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CHANGING PRICES …. CHANGING TIMES: EVIDENCE FOR ITALY

by Silvia Fabiani* and Mario Porqueddu*

Abstract

This paper examines the process of adjustment of prices in Italy to determine whether nominal flexibility, measured by the frequency of price changes, has increased in the recent years of protracted stagnation and double-dip recession. The analysis is based on a large micro-level dataset of individual prices collected monthly by Istat from 2006 to 2013 for the Consumer Price Index. We find that both the percentage of prices adjusted monthly and the average size of the adjustment have risen significantly since the 1996-2001 period, in particular for downward changes. This greater flexibility is related in part to the spread of modern distribution structures. Our estimates further indicate that the recession has affected the price adjustment mechanism: for manufactures, price cuts have become larger and more frequent, while increases are more moderate; for services, both the frequency and the size of price increases have diminished.

JEL Classification: E31, D21, D40, L11.
Keywords: consumer prices, nominal flexibility, frequency of price adjustment.

Contents

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1 Introduction and main conclusions[1]

The evolving mechanism of price formation and adjustment carries major macroeconomic implications, in particular for the effects of cyclical fluctuations, real exchange rates and optimal monetary policy. The empirical literature on price behaviour at micro level has grown enormously by comparison with the relatively scanty evidence captured fifteen years ago by Taylor (1999), thanks above all to the availability of ample databases of elementary prices (the single prices used in computing consumer and producer price indexes, scanner data, and so on). Bils and Klenow (2004), Dhyne et al. (2006), Nakamura and Steinsson (2008), and Berardi, Gautier and Le Bihan (2013) are just a few of the many studies that analyse price formation and adjustment mechanisms to document the degree of nominal price rigidity. In particular Dhyne et al. (2006) summarize an extensive research project conducted by the Eurosystem in 2003-04, the Inflation Persistence Network (IPN). The results, relating to consumer prices in euro-area countries, derive from the analysis of a dataset of monthly price observations from 1996 to 2001 on a harmonized sample of goods and services forming part of the consumer price index basket. The degree of price rigidity, gauged by the frequency, amplitude and direction of price adjustments, was found to be quite heterogeneous between products. For the euro area as a whole, the average frequency of price changes ranged from 5.6 per cent for services to 28.3 per cent for unprocessed food products to 78 per cent for energy products. There was significant dispersion among countries as well. Italy was at the top of the rigidity range, with only 10 per cent of product prices changing each month as against 15 per cent area-wide.[2] The evidence on the Italian micro data on consumer prices used by the IPN is discussed in Fabiani et al. (2006).[3]

Have Italian price formation and adjustment mechanisms changed since the IPN study? In particular, the question is whether, in an environment of protracted economic stagnation and a double-dip recession that has depressed consumption to historically low levels, there has been an increase in nominal price flexibility, including downward flexibility. We answer this question by examining, like the IPN, the individual elementary prices of goods and services observed monthly by Istat to calculate its Consumer Price Index (*indice nazionale dei prezzi al consumo per l'intera*

[1] An Italian version of this paper ("È aumentata la flessibilità nominale negli ultimi anni? Evidenze per l'Italia sui prezzi al consumo") is published in "Gli effetti della crisi sul potenziale produttivo e sulla spesa delle famiglie in Italia" *http://www.bancaditalia.it/pubblicazioni/collana-seminari-convegni/2014-0018/Effetti-crisi-n-18.pdf.*

[2] Alvarez and Hernando (2007) show that prices tend to be more rigid in countries with markets that are more highly regulated and less open to competition.

[3] S. Fabiani, A. Gattulli, R. Sabbatini and G. Veronese (2006), *Consumer price setting in Italy*, Giornale degli Economisti e Annali di Economia, Bocconi University, Vol. 65(1), pp. 31-74, which bore on prices of products analogous to those examined in the present paper.

collettività, abbreviated in Italian as "NIC").[4] As in the empirical literature, we measure flexibility by the length of the period during which prices tend to remain unchanging or, equivalently, the frequency and direction of revisions.

We cover the period 2006-2013, examining the results both over time and during the recent recessions and also comparing them with the IPN findings for 1996-2001, to determine whether the last decade has shown a tendency to increasing price flexibility, in particular with regard to goods and services whose prices ordinarily show a high degree of rigidity. We focus on the nature of price adjustment during the recessions of 2008-09 and 2011-13.

The data are monthly observations, a sample of 960,000 elementary prices for 49 goods and services in the CPI basket between January 2006 and December 2013.

We take two methodological approaches to estimating the flexibility indicators, in line with the IPN. The first calculates the duration of the prices of single products, i.e. the number of months during which the price of a given product at a given retailer remains unchanged. The second calculates the share of products whose prices change from one month to the next. The average of this share over a given interval, i.e. the frequency of price adjustment, can also be used to derive a gauge of price duration. In both methods, the results depend significantly on the assumptions used in handling the first and last observations in each sequence – the so-called "censoring" problem. Where possible, we set out the results produced on the basis of different approaches to the problem, emphasizing in any case those based on "intermediate censoring."

Our main findings can be summed up as follows:

- Between 2006 and 2013, average price duration was between 4 and 6 months (depending on censoring choice), about 3 months less than in the study for 1996-2001. Energy prices change practically every month, while service prices hold stable for nearly a year.
- About 15 per cent of product prices change every month, on average, going by our preferred methodology.
- We confirm the existence of differences in nominal flexibility depending on product category. The prices of practically all energy goods and nearly a third of unprocessed food change every month. For other components, the share of monthly adjustments comes down to 11 per cent for processed food and services and 6 per cent for non-food, non-energy goods, which remain the type of product with a relatively high nominal price rigidity.

[4] Thanks to Istat's collaboration, we were able to analyse a subset of the database of micro-prices collected monthly at local level for the CPI. In particular, our thanks to Alessandro Brunetti, Federico Polidoro, Paola Pompei, Luca Rondini, Antonella Simone and Davide Zurlo.

- Compared with 1996-2001, in more recent years the percentage of prices adjusted monthly has increased significantly (from 9.5 to 15.5 per cent by our preferred method). Distinguishing between upward and downward adjustments, both increased in frequency (the former from 6 to 9.3 per cent, the latter more sharply, from 3.4 to 6.2 per cent).
- The size of adjustments too was greater than in the earlier period, on average; this was especially true of price reductions, which averaged 13.6 per cent compared with 7.4 per cent in 1996-2001. The increase in both the size and the frequency of price reductions contributed to the gradual attenuation of the asymmetry in the distribution of changes in the prices of non-food, non-energy industrial goods (NEIG) and of services (the latter result being driven chiefly by "hotel services").
- In the modern retailing sector (supermarkets, hypermarkets, discount supermarkets), price flexibility is not only greater than at traditional retailers; it has also increased more markedly by comparison with the period 1996-2001. These differences reflect the price behaviour of processed food and non-food, non-energy goods, which are more flexible downwards in modern distribution structures.
- The pass-on of the increases in the ordinary VAT rate in 2011 and 2013 was quicker in modern retail outlets than in traditional shops.
- Over the period studied, there is a clear tendency to greater price flexibility, especially in the last two years considered. Our estimates indicate that the two recessions have had an impact on the price adjustment mechanism. For NEIG goods, the effects have been more frequent and larger price cuts, and more moderate price increases. For services, both the frequency and the size of price increases have diminished.

2 Inflation: aggregate trends

Between 2006 and 2013 the average annual Italian rate of inflation recorded a high of 3.3 per cent in 2008 and a low of 0.8 per cent in 2009, heavily influenced by the performance of the volatile components (Table 1). The average annual changes in fuel prices, which exceeded 10 per cent in from 2008 to 2012, reflected oil prices and, in late 2011 and early 2012, increased excise taxes and the depreciation of the euro. For the food component, the rate peaked at 5.9 per cent in 2008 for processed and 4.5 per cent for unprocessed food, owing chiefly to higher world commodity prices, especially for cereals.

The twelve-month rise in the prices of non-food, non-energy goods was virtually stable for almost the entire period at around 1 per cent, going above that threshold in 2011 and 2012 in part

owing to the increase in the ordinary VAT rate in October 2011. Since the end of 2012 the rate has been cut in half, however, to around 0.5 per cent. Service price inflation has fluctuated at around 2 per cent, with a peak of 3.0 per cent in 2008, owing in part to transport services, especially airfares, which themselves are heavily affected by fuel costs. This component too slowed down sharply towards the end of 2012.

The period considered had four distinct cyclical phases: (i) growth from 2006Q1 to 2008Q1; (ii) the global recession from 2008Q2 to 2009Q2, which cut GDP by 7 per cent and private consumption by 3 per cent; (iii) two years of modest recovery, with GDP recouping about a third of the cumulative loss and private consumer spending regaining its early-2008 level by the end of 2010; (iv) a second recession beginning in 2011Q3, which by the end of 2013 pushed GDP 9 per cent and household spending 8 per cent below their 2008Q1 peaks. The impact of the two recessions on consumer price behaviour will be examined in the last section of the paper in respect of the components least subject to exogenous shocks, namely non-food, non-energy goods and services.[5]

Table 1 – Inflation, GDP, consumption and euro prices of commodities, 2006-2013
(percentage changes on previous period)

	Inflation						GDP	Private consumption	Food commodities	Oil	$/€ exchange rate
	CPI	Processed food	Unprocessed food	NEIGs	Services	Unregulated energy					
2006	2.1	2.0	1.4	0.8	2.2	6.1	2.1	1.4	8.9	18.2	0.9
2007	1.8	2.5	3.4	0.8	2.1	0.7	1.3	1.2	5.0	2.5	9.2
2008	3.3	5.9	4.5	0.9	3.0	10.4	-1.1	-1.1	15.6	23.1	7.3
2009	0.8	2.1	1.5	1.0	1.8	-13.2	-5.5	-1.5	-8.0	-32.6	-5.3
2010	1.5	0.6	-0.3	1.0	1.9	11.2	1.7	1.2	17.8	37.1	-4.8
2011	2.8	2.4	2.5	1.3	2.3	14.6	0.7	0.0	13.8	33.8	4.9
2012	3.0	2.7	2.2	1.2	2.1	14.3	-2.3	-4.1	4.0	8.4	-7.6
2013	1.2	2.0	3.0	0.5	1.5	-1.6	-1.9	-2.7	-0.7	-5.2	3.3

Source: our elaborations on Istat data.

3 The dataset

Between January 2006 and December 2013 Istat made monthly observations of between 550,000 and 600,000 elementary prices, some 500,000 collected locally by municipal statistics offices in over 80 provincial capitals and the rest observed centrally. The present work is based on a subset of the prices observed locally in 17 cities:[6] 965,298 single prices for 49 products forming part of the CPI basket (which comprised a total of 603 products in 2013) between January 2006 and December 2013. The sample of products was selected for the greatest possible comparability with

[5] Transport services are not included in the dataset available to us.

[6] Sixteen regional capitals (Aosta, Turin, Genoa, Milan, Trento, Venice, Trieste, Bologna, Florence, Ancona, Perugia, Rome, Naples, Bari, Palermo and Cagliari) plus Reggio Calabria. The capitals of the Abruzzo, Basilicata and Molise regions are excluded.

the study done a decade ago, using similar methodologies, on price changes in 1996-2003 (Appendix, Table A1). These goods and services represent about a fifth of the CPI basket, the proportion varying with type of product: they cover practically all unregulated energy goods, while unprocessed food and NEIG are underrepresented (Table 2).[7]

Table 2 – Elementary prices by type of product

Type of product	Elementary prices in the database		Weight in CPI (%) of products in our sample (2012=100)	Weight (%) in CPI (2012=100)	
	Number of price observations	%	actual weight	rescaled weight (1)	sample coverage
Processed food	308,252	31.93	2.41	10.43	23.11
Unprocessed food	150,759	15.62	1.02	6.46	15.76
Energy	34,380	3.56	4.61	9.04	51.04
NEIG	264,176	27.37	3.26	28.57	11.39
Services	207,731	21.52	8.90	43.26	20.58
Total	965,298	100	20.20	97.76	20.66

Source: our elaborations on Istat data. (1) The weights are rescaled so that the sum of the weights of the single items for each type of product is equal to that type's weight in the CPI basket.

The metadata available for each elementary price are described in Appendix Table A2. They enable us to track the price of a product of a given brand at a given retailer over time, i.e. to trace what we call a "price trajectory." A product will be replaced by a substitute if it is no longer sold by the retailer, if the retailer goes out of business, if the reference article ceases to be the most commonly sold, or if it is discarded in Istat's yearly review of the sample. The first two cases represent forced substitution; the last two, choices by Istat. The metadata for each price quote allow identification of substitutions but not of the reasons for them.

By type of retailer, about 39 per cent of the prices in our sample come from supermarkets, hypermarkets or discount supermarkets (Table 3), designated as "modern" retailing institutions, 46 per cent come from "traditional" retailers (minimarkets, shops, consumer cooperatives, street markets, non-food specialty shops), the rest from "other" sales points (miscellaneous units, businesses not classified elsewhere, cinemas, pharmacies, stores selling non-prescription drugs, medical offices and clinics).

These proportions are broadly representative of the overall CPI basket. By comparison with the data for the period 1996-2003, they show a significant increase in the relative importance of modern distribution (a gain of more than 10 percentage points) at the expense of traditional retailers.

[7] Price-regulated energy products, such as gas and electricity tariffs, are not included, however, so our sample comprises about half the energy component.

Table 3 – Elementary prices by type of retailer

(percentages, unweighted)

Distribution channel	% elementary price quotes	
	1996-2003	2006-2013
Traditional	56.8	45.8
Modern	27	39.3
Other	16.2	14.9
Total	100	100.0

Source: our elaborations on Istat data.

4 Methodology

Our analysis exploits both the elementary price data and the related metadata. For clarity and simplicity of interpretation, a concise account of the basic definitions will be helpful:

<u>*Elementary price*</u>: This is the price P of product j (j =1,.., n_j, where n_j is the total number of products), sold at retailer l in a given city at time t (t=1,....T). The elementary price is thus described by $P_{jl,t}$ and the elementary product is defined by the pair (j,l). For example, for product j "coffee", the elementary price $P_{jl,t}$ is the price of a certain brand of coffee sold at retail outlet l in a specified city and observed in month t. As mentioned, our dataset consists of some 965,000 monthly elementary price observations[8] ($P_{jl,t}$) and 49 products (n_j), observed at commercial outlets in 17 cities during the period from January 2006 to December 2012 (T).

<u>*Price spell*</u>: an unbroken sequence of elementary prices for the elementary product (j,l), i.e. the sequence $P_{jl,t}$, $P_{jl,t+1}$,…, $P_{jl,t+k-1}$, where $P_{jl,t+s} = P_{jl,t}$ for $s=1,...,t+k-1$. That is, the price spell is described by three elements: the date of the first price quote (t), the price ($P_{jl,t}$) and the duration (k) of the period for which the price remains unchanged, i.e. $\{P_{jl,t}, t, k\}$.

<u>*Price trajectory*</u>: a succession of s price spells for the product (j,l), i.e. ($\{P_{jl,t}, t_1, k_1\}$, $\{P_{jl,t+k1}, t_2, k_2\}$, $\{P_{jl,t+k1+k2}, t_3, k_3\}$,….,$\{P_{jl,t+k1+...+ks-1}, t_s, k_s\}$). The length of the trajectory for the elementary product *(j,l)* is the sum of the durations of these sequences $L_{jl}=(k_1 +... +k_s)$.

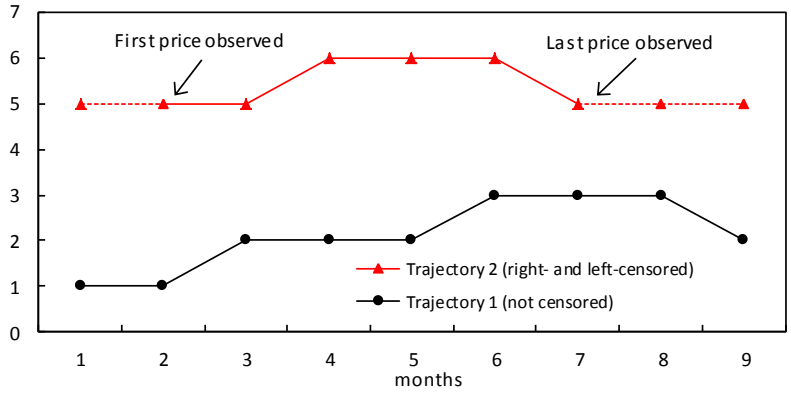
Figure 1 represents these definitions graphically. Price trajectory 1 can be described as the succession of four price spells (with durations of 2, 2, 2, and 1 month): ($\{P$=1, t_0=1, k_1=2$\}$, $\{P$=2, t_0=3, k_2=3$\}$,$\{P$=3, t_0=6, k_3=3$\}$, $\{P$=2, t_0=9, k_3=1$\}$). Price trajectory 2 is a succession of three price spells, each of 3 months' duration: ($\{P$=5, t_0=1, k_1=3$\}$, $\{P$=6, t_0=4, k_2=3$\}$,$\{P$=5, t_0=7, k_3=3$\}$.

On the basis of these definitions, price adjustment policies can be studied by two distinct methods: the duration approach and the frequency approach. The former measures the duration of

[8] For prices observed bimonthly, monthly averages were used.

price spells, whereas the latter calculates the frequency of price adjustments, measuring this indirectly as the percentage of products whose prices change each month. The duration method allows deriving an "implicit" frequency as the inverse of duration; the frequency method, an "implicit" duration as the inverse of frequency. Under certain conditions, then, the two measures are equivalent and yield the same results.

Figure 1 – Price trajectories



In both cases, estimating summary measures for the entire sample of products or selected types or sub-categories requires aggregating the statistics obtained at elementary product level. The method of aggregation can affect the results significantly (see Baharad and Eden, 2004).[9] We take a bottom-up approach, on the hypothesis that products are quite homogeneous within a given category. To ensure that the results are representative, the aggregate statistics (means, medians, standard deviations) are also weighted – that is, calculated rescaling the contribution of each according to the weight of its type within the CPI basket.

4.1 Duration approach

In this method the first stage is the identification of price trajectories, i.e. the sequences of prices, month by month, for each product/retailer pair. A trajectory ends when the product is replaced, for any of various reasons, by another good or service. Once the trajectories are traced, price spells are identified within them, i.e. the sequences between one price adjustment and the next, and their average duration is calculated. In the example in Figure 1, the average duration of price spells in Trajectory 1 is the simple average of the individual durations (2, 3, 3, and 1); this is tantamount to dividing the number of observations (9) by the number of spells (4).

9 Baharad and Eden (2004).

The average duration of prices can be calculated by various formulas. The simplest is to aggregate all the spells and assign the same weight to each:

$$\bar{d} = \frac{1}{N_{spells}} \sum_{j=1}^{n_j} \sum_{s=1}^{N_{sj}} d_{js} = \frac{N_{observations}}{N_{spells}}$$

where j is the product (J=49), d_{js} is the duration of spell s of product j and N_{sj} is the number of spells for product j. Clearly, this formula attributes greater weight to the products with more frequent price variations (which have more spells). This shortcoming is overcome by calculating first the average duration of spells by product and then aggregating that average duration on all the products:

$$\bar{d}_j = \frac{N_{observations\ for\ product\ j}}{N_{spells\ for\ product\ j}}; \quad \bar{\bar{d}} = \sum_{j=1}^{n_j} \frac{1}{n_j} \bar{d}_j$$

If we consider the weights of the individual products in the CPI basket or, as in this work, their rescaled weights (which sets the contribution of the single products equal to the CPI index weight of the product type to which they belong) we get the weighted average duration of price spells, aggregated by product:

$$\bar{\bar{d}}^w = \sum_{j=1}^{n_j} \omega_j \bar{d}_j$$

4.2 Frequency approach

The literature offers many analyses of price adjustment by the frequency approach (see for instance Bils and Klenow, 2004). For every product j, the average frequency of adjustment at time t is here defined as the number of observations in each period for which a price change is observed (NUM_{jt}, where t=2,….,T), as a ratio to the total number of observations for that production during the same period (DEN_{jt}):

$$F_{jt} = \frac{NUM_{jt}}{DEN_{jt}} = \frac{Total\ changes}{Total\ observations}$$

so the average frequency for the product is given by:

$$F_j = \frac{\sum_{t=2}^{T} NUM_{jt}}{\sum_{t=2}^{T} DEN_{jt}}$$

The same formula can be used to calculate upward and downward price adjustments separately, simply by taking as numerator the number of positive (negative) price variations in the period:

$$F_j = \frac{\sum_{t=2}^{T} NUMUP_{jt}}{\sum_{t=2}^{T} DEN_{jt}} \quad \left(F_j = \frac{\sum_{t=2}^{T} NUMDW_{jt}}{\sum_{t=2}^{T} DEN_{jt}} \right)$$

Under certain conditions of stationarity of the process that generates price spells both over time and among products, and assuming that price adjustments come at discrete intervals, the average duration of the spells for product *j* is derived as the inverse of the frequency:

$$\overline{T}_j = \frac{1}{F_j}$$

As with the duration method, the average frequency of price adjustments by type of product and for all goods and services taken together is obtained, either unweighted or weighted) by the following aggregations:

Average overall unweighted frequency: $\overline{\overline{F}} = \sum_{j=1}^{n_j} \frac{1}{n_j} \overline{F}_j$

Average overall weighted frequency: $\overline{\overline{F}}^{w} = \sum_{j=1}^{n_j} \omega_j \overline{F}_j$

For a generic time interval and a subset of observations – say, those for a given product type – the formula used in this work for average frequencies is:

Average frequency for subset J of prices in period T: $F_{JT}{}^{w} = \sum^{j \in J} \sum^{t \in T} \omega_j F_{jt}$

A great advantage of this approach is that it does not require data over long periods of time. In principle, the observation window may even be shorter than the average price spell. Second, the approach allows explicit exclusion of periods (one or more months) marked by exceptional events that could distort the results – for instance, an increase in the VAT rate. Finally, it is less exposed than the duration method to loss of observations due to censoring.

4.3 The treatment of censoring

Both the above approaches are affected by the assumptions made concerning the first and last observations of the trajectory. For even though these are the first and last observations made by Istat, they do not necessarily coincide with the first and last prices available for a given product.

The problem, known as "censoring" in the literature, is illustrated in Figure 1. The first spell in Trajectory 2 is truncated on the left (left-censored), in that the price begins to be tracked in period t=2 even though the quote is present also at t=1. And the last spell is right-censored, as the observation ends with period t=7 even though the quote is available in the next two periods as well. In this trajectory, therefore, unlike Trajectory 1, the first and last observations do not coincide with the first and last prices. Two empirical strategies can be used to deal with censoring:

a) No censoring – The problem is simply ignored, and all spells are used in the analysis.

b) Full censoring – It is assumed that the first and last spells of each trajectory are censored, hence excluded from the analysis. This produces a smaller number of observations (limited to the prices of the non-extreme spells in each trajectory) than those that could potentially be used.

In lieu of these "extreme" strategies, intermediate solutions are also possible. Very often censoring is due to a change of product, variety, or company. As noted, the change can be either a forced substitution (the product is no longer sold or the retailer goes out of business) or optional (on the occasion of the rebasing of the index at the end of each year). As our metadata do not distinguish between the two types of substitution, we assume that all changes in January (of product, variety, or company) are optional, as part of rebasing, and all the others are forced. So our third strategy is:

c) Intermediate censoring – We define as censored only the first and last spells of a trajectory that begins in January or ends in December; those of the trajectories that begin or end with a forced substitution (i.e. in any other month) are deemed uncensored. This clearly increases the number of observations available for analysis. For some product categories in particular this approach may underestimate adjustment frequency (or overestimate price duration). A good example is clothing: typically, at the start of every season a new model is introduced and sold at a given price until it is replaced by a new, slightly different version. Under intermediate censoring the old model never changes price. This distortion can be attenuated by the additional assumption that in the same month in which the old model goes out of stock and is replaced by a new one, there is a change in its price (though it is no longer observed). This hypothesis leads to a fourth strategy:

d) Intermediate censoring with pseudo-change of prices – Here again, we consider to be censored and exclude from the analysis only the first and last spells of trajectories in connection with optional substitutions. We further assume that the first and last spells of trajectories that begin or end by forced substitution (uncensored) coincide with a price change. This change is factored into the calculation of frequency but obviously not the size of price adjustments, in that it is an "implicit" variation that is not actually observed.

The estimates of price duration and adjustment frequency depend very significantly on the censoring approach adopted. As all the methods described here have shortcomings, we have elected, where possible, to calculate the statistics for our analysis using all four. However, we focus principally on the results obtained with intermediate censoring, which we consider to be the least constrained by strong assumptions.

5 Results

5.1 Product types

We identify nearly 30,000 price trajectories. The average duration is 33 months; it is especially long for unprocessed food and energy products (almost 50 months in both cases), shorter for non-food, non-energy goods (22 months). The great dispersion by product type characterizes median duration as well (Table 4). By comparison with the findings for 1996-2001 (given in Fabiani et al., 2006), the trajectories for processed food and energy products are longer, those for other goods and services slightly shorter.

Table 4 – Price trajectories by product type
(unweighted)

	2006-2013				1996-2001			
	No. observations	Mean	Median	Std. Deviation	No. observations	Mean	Median	Std. Deviation
Unprocessed food	3,038	48	40	34	1,297	48	46	29
Processed food	8,406	37	25	31	6,304	33	25	26
NEIG	12,034	22	12	23	6,815	30	24	24
Energy	694	49	44	34	717	43	36	27
Services	4,808	43	31	33	3,725	49	47	31
Total	**28,980**	**33**	**21**	**31**	**18,858**	**36**	**30**	**28**

Source: our elaborations on Istat data.

Depending on censoring method, the length of time over which prices are unchanged, i.e. the duration of the price spells, ranges from an average of 4 months with full censoring to 6 months with no censoring (Table 5). The median is lower, just 1 month. Both statistics are appreciably lower for energy goods and unprocessed food, higher for services and NEIG goods. The duration, both mean and median, appears to be between 1 and 4 months shorter in the 2006-2013 period than in 1996-2001, depending on censoring method. The shortening involves all product types.

Figure 2 confirms the great heterogeneity not only of mean and median but also of the entire distribution of duration by product type. In the case of energy goods, 97 per cent of the spells observed in the entire period last just a single month. The figure comes down to 65 per cent for unprocessed food and well below 30 per cent for other product types, with a low of 11 per cent for

non-food, non-energy goods. All in all, the distribution is more uniform for processed food, services, and NEIG goods, with a mean of just under one year and medians of 3 to 6 months.

Table 5 – Duration of price spells by product type

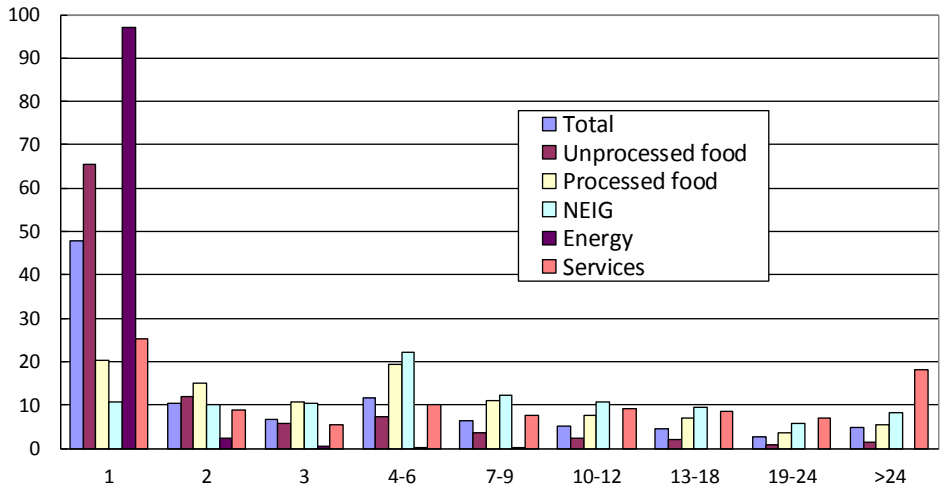
(observations and months)

	2006-2013			1996-2001		
	No. observations	Mean	Median	No. observations	Mean	Median
Unprocessed food	50,266	4	1	13,447	9	3
Processed food	41,802	8	4	19,689	9	5
NEIG	26,909	10	6	13,505	14	10
Energy	32,665	1	1	14,845	2	1
Services	15,096	10	3	7,822	15	11
Total no censoring	166,738	**6**	**1**	**69,308**	**10**	**5**
Total full censoring	**120,357**	**4**	**1**	**43,886**	**6**	**2**
Total intermediate censoring	**141,319**	**4**	**1**	**58,397**	**8**	**4**

Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket. The results using intermediate censoring with pseudo-change of prices are not shown here, because using the duration method it yields the same result as with intermediate censoring.

Figure 2 – Distribution of duration of price spells by product type

(percentages; no censoring)



Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

This initial evidence on price duration is confirmed by direct calculation of adjustment frequency, which averaged 14.1 per cent in the period 2006-13 with no censoring, 16.5 per cent with full censoring, and 15.5 per cent with intermediate censoring (Table 6). Apart from the differences in level, trends in frequency are relatively homogeneous among the various censoring methods. After a low in 2009, for all three methods there is a significant increase in 2011, when the ordinary VAT rate was raised by one percentage point, and a continuation of the rising tendency in 2012 and 2013.

Under intermediate censoring, which in our opinion produces the most robust results, the average frequency of price adjustments declined from 15 per cent in 2006 to 14 per cent in 2009, subsequently turning back upwards, with an especially large increase in 2013 to 19.1 per cent.

Table 6 – Frequency of price adjustment
(percentages)

	No censoring	Full censoring	Intermediate censoring	Intermediate censoring with pseudo-change of price
2006	12.3	15.7	14.8	14.4
2007	13.4	15.9	14.9	16.6
2008	13.6	15.6	14.6	15.7
2009	13.1	14.8	14.0	15.1
2010	13.8	15.5	14.6	15.9
2011	15.7	17.1	16.4	17.6
2012	15.3	17.8	16.7	17.8
2013	16.6	20.0	19.1	20.5
2006-2013	**14.1**	**16.5**	**15.5**	**16.7**
Unprocessed food	27.5	30.8	29.4	29.7
Processed food	9.2	12.0	10.7	11.5
NEIG	5.4	7.6	5.9	8.7
Energy	97.0	97.2	97.1	97.1
Services	9.0	11.4	11.1	11.4

Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

The significant differences between product types in the pattern of price adjustments stand confirmed. Every month nearly all energy products show a price change, as do 30 per cent of unprocessed food. For the other three components, monthly adjustments are considerably less frequent: just over 9 per cent for processed food and services, and between 5 and 9 per cent for NEIG goods. For services, the result is driven by hotel prices, net of which the average frequency falls drastically to 4 per cent.

By comparison with the 1996-2001 period, the average frequency of price adjustment was markedly higher in 2006-13, and price duration correspondingly shorter. Under intermediate censoring, monthly adjustment frequency rises from 9.5 to 15.5 per cent, while implicit duration falls from 10.5 to 6.5 months (Table 7). The higher frequency is confirmed also when upward and downward adjustments are taken separately. By our preferred censoring approach, there was a significant increase in price rises (from 6 to 9.3 per cent per month) and also in price cuts (from 3.4 to 6.2 per cent).

Table 7 – Period 2006-13 and period 1996-2001 compared

(percentages)

	Freq. change		Average price duration	
	2006-2013	1996-2001	2006-2013	1996-2001
No censoring	14.1	8.8	7.1	11.3
Full censoring	16.5		6.1	
Intermediate censoring	15.5	9.5	6.5	10.5
Pseudo-change in price	16.7		6.0	
	Freq. increase		**Freq.decrease**	
	2006-2013	1996-2001	2006-2013	1996-2001
No censoring	8.6	5.6	5.5	3.2
Full censoring	9.8		6.6	
Intermediate censoring	9.3	6.0	6.2	3.4
Pseudo-change in price	9.2		6.2	

Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

A closer examination, according to product type, finds that the largest increase in price flexibility between the two periods was in services, whose average adjustment frequency more than doubled, followed by non-regulated energy goods (Table 8). For the other types, the increase in adjustment frequency ranges from 2 percentage points for NEIG goods and processed food to more than 8 points for unprocessed food. The overall increase in average flexibility is the outcome of an accelerating trend during the period. For core components only, which are less subject to outside shocks, adjustment frequency rose from 5.3 per cent in 2006 to 7.7 per cent in 2013 for NEIGs and from 10.7 to 16.2 per cent for services.

Looking only at upward price adjustments, the increase in frequency is clear, both by comparison with 1996-2001 and in the course of the 2006-13 period. For services, the average monthly share of price increases rises from 3.7 to 6.4 per cent, and between 2006 and 2013 it goes up by around 4 points, from 5.5 to 9 per cent. For NEIG products the difference between the two periods is less marked, as is the growth of flexibility during the second period (on average, from 3.0 to 3.8 per cent between the two periods and from 3.4 to 4.4 per cent from 2006 to 2013). Moreover, the results for this component are significantly affected by the rise in the ordinary VAT rate in the autumn of 2011, when price adjustments were made for about 20 per cent of the products (Figure 3). The product type recording the sharpest average increase between the earlier and later periods is energy goods, from 34 to 59 per cent.

However, the clearest indication of the increased price flexibility comes from downward adjustments, especially for the core components. In the 2006-13 period the average percentage of price cuts was more than twice as high for NEIGs and more than four time as high for services as in 1996-2001. For these product types the sharpest discontinuity is in the last two years of our sample

period, with frequencies rising from 1.9 to 3.3 and from 4.6 to 7.2 per cent respectively (the latter again owing chiefly to the more frequent decreases in hotel prices).

Table 8 – Product types

(frequency in percentages, duration in months; intermediate censoring)

	Unprocessed food						Processed food					
	Freq. Increase	Freq. decrease	Freq. change	Asymmetry	Average duration	Median duration	Freq. Increase	Freq. decrease	Freq. change	Asymmetry	Average duration	Median duration
2006	14.3	15.3	29.6	-1.0	3.4	2.0	5.2	3.8	9.0	1.4	11.1	7.3
2007	16.3	10.5	26.8	5.8	3.7	2.2	9.5	2.9	12.4	6.6	8.1	5.2
2008	16.1	11.6	27.7	4.5	3.6	2.1	9.3	2.7	11.9	6.6	8.4	5.5
2009	12.7	13.2	25.8	-0.5	3.9	2.3	4.0	4.0	8.0	0.0	12.5	8.3
2010	14.2	12.4	26.6	1.8	3.8	2.2	4.4	4.2	8.6	0.2	11.6	7.7
2011	19.2	14.3	33.5	4.9	3.0	1.7	9.2	3.2	12.4	6.0	8.1	5.2
2012	18.3	14.4	32.7	3.9	3.1	1.8	7.3	3.9	11.2	3.4	8.9	5.8
2013	18.8	16.1	34.9	2.7	2.9	1.6	7.8	4.7	12.5	3.1	8.0	5.2
2006-2013	**16.2**	**13.3**	**29.4**	**2.9**	**3.4**	**2.0**	**7.2**	**3.6**	**10.7**	**3.6**	**9.3**	**6.1**
1996-2001	**11.2**	**9.8**	**21.1**	**1.4**	**4.7**	**2.9**	**5.2**	**3.2**	**8.4**	**2.0**	**11.9**	**7.9**
	NEIG						**Energy**					
	Freq. Increase	Freq. decrease	Freq. change	Asymmetry	Average duration	Median duration	Freq. Increase	Freq. decrease	Freq. change	Asymmetry	Average duration	Median duration
2006	3.4	2.0	5.3	1.4	18.9	12.7	46.0	41.7	87.7	4.3	1.1	0.3
2007	3.7	1.8	5.5	1.9	18.2	12.3	71.9	23.9	95.8	48.0	1.0	0.2
2008	3.9	2.0	5.8	1.9	17.2	11.6	43.9	55.3	99.2	-11.4	1.0	0.1
2009	3.3	1.9	5.1	1.4	19.6	13.2	56.0	42.6	98.6	13.4	1.0	0.2
2010	3.2	2.0	5.2	1.2	19.2	13.0	66.4	31.6	98.0	34.8	1.0	0.2
2011	5.3	1.9	7.2	3.4	13.9	9.3	77.2	21.6	98.9	55.6	1.0	0.2
2012	3.4	2.2	5.6	1.2	17.9	12.0	51.6	47.1	98.7	4.5	1.0	0.2
2013	4.4	3.3	7.7	1.1	13.0	8.7	53.8	43.7	97.5	10.1	1.0	0.2
2006-2013	**3.8**	**2.1**	**5.9**	**1.7**	**16.9**	**11.4**	**58.8**	**38.3**	**97.1**	**20.5**	**1.0**	**0.2**
1996-2001	**3.0**	**1.0**	**4.0**	**2.0**	**25.0**	**17.0**	**34.0**	**27.9**	**61.9**	**6.1**	**1.6**	**0.7**
	Services						**Total**					
	Freq. Increase	Freq. decrease	Freq. change	Asymmetry	Average duration	Median duration	Freq. Increase	Freq. decrease	Freq. change	Asymmetry	Average duration	Median duration
2006	5.5	5.1	10.7	0.4	9.3	6.1	7.9	6.9	14.8	1.0	6.8	4.3
2007	5.4	3.7	9.1	1.7	11.0	7.3	10.2	4.7	14.9	5.5	6.7	4.3
2008	5.3	3.5	8.8	1.8	11.4	7.5	8.2	6.4	14.6	1.8	6.8	4.4
2009	5.3	4.1	9.4	1.2	10.6	7.0	7.9	6.2	14.0	1.7	7.1	4.6
2010	6.2	4.2	10.4	2.0	9.6	6.3	9.0	5.6	14.6	3.4	6.8	4.4
2011	6.3	4.6	10.9	1.7	9.2	6.0	11.1	5.3	16.4	5.8	6.1	3.9
2012	7.1	6.0	13.1	1.1	7.6	4.9	9.3	7.5	16.7	1.8	6.0	3.8
2013	9.0	7.2	16.2	1.8	6.2	3.9	10.7	8.4	19.1	2.3	5.2	3.3
2006-2013	**6.4**	**4.7**	**11.1**	**1.7**	**9.0**	**5.9**	**9.3**	**6.2**	**15.5**	**3.1**	**6.5**	**4.1**
1996-2001	**3.7**	**1.1**	**4.8**	**2.6**	**20.8**	**14.1**	**6.0**	**3.5**	**9.5**	**2.5**	**10.5**	**6.9**

Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

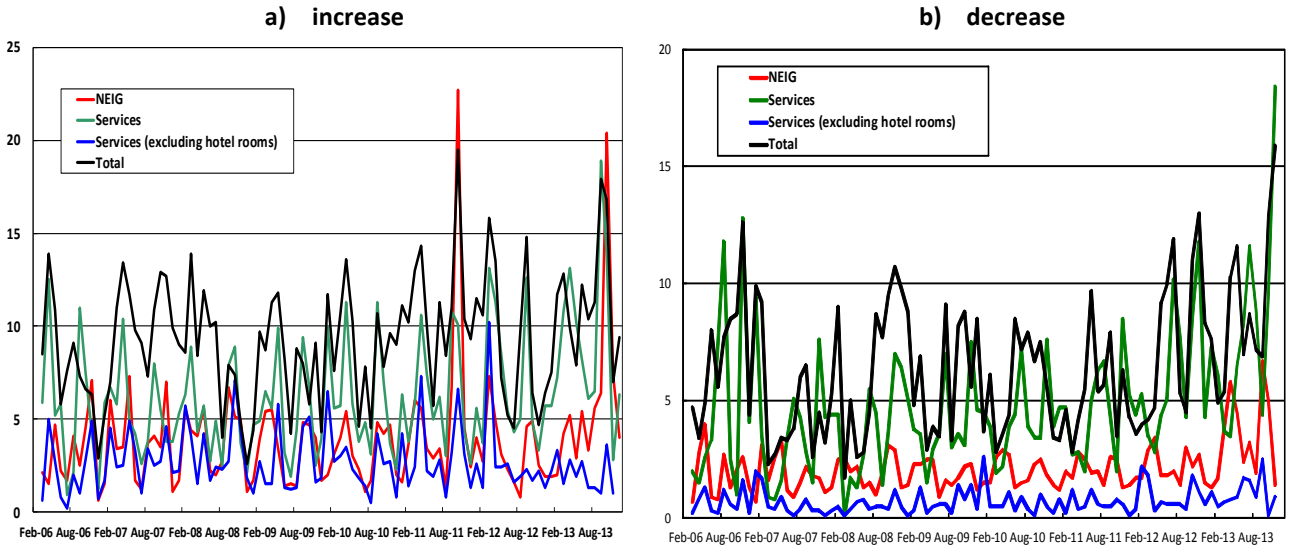
As a result of these changes, in particular the rising frequency of downward adjustments, the asymmetry of price mechanisms, measured as the difference between the incidence of price rises and cuts, was less marked in the later than in the earlier period for both NEIG goods and services (Table 8, fourth column of each panel). On the other hand, the sharp rises in commodity prices in many recent years resulted in greater asymmetry in the food and energy goods segments. Fuel prices responded very quickly to fluctuations in oil prices, while the upward pressure on food

commodities affected chiefly the prices of processed food (especially pasta and bread in 2007 and 2008, and in 2011 and 2012 also other food products).

As for services, the attenuation of the asymmetry in price variations was driven most powerfully by the heightened frequency price cuts for "hotel rooms" (from 1.6 per cent in 1996-2001 to 18 per cent in 2006-13), presumably owing to the greater use of the Internet for selecting and booking rooms. The frequency of reductions rose steadily throughout the period, nearly matching the frequency of price rises during the recession (around 20 per cent in 2012 and 30 per cent in 2013). Excluding this item, the statistics on price adjustment frequency in the service segment remain very close to those for 1996-2001 (Figure 3).

Figure 3 – Frequency of price adjustment

(percentages; intermediate censoring)



Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

In recent years, this greater frequency of price adjustments has been accompanied by greater average amplitude, both upwards and downwards (Table 9).

The average rise increased from 6.9 to 8.6 per cent, the average reduction from 7.4 to 13.6 per cent. The latter's greater amplitude can be ascribed above all to NEIGs and services, whose average variations were much greater than in the past. For energy goods, where they were most frequent, both upward and downward adjustments were on the order of 2 per cent.

In short, in recent years the distribution of price changes has become less asymmetrical, owing above all to a significant increase in both the frequency and the amplitude of price reductions.

Table 9 – Amplitude of price adjustments by product type

(percentages; intermediate censoring)

	Unprocessed food		Processed food		NEIG	
	Average increase	Average decrease	Average increase	Average decrease	Average increase	Average decreas
2006	10.0	-10.9	6.1	-5.4	7.3	-7.3
2007	11.0	-10.7	7.3	-6.8	8.1	-10.7
2008	11.0	-11.9	7.0	-8.7	7.1	-10.7
2009	11.2	-12.1	6.7	-7.4	7.6	-13.4
2010	12.3	-11.6	7.0	-7.3	7.1	-11.5
2011	9.2	-10.1	6.3	-7.9	8.0	-13.2
2012	9.5	-10.2	5.6	-7.0	9.4	-10.4
2013	9.2	-10.0	5.4	-6.0	5.8	-8.2
2006-2013	10.5	-11.1	6.6	-7.4	7.6	-11.6
1996-2001	7.3	-8.0	5.9	-5.9	6.5	-8.1
	Energy		**Services**		**Total**	
	Average increase	Average decrease	Average increase	Average decrease	Average increase	Average decreas
2006	1.4	-2.0	12.8	-8.5	9.1	-7.5
2007	1.7	-1.2	9.8	-10.3	8.6	-9.5
2008	2.1	-4.2	10.1	-12.8	8.4	-11.0
2009	2.0	-1.7	10.3	-12.5	8.7	-11.5
2010	1.8	-1.2	9.3	-14.6	8.2	-11.6
2011	2.0	-0.9	10.7	-13.1	8.8	-11.5
2012	2.0	-1.5	10.8	-12.4	9.3	-10.2
2013	1.0	-1.4	10.9	-19.1	8.1	-12.0
2006-2013	1.8	-1.7	10.2	-19.2	8.6	-13.6
1996-2001	1.8	-1.7	8.9	-11.9	6.9	-7.4

Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

5.2 Type of retailer

Price adjustments are much more frequent in modern distribution networks (supermarkets, hypermarkets, discount supermarkets). In traditional shops the prices of food and NEIG goods – for which a comparison with modern distributors is possible – tend to change much less frequently, hence to remain unchanged for longer (frequency of 8.4 as against 12 per cent; Table 10).[10]

The principal factor in this result is the lesser downward flexibility of traditional shops, where the frequency of price cuts averages about 3 per cent, 2 points less than in supermarkets and the like. By product type, the differences are sharpest for processed food and NEIG products, where the frequency of reductions is half as great in traditional as in modern retail outlets.

By contrast, the average amplitude of adjustments does not differ significantly according to retail channel. The largest divergences involve NEIG goods, where the average size of price

[10] Homogeneous comparison with the results for 1996-2001 is impossible. For the earlier period, only intermediate censoring with pseudo-change of prices was used, and only the total was calculated. In any case, the available evidence indicates that the fraction of products whose prices change every month has increased, by about 2 percentage points for modern and 1 point for traditional retailing outlets.

reductions is greater in traditional shops, and unprocessed food, where price rises are larger at modern outlets.

Table 10 – Frequency and amplitude of price adjustments by distribution channel

(percentages; intermediate censoring)

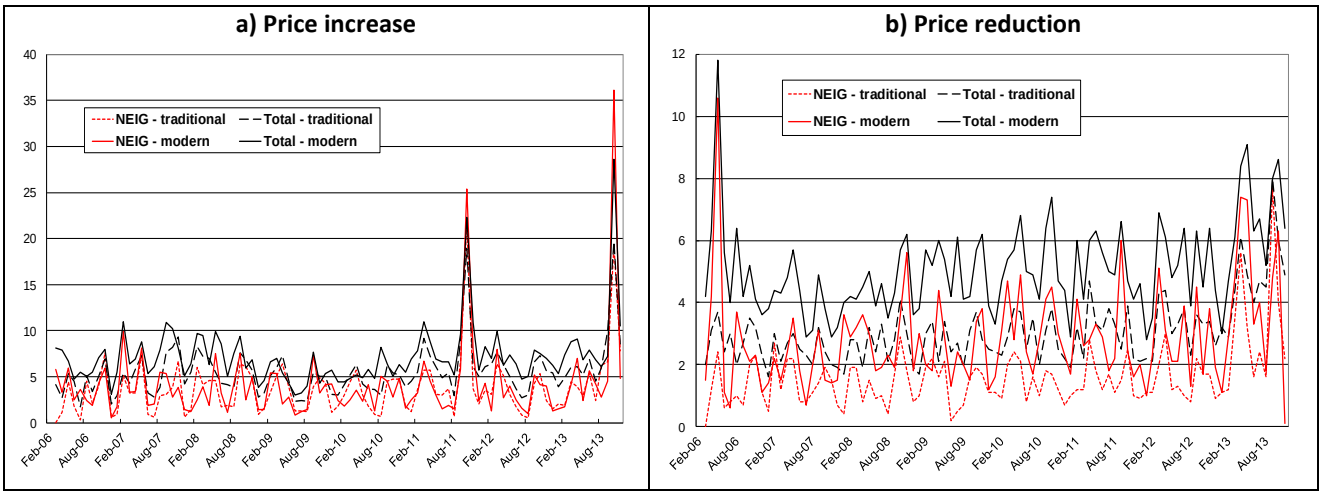
		Unprocessed food					Processed food				
		Freq. Increase	Freq. decrease	Freq. change	Average increase	Average decrease	Freq. Increase	Freq. decrease	Freq. change	Average increase	Average decrease
2006	Modern	16.4	17.3	33.7	11.0	-12.2	6.0	4.6	10.6	6.1	-6.2
	Traditional	*10.8*	*11.8*	*22.6*	*8.2*	*-9.5*	*3.0*	*1.2*	*4.2*	*6.8*	*-6.0*
2007	Modern	18.7	13.1	31.8	12.0	-11.5	10.9	3.7	14.6	7.0	-7.0
	Traditional	*13.9*	*8.3*	*22.3*	*9.9*	*-9.2*	*6.7*	*1.2*	*7.9*	*7.6*	*-5.9*
2008	Modern	18.7	12.8	31.5	11.3	-12.9	10.6	3.2	13.8	7.4	-12.1
	Traditional	*12.9*	*10.3*	*23.2*	*10.8*	*-12.1*	*6.6*	*1.3*	*7.8*	*6.2*	*-7.8*
2009	Modern	13.8	15.8	29.6	11.7	-12.1	4.5	5.0	9.5	7.0	-7.5
	Traditional	*11.4*	*10.3*	*21.7*	*11.6*	*-13.1*	*2.8*	*1.5*	*4.3*	*6.3*	*-6.1*
2010	Modern	16.7	14.4	31.1	13.2	-12.3	4.7	4.9	9.6	7.4	-7.2
	Traditional	*11.6*	*10.2*	*21.9*	*10.5*	*-11.6*	*3.6*	*2.0*	*5.6*	*6.7*	*-7.6*
2011	Modern	21.9	16.5	38.3	9.9	-10.9	10.2	3.8	14.0	6.3	-6.9
	Traditional	*15.9*	*11.9*	*27.8*	*8.4*	*-9.5*	*6.7*	*1.4*	*8.0*	*6.0*	*-9.8*
2012	Modern	20.6	15.9	36.5	9.9	-10.6	8.0	4.4	12.4	5.4	-6.9
	Traditional	*15.4*	*11.6*	*26.0*	*9.6*	*-12.1*	*5.2*	*1.9*	*7.1*	*6.1*	*-6.4*
2013	Modern	20.8	17.3	38.0	9.7	-11.1	8.8	5.4	14.2	5.3	-6.0
	Traditional	*16.2*	*13.9*	*30.1*	*8.3*	*-8.8*	*4.9*	*3.1*	*8.0*	*5.3*	*-5.7*
2006-2013	**Modern**	**18.5**	**15.2**	**33.8**	**11.1**	**-11.8**	**8.0**	**4.3**	**12.3**	**6.7**	**-7.8**
	Traditional	**13.5**	**10.9**	**24.5**	**9.8**	**-11.2**	**5.2**	**1.6**	**6.8**	**6.4**	**-7.5**
		NEIG					**Total**				
		Freq. Increase	Freq. decrease	Freq. change	Average increase	Average decrease	Freq. Increase	Freq. decrease	Freq. change	Average increase	Average decrease
2006	Modern	3.5	3.0	6.4	6.9	-7.4	6.0	5.5	11.5	7.3	-7.9
	Traditional	*3.1*	*1.3*	*4.4*	*7.0*	*-8.4*	*4.2*	*2.9*	*7.1*	*7.1*	*-7.9*
2007	Modern	4.0	1.9	5.9	6.8	-12.4	7.8	4.0	11.8	7.6	-10.8
	Traditional	*3.3*	*1.4*	*4.7*	*7.7*	*-10.7*	*5.6*	*2.4*	*8.0*	*8.0*	*-9.4*
2008	Modern	3.5	2.9	6.4	7.0	-10.2	7.4	4.5	11.9	7.7	-11.0
	Traditional	*3.7*	*1.4*	*5.0*	*7.6*	*-10.7*	*5.7*	*2.7*	*8.4*	*7.8*	*-10.3*
2009	Modern	3.2	2.5	5.7	8.3	-14.7	5.1	5.0	10.1	8.5	-12.7
	Traditional	*3.2*	*1.4*	*4.5*	*7.2*	*-15.3*	*4.3*	*2.7*	*7.1*	*7.7*	*-12.9*
2010	Modern	3.1	3.1	6.2	7.9	-11.0	5.5	5.2	10.7	8.6	-10.3
	Traditional	*3.1*	*1.4*	*4.5*	*7.1*	*-11.7*	*4.5*	*2.9*	*7.4*	*7.6*	*-10.8*
2011	Modern	5.4	2.8	8.2	7.4	-13.6	9.0	5.1	14.0	7.6	-11.7
	Traditional	*5.0*	*1.5*	*6.5*	*8.2*	*-13.4*	*7.0*	*3.0*	*10.0*	*7.7*	*-11.9*
2012	Modern	3.3	2.8	6.1	7.0	-7.5	*7.0*	*5.1*	*12.1*	*7.1*	*-7.8*
	Traditional	*3.2*	*1.5*	*4.7*	*9.5*	*-11.6*	*5.5*	*3.2*	*8.7*	*8.7*	*-10.4*
2013	Modern	4.4	4.1	8.5	4.2	-8.0	*7.9*	*6.4*	*14.2*	*5.3*	*-8.0*
	Traditional	*4.2*	*2.9*	*7.1*	*5.9*	*-11.2*	*6.2*	*4.6*	*10.8*	*6.1*	*-9.3*
2006-2013	**Modern**	**3.9**	**2.8**	**6.7**	**7.3**	**-11.0**	**7.0**	**5.0**	**12.0**	**7.7**	**-10.4**
	Traditional	**3.6**	**1.5**	**5.1**	**7.7**	**-12.2**	**5.5**	**3.0**	**8.4**	**7.8**	**-11.0**

Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

Also with the ordinary VAT rate increases in October 2011 and October 2013, which affected 87 per cent of the NEIG goods, the frequency of price rises for those products was greater in modern than in traditional outlets (Figure 4a), signalling a faster pass-along of the VAT increase.

Figure 4 – Frequency of price adjustment for non-food, non-energy goods

(percentages; intermediate censoring)



Source: our elaborations on Istat data. Statistics weighted by shares of product types in CPI basket.

5.3 The effects of the two recessions

For each period, aggregate inflation or inflation for a single type of goods can be proxied by summing the products of frequency and amplitude of price increases and price decreases:

$$\pi = F^{+}\Delta p^{+} + F^{-}\Delta p^{-}.$$

Starting from this equation, we can decompose the rate of inflation into four components: average inflation for the entire period, the contribution of frequencies (the "extensive margin"), the contribution of amplitudes ("intensive margin"), and a residual.

Figure 5 graphs this decomposition for the month-on month inflation rate for NEIG goods, using the 16 products that belong to this category in our dataset disaggregated into the contributions of average inflation and of the frequencies and amplitudes of upward and downward price adjustments.[11] The figure shows that a good part of the trend in the monthly inflation rate for these products depends on the frequency of price rises; this component also captures a large part of the seasonal component and of the two increases in the ordinary VAT rate in October 2011 and October 2013.

The decomposition enables us to represent the distribution of price changes in each period with a limited number of statistics. Table 11 illustrates this for the NEIG component[12] at the times that VAT rates were raised. It shows that the smaller rise in prices in October 2013 compared with 2011

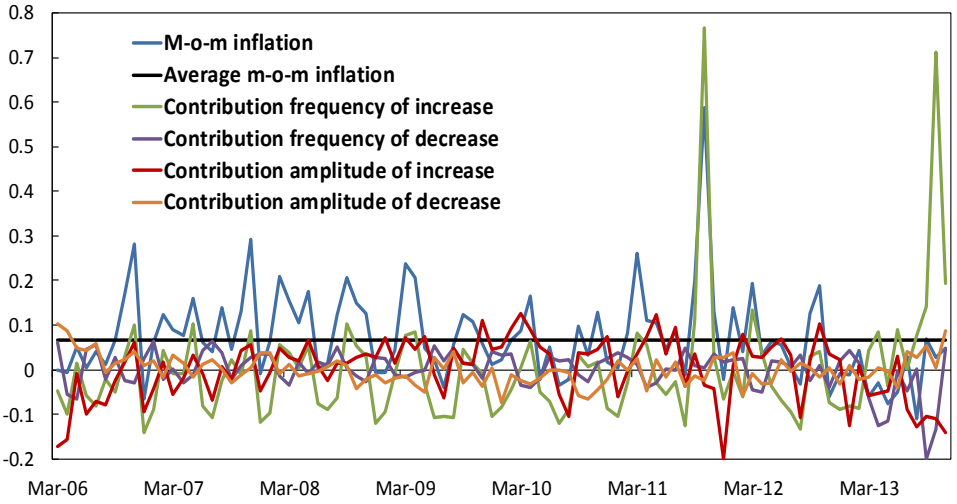
[11] The contributions are calculated by multiplying the frequency (or amplitude) of upward (or downward) deviations from the mean for the entire period by the average of the corresponding amplitude (or frequency) of upward (or downward) adjustments. By construction, these contributions have a mean of zero. The residuals, not shown in the graph, are obtained by multiplying the variables measured as deviation from the mean.

[12] In the table, the statistics are calculated directly from observations weighted by the weights of the single products in the CPI basket. In Figure 7 weighting is at the level of single statistics for products.

is explained by three factors, all working in the same direction: *i*) a lower percentage of products whose prices were raised during the month (17.9 as against 20.6 per cent); *ii*) a smaller mean increase (1.9 as against 3.6 per cent); and *iii*) a higher percentage of products with price reductions.

Figure 5 – Month-on-month inflation rate, NEIG goods: decomposition

(per cent)



Source: our elaborations on Istat data.

Table 11 – NEIG price changes on occasion of VAT rises

(per cent)

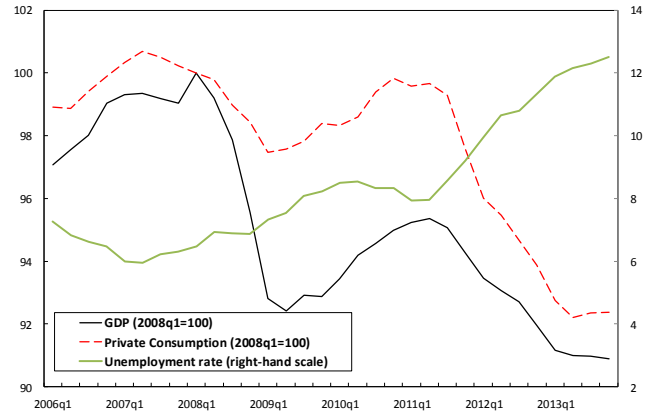
	October 2011	October 2013
a) Frequency of increase	20.6	17.9
b) Frequency of decrease	2.3	3.9
Mean amplitude	0.6	0.0
c) Mean amplitude of increase	3.6	1.9
d) Mean amplitude of decrease	-8.4	-7.0
Median amplitude of increase	1.7	1.2
Median amplitude of decrease	-6.9	-8.5
Contribution of increases (a*c)	0.7	0.3
Contribution of decreases (b*d)	-0.2	-0.3
Average change in price (a*c + b*d)	0.5	0.1

Source: our elaborations on Istat data.

Between 2006 and 2013, Italy had two phases of moderate growth and two recessions, the latter continuing into 2014 as well. Whereas the effect of the 2008-09 recession on consumption was limited and transitory on the whole, the recession that began in 2011 had produced, by the end of 2013, a fall in household spending of about the same size as that in GDP, by comparison with the

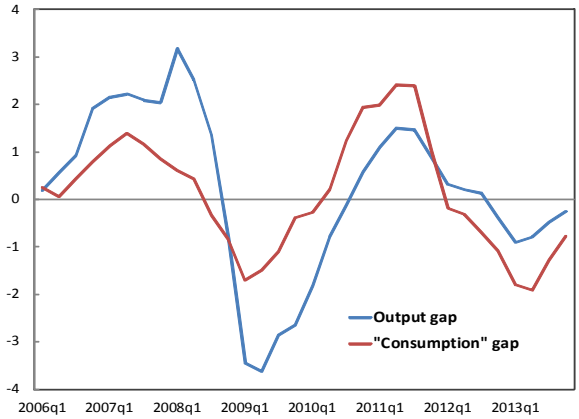
cyclical peak in the first quarter of 2008 (Figure 6).[13] Between mid-2011 and the end of 2013 the unemployment rate rose from 8 to over 12 per cent.

Figure 6 – GDP, consumption and unemployment
(indices; per cent for unemployment)



Source: Istat.

Figure 7 – Output and consumption gap
(per cent)



Source: our elaborations on Istat data.

In both recessions, more markedly in the second, core inflation (NEIG products and services, which are less subject to exogenous shocks than energy and food products) fell sharply on both a quarterly and a yearly basis.

The decomposition made possible by our rich dataset enables us to identify the aspects of price adjustment that determined this decline, i.e. the relationship between the cyclical phase (measured by consumption, GDP and unemployment rate) and the frequency, amplitude and direction of price changes. We estimate a series of models relating each inflation component with a constant, a dummy for the two VAT increases, a set of seasonal dummies, the inflation rate (the twelve-month rise in the sub-index for the relevant product type, with a lag of 1 to 5 quarters) and a proxy for cyclical performance of the economy, with a lag of 0 to 4 quarters. Various specifications of the proxy are considered: output and consumption gaps (i.e. the deviation of GDP or consumption from long-term trend, obtained via an HP filter; Figure 7), and the unemployment rate. Consumer spending refers to resident households.

The results of this exercise – by the OLS method, taking as dependent variables the average monthly frequency and amplitude of price increases or decreases – are given in Table 12. The last row of the table also gives an estimate of the effect of a 1-per-cent deviation of GDP or consumption below trend or of a 1-point rise in the unemployment rate on the index of NEIG prices

[13] For a study of earlier recessions, see A. Bassanetti, M. Cecioni, A. Nobili and G. Zevi, Bank of Italy Occasional Papers, No. 46, "The Main Recessions in Italy: A Retrospective Comparison", July 2009.

or service prices (net of hotels). This estimate takes the average frequency and amplitude of price changes during our sample period.

Table 12 – The effect of the economic cycle on the frequency and amplitude of price changes
(OLS estimates)

NEIG												
Dependent variable	Freq. increase			Freq. decrease			Average amplitude increase			Average amplitude decrease		
Measure of cycle	Output gap	Cons. gap	Unemp. Rate	Output gap	Cons. gap	Unemp. Rate	Output gap	Cons. gap	Unemp. Rate	Output gap	Cons. gap	Unemp. Rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VAT dummy	**8.05**	**8.32**	**16.74**	0.44	0.52	0.89	**-3.25**	**-3.75**	-1.90	1.35	1.18	-0.59
(t-stat)	**12.38**	**12.83**	**16.07**	0.94	1.32	1.63	**-4.73**	**-4.46**	-1.61	1.79	1.33	-0.42
Inflation	**-1.48**	**-1.24**	**-0.78**	-0.43	-0.40	**-0.55**	**1.99**	0.68	**1.96**	**-1.46**	**-2.12**	**-1.03**
(t-stat)	**-3.14**	**-2.51**	**-1.90**	-1.29	-1.39	**-2.59**	**4.23**	1.07	**4.26**	**-2.82**	**-2.86**	**-1.90**
lag	2	3	5	2	2	5	1	3	5	1	1	5
Cycle	0.11	-0.18	0.08	-0.04	**-0.22**	**0.21**	-0.17	0.27	**-0.28**	**0.40**	**0.58**	0.09
(t-stat)	1.27	-1.54	1.13	-0.71	**-3.04**	**5.36**	-1.88	1.72	**-3.34**	**4.09**	**2.60**	0.88
lag	4	1	0	0	1	4	4	1	3	4	4	4
R2	0.92	0.91	0.87	0.19	0.41	0.56	0.75	0.57	0.42	0.60	0.46	0.25
Effect on prices	0.00	0.01	0.00	0.00	**-0.01**	**-0.01**	0.01	-0.01	**-0.01**	**-0.01**	**-0.01**	0.00
Services net of hotels												
Dependent variable	Freq. increase			Freq. decrease			Average amplitude increase			Average amplitude decrease		
Measure of cycle	Output gap	Cons. gap	Unemp. Rate	Output gap	Cons. gap	Unemp. Rate	Output gap	Cons. gap	Unemp. Rate	Output gap	Cons. gap	Unemp. Rate
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
VAT dummy	0.08	0.11	1.57	-0.29	-0.28	-0.61	-1.23	-1.50	-1.15	0.75	1.00	1.82
(t-stat)	0.12	0.18	1.20	-1.07	-1.10	-1.73	-1.58	-1.98	-0.87	1.00	1.23	1.44
Inflation	0.80	0.95	0.16	-0.18	-0.23	0.07	1.52	1.49	0.21	-1.06	-0.82	-0.42
(t-stat)	1.88	2.04	0.37	-0.91	-1.24	0.63	2.79	2.62	0.49	-2.12	-1.48	-1.04
lag	1	5	5	5	5	4	1	5	5	1	1	1
Cycle	-0.12	**0.44**	-0.11	-0.05	-0.10	**0.07**	**-0.32**	**0.55**	-0.15	**0.36**	0.35	-0.13
(t-stat)	-1.19	**3.10**	-1.13	-1.20	-1.84	**2.70**	**-2.39**	**3.15**	-1.52	**2.93**	1.73	-1.40
lag	4	2	4	0	1	3	3	2	4	2	3	0
R2	0.31	0.48	0.25	0.12	0.19	0.21	0.46	0.55	0.27	0.43	0.31	0.14
Effect on prices	0.00	**-0.02**	0.00	0.00	0.00	**0.00**	**0.01**	**-0.01**	0.00	**0.00**	0.00	0.00

Source: our elaborations on Istat data.

For NEIG goods we find a statistically significant correlation (shown in boldface) between cyclical phase – measured by the consumption gap (column 5) and the unemployment rate (column 6) – and the frequency of price reductions. The effect appears to be relatively small: an increase of 1 point in the unemployment rate or a fall in consumer spending of the same size with respect to trend increases the frequency of downward NEIG price adjustments by about 0.2 percentage points; the overall effect on that price index is just 0.01 points. But given that the unemployment rate rose by four points between mid-2011 and end-2013, the estimated impact on NEIG inflation comes to nearly half a percentage point. The fall in GDP and in consumption is also significantly correlated with the magnitude of price cuts (columns 10 and 11), amplifying the downward impact of those adjustments on inflation.

The findings on the cyclical sensitivity of upward price adjustments are only significant for amplitude, and only when cyclical variations are proxied by the unemployment rate (column 9). The correlation is inverse, indicating that the intensification of the recession brings smaller price adjustments, with an overall effect on NEIG inflation comparable to that deriving from the more frequent reductions.

As for services, the greatest cyclical impact appears to stem from decreased frequency (column 14) and average amplitude (column 20) of price increases, as a consequence of declining consumer spending. The rise in unemployment apparently had only a slightly positive impact on the frequency of price cuts (column 18). The only two equations with a statistically significant effect on the output gap (columns 19 and 22) indicate that cyclical expansion is associated with smaller upward and larger downward price adjustments.

Overall, for NEIG goods, the two recessions are associated with greater frequency and amplitude of price reductions and decreased amplitude of price increases. For services, by contrast, both the frequency and the size of price increases has diminished. Of the cyclical variables, in most cases the output gap is not significant, while the consumption gap and the unemployment rate have greater explanatory power.

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Appendix

Table A1 – Products in the dataset

Product	Type	Observation period
Bread	Processed food	Monthly
Pasta, durum wheat	Processed food	Monthly
Spinach, frozen	Processed food	Monthly
Sugar	Processed food	Monthly
Coffee, roast	Processed food	Monthly
Mineral water	Processed food.	Monthly
Table wine	Processed food	Monthly
Beer, domestic	Processed food	Monthly
Beef, fresh, ground	Unprocessed food	Monthly
Anchovies, fresh, fished	Unprocessed food	Bi-monthly
Milk, fresh	Unprocessed food	Monthly
Bananas (Central America)	Unprocessed food	Bi-monthly
San Marzano tomatoes for sauce	Unprocessed food	Bi-monthly
Jeans, men's	NEIG	Monthly
Shirts, cotton, men's	NEIG	Monthly
Shoes, men's	NEIG	Monthly
Sneakers, men's	NEIG	Monthly
Plastic building blocks	NEIG	Monthly
Dog food	NEIG	Monthly
Toothpaste	NEIG	Monthly
Ceramic tiles	NEIG	Monthly
Armoire	NEIG	Monthly
Towel set	NEIG	Monthly
Iron, electric	NEIG	Monthly
Light bulb, energy-saving	NEIG	Monthly
Tyre for cars up to engine size 1500 cc	NEIG	Monthly
Colour TV	NEIG	Monthly
Soccer ball	NEIG	Monthly
Suitcase	NEIG	Monthly
Diesel fuel, pump service	Energy	Bi-monthly
Lead-free petrol, pump service	Energy	Bi-monthly
Heating fuel	Energy	Bi-monthly
Domestic help, hourly	Services	Monthly
Meal in pizzeria	Services	Monthly
Beer at bar	Services	Monthly
Cappuccino at coffee bar	Services	Monthly
Ice cream, packaged	Services	Monthly
Cleaning and pressing, men's suit	Services	Monthly
Carwash	Services	Monthly
Auto repair – tyre balancing	Services	Monthly
Garage	Services	Monthly
Taxi	Services	Monthly
Cinema	Services	Monthly
Hotel room, 3-star	Services	Monthly
Haircut, men's	Services	Monthly
Hairdresser, women's	Services	Monthly
Plumber	Services	Monthly
Electrician	Services	Monthly
Photocopy	Services	Monthly

Table A2 – The metadata

Year	
Month	
Province	*Name of provincial capital*
Firm	*Company code*
Zone	*Farm, city centre, etc.*
Type retailer	*Department store, supermarket, etc.*
Brand	*Brand description*
Product code	*COICOP code*
Trajectory code	*Code identifying combination of product, retailer and city*
Variety	*Product description*
Price observed	*Price actually observed*
Price per unit	*Price per amount (e.g., per litre of water)*
Price previous month	
Discounted price	
Base price	*Price in December of previous year*
Control code	
Change of brand	*Variable=1 if price of a different brand is taken*
Change of variety	*Variable=1 if price of a different variety is taken*
Change of quantity	*Variable=1 if price for a different amount is taken*
Change of firm	*Variable=1 if price is taken at a different firm*
Indication of estimate	