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Price adjustments and inflation - evidence from Norwegian consumer price data 1975-2004

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Price Adjustments and Inflation—Evidence from Norwegian Consumer Price Data 1975–2004

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Abstract

I document price adjustments in both high and low inflation years from 14 million monthly price observations of 1,133 goods and services. The variation in the frequency of price changes explains all the variation in the inflation rate. On average, prices increase more often when inflation is high, and decrease more often when inflation is low. There is also substantial variation both in the duration and size of price changes within and between items.

JEL: E31, D40, C2
Keywords: Consumer prices, price rigidity

*Norges Bank, PO Box 1179 Sentrum, 0107 Oslo, Norway. email: fredrik.wulfsberg@norges-bank.no, homepage: www.norges-bank.no/research/wulfsberg. I wish to thank Statistics Norway for providing data and giving invaluable comments. I am grateful to Alf Erik Ballangrud and Ingvil Benterud Gaarder for excellent research assistance, and to the Federal Reserve Bank of Boston, where I started this project. Carlos Carvalho, Mike Golosov, Steinar Holden, Gisle Natvik, Julio Rotemberg, Asbjørn Rødseth, and Alexander Wolman gave useful comments as did seminar participants at Norges Bank, NTNU, University of Oslo, and BI Norwegian School of Management. Views and conclusions expressed in this paper are mine alone and cannot be attributed to Norges Bank.

I document the frequency and size of price adjustments using observations of more than 14 million monthly retail price quotes from 1975–2004. Following Bils and Klenow (2004) many empirical studies have recently documented price adjustments using micro data for a large number of individual goods. Klenow and Kryvtsov (2008) and Nakamura and Steinsson (2008) investigate US data from 1988–2005, and Dhyne et. al (2006) summarizes the IPN study of 10 euro area countries from 1996–2001.[1] One important issue is how price adjustments vary with inflation. Nakamura and Steinsson (2008) find that the frequency of price increases covary strongly with inflation, while the frequency of decreases and the size of the price adjustments do not. In contrast, Klenow and Kryvtsov (2008) report that the variation in inflation is mostly explained by variation in the size of price adjustments. Dhyne et. al (2006) find that inflation has a positive effect on the frequency and the size of price increases, and a negative effect on the frequency and the size of price decreases.

These studies, however, use data from periods of relatively low steady state inflation: In the US average inflation was 3.3 percent during 1988–2004, while the average inflation rate in the euro area was 1.7 percent during 1996–2001. The small amount of inflation variability prevents firm conclusions regarding how price adjustments covary with inflation. This paper presents evidence on price adjustments from 30 years of both high and low steady state inflation. As in other OECD countries CPI inflation in Norway was high and volatile during the Great Inflation years in the 1970s and 1980s. After peaking at 15.1 percent in January 1981, inflation decreased during the 1980s only interrupted in 1986 when the NOK was devalued by 7 percent. The sample period splits nicely into a high-inflation period from 1975 to 1989 when the average CPI inflation was 8.4 percent, and a low-inflation period from 1990 to 2004 when average inflation was 2.4 percent per year. The low-inflation period is thus quite similar in terms of the sample variation in inflation in the US and European studies .

An important exception from the studies cited above is Gagnon (2009) who analyzes micro CPI data from Mexico 1994–2004, where inflation soared from 6.5 percent in 1994 to more than 90 percent in 1995 due to the collapse in the Mexican peso. The inflation

[1] Bils and Klenow (2004) investigate categories of consumption goods and services (Entry Level Items) for the US from 1995–1997. The Inflation Persistence Network (IPN) analyzed data from Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain. See also studies from other countries: Hansen and Lynggård Hansen (2006) for Denmark (1997–2005); Gábriel and Reiff (2007) for Hungary (2002–2006); and Coricelli and Horváth (2006) for Slovakia (1997–2001).

rate did not fall below 10 percent until 2000. Gagnon finds that the frequency of price changes account for little of the inflation variance, and that the frequency of price changes is only correlated with inflation when inflation is above 10–15 percent.

Even if inflation was high and volatile in Norway during the 1970s and 1980s, it did not fluctuate as much as in Mexico in the 1990s. However, the shocks that hit the Mexican economy in the 1990s were different from those leading to the Great Inflation in the OECD economies, which makes it interesting to study micro data also from this era. Furthermore, the present data cover a longer period providing more information for comparing price setting under high inflation with price setting under low inflation.

Evidence of price adjustment under high and low inflation is important to evaluate the relevance of different models of price setting. Assumptions regarding price setting behavior may have important implications for optimal monetary policy and welfare analysis. Time and state dependent models represent two polar cases of price setting behavior. An important difference is that time dependent models (Calvo, 1983, and Taylor, 1980) assume that the frequency of price adjustment is exogenous, while state dependent models (Barro, 1972 and Sheshinski and Weiss, 1977) treat both the frequency and magnitudes of price adjustment as choice variables to the firms. In state dependent models firms face a fixed administrative cost of changing prices implying that there is a range of inactivity; firms keep their prices fixed if it is between an upper and lower threshold price. Inflation erodes the relative price until it equals the lower threshold, at which point the firm increase the price to the upper threshold. An increase in the rate of inflation unambiguously increase the magnitude of price changes, but the effect on the frequency of price changes is ambiguous (Sheshinski and Weiss, 1977, Proposition 1) because a higher rate of inflation has two opposite effects on the profitability of repricing.[2]

In section 2 I describe the variation in the frequency of price adjustments over time and across items. I find that (i) the frequency of price increases declined over the period and is strongly correlated with inflation; (ii) prices changed on average once every 7 month in the high-inflation period, and every 12 month in the low-inflation period; and (iii) there is substantial variation in the frequency of price changes between items. Prices for energy products and non-processed food change frequently, while services change prices

[2] An increase in inflation reduces both the benefit and cost of postponing a price change.

infrequently. In section 3 I look at the magnitude of price adjustments. I find that (iv) the average size of price changes is negatively correlated with the inflation rate; (v) the average price change (in absolute value) increased from 9–10 percent in the high-inflation period 1975–1989, to 11–13 percent in the low-inflation period 1990–2004; and (vi) there is substantial variation in the magnitude of price changes between items. In section 4 I decompose the variation in the CPI inflation rate into the variation in the frequency and magnitude of price changes. I find that (vii) the variation in the inflation rate is explained by variation in the frequency and not the size of price changes. The declining frequency of price increases and increasing frequency of price decreases both contributed to the variation in inflation. The increasing magnitude of price increases and decreases had opposite effects on the inflation rate cancelling each other out. Section 5 concludes that neither time dependent models nor state dependent models are able to explain the observed patterns of price adjustment.

1 Data

Every month Statistics Norway collect data for price quotes on a wide range of consumer goods and services to produce the consumer price index, CPI (see Statistics Norway (2001, 2006) for details). For example they record the price of a bag of 8 buns without raisins in a specific shop once a month. Such detailed observations provide information of price setting at the retail level. On the basis of these collections of data I have constructed a panel database on prices for 1,133 items covering the 360 months from January 1975 to December 2004, all together 14,363,828 price observations. The average number of observations per month is 39,900.

Several prices for the same item are recorded at several outlets. Price observations of an item from the same outlet constitute a price trajectory of which there are 433,666. On average there are 33.1 observations per trajectory. The average number of observations by item is 12,678 and the average number of trajectories for each item is 383. The sampled items change over time as new goods are introduced while other goods disappear. The number of items in 1975 are 548 and in 2004 there are 845 items.

Figure 1 shows examples of typical price trajectories for four different items: Petrol,

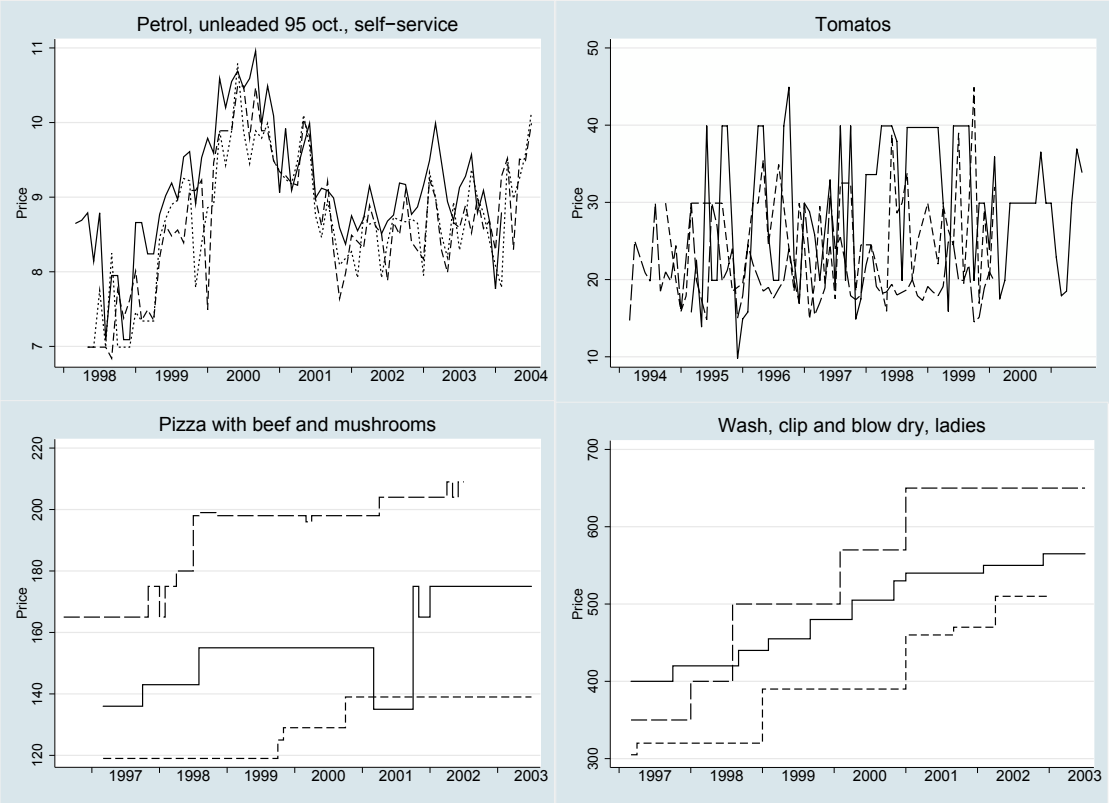

Figure 1: Examples of price trajectories.

unleaded 95 octane, self-service; Tomatoes; Pizza with beef and mushrooms; and Wash, clip and blow dry, ladies. The trajectories show different patterns of variation. Petroleum and tomato prices seem to change every month (and possibly more often), at least for this period. In contrast hairdressers seem to keep prices constant for some time, and at least for these hairdressers, all price changes are increases. The price for a pizza are also kept constant for long periods, but sometimes prices are increased and sometimes reduced.

Items are defined with varying degrees of precision. Item *423 Stove, ceramic (Beha, A2055K)* is precisely defined, while item *647 Sweater, lamb's wool, size grown-up* is less precisely defined. The sweaters are not necessarily identical across firms, but the outlets report the price of the same brand, color and size of the sweater as the previous month. For this paper it is important to compare prices for the same product in two consecutive months. Sometimes the firms report the price of a different product than the previous month if it does not longer exist, if there is a change in the quality of the good since last month, or if the good is substituted by a new good. 1.44 percent of the observations

are flagged with either of these properties, which I drop from the database. For many trajectories there are missing values. In this paper I do not replace these with imputed prices. When reporting their prices to Statistics Norway, firms also report when a product is on sale. 3.3 percent (472 701 observations) of all price change observations are related to sales. This fraction is similar to euro area data, but much lower than in the US.

When constructing the CPI, Statistics Norway apply weights, ω_{it}, to each item, i, reflecting its importance in the average consumption basket. The weights are computed as the average of the fraction of consumers' expenditure over the last three years, hence it changes over time. The items in this database represent on average 73.9 percent of the CPI.

2 The Frequency of Price Changes

In this section I document the variation in the frequency of price changes over time and how they are correlated with the CPI inflation rate. I first compute the average monthly frequency of price changes for each item each year, f_{it}, as the fraction of the total number of price changes to all (price change) observations. Then I decompose f_{it} into the frequencies of price increases and decreases; $f_t = f_{it}^+ + f_{it}^-$. The left panel of Figure 2 shows how the mean frequency of price increases, f_t^+, and decreases, f_t^-, varies over time. In computing the means I have weighted the items by their current CPI-weight. The frequency of price increases declined markedly from around 20 percent in the early 1980s to around 12 percent after 2000. The price (and wage) freeze law in 1979 had a clear on the frequency of price increases, and the devaluation of the NOK explains the spike in 1986. The variation in the frequency of price increases is clearly connected to the variation in the CPI inflation rate as seen from the right panel of Figure 2 which plots the frequency of price increases and decreases versus the inflation rate. The frequency of price increases is highly correlated with CPI inflation with a correlation coefficient of 0.802, illustrated by the regression line.

Price decreases are prominent in the data, but less frequent than price increases. While 24 percent of the price changes were price decreases during the 1970s and 1980s, this fraction was 44 percent after 2000. The mean frequency of price decreases hovers

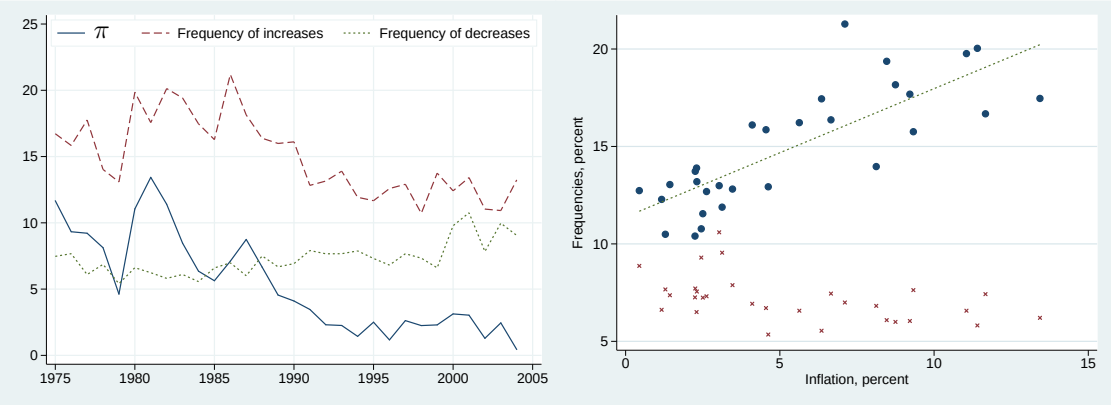

Figure 2: Left: CPI *inflation, π (solid line), the mean weighted frequency of price increases (dashed line) and decreases (dotted line). Right: Mean weighted frequency of increases and decreases vs inflation. Annual rates. Percent.*

around 6–8 percent, but increased to 8–10 percent after year 2000. The hike in 2001 is associated with a 50 percent decrease in the value added tax on food. The frequency of price decreases exhibits less variation over time than the frequency of price increases, nevertheless the correlation coefficient between the frequency of price decreases and CPI inflation is –0.492.[3] Price reductions may be caused by idiosyncratic shocks: When a firm has been hit by an adverse idiosyncratic shock, it needs to reduce the price, see Golosov and Lucas (2007). (In time dependent and state dependent models without idiosyncratic shocks, all price changes are increases.)

Note that in a Calvo model with idiosyncratic shocks, the firms receive an exogenous signal allowing them to change their price. Whether the firm choose to increase or reduce its price may, however, be endogenous depending on e.g. inflation. Correlation between the frequency of price increases and decreases and inflation may thus be consistent with the Calvo model. However, the correlation coefficient between the average frequency of all price changes, f_t, and inflation is 0.700.

Despite little variation in the inflation rate over their sample periods, Nakamura and Steinsson (2008) and Goette, Minsch, and Tyran (2005) do find a positive correlation between inflation and the frequency of price increases. Gagnon (2009) finds no correlation between the frequency of *all* price changes and inflation when inflation is below 10–15

[3]The temporal features of the frequency of price increases and decreases are not confined to the means only. Figure **??** in the appendix shows a similar tendency for different percentiles of the year-specific distributions of the frequencies of price increases and decreases. However, it is the upper tails of the distributions that show the biggest change. Hence, the dispersion in the frequency of price increases is smaller when inflation is low.

Table 1: The median, mean, and standard deviation of the weighted frequency of price changes and implied duration.

	1975–1989	*1990–2004*	*Full sample*	*Excluding sales*
	Frequency of price increases, f_i^+, (%)			
Median	12.8	8.3	9.4	9.2
Mean	17.9	12.1	14.8	14.6
Std error	14.1	11.3	12.6	12.7
	Frequency of price decreases, f_i^-, (%)			
Median	3.5	4.5	4.3	3.8
Mean	5.8	7.5	7.1	6.7
Std error	6.8	8.6	7.8	7.7
	Frequency of price changes, f_i, (%)			
Median	15.6	12.8	14.3	13.0
Mean	23.7	19.6	21.9	21.3
Std error	18.6	18.6	18.6	18.6
	Duration, D_i, (months)			
Median	5.9	7.3	6.5	7.2
Mean	6.7	12.3	8.1	8.4
Std error	7.2	42.5	11.5	11.2

percent, but does not report separate correlations between inflation and the frequency of price increases or price decreases.

Columns 1 and 2 of Table 1 report the CPI-weighted moments of the average monthly frequency of price changes, f_i, increases, f_i^+, and decreases, f_i^-, for each item for 1975–89 (the high inflation period) and 1990–2004 (the low-inflation period). I report both the median and mean as the distributions are skewed. The mean frequency of price increases was 17.9 percent in the high-inflation years and 12.1 percent during the low-inflation years, which is 32 percent lower. The median frequency of price increases fell by a similar amount from 12.8 to 8.3 percent. The mean frequency of price decreases increased from an average of 5.8 percent in the high inflation period to 7.5 percent in the low inflation period. Thus, 62 percent of the price changes in the low-inflation period are price increases, which is somewhat higher than in the US and the euro area where the fraction of price increases are 57 and 58 percent (see Nakamura and Steinsson (2008, Table 1) for the US and Dhyne et. al (2006, Table 4) for the euro area).

Inversely related to the frequency of price changes, is the duration of a price spell, which is the number of months between a price change and the next. We follow the

approach in the literature by deriving the mean implied duration for each item, D_i, from the weighted frequency estimates by using the formula[4] $D_i = -1/ln(1 - f_i)$. From the bottom panel of Table 1, we see that the mean implied duration increased from an average of 6.7 months during the high-inflation period to 12.3 months during the low-inflation period.[5]

Our estimate of mean implied duration for the low-inflation period is similar to the euro area which is 13 months (see Dhyne et. al, 2006) and higher than the estimates for the US which is about 8–9 months (see Nakamura and Steinsson, 2008).[6] Dhyne et. al (2006) conclude from the evidence of the frequency of price changes that prices are more sticky in Europe than in the US. However, the evidence suggest that one should be careful of interpreting the frequency of price adjustments as a measure of price rigidity without controlling for inflation. It would for example be wrong to conclude that prices were more rigid in the low-inflation period than in the high-inflation period as deregulations and increased competition over this period have made consumer markets more flexible.

For completeness, I report the overall average weighted median, mean and standard errors of the frequency of price changes and implied duration in column 3 of Table 1. The weighted median and mean frequencies of price increases are 9.4 and 14.8 percent, while the median and mean frequencies of price decreases are 4.3 and 7.1 percent. The weighted median and mean frequencies of price changes are 14.3 and 21.9 percent, and the weighted median and mean implied duration are 6.5 and 8.1 months.

Nakamura and Steinsson (2008) report that sales related temporary price changes have a big impact on their duration estimates. In their data 21.5 percent of the price change observations in the US are sales related. The last column of Table 1 report the frequencies of price changes and implied duration when 472,701 sales related observations (3.3 percent) are replaced by a missing value. The impact of sales on the frequency of price changes are small. For example, the mean duration increases by only 0.3 months to

[4]Conditions for this relationship to hold are that the products are homogeneous and that the process is stationary. An advantage of using the frequencies to estimate the duration is that censored price spells does not affect the estimates. Measuring the duration directly requires assumption about censored spells. See Baudry et. al (2007) for a discussion on this method.

[5]Note that because of the non-linear relationship between the frequency of price changes and implied duration, applying the formula to the mean frequency yields a duration of $-1/\ln(1-0.217) = 4.1$ months which is different from the mean implied duration.

[6]Hansen and Lynggård Hansen (2006) report an average duration of 12–15 months for Denmark.

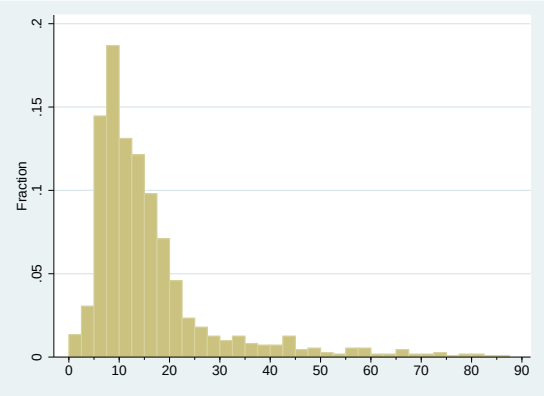

Figure 3: The distribution of the frequency of price changes in percent across items.

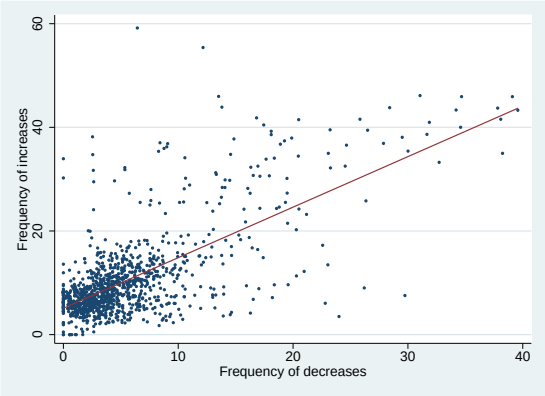

Figure 4: The frequency of price increases and decreases at the item level.

8.4 months. Dhyne et. al (2006) also report that sales have little impact on the estimates on European data, with evidence from France and Belgium that only 3 percent of the price changes are sales related. Sales related price changes thus seems to be less important in Europe than in the US.

Heterogeneity

A striking result in the recent studies on micro CPI data is the marked heterogeneity in the frequency of price changes between the goods. Not surprisingly, there is a lot of variation in the frequencies across items also in the Norwegian data, as documented by the substantial standard errors in Table 1. For example, the standard errors of the implied duration is 11.5 months for the whole sample. The heterogeneity is also striking in Figure 3 which shows the distribution of f_i, which is skewed with a right tail. Vegetables, fruit and petrol are examples of items with frequent price changes, while various services have less frequent price changes. Three quarters of the items have an implied duration of less than a year. Differences in consumption patterns between countries may explain why prices in one country on average change more or less frequently than in others.

The scatter plot of f_i^+ vs f_i^- in Figure 4 reveals that there is a tendency for items with a higher frequency of price increases to also have a higher frequency of price decreases, like petrol and tomatoes as seen in Figure 1. This correlation was also reported for the euro area (see Dhyne et. al, 2006, Figure 2).

Table 2 reports frequencies and duration estimates for the high and low inflation

periods for 12 COICOP divisions.[7] The mean duration varies between 3.8 months for *Food* in the high inflation period (1975–1989) and 39.6 months for *Miscellaneous goods and services* in the low inflation period (1990–2004). The standard error of the duration within each division, however, is large, but for most categories smaller than or equal to the overall standard deviation.

The frequency of price changes are not constant between the high and low inflation periods within the product categories. The frequency of price changes is lower (and implied duration is longer) in the low inflation period compared to the high inflation period for all COICOP divisions but for *Clothing and footwear*, *Communication*, and *Recreation and culture*. For all categories the frequency of price increases is higher in the high inflation period, in particular for *Restaurants and hotels* and *Food*. The frequency of price decreases is higher in the low inflation period for all categories but *Food, Education*, and *Restaurants and hotels*. In particular the frequency of price decreases was thrice as high for *Housing* and *Communication* products, and almost twice as high in the low inflation period for *Clothing and footwear*. Table B1 in the appendix report the statistics for the less aggregate COICOP groups and classes.

Within the COICOP system, the products are also classified as *Non-durable goods, Semi-durable goods, Durable goods*, and *Services*.[8] Table 3 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.

Dhyne et. al (2006) report estimates for the five main components of the HICP: *Energy, Unprocessed food, Processed food, Non-energy industrial goods*, and *Services*, which are much used within the Eurosystem.[9] The relative frequency of price changes between

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

[8] 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.

[9] Energy includes electricity, gas, liquid and solid fuels and lubricants, heating; Unprocessed food includes meat, fish, fresh fruit and vegetables; Processed food includes bread, milk, beverages and tobacco; Non-energy industrial goods includes clothing and shoes, furniture, household appliances, medical prod-

Table 2: Mean frequency of price changes and mean price duration in months by COICOP *divisions (two-digit level).*

COICOP *Division*	*Period*	*n*	*Items*	f^+	f^-	*D*
1 Food and non-alcoholic beverages	1975–1989	4,229,361	264	22.6	11.9	3.8 (3.2)
	1990–2004	3,031,220	267	13.4	10.2	5.8 (5.1)
2 Alcoholic beverages, tobacco and narcotics	1975–1989	87,036	41	16.0	1.6	5.4 (1.3)
	1990–2004	188,042	42	11.0	3.2	7.1 (2.0)
3 Clothing and footwear	1975–1989	558,401	104	7.5	4.5	8.6 (3.3)
	1990–2004	530,975	133	5.7	8.3	7.8 (4.0)
4 Housing, water, electricity, gas and other fuels	1975–1989	39,829	26	16.2	2.8	6.3 (3.0)
	1990–2004	139,542	29	13.5	9.6	8.4 (6.6)
5 Furnishings, household equipment and routine household maintenance	1975–1989	774,272	130	10.3	3.2	8.0 (3.4)
	1990–2004	693,303	137	7.3	5.0	9.1 (4.7)
6 Health	1975–1989	3,070	15	8.8	0.7	11.7 (5.0)
	1990–2004	199,018	52	7.5	2.0	12.6 (5.6)
7 Transport	1975–1989	228,883	111	29.9	7.3	4.2 (4.3)
	1990–2004	458,504	86	23.1	11.6	16.0 (87.9)
8 Communication	1975–1989	3,131	10	4.0	2.6	21.2 (31.1)
	1990–2004	14,885	15	2.6	8.2	13.7 (17.7)
9 Recreation and culture	1975–1989	131,627	88	9.7	3.2	9.7 (5.7)
	1990–2004	344,534	120	9.2	4.9	9.7 (7.2)
10 Education	1975–1989	1,476	7	8.4	0.4	11.6 (2.6)
	1990–2004	990	7	6.7	0.4	13.9 (3.0)
11 Restaurants and hotels	1975–1989	7,914	15	23.5	1.7	4.6 (3.5)
	1990–2004	184,723	44	5.9	1.7	14.7 (5.6)
12 Miscellaneous goods and services	1975–1989	305,800	58	15.8	1.9	6.6 (3.2)
	1990–2004	414,329	96	6.9	2.7	39.6 (61.7)

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.

Table 3: Weighted mean frequency of price changes, duration and size of price changes by types of goods (COICOP).

	Period	*n*	*Items*	f^+	f^-	*D*
Non-durable goods	1975–1989	5,181,731	437	22.0	9.3	4.2 (3.2)
	1990–2004	4,280,974	490	17.3	11.8	5.9 (5.5)
Durable goods	1975–1989	178,431	101	23.6	4.5	5.2 (3.8)
	1990–2004	346,304	109	14.0	6.9	6.3 (4.9)
Semi-durable goods	1975–1989	889,757	184	7.5	3.5	9.7 (4.8)
	1990–2004	1,046,342	230	5.7	6.2	9.4 (4.5)
Services	1975–1989	120,881	147	12.8	1.7	10.6 (12.6)
	1990–2004	526,445	199	7.3	2.6	25.6 (76.0)

Table 4: Weighted mean frequency of price changes, duration and size of price changes by HICP sectors.

HICP	*Period*	*n*	*Items*	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)

the HICP categories show the same pattern across countries: *Energy* prices change most frequently (except for Japan and Portugal) and *Services* least frequently. For Norway, the prices change most frequently for *Unprocessed food* with an implied duration of only 2.1 months when inflation is high and 3.8 months when inflation is low, see Table 4. *Energy* products change almost as frequently with an implied duration of 3.5 and 4.4 months. For the (HICP) *Services* the duration is about 10 months in the high inflation

ucts, cars, PCs and TVs; and Services includes rents and repairs, as well as cultural, recreational and medical services.

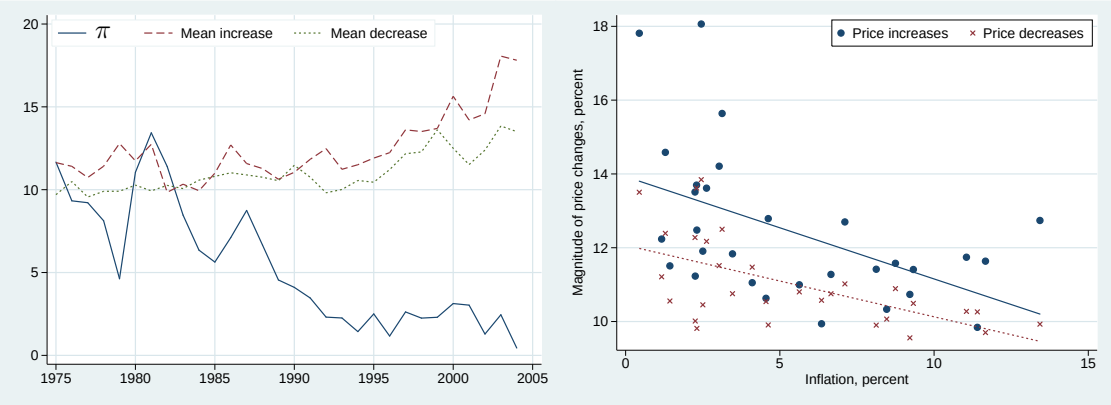

Figure 5: Left: The CPI *inflation rate (solid line), the mean weighted magnitude of price increases (dashed line) and decreases in absolute values (dotted line). Right: The mean weighted magnitude of price increases (dots) and decreases in absolute values (×s) plotted against the inflation rate with regression lines. Annual rates. Percent.*

period and about 25 months in the low inflation period. For the other groups the increase in duration from the high to the low inflation period are moderate (in absolute terms). The frequency of price increases is lower in the low inflation period for all groups apart from Energy. The frequency of price decreases is lower when inflation is low for both *Processed and Unprocessed food*, while it is higher in the low inflation period for the other groups, in particular *Energy* products.

3 The Size of Prices Changes

To investigate the time variation in the magnitude of price changes, I compute the weighted average magnitude of monthly price increases and decreases in percent for each item and year, dp_{it}^{+} and dp_{it}^{-}. The left panel of Figure 5 plots the CPI-weighted mean increase and decrease for each year, dp_{t}^{+} and dp_{t}^{-}, together with the inflation rate. Both the mean size of price increases and the absolute value of price decreases have trended upwards. The mean size of price increases rose from 11 percent in 1975 to 18 percent in 2004. Similarly, the mean price decrease trended upwards in absolute value from about 10 percent to almost 14 percent by the end of the sample. As inflation came down at the same time, the absolute value of the size of the price increases and decreases are negatively correlated to the inflation rate. The correlation coefficient between inflation and price increases is –0.520, while the correlation coefficient between inflation and the absolute value of the size of price decreases is –0.598, see the right panel of Figure 5. As

Table 5: The weighted average price increase and decrease. Percent.

	1975–1989	*1990–2004*	*Full sample*	*Excluding sales*
	Average size of price increases (%)			
Median	7.6	9.9	9.3	8.9
Mean	10.5	13.2	12.3	11.5
Std error	18.9	14.6	11.8	10.2
	Average size of price decreases (%)			
Median	–7.8	–10.2	–9.7	–9.0
Mean	–9.1	–11.2	–10.5	–9.7
Std error	7.3	8.4	7.8	7.0

inflation does part of the job in reducing relative prices, we would expect a negative correlation between price decreases and inflation. The negative correlation between inflation and price increases is less intuitive.

While Gagnon (2009) also report a negative correlation between the magnitude of price increases and decreases versus inflation,[10] neither Nakamura and Steinsson (2008) nor Dhyne et. al (2006) report any correlation between inflation and the magnitude of price changes. The trend in the magnitude of price changes documented above thus requires some scrutiny. How robust is this finding? First, the trend increase in the magnitude of price changes is also present in the data if I remove extreme observations. Third, the trend is robust if we look at the products which are included in the CPI basket over the entire period (i.e. I remove the items that enter or exit the sample over time). Hence, the trend is not explained by changes in the composition of goods and services. Fourth, the trend increase is significant for some but not all of the COICOP divisions and delivery sectors, (documented in section on heterogeneity below).

Columns 1 and 2 of Table 5 report the weighted moments of the average size of price changes of the high-inflation period (1975–1989) and low-inflation period (1990–2004). The mean average size of price increases and decreases were 13.2 and –11.2 percent in the low inflation period, about 2–3 percentage points higher in absolute values than in the high inflation period. Because inflation decreases the relative price between price adjustments, one would expect price increases to be larger than price decreases as observed, (see Ball and Mankiw, 1994). The estimates for the low-inflation period are similar to the European and US data. Klenow and Kryvtsov (2008) find that the mean average

[10] See Figure 9 in the May 2008 version of his paper.

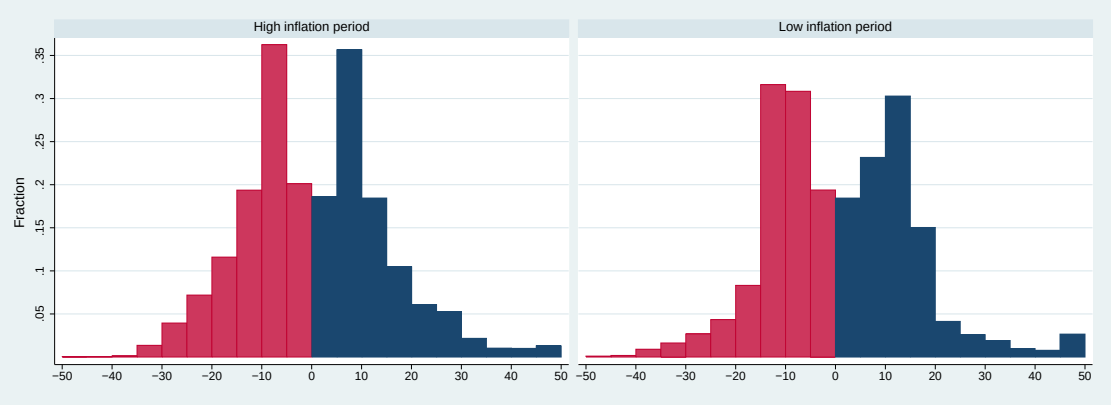

Figure 6: Histograms of average price decreases (dp_{it}^{-}) and increases (dp_{it}^{+}) by item for the high inflation period 1975–1989 (left) and low inflation period 1990–2004 (right). The distributions are truncated at –50 and 50 percent.

price increase is 12.7 percent and the mean average price decrease is –14.1 percent in the US. Dhyne et. al (2006) report that the average price increase in the euro area is 8.2 percent and the average price decrease is –10.0 percent.

To help understand the increase in mean size of price changes over time, I plot the histograms of the average size of price changes by item for the high-inflation and low inflation periods in Figure 6.[11] Note that there are two histograms in different colors for each period, one for price decreases and one for price increases. The fraction of smaller price changes (below 5 percent) 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. Note that the combined distributions of the average price decreases and increases per item are twin peaked.

For completeness, Column 3 of Table 5 reports the overall weighted median, mean and standard error of the average magnitudes of price increases and decreases. The median and mean average price increase by item are 9.3 and 12.3 percent, while the median and mean average price decreases are –9.7 and –10.5 percent. The fourth column of Table 5 report the average size of price changes excluding sales related observations. Because there are relatively few sales related price changes, the effect of sales on the average size of price increases and decreases are a mere 1 percentage point. Nakamura and Steinsson

[11] Figure C1 in the appendix shows percentiles of the year-specific distributions of the magnitude of price changes.

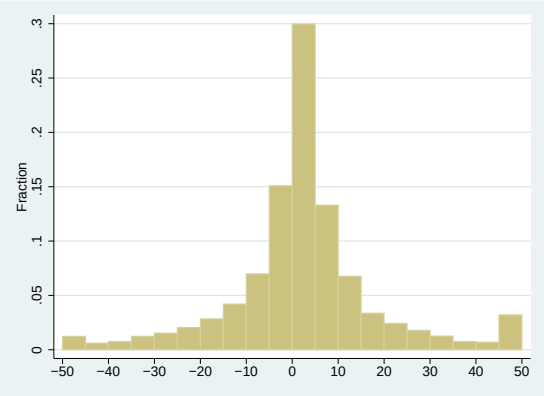

Figure 7: Histogram of all observations of price changes truncated at –50 and 50 percent.

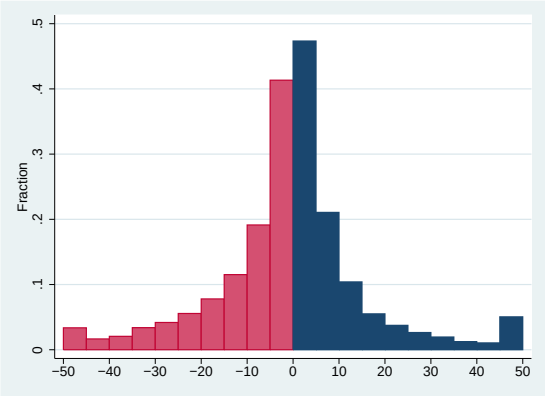

Figure 8: Histograms of all price decreases and increases truncated at –50 and 50 percent.

(2008) report a median average size of price increases and decreases of 7.5 and –9.2 percent excluding sales for the US.

Heterogeneity

There is substantial heterogeneity between goods also in the size of price changes. The standard error of price increases and decreases are 15.6 and 7.8 percent for the full sample (see Table 5). While Figure 6 illustrates the dispersion in the average sizes of price increases and decreases across items, the histogram in Figure 7 shows the distribution of the size of *all* price changes. The zero observations are omitted in order not to overwhelm the graph. Price increases are more common than decreases and there are many large price changes (in absolute values) represented by the thick tails. However, 45 percent of the price changes are less than 5 percent in absolute value. Figure 8 plots the separate distributions of all price decreases and increases, (i.e. rescales the fractions from Figure 7). For example about 40 percent of the price decreases are larger than –5 percent, and almost half of the price increases are less than 5 percent. Note that the histograms in Figure 7 and 8 are dominated by items with many observations.

Table 6 reports the mean absolute price increases and decreases for the COICOP divisions for the high and low inflation periods. There are systematic differences between and within the divisions. We see that the mean sizes of the price changes are larger for *Clothing and footwear* with 44.2 and 29.5 percent for increases and decreases when inflation is low, compared to the other product categories. The size of price changes are smaller for

Table 6: The mean absolute size of price increases and decreases by COICOP *division and high and low inflation period. 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

Alcohol and tobacco, Communication, Transport, and *Health* varying between 3.6 and 9.5 percent in absolute value. For all divisions the absolute size of price changes are higher in the low inflation period compared to the high inflation period with the exception of price increases for *Transport* and *Education*. In particular the absolute size of price decreases were higher in the low inflation period for *Education* and *Restaurants and hotels*. Figure C2 in the appendix plots the distributions of the size of price changes within the COICOP divisions. It shows that the distributions are all singe peaked with many small price changes, but the degree of peakedness differ. The COICOP divisions *Clothing and footwear, Communication*, and *Recreation and culture* possess less peaked distributions than particularly *Alcoholic beverages and tobacco, Transport*, and *Education*.

Regarding types of products, Table 7 also shows that the absolute size of price changes are larger in the low inflation period than in the high inflation period for all categories. Semi-durable goods change prices by the largest amounts. For HICP product categories, we see from the bottom panel of Table 7 that prices for *Non-energy industrial goods* and *Unprocessed food* also change by large amounts (11–18 percent on average). Prices for *Energy goods* adjust by the smallest amount with an average size of price increases of 2.0

Table 7: The mean abolute size of price increases and decreases by types of goods.

	Increases		*Decreases*	
COICOP	*1975–1989*	*1990–2004*	*1975–1989*	*1990–2004*
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
HICP				
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

Figure 9: The size of price increases plotted on the vertical axis against the absolute size of price decreases. Log scales.

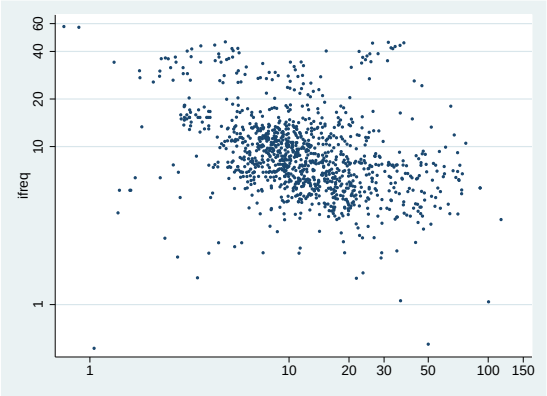

Figure 10: The frequency of price increases plotted on the vertical axis against the size of price increases. Log scales.

percent when inflation is high and with 4.0 percent when inflation is low.

In Figure 9 we see a strong positive correlation between the average size of price increases and decreases for each item, which 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 0.65. However, a few goods have a large reduction in prices on average while the average price increase is close to zero and vice versa. Furthermore, Figure 10 shows a weak, albeit significant tendency that items which prices increase more often, adjust by a smaller size, indicating that the size of price increases may be positively related to duration. The correlation coefficient between the (log) frequency of price increases and (log) size of price increases is –0.36. There is not any similar relationship between the

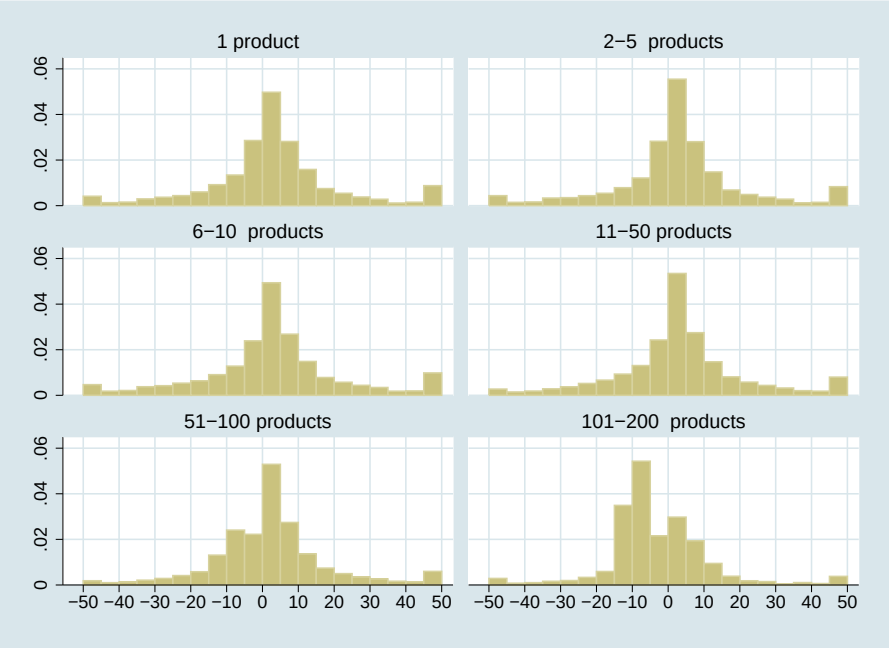

Figure 11: Histograms of non-zero price changes by the number of products per firm. Truncated at –50 and 50 percent.

frequency and size of price decreases.

The large number of small price changes are not consistent with state dependent models where firms face a fixed cost of repricing. Lach and Tsiddon (2007) argue that many small price changes illustrated by the peaked distributions of non-zero price changes, in combination with a high average price change is, however, consistent with menu cost when firms sell many products and if there are economies of scope in price adjustments (see also Midrigan, 2008). To investigate this hypothesis I plot histograms of non-zero price changes for categories of multi-product firms in Figure 11. The histogram in the top left shows the size price changes for firms reporting only one price, the top right panel shows the size price changes for firms reporting prices for 2–5 products and so on. We see that small price changes in single product firms are as frequent as small price changes in multi-product firms. Surprisingly, the histograms for firms reporting more than 100 products in a single month is not single peaked around zero, exactly what we would expect for single product firms if there are economies of scale in price setting.

4 Contributions to the inflation rate

Section 2 and 3 show that both the mean frequency and the magnitude of price changes are correlated with inflation, in particular the frequency of price increases. A simple way to illustrate their partial contribution to the variation in inflation and in particular the period of disinflation from mid-1980s, is to decompose the inflation rate into the frequencies and the magnitudes of price increases and decreases. I then construct four conditional estimates of CPI inflation allowing only one component to vary at a time while holding the other constant at their means, and compare the correlation between the conditional estimates of CPI inflation with CPI inflation itself.

Formally, inflation is a weighted average of item specific price changes,

$$\hat{\pi}_t = \sum_i \omega_{it} dp_{it}, \tag{1}$$

where $\hat{\pi}_t$ is the average monthly inflation rate in year t, and dp_{it} is the average monthly price change for item i in year t. ω_{it} is the CPI weight for item i in year t. dp_{it} is equal to the frequency of price changes (the extensive margin), f_{it}, times the magnitude of non-zero price changes (the intensive margin), dp^*_{it},

$$dp_{it} = f_{it} dp^*_{it}. \tag{2}$$

The average size of non-zero price changes for item i in year t, can be decomposed into the the average size of price increases, dp^+_{it}, and decreases, dp^-_{it}, weighted by their relative frequencies:

$$dp^*_{it} = \frac{f^+_{it}}{f_{it}} dp^+_{it} + \frac{f^-_{it}}{f_{it}} dp^-_{it}. \tag{3}$$

Hence, from (1)–(3) the estimate of CPI inflation is the weighted product-sum of item specific frequencies and magnitudes of price changes:

$$\hat{\pi}_t = \sum_i \omega_{it} f_{it} dp^*_{it} = \sum_i \omega_{it} \left(f^+_{it} dp^+_{it} + f^-_{it} dp^-_{it} \right) \tag{4}$$

Figure 12 shows the mean adjusted annualized $\hat{\pi}_t$ with the observed CPI inflation rate,

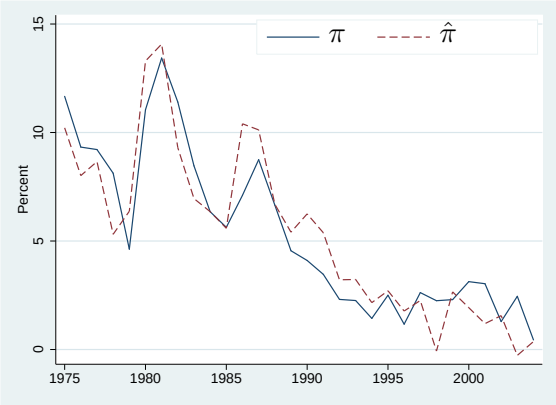

Figure 12: CPI *inflation π_t (solid line) and (mean adjusted) predicted inflation rate, $\hat{\pi}_t$ (dashed line). Annual rates. Percent.*

π_t.[12] We see that $\hat{\pi}_t$ tracks π_t extremely well, with a correlation coefficient of 0.909.[13] Note that (4) differs from the measure in Klenow and Kryvtsov (2008) who decompose the inflation rate into the mean average weighted frequencies and magnitudes of price changes: $\hat{\pi}_t = f_t dp_t^* = f_t^+ dp_t^+ + f_t^- dp_t^-$ (their equation (3.8)). Computing their proposed estimate of inflation with the present data yields a correlation coefficient with the CPI inflation rate of 0.667 which is considerably lower.

I then construct four conditional estimates of CPI inflation, denoted as $\hat{\pi}_t|_{f^+}$, $\hat{\pi}_t|_{f^-}$, $\hat{\pi}_t|_{dp^+}$, and $\hat{\pi}_t|_{dp^-}$, where I allow only one component to vary at a time while holding the other three components constant at their means:

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

For example, $\hat{\pi}_t|_{f^+}$ is the predicted inflation rate when the average frequency of price increases varies as observed while holding the other three components constant at their means: f_i^-, dp_i^+, and dp_i^-.

The four panels of Figure 13 displays $\hat{\pi}_t|_{f^+}$, $\hat{\pi}_t|_{f^-}$, $\hat{\pi}_t|_{dp^+}$ and $\hat{\pi}_t|_{dp^-}$, together with π_t. We see that the decline in the frequency of price increases (top left panel), the increase in the frequency of price decreases (bottom left), and the increased magnitude

[12] The means of $\hat{\pi}_t$ and π_t are 8.2 and 5.4 percent.

[13] Note that constructing the CPI from the observations of individual prices is a complicated procedure, which involves adjusting for quality, regional differences, imputing prices, and weighting observations (see Statistics Norway, 2001). Considering the simple algorithm (3) and that I do not have the full set of observations used to construct the CPI one should not expect a perfect fit.

Figure 13: 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.

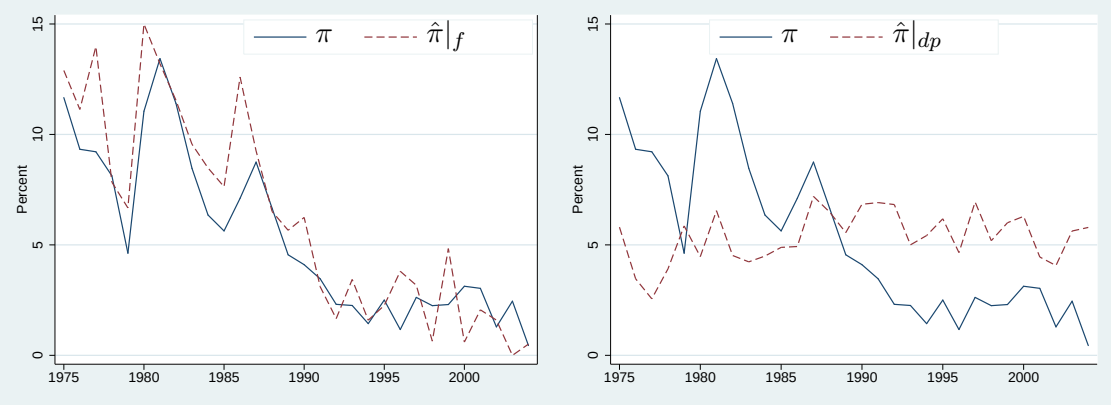

Figure 14: Inflation (solid line) and the contribution from the frequency of price changes (left), and the mean size of price changes (right). Annual rates. Percent.

of price decreases (bottom right) all contributed to the decline in the inflation rate. The larger size of the prices increases contributes significantly to a *higher* inflation rate (top right). The correlation coefficient between π_t and $\hat{\pi}_t|_{f+}$ is highest with 0.899, and the correlation coefficient between π_t and $\hat{\pi}_t|_{f-}$ and $\hat{\pi}_t|_{dp-}$ are 0.788 and 0.739, while the correlation coefficient between π_t and $\hat{\pi}_t|_{dp+}$ is –0.412.

The contribution from the size of price increases on inflation is thus opposite to the contribution from the size of price decreases. What is then the net effect of the intensive margin on inflation? To answer this question I compute the conditional inflation rate where the frequency of price changes are kept constant at their means while allowing the size of price changes to vary:

$$\hat{\pi}_t|_{dp} = \sum_i \omega_{it} \left(f_i^+ dp_{it}^+ + f_i^- dp_{it}^- \right) \tag{5}$$

Similarly, I compute the net contribution from the extensive margin

$$\hat{\pi}_t|_f = \sum_i \omega_{it} \left(f_{it}^+ dp_i^+ + f_{it}^- dp_i^- \right) \tag{6}$$

The left panel of Figure 14 shows the contribution from the extensive margin, $\hat{\pi}_t|_f$, and the right panel shows the contribution from the intensive margin, $\hat{\pi}_t|_{dp}$. The intensive margin is negatively correlated with the CPI (correlation coefficient of –0.115); there is no net contribution from the intensive margin to the variation in the inflation rate. The effect form the size of price decreases on inflation is thus canceled out by a stronger opposite effect from the size of price increases. The extensive margin, $\hat{\pi}_t|_f$, is strongly correlated with CPI inflation (correlation coefficient of 0.914). This result shows that the variation in inflation and in particular the disinflation period is entirely explained by the frequency; the size doesn't matter.

The dominant contribution of the extensive margin indicates a strong state dependence in price setting, which is the opposite result from Klenow and Kryvtsov (2008) and Gagnon (2009). Gagnon do find that the frequency of price changes is correlated with inflation when inflation is above 10–15 percent, however, the frequency of price changes account for little of the inflation variance in Mexico. One possible explanation for the difference with the Klenow and Kryvtsov result is that the Norwegian data represent more variation in inflation. Over the low inflation period 1990–2004, the correlation coefficient between $\hat{\pi}|_{dp}$ and π is 0.509, while the correlation coefficient between $\hat{\pi}|_f$ and π is 0.355. Thus I replicate the Klenow and Kryvtsov result that the intensive margin is more important for the variation in inflation when I look at the low inflation period

in isolation. The reason for this correspondence is that the contribution of the intensive margin is more or less constant over time and thus positively correlated with a low and stable inflation rate. Evaluating evidence using data with more variation in the inflation rate yield the opposite conclusions.

5 Conclusions

There is substantial evidence on price adjustments in economies with low inflation. This paper contributes to this evidence by investigating monthly retail price data from four decades of both high and low inflation. During the 1970s and 1980s, CPI inflation in Norway was high and volatile peaking at 15.1 percent in 1981. Inflation then decreased during the 1980s, and from 1990 onwards CPI inflation has varied around 2.4 percent per year. The empirical findings detect some challenging facts for price setting theories.

(i) The mean frequency of price increases and decreases have varied over time together with the variation in the CPI inflation rate. The frequency of price increases peaked at 20 percent in the early 1980s and declined to around 12 percent after 2000. The frequency of price decreases increased from 6 to 10 percent over the same period.

(ii) The mean size of price increases almost doubled from 11 percent in 1975 to 20 percent in 2004. Similarly, the mean price decrease trended upwards in absolute value from about 9 percent to about 13 percent by the end of the sample. This trend is also robust across different product categories.

(iii) Changes in the frequency of price changes have been far more important for the variation in the inflation rate than variation in the magnitude of price changes. An increase in the size of price decreases has indeed contributed to a lower inflation rate, but the effect has been canceled by an opposite effect of the size of price increases.

(iv) While the average size of price changes is large, more than one third of the (non-zero) price changes are smaller than five percent in absolute value. There are fewer small price changes when inflation is low than when inflation is high.

(v) There is a lot of heterogeneity. At the item level, the frequency of price increases is positively correlated to the frequency of price decreases, and the size of price increases is positively correlated to the size of price decreases. Energy products and unprocessed

food change prices most frequently, and services least frequently. Clothing and footwear exhibit the largest changes of both price increases and decreases.

Prices thus increase on average more frequently, but in smaller amounts when inflation is high, and less frequently with larger amounts when inflation is low. Price decreases, on the other hand, are more frequent and larger in size when inflation is low. This evidence is a strong indication that firms not only treat the size of price changes, but also the timing of price changes as choice variables. The probability of changing prices should thus be treated as an endogenous variable depending on the state of the economy. The inflation history in Norway 1975–2004, which is similar to other OECD economies, is almost entirely explained by changes in the frequency of price changes; the size doesn't matter.

Standard sticky price models can hardly explain these facts. First, time dependent models (Calvo, 1983, and Taylor, 1980) assume that the frequency of price adjustment is exogenous, and are thus not able to explain the variation in inflation. Second, while state dependent models (see Barro, 1972 and Sheshinski and Weiss, 1977) may explain the positive correlation between the frequency of price increases and inflation, they unambiguously predict a positive correlation between the size of prices increases and inflation which is inconsistent with the empirical evidence. Neither can state dependent models explain why there are so many small and frequent price changes both in high and low inflation environments unless there are economies of scope in price adjustments (Midrigan, 2008). However, the present evidence does not seem to support this hypothesis.

One possible explanation for the empirical regularities is that when inflation is high, price setters increase prices regularly to keep up with the pace of inflation. But sometimes prices also change by larger amounts to change the relative price of the product. When inflation is low and stable, there is less need to keep up with the inflation rate and hence the frequency of smaller price changes decreases.

The marked heterogeneity between goods is a reminder of the complexity of price setting. Heterogeneity may reflect that firms adjust prices depending on idiosyncratic shocks from specific market structures, demand and costs factors. Carvalho (2006) argue that monetary shocks may have larger and more persistent effects on the real economy when price setting is heterogeneous, while Dhyne et. al (2006) argue that models used

for monetary policy analyses and forecasts, need to take heterogeneity into account by modelling at least two sectors.

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Appendix

A Data

Today the Norwegian CPI is computed from monthly data of 900 representative goods and services from approximately 2200 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 6 years (72 months).

The price data are reported monthly by the firms either by completed forms or scanner data. The quality of the observations are evaluated and revised before used to construct the CPI. The revision status, i.e. if the price observation is imputed or corrected, status of the item itself, and whether the observation is used or not in the CPI is known. There are missing observations in the sample resulting in breaks in the trajectories.

Items represented by an index are excluded from the data set used in this paper.

I have removed 174,900 observations where the item is not offered anymore, has changed in quality from the previous month, or is a new item.

The number of observations per month 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 for then to increase 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 to the right.

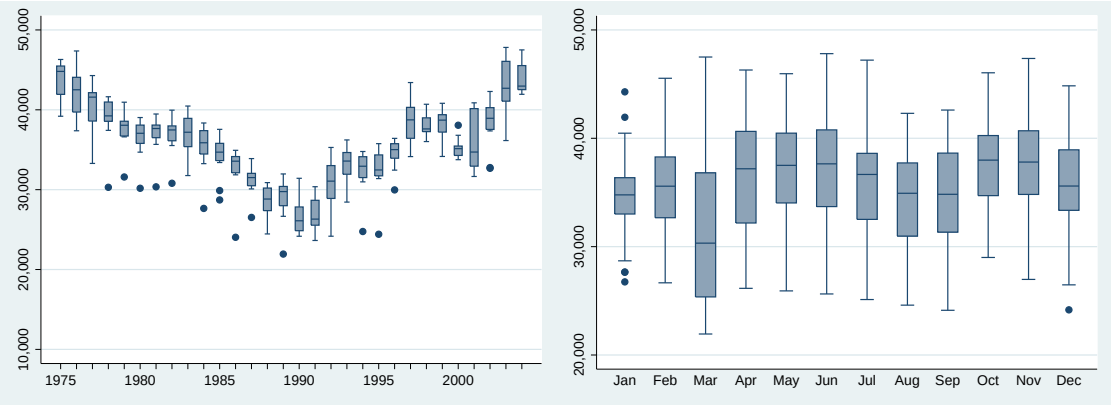

Figure A1: The variation in the number of observations by year (left) and by month (right)

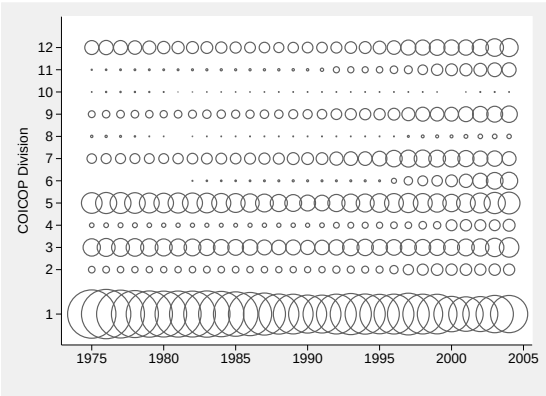

Figure A2: The distribution of observations across coicop groups over time.

B Tables

Table B1: 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

Table B1 continues on next page.

Table B1 continued.

	COICOP Group/Class	n	f	f^+	D	dp^+	dp^-
45	Electricity, gas and other fuels	26,373	31.8	17.5	6.7 (8.2)	10.1	9.1
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 B1 continues on next page.

Table B1 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 B1 continues on next page.

Table B1 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

Notes: n.e.c. is short for not elsewhere classified.

C Figures

Figure C1: 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.

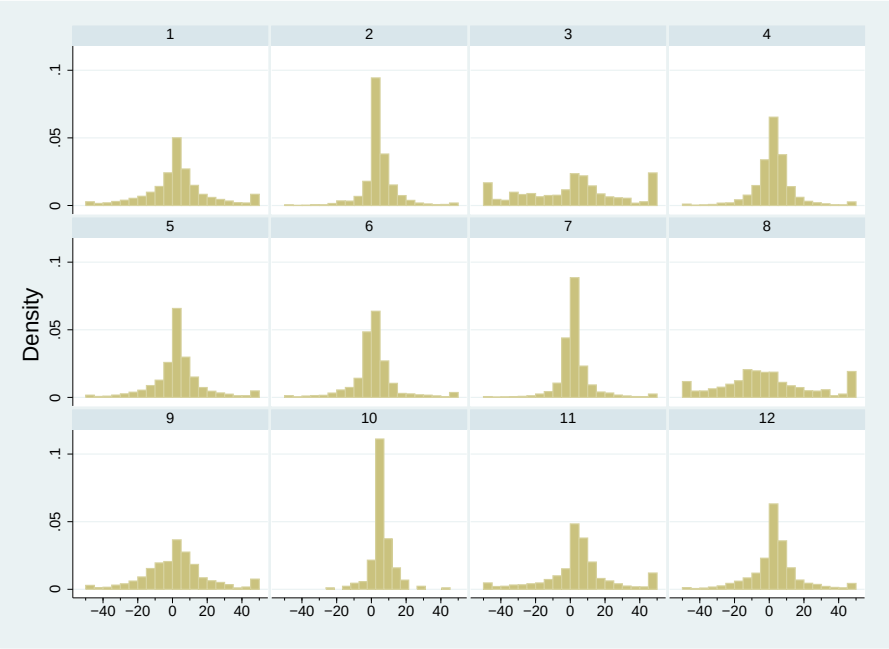

Figure C2: Histogram of all non-zero price changes in percent by COICOP *division. The distributions are truncated at –50 and 50 percent. The* COICOP *divisions are 1: Food and non-alcoholic beverages; 2: Alcoholic beverages, tobacco and narcotics; 3: Clothing and footwear; 4: Housing, water, electricity, gas and other fuels; 5: Furnishings, household equipment and routine household maintenance; 6: Health; 7: Transport; 8: Communication; 9: Recreation and culture; 10: Education; 11: Restaurants and hotels; 12: Miscellaneous goods and services.*