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2. Rounding and "anomalous" changes in Italian consumer prices in 2002

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2.1 Introduction[1]

One of the main concerns before the euro cash changeover was that the rounding of prices in the new currency would be mainly upwards, increasing consumer price inflation (European Central Bank 2002). Community rules called on economic agents to convert and round prices to the nearest cent,[2] but this could not rule out the possibility that the changeover would have an adverse impact on prices, in connection with the likelihood that rounding to what vendors considered "attractive" prices in euros would be mainly upward. In the run-up to the changeover there was a concern that the switch might give merchants the chance to raise their prices, though it was believed that the neutrality of the redenomination and the operation of market forces would ward off such effects. Empirical studies by central banks and statistical institutes during 2001 showed that the proportion of attractive prices in the national currencies was quite high, confirming the risk that from January 2002 there might be a significant inflationary impact from euro price rounding.

Here we use a sample of monthly elementary price quotes that go into ISTAT's calculation of the general consumer price index (CPI) to estimate the inflationary impact of rounding with the changeover in Italy. Section 2.2 reports the prior estimates made in 2001, section 2.3 presents the ex post estimates for the period following the changeover, and section 2.4 supplements this analysis

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[2] Council Regulation 1103/97, 17 June 1997, fixed the rules for rounding prices converted into euros (European Commission, "The introduction of the euro and the rounding of currency amounts" on the Commission's website; see also Banca d'Italia 2001).

with an inquiry into the consumer price impact of the anomalous variations registered in 2002, whether in connection with rounding or not. The objective is to provide a range of estimates permitting an approximate evaluation of the order of magnitude of the inflationary effects that can be reasonably attributed to the introduction of the new currency. The results are summarized in section 2.5.

2.2 The ex ante estimate

Empirical studies in various euro-area countries in 2001 were directed to two points (see the appendix to Chap. 7). Was the incidence of attractive prices in national currency such as to warrant fears of a significant inflationary impact due to the rounding of euro prices to produce equally attractive figures? And if so, assuming that merchants who set attractive prices in national currency would continue to do so in euros, what inflationary impact would the changeover have through this channel? All these works postulated three types of attractive prices:

- "psychological" prices (e.g. €1.99 instead of €2.00), used in the belief that buyers unconsciously undervalue the last digit or two;
- "fractional" prices (e.g. €1.70 instead of €1.67), to simplify making change and make payments faster and easier;
- "exact" prices (e.g. €50.00), generally for large amounts, avoiding the use of coins and small notes in making change.

The quantitative estimate of the incidence of attractive prices on the price observations for the CPI, hence the estimate of the inflationary impact of rounding, depended on correct identification of attractive price levels in the two currencies and on the rounding behaviour of individual agents, which was hard to predict.[3] For Italy, the analysis was based on some 90,000 elementary price quotes, or more than 30 per cent of ISTAT's monthly observations for the Italian CPI, taken in September 2001 in the regional capitals.[4] In all, these prices were representative of more than 65 per cent of the products included

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Fig. 2.1. Types of prices

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[3] See Mostacci and Sabbatini (2001) for the assumptions adopted in the empirical analysis.

[4] The data are collected in each municipality; quotes are for precisely specified goods and services (e.g. 1 kg of a given brand of spaghetti in a given store). For more detail, including the weighting used to aggregate the elementary quotes, see Mostacci and Sabbatini (2003).

in the general consumer price basket at the time of the study (for a more thorough discussion of the choice of items, see Sect. 2.3.3).

Attractive prices in lire were very common in Italy, accounting for some 90 per cent of our elementary quotes (Fig. 2.1), warranting fears of an inflationary impact on the occasion of the changeover.
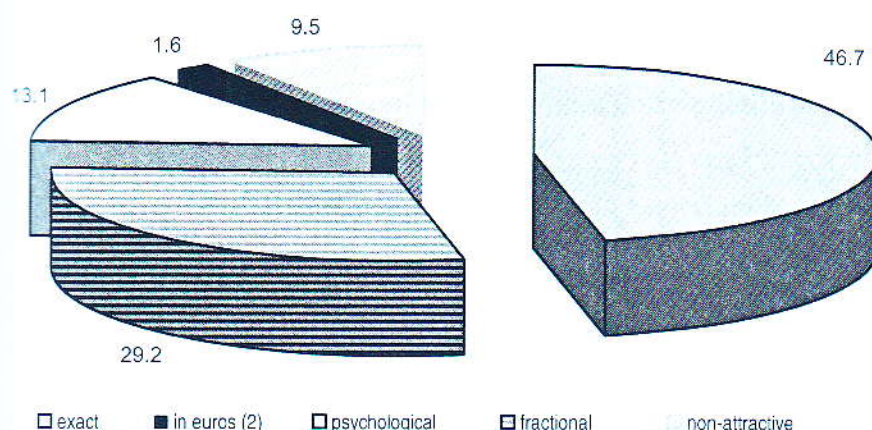
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Fig. 2.1. Types of prices in Italy, autumn 2001 (percentage shares) (1)

Source: Authors' calculations based on ISTAT data.

Notes: (1) Percentage share of each type in total price quotes in the sample (weighted quotes). (2) Considering the possibility that prices may already have been implicitly set in euros before January 2002; these are lira prices ending with a digit other than 0 or 5 (e.g. 1,936 lire = €1.00).

To estimate this impact, in addition to the rules defining attractive prices we had to make assumptions on how vendors would behave. We assumed that vendors with attractive prices in lire would continue to have them in euros. Three rounding scenarios were designed: rounding to an attractive level systematically upward ("worst case scenario"), systematically downward ("virtuous scenario"), or to the nearest attractive level ("symmetrical scenario"). We calculated the total impact on consumer prices, i.e. the cumulative variation in the CPI between the month of the survey and the hypothetical month in which all the adjustments are assumed to have been completed. The resulting estimates were for a 1 percentage point increase in the price level in the worst case scenario, a very slight decline (-0.1 points) in the symmetrical scenario, and a reduction of nearly 1 percentage point in the virtuous scenario (Mostacci and Sabbatini 2001). The studies for the other countries reached similar conclusions (see appendix 7.A).

Attractive prices (exact, psychological or fractional) were common everywhere, and the worst-case impact averaged about 1 percentage point for the euro area.

2.3 The ex post estimate

2.3.1 Definition and estimation of the rounding effect

After the cash changeover, empirical studies in Italy and elsewhere estimated the impact of rounding on price observations for the CPI. For Italy, Mostacci and Sabbatini (2003) studied the data gathered by ISTAT between December 2001 and October 2002 (the last month for which data were available at the time). Here we supplement the main findings of that study with new evidence on the performance of some specific prices not considered earlier (in particular, unprocessed foods).

In assessing the results, some limitations of the exercise should be borne in mind. First, the aim was only to quantify the effects of rounding, albeit applying both more and less restrictive interpretations. Second, rounding on the occasion of the cash changeover could have reflected unrelated phenomena (say, demand and supply shocks).

For comparability with the ex ante estimates, the analysis used a sample of quotes with the same characteristics. In this regard, some specifications are needed. It was decided to exclude some items in both exercises: consumer durables and some services, including rents, for which the high level of prices made the effect of rounding likely to be negligible; and energy products, whose prices are not generally rounded. A supplement to the analysis was necessary for some fresh foods (fruit, vegetables, fish) that were excluded from the sample for methodological rather than economic reasons (see below). Finally, public service charges and regulated prices were excluded in view of the pledge by national governments that rounding would be neutral (or, if anything, in the consumer's favour). Ex post, this decision no longer seemed fully justified, and we found it necessary to supplement the analysis by looking at the performance of these prices as well. In what follows we describe the ex post exercise. Section 2.3.2 summarizes the results and section 2.3.3 describes the supplements on specific items.

The rules used to distinguish attractive from non-attractive prices in euros are the same as those of the ex ante study (Table 2.1).

Table 2.1.

Price in euros

Below €5.00

Over €5.00

Notes: (1) Table gives
any possible integer: X

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Method 1: rounding

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Table 2.1. Rules for defining attractive prices in euros (1)

Price in euros	Type of price		
	Exact or fractional	Psychological	Non-attractive
Below €5.00	*.00; *.X0; *.X5	*.X9; *.90; *.95; *.99	*.XX
Over €5.00	*.00; *.50	*.X9; *.90; *.95; *.99	*.XX

Notes: (1) Table gives the two decimals of the price in euros. The asterisk stands for any possible integer; X stands for a digit other than 0 or 9.

The timing of individual vendors' shift to attractive prices in euros was not known in advance, and after the changeover, and even after the period of dual circulation (February 2002), some outlets continued to set prices in lire, naturally posting prices in both currencies. This might have been justified assuming, for instance, that consumers were still oriented to attractive prices in lire, which were obviously not necessarily attractive in euros. Both of the methods described below trace the course of each elementary price quote from December 2001 to October 2002 to measure the impact of rounding only in the month in which it first becomes attractive in euros. Tracing individual prices restricts the methods that can be used to estimate the effect of rounding. Since with the change of base in December of every year the quotes observed over the next year may change (for instance, due to the rotation within each city of the sample of stores surveyed), the time series at this level of detail are generally short.

We use two methods to measure the effects of rounding. The first refers to the smallest variation necessary to produce an attractive price in euros. The findings of this method should thus be read as an estimate of the effects of rounding "in the strict sense". The second defines rounding "in the broad sense" as all changes in connection with the move to an attractive price are taken, though they are not necessarily entirely due to this motive. In Mostacci and Sabbatini (2003) and in comparable studies in other countries, the estimates of the two methods have been interpreted as the lower and upper bounds of the rounding effect.

Method 1: rounding "in the strict sense" (to nearest attractive price level)

This method assumes that in month *t*, when a given quote first becomes attractive, the part of the change attributed to rounding is only the difference between the price at *t-1* and the attractive price *nearest* to that quote, under the rules set out in Table 2.1. Rounding is either upward or downward

depending on how the price itself moved between the two observations. For example, if a quote goes from €1.36 to €1.45 (an attractive price by our rules), the portion of the rise attributed to rounding is just the difference between €1.36 and €1.39 (the nearest attractive price). If at t the price had gone down to €1.25, the rounding effect would be negative, equal to the difference between €1.36 and €1.35.

Method 2: rounding "in the broad sense" (difference between changes in the prices that become attractive each month and changes in the other quotes)

The measurements according to the second definition are based on a broader criterion; this is a two-phase method, which can be summarized as follows.

Phase 1. In month t, under the rules of Table 2.1 for defining attractive prices, the elementary quotes are classed into four groups:

	Prices in month t	
Prices in month $t-1$	Attractive	Non-attractive
Attractive	S1A	S1C
Non-attractive	S2	S1B

This classification enables us to isolate the subset of prices that were not attractive in $t-1$ and become so for the first time in month t (S2). To estimate the impact of rounding, for each month these subsets are regrouped into two sets:

- $S1=S1A \cup S1B \cup S1C$: the set of prices that were attractive in month $t-1$ and remained so in month t (S1A), plus those that remained or became non-attractive in month t (S1B and S1C respectively).[5] For all the quotes in this set (whose weight is denoted by $W1$), we calculate the percentage change on the previous month ($VC1$). By construction, this variation is not affected by rounding to attractive prices in euros but reflects the other causal variables of price changes.

- $S2$: the set of prices that were not attractive in month $t-1$ and become attractive for the first time in month t. Their weight is denoted by $W2$, and

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[5] The subset $S1C$ serves to allow for the possibility of a previously attractive price reverting to non-attractive. Actually, these cases are in fact quite rare. And in any event, since their rounding impact was already taken into account in some month prior to t, it is not reconsidered if in a series of changes it reverts to non-attractive and then becomes attractive once more.

their overall change on the previous period by $VC2$; by construction, this represents both the effect of rounding and the effect of the other causal variables of price changes.

Phase 2. The impact of rounding on the general price index in month t, $IM2$, is given by:

$$IM2=(VC2-VC1)*W2 \qquad (2.1)$$

This estimate reflects a series of considerations. Part of the change in the prices becoming attractive in month t may be due to other factors that would have acted regardless of the cash changeover. To take this into account, the impact of rounding is estimated with reference to the difference between the average change in the quotes that become attractive for the first time (set $S2$) and that in those that do not (set $S1$). We distinguished between goods – groceries and non-groceries[6] – and services, in order to calculate the difference between $VC2$ and $VC1$ for relatively homogeneous product categories for which the causal factors in price trends should be similar. The overall impact in month t is thus given by:

$$IM2=(VC2^{grocery}-VC1^{grocery})*W2^{grocery}+(VC2^{non\text{-}grocery}-VC1^{non\text{-}grocery})$$
$$*W2^{non\text{-}grocery}+(VC2^{services}-VC1^{services})*W2^{services} \qquad (2.2)$$

For each month we repeat phases 1 and 2. Note that in the entire period from January through October 2002, for each elementary quote the impact of rounding is considered only once, in the month in which the price first becomes attractive. All subsequent movements are attributed to other factors.

In short, the set of prices first becoming attractive in each month is obviously the same in both methods. The essential difference is that under Method 1 the rounding effect is as small as possible: for instance, if a quote goes from €0.73 to €0.80 the part imputed to rounding is just the difference between €0.73 and €0.75, the nearest attractive level. This is rounding "in the strict sense", the lower limit of the rounding impact. The assumption underlying Method 2, i.e. that non-rounding factors have an equal impact each month on the prices that become attractive and on the others, may be extreme in that there is a risk of ascribing to rounding too large a part of the actual price change. This is thus termed rounding "in the broad sense" and can be considered as an upper limit to the rounding impact.

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[6] In addition to food, groceries includes home cleaning and personal hygiene products.

2.3.2 The main results

With the cash changeover the Italian price system underwent a substantial adjustment. The share of attractive prices fell immediately from about 90 per cent to 20 per cent in January 2002, then recovering gradually to just over 50 per cent in October (the other countries showed similar patterns: see Chap. 7).

A first indication of the inflationary impact of rounding is derived from a comparison between the changes in prices that became attractive and those that did not. These data are given in Tables 2.2-2.4.

Table 2.2 shows that the prices becoming attractive rose more than the others, especially in September and October, the months when firms traditionally revise prices.

Table 2.2. Price increases by type of price
(percentage change on previous month) (1)

2002	Type of price		
	attractive (1)	non-attractive	CPI
January	2.37	0.14	0.25
February	2.74	0.26	0.47
March	2.25	0.07	0.16
April	2.30	0.09	0.18
May	2.71	0.23	0.42
June	2.10	0.07	0.12
July	2.37	0.06	0.11
August	2.53	0.10	0.18
September	4.45	0.21	0.40
October	3.37	0.16	0.30
Cumulative inflation, Jan.-Oct.			2.40

Notes: (1) The percentage change in attractive prices is calculated, for each month, with reference to the set of quotes designated *S2* (i.e. those that become attractive for the first time in that month).

Tables 2.3 and 2.4 highlight two additional characteristics of these developments. First, the rises in attractive prices in the services sector are perceptibly greater than for goods (Table 2.3). Second, there is a marked difference according to distribution channel: attractive prices are raised much more in traditional than in modern distribution channels (Table 2.4).

Table 2.3. F

2002	Total	
		att
January	0.25	
February	0.47	
March	0.16	
April	0.18	
May	0.42	
June	0.12	
July	0.11	
August	0.18	
September	0.40	
October	0.30	
Cumulative inflation. Jan.-Oct.	2.40	

Notes: (1) Foods, hom the rules given in Tabl for each month. for th in that month).

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Both methods com of product and the c prices is twice as gre products sold throug (Tables 2.5-2.6). Th differences in comp classed as "traditio the services sector compare goods only

Table 2.3. Price increases by type of product and type of price
(percentage change on previous month)

2002	Total	Groceries (1)			Other goods			Services		
		attractive (2)	non-attractive	total	attractive (2)	non-attractive	total	attractive (2)	non-attractive	total
January	0.25	1.84	0.19	0.26	0.41	0.09	0.10	3.34	0.15	0.40
February	0.47	0.83	0.07	0.10	1.91	0.21	0.32	3.60	0.48	0.91
March	0.16	0.95	0.05	0.09	1.88	0.08	0.19	4.87	0.07	0.20
April	0.18	1.40	0.14	0.18	1.73	0.08	0.16	3.98	0.08	0.21
May	0.42	1.75	0.14	0.20	1.85	0.11	0.28	3.98	0.42	0.74
June	0.12	1.95	0.16	0.22	2.36	0.02	0.06	2.02	0.07	0.11
July	0.11	2.26	0.10	0.17	2.14	0.05	0.08	2.81	0.05	0.09
August	0.18	1.67	0.11	0.15	0.80	0.07	0.10	4.81	0.12	0.29
September	0.40	2.60	0.27	0.38	4.23	0.18	0.32	6.01	0.20	0.49
October	0.30	2.55	0.11	0.20	2.99	0.25	0.45	5.63	0.10	0.22
Cumulative inflation, Jan.-Oct.	2.40									

Notes: (1) Foods, home cleaning and personal hygiene products. (2) Identified by the rules given in Table 2.1. The percentage change in attractive prices is calculated, for each month, for the S2 set of prices (those becoming attractive for the first time in that month).

The impact of rounding on the CPI in 2002 under the two methods is estimated in Tables 2.5-2.6. Table 2.5, on rounding in the strict sense, shows an impact of about 0.2 percentage points on the cumulative rise in the CPI between January and October 2002. That is, without this effect inflation over the period would have been 2.2 per cent rather than the 2.4 per cent actually recorded. For rounding in the broad sense, Table 2.6 shows the impact over the same period at 0.8 percentage points, which is to say that in the absence of this effect cumulative inflation would have been 1.6 per cent.

Both methods confirm the relevance suggested by Tables 2.3-2.4 of the type of product and the distribution channel. The impact of rounding on services prices is twice as great as on goods prices. And the effect is significant only for products sold through traditional channels; for mass retailers it is negligible (Tables 2.5-2.6). The difference between the two channels only partly reflects differences in composition (in particular the fact that services are always classed as "traditional" distribution). Removing the estimated impact in the services sector from the total estimate for the traditional distribution to compare goods only under Method 2, which produces the greatest rounding

impact, the estimated impact for goods sold in traditional outlets is around 0.3 percentage points, compared with practically nil in the modern outlets.

Table 2.4. Price increases by distribution channel and type of price (percentage change on previous month)

2002	Total	Modern retail outlets			Traditional outlets		
		attractive (1)	non-attractive	total	attractive (1)	non-attractive	total
January	0.25	1.82	0.14	0.20	2.47	0.14	0.26
February	0.47	0.15	0.01	0.02	3.02	0.32	0.57
March	0.16	0.53	0.01	0.04	2.62	0.08	0.19
April	0.18	0.82	0.15	0.17	2.59	0.08	0.19
May	0.42	1.76	0.19	0.28	2.85	0.23	0.46
June	0.12	1.65	0.17	0.22	2.30	0.05	0.10
July	0.11	1.51	0.07	0.11	2.77	0.06	0.11
August	0.18	0.71	0.10	0.13	3.01	0.10	0.19
September	0.40	2.17	0.19	0.30	5.10	0.22	0.42
October	0.30	1.30	0.11	0.16	3.77	0.17	0.34
Cumulative inflation, Jan.-Oct.	2.40						

Notes: (1) Identified by the rules given in Table 2.1. The percentage change in attractive prices calculated, for each month, for the $S2$ set of prices (those becoming attractive for the first time in that month).

2.3.3 Some extensions

As noted, some items are excluded from the foregoing empirical analysis: regulated prices,[7] unprocessed food (fruit, vegetables and fish), unregulated energy products (petrol), rents, certain durable goods (e.g. automobiles. motorcycles and personal computers), and financial and insurance services. For some of these items the impact of rounding is probably very modest, so their exclusion does not alter the results. The contribution of upward rounding

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[7] The items involved are: tobacco goods, electricity, gas, drinking water, rail transport, maritime transport, urban transport, inter-city and suburban transport, taxis and delivery services, motorway tolls, the state television subscription fee, postal services, telephone services, medical services, betting pools, urban solid waste removal, certificates and licence duties, secondary education, university education, funeral transport, and medical products.

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Table 2.5. Inflation by type

2002	Inflation R in month (2)
January	0.43
February	0.34
March	0.25
April	0.25
May	0.25
June	0.08
July	0.17
August	0.17
September	0.17
October	0.25
Cumulative inflation, Jan.-Oct.	2.40

Notes: (1) The impact is percentage change in each attractive level by its we underwent no rounding ef month). (3) Foods, home

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of durable goods, insurance and rents, in particular, is marginal, since these items have very high unit prices and the impact of any rounding up to attractive thresholds in euros is accordingly limited. Petrol prices are generally not set at attractive levels anyway, and they change frequently, often by as little as a few cents, following world crude oil price movements.

Table 2.5. Inflationary effect of rounding in the strict sense (Method 1)
by type of product and distribution channel (1)

2002	Inflation in month (2)	Rounding effect	Type of product			Distribution channel	
			Groceries (3)	Other goods	Services	Modern	Traditional
January	0.43	0.01	0.00	0.00	0.01	0.00	0.01
February	0.34	0.02	0.00	0.00	0.02	0.00	0.02
March	0.25	0.02	0.00	0.01	0.01	0.00	0.02
April	0.25	0.01	0.00	0.00	0.01	0.00	0.01
May	0.25	0.02	0.01	0.01	0.00	0.00	0.02
June	0.08	0.01	0.00	0.00	0.00	0.00	0.01
July	0.17	0.01	0.01	0.00	0.00	0.00	0.01
August	0.17	0.01	0.00	0.00	0.01	0.00	0.01
September	0.17	0.02	0.01	0.00	0.01	0.00	0.02
October	0.25	0.02	0.00	0.01	0.01	0.00	0.02
Cumulative inflation, Jan.-Oct.	2.40	0.16	0.04	0.04	0.08	0.02	0.14

Notes: (1) The impact is in percentage points. It is estimated by multiplying the percentage change in each price becoming attractive during the month to the nearest attractive level by its weight in the basket, assuming that the items not included underwent no rounding effect in that month. (2) CPI (percentage change on previous month). (3) Foods, home cleaning and personal hygiene products.

The case is different for regulated prices and unprocessed food. The former were excluded for consistency with the ex ante exercise, but if this exclusion was justified ex ante by governments' commitment to ensure that conversion would be neutral (or actually advantageous to consumers), in the ex post exercise it is proper to evaluate the actual performance of these items.[8] For unprocessed food, the exclusion from both exercises is motivated methodologically (these prices are surveyed twice a month, which complicates

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[8]   From a methodological viewpoint, the complexity of the pricing structure makes it very hard to verify how regulated prices were rounded on the basis of the elementary data (consider, for example, the structure of the telephone bill).

treatment of the elementary data with respect to the two methods utilized in the empirical analysis of rounding). Accordingly, for both regulated prices and food products we considered it useful to develop a separate estimation of the price rises recorded on the occasion of the changeover. For the other items not included in the two exercises, Table 2.7 compares the price changes in the two years 2002-03 with those of the preceding years.

Table 2.6. Inflationary effect of rounding in the broad sense (Method 2) by type of product and distribution channel (1)

2002	Inflation in month (2)	Rounding effect	Type of product			Distribution channel	
			Groceries (3)	Other goods	Services	Modern	Traditional
January	0.43	0.07	0.01	0.00	0.06	0.01	0.06
February	0.34	0.13	0.00	0.03	0.10	0.00	0.13
March	0.25	0.06	0.01	0.02	0.03	0.00	0.06
April	0.25	0.06	0.01	0.02	0.03	0.00	0.06
May	0.25	0.12	0.01	0.04	0.07	0.01	0.11
June	0.08	0.03	0.01	0.01	0.01	0.01	0.02
July	0.17	0.03	0.01	0.01	0.01	0.01	0.02
August	0.17	0.05	0.00	0.01	0.04	0.00	0.05
September	0.17	0.12	0.02	0.03	0.07	0.01	0.11
October	0.25	0.09	0.01	0.05	0.03	0.00	0.09
Cumulative inflation, Jan.-Oct.	2.40	0.75	0.09	0.22	0.44	0.05	0.70

Notes: (1) The impact is in percentage points. It is estimated by multiplying the percentage change in each price becoming attractive during the month by its weight in the basket, assuming that the items not included underwent no rounding effect in that month. (2) CPI (percentage change on previous month). (3) Foods, home cleaning and personal hygiene products.

For regulated prices, in general the commitment to make rounding neutral or advantageous for consumers appears to have been honoured in Italy; the increase in the prices of regulated goods and services in 2002 was close to the lows of recent years. Betting pools are an exception: in January 2002 the minimum bet for the Totocalcio, Totogol, Totosei and Totip pools was raised from 1,600 lire to €1.00 (an increase of 21 per cent) and that for Superenalotto from 1,900 lire to €1.00 (1.9 per cent). The impact of these increases on average monthly inflation in January is estimated at 0.05 percentage points.[9]

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[9]   Note that the calculation of the index does not take into account the fact that the higher cost of betting was accompanied by an increase in the total prize payout.

Table 2.7. Chang in th

	Unprocessed food	Unre energ
	1 month	12 months	1 mont
1997 I	-0.2	1.2	0.-
II	0.0	-1.6	-1.
III	-1.0	-2.1	0.1
IV	0.8	-0.5	0.7
1998 I	1.3	1.0	-1.6
II	0.4	1.5	-1.
III	-0.5	2.0	-0.
IV	0.7	1.9	-0.9
1999 I	1.4	2.0	-0.
II	0.4	2.0	4.
III	-2.0	0.5	3.
IV	0.2	0.0	2.
2000 I	1.4	0.0	3.6
II	1.8	1.4	2.
III	-0.5	2.9	4.
IV	1.2	3.8	1.6
2001 I	3.0	5.5	-5.
II	2.5	6.2	2.
III	0.4	7.3	-2
IV	0.6	6.6	-4.
2002 I	3.1	6.8	-1.
II	1.5	5.8	4.
III	-1.3	4.0	-0.
IV	1.3	4.7	0.
2003 I	1.3	2.8	3.
II	1.5	2.8	-3.
III	1.1	5.3	-0.
IV	1.9	5.9	-0.

Source: Based on ISTAT
Notes: (1) Insurance and

As regards unproces
high twelve-month pri
area countries (7 per c
took considerably long

Table 2.7. Changes in the consumer prices of the items not included
in the estimations of the changeover effect
(quarterly data: percentages)

	Unprocessed food		Unregulated energy goods		Durable goods		Financial services (1)		Rents		Regulated goods and services (2)	
	1 month	12 months	1 month	12 months	1 month	12 months	1 month	12 months	1 month	12 months	1 month	12 months
1997 I	-0.2	1.2	0.4	3.9	-0.6	0.9	1.2	5.1	1.3	7.9	2.6	2.2
II	0.0	-1.6	-1.2	1.0	0.4	0.4	1.2	5.7	1.3	6.7	1.7	3.6
III	-1.0	-2.1	0.1	1.4	0.1	0.1	2.4	5.8	1.1	6.2	0.3	5.2
IV	0.8	-0.5	0.7	-0.1	0.6	0.5	0.8	5.7	1.8	5.7	0.2	4.8
1998 I	1.3	1.0	-1.6	-2.1	0.5	1.6	2.8	7.4	0.9	5.3	0.9	3.1
II	0.4	1.5	-1.3	-2.2	0.4	1.7	1.0	7.2	1.8	5.8	0.8	2.2
III	-0.5	2.0	-0.3	-2.5	-0.2	1.4	3.0	7.8	0.6	5.2	0.2	2.1
IV	0.7	1.9	-0.9	-4.1	-0.4	0.4	0.9	8.0	1.1	4.5	-0.1	1.8
1999 I	1.4	2.0	-0.2	-2.8	0.3	0.2	2.8	8.0	0.5	4.0	-0.3	0.6
II	0.4	2.0	4.4	2.9	0.4	0.2	3.1	10.1	1.1	3.4	0.1	0.0
III	-2.0	0.5	3.4	6.7	0.3	0.7	5.0	12.2	0.4	3.2	1.2	1.0
IV	0.2	0.0	2.3	10.2	0.5	1.6	2.7	14.2	0.6	2.7	0.6	1.7
2000 I	1.4	0.0	3.6	14.4	0.1	1.4	2.4	13.8	0.6	2.8	0.4	2.4
II	1.8	1.4	2.7	12.5	0.4	1.4	-1.8	8.4	0.5	2.2	0.9	3.2
III	-0.5	2.9	4.2	13.3	0.4	1.6	0.6	3.9	0.6	2.5	1.2	3.2
IV	1.2	3.8	1.6	12.6	0.5	1.5	0.7	1.8	0.5	2.4	0.7	3.2
2001 I	3.0	5.5	-5.2	3.0	0.3	1.7	3.0	2.4	0.6	2.4	2.3	5.2
II	2.5	6.2	2.2	2.5	0.4	1.6	5.3	9.8	0.4	2.2	0.2	4.5
III	0.4	7.3	-2.3	-3.8	0.3	1.5	1.8	11.1	0.7	2.2	-0.3	2.8
IV	0.6	6.6	-4.1	-9.2	0.2	1.2	1.5	12.0	0.5	2.2	0.2	2.3
2002 I	3.1	6.8	-1.3	-5.5	0.7	1.6	1.9	10.8	0.5	2.1	0.4	0.4
II	1.5	5.8	4.4	-3.4	0.6	1.8	3.0	8.4	0.7	2.4	-0.5	-0.4
III	-1.3	4.0	-0.7	-1.8	0.2	1.7	1.9	8.6	0.4	2.1	0.6	0.6
IV	1.3	4.7	0.9	3.4	0.3	1.8	1.1	8.2	0.9	2.5	0.3	0.7
2003 I	1.3	2.8	3.5	8.4	0.4	1.5	3.6	10.0	0.7	2.7	0.7	1.1
II	1.5	2.8	-3.2	0.5	0.3	1.2	0.5	7.3	0.7	2.8	1.3	2.9
III	1.1	5.3	-0.2	1.0	0.2	1.2	0.7	6.0	0.5	2.9	0.0	2.3
IV	1.9	5.9	-0.4	-0.4	-0.1	0.8	1.3	6.2	0.7	2.7	0.1	2.2

Source: Based on ISTAT CPI data.
Notes: (1) Insurance and banking services. (2) Excluding rents.

As regards unprocessed food, bad weather was blamed for the historically high twelve-month price rises recorded in January 2002 in nearly all the euro-area countries (7 per cent in Italy and 8 per cent on average for the area). It took considerably longer for these strains to abate in Italy than elsewhere:

between the first and third quarter of 2002 the year-on-year rate of increase in the prices of unprocessed food fell by almost 6 percentage points in the area as a whole (harmonized index of consumer prices) and by just 2.5 points in Italy. This suggests that the increases in Italy may have reflected not only the weather but also pricing decisions connected with the introduction of the euro.[10] We ran a simple econometric exercise to distinguish the latter effect from the former, regressing the monthly changes in the prices of unprocessed food on seasonal dummies and monthly mean temperatures, finding that weather conditions account for only 0.7 percentage points of the 2.2 per cent price rise recorded in January 2002. Accordingly, the changeover effect could have accounted for up to 1.5 points of the January rise in the prices of unprocessed food, with an impact on the consumer price index of approximately 0.1 points.[11]

2.3.4 Summary of the results

The results are summarized in Table 2.8, which reports the estimates of rounding obtained on the basis of elementary quotes and those for the items not included in the exercise, obtained as described. Rounding up to attractive levels of goods and services for which the elementary quotes were analyzed had an overall inflationary impact of between 0.16 and 0.75 percentage points in the period from January through October 2002 (Table 2.8; first line, columns A and B). These estimates do not take account of the fact that in October 2002 (the last month for which elementary quotes were available) the proportion of attractive prices was around 30 percentage points lower than it had been estimated for the price distribution in lire. Assuming that the two distributions, in lire and in euros, resemble each other once all price adjustments have been completed, and that the effect of rounding on consumer prices is similar to that estimated using the available micro-data, the total impact of rounding works out to between 0.2 and 1 percentage point (first line, columns C and D).

Adding the contribution of unprocessed food and regulated prices, the ultimate impact of rounding, all adjustments made, works out to between 0.4 and 1.2 percentage points of additional cumulative inflation from January to October 2002. As to a average inflation in 2002, which was 2.5 per cent on the basis of the CPI, the contribution of the currency

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[10] It should also be borne in mind that in Italy, unlike the other European countries, the method used for calculating the price index for fresh fruit and vegetables attenuates the impact of supply shocks on consumer prices (see Sect. 1.3 in Chap. 1).

[11] Similar results are obtained by restricting the analysis to fruit and vegetables.

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Table 2.8. Summar

Items

Estimates for the items
by the empirical analysi
micro-data

Estimates for specific it
based on ad hoc assump
    Unprocessed food
    Regulated prices

Total (2)

Notes: (1) The proportio
in October 2002 than th
September 2001. In the
of euro prices that mus
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October 2002.

2.4 Estimates ba

This section presents
the consumer price in
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for Portugal by Santo
(2004). The basic ide
in the course of 2002
introduction of the eu

changeover through the upward rounding to attractive thresholds in euros can be estimated to lie between 0.2 and 0.5 percentage points of extra inflation.

Table 2.8. Summary of the estimates of the changeover inflationary impact
in the first ten months of 2002
(percentage points)

Items	Without assuming a proportion of attractive prices equal to that observed before the changeover		Assuming a proportion of attractive prices equal to that observed before the changeover (1)	
	Method 1 (A)	Method 2 (B)	Method 1 (C)	Method 2 (D)
Estimates for the items covered by the empirical analysis of micro-data	0.16	0.75	0.20	1.00
Estimates for specific items based on ad hoc assumptions				
Unprocessed food	0.10	0.10	0.10	0.10
Regulated prices	0.05	0.05	0.05	0.05
Total (2)	0.31	0.90	0.35	1.15

Notes: (1) The proportion of attractive prices was around 30 percentage points lower in October 2002 than that calculated on the distribution of lira prices observed in September 2001. In the calculation it is assumed that the impact due to rounding of euro prices that must still become attractive is the same as that estimated for those that already have become so. (2) Cumulated impact between January through October 2002.

2.4 Estimates based on anomalous price movements

This section presents the results of two exercises based on an examination of the consumer price indices published each month by ISTAT. The analysis is similar to those conducted for the euro area as a whole by Eurostat (2002), for Portugal by Santos et al. (2002) and for Spain by Álvarez González et al. (2004). The basic idea is to identify anomalous price movements observed in the course of 2002, on the hypothesis that they can be attributed to the introduction of the euro.

2.4.1 Comparison with the average movements of the previous years

The first test for anomalies in the behaviour of consumer prices in 2002 is based on the comparison of the price dynamics that year with the average for the years 1999-2001 for each of the approximately 200 categories of expenditure released by ISTAT. The contribution of each item to consumer price inflation in 2002 is approximated by assigning the CPI basket weight to the difference between its increase in 2002 and its average increase in the 1999-2001 period.

Table 2.9 shows a practically negligible overall difference for the items considered, suggesting that the price movements in 2002 were not very different from the averages recorded in the years preceding; however, excluding energy products whose prices fell sharply in 2002 mirroring the fall in oil prices, the difference comes to 0.6 percentage points.

Table 2.9. Difference between price dynamic in 2002 and its average in 1999-2001 (1)

	Contribution (percentage points)	Percentage weights (2002=100)
Non-regulated prices	0.45	82.0
Unprocessed food	0.16	7.2
Energy products	-0.22	3.1
Processed food	0.03	9.9
Non-food and non-energy products	0.19	32.6
Services	0.29	29.2
Regulated prices	-0.32	18.0
Processed food	0.03	1.8
Energy products	-0.24	3.1
Non-food and non-energy products	-0.12	3.3
Services	0.05	9.8
Total	0.13	100.0
Total net of energy products	0.59	93.8

Source: Based on ISTAT data.

Notes: (1) For each of the 207 product items posted by ISTAT on its website we calculate the following: (i) the average percentage change in each year; (ii) the average percentage change in the years 1999-2001; (iii) the difference between the average change in 2002 and that in the years 1999-2001. Lastly, the difference obtained at point (iii) is weighted using the items' respective weights. The Table shows the sum of the contributions estimated as just described for each component indicated.

2.4.2 A regression

A regression was per the CPI calculated by variable, a linear tr dummies (one for ea latter will capture ar The statistically sigr regressions run indiv weights of the respec

The results, repor anomalous changes ir 0.5 percentage points quarter: the effect is and in services in all

Table 2.10. Regressio

General index
  Processed food
  Unprocessed food
  Energy products
  Non-food and non-
  Services

The results for Spa with ours (see Chap. only the first quarter around 0.2 percentag González et al. 2004) inflation in the whole Eurostat (2002) estim to consumer price inf

This specification is

2.4.2 A regression analysis

A regression was performed for each of the roughly 200 items taken into the CPI calculated by ISTAT, using as regressors the lags of the dependent variable, a linear trend, four seasonal dummies and four changeover dummies (one for each quarter of 2002).[12] The basic hypothesis is that the latter will capture any anomalous behaviour of the indices during 2002. The statistically significant coefficients of these variables, obtained by regressions run individually for each time series, were summed, using the weights of the respective items in the ISTAT basket.

The results, reported in Table 2.10, indicate that the contribution of anomalous changes in the behaviour of the CPI amounted to approximately 0.5 percentage points in 2002 as a whole. Half of this impact is in the first quarter; the effect is concentrated in unprocessed food in the first quarter and in services in all four quarters.

Table 2.10. Regression analysis of anomalous contributions to inflation in 2002 (percentage points)

	Q1	Q2	Q3	Q4	Average 2002
General index	0.25	0.05	0.10	0.07	0.46
Processed food	0.00	0.00	0.00	0.00	0.01
Unprocessed food	0.13	0.01	0.00	0.00	0.13
Energy products	0.00	0.00	0.00	0.00	0.00
Non-food and non-energy products	0.03	0.00	0.01	0.01	0.04
Services	0.09	0.04	0.09	0.06	0.27

The results for Spain and Portugal, derived by a similar method, are in line with ours (see Chap. 7). The study on Portugal (Santos et al. 2002), covering only the first quarter of 2002, finds that the introduction of the euro caused around 0.2 percentage points of added inflation. That on Spain (Álvarez González et al. 2004) attributes about 0.4 percentage points of consumer price inflation in the whole 2002 to the changeover. For the euro area as a whole, Eurostat (2002) estimates that the changeover added no more than 0.16 points to consumer price inflation in the first quarter of 2002.

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[12] This specification is similar to that of Santos et al. (2002).

2.5 Conclusions

Before the introduction of euro notes and coins, fears of the potentially inflationary impact centred on the possibility that the propensity of economic agents to set prices at attractive threshold figures would result in prevalently upward rounding. In the first part of the chapter we estimated this impact in Italy for the period January-October 2002 on the basis of a set of elementary price quotes observed by ISTAT representing more than 60 per cent of the CPI basket. We found that between 0.2 and 0.5 percentage points of the average consumer price inflation rate of 2.5 per cent in 2002 can be attributed more or less directly to rounding to attractive prices. The effect was considerably greater for services than for goods; for goods, it was larger for traditional sales channels, and very limited for mass retailers.

The second part of the chapter seeks to identify any anomalous movement in consumer prices in 2002, whether associated with rounding or not. The results indicate an impact of between 0.1 and 0.6 percentage points of additional inflation on average for the year, comparable in magnitude to that found in the exercises on the rounding effects and in similar studies of other euro-area countries (see Chap. 7).

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