Online Appendix for

Inflation and price adjustments: micro evidence from Norwegian consumer prices 1975–2004

by Fredrik Wulfsberg, Oslo Business School

November 3, 2015

A. Data

Today the Norwegian CPI is computed from monthly data for 900 representative goods and services from approximately 2,200 firms. Once a year the representative goods and services are revised. The sample of firms is rotated so that a firm is included for a maximum of six years (72 months).

The firms report price data monthly, either by completed forms or by providing scanner data. The quality of the observations are evaluated and revised before being used to construct the CPI, which takes account of the revision status – meaning whether or not the price observation is imputed or corrected, status of the product itself, and whether the observation is used in the CPI. There are missing observations in the sample resulting in breaks in the trajectories.

Products represented by an index are excluded from the data set used in this paper. I removed 174,900 observations when the product is not offered anymore, has changed in quality from the previous month, or is a new product.

The number of monthly observations varies between 17,606 and 46,128. Figure A1, left panel, shows that the number of observations per month declines steadily, from an average of 42,815 in 1975 to 25,762 in 1990, then increasing to 38,836 in 2004. The right panel of Figure A1 shows that there is no systematic variation between different months. Figure A2 illustrates the number of observations by COICOP groups over time, with the number of observations in 2004 appearing on the right.
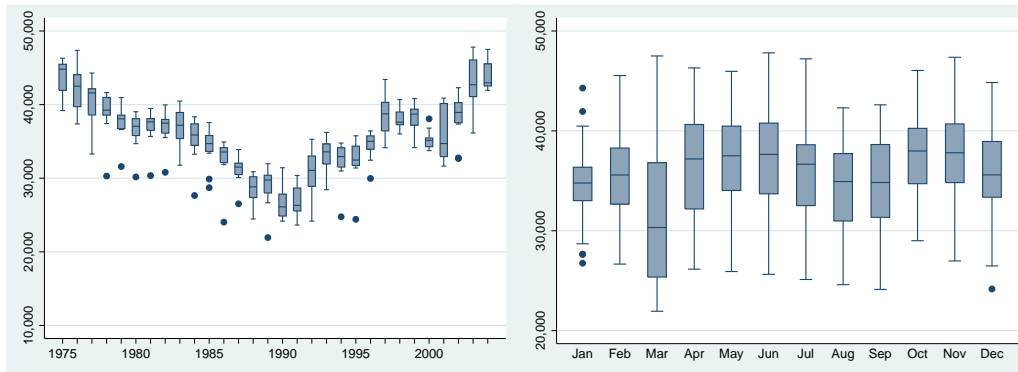

FIGURE A1. THE VARIATION IN THE NUMBER OF OBSERVATIONS BY YEAR (LEFT) AND BY MONTH (RIGHT)
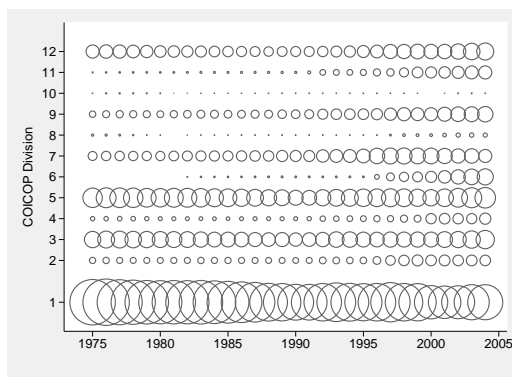
FIGURE A2. THE DISTRIBUTION OF OBSERVATIONS ACROSS COICOP GROUPS OVER TIME.

B. Heterogeneity

Figure B1 shows the distribution of the frequency of price adjustments f_i. The distribution is skewed to the right with a mean and median frequency of 21.9 and 14.3 percent (as reported in Table 1).

Table B1 reports average frequencies and duration estimates for the high- and low-inflation periods for twelve COICOP divisions.[19] The mean duration varies between 3.8 months for 1 *Food and beverages* in the high inflation period and 39.6 months for 12 *Miscellaneous goods and services* in the low inflation period.

The frequency of price changes is higher in the high-inflation period than in the low-inflation period for all COICOP divisions except for 3 *Clothing and footwear*, 8 *Communication*, and 9 *Recreation and culture.* For all categories the frequency of

---

[19]COICOP is an acronym for Classification of Individual Consumption According to Purpose. Each product is classified at the five-digit COICOP level (see United Nations, 2000).
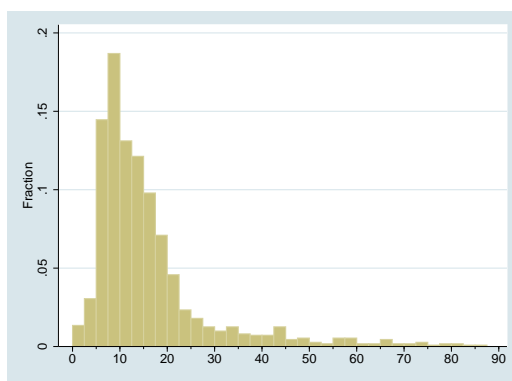

FIGURE B1. THE DISTRIBUTION OF THE FREQUENCY OF PRICE CHANGES IN PERCENT ACROSS PRODUCTS.

Table B1—Mean frequency of price changes and mean price duration in months by coicop divisions (two-digit level).

coicop *Division*	*Period*	*n*	*Products*	f^+	f^-	*D*
1 Food and non-alcoholic	1975–1989	4,229,361	264	22.6	11.9	3.8
beverages	1990–2004	3,031,220	267	13.4	10.2	5.8
2 Alcoholic beverages, tobacco	1975–1989	87,036	41	16.0	1.6	5.4
and narcotics	1990–2004	188,042	42	11.0	3.2	7.1
3 Clothing and footwear	1975–1989	558,401	104	7.5	4.5	8.6
	1990–2004	530,975	133	5.7	8.3	7.8
4 Housing, water, electricity,	1975–1989	39,829	26	16.2	2.8	6.3
gas and other fuels	1990–2004	139,542	29	13.5	9.6	8.4
5 Furnishings, household	1975–1989	774,272	130	10.3	3.2	8.0
equipment and routine	1990–2004	693,303	137	7.3	5.0	9.1
household maintenance						
6 Health	1975–1989	3,070	15	8.8	0.7	11.7
	1990–2004	199,018	52	7.5	2.0	12.6
7 Transport	1975–1989	228,883	111	29.9	7.3	4.2
	1990–2004	458,504	86	23.1	11.6	16.0
8 Communication	1975–1989	3,131	10	4.0	2.6	21.2
	1990–2004	14,885	15	2.6	8.2	13.7
9 Recreation and culture	1975–1989	131,627	88	9.7	3.2	9.7
	1990–2004	344,534	120	9.2	4.9	9.7
10 Education	1975–1989	1,476	7	8.4	0.4	11.6
	1990–2004	990	7	6.7	0.4	13.9
11 Restaurants and hotels	1975–1989	7,914	15	23.5	1.7	4.6
	1990–2004	184,723	44	5.9	1.7	14.7
12 Miscellaneous goods and	1975–1989	305,800	58	15.8	1.9	6.6
services	1990–2004	414,329	96	6.9	2.7	39.6
Main categories						
Non-durable goods	1975–1989	5,181,731	437	22.0	9.3	4.2
	1990–2004	4,280,974	490	17.3	11.8	5.9
Durable goods	1975–1989	178,431	101	23.6	4.5	5.2
	1990–2004	346,304	109	14.0	6.9	6.3
Semi-durable goods	1975–1989	889,757	184	7.5	3.5	9.7
	1990–2004	1,046,342	230	5.7	6.2	9.4
Services	1975–1989	120,881	147	12.8	1.7	10.6
	1990–2004	526,445	199	7.3	2.6	25.6

Note: n is the number of observations, f^+ is the rate of price increases, f^- is the rate of price decreases, and D is the mean implied duration.

price increases is higher in the high-inflation period, in particular for 11 *Restaurants and hotels* and 1 *Food*. In contrast the frequency of price decreases is higher in the low-inflation period for all categories but 1 *Food*, 10 *Education*, and 11 *Restaurants and hotels*. In particular the frequency of price decreases was thrice

as high for 4 *Housing and fuels* and 8 *Communication* products, and almost twice as high in the low-inflation period for 3 *Clothing and footwear*.

The COICOP system also classify the products as *non-durable goods, semidurable goods, durable goods*, and *services*.[20] The bottom panel of Table B1 shows that the frequency of price increases are higher in the high-inflation period and that the frequency of price decreases is higher in the low-inflation period for all types of goods. The net effect is that duration is more than one month higher for *durables* and *non-durables* in the low-inflation period. For *services* the mean duration is 25.6 months in the low-inflation period compared to 10.6 months in the high-inflation period.

There are substantial differences between the COICOP divisions also regarding the size of price changes, see Table B2. For example when inflation is low, the mean sizes of the price increases and decreases vary from 44.2 and –29.5 percent for 3 *Clothing and footwear* to 4.4 and –4.0 percent for 7 *Transport*. For all COICOP divisions the absolute size of price decreases were higher in the low-inflation, particularly for 10 *Education* and 11 *Restaurants and hotels*. Price increases were also higher in the low-inflation period for all COICOP divisions but for 7 *Transport* and 10 *Education*.

In the bottom panel for the main categories we see that the absolute size of price increases are larger in the low-inflation period than in the high-inflation period in particular for *Services* and for the absolute size of price decreases for *Semi-durables*. The latter category change prices by the largest amounts.

There is also a lot of variation in the size of price changes within each category. Figure B2 shows histograms of individual non-zero price changes for each COICOP division. All histograms are single peaked, but the degree of kurtosis (peakedness) differs.

Table B3 and B4 report estimates for the main components of the Harmonized Index of Consumer Prices (HICP): *energy, unprocessed food, processed food, non-energy industrial goods*, and *services*. Although there are big differences between types of products, they share the features that the frequency of price changes is higher in the high-inflation period than in the low-inflation period and that the absolute size of price changes is higher when inflation is low.

Table B5 reports frequency and size statistics for the less aggregated COICOP groups and classes for the whole period. *Vegetables, fruit* and *petrol* are examples of products with frequent price changes, while various services experience less frequent price changes.

---

[20]The distinction between non-durable goods and durable goods is based on whether the goods can be used only once, or repeatedly over a period of considerably more than one year. Semi-durable goods differ from durable goods in that their expected lifetime of use, though more than one year, is often significantly shorter and their purchasers price is substantially less.

TABLE B2—THE MEAN ABSOLUTE SIZE OF PRICE INCREASES AND DECREASES BY COICOP DIVISIONS, MAIN CATEGORIES AND HIGH AND LOW INFLATION PERIODS. PERCENT.

	Increases		Decreases	
COICOP *Division*	*1975–1989*	*1990–2004*	*1975–1989*	*1990–2004*
1 Food and non-alcoholic beverages	11.5	13.6	−10.6	−11.9
2 Alcoholic beverages, tobacco and narcotics	4.5	6.0	−3.6	−6.1
3 Clothing and footwear	25.5	44.2	−22.0	−29.5
4 Housing, water, electricity, gas and other fuels	5.9	10.8	−4.9	−9.2
5 Furnishings, household equipment and routine household maintenance	11.9	14.5	−10.3	−12.7
6 Health	7.1	9.5	−5.7	−7.1
7 Transport	7.4	4.4	−3.5	−4.0
8 Communication	5.8	7.8	−4.7	−9.5
9 Recreation and culture	9.9	13.7	−8.7	−11.6
10 Education	9.6	6.2	−2.8	−15.5
11 Restaurants and hotels	3.7	13.3	−2.6	−12.4
12 Miscellaneous goods and services	8.3	9.9	−8.7	−10.1
Main categories				
Non-durable goods	8.0	8.5	−9.6	−10.6
Durable goods	6.1	7.1	−7.9	−9.4
Semi-durable goods	17.5	20.5	−23.7	−33.8
Services	5.3	9.6	−8.2	−8.8

TABLE B3—WEIGHTED MEAN FREQUENCY OF PRICE CHANGES AND DURATION BY HICP SECTORS.

| HICP	*Period*	*n*	*Products*	f^+	f^-	*D*
Unprocessed food	1975–1989	1,941,510	139	30.4	16.9	2.1 (2.1)
	1990–2004	1,229,353	128	18.7	15.8	3.8 (4.9)
Processed food	1975–1989	2,374,887	166	15.2	5.7	5.4 (3.0)
	1990–2004	1,989,909	181	9.6	5.1	7.3 (4.1)
Energy	1975–1989	39,954	13	27.4	10.4	3.5 (3.3)
	1990–2004	74,561	12	28.9	22.5	4.4 (7.1)
Non energy industrial goods	1975–1989	1,666,925	366	16.0	4.0	7.1 (4.6)
	1990–2004	2,097,145	465	10.9	6.4	7.6 (5.0)
Services	1975–1989	347,524	185	12.8	1.8	10.4 (12.3)
	1990–2004	809,097	242	7.3	2.6	24.9 (74.5)
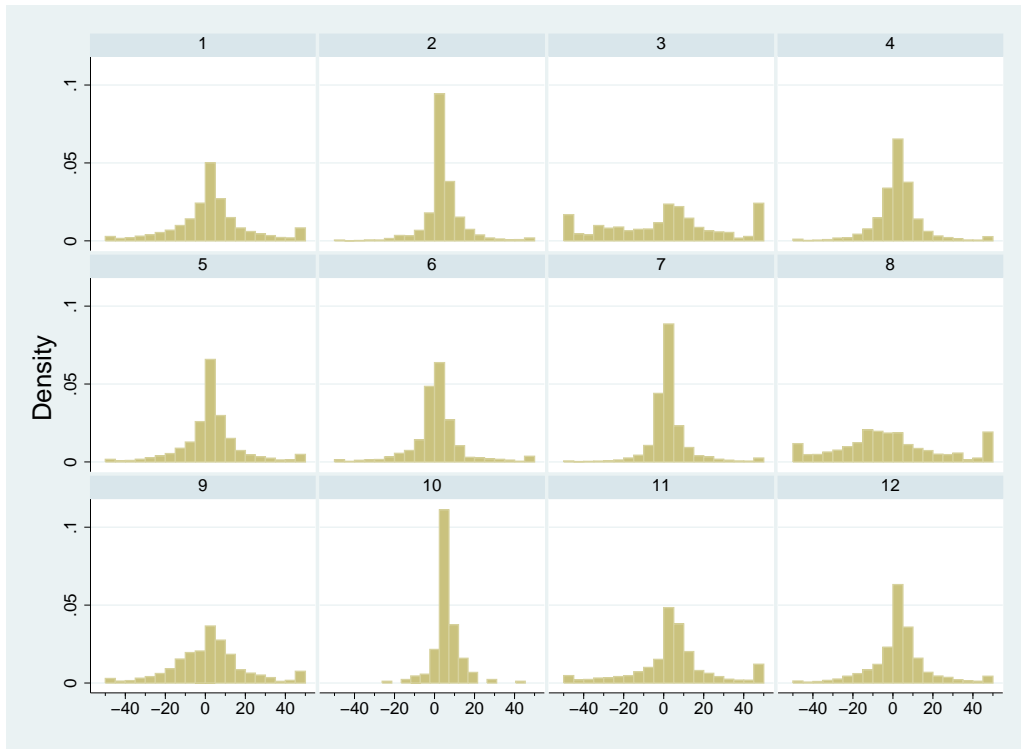
FIGURE B2. HISTOGRAM OF ALL NON-ZERO PRICE CHANGES IN PERCENT BY COICOP DIVISION. THE DIS-
TRIBUTIONS ARE TRUNCATED AT –50 AND 50 PERCENT.

TABLE B4—THE MEAN ABSOLUTE SIZE OF PRICE INCREASES AND DECREASES BY HICP TYPES OF GOODS.

	Increases		Decreases	
HICP	1975–1989	1990–2004	1975–1989	1990–2004
Unprocessed food	12.1	13.0	−14.5	−17.8
Energy	2.0	4.0	−7.0	−7.5
Processed food	8.1	8.8	−8.8	−9.2
Non energy industrial goods	11.2	12.6	−14.2	−18.5
Services	5.6	9.6	−8.5	−9.0

Table B5—: Mean frequency of price changes and mean price duration in months by coicop groups (three-digit level) and classes (four-digit level).

coicop Group/Class			n	f	f^+	D	dp^+	dp^-
11	Food		6,629,455	31.4	20.0	4.4 (4.2)	11.9	−11.0
	111	Bread and cereals	1,158,122	16.7	11.6	6.0 (1.8)	10.9	−11.6
	112	Meat	1,080,387	42.1	27.6	2.6 (5.0)	9.2	−9.7
	113	Fish and seafood	750,056	25.2	15.7	3.7 (1.1)	12.5	−11.7
	114	Milk, cheese and eggs	739,958	19.2	13.1	5.7 (2.1)	8.3	−6.8
	115	Oils and fats	213,994	25.5	16.3	3.5 (0.9)	8.8	−8.1
	116	Fruit	455,828	52.1	28.7	2.4 (2.9)	23.2	−18.3
	117	Vegetables	902,300	53.8	31.8	2.4 (2.5)	21.9	−18.7
	118	Sugar, jam, honey, chocolate and confectionery	695,046	13.6	8.6	9.0 (5.2)	12.0	−10.8
	119	Food products n.e.c.	633,764	15.0	10.1	6.7 (2.1)	9.7	−9.1
12	Non-alcoholic beverages		631,126	26.7	16.3	4.3 (2.6)	11.1	−10.4
	121	Coffee, tea and cocoa	246,527	38.7	22.1	2.3 (1.3)	10.6	−8.7
	122	Mineral waters, soft drinks, fruit and vegetable juices	384,599	16.0	11.0	6.2 (2.0)	11.5	−11.9
21	Alcoholic beverages		124,910	18.2	14.5	5.1 (1.0)	4.6	−4.9
	211	Spirits	2,546	20.5	16.5	4.4 (0.3)	3.4	−2.8
	212	Wine	2,034	16.3	13.4	5.7 (0.7)	3.9	−4.4
	213	Beer	120,330	17.2	13.4	5.4 (1.1)	5.6	−6.5
22	Tobacco		150,168	11.1	9.8	8.6 (1.4)	7.6	−7.0
31	Clothing		917,552	12.6	6.7	8.5 (3.6)	33.3	−25.3
	311	Clothing materials	20,997	7.2	5.2	13.8 (2.5)	18.8	−20.9
	312	Garments	807,201	13.5	6.7	7.6 (3.0)	36.3	−27.5
	313	Other articles of clothing and clothing accessories	73,983	8.1	6.3	12.6 (3.5)	20.7	−14.8
	314	Cleaning, repair and hire of clothing	15,371	18.7	15.8	7.7 (5.3)	7.4	−10.0
32	Footwear		171,824	11.8	6.2	8.5 (2.6)	28.1	−24.9
	321	Shoes and other footwear	163,261	11.9	6.2	8.4 (2.5)	28.4	−25.1
	322	Repair and hire of footwear	8,563	7.0	5.4	14.1 (2.2)	12.8	−15.0
41	Actual rentals for housing		49,926	7.4	5.1	13.0 (.)	13.7	−10.2
43	Maintenance and repair of the dwelling		103,072	20.2	15.2	5.9 (3.0)	8.2	−7.0
	431	Materials for the maintenance and repair of the dwelling	103,072	20.2	15.2	5.9 (3.0)	8.2	−7.0
45	Electricity, gas and other fuels		26,373	31.8	17.5	6.7 (8.2)	10.1	−9.1

Table B5 continues on next page.

Table B5 continued.

		COICOP Group/Class	n	f	f^+	D	dp^+	dp^-
	451	Electricity	9,967	29.9	15.5	7.3 (11.6)	10.8	−9.8
	453	Liquid fuels	13,726	53.2	34.2	1.3 (0.1)	4.5	−3.7
	454	Solid fuels	2,473	8.5	6.1	12.3 (3.9)	13.5	−12.0
	455	Heat energy	207	33.8	18.3	2.4 (0.0)	8.2	−6.0
51		Furniture and furnishings, carpets and other floor coverings	154,657	11.7	7.9	8.5 (2.5)	13.1	−12.4
	511	Furniture and furnishings	137,512	11.9	8.1	8.4 (2.6)	13.1	−12.2
	512	Carpets and other floor coverings	17,145	10.8	7.0	9.0 (1.7)	13.2	−13.8
52		Household textiles	108,081	9.7	6.3	10.2 (2.3)	27.6	−18.4
	520	Household textiles	108,081	9.7	6.3	10.2 (2.3)	27.6	−18.4
53		Household appliances	172,532	18.5	11.5	5.3 (1.6)	8.1	−8.0
	531	Major household appliances whether electric or not	137,759	18.2	10.8	5.2 (1.3)	7.6	−8.1
	532	Small electric household appliances	34,578	13.4	8.0	7.1 (1.2)	12.8	−11.4
	533	Repair of household appliances	195	32.2	25.5	2.6 (.)	4.4	−0.6
54		Glassware, tableware and household utensils	153,311	10.3	7.4	10.8 (7.0)	16.0	−16.4
55		Tools and equipment for house and garden	95,651	10.6	7.7	10.6 (5.1)	13.0	−12.3
	551	Major tools and equipment	8,095	10.7	6.3	8.9 (0.6)	12.7	−12.1
	551	Major tools and equipment	8,095	10.7	6.3	8.9 (0.6)	12.7	−12.1
	552	Small tools and miscellaneous accessories	87,556	10.6	7.9	10.9 (5.5)	13.0	−12.4
	552	Small tools and miscellaneous accessories	87,556	10.6	7.9	10.9 (5.5)	13.0	−12.4
56		Goods and services for routine household maintenance	783,343	14.5	10.5	8.1 (6.7)	10.2	−9.1
	561	Non-durable household goods	778,387	15.9	11.2	7.6 (7.6)	10.4	−9.9
	562	Domestic services and household services	4,956	10.0	8.5	9.5 (1.4)	9.8	−6.6
61		Medical products, appliances and equipment	201,344	12.6	8.7	9.2 (5.0)	11.2	−8.2
	611	Pharmaceutical products	184,185	15.3	10.4	6.3 (1.6)	6.2	−4.9
	612	Other medical products	9,109	12.6	8.4	7.8 (2.2)	11.8	−9.0
	613	Therapeutic appliances and equipment	8,050	6.3	4.6	16.2 (4.0)	22.8	−16.0
62		Outpatient services	744	6.9	6.8	14.7 (4.0)	8.1	−1.8
	621	Medical services	199	4.9	4.4	19.9 (.)	10.0	−1.6
	622	Dental services	185	8.0	8.0	12.0 (0.0)	5.1	
	623	Paramedical services	360	6.0	5.8	17.1 (4.2)	13.3	−2.0

Table B5 continued.

		COICOP Group/Class	n	f	f^+	D	dp^+	dp^-
71		Purchase of vehicles	70,360	36.0	30.4	3.0 (1.7)	3.3	−3.5
	711	Motor cars	51,850	37.1	31.6	2.8 (1.4)	2.9	−3.2
	712	Motor cycles	3,767	11.7	6.0	8.1 (0.9)	11.7	−7.6
	713	Bicycles	14,743	13.3	7.6	7.0 (0.3)	11.8	−11.4
72		Operation of personal transport equipment	607,779	46.0	29.8	8.1 (30.6)	5.0	−4.2
	721	Spare parts and accessories for personal transport equipment	270,143	11.4	8.1	8.5 (1.6)	9.2	−8.8
	722	Fuels and lubricants for personal transport equipment	88,142	61.3	39.1	1.3 (1.5)	3.4	−2.8
	723	Maintenance and repair of personal transport equipment	234,542	10.9	8.8	9.3 (3.3)	9.9	−8.9
	724	Other services in respect of personal transport equipment	14,952	35.1	22.8	46.9 (90.7)	4.6	−1.5
73		Transport services	9,248	8.1	7.7	12.7 (3.8)	18.2	−4.6
	731	Passenger transport by railway	2,537	6.9	6.7	14.6 (4.6)	9.4	−7.6
	732	Passenger transport by road	5,497	6.8	6.5	14.7 (3.0)	34.7	−5.7
	733	Passenger transport by air	203	11.0	10.4	8.6 (0.0)	4.1	−3.2
	734	Passenger transport by sea and inland waterway	1,011	8.4	7.7	11.6 (1.4)	6.4	−4.7
81		Postal services	699	4.8	4.8	20.4 (3.0)	13.2	
	810	Postal services	699	4.8	4.8	20.4 (3.0)	13.2	
82		Telephone and telefax equipment	13,816	28.2	10.3	4.1 (3.1)	34.6	−19.8
83		Telephone and telefax services	3,501	8.1	3.2	16.7 (25.6)	5.2	−7.3
91		Audio-visual, photographic and information processing equipment	152,405	18.2	8.7	6.4 (3.5)	17.7	−11.1
	911	Equipment for the reception, recording and reproduction of sound and pictures	75,610	18.0	8.0	5.5 (1.9)	14.0	−10.0
	912	Photographic and cinematographic equipment and optical instruments	18,864	15.4	6.4	7.4 (4.0)	18.5	−12.3
	913	Information processing equipment	12,483	26.2	9.4	4.1 (3.0)	20.8	−14.2
	914	Recording media	45,249	8.7	5.3	11.4 (2.5)	29.8	−14.2
	915	Repair of audio-visual, photographic and information processing equipment	199	32.6	25.0	2.5 (0.0)	2.2	−0.5
92		Other major durables for recreation and culture	8,895	7.8	7.0	12.6 (2.4)	9.0	−8.7
	921	Major durables for outdoor recreation	1,216	7.9	7.8	12.2 (1.2)	7.2	−2.7
	922	Musical instruments and major durables for indoor recreation	7,679	7.5	4.4	14.0 (4.4)	14.4	−13.1
93		Other recreational items and equipment, gardens and pets	168,794	13.9	7.5	10.4 (8.6)	18.6	−15.8

Table B5 continues on next page.

Table B5 continued.

		COICOP Group/Class	n	f	f^+	D	dp^+	dp^-
	931	Games, toys and hobbies	18,438	8.2	4.8	12.5 (3.1)	19.9	−15.9
	932	Equipment for sport, camping and open-air recreation	87,083	8.0	5.3	16.2 (13.0)	17.2	−16.0
	933	Gardens, plants and flowers	47,300	24.2	11.6	4.8 (3.7)	22.0	−17.4
	934	Pets and related products	15,973	11.4	7.0	8.4 (1.2)	8.1	−10.1
94		Recreational and cultural services	29,807	9.0	7.9	12.7 (6.2)	9.8	−9.7
	941	Recreational and sporting services	727	11.9	11.1	9.4 (5.1)	5.6	−2.8
	942	Cultural services	29,080	7.4	6.3	14.4 (6.3)	11.9	−15.0
95		Newspapers, books and stationery	116,061	16.3	14.8	9.3 (6.3)	9.2	−13.5
	951	Books	36,860	7.1	5.9	14.3 (3.8)	12.5	−14.5
	952	Newspapers and periodicals	42,015	24.5	22.9	4.4 (2.9)	4.4	−9.3
	954	Stationery and drawing materials	37,186	6.5	4.8	16.0 (4.8)	19.7	−16.7
96		Package holidays	199	10.3	7.7	9.2 (.)	4.7	−1.9
101		Pre-primary and primary education	235	7.2	6.7	13.3 (.)	9.9	−0.0
102		Secondary education	777	7.4	7.1	13.0 (0.8)	7.8	−18.0
104		Tertiary education	1,454	7.8	7.3	12.3 (0.9)	5.6	−8.6
111		Catering services	154,295	6.8	5.5	15.2 (4.8)	12.5	−11.7
	1111	Restaurants, cafes and the like	141,037	6.9	5.6	15.2 (5.0)	12.4	−11.3
	1112	Canteens	13,258	6.4	4.9	15.4 (2.4)	14.4	−16.9
112		Accommodation services	38,342	13.5	9.5	8.2 (3.6)	15.6	−10.5
121		Personal care	677,888	12.1	9.0	8.6 (2.6)	10.0	−11.1
	1211	Hairdressing salons and personal grooming establishments	74,108	9.5	8.6	10.2 (1.2)	7.8	−9.3
	1212	Electric appliances for personal care	8,476	12.0	6.6	8.0 (1.5)	20.1	−15.7
	1213	Other appliances, articles and products for personal care	595,304	13.8	9.3	7.6 (2.7)	11.0	−12.1
123		Personal effects n.e.c.	37,028	9.1	5.6	12.1 (5.9)	20.9	−14.6
	1231	Jewellery, clocks and watches	16,146	9.0	5.6	11.7 (4.6)	17.0	−9.9
	1232	Other personal effects	20,882	9.4	5.6	12.4 (7.7)	25.9	−20.6
124		Social protection	516	5.2	5.1	20.4 (6.6)	5.7	−10.7
125		Insurance	188	22.3	20.0	4.0 (.)	3.1	−0.8
126		Financial services n.e.c.	4,509	4.8	2.6	48.2 (58.0)	10.8	−30.0

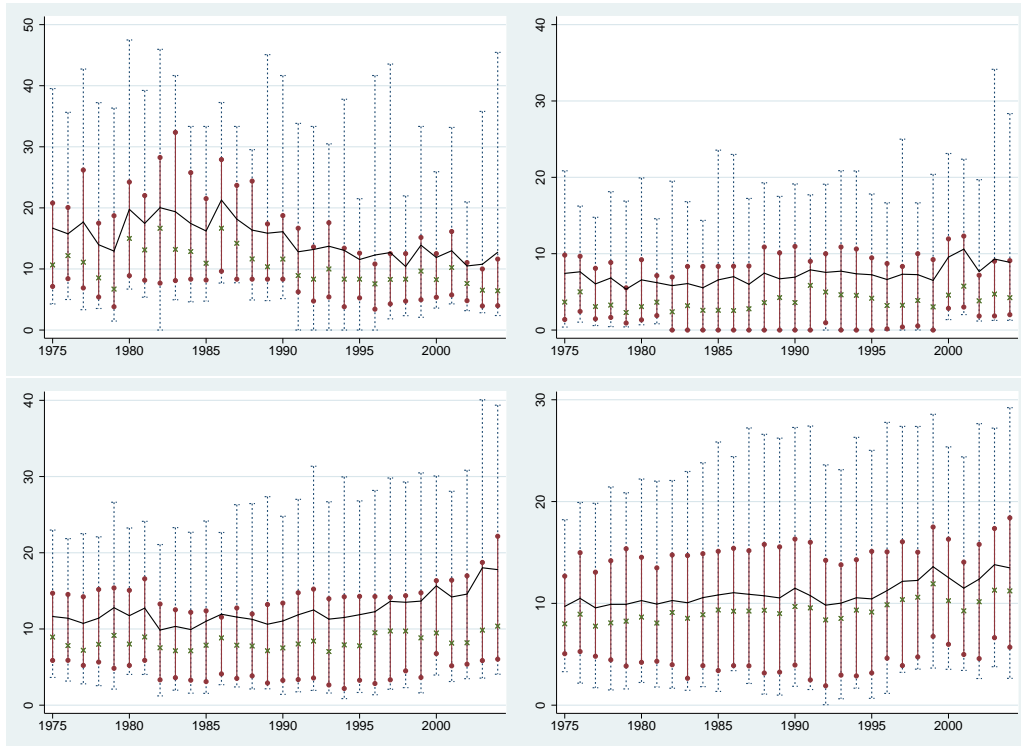*Note:* n.e.c. is short for not elsewhere classified.

FIGURE B3. THE ANNUAL DISTRIBUTIONS OF THE MONTHLY FREQUENCY OF PRICE INCREASES (TOP LEFT), THE FREQUENCY OF PRICE DECREASES (TOP RIGHT), THE AVERAGE PRICE INCREASE (BOTTOM LEFT), AND THE AVERAGE PRICE DECREASE (BOTTOM RIGHT). THE UPPER AND LOWER ENDS OF THE DASHED LINES REPRESENT THE 90TH AND 10TH PERCENTILES, THE DOTS MARKING THE UPPER AND LOWER ENDS OF THE SOLID LINES REPRESENT THE 75TH AND 25TH PERCENTILES, THE HORIZONTAL LINES REPRESENT THE MEDIAN, AND THE SOLID LINES REPRESENT THE MEANS. PERCENT.

Figure B3 shows the cross-sectional variation in f_{it}^+, f_{it}^-, dp_{it}^+ and dp_{it}^- over time.

Figure B4 shows a strong positive correlation between the average size of price increases and decreases for each product, a relationship that was also detected in the euro area (see Dhyne et al., 2006, Figure 2). The correlation coefficient between the size of price increases and decreases is .65.

Figure B5 shows a weak, albeit significant, tendency that products for which prices increase more often, adjust by a smaller size, thus indicating that the size of price increases may be positively related to duration. The correlation coefficient between the (log) frequency of price increases and the (log) size of price increases is –.36. There is not any similar relationship between the frequency and size of price decreases.

To help understand the increase in the mean size of price changes over time as shown in Figure 4, Figure B6 plots the histograms of the average size of price
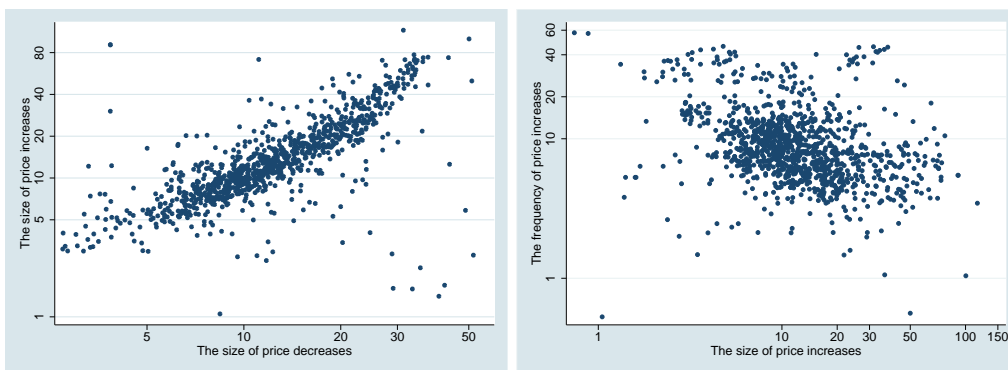
FIGURE B4. THE SIZE OF PRICE INCREASES BY PROD-
UCT, dp_i^+, PLOTTED ON THE VERTICAL AXIS AGAINST
THE ABSOLUTE SIZE OF PRICE DECREASES BY PROD-
UCT, dp_i^-. LOG SCALES.

FIGURE B5. THE FREQUENCY OF PRICE INCREASES
BY PRODUCT, f_i^+ PLOTTED ON THE VERTICAL AXIS
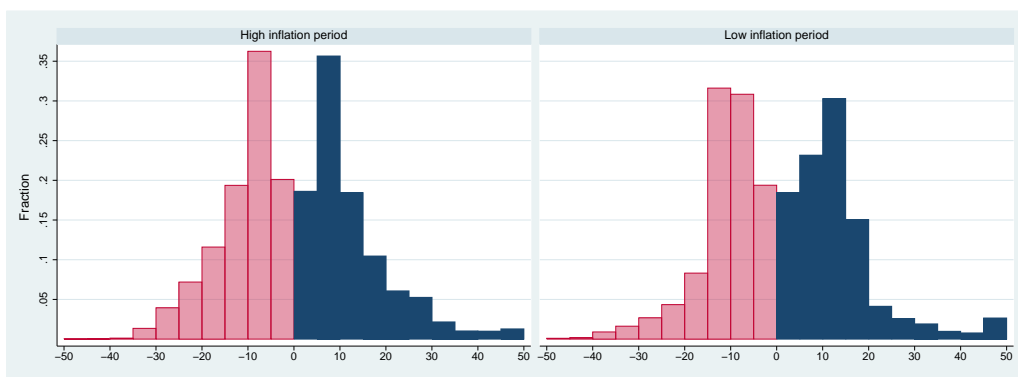AGAINST THE SIZE OF PRICE INCREASES BY PRODUCT,
dp_i^+. LOG SCALES.

FIGURE B6. HISTOGRAMS OF AVERAGE PRICE DECREASES (dp_i^-) AND INCREASES (dp_i^+) BY PRODUCT FOR
THE HIGH INFLATION PERIOD 1975–1989 (LEFT) AND LOW INFLATION PERIOD 1990–2004 (RIGHT). THE
DISTRIBUTIONS ARE TRUNCATED AT −50 AND 50 PERCENT.

decreases dp_i^- and increases dp_i^+ for the high-inflation and low-inflation periods.
Note that for each period there are two histograms, one for the mean price de-
creases dp_i^- (in red) and one for the mean price increases dp_i^+ (in blue). The
fraction of smaller mean price changes (below 5 percent in absolute value) are
about the same for both periods. The fraction of price changes between 5 and 10
percent (in absolute value) is smaller for both decreases and increases in the low
inflation period, while the fraction of price changes between 10 and 15 percent
is larger. Also the far tails of the distributions are fatter, especially for price
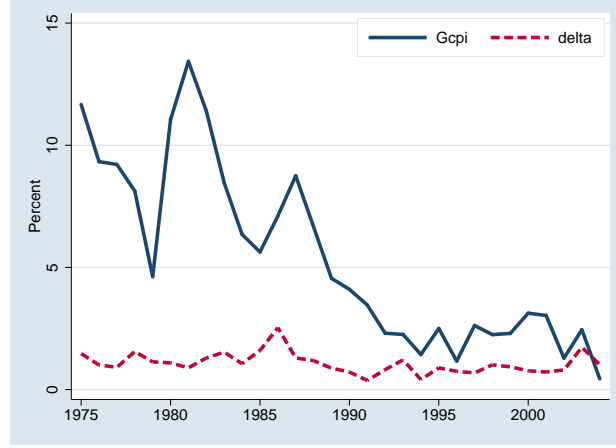increases.

C. The aggregation wedge

FIGURE C1. THE AGGREGATION ERROR Δ_t AND CPI INFLATION. PERCENT.

D. Detailed decomposition analyses

To further explore the effect of variation in the frequencies and sizes of price adjustments I compute four conditional estimates of CPI inflation allowing only one component to vary over time while holding the other three components constant at their product-specific means. For example, $\hat{\pi}_t(f_{it}^+|f_i^-, dp_i^-, dp_i^+)$ is the predicted inflation rate when only the frequency of price increases f_{it}^+ varies as observed, when the other three components f_i^-, dp_i^-, and dp_i^+ are held constant at their means.

$$\hat{\pi}_t(f_{it}^+|f_i^-, dp_i^-, dp_i^+) = \sum_i \omega_{it} \left(f_{it}^+ dp_i^+ + f_i^- dp_i^- \right),$$

$$\hat{\pi}_t(f_{it}^-|f_i^+, dp_i^-, dp_i^+) = \sum_i \omega_{it} \left(f_i^+ dp_i^+ + f_{it}^- dp_i^- \right),$$

$$\hat{\pi}_t(dp_{it}^+|f_i^-, f_i^+, dp_i^-) = \sum_i \omega_{it} \left(f_i^+ dp_{it}^+ + f_i^- dp_i^- \right), \text{ and}$$

$$\hat{\pi}_t(dp_{it}^-|f_i^-, f_i^+, dp_i^+) = \sum_i \omega_{it} \left(f_i^+ dp_i^+ + f_i^- dp_{it}^- \right).$$

For example, $\hat{\pi}_t(f_{it}^+|f_i^-, dp_i^-, dp_i^+)$ is the predicted inflation rate when only the frequency of price increases f_{it}^+ varies as observed, when the other three components f_i^-, dp_i^-, and dp_i^+ are held constant at their means. Figure D1 displays these four predicted series. We see that the decline in the frequency of price increases (depicted in the top left panel), the increase in the frequency of price decreases (on the bottom left), and the increased absolute magnitude of price
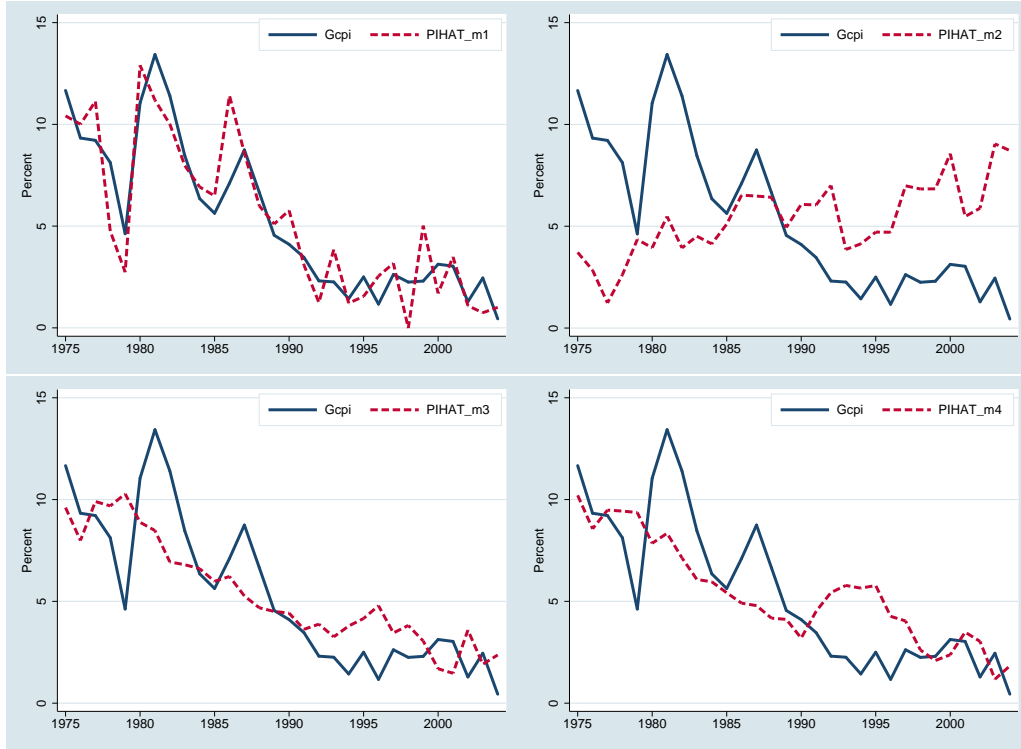
FIGURE D1. INFLATION (SOLID LINE) AND THE CONTRIBUTION FROM THE FREQUENCY OF PRICE INCREASES (TOP LEFT), THE FREQUENCY OF PRICE DECREASES (BOTTOM LEFT), THE MEAN SIZE OF PRICE INCREASES, (TOP RIGHT) AND THE MEAN SIZE OF PRICE DECREASES (BOTTOM RIGHT). ANNUAL RATES. PERCENT.

decreases (in the bottom right) all contributed to the downward trend in the inflation rate. The correlation coefficient between π_t and $\hat{\pi}_t(f_{it}^+|\bullet)$ is the highest of .90, while $\text{corr}(\pi_t, \hat{\pi}_t(f_{it}^-|\bullet) = 0.79$ and $\text{corr}(\pi_t, \hat{\pi}_t(dp_{it}^-|\bullet) = 0.73$. The variation in the size of the price increases contributes significantly to a counterfactual *positive* trend in the inflation rate (top right) with a correlation coefficient between π_t and $\hat{\pi}_t(dp^+|*)$ of $-.51$. The contribution to inflation from the size of price increases is thus opposite to the contribution from the size of price decreases. The effect on inflation from the size of price decreases is thus canceled out by a stronger opposite effect from the size of price increases as seen in the right panel of Figure 6. The short-run variability in the frequency of price increases is important for estimating the short-run variability in inflation, as $\text{corr}(\Delta\pi, \Delta\hat{\pi}_t|_{f^+}) = .58$.

Figure D2 compares how price decreases (depicted on the left hand panel) and price increases (depicted on the right) contribute to inflation. The graph shows Similarly, I compute the separate contributions from price increases and decreases, by $\hat{\pi}_t|_{POS} = \sum_i \omega_{it}\left(f_{it}^+ dp_{it}^+ + f_i^- dp_i^-\right)$, and $\hat{\pi}_t|_{NEG} = \sum_i \omega_{it}\left(f_i^+ dp_i^+ + f_{it}^- dp_{it}^-\right)$. Time variation in price increases and decreases both contributed to the variation
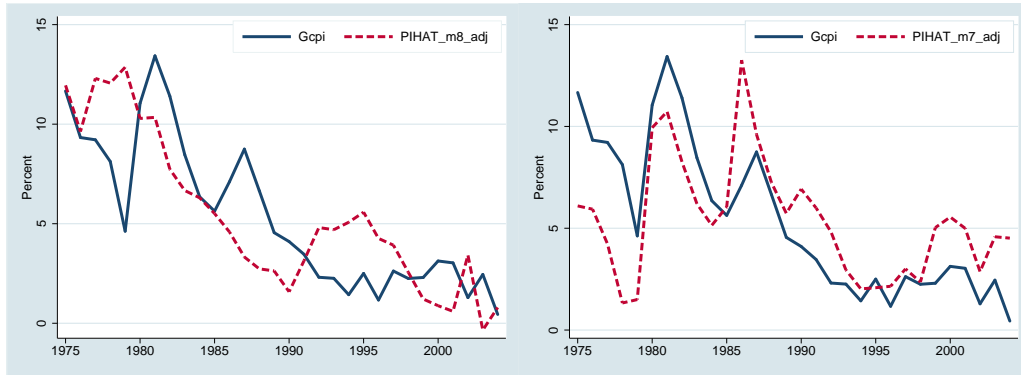
Figure D2. Inflation (Solid Line) and the Contribution From Price Decreases (Left), and Price Increases (Right). Annual Rates. Percent.

in inflation, as shown by correlation coefficients of .62 (increases) and .70 (decreases). However, short-run variability in price increases is more important for short-run variability in inflation than short-run variability in price decreases, as $\mathrm{corr}(\Delta\pi, \Delta\hat{\pi}_t|_{POS}) = .65$, compared to $\mathrm{corr}(\Delta\pi, \Delta\hat{\pi}_t|_{NEG}) = -.27$.