Euro cash changeover.

Belgium. Data source: Statbel (2018).

The dataset has been made available to the National Bank of Belgium (NBB) by the Belgian Statistical Office (Statbel), on the grounds that it also produces statistics within the National Accounts Institute (NAI), which is a member of the European

Statistical System (ESS). The confidentiality of the dataset must be guaranteed, namely only aggregated and anonymous results can be published. The dataset covers the period from 2007M1 to 2017M12 at a monthly frequency. Data collection over the period 2007-2015 was mostly made by regular visits of pollsters to retail shops, except in the case of cars where prices were collected from catalogues. By contrast, as of 2016, the Statistical Office has relied primarily on scanner data for a wide range of products sold at supermarkets in Belgium. As these data could not be released to the NBB for confidentiality reasons, the dataset has a limited product coverage from 2016 onwards. The Belgian HICP coverage falls from 46% (average 2007-2015) to 23% (average 2016-2017). For this reason, we drop the last two years and consider only the period between January 2007 and December 2015 in our analysis. Flags in the dataset indicate a price promotion, unavailability of the product for at least a month, and imputed price.

Individual products are grouped in 363 COICOP categories at the 6-digit level and 95 ECOICOP categories at the 5-digit level.

The Belgian micro price database does not contain seasonal sales (which are allowed twice a year in January and July), only temporary promotions (throughout the year), which are flagged. However, the NSI does apply a percentage reduction in prices in the January and July HICP releases, based on a sub-sample of items on sale. In other words, the sales percentages are measured on a sub-sample of products and then extrapolated to all products concerned when the HICP is calculated.

France. Data source: INSEE (2019).

We rely on the longitudinal CPI dataset of monthly price quotes collected by the Institut National de la Statistique et des Études Économiques (INSEE) for the period 2003M3 to 2019M9. Micro data have been made available to Banque de France researchers after a formal approval from the INSEE for this specific project. After INSEE's formal approval of this Banque de France project, BdF researchers got access to the data via a data procedure (see `https://www.comite-du-secret.fr/home/`) and via a restricted access to a secure data hub (Secure Data Access Center – CASD, `https://www.casd.eu/en/`) (for more details, see the readme file associated with French data in the replication package Gautier et al. (2023)). Centrally collected prices, such as car prices, administered prices (e.g. tobacco), public utility prices (e.g. electricity), and rents, are not part of the dataset. Since 2017, gasoline prices are collected through a dedicated website and are no longer available in the research dataset. Prices collected on internet are not part of this dataset. Individual products are classified in about 4,000 product categories at the most disaggregate (elementary) level of

product classification. These categories are grouped in 334 COICOP categories at the 6-digit level and 230 ECOICOP categories at the 5-digit level. The dataset also contains information to recover the collected individual price (i.e. before quality/quantity adjustments) and various flags indicating changes in quantities or packaging, imputed prices or sales and temporary promotions.

Germany. Data source: Destatis (2019).

The German CPI micro dataset contains more than 70 million of observations for the period 2010M1-2019M12. The dataset is provided by the Research Data Centres (RDC) of the Federal Statistical Office and Statistical Offices of the Federal States and publicly available for research purposes (for more details, see the readme file associated with German data in the replication package Gautier et al. (2023)).[58] Most prices in the data base are decentrally collected by the Federal States. For prices of goods, the sample comprises up to eight different outlet types (e.g. department stores, discounters, supermarkets, internet trade). Concerning individual price information, the database contains flag indicators on sales, replacements and imputation as well as information on quality and quantity adjustment of the individual price. We use the quality and quantity-adjusted price of a product, which enters the official CPI. The lowest level of product category with weight information is the COICOP-10 level (e.g. "01.1.1.1.01100 - Rice"); After dropping those product categories based on less than 3 (offline) stores and products, our underlying research dataset contains more than 700 product categories at the COICOP-10 level. We have also excluded price spells flagged in the data set as aggregate numbers (and not micro price data) such as the package holiday index), which we need to drop beforehand. Overall, after excluding these observations, we use 46.8 million price observations to calculate price rigidity statistics used in the paper. Price rigidity statistics are computed stepwise: i) as a product-weighted average at the COICOP-5 level (e.g. "01.1.1.1 - Rice incl. rice preparations" using COICOP-10 weights) for 16 Federal States in Germany plus some centrally collected prices at the Federal level, and ii) as a German average (using state weights). The product id is constructed based on a combination of five variables (region, store id, COICOP-10 number, survey id and product variant). Due to the regular revision of the survey id with every new base year, the dataset contains a statistical break in 2015M1; thus, all price rigidity statistics are computed on each subsample separately (base year 2010: 2010M1-2014M12 and base year 2015: 2015M1-2019M12) and then weighted together.

[58] See "Verbraucherpreisindex für Deutschland", EVAS 61111, 2010 - 2019, DOI: https://doi.org/10.21242/61111.2010.00.00.3.1.0 to https://doi.org/10.21242/61111.2019.00.00.3.1.0.

Greece. Data source: ELSTAT (2019).

The Greek micro CPI dataset contains about 8 million observations for the period 2002M1 to 2020M3. It consists of price quotes on 744 products, across unique outlets at the regional level (NUTS 2 of the geographical classification), which translates into 46,729 unique product identifiers. It covers more than 75 percent of the Greek HICP. Centrally collected prices are not part of the dataset. Moreover, the data do not contain information/flags on sales, product substitution or product metric. The data were originally by 'product names' which have been matched to COICOP 8 level digits using a list on "products researched for the HICP index" for the years 2015 and 2010. Products that have not been included in these two lists have been approximated with a COICOP 8 digit by the Bank of Greece researchers. The data has been provided to the Bank of Greece by the Hellenic Statistical Authority based on a confidentiality agreement and cannot be shared.

Italy. Data source: ISTAT (2018).

The Italian CPI micro prices includes about 22 million of observations for the period 2011M1-2018M12, collected by the Istituto Nazionale di Statistica (ISTAT) and made available to Banca d'Italia within the agreement between ISTAT and Banca d'Italia in the PRISMA framework. The data are confidential and cannot be shared with researchers outside of the Banca d'Italia. Prices have been locally collected in 77 Italian province. Centrally collected prices, such as air fares, electricity and gas, gasoline etc. are not part of the data set. The database contains flag indicators on sales, replacements and imputation as well as information on quantity adjustment of the individual price. The elementary level of product category is at 10-digit (e.g 03.1.2.1.3.00.01-Men shirt) level but for the computation of statistics reported in this work we use the 5-digit COICOP level aggregation. The price quotes have been transformed to prices per unit in order to account for changes in quantity. Our data contains a structural break in 2016 as the COICOP classification changed and therefore we have proceeded to connect the products using our own methodology.

Latvia. Data source: CSP (2019).

The Latvian CPI micro prices are available to Latvijas Banka on the basis of a contract with Centrala Statistikas Parvalde (CSP), the Central Statistical Bureau of the Republic of Latvia. The micro data is confidential and cannot be shared with researchers outside the bank. The database includes about 670,000 observations for the period

2017M1-2019M12 and covers the full set of products and services. There are around 516 goods and services for which prices are regularly collected in 2,000 different outlets located in 11 Latvian cities. Each month almost 25,000 prices are reported. Prices are available at 5-digit COICOP level. Price quotes are reported as observed in the store and re-estimated per unit of measurement. The database includes flag indicators on replacements, imputations and price reductions due to temporary promotions and sales. Quality adjustment for prices is not available.

Lithuania. Data source: Lietuvos Statistika (2018).

The database is provided to the Lithuanian central bank (Lietuvos Bankas) by the statistical institute (Lietuvos Statistikos Departamentas). The use of the data is for research purposes and cannot be shared. Prices are a sample from the CPI database between 2010M1 and 2018M12. The price quotes are identifiable between the "elementary product group" (EPG) and "target sample" levels (according to the HICP manual). An example of an item is a 1 kg pack of "rice" characterized by a 12-digit identifier (01.1.1.1.00.00.00.01), a unique outlet number and type and the geographical location where it is sold (among 6 Lithuanian cities). In addition, the database contains "flags" that can indicate a reason for a price change in a given month. There are 25 different flags reporting sales, replacements, seasonality, etc. In total, the dataset covers 231 (out of 303) ECOICOP4 categories after cleaning. The changeover to the euro in Lithuania is included in the sample (January 2015). Statistics are adjusted to avoid capturing rounding effects at the changeover and are calculated using unit prices to account for changes in quantity.

Luxembourg. Data source: Statec (2017).

The dataset is provided by the Institut national de la statistique et des études économiques (Le Statec) via a confidentiality agreement with the Banque Centrale du Luxembourg. The dataset covers a period going from 2005M1 to 2017M12. It contains about 1 million individual prices. Sales flags have been included in the dataset only from 2015 onwards. A product replacement flag is available.

Slovakia. Data source: SUSR (2020).

The Slovak CPI micro dataset is available to Národná banka Slovenska (NBS) on the basis of a contract with the Statistický úrad Slovenskej republiky (ŠÚ SR), which is the national statistical agency of Slovakia. The data are collected on the level of 720 individual "representatives" which can be connected to ECOICOP-5 categories though

a matching file developed by Branislav Karmažin at the NBS. No sales or replacement flags are present in the dataset. The dataset covers the period 2011M1 – 2020M12 and contains about 9 million observations, we have excluded observations associated with year 2020 to exclude Covid-related observation and we use 8.3 million observations for the computation of the price rigidity statistics. About 65% of the entire consumption basket is covered until 2017. Excluded are prices of items such as administrative fees and utilities. Starting in 2017, all prices are included. The dataset is not freely available to researchers.

Spain. Data source: INE (2018).

The dataset has been made available to the Banco de España (BdE) by the Instituto Nacional de Estadística (INE), the Spanish national statistical agency. The confidentiality of the dataset must be guaranteed, namely only aggregated and anonymous results can be published. This is written in an official agreement signed between INE and BdE, following multiple meetings with representatives of INE, during which BdE explained the goal of the project and the microdata that would be needed. No researcher external to the BdE can make use of these data. The data is also not available for external researchers on the BdE's publicly accessible data labs. The sample used covers the period from January 2008 to December 2018 at a monthly frequency. Data collection over this period was made by regular visits of pollsters to retail shops, but also through emails and phone calls.[59] To produce its official CPI numbers, INE samples prices from 177 Spanish municipalities, 12 product groups, and 479 distinct articles corresponding to 6-digit COICOP categories.[60] To arrive at a final official figure for the Spanish consumption price index, INE uses about 220,000 price observations per month. Our sample, in contrast, includes municipalities from 17 provinces, 188 of the 479 articles used by INE to compute the CPI, and about 10,300 price observations per month of the 220,000 monthly observations used by INE on average.[61] Overall, our sample includes about 1.36 million price observations. All groups are represented with the least represented being Education (with 14.3% of the products that are used by INE to compute the CPI being included in our sample) and the most represented one being Health (63.3%).

[59] Since 2020, INE also includes scanner data in its CPI calculations, but these are not covered in the dataset used for this project.

[60] The 12 product groups are: food and non-alcoholic beverages, alcoholic beverages and tobacco products, clothing and footwear, housing, household products, health products, transportation, communication, leisure products, education, hotels and restaurants, and other goods and services. The most represented group is food an non-alcoholic beverages (with 170 articles), followed by clothing and footwear (with 66 articles), and household products (with 57 articles).

[61] The 17 provinces included in our sample are: A Coruña, Álava, Asturias, Badajoz, Barcelona, Cantabria, Comunidad de Madrid, Illes Balears, La Rioja, Las Palmas, Murcia, Navarra, Sevilla, Toledo, Valencia, Valladolid, and Zaragoza. These include some of the largest municipalities in Spain. For reference, Spain is composed of 50 provinces and two autonomous cities (Ceuta and Melilla).

A.2 Common Product Sample

Table A1: HICP 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 dataset covers the country-specific periods as indicated in Table 1 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). 'HICP total share' corresponds to euro area HICP weights calculated on average over the period 2017-2020. 'Share not covered' corresponds to the share (HICP euro area weights) of products missing in our common sample of COICOP-5 products. 'Share covered' corresponds to the share (HICP euro area weights) of products included in our common sample of COICOP-5 products.

A.3 Data Methodology

In this Appendix, we define the main price variables we use, how we deal with sales and promotions, how we calculate frequencies of price changes and how we aggregate the statistics at the euro area level.

A.3.1 Price Changes including Sales

First, we denote $P_{i,j,t}$ as the price of an individual store-specific product item i belonging to the (COICOP-5) product group j in month t.

We can then define the log-price change as:

$$dp_{i,j,t} = \ln\left(P_{i,j,t}\right) - \ln\left(P_{i,j,t-1}\right) \tag{A1}$$

We can then define a dummy variable equal to one if $dp_{i,j,t}$ is different from 0:

$$y_{i,j,t} = \begin{cases} 1, & \text{if } dp_{i,j,t} \neq 0 \\ 0, & \text{otherwise} \end{cases}$$

The frequency of price changes for a given product, F_j, is computed as the (weighted) share of non-zero price changes relative to the total number of observations, N_j:

$$F_j = \frac{\sum_{i=1}^{n_j}\sum_{t=2}^{\tau} y_{i,j,t}}{\sum_{t=2}^{\tau} N_{j,t}} \tag{A2}$$

where n_j represents the number of individual items of a given product j. The item-specific price changes i are aggregated to the product level j either unweighted or, if available, by using weights below the COICOP-5 level.[62]

For size statistics, we use only non zero price changes and for instance, the average size of price increases for the product j $\bar{dp}_j^+$ is computed as:

$$\bar{dp}_j^+ = \frac{\sum_{i=1}^{n_j}\sum_{t=2}^{\tau} dp_{i,j,t} y_{i,j,t}^+}{n_j^+} \tag{A3}$$

where n_j^+ is the total number of price increases for product j (i.e. $\sum_{i=1}^{n_j}\sum_{t=2}^{\tau} y_{i,j,t}^+$) and $y_{i,j,t}^+$ a dummy variable for price increases. The item-specific price changes i are aggregated to the product level j either unweighted or, if available, by using weights below the COICOP-5 level.

A.3.2 Price Changes excluding Sales

To calculate statistics excluding price changes due to sales and promotions, we use two different approaches: using NSI flag and an ad-hoc sales filter. For both methods, we

[62] This is the case for Germany and Slovakia.

define a new price variable (regular price) filtered for periods of sales and promotions identified either by the flag or the filter.

NSI flag When an NSI flag is available in the dataset, we define the regular price as follows:

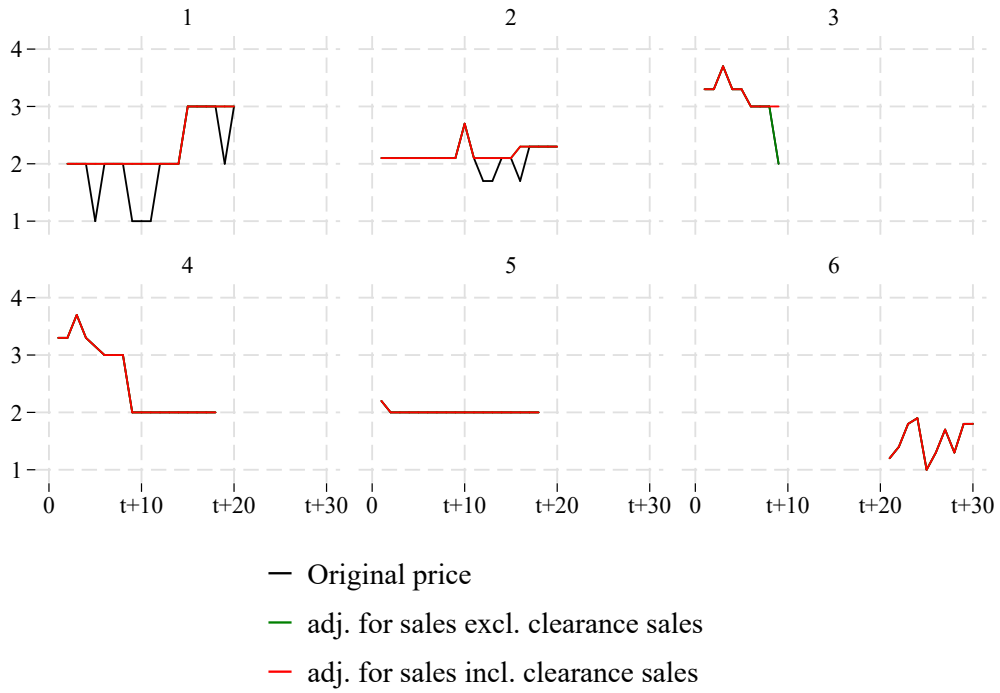
$$P_{i,j,t}^{reg} = \begin{cases} P_{i,j,t} & \text{if flag} = 0 \\ P_{i,j,t-1}^{reg} & \text{if flag} = 1 \end{cases}$$

Then, the frequency and size statistics are computed the same way as for actual prices $P_{i,j,t}$. In the previous expressions, we replace $P_{i,j,t}$ by $P_{i,j,t}^{reg}$.

Sales filter In order to rule out that our results are driven by methodological differences in defining and flagging sales across euro area member states, we implement an algorithm that defines sales periods in our dataset in a harmonised manner. Basically, we use the filter proposed by Nakamura and Steinsson (2008*a*) which is described in detail in the supplement to the original paper (Nakamura and Steinsson, 2008*b*). This method consists of identifying prices for products on sales from the price patterns. In a nutshell, the functioning of the filter is illustrated in Figure (A1) with the help of simulated data.

As shown in the figure, this method consists of creating a new variable $P_{i,j,t}^{regf}$ which is equal to $P_{i,j,t-1}^{regf}$ when the filter identifies a sales period by specific price patterns (as illustrated for good '1' and good '2'). Good '3' illustrates an additional feature that we added to the baseline filter developed by Nakamura and Steinsson (2008*a*). Many seasonal goods such as clothing are marked by clearance sales meaning that shops lower prices at the end of the season to clear their shelves. We take this on board by defining a sales period if the last price of a product is lower than the previous price over a given period. Hence, good '3' is affected by a clearance sale as shown by the red solid line highlighting the new regular price at the end of the product life-cycle, which is not found by the original sales filter of Nakamura and Steinsson (2008*a*) (green solid line). Good '4' has also a price drop at the end of its lifetime, however, the period over which this low price prevails is too long to be considered as a sale. By this restriction, we want to avoid that a long time span of constant prices is classified as a (clearance) sales period, as it was the case for product '5'. Finally, prices of good '6' are too volatile to be identified as sales.

Figure A1: Functioning of the Sales Filter including Clearance Sales



Notes: The graph shows the price trajectories of 6 hypothetical products. The black solid line gives the original price, the green solid line the price adjusted for sales using the filter developed by Nakamura and Steinsson (2008a) and the red solid line shows the price adjusted for sales and clearance sales.

The sales filter depends on four parameters:[63]

l : maximum length of the sales period followed by a new regular price.

k : maximum number of new regular prices to be considered.

j : maximum length of the sales period where the price returns exactly to the same price as before the sales period.

c : maximum number of periods used to identify a clearance sale at the end of a product's life-cycle.

In a preliminary analysis (available upon request), we have investigated the behaviour of the sales filter with respect to different parameter values for a subset of countries including Austria, Germany, France and Italy. Based on this, we use the parameters: $l = 3$, $k = 3$, $j = 5$ (like in Nakamura and Steinsson, 2008*a*) and $c = 3$.

This method delivers a new price variable $P^{reg}_{i,j,t}$ and all statistics at the product level are produced by replacing $P_{i,j,t}$ by $P^{regf}_{i,j,t}$ in the previous formulas.

[63] The filter is written as an ado-file in Stata and is available upon request.

A.3.3 Replacements

For country datasets in which we have information on product substitutions, we can define a new price variable $P^{subs}_{i,j,t}$. When a product i is replaced by a close substitute i' at date t, we can define a new product $i*$ and $P^{subs}_{i*,j,\tau} = P^{subs}_{i,j,\tau}$ when $\tau < t$ and $P^{subs}_{i*,j,\tau} = P^{subs}_{i',j,\tau}$ when $\tau \geq t$. Again, statistics can then be calculated using $P^{subs}_{i*,j,t}$ instead of $P_{i,j,t}$, they will include price changes at the product replacements.

A.3.4 Aggregation

For each product j in country c, we calculate product-level statistics. We then aggregate these statistics to produce country statistics, EA statistics and broad-sector statistics.

In our baseline exercises, we first calculate country-level statistics using euro area HICP weights averaged over the period 2017-2020. For instance, for frequencies, $F_{j,c}$ is the frequency of price changes in product j for country c and w_j is the euro area HICP weight of this product, then:

$$F_c = \sum_{j=1}^{N_{jc}} w_j F_{j,c} \tag{A4}$$

where N_{jc} is the number of COICOP 5-digit products available for each country c in the common sample of COICOP products.

Second, we apply HICP country weights W_c (averaged over 2017-2020) to derive the euro area aggregate.

$$F = \sum_{c=1}^{N_c} W_c F_c \tag{A5}$$

where N_c is the number of euro area countries (here 11).

Another option we use in a robustness analysis and in the EA vs US comparison, is to first calculate product-level EA statistics and then to average over the products. The EA frequency at the product level would be defined as:

$$F_j = \sum_{c=1}^{N_c} W_c F_{j,c} \tag{A6}$$

and then we could calculate:

$$\tilde{F} = \sum_{j=1}^{N_j} w_j F_j \tag{A7}$$

where N_j is the number of COICOP 5-digit products in the common sample of products.

$\tilde{F}$ and F differ because product coverage can differ between countries (see Table 1).

A.4 Additional Evidence on Sales

Table A2: Sale Periods

Country	Set periods for sales	Winter sales	Summer sales	Comments
Austria	No	Usually shortly after Christmas until February.	Usually from July until August.	
Belgium	Yes	3-31 January (if January 3rd is a Sunday, the winter sales start on Saturday, January 2nd).	1-31 July (if July 1st is a Sunday, the summer sales start on Saturday, June 30th).	Promotions are allowed throughout the year but, contrary to the seasonal sales period, shops cannot sell at a loss. In both cases, unfair trade practices are forbidden vis-à-vis the consumer.
France	Yes	Winter sales usually start the 2nd Wednesday of January (or the 1st Wednesday after the 12th of January).	Summer sales usually start the last Wednesday of June (or the Wednesday before, if the last Wednesday is after the 28th of June).	There are two main sales periods of a maximum duration of four weeks in winter and summer. The sale dates are decided by each French department by order of the Prefect. Beginning and ending dates are fixed compulsory for all sellers.
Germany	No	The winter sales usually begin at the end of January / beginning of February.	The summer sales usually start at the end of July / beginning of August.	
Greece	Yes	Winter sales: from the second Monday of January until end of February. Spring sales: 1-10 May.	Summer sales: from the second Monday of July until end of August. Autumn sales: 1-10 November.	
Italy	Yes	Winter sales usually start between the first and the second week of January and last approximately 60 days.	Summer sales usually from the first week of July until end of August.	Sales are regulated by regions.
Latvia	No			Usually in the middle or at the end of the season.
Lithuania	No	1-31 January, but allowed to prolong until the end of winter.	1-31 July, but limits are not strict, can be prolonged until end of summer.	Mid-season sales also allowed.
Luxembourg	Yes	Winter sales are usually organised at the beginning of January.	Summer sales are usually organised in the middle or the end of July.	The law foresees two sales periods per year which are annually fixed.
Slovakia	No	Usually after Christmas.	Usually after summer season.	
Spain	Yes	The starting date is usually 7 January, although it is possible that in certain cities, such as Madrid, winter sales may begin on 1 January. Depending on the region of Spain, the length varies and can even last until the end of March.	Usually from 1 July until the end of September. Depending on the region, the summer sales may be extended by a few days.	According to current legislation (article 25 of Law 7/1996, on the organization of retail trade), each establishment is free to choose the period and duration of the sales throughout the year.

Source: European Consumer Center Germany, https://www.evz.de/en/shopping-internet/retail-store/sales-periods-in-europe.html (as of January 29, 2021); own research.

Table A3: Cross-Product Distribution of the Share of Sales

	% of sales prices											
	NSI flag if available (filter otherwise)						**Sales filter**					
	Average	25th	50th	75th	90th	95th	Average	25th	50th	75th	90th	95th
EURO AREA	**3.8**	**0.1**	**1.7**	**4.5**	**12.7**	**18.8**	**4.7**	**0.7**	**3.4**	**6.6**	**12.3**	**17.2**
by Sector												
Unprocessed Food	5.7	4.6	5.2	5.7	8.9	9.7	8.7	6.5	9.2	9.8	12.4	13.1
Processed Food	3.3	2.2	3.0	4.0	6.0	6.3	5.5	4.2	5.4	6.6	8.2	8.6
NEIG	8.1	2.1	4.7	15.7	19.3	21.5	7.9	3.1	5.7	13.8	16.3	18.5
Services	0.2	0.0	0.0	0.3	0.6	0.8	0.9	0.3	0.5	0.9	2.2	3.7
COUNTRY												
Austria	5.1	0.2	3.3	7.5	16.8	18.8	4.2	0.8	2.9	6.2	11.1	11.3
Belgium	1.1	0.0	0.1	2.0	3.6	3.8	3.8	0.7	2.3	6.6	8.7	10.0
France	3.2	0.2	1.6	3.8	11.0	13.4	5.0	1.2	5.1	7.5	10.9	12.2
Germany	4.1	0.1	1.9	5.3	13.0	21.6	4.2	0.1	1.9	5.4	13.2	21.8
Greece	3.8	0.8	2.9	5.7	8.9	10.6	3.8	0.8	3.0	5.7	8.9	10.6
Italy	4.3	0.0	1.5	3.8	15.2	23.8	5.4	1.0	3.3	6.4	14.7	22.4
Latvia	10.7	0.2	5.5	20.7	28.8	32.7	7.5	0.5	3.8	15.0	21.6	22.7
Lithuania	2.3	0.0	1.8	3.6	5.4	7.6	5.3	0.8	5.4	8.3	12.0	12.9
Luxembourg	4.6	0.7	3.5	7.8	12.3	12.8	4.6	0.7	3.5	7.8	12.3	12.8
Slovakia	4.9	0.5	2.7	8.9	12.8	15.2	4.9	0.5	2.7	8.9	12.8	15.2
Spain	5.1	1.0	4.8	7.7	11.1	12.6	5.1	1.0	4.8	7.7	11.1	12.6

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 and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

B Additional Results on Cross-Sectional Statistics

B.1 Percentage of Price Increases

Table A4: Fraction of Price Increases Among of Price Changes

	Including sales	**Excluding sales**	
		NSI flag	Sales filter
EURO AREA	**64.0**	**68.8**	**66.7**
by Sector			
Unprocessed Food	54.5	57.6	58.5
Processed Food	57.0	61.8	62.3
NEIG	48.2	59.8	55.2
Services	82.5	82.4	80.4
COUNTRY			
Austria	64.5	72.0	70.6
Belgium	69.0	69.7	70.9
France	60.8	67.0	65.4
Germany	61.9	67.2	67.1
Greece	61.3	63.9	63.9
Italy	69.9	75.6	67.0
Latvia	60.0	71.1	62.7
Lithuania	62.3	68.4	65.5
Luxembourg	73.4	78.4	78.4
Slovakia	64.8	66.6	66.6
Spain	64.0	65.3	65.3

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 and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

B.2 Robustness: Product Replacements

Table A5: Frequency and Size of Price Changes – including Replacements

	Including sales		**Excluding sales** (Flag when available)		**Including sales**		**Excluding sales** (Flag when available)	
	Freq. price changes	% price increases	Freq. price changes	% price increases	Median Increase	Median Decrease	Median Increase	Median Decrease
EURO AREA	**13.6**	**63.8**	**9.8**	**67.3**	**10.4**	**13.4**	**7.5**	**9.5**
by Sector								
Unprocessed Food	32.0	54.5	24.7	57.2	13.0	15.2	10.4	11.3
Processed Food	16.1	56.6	11.0	60.7	9.6	12.5	6.1	7.1
NEIG	15.9	51.6	9.4	58.4	15.8	19.3	9.8	11.9
Services	6.8	79.3	6.6	80.0	5.9	8.8	5.8	8.5
COUNTRY								
Austria	13.9	62.7	10.1	64.3	11.8	16.4	8.3	11.8
France	14.9	61.9	12.1	64.5	8.8	12.0	6.5	8.6
Germany	13.5	62.5	10.2	66.6	12.4	16.0	9.1	11.2
Greece	11.3	61.3	7.3	63.9	9.6	12.8	8.0	11.4
Italy	11.5	68.9	6.3	74.6	9.6	12.0	5.0	6.5
Latvia	21.2	61.6	10.5	70.3	16.6	14.6	12.1	8.3
Lithuania	15.1	63.4	12.0	68.4	14.1	16.8	12.8	13.2
Luxembourg	14.3	72.8	9.0	77.7	7.5	11.5	5.6	8.5
Slovakia	14.3	64.8	14.3	66.6	10.5	11.1	10.5	11.1
Spain	14.9	63.4	10.4	64.3	9.2	11.2	8.5	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 included. Belgium does not have information on product replacements. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

B.3 Robustness: Common Time Period

Table A6: Frequency and Size of Price Changes Based on Harmonised Sample Period 2011-2017

	Including sales		**Excluding sales** (Flag when available)		**Including sales**		**Excluding sales** (Flag when available)	
	Freq. price changes	% price increases	Freq. price changes	% price increases	Median Increase	Median Decrease	Median Increase	Median Decrease
EURO AREA	**12.4**	**63.4**	**8.7**	**68.5**	**9.7**	**13.2**	**6.8**	**9.0**
by Sector								
Unprocessed Food	31.2	54.3	24.0	57.3	12.6	14.9	10.1	10.9
Processed Food	15.3	56.5	10.4	61.3	9.1	11.8	5.8	6.6
NEIG	12.9	47.8	6.5	59.0	14.3	19.4	8.2	11.0
Services	6.3	81.6	6.2	82.6	5.8	8.6	5.7	8.2
COUNTRY								
Austria	12.3	64.8	7.4	73.9	11.8	16.2	7.0	9.9
Belgium	14.4	68.8	13.2	69.5	6.8	8.1	6.4	7.4
France	12.5	60.5	9.7	66.4	7.9	12.0	5.2	7.5
Germany	12.9	61.9	9.6	67.2	11.6	16.0	8.6	11.1
Greece	11.6	50.6	6.7	50.9	12.7	14.7	10.8	13.1
Italy	10.5	70.0	5.5	77.4	9.1	11.8	4.5	5.8
Latvia	18.6	60.0	11.1	62.7	15.9	14.8	11.5	11.8
Lithuania	13.1	62.9	9.9	69.4	13.3	16.7	11.6	12.3
Luxembourg	14.1	73.4	9.5	78.0	7.5	10.7	5.4	7.6
Slovakia	14.7	62.3	9.5	63.8	10.3	11.0	9.1	8.5
Spain	13.1	62.3	8.9	63.8	9.0	11.4	8.2	10.5

Notes: Statistics are based on the common sample period of 2011-2017 (Belgium: 2011-2015; Latvia: 2017) 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 and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included.

B.4 Robustness: Sample of Products

Table A7: Frequency of Price Changes Based on the Country-Specific Product Sample

	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	**11.8**	**66.9**	**8.5**	**71.0**	**8.0**	**68.9**	**3.2**	**4.2**
by Sector								
Unprocessed food	31.3	54.5	23.9	57.6	19.7	58.5	5.7	8.7
Processed food	14.7	60.6	10.1	64.9	8.9	65.4	2.9	5.1
NEIG	12.4	52.5	6.7	62.7	6.9	58.5	7.1	7.1
Services	6.8	82.3	6.5	82.0	6.3	79.9	0.2	1.0
COUNTRY								
Austria	12.7	66.9	9.4	72.7	9.1	71.9	4.7	3.9
Belgium	13.6	71.7	12.6	72.3	10.4	73.5	1.0	3.6
France	13.8	64.5	11.3	69.4	9.8	68.3	2.7	4.7
Germany	10.7	67.5	8.0	71.6	7.0	71.4	3.1	3.2
Greece	10.6	62.2	7.1	64.3	7.1	64.3	.	3.5
Italy	9.8	70.4	4.5	76.1	5.9	67.0	4.0	5.1
Latvia	22.7	60.0	14.9	68.6	16.8	62.7	7.8	5.9
Lithuania	12.7	62.9	10.1	68.0	9.4	66.1	1.9	5.1
Luxembourg	12.5	75.1	8.6	78.7	8.6	78.7	.	3.6
Slovakia	13.5	66.7	9.7	68.2	9.7	68.2	.	3.8
Spain	13.2	64.2	8.8	65.4	8.8	65.4	.	5.0

Notes: Statistics are based on the country-specific period and on all products that are available for an individual country. Price changes due to replacement are excluded beforehand (except for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

Table A8: Size of Price Changes Based on the Country-Specific Product Sample

	Including sales		**Excluding sales** (NSI sales flag if available)		**Excluding sales** (Sales filter)	
	Median		Median		Median	
	Increase	Decrease	Increase	Decrease	Increase	Decrease
EURO AREA	**8.6**	**11.6**	**6.3**	**8.0**	**6.7**	**10.0**
by Sector						
Unprocessed food	12.6	15.0	10.0	10.9	10.6	11.9
Processed food	8.6	11.0	5.6	6.1	5.7	6.6
NEIG	12.3	16.8	7.2	9.8	8.1	12.6
Services	5.5	7.6	5.3	7.2	5.5	9.2
COUNTRY						
Austria	8.6	11.9	6.0	7.5	6.4	9.0
Belgium	6.4	7.5	6.1	6.9	6.0	6.7
France	6.5	10.0	4.5	6.3	4.9	8.1
Germany	10.2	13.7	7.7	9.8	8.1	11.6
Greece	9.6	12.9	8.3	11.8	8.3	11.8
Italy	8.8	11.1	4.4	5.5	5.2	9.9
Latvia	13.5	12.3	7.9	6.0	10.4	10.1
Lithuania	12.7	15.4	11.4	12.0	10.5	11.4
Luxembourg	7.8	9.5	6.4	7.4	6.4	7.4
Slovakia	9.3	10.3	8.5	8.5	8.5	8.5
Spain	8.8	11.0	8.0	10.3	8.0	10.3

Notes: Statistics are based on the country-specific period and on all products that are available for an individual country. Price changes due to replacement are excluded beforehand (except for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

Table A9: Frequency of Price Changes Based on the Sample of Products Common to All Countries

	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	**11.6**	**62.3**	**6.8**	**68.9**	**6.6**	**66.2**	**5.2**	**5.7**
by Sector								
Unprocessed food	19.6	56.4	11.9	61.3	10.0	62.3	6.3	7.6
Processed food	15.4	57.0	10.4	61.8	9.1	62.3	3.4	5.5
NEIG	14.9	38.8	4.8	58.6	6.2	49.6	14.2	12.1
Services	3.7	86.4	3.7	85.3	3.8	83.4	0.2	0.8
COUNTRY								
Austria	9.8	61.9	5.0	73.1	5.3	69.8	6.6	4.6
Belgium	11.0	70.3	10.0	71.0	8.2	72.3	0.9	3.1
France	12.4	58.8	8.6	67.7	7.4	64.3	4.2	5.4
Germany	9.8	59.8	5.1	68.1	4.9	67.3	5.6	5.7
Greece	12.5	60.3	7.7	63.5	7.7	63.5	.	4.5
Italy	12.6	68.5	5.6	73.9	6.9	66.0	6.3	7.4
Latvia	15.8	60.8	4.0	75.1	7.4	63.6	11.8	8.4
Lithuania	11.6	62.1	8.3	68.7	7.8	66.9	2.3	5.3
Luxembourg	14.1	72.6	7.7	78.5	7.7	78.5	.	5.4
Slovakia	15.7	62.6	9.1	65.3	9.1	65.3	.	6.3
Spain	13.1	63.1	8.6	64.7	8.6	64.7	.	4.9

Notes: Statistics are based on the country-specific period and on products that are common to all countries (56 products, of which 4 for unprocessed food, 35 for processed food, 11 for NEIG and 6 for services). Price changes due to replacement are excluded beforehand (except for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

Table A10: Size of Price Changes Based on the Sample of Products Common to All Countries

	Including sales		**Excluding sales** (NSI sales flag if available)		**Excluding sales** (Sales filter)	
	Median		Median		Median	
	Increase	Decrease	Increase	Decrease	Increase	Decrease
EURO AREA	**10.6**	**14.5**	**6.5**	**8.6**	**7.2**	**11.1**
by Sector						
Unprocessed food	10.1	13.3	6.2	7.2	6.5	8.3
Processed food	9.2	12.1	5.8	6.5	5.9	7.1
NEIG	19.5	27.3	9.2	13.6	11.4	20.0
Services	5.6	7.8	5.4	7.2	5.4	9.2
COUNTRY						
Austria	11.9	17.6	6.7	9.1	7.4	12.4
Belgium	6.3	7.6	6.0	6.9	5.8	6.6
France	8.2	12.6	4.4	6.6	5.2	10.2
Germany	12.9	18.8	8.3	11.3	9.1	13.6
Greece	9.2	11.8	7.2	10.3	7.2	10.3
Italy	11.1	13.1	4.2	4.7	5.0	9.2
Latvia	16.0	14.9	7.0	5.2	11.0	11.5
Lithuania	13.1	17.1	11.1	12.0	9.7	11.8
Luxembourg	7.4	10.4	4.5	6.2	4.5	6.2
Slovakia	10.5	11.3	8.7	8.1	8.7	8.1
Spain	9.8	11.6	9.3	11.2	9.3	11.2

Notes: Statistics are based on the country-specific period and on products that are common to all countries (56 products, of which 4 for unprocessed food, 35 for processed food, 11 for NEIG and 6 for services). Price changes due to replacement are excluded beforehand (except for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

B.5 Robustness: Country Weights

Table A11: Frequency of Price Changes Using Country-Specific Product Weights for Aggregation

	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	**12.5**	**64.3**	**8.6**	**69.0**	**8.0**	**67.1**	**3.8**	**4.7**
by Sector								
Unprocessed food	32.8	54.4	25.4	57.4	20.9	58.2	5.6	8.6
Processed food	15.4	56.9	10.3	61.7	9.0	62.2	3.4	5.5
NEIG	13.2	48.9	6.8	60.0	6.9	55.8	8.0	7.8
Services	6.3	82.9	5.9	82.8	5.6	81.2	0.2	0.8
COUNTRY								
Austria	10.1	65.7	6.9	73.0	6.6	71.8	4.6	3.9
Belgium	14.5	68.6	13.3	69.3	10.9	70.7	1.1	3.9
France	12.5	61.8	9.9	67.2	8.1	66.1	2.9	4.9
Germany	12.8	61.5	9.4	66.9	8.3	66.7	4.1	4.1
Greece	12.4	61.6	8.4	64.2	8.4	64.2	.	3.9
Italy	10.7	69.9	4.8	75.6	5.9	67.7	4.7	5.7
Latvia	22.4	56.3	7.1	67.9	11.9	59.2	15.3	10.5
Lithuania	15.0	57.7	11.0	65.1	10.3	62.4	2.9	6.7
Luxembourg	13.1	74.2	7.8	79.2	7.8	79.2	.	4.6
Slovakia	17.0	62.7	10.2	65.0	10.2	65.0	.	6.5
Spain	13.6	66.1	9.2	67.3	9.2	67.3	.	4.9

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 for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

Table A12: Size of Price Changes Using Country-Specific Product Weights for Aggregation

	Including sales		**Excluding sales** (NSI sales flag if available)		**Excluding sales** (Sales filter)	
	Median		Median		Median	
	Increase	Decrease	Increase	Decrease	Increase	Decrease
EURO AREA	**9.4**	**12.8**	**6.6**	**8.6**	**7.0**	**10.6**
by Sector						
Unprocessed food	12.8	15.1	10.4	11.3	11.1	12.2
Processed food	9.2	12.0	5.8	6.5	5.9	7.0
NEIG	13.8	18.9	7.9	10.6	8.8	13.9
Services	5.5	8.1	5.4	7.8	5.4	9.6
COUNTRY						
Austria	9.5	13.6	6.5	8.4	6.9	10.3
Belgium	6.9	8.2	6.5	7.4	6.5	7.1
France	7.2	11.2	4.9	6.8	5.4	8.8
Germany	11.3	15.8	8.1	10.8	8.6	13.0
Greece	8.6	11.4	7.3	10.1	7.3	10.1
Italy	9.7	12.0	4.5	6.1	5.3	9.9
Latvia	16.8	15.3	7.7	5.7	11.9	12.0
Lithuania	13.9	17.8	12.0	12.7	10.1	12.1
Luxembourg	7.0	10.7	5.0	7.7	5.0	7.7
Slovakia	11.0	11.8	9.1	8.4	9.1	8.4
Spain	8.9	11.0	8.2	10.4	8.2	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 for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

B.6 Robustness: EA Aggregation

Table A13: Frequency of Price Changes Using Alternative Aggregation

	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	**12.5**	**64.1**	**8.7**	**68.9**	**8.1**	**66.7**	**3.8**	**4.7**
by Sector								
Unprocessed food	35.0	53.8	27.5	56.3	22.5	57.3	5.9	9.1
Processed food	15.3	57.0	10.4	61.8	9.0	62.3	3.3	5.4
NEIG	13.0	48.2	6.5	59.9	6.8	55.2	8.2	7.9
Services	6.4	82.1	6.0	82.0	5.8	79.7	0.2	0.9

Notes: We first aggregate at the product level and then calculate the average over the products. 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 for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

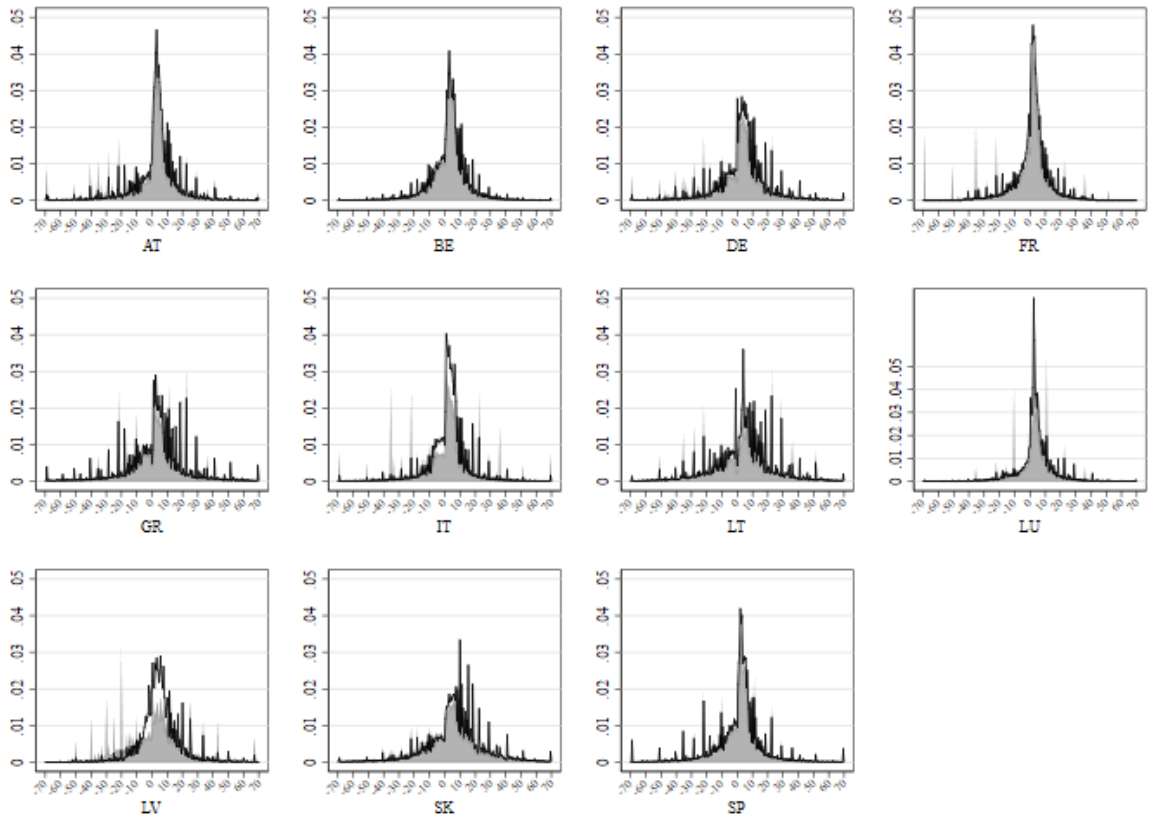
Table A14: Size of Price Changes Using Alternative Aggregation

	Including sales		**Excluding sales** (NSI sales flag if available)		**Excluding sales** (Sales filter)	
	Median		Median		Median	
	Increase	Decrease	Increase	Decrease	Increase	Decrease
EURO AREA	**9.6**	**13.0**	**6.7**	**8.7**	**7.2**	**10.9**
by Sector						
Unprocessed food	13.8	16.0	11.5	12.5	12.1	13.4
Processed food	9.2	12.0	5.8	6.5	5.9	7.1
NEIG	13.8	19.1	7.7	10.6	8.8	14.1
Services	5.6	8.1	5.5	7.7	5.7	10.0

Notes: We first aggregate at the product level and then calculate the average over the products. 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 for Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

B.7 Distribution of Price Changes

Figure A2: Distribution of (Log-)Price Changes by Country (in %)



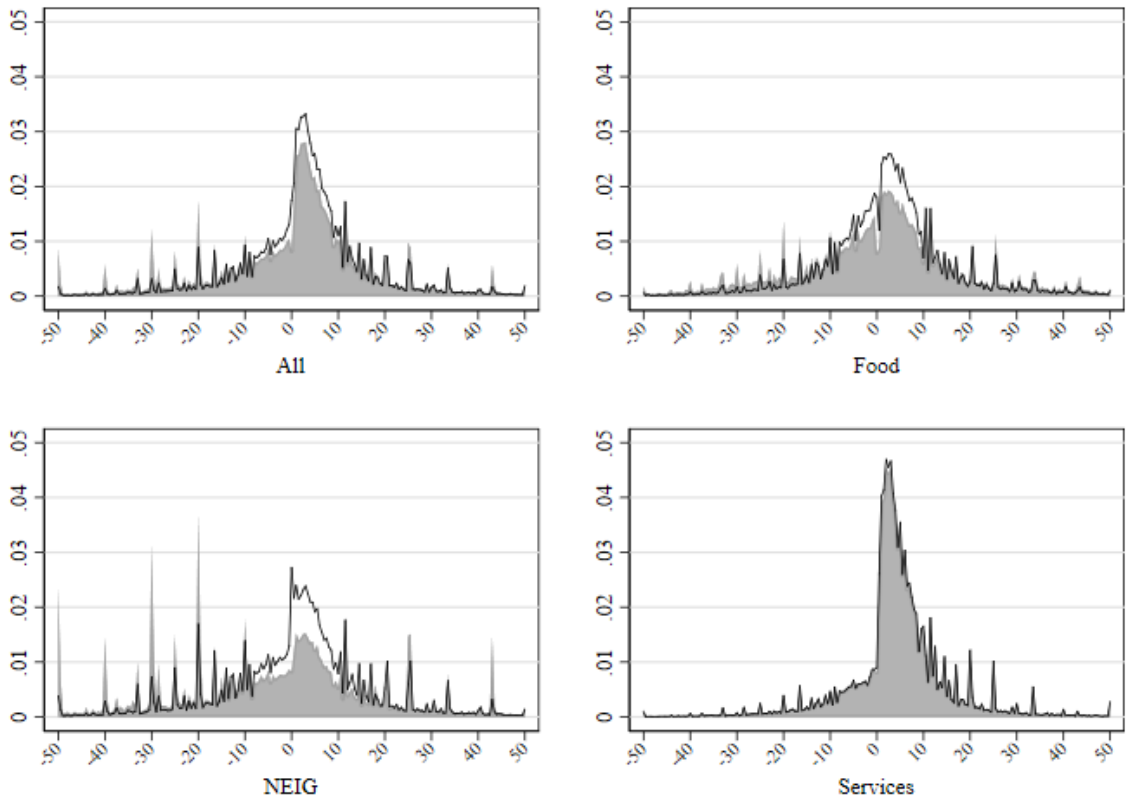
Notes: The histograms plot the distribution of price changes calculated first at the country level for the common sample of products and weighted using the EA product weights. Grey shaded histogram corresponds to the distribution of price changes including price changes due to sales whereas the black line corresponds to the distribution of price changes excluding price changes due to sales. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

Table A15: Distribution of (Non-Zero) Absolute Price Changes

	Absolute size of price changes (in %)							
	Including sales				Excluding sales[1]			
	10th	25th	75th	90th	10th	25th	75th	90th
EURO AREA	**3.0**	**6.0**	**18.8**	**28.9**	**2.0**	**3.9**	**12.5**	**20.5**
by Sector								
Unprocessed Food	3.6	6.9	25.4	38.3	3.1	5.8	18.2	28.0
Processed Food	2.5	4.7	19.4	29.1	1.9	3.3	10.5	17.8
NEIG	4.7	9.8	27.6	41.2	2.1	4.6	15.7	25.8
Services	1.9	3.3	10.1	17.0	1.9	3.2	9.7	16.0
COUNTRY								
Austria	3.3	6.7	21.1	31.4	1.8	4.0	13.4	22.5
Belgium	2.1	4.0	13.7	23.3	2.0	3.8	12.2	20.8
France	2.4	5.3	16.9	27.5	1.3	2.7	9.9	16.8
Germany	3.9	7.3	22.9	34.1	2.8	5.0	15.6	25.9
Greece	3.0	5.6	19.4	31.6	2.4	4.6	17.0	30.6
Italy	2.6	5.3	16.7	25.0	1.3	2.4	7.9	12.2
Latvia	4.2	8.4	24.1	34.7	2.1	3.9	13.1	21.1
Lithuania	3.5	7.3	25.2	35.0	3.0	5.9	22.0	32.5
Luxembourg	2.2	3.9	12.8	21.7	1.8	3.1	10.7	17.9
Slovakia	2.9	5.6	18.0	25.1	2.7	5.0	16.0	23.5
Spain	2.9	5.4	16.0	25.0	2.6	5.0	14.5	23.1

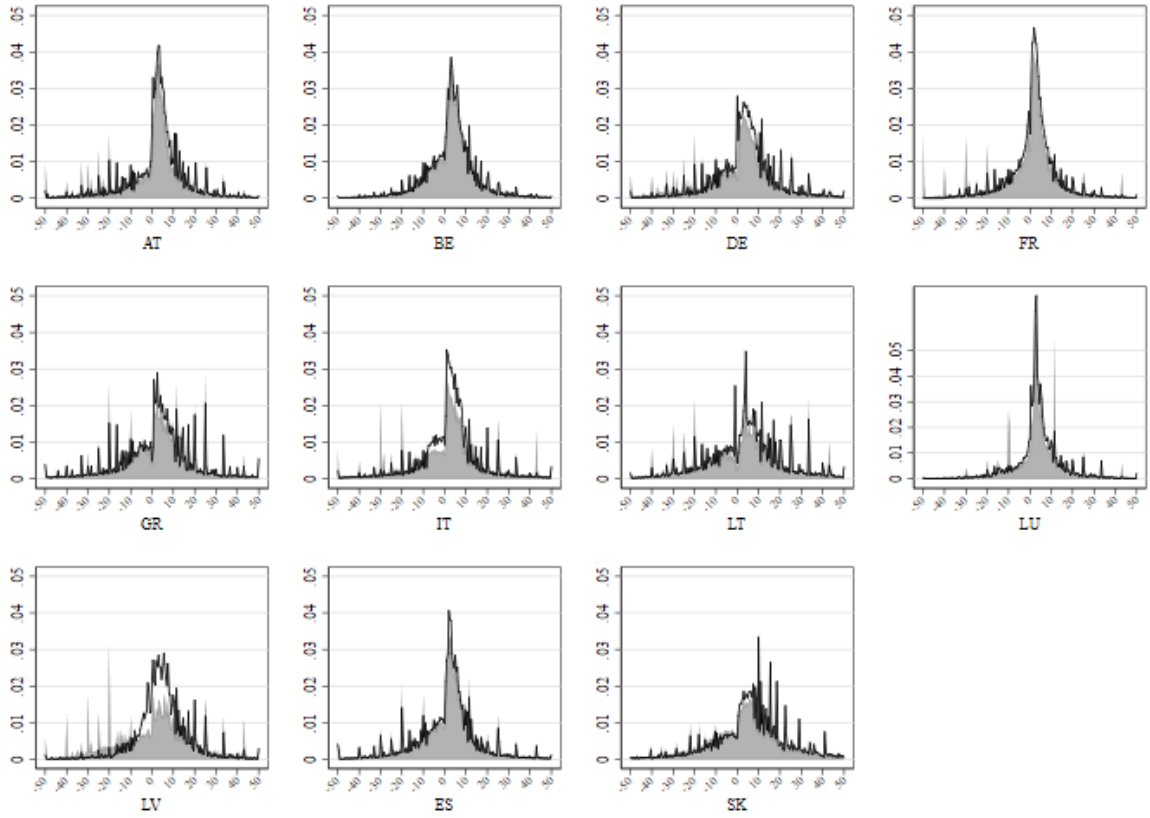
Notes: Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. 1) Results excluding sales are based on NSI sales flag, if available, or common sales filter.

Figure A3: Distribution of Price Changes (Euro Area - in %)



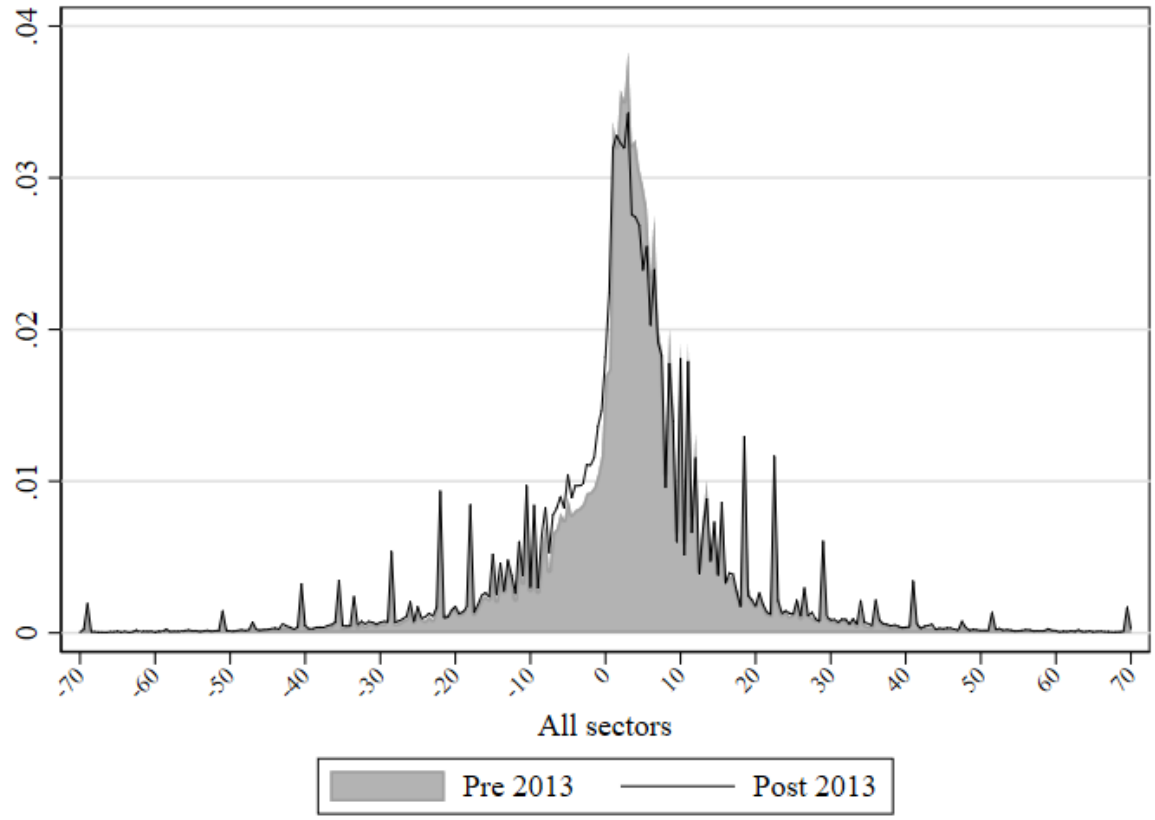
Notes: The histograms plot the distribution of price changes (in %) calculated first at the country level by product for the common sample of products (bins of 0.5 pp), then aggregated at the country level using euro area product weights and then aggregated at the euro area level using HICP country weights. Grey shaded histogram corresponds to the distribution of price changes including price changes due to sales whereas the black line corresponds to the distribution of price changes excluding price changes due to sales. Results excluding sales are based on NSI sales flag if available, common sales filter otherwise.

Figure A4: Distribution of Price Changes by Country (in %)



Notes: The histograms plot the distribution of price changes calculated first at the country level for the common sample of products and weighted using the EA product weights. Grey shaded histogram corresponds to the distribution of price changes including price changes due to sales whereas the black line corresponds to the distribution of price changes excluding price changes due to sales. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

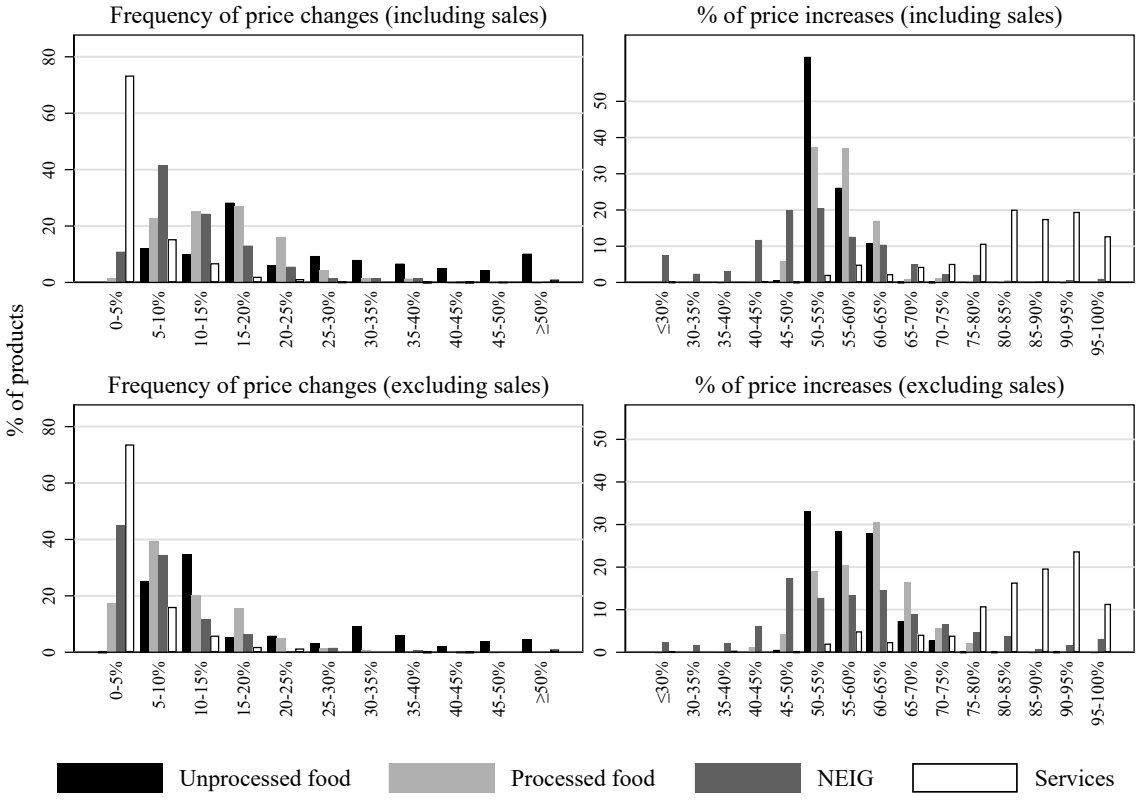
Figure A5: Distribution of (Log-)Price Changes before/after 2013 (in %)



Notes: The histograms plot the distribution of price changes calculated first at the country level for the common sample of products and weighted by the EA product weights and then weighted at the EA level using HICP country weights. Grey shaded histogram corresponds to the distribution of price changes excluding sales before 2013 and the solid black line corresponds to the distribution of price changes excluding sales after 2013. Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter.

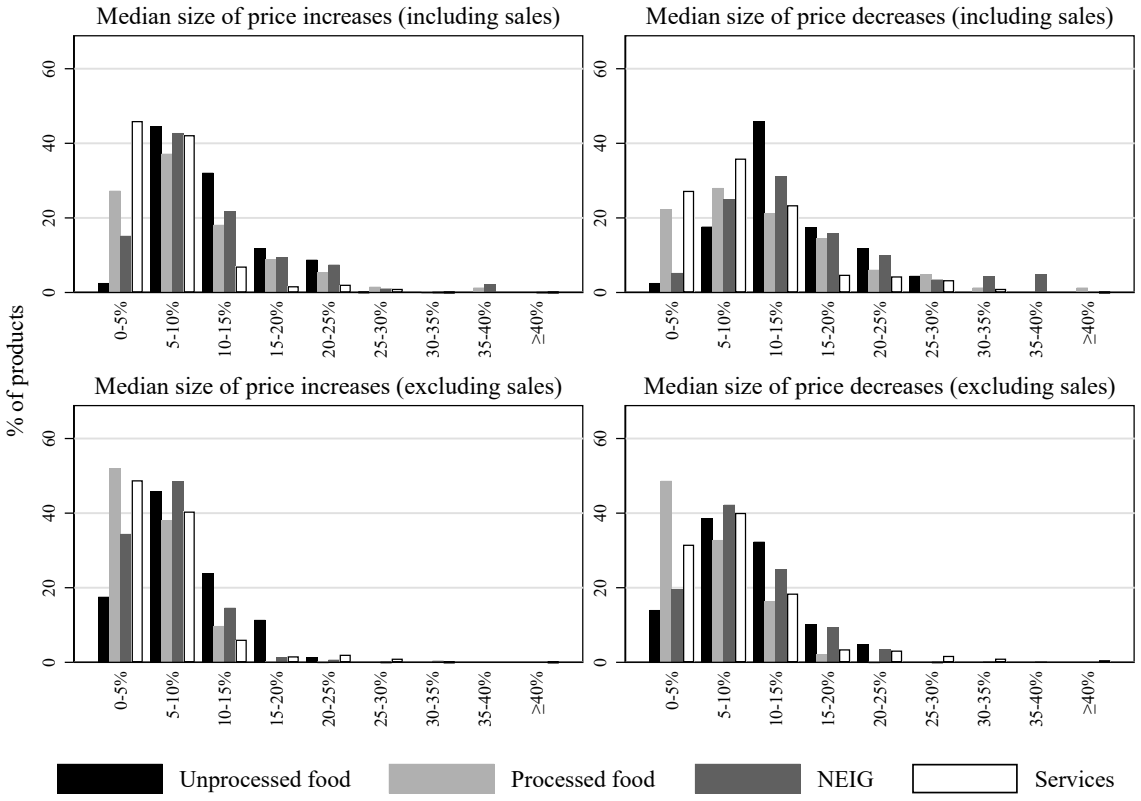
B.8 Sectoral Heterogeneity

Figure A6: Euro Area - Frequency of Price Changes: Distribution of COICOP-5 Products by Sector



Notes: The histograms use country/product observations with country weights, and 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 for Greece and Slovakia). Results excluding sales are based on ***1)*** *NSI sales flag (if available) or* ***2)*** *common sales filter.*

Figure A7: Euro Area - Size of Price Changes: Distribution of COICOP-5 Products by Sector



Notes: The histograms use country/product observations with country weights, and 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 for Greece and Slovakia). Results excluding sales are based on ***1)*** *NSI sales flag (if available) or* ***2)*** *common sales filter.*

B.9 Cross-Country Similarities

Table A16: Correlations between Countries

Frequency of price changes (average correlation: 0.59)											
	Austria	Belgium	France	Germany	Greece	Italy	Latvia	Lithuania	Luxembourg	Slovakia	Spain
Austria	1										
Belgium	0.86	1									
France	0.73	0.87	1								
Germany	0.55	0.67	0.46	1							
Greece	0.38	0.60	0.78	0.39	1						
Italy	0.30	0.21	0.57	0.32	0.70	1					
Latvia	0.45	0.80	0.65	0.41	0.46	0.33	1				
Lithuania	0.61	0.78	0.74	0.46	0.52	0.43	0.73	1			
Luxembourg	0.50	0.60	0.61	0.46	0.54	0.60	0.34	0.51	1		
Slovakia	0.57	0.81	0.82	0.49	0.68	0.56	0.65	0.83	0.53	1	
Spain	0.58	0.80	0.82	0.50	0.82	0.58	0.59	0.62	0.63	0.78	1
Median size of price increases (average correlation: 0.28)											
	Austria	Belgium	France	Germany	Greece	Italy	Latvia	Lithuania	Luxembourg	Slovakia	Spain
Austria	1										
Belgium	0.08	1									
France	0.20	0.44	1								
Germany	0.67	-0.02	0.17	1							
Greece	-0.13	0.42	0.60	-0.15	1						
Italy	0.46	0.16	0.72	0.38	0.45	1					
Latvia	0.44	0.38	0.23	0.48	0.21	0.36	1				
Lithuania	0.31	-0.05	-0.07	0.30	-0.15	0.04	0.52	1			
Luxembourg	0.23	0.47	0.39	0.20	0.42	0.40	0.26	-0.00	1		
Slovakia	0.36	-0.01	-0.20	0.43	-0.26	0.01	0.23	0.32	0.08	1	
Spain	0.49	0.45	0.82	0.38	0.57	0.87	0.47	0.10	0.50	-0.14	1
Median size of price decreases (average correlation: 0.27)											
	Austria	Belgium	France	Germany	Greece	Italy	Latvia	Lithuania	Luxembourg	Slovakia	Spain
Austria	1										
Belgium	0.27	1									
France	0.27	0.49	1								
Germany	0.71	0.03	0.36	1							
Greece	-0.01	0.27	0.51	0.06	1						
Italy	0.58	0.37	0.70	0.55	0.45	1					
Latvia	0.53	0.12	0.25	0.57	0.22	0.38	1				
Lithuania	0.48	-0.12	0.04	0.44	-0.02	0.32	0.53	1			
Luxembourg	0.10	0.46	0.20	0.19	0.16	0.18	0.06	-0.03	1		
Slovakia	0.35	-0.28	-0.34	0.34	-0.29	-0.04	0.26	0.43	-0.12	1	
Spain	0.39	0.45	0.71	0.38	0.54	0.68	0.35	0.19	0.16	-0.24	1

Notes: The correlations are calculated using statistics at the product level. Products that are common to at least 3 of the 4 largest countries are included. The reported averages are the mean correlations over all country pairs. Statistics are based on the country-specific period. Price changes due to sales are included, but price changes due to replacements are excluded beforehand (except Greece and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Individual products can have a substantial impact on the correlation of a country pair.

B.10 Explanatory Variables of the Frequency and Size of Price Changes

Table A17: Description and Source of the Explanatory Variables Used in the Regressions

Variable	Description	Source	Comments
Share of labour costs	The compensation of employees (aggregated over all parts of the domestic part of the production chain) that is required as input for domestically manufactured products from a certain product category that are consumed by households, divided by household expenditures on domestically manufactured products from that product category	Euro area input-output table, year 2015, Eurostat	We use the inverted symmetric input-output table by product (65), classified by CPA, that is the EU official classification of products by activity. In order to match each COICOP with its corresponding CPA, we use the Reference And Management Of Nomenclatures (RAMON) by Eurostat. When the matching is not unique, we use the average of the corresponding CPA products
Share of imported energy and raw material inputs	The value of imported raw materials (including energy) that are required as input for domestically manufactured products from a certain product category that are consumed by households, divided by household expenditures on domestically manufactured products from that product category	Euro area input-output table, year 2015, Eurostat	See note on "Share of labour costs"
Share of all imported inputs	The value of all imported products that are required as input for domestically manufactured products from a certain product category that are consumed by households, divided by household expenditures on domestically manufactured products from that product category	Euro area input-output table, year 2015, Eurostat	See note on "Share of labour costs"
% of online consumers	Percentage of individuals that bought a certain type of product online in the last 12 months	European Union survey on ICT usage in households and by individuals, country-specific data, year 2015, Eurostat	There are 16 possible answers on the types of products bought. Each COICOP has been matched to the closest product type when possible
Regulated price dummy	Administered prices cover all goods and services of which the prices are fully ("directly") set or mainly ("to a significant extent") influenced by the government (central, regional, local government including national regulators)	Country-specific data and country-specific sample period, Eurostat	Each COICOP is assigned a value of 1 or 0 indicating whether it is administered or not
Retail market concentration (HHI)	$HHI = \frac{\sum_{i=1}^{N} s_i^2}{100}$ where s_i is the market share of firm i in the market, and N is the number of firms. The measure can range between 0 and 100 (0 being where there are an "infinite" number of "infinitely" small firms, and 100 being where there is a monopoly with a market share of 100%)	Country-specific data, average 2004-2009, ECB, Structural features of distributive trades and their impact on prices in the euro area, Occasional paper, September 2011	The markets are grocery; health and beauty; clothing and footwear; house and gardening; electronics and appliances; leisure and personal. Each COICOP has been matched to the closest product type when possible

B.11 Regression of the Size of Price Changes

Table A18: Some Determinants of the Median Size of Price Changes in the Euro Area

	I	II	III	IV
Share of labour costs	-0.089***	-0.098**	-0.093***	-0.097***
Share of imported energy and raw material inputs	-0.358***	-0.347***	-0.034	-0.337***
Share of all imported inputs	-0.034	-0.049	0.091*	-0.098
% of online consumers	0.0005***	0.0005***	0.0019***	0.0004**
Regulated price dummy	0.009		-0.016	0.009
Retail market concentration (HHI)		-0.0004		
Unprocessed food dummy				0.010
Processed food dummy				-0.011**
Services dummy				-0.012
Constant	0.106***	0.114***	0.091***	0.125***
Country dummies	✓	✓	✓	✓
Number of observations	1,622	1,293	1,622	1,622
R^2	0.280	0.385	0.294	0.293

*Notes: All regressions are estimated using OLS and are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Standard errors are clustered at the product level. *, **, and *** denote significance at respectively 10%, 5%, and 1%. The dependent variable in Column I is the median size of the absolute non-zero price changes, excluding sales and excluding product replacements (for Greece, Luxembourg, Slovakia, and Spain sales are excluded via the sales filter, Greece and Slovakia include product replacements). Column II adds the Herfindahl–Hirschman Index (HHI) of the retail sector as explanatory variable. This regression uses fewer observations as the HHI is not available for all products (e.g., non-retail products). The regulated price dummy is not included in this regression as there is only one observation available for estimation. In Column III the dependent variable is the median size of price changes including sales and excluding product replacements (instead of excluding sales and excluding product replacements). Column IV adds sector dummies to the regression in Column I. The reference sector is NEIG.*

C Comparison with Dhyne et al. (2006)

To be consistent with Dhyne et al. (2006), three main adjustments of our calculations based on the micro price data were necessary. First, the statistics in Dhyne et al. (2006) were derived from the same set of 50 single products across countries. However, for Luxembourg and Spain, our micro dataset does not allow identification of products at the same level of disaggregation as in Dhyne et al. (2006), e.g. due to missing product id information. Thus, we have to limit our comparison to five countries (Austria, Belgium, France, Germany and Italy). In terms of product groups, only one (out of four) unprocessed food item is available for France and Italy. Additionally, no energy products are available for Belgium and Italy. Thus, we drop unprocessed food and energy from our comparison. This leaves us with a sample of 43 of the original 50 products which is further reduced due to unavailability of certain products for some countries (see Table A19). The coverage of processed food, NEIG and services items, however, is quite good across countries, with the exception of Belgium for which only five out of 17 NEIG and eight out of 19 Services items are available. Although in the dataset underlying Dhyne et al. (2006) more products are available for most countries, we only include those products in our comparison that are available in both samples.

A factor hampering comparability across countries already in Dhyne et al. (2006) was the fact that – due to data availability at that time – their frequency statistics included price changes due to sales for some countries (Austria and France) but excluded them for other countries (Belgium, Germany and Italy). In order to be consistent with this pattern, we also excluded sales from the frequencies in our results for Belgium, Germany and Italy but included them for Austria and France.[64] With this in mind, the resulting frequencies should not be compared across countries but rather across time, i.e. between the older and the more recent results.

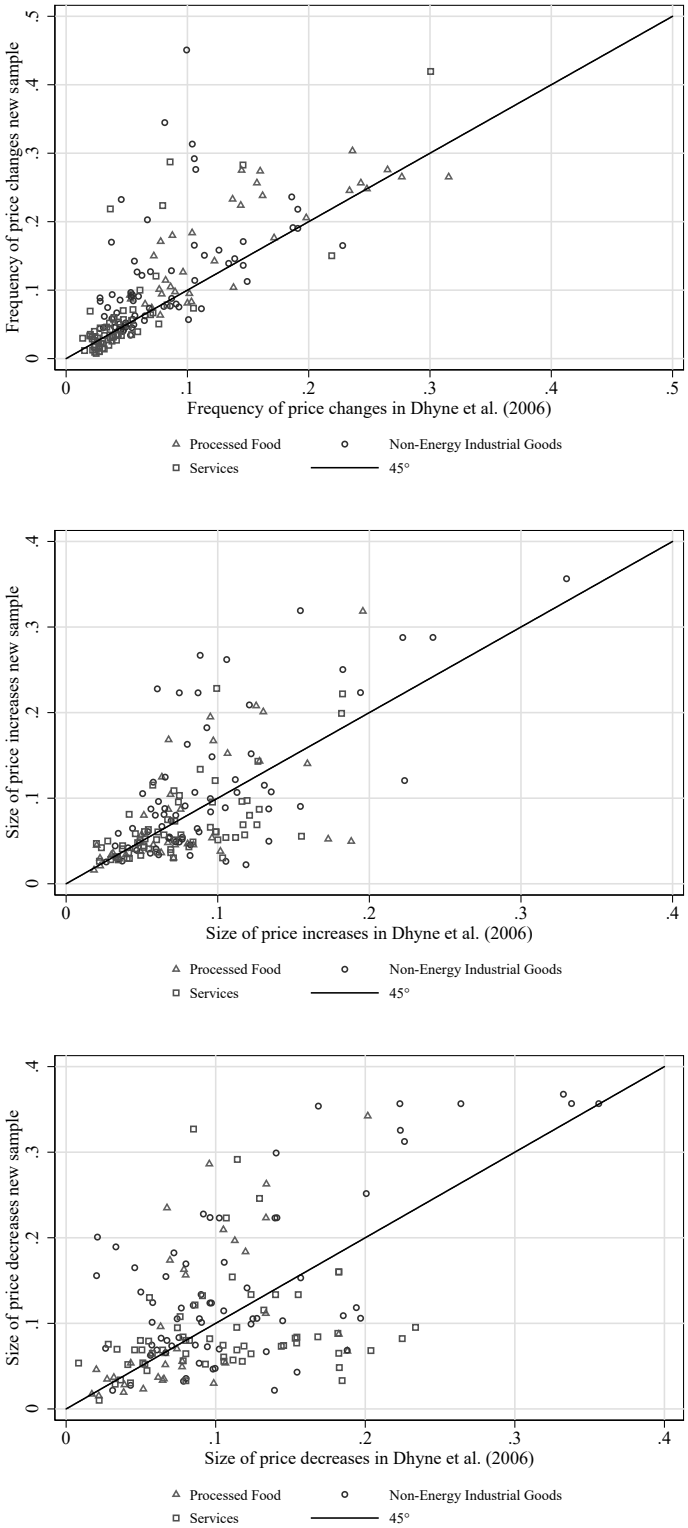
Furthermore, to perform a clean, i.e. non-overlapping, comparison of the older with more recent evidence, we restrict the sample period of our analysis to the time span 2011-2017 harmonised across countries (with the exception of Belgium for which the sample runs only until 2015), while the results from Dhyne et al. (2006) cover the period 1996-2001 for most countries. Finally, to control for changes in the weighting structure over time, we apply the same country-specific product and product-group weights as well as country weights (average of 2011-2017) in the aggregation for both samples. As a result, the reported numbers in Dhyne et al. (2006) diverge slightly from the ones reported in Table 6.

[64] For Germany, the old dataset lacked only information on seasonal sales which mainly affects clothing and footwear, so our comparison for processed food in Germany includes sales. See Dhyne et al. (2005), footnote 21 of their Technical Appendix.

Table A19: Availability of the 50 Products from Dhyne et al. (2006) in Our Dataset

	Austria	Belgium	France	Germany	Italy
Unprocessed food					
Steak	x	x	x	x	x
Fresh fish	x	x		x	
Lettuce	x	x		x	
Banana	x	x		x	
Processed food					
Milk	x	x	x	x	x
Sugar	x	x	x	x	x
Frozen spinach	x	x	x	x	x
Mineral water	x	x	x	x	x
Coffee	x	x	x	x	x
Whisky	x	x	x	x	x
Beer in a shop	x	x	x	x	x
Energy					
Heating oil	x		x	x	
Fuel type 1	x		x	x	
Fuel type 2	x		x	x	
Non-energy industrial goods					
Socks	x	x		x	x
Jeans	x	x	x	x	x
Sport shoes	x	x	x	x	x
Shirt (men)	x	x	x	x	x
Acrylic painting	x		x	x	x
Cement	x		x	x	x
Toaster	x		x	x	x
Electric bulb	x			x	x
Type of furniture	x		x	x	x
Towel	x		x	x	x
Car tyre	x			x	x
Television set	x			x	
Dog food	x		x	x	x
Tennis ball	x		x	x	x
Construction game (Lego)	x	x	x	x	x
Toothpaste	x		x	x	x
Suitcase	x		x	x	x
Services					
Dry cleaning	x		x	x	x
Hourly rate of an electrician	x			x	
Hourly rate of a plumber	x			x	
Domestic services	x				x
Hourly rate in a garage	x	x	x	x	x
Car wash	x	x	x	x	x
Balancing of wheels	x	x		x	x
Taxi	x			x	
Telephone/Fax machine	x		x	x	x
Movie	x			x	x
Videotape hiring				x	
Photo development	x			x	x
Hotel room	x			x	x
Glass of beer in a café	x	x	x	x	x
Meal in a restaurant	x	x	x	x	
Hot-dog	x		x		x
Cola based lemonade in a café	x	x	x	x	x
Haircut (men)	x	x	x	x	
Hairdressing (ladies)	x	x	x	x	x
Total	49	24	34	48	37
Total excl. Unproc. Food and Energy	**42**	**20**	**30**	**41**	**36**

Figure A8: Frequency and Size of Price Changes – Period 2011-2017 vs. Dhyne et al. (2006)



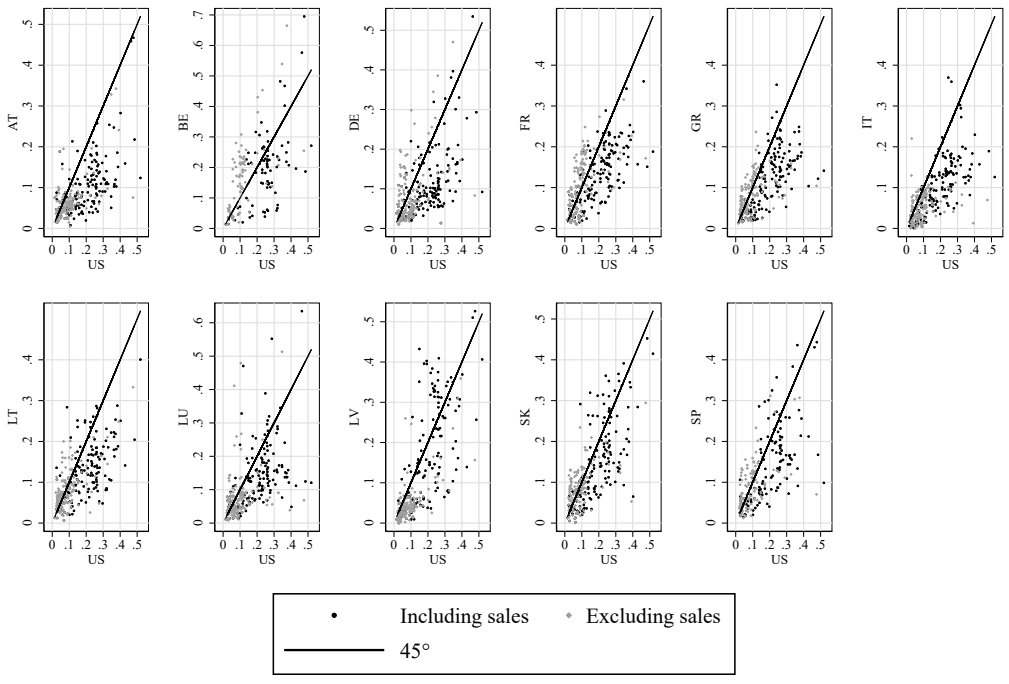
Notes: Frequencies and size of price changes at the product level for Processed Food, NEIG and Services items (at most 43 products depending on availability). Countries covered are Austria, Belgium, France, Germany and Italy.

D Comparison with US Evidence

To compare our results with the results for the United States from Nakamura and Steinsson (2008*a*), we downloaded the data tables from the authors' websites, which are part of the supplementary materials of the published paper. In particular, we extracted data from the ELI-level tables on frequency of price changes including and excluding sales (Table 19 in their paper), the absolute size of price changes for consumer prices (Table 22), and moments of the distribution of price changes (Table 26). For the mapping to the European data, we created correspondence tables between ELI and COICOP nomenclatures (available as online material), and stored the US results using the corresponding COICOP classification. For the comparison, we applied euro area HICP weights to all products in order to derive aggregate statistics for both economic areas.

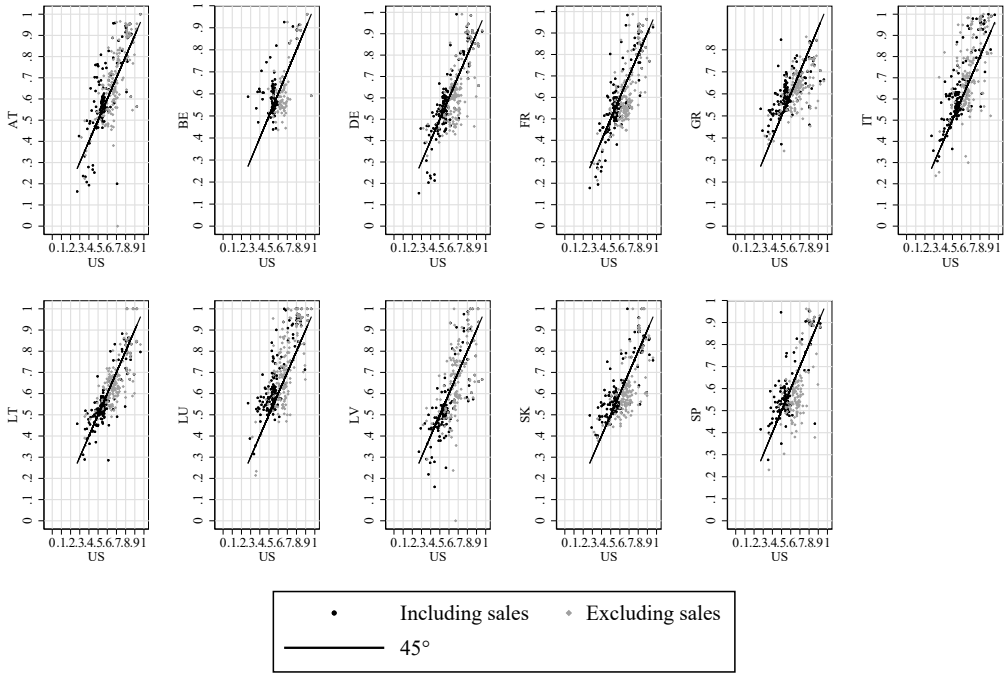
In the following figures, we report country-specific scatter plots for the frequency of price changes (Figure A9), the share of price increases (Figure A10), the size of price increases (Figure A11), and the size of price decreases (Figure A12).

Figure A9: Frequency of Price Changes at the Product Level: Euro Area countries vs United States



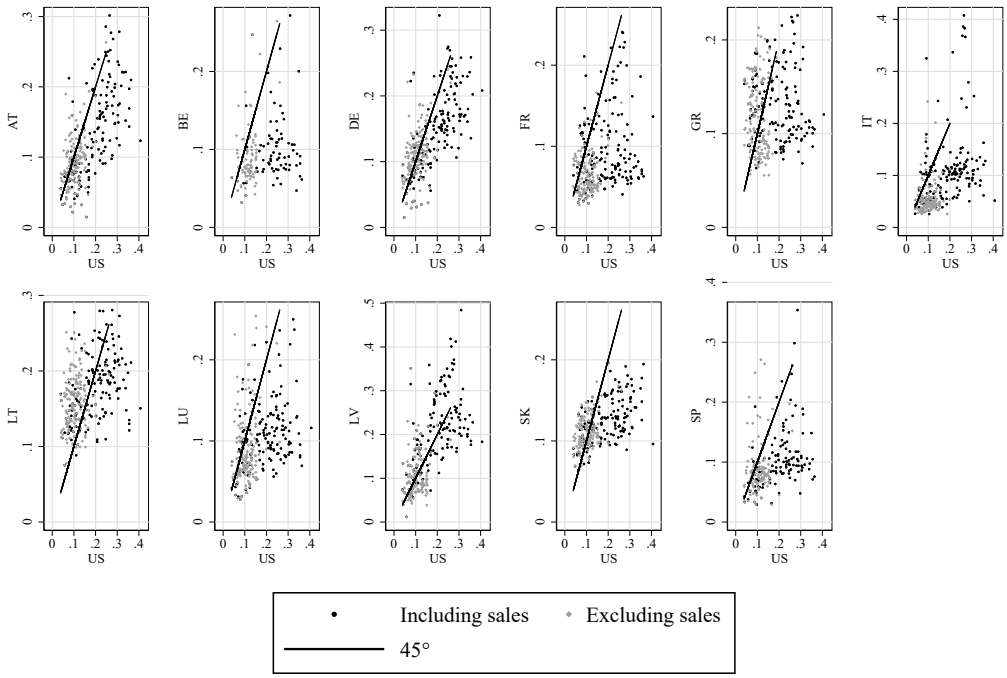
Notes: US product results are taken from Nakamura and Steinsson (2008a). Euro area statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries.

Figure A10: Average Share of Price Increases at the Product Level: Euro Area countries vs United States



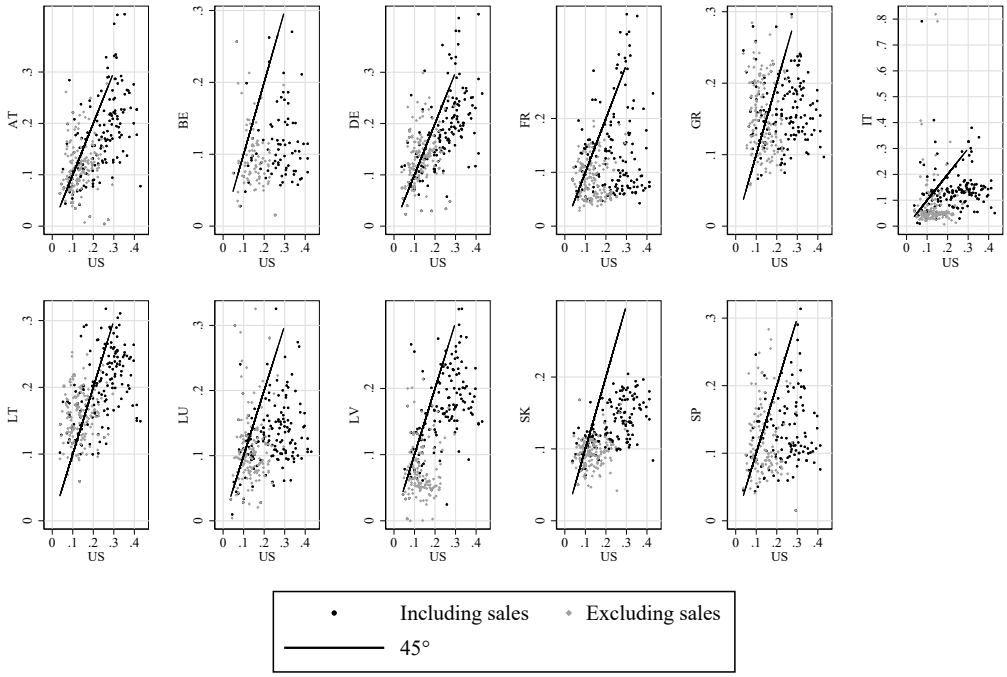
Notes: US product results are taken from Nakamura and Steinsson (2008a). Euro area statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries.

Figure A11: Average Size of Price Increases at the Product Level: Euro Area countries vs United States



Notes: US product results are taken from Nakamura and Steinsson (2008a). 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.

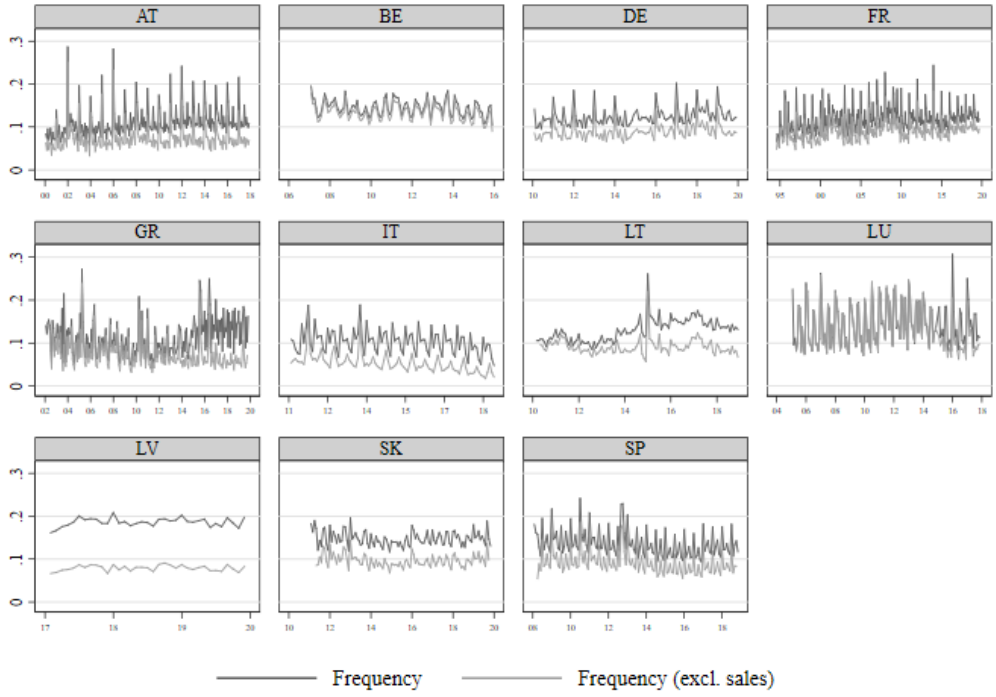
Figure A12: Average Size of Price Decreases at the Product Level: Euro Area countries vs United States



Notes: US product results are taken from Nakamura and Steinsson (2008a). 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.

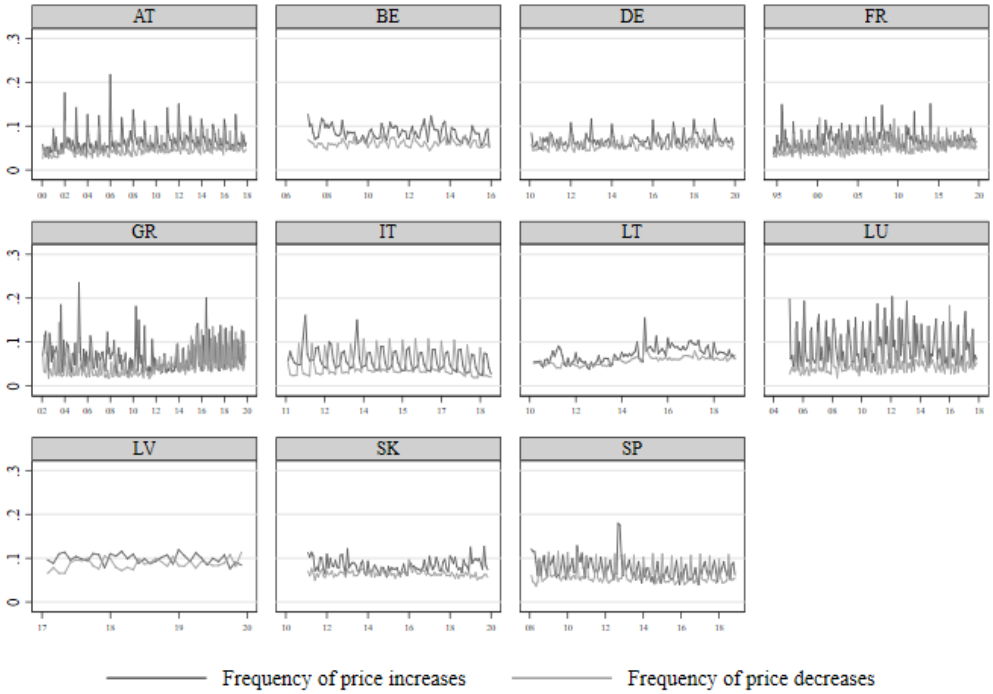
E Additional Results on Time Series Statistics

Figure A13: Frequency by Country over Time



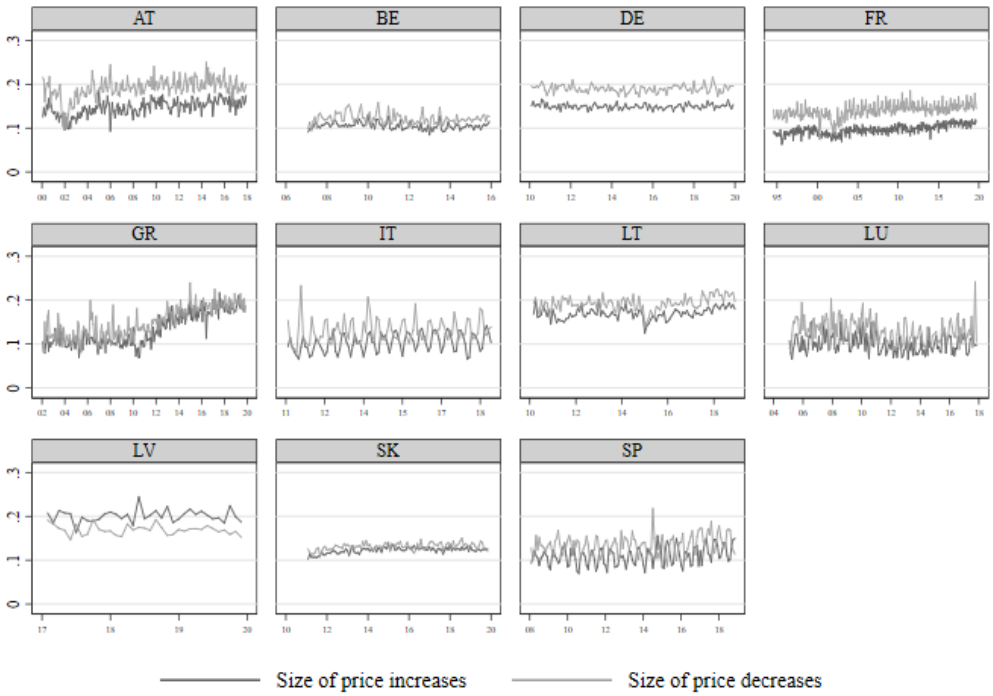
Notes: Statistics are based on products that are common to at least 3 of the 4 largest countries and calculated using euro area product weights at the COICOP-5 level (2017-2020 average). For the trend, a HP filter is applied. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Outliers adjusted beforehand.

Figure A14: Frequencies of Price Increases and Decreases by Country over Time



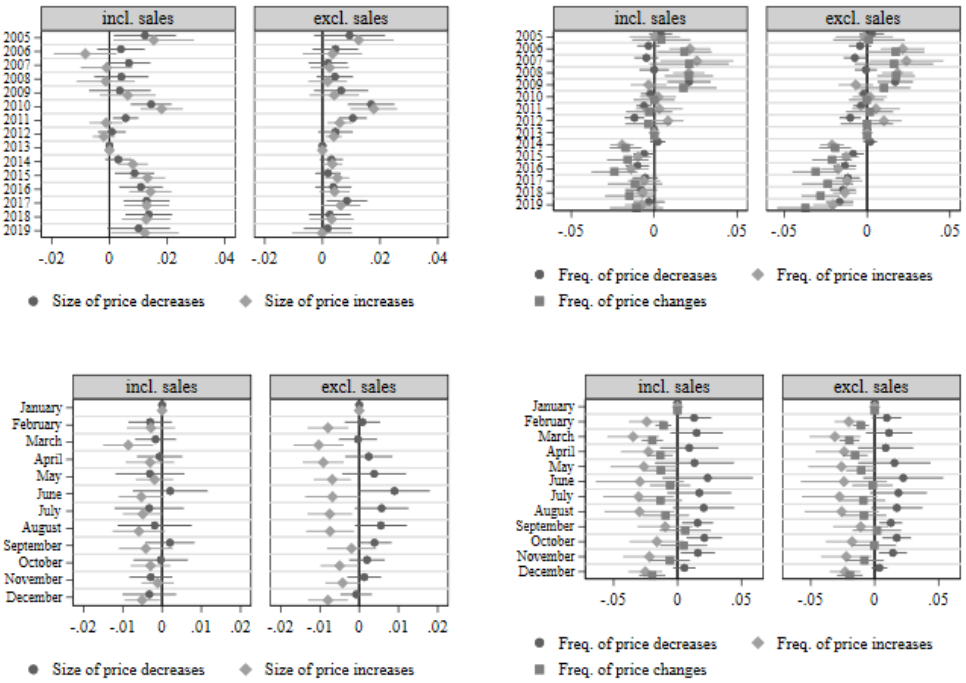
Notes: Statistics are based on products that are common to at least 3 of the 4 largest countries and calculated using euro area product weights at the COICOP-5 level (2017-2020 average). For the trend, a HP filter is applied. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Outliers adjusted beforehand.

Figure A15: Mean Size of Price Increases and Decreases by Country over Time



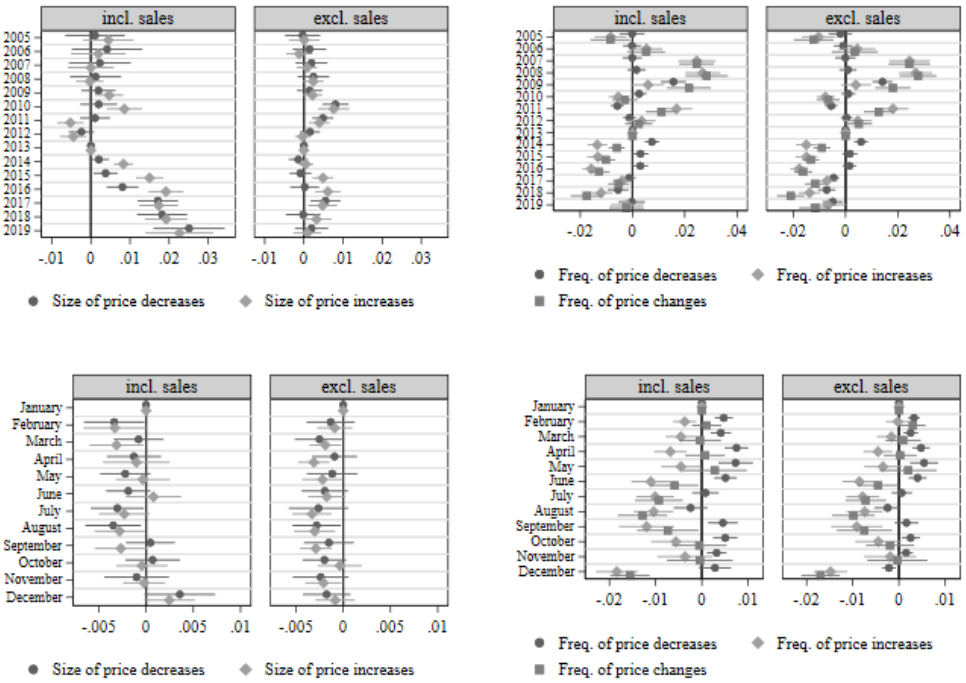
Notes: The chart shows the mean size of non-zero price changes. Statistics are based on products that are common to at least 3 of the 4 largest countries and calculated using euro area product weights at the COICOP-5 level (2017-2020 average). Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Outliers adjusted beforehand.

Figure A16: Seasonal Patterns, Annual Changes, and Effect of Sales: Unprocessed Food



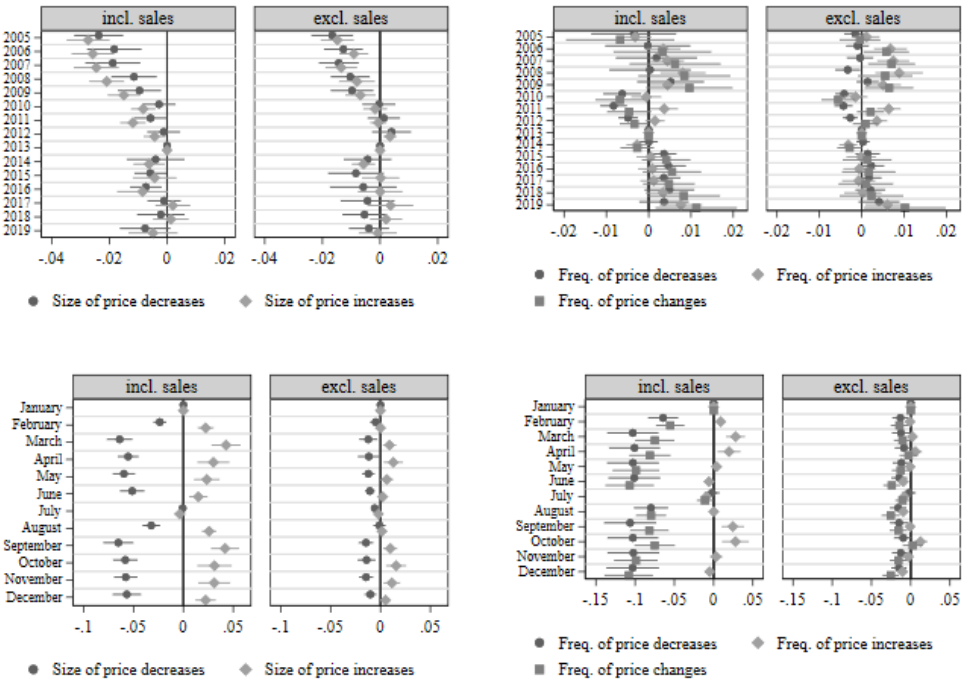
Notes: Coefficient plots from weighted panel regressions with COICOP, country, and time fixed effects and dummy for VAT changes in France (04/00, 01/12, 01/14), Italy (09/11), Slovakia (01/11), and Spain (09/12, 07-09/10), with country weights in euro area HICP (2017-2020 average) and robust standard 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. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter. Outliers adjusted beforehand.

Figure A17: Seasonal Patterns, Annual Changes, and Effect of Sales: Processed Food



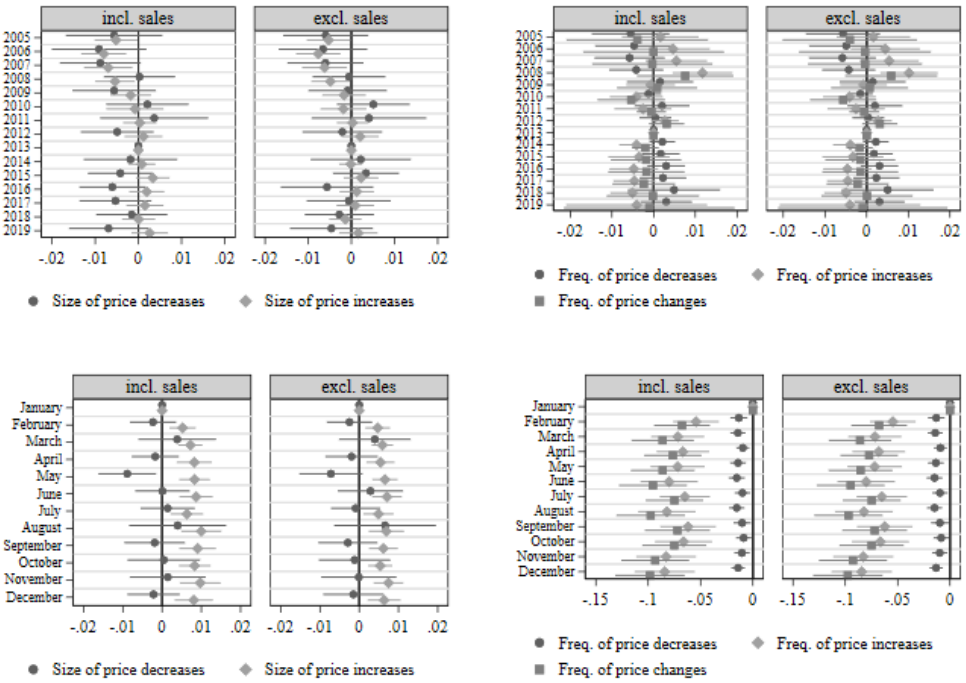
Notes: Coefficient plots from weighted panel regressions with COICOP, country, and time fixed effects and dummy for VAT changes in France (04/00, 01/12, 01/14), Italy (09/11), Slovakia (01/11), and Spain (09/12, 07-09/10), with country weights in euro area HICP (2017-2020 average) and robust standard 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. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter. Outliers adjusted beforehand.

Figure A18: Seasonal Patterns, Annual Changes, and Effect of Sales: NEIG



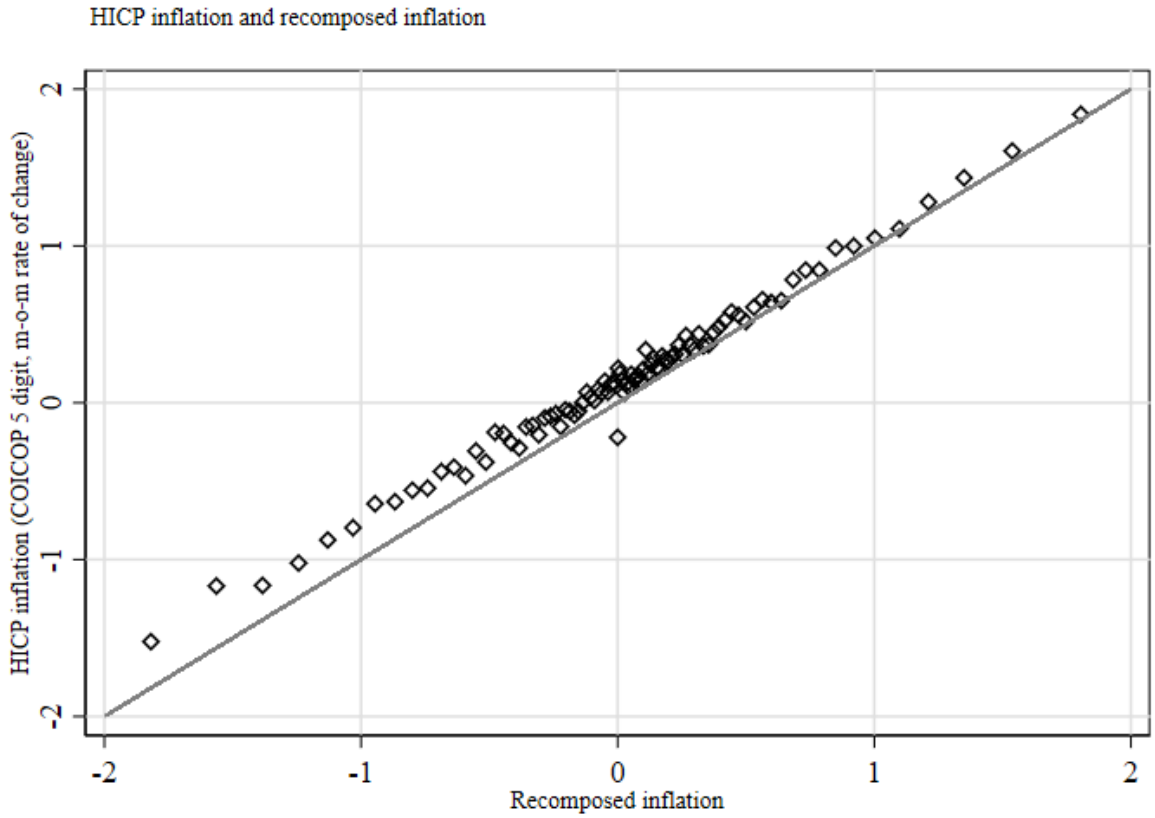
Notes: Coefficient plots from weighted panel regressions with COICOP, country, and time fixed effects and dummy for VAT changes in France (04/00, 01/12, 01/14), Italy (09/11), Slovakia (01/11), and Spain (09/12, 07-09/10), with country weights in euro area HICP (2017-2020 average) and robust standard 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. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter. Outliers adjusted beforehand.

Figure A19: Seasonal Patterns, Annual Changes, and Effect of Sales: Services



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. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Results excluding sales are based on 1) NSI sales flag if available or 2) common sales filter. Outliers adjusted beforehand.

Figure A20: Recomposed and HICP Inflation



Notes: The figure compares the recomposed inflation, as in Equation 3, and m-o-m HICP inflation at the COICOP 5-digit level. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Statistics are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries.

Table A20: Cross-Correlation between Recomposed Inflation and Its Components

	f_{jt}	dp_{jt}	f_{jt}^{+}	f_{jt}^{-}	dp_{jt}^{+}	dp_{jt}^{-}	f_{jt}^{+}/f_{jt}
EURO AREA							
π_{jt} (incl. sales)	-0.160	0.793	0.373	-0.612	0.065	-0.381	0.557
π_{jt} (excl. sales)	0.018	0.628	0.340	-0.378	0.122	-0.180	0.405
By Sector							
Unprocessed Food	-0.000	0.909	0.426	-0.419	0.121	-0.178	0.674
Processed Food	0.083	0.796	0.486	-0.448	0.070	-0.067	0.634
NEIG	-0.367	0.819	0.554	-0.804	0.172	-0.481	0.695
Services	0.148	0.571	0.372	-0.272	0.132	-0.196	0.417
COUNTRY							
Austria	-0.184	0.762	0.286	-0.602	-0.044	-0.359	0.547
Belgium	0.012	0.656	0.310	-0.301	0.129	-0.163	0.310
France	-0.306	0.836	0.260	-0.706	-0.260	-0.534	0.576
Germany	-0.109	0.806	0.294	-0.494	-0.171	-0.438	0.607
Greece	-0.034	0.678	0.529	-0.629	0.046	-0.083	0.565
Italy	-0.184	0.861	0.667	-0.752	0.555	-0.299	0.630
Lithuania	0.024	0.709	0.387	-0.383	0.082	-0.251	0.585
Luxembourg	-0.075	0.780	0.410	-0.528	0.171	-0.185	0.496
Latvia	0.211	0.718	0.579	-0.235	0.223	-0.159	0.554
Slovakia	0.119	0.653	0.424	-0.236	0.143	-0.165	0.502
Spain	-0.156	0.784	0.422	-0.640	0.328	-0.319	0.644

Notes: The table shows correlations between recomposed inflation (π_{jt}), as in Equation 3, and its components (all product-country level statistics are pooled together, statistics are weighted using product-country HICP weights). 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 and Slovakia). Seasonal sales are excluded in the Belgian dataset but temporary promotions are included. Results excluding sales are based on the NSI sales flag if available, and the common sales filter otherwise.

F More on Local Projection Exercises

F.1 Data Sources

This section documents the main sources for shocks used in the local projection exercises.

Monetary policy:

The series of euro area monetary policy shocks used is the one estimated by Jarociński and Karadi (2020) (available over the period March 1999 - December 2016). IRFs are rescaled to produce an inflation reaction to a positive surprise in the 3-month EONIA swap rate of 25 basis points.

The shock series has been downloaded from AEJ Macro web site (additional materials - Data Set of Jarociński and Karadi (2020)).

Oil:

The oil shock is the shock to the growth rate of monthly world crude oil production, estimated using the methodology of Baumeister and Hamilton (2019). The shock series (vintage ending in August 2020) has been downloaded from Christiane Baumeister's web site:

https://sites.google.com/site/cjsbaumeister/research.

Global demand:

The global demand shock is the shock to economic activity estimated using the methodology of Baumeister and Hamilton (2019). The shock series (vintage ending in August 2020) has been downloaded from Christiane Baumeister's web site:

https://sites.google.com/site/cjsbaumeister/research.

In both cases, the IRFs give the price reaction to a 1-standard deviation positive shock to the oil supply or to the global demand.

VAT:

VAT shocks are defined as the monthly rate difference between the HICP and the HICP at constant taxes. Per definition, the National Statistical Institutes (NSI's) assume full and immediate pass-through of tax changes, thus any difference in inflation rates is equal to the tax change. The series are available at the COICOP-5 level post 2015, while prior to 2015 they are approximated by the same series at the COICOP-4 level. The data are available at: https://ec.europa.eu/eurostat/databrowser/view/prc_hicp_cmon/default/table?lang=en. The exception to the above data source are France and Greece, for which, more complete data where avail-

able. Specifically, for the former, historical VAT rates and rate changes, have been provided for France at the COICOP-5 level while for the latter, historical data at the product level, have been provided by the Bank of Greece and were aggregated up to the COICOP-5 level. Out of 1402 non-zero VAT changes in the total sample, about 80 percent are from the three countries: France, Spain and Greece. By contrast, Belgium, Germany and Slovakia did not have a VAT change for the relevant period and are thus excluded.

In this exercise, the IRF gives the price reaction to a 1-pp increase in the VAT rate.

Local demand:

Unemployment - first difference of monthly seasonally adjusted (not calendar adjusted) unemployment rate measured as percentage of active population; EUROSTAT table *une_rt_m*.[65]

In this exercise, the IRF gives the price reaction to a 1-pp increase in the unemployment rate.

F.2 Decomposition of the Effects on IRF

In this subsection, we document how a shock is transmitted through the different price adjustment margins (intensive and extensive margins). Recall that for each shock S_t, the local-linear projection is:

$$\pi_{j,t,t+h} = \alpha_{j,h} + \alpha_{m,h} + \beta_h S_t + \gamma_y X_{j,t} + \epsilon_{j,t_h} \tag{A8}$$

where $\pi_{j,t,t+h}$ is the cumulative inflation for a product-country specific j between $t-1$ and $t+h$ (calculated as the sum of monthly inflation rates between date t and $t+h$ $= \sum_{\tau=0}^{h} \pi_{j,t+\tau,t+\tau+1}$), $\alpha_{j,m,h}$ are fixed-effects and X_{jt} are control variables. The β_h are the IRF of interest.

In our empirical exercise, we then calculate for each product j, monthly recomposed inflation rates, a first counterfactual inflation rate where frequency is constant to its average and inflation varies with size $\pi^{\bar{f}}_{jt} = f_{j.} \times dp_{jt}$ and a second one where the average size is constant $\pi^{\bar{dp}}_{jt} = f_{jt} \times dp_{j.}$. We can approximate counterfactual inflation rates over the horizon t - t+h by summing the monthly rates:

$$\pi^{\bar{f}}_{j,t,t+h} = \sum_{\tau=0}^{h} \pi^{\bar{f}}_{j,t+\tau-1,t+\tau} = f_{j.} \sum_{\tau=0}^{h} dp_{j,t+\tau-1,t+\tau} \tag{A9}$$

We can construct the same cumulative counterfactual inflation rate when assuming

[65] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=une_rt_m&lang=en

constant size:

$$\pi^{\bar{dp}}_{j,t,t+h} = \sum_{\tau=0}^{h} \pi^{\bar{dp}}_{j,t+\tau-1,t+\tau} = dp_{j.} \sum_{\tau=0}^{h} f_{j,t+\tau} \tag{A10}$$

We then use these two variables as left-hand side variables in the local projection estimations.

As previous decomposition, in our empirical exercises, we will compute for each product j, a counterfactual inflation rate where frequencies of price increases and decreases are constant to their average and inflation varies with sizes of price increases and decreases $\pi^{\bar{f}^+,\bar{f}^-}_{jt} = f^+_{j.} \times dp^+_{jt} - f^-_{j.} \times dp^-_{jt}$ and a second one where the average sizes of increases and decreases are constant $\pi^{\bar{dp}^+,\bar{dp}^-}_{jt} = f^+_{jt} \times dp^+_{j.} - f^-_{jt} \times dp^-_{j.}$. We can approximate counterfactual inflation rates over the horizon t - t+h by summing the monthly rates:

$$\pi^{\bar{f}^+,\bar{f}^-}_{j,t,t+h} = \sum_{\tau=0}^{h} \pi^{\bar{f}^+,\bar{f}^-}_{j,t+\tau-1,t+\tau} = f^+_{j.} \sum_{\tau=0}^{h} dp^+_{j,t+\tau-1,t+\tau} - f^-_{j.} \sum_{\tau=0}^{h} dp^-_{j,t+\tau-1,t+\tau} \tag{A11}$$

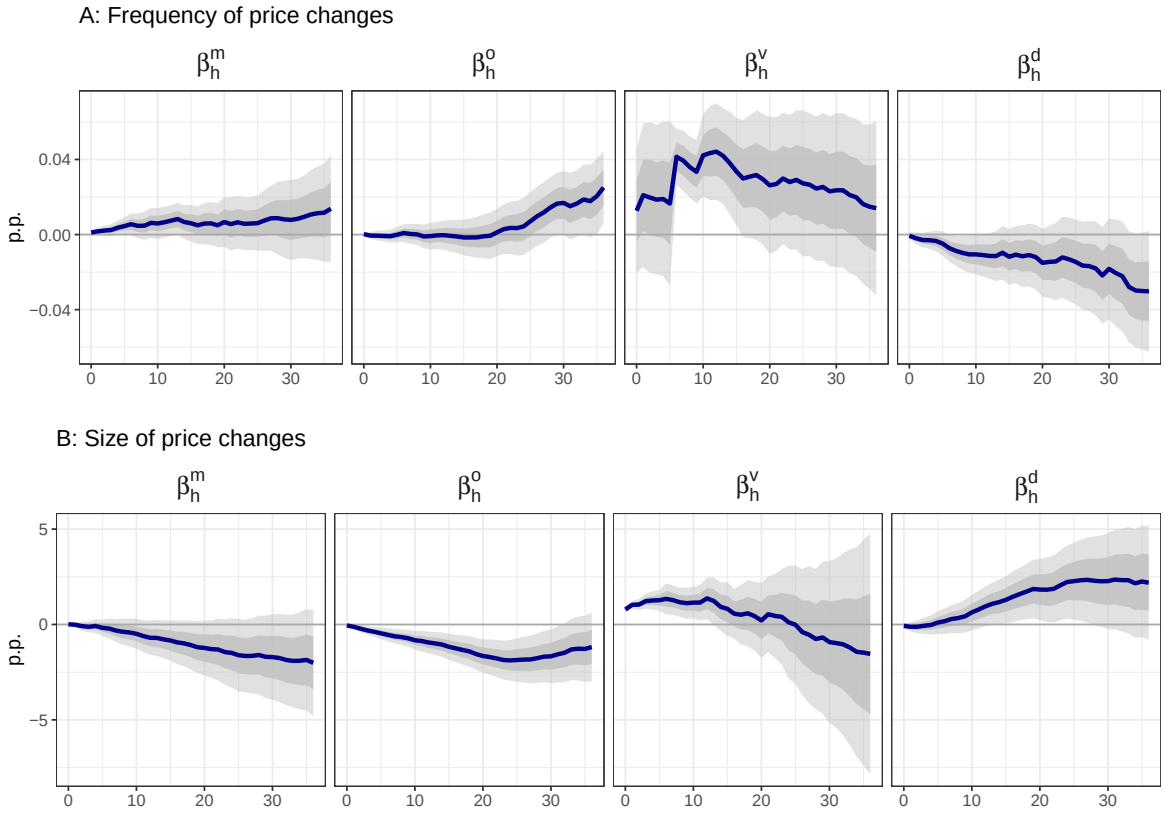
We can construct the same cumulative counterfactual inflation rate when assuming constant size:

$$\pi^{\bar{dp}^+,\bar{dp}^-}_{j,t,t+h} = \sum_{\tau=0}^{h} \pi^{\bar{dp}^+,\bar{dp}^-}_{j,t+\tau-1,t+\tau} = dp^+_{j.} \sum_{\tau=0}^{h} f^+_{j,t+\tau} - dp^-_{j.} \sum_{\tau=0}^{h} f^-_{j,t+\tau} \tag{A12}$$

We then use these two variables as left-hand side variables in the local projection estimations.

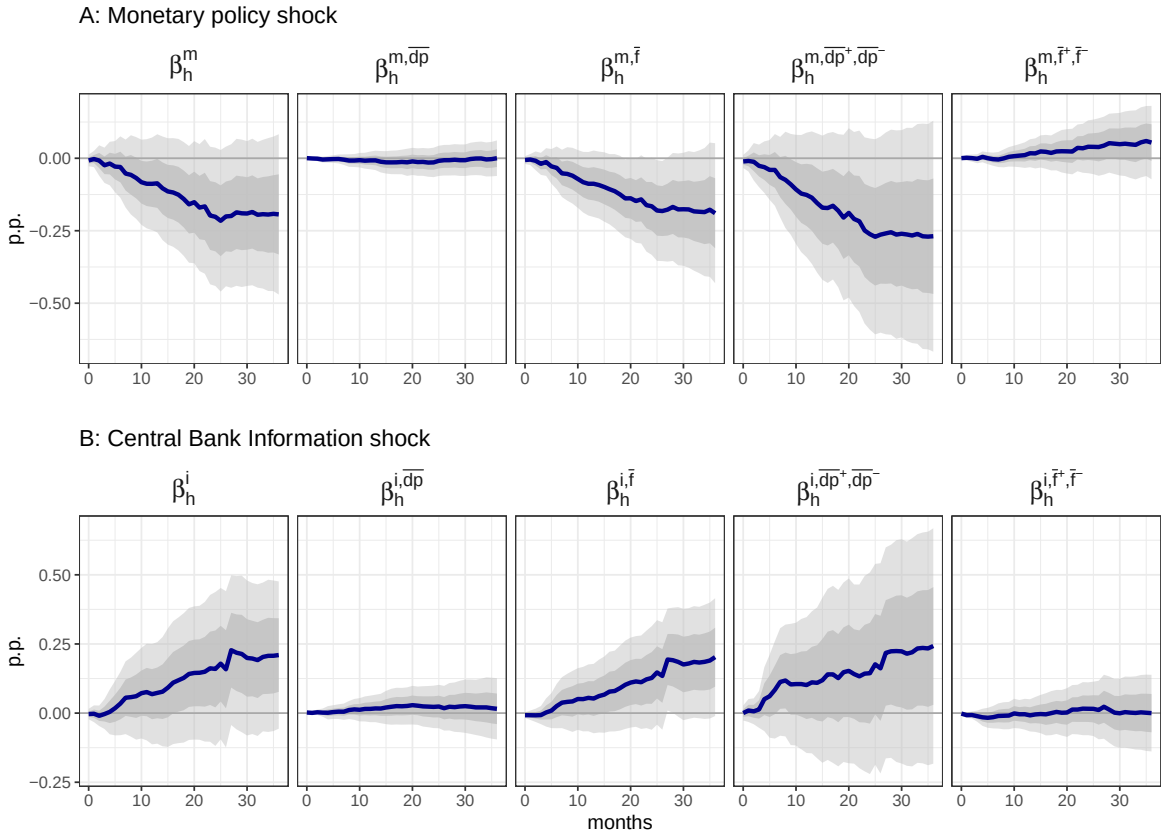
F.3 Impulse Response Functions - Robustness

Figure A21: Conditional Responses of Frequency and Size of Price Adjustment to Positive Aggregate Shocks



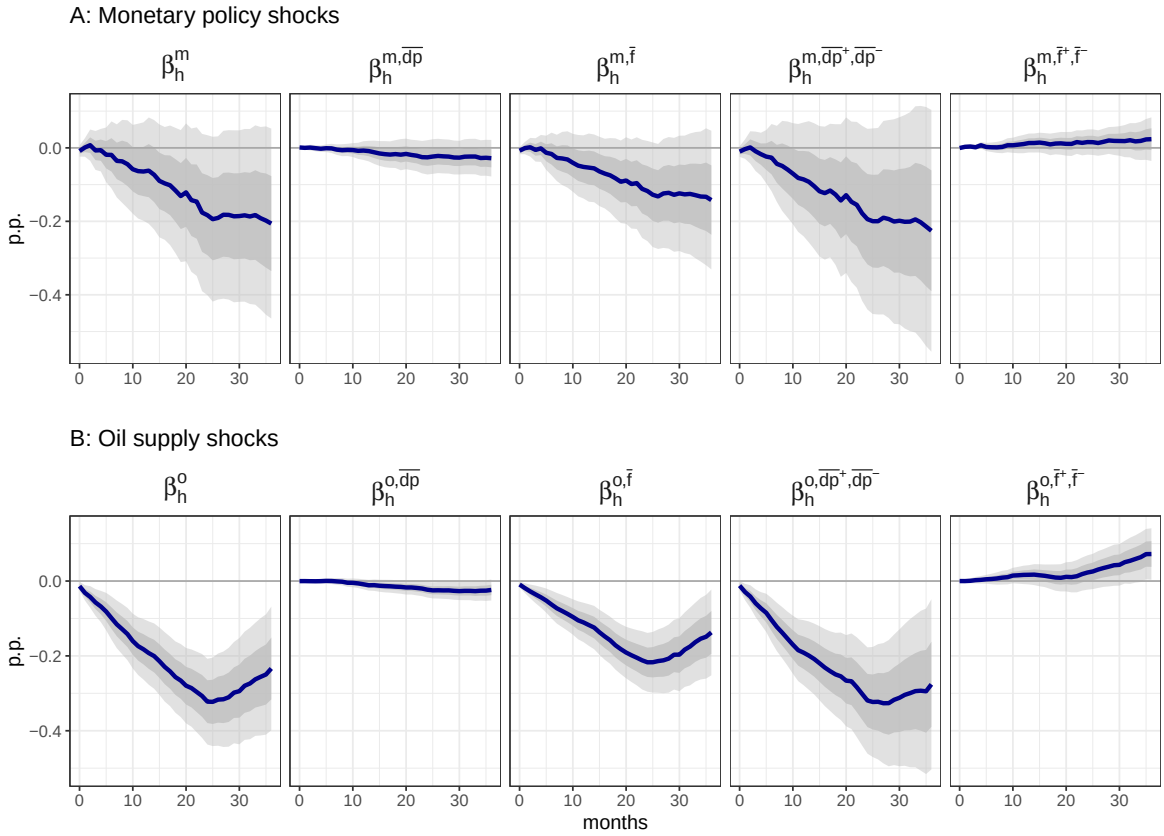
Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Superscripts $x \in \{m, o, v, d\}$ represent the monetary, oil, VAT and demand shocks respectively. The models are specified in equation (11). The light and dark gray areas correspond to one and two standard error bands, assuming calendar-based clusters.

Figure A22: Conditional Responses to Monetary Shocks - Monetary Policy Shock vs Central Bank Information Shock



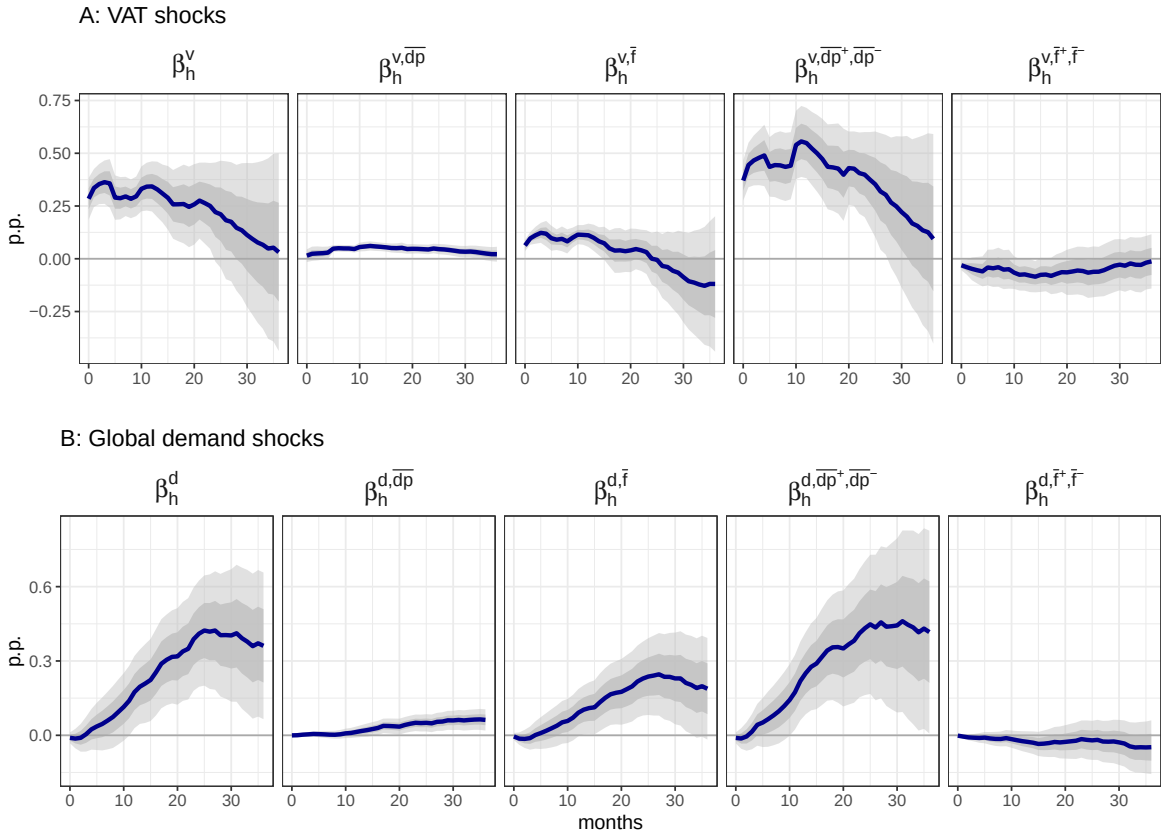
Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Superscripts $x \in \{m, i\}$ represent the monetary policy shocks (as in the baseline case) and CB information shock respectively. The models are specified in equation (11). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x, counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{dp}}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{dp}^+,\bar{dp}^-}$ 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.

Figure A23: Conditional Responses to Positive Aggregate Shocks - excluding Sales - Monetary Policy and Oil Supply Shocks



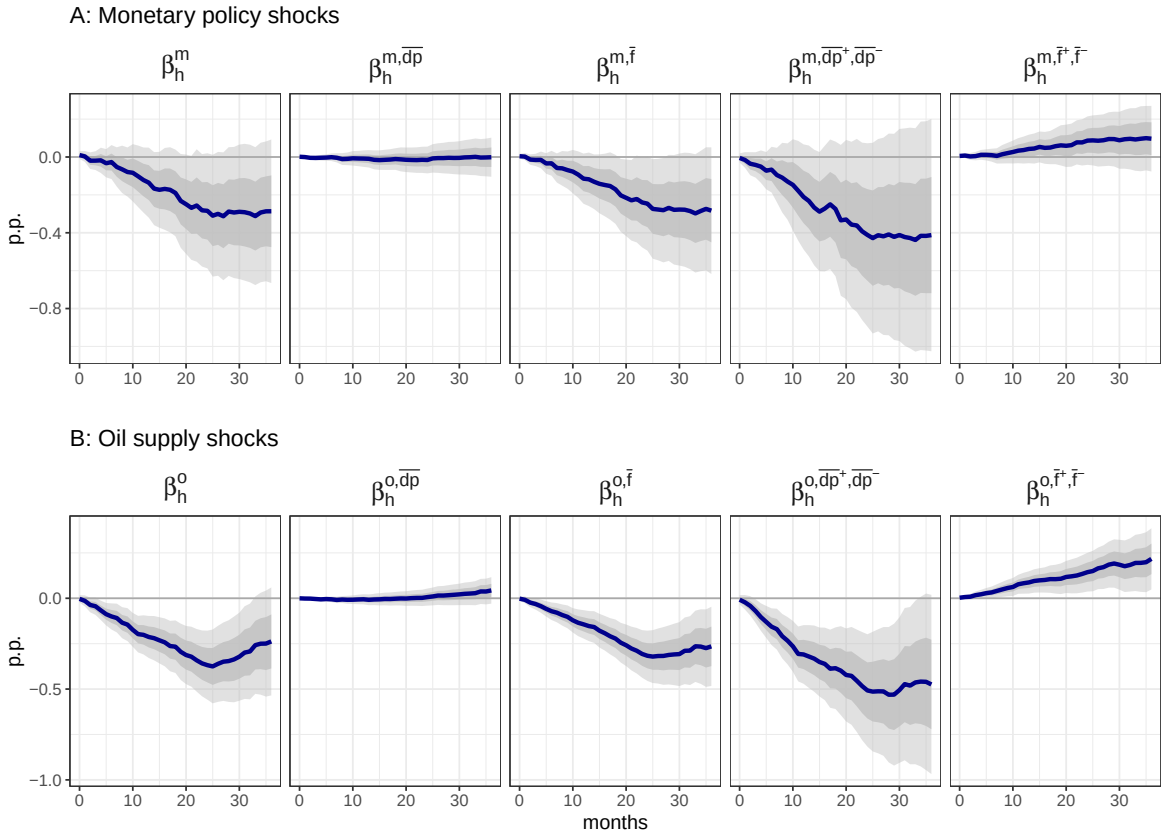
Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Superscripts $x \in \{m, o\}$ represent the monetary and oil shocks respectively. The models are specified in equation (11). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x, counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{dp}}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{dp}^+,\bar{dp}^-}$ 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.

Figure A24: Conditional Responses to Positive Aggregate Shocks - excluding Sales - VAT and Global Demand Shocks



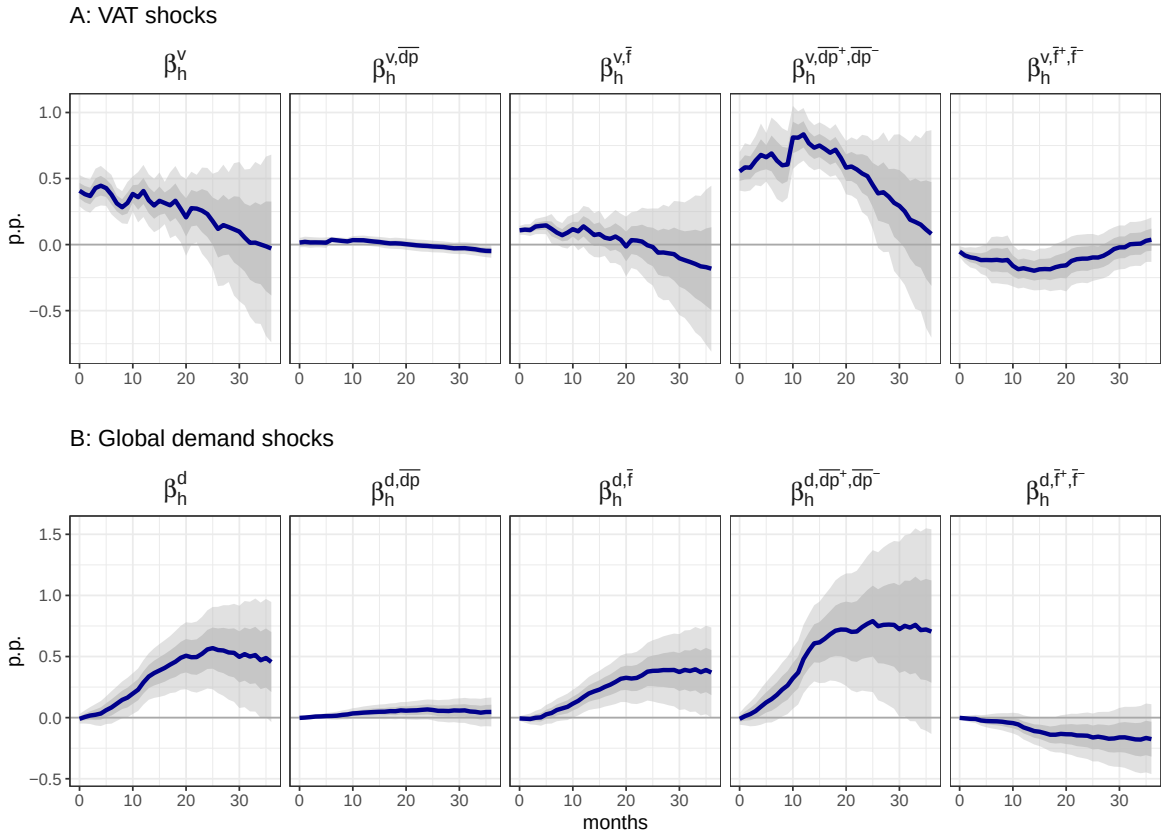
Notes: Local projections are based on the country-specific period and on products that are common to at least 3 of the 4 largest countries. Price changes due to replacement are excluded beforehand (except Greece and Slovakia). Superscripts $x \in \{v, d\}$ represent the VAT and global demand shocks respectively. The models are specified in equation (11). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x, counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{dp}}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{dp}^+,\bar{dp}^-}$ 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.

Figure A25: Conditional Responses to Positive Aggregate Shocks - Three Countries with Longer Sample (AT, FR, GR) - Monetary Policy and Oil Supply 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 $x \in \{m, o\}$ represent the monetary and oil supply shocks respectively. The models are specified in equation (11). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x, counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{dp}}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{dp}^+,\bar{dp}^-}$ 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.

Figure A26: Conditional Responses to Positive Aggregate Shocks - Three Countries with Longer Sample (AT, FR, GR) - VAT and 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 (11). In the order of the panels, the coefficients correspond to: The recomposed inflation β_h^x, counterfactual inflation assuming constant sizes of price changes $\beta_h^{x,\bar{dp}}$, counterfactual inflation assuming constant frequency of price changes $\beta_h^{x,\bar{f}}$, counterfactual inflation assuming constant sizes of price increases and decreases $\beta_h^{x,\bar{dp}^+,\bar{dp}^-}$ 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.