The dynamics of inflation components and their comparability among countries: the case of the HICP[1]

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Abstract

The paper presents a method to classify the dynamic patterns of the whole set of sub-indices that make up the harmonised index of consumer prices (HICP) and to assess the comparability of the national series referred to a same elementary aggregate of the target consumption expenditure. We consider more than 1.200 series in the period 2004-2008, referred to nearly 100 elementary aggregates and 14 EU countries. Based on the values assumed by a set of variability indicators compiled for each series, we explore the outcomes of a classification of sub.-indices obtained through the sequential use of principal components and hierarchical clustering. From a measurement of the degree of heterogeneity of the series within each elementary aggregate, we derive a list of the most problematic aggregates which possibly deserve further methodological harmonisation in order to provide comparable estimates. Three distinct case studies are more thoroughly analysed and discussed: air transport, package holidays and electricity.

Keywords: Consumer price index, European Union, Harmonisation, Industrial policies, Cluster analysis, Principal components, Variability

1. Introduction

Notwithstanding its aggregative structure, the consumer price index (CPI) has been traditionally seen in the literature as a typical macroeconomic indicator to be used mainly as a tool to target monetary policies, while much less importance has been given to its potential uses to support industrial, competition or consumer protection policy purposes. These uses seem nevertheless to have been gaining ground in the last years at least in the European Union (EC 2009; EUROSTAT 2009), also due to the presence of a harmonised CPI (the HICP) produced by 30 countries according to a common legal basis. They seem to pave the way for further extensions of the scope of CPIs well beyond the needs of monetary policy.

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1 This paper is dedicated to the memory of Carmina Munzi, colleague and friend at Price statistics in ISTAT, and to the rest of the colleagues in charge from 2004 to 2007 of centralised price collection, with whom I shared fundamental experiences and training on this field (Patrizia Caredda, Stefania Fatello, Rosanna Lo Conte, Maurizio Massaroni, Stefano Mosca, Francesca Rossetti, Paola Zavagnini). The empirical core of the paper has been prepared during a period of secondment at the Price statistics unit of EUROSTAT, where it has been used to address the activity of a Task Force on HICP Sampling: a preliminary version has been discussed at the Workshop on Exploratory Data analysis and Visualisation (Vienna, 27-28 May 2010) organised by EUROSTAT and Statistik Austria. I also wish to thank Alexandre Makaronidis, Keith Hayes, Emilio Di Meglio, the colleagues of the Methodologist Network of EUROSTAT and the anonymous referee for their comments and suggestions. The author is anyway the sole responsible for the views expressed in the paper which are not necessarily those of EUROSTAT nor of ISTAT.

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As any other CPI, the HICP is obtained in each country from the weighted average of several hundreds of sub-indices, each referred to an elementary aggregate derived from an exhaustive partition of the target consumer expenditure. Two main points deriving from this structure will be stressed in this paper. The first derives from the acknowledgement that CPIs derive from the aggregation of possibly largely diversified price dynamics: flatly or smoothly time-linear, erratic or seasonal fluctuations, sharp rises or declines, and so forth. Is it possible to measure this heterogeneity and to derive a classification of the behaviours of the whole set of sub-indices? Secondly, it may be reasonable to expect that the sub-indices referred to a same elementary aggregate behave according to similar rules across EU or at least that they can be compared in order to give an economic explanation to different behaviours of a same market in different countries. In other words, are the national series referred for instance to cars really comparable? Aren't such comparisons affected by heterogeneities in the methods applied to estimate them? Do the sub-indices of the HICP represent a useful tool for comparative market analysis and policy purposes?

The paragraphs that follow propose a method to classify the behaviour of sub-indices and to evaluate their comparability across countries, with some suggestions concerning the possible improvements to make it viable the use of sub-indices as a policy tool. For a given elementary aggregate, the possible lack of methodological harmony can have manifold causes which cannot be properly detected without a detailed look into the microdata and into the sampling designs adopted by the National Statistical Institutes (NSIs): but microdata are rarely available, and also the detailed and systematic descriptions of survey designs are quite rare.[3] Given this premise, the approach which is proposed here is based on the examination of the actual behaviour of more than 1.200 HICP series in the period 2004-2008, broken down by country and by about one hundred exhaustive consumption purposes.[4] The series are classified on the basis of the values assumed by a set of indicators which are analysed by means of the sequential use of principal components and hierarchical clustering.[5]

In the second paragraph some background of this discussion is provided. Paragraph 3 provides a description of the HICP database adopted in the analysis and of the list of the indicators on the behaviour of the series. Paragraph 4 describes the results of principal components analysis on this database and a classification of behavioural patterns. Paragraph 5 presents a ranking of the elementary aggregates according to their cross country heterogeneity. Three case studies concerning the markets for air transports, package holidays and electricity are finally discussed, with the further purpose of evaluating the information content of national HICPs and their adequacy for policy support.

3 See as an example De Gregorio et al. (2008) on a subset of the CPI surveys currently run by ISTAT.

4 They correspond to the classes (four digits) of the COICOP classification (EUROSTAT 2001, 281-318), that is to the highest level of detail with which data are publicly available for download from the website of EUROSTAT: these data are thus available for analysis and comparisons to any user. This is also the same detail with which Member states deliver their monthly data to EUROSTAT, according to an agreed calendar.

5 The approach used in this paper has been adopted in Anitori et al. (2004) and it has been applied to price statistics in Brunetti et al. (2004) and in ISTAT (2005, p.42-44).

2. Comparability and variability issues concerning CPI sub-indices

With the exception of a pioneering work by Dalèn (1998), at the dawn of the HICP, systematic and detailed longitudinal comparative analyses of CPI sub-indices are not yet available in the literature, neither with reference to the HICP nor to any other group of national CPIs. With different objectives, the cross section variability of CPI components has been recently examined with at least two distinct purposes. On one side the literature on the "relative price variability" – see for recent overviews Fielding et al. (2001), Nautz et al. (2006), Caraballo et al. (2006) – has investigated the nature of the relationships between the changes occurring in relative prices and the overall inflationary processes, and their implications on the economy depending on the type of inflationary regime. On a different perspective – mainly originated from the central banks' need to target inflation, see for example Wynne (1999) and Roger (1998) – the literature on "core inflation" dealt with the task of finding out a consistent theoretical definition and a viable measurement of the inflationary process in the medium and longer term: practical solutions have focussed mainly on the classification of sub-indices according to their variability in order to freeze the effect of the most volatile ones.

Both these approaches focussed on a single country and on typically macroeconomic purposes, mainly tied to monetary policy. The Harmonised Index of Consumer Prices (HICP) – compiled in 30 European countries[6] within a common legal basis (EUROSTAT 2001) – offers instead the opportunity to move the focus towards the analysis of the behaviour of national sub-indices. It is well known that in general national CPIs are not perfectly comparable. Basic principles might differ, for instance, in the target consumption expenditure, in the classification, in weighting, in the time reference. Such differences make the aggregate indices quite peculiar to each country; the sub-indices on the contrary are far less concerned with general principles and more with national habits having to do with the organisation and the methodology of the numerous distinct surveys which feed CPI estimates. With the binding legal framework of the HICP - whose monthly series started in 1996- many methodological aspects have been harmonised and many heterogeneities have formally disappeared, starting from more general aspects: a common classification; the coverage in terms of consumption expenditure, population, territory; the annual chaining; the weighting. Also some more specific issues have been harmonised, concerning the treatment of tariffs, some coverage aspects in selected sectors (such as insurance, health, education, social protection), the price collection period. Given this huge harmonisation effort, the HICP has no doubt become the price index with the largest background literature, legal basis, documentation and debate.

Not differently from national CPIs, the HICP is primarily adopted as a macroeconomic indicator, for setting and evaluating monetary policies within the euro area: nevertheless, its use for a larger set of policies was already envisaged in its founding documents.[7] The availability of indices with a relatively high degree of harmonisation across the EU, regularly disseminated on the web, broken down by country and by about 100 exhaustive sub-indices, has induced their use to provide evidence for consumer market monitoring, and

6 That is in the 27 countries participating to the EU plus Norway, Iceland and Switzerland.

7 See the Council Regulation (EC) No 2494/95 of 23 October 1995 concerning harmonized indices of consumer prices. Official Journal, L 257, October 10, p. 1–4.

namely to support competition and consumer protection policies.[8] Such developments appear quite natural, given the growing importance of these policies within the EU and the availability of a huge amount of comparable information on the dynamics of consumer prices in each member state.

Nevertheless, methodological harmonisation of the HICP is still a work in progress, and several sources of methodological heterogeneity among countries may still persist. Consumer markets are in fact numerous and very much differentiated: they require specific methodological approaches and solutions to the provision of estimates. Lack of harmonisation might concern more general aspects (such as the definition of the population parameter) or the approach to sampling, the treatment of seasonal pricing, the alternative use of list or bargain prices, the management of replacements, quality adjustments, the aggregation formula and may reflect differences in the interpretation of the functioning of consumer markets. As a matter of fact, compared with other branch of statistics, price statistics has received by far less attention on more specific but crucial methodological grounds, such as sample design and variance of the estimates. These issues are only recently acquiring a growing and systematic importance,[9] since scholars on price indices have largely explored other mainstream subjects: from the properties of estimates and indices (Allen 1975; Balk 2008) to quality adjustment and hedonic modelling, the latter having been generally treated as an issue formally distinct from sampling. One of the most promising developments of the HICP has to do with the fact that in the latest years the focus of harmonisation has been moved towards a more methodological ground, running straight into the issue of the estimation of the HICP.[10] Within the process of methodological harmonisation, the whole set of aspects involved in the production of CPI estimates has been treated within a unitary approach, based on the principle that sample design, sample selection and the other typical technicalities of price statistics (elementary aggregation, replacements, quality adjustment etc.) need a common foundation based primarily on proper and coherent definitions of the target population and of the parameter to be estimated.[11]

3. The data base and the indicators

3.1 The construction of the HICP

The HICP is a fixed base chained Laspeyres index, where the fixed base is given by the average of a reference year, namely 2005. In the month *m* of year *t* the aggregate HICP is given by the chaining of an annual link and a fixed base index:

[8] Recently the European Commission has been pushing for a deeper use of CPI microdata to feed analyses both for competition policy and consumer protection. This has brought recently to an in-depth analysis of the food chain (EC 2009) to the use of the microdata of price surveys to estimate average price levels and to compare the efficiency of retailing in a larger set of consumer markets. A convergence in the purpose and scope of CPI and Purchasing Power Parities (PPP) estimates is increasingly considered as an area of further developments in price statistics.

[9] One of the main concerns for the production of price index estimates has to do with the definition of the target population and of the parameter to be estimated: see Ribe (2000) on this subject. As infrequent examples of statistical theory applied to price statistics see also Baskin (1996) and Norberg (2004).

[10] See the Commission Regulation (EC) No 1334/2007 of 14 November 2007 amending Regulation (EC) No 1749/96 on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonised indices of consumer prices. Official Journal, L 296, November 15, p. 22-26.

[11] See Ribe (2000) and Dalen (2001).

$$X_{m,t} = X_{12,t-1} H_{m,t} \tag{1}$$

where X is the fixed base HICP and H is the annual link based in the month of December of the previous year (EUROSTAT 2001, p.175-97). The latter is derived as the weighted mean of an exhaustive set of sub-indices:

$$H_{m,t} = \sum_j h_{j;m,t} w_{j,t} \tag{2}$$

where with h we label the links corresponding to the elementary aggregate j. The normalised expenditure weights (w) change every year[12] and the fixed base sub-indices x are given by:

$$x_{m,t} = x_{12,t-1} \, {}^{12,t-1}h_{m,t} \qquad (3)^{13}$$

3.2 The data base

The series used for this analysis are publicly and freely available from EUROSTAT web site. They correspond to the monthly indices based on year 2005 and referred to the 94 classes of the COICOP-HICP classification (the highest available breakdown): 14 countries were considered, 11 from the euro area[14] plus Denmark, Sweden and the UK. The download has regarded the 60 months from January 2004 to December 2008. As a consequence, the data base includes as a whole 1.257 series and about 75.000 monthly indices.

All the selected countries show in the period a relatively homogeneous overall price dynamics.[15] Table 1 resumes the main HICP figures in the target period: the range of the inflation rates across countries has kept constantly below three percentage points, and their coefficient of variation even decreased in 2008 notwithstanding the higher inflation.

From here on, the original series of the fixed base indices are labelled with x_i, where $i \in \mathrm{I}_x = \{1,...,n_x\}$ counts the months from January 2004 to December 2008 (hence $n_x = 60$). The series of the yearly rates have been derived from the original fixed base series as follows:

$$y_i = {}^{x_i}\!/_{x_{i-12}} \tag{4}$$

12 In a Laspeyres context, these weights are referred to the consumption expenditure of year t-1.

13 As a consequence – and since the weighting structure changes every year - the fixed base HICP cannot be derived as a weighted average of the fixed base sub-indices but throughout the chain-linking of the weighted averages of the annual links of the sub-indices.

14 Excluding Luxembourg, Cyprus, Malta, Slovenia and Slovakia.

15 This happens in period 2004-2007, characterised by very low inflation rates, but still remains valid with the further inclusion of year 2008, which has been characterised by a sudden and short lived surge in inflation. Separate analyses have been conducted on 2004-2007 data and to the whole period extended to 2008: the results obtained in the classification of the indices and in the measurement of heterogeneity almost identical. Here we propose the entire five years from 2004 to 2008.

where $i \in \mathrm{I}_y = \{13,...,n_x\}$ and $n_y = n_x - 12 = 48$. Accordingly, the series of the monthly rates are derived as:

$$z_i = {x_i}/{x_{i-1}} \qquad (5)$$

where $i \in \mathrm{I}_z = \{2,...,n_x\}$ and $n_z = n_x - 1 = 59$.[16]

Table 1 - HICP annual averages, by year and country (years 2004-2008)

COUNTRY	Average index (base: 2005=100)				Yearly rate of change			
	2004	2006	2007	2008	2005	2006	2007	2008
Austria	97.9	101.7	103.9	107.3	2.1	1.7	2.2	3.2
Belgium	97.5	102.3	104.2	108.9	2.5	2.3	1.8	4.5
Germany	98.1	101.8	104.1	107.0	1.9	1.8	2.3	2.8
Denmark	98.3	101.8	103.5	107.3	1.7	1.8	1.7	3.6
Spain	96.7	103.6	106.5	110.9	3.4	3.6	2.8	4.1
Finland	99.2	101.3	102.9	106.9	0.8	1.3	1.6	3.9
France	98.1	101.9	103.6	106.8	1.9	1.9	1.6	3.2
Greece	96.6	103.3	106.4	110.9	3.5	3.3	3.0	4.2
Ireland	97.9	102.7	105.6	109.0	2.2	2.7	2.9	3.1
Italy	97.8	102.2	104.3	108.0	2.2	2.2	2.0	3.5
The Nederland's	98.5	101.7	103.3	105.5	1.5	1.7	1.6	2.2
Portugal	97.9	103.0	105.5	108.3	2.1	3.0	2.4	2.7
Sweden	99.2	101.5	103.2	106.7	0.8	1.5	1.7	3.3
UK	98.0	102.3	104.7	108.4	2.1	2.3	2.3	3.5
Range	2.61	2.29	3.63	5.36	2.72	2.29	1.41	2.28
Standard deviation	0.71	0.68	1.14	1.50	0.74	0.68	0.49	0.62
Coefficient of variation (%)	0.7	0.7	1.1	1.4	36.2	30.4	22.9	18.0

Source: Elaborations on Eurostat HICP data base

3.3 Some indicators

Relative variability

Three classes of indicators have been calculated for original, monthly and yearly rates series: relative variability indicators, time-linear dynamics indicators and other miscellaneous dynamics indicators. In the formulas that follow, the symbol k (with $k \in \{x, y, z\}$) will be used to represent the three series above.

[16] Yearly and monthly rates of change are conventionally used to summarise price dynamics: they are the most visible and commented outcomes of CPI estimates.

As concerns relative variability,[17] a first set of two indicators (the coefficient of variation and the Gini mean difference) use all the information available for each series:

$$CV_k = \frac{\sigma_k}{\mu_k} = \frac{\sqrt{\dfrac{\sum_{i \in I_k} (k_i - \mu_k)^2}{n_k}}}{\dfrac{\sum_{i \in I_k} k_i}{n_k}} \quad (6)$$

$$RGini_k = \frac{\dfrac{1}{\binom{n_k}{2}} \sum_{\substack{i<j \\ i,j \in I_k}} \left| k_i - k_j \right|}{\mu_k} \quad (7)$$

where μ and σ are respectively the mean and the standard deviation of the series, while n is the total number of monthly observations.

The remaining indicators are built by trimming away part of the data of each series. The range considers only the extremes:

$$RRange_k = \frac{\max(k_i) - \min(k_i)}{\mu_k} \quad (8)$$

the MAD (median absolute difference from the median) takes the median of all the distances from the median:

$$RMAD_k = \frac{median\left(\left|k_i - median(k_i)\right|\right)}{median(k_i)} \quad (9)$$

the interquartile range uses only the extreme quartiles (Q_1 and Q_3) of each distribution:

$$RQrange_k = \frac{Q_3(k_i) - Q_1(k_i)}{median(k_i)} \quad (10)$$

Time-linear dynamics

A second set of indicators has been adopted in order to account for some aspects of the linear relationships with time attributable to each series. In particular, the coefficient of determination R^2 evaluates the goodness of fit provided by the model:

$$x_i = \alpha + \beta i + \varepsilon_i \quad (11)$$

[17] The absolute value of the underlying variability indicator has been divided by a level indicator (the mean or the median). It is important to remark that expressions from (6) to (10) measure variability independently of the order of the observations and simply on the basis of the distribution of their values.

where *i* labels the months. The autocorrelation coefficients, with lags equal to 1 and 12 months, are also estimated using the following model:[18]

$$x_i = -A_1 x_{i-1} - A_2 x_{i-2} .... - A_{12} x_{i-12} + \varepsilon_i \qquad (12)$$

Other dynamics indicators

Two further indicators summarise the difference, within each country, between the yearly rates of each sub-index and those of the corresponding aggregate HICP. For the *i*-th month we have:

$$d_i = y_i - y_i^{CP00} \qquad (13)$$

where y_i^{CP00} is the yearly rate of growth of the aggregate HICP in month *i*. The Euclidean distance between the two series is derived by averaging the squares of these residuals:

$$D2_y = \sqrt{\frac{\sum_i d_i^2}{n_y}} \qquad (14)$$

while the mean of the residuals delivers an evaluation of the systematic discrepancies between them:

$$D1_y = \frac{\sum_i d_i}{n_y} \qquad (15)$$

A last indicator has the objective to evaluate the propensity of each index to move monthly and it is given by the share of months in which each series has shown a change with respect to the preceding month. In particular:

$$M_z = \frac{\sum_i M_{iz}}{n_z} \qquad (16)$$

where

$$M_{iz} = \begin{cases} 1\, if\ z_i \neq 1 \\ 0\, if\ z_i = 1 \end{cases} \qquad (17)$$

[18] The coefficient A_{12} is used in order to give a rough indication on the yearly seasonal nature of the series, while A_1 is used in order to evaluate short term autocorrelation. Given this formula, a negative value for the coefficients of this linear relation implies a positive autocorrelation, and vice versa. This aspect should be reminded when commenting tables and principal factors in par.4.

Overall features of indices' variability

The final matrix that is used in the analysis is thus composed by 21 indicators referred to 1.257 series. Relative variability is in general higher for fixed base indices (Table 2).[19] The average values assumed by these indicators are all higher than their median, given a positive asymmetry generated by a limited number of series with high or very high levels of relative variability and a large number of series whose behaviour is instead very smooth. The asymmetry is more evident for yearly and monthly rates. Most fixed base series show an approximately time-linear longitudinal pattern: R^2 is very near to unity for 25% of the series, its mean is well below the median and the first quartile is still high. An appreciable lag 12 autocorrelation appears in less then 10% of the series.[20]

The distribution of the distances from aggregate series is also positively skewed. Series diverge in fact on average by four percentage points (pp) from the corresponding aggregate HICP; but, while for a half of them this average is lower than 2.5 pp, for 10% of the series *D2* is over eight pp. As a consequence, the median is lower than the arithmetic mean. The distribution of *D1* appears instead nearly symmetric. Nevertheless, both 5%-tails reveal the existence of series which diverge systematically from the aggregate HICP: in particular, the number of sub-indices running below the aggregated index appears slightly higher. Finally, according to the variable *M*, on average series have a 77% propensity to monthly movement: the distribution is in this case negatively skewed.[21]

Two objectives are pursued in the following paragraphs 4 and 5: to obtain a classification of HICP sub-indices according to the characteristics of their behaviour and to measure the degree of heterogeneity across countries of the series belonging to a same elementary aggregate. The classification is obtained by applying a clustering algorithm to the scores obtained by the prior application of principal components (PC) to the matrix of indicators.[22] This paragraph describes the main results of PC and some partitions of the original data derived from cluster analysis. In paragraph 5 the coordinates corresponding to the main principal components are used to provide a measure of the entropy within each elementary aggregate and to highlight the aggregates that might need more urgently further methodological harmonisation.

[19] This is obvious since yearly and monthly rates refer to more constrained time spans.

[20] Given expression (12), negative coefficients imply positive autocorrelation.

[21] There is a tail of a 10% of the series which tend to show some movement only in one month out of four. For the estimates of some sub-indices, many NSIs in fact collect prices only on a quarterly basis instead of monthly. Furthermore, imputation is rarely adopted to replace missing monthly observations and last available estimates are often simply carried over. EUROSTAT has ruled out such practices. See the Council regulation (EC) No 701/2006 of 25 April 2006 laying down detailed rules for the implementation of Regulation (EC) No 2494/95 as regards the temporal coverage of price collection in the harmonised index of consumer prices. Official Journal, L 122, November 15, p. 3-4.

[22] For the use of this, so called, "tandem analysis" to business statistics see Anitori et al. (2004). As regards more specific applications to price statistics, see Brunetti et al. (2004) and ISTAT (2005, p.42-44).

Table 2 - Averages and percentiles of the distribution of variability indicators

INDICATOR	Mean	Percentiles									Median/ Mean
		1st	5th	10th	Q1	Median	Q3	90th	95th	99th	
						INDEX LEVELS					
CV	5,4	0,7	1,2	1,6	2,7	4,4	6,5	9,9	14,1	24,9	0,80
RQrange	8,1	0,5	1,3	1,9	3,6	6,4	10,0	15,2	21,9	38,7	0,79
RGini	6,1	0,7	1,3	1,8	3,0	4,9	7,5	11,1	15,7	27,5	0,80
RMad	3,8	0,2	0,5	0,8	1,6	2,9	4,8	7,1	10,0	18,6	0,77
RRange	19,2	2,3	4,4	5,9	9,3	14,6	22,6	36,9	50,5	94,5	0,76
R^2	0,73	0,00	0,07	0,19	0,60	0,88	0,96	0,98	0,99	1,00	1,19
A_1	-0,8	-1,3	-1,1	-1,1	-1,0	-0,8	-0,7	-0,4	-0,3	0,0	1,05
A_{12}	0,0	-0,5	-0,3	-0,2	-0,1	0,0	0,1	0,1	0,2	0,2	-0,71
						YEARLY CHANGES					
CV	2,5	0,3	0,4	0,6	0,9	1,6	3,0	5,4	7,6	15,3	0,64
RQrange	3,6	0,3	0,5	0,7	1,2	2,2	4,2	7,5	11,0	21,7	0,63
RGini	2,8	0,3	0,5	0,7	1,0	1,8	3,3	5,9	8,5	16,9	0,64
RMad	1,5	0,1	0,2	0,3	0,6	0,9	1,7	3,1	4,5	9,1	0,64
RRange	9,6	0,8	1,7	2,2	3,5	6,1	11,6	20,5	29,7	57,3	0,64
D2	4,0	0,7	1,0	1,2	1,6	2,5	4,5	8,2	12,0	22,0	0,63
D1	-0,4	-16,4	-6,4	-3,7	-1,6	-0,2	1,3	3,0	4,8	11,2	0,48
						MONTHLY CHANGES					
CV	1,4	0,1	0,2	0,3	0,4	0,7	1,4	3,4	5,6	9,3	0,52
RQrange	1,1	0,0	0,0	0,0	0,2	0,4	1,0	2,9	4,8	9,6	0,39
RGini	1,3	0,1	0,2	0,3	0,4	0,6	1,2	3,4	5,7	9,6	0,46
RMad	0,5	0,0	0,0	0,0	0,1	0,2	0,5	1,3	2,3	4,5	0,36
RRange	7,7	0,6	1,1	1,3	2,3	4,2	8,4	18,7	26,5	53,6	0,55
M	0,77	0,09	0,15	0,28	0,65	0,90	0,97	1,00	1,00	1,00	1,17

Source: Elaborations on Eurostat HICP data base

4. Main results from multivariate data analysis

4.1 Principal components

No weights have been applied to this analysis.[23] The first two principal components account for 68.1% of total inertia, the first five overcome 90% (Table 3).[24] The first factor might be interpreted as expressing general variability: higher scores identify series with a high overall dynamics, especially in the level of the fixed base index and in its yearly growth rates. Furthermore this factor has a positive correlation with the average quadratic distance from the overall HICP, while no significant correlation emerges with the variables concerned with time-linear dynamics.

[23] Some experiments have been made by weighting series, but no relevant changes in the overall results occurred. The structure of the data base is quite robust, and remains substantially unvaried if expenditure and/or country weights are introduced.

[24] The sum of the eigenvalues of the first ten principal components nearly reaches 99% of total inertia.

Table 3 - Correlation between the first five principal components and the original variables

VARIABLE	Principal components				
	Prin1	Prin2	Prin3	Prin4	Prin5
Eigenvalue (%)	50.0	18.1	11.3	7.0	4.2
		INDEX LEVELS			
CV	0.84	0.46	0.27	0.02	0.01
Qrange	0.71	0.52	0.38	-0.02	-0.01
Gini	0.82	0.47	0.30	0.01	0.02
MAD	0.66	0.52	0.46	-0.06	0.05
Range	0.88	0.33	0.24	0.00	0.04
R^2	-0.21	0.66	0.28	0.09	-0.08
A_1	0.08	-0.51	0.53	0.10	-0.03
A_{12}	-0.01	0.37	-0.53	0.07	-0.05
		YEARLY CHANGES			
CV	0.88	0.05	-0.41	0.00	0.07
Qrange	0.84	0.12	-0.44	0.05	-0.05
Gini	0.89	0.05	-0.41	0.10	-0.06
MAD	0.83	0.06	-0.35	-0.18	0.23
Range	0.91	-0.06	-0.33	-0.01	0.04
D2	0.87	0.34	-0.01	-0.19	0.23
D1	0.14	-0.04	-0.50	0.16	-0.16
		MONTHLY CHANGES			
CV	0.74	-0.57	0.15	0.29	0.41
Qrange	0.67	-0.59	0.17	0.34	-0.14
Gini	0.72	-0.62	0.18	-0.47	-0.11
MAD	0.66	-0.59	0.15	-0.08	-0.22
Range	0.75	-0.50	0.07	0.60	0.52
M	0.21	-0.17	0.03	-0.72	0.44

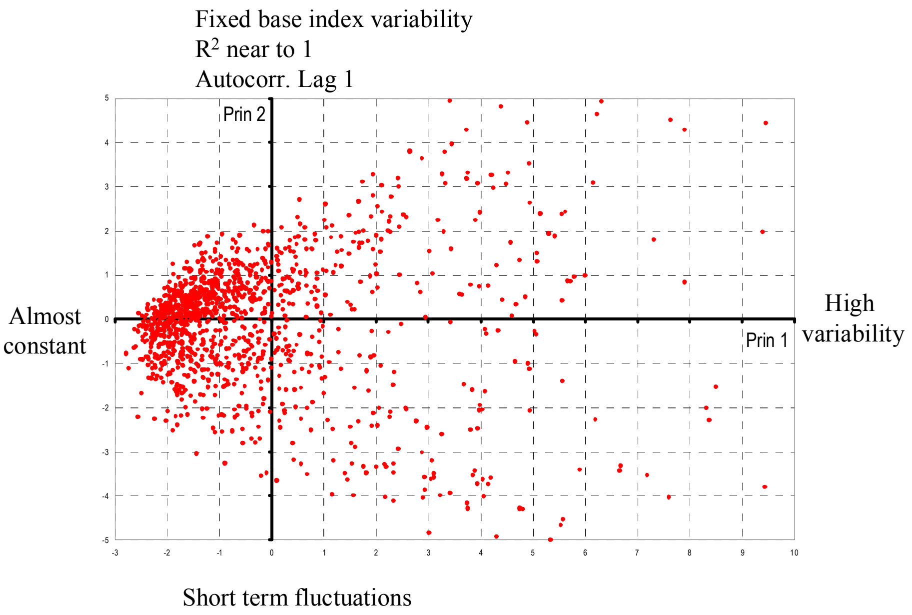
Source: Elaborations on Eurostat HICP data base

The second factor accounts for the relationship between overall variability and time-linear dynamics: in particular, the scores are directly related with the variability of the fixed base index, and negatively related with the variability of its monthly changes. This component shows also a positive relation with R^2 and with lag 1 autocorrelation. Higher scores identify series with a regular trend - positively or negatively sloped - and consequently a higher variability in the level of the fixed base index as expressed in particular by *MAD* and *QRange*. Negative scores at the opposite identify fluctuations and, as a consequence, index levels have a smaller range.

In a similar way, the third principal component shows a negative relation with the variability of yearly rates and a positive one with that of fixed base indices. The higher the score on this axis, the more the yearly rates tend to be constant, the lag 12 autocorrelation high and the lag one low. Positive values of this factor characterise series whose behaviour has some yearly seasonality and whose yearly changes tend to be systematically lower than those of the corresponding aggregate HICP. On the negative side the opposite applies: it is possible to find there series with quite irregular yearly rates of change, which tend to be higher than the aggregate HICP.[25]

Most sub-indices show negative scores on the first component (relatively low variability profiles), while their distribution on the second appears more even (Figure 1).[26] The more we move to positive values of the first, the more the coordinates on the second component tend to increase their dispersion: the position of each series depends respectively on whether it assumes a monotone (north-east) or an erratic (south-east) short term dynamics.[27]

Figure 1 - The scatter of HICP series in the space given by the first two components



Source: Elaborations on Eurostat HICP data base

[25] The fourth factor captures the inverse association between seasonality and faster yearly growth on one side and the frequency of monthly changes on the other, while the fifth shows the direct association between these last two variables.

[26] Only 31% of the series show a positive coordinate on the first factor while 58% have a positive one on the second.

[27] Something similar could be said with reference to the form of the scatter in the space given by the first and third factor. The variability on the third factor is quite reduced, also in comparison with the second one. In any case, as overall variability increases along the first axes, the third one discriminates between more regular seasonal behaviours (positive values) and occasional sharp level shifts (negative).

4.2 Clustering series

We explored the possibility to classify series according to their behaviour without any a priori hypothesis on the structure of the classification itself. For this purpose we opted for the use of hierarchical aggregative clustering algorithms in order to investigate alternative segmentations of the series. The results that we present here are referred to the application of the Ward (1963) algorithm, although there is a high similarity with those obtained with average linkage clustering. The Ward algorithm has been applied to the main principal components: alternative solution have been explored including from a minimum of five up to twelve components (99.6% of total variability), and the results appeared quite robust with only marginal changes. We will discuss then the twelve components case and a hierarchy of partitions ranging from two to nine clusters (see Table 4).[28]

The partition in two main clusters, A and B, explains 27.4% of total variance. It separates the series in two exhaustive sets: the series with a very low variability (cluster A) and those with an appreciable variability. Cluster A includes the large majority of the series, more than 900 corresponding nearly to the 75% of the total (see Table 5). At a deeper level of detail, each main cluster can be split in three distinct clusters, and in the case of cluster B the breakdown has been brought further to six clusters. The partition in four clusters, with the original cluster B split in three subsets (BB, BC and BD), brings a considerable gain in the share of the variance between (near to 50% of total variance: see Table 4). The further partition in nine clusters brings this share over 67%.[29]

Table 4 - Cluster aggregation

SPLIT	IN	Variance between	Clusters	
			No.	Name
Population	A and B	27.4%	2	A, B
B	(BC+BD) and BB	38.0%	3	A, BB, (BC+BD)
(BC+BD)	BC and BD	46.7%	4	A, BB, BC, BD
BD	BD1 and BD2	54.4%	5	A, BB, BC, BD1, BD2
A	(A1+A2) and A3	58.3%	6	(A1+A2), A3, BB, BC, BD1, BD2
BB	BB1 And BB2	61.8%	7	(A1+A2), A3, BB1, BB2, BC, BD1, BD2
BC	BC1 and BC2	64.9%	8	(A1+A2), A3, BB1, BB2, BC1, BC2, BD1, BD2
(A1+A2)	A1 and A2	67.2%	9	A1, A2, A3, BB1, BB2, BC1, BC2, BD1, BD3

Source: Elaborations on Eurostat HICP data base

[28] Further partitions have also been examined, although the gains are rather smooth (the marginal contribution of further partitions was less then 2% of total variability): it is possible to explain 75% of total variance with 16 clusters, which mainly derive from splitting A1, A2, BB1, BC1 and BD1.

[29] Further partitions have also been examined, although the gains are rather smooth: it is possible to explain 75% of total variance with 16 clusters, who mainly derive from splitting clusters A1, A2, BB1, BC1 and BD1.

Table 5 - Cluster size and centre

CLUSTER	DESCRIPTION	Series		Principal components				
		No.	%	Prin1	Prin2	Prin3	Prin4	Prin5
Total		1257	100					
A	Low variability	921	73.3	-1.5	0.6	0.2	-0.3	0.6
B	Higher variability	336	26.7	3.9	0.0	0.0	0.0	-0.1
A1	Low variability discrete	256	20.4	-1.6	0.1	0.6	1.3	-0.2
A2	Low variability monotone	393	31.3	-1.5	0.6	0.2	-0.3	0.6
A3	Low variability irregular	272	21.6	-1.2	-0.9	-0.8	-0.8	-0.5
BB	Medium variability non time linear	108	8.6	4.2	-4.0	1.3	-0.2	0.1
BC	Medium variability time-linear	180	14.3	2.7	1.1	-1.4	0.4	0.1
BD	High variability	48	3.8	8.2	4.4	2.3	-1.3	-0.9
BB1	Regular seasonal	92	7.3	3.1	-3.7	1.3	-0.2	0.1
BB2	Irregular seasonality and fluctuations	16	1.3	10.7	-5.9	1.0	-0.4	0.5
BC1	Marked irregular time-linear trend	61	4.9	5.5	1.2	1.1	-1.0	0.3
BC2	Irregular time-linear trend	119	9.5	1.2	1.1	-1.0	0.3	0.0
BD1	Strongly downward time-linear trend	36	2.9	5.6	5.0	4.4	-2.5	-1.6
BD2	Strongly irregular yearly rates	12	1.0	16.2	2.7	-4.1	2.4	1.1

Source: Elaborations on Eurostat HICP data base

Lower variability (A)

The sub-indices in the lower variability domain on average show a relative variability between two to five times lower than the average of cluster B, with a low propensity to monthly change: they in fact have mainly negative scores on the first principal component. This huge area of low variability can be further split in three distinct clusters (A1, A2 and A3), on the basis of a slight differentiation of the scores on the second and third component.

Cluster A1 identifies sub-indices with small and discrete movements: it contains 20.4% of the series, which have on average the lowest coordinates on the first component (Table 5). They are characterised by a very low propensity to move (Table 6). Yearly changes are particularly weak and monthly changes as well, especially if extremes are trimmed off.

Cluster A2 concentrates 31.3% of the series, which can be labelled as "Monotone" since they show very small and regular monthly changes. As a consequence, the indicators relating to index levels - and based on the range - are a slightly higher than the rest of cluster A. The yearly rates lay on average shortly below the aggregate HICP. In this cluster and in A1, series have on average a R^2 close to unity.

The behaviour of the 21% of the sub-indices which are included in cluster A3 shows some irregularity. Yearly and monthly changes are more volatile and the series fluctuate moderately: the time-linearity of the series, as measured by the R^2, appears very limited. The range of index levels is consequently more constrained: their variability is on average almost one half with respect to the rest of cluster A. The inflationary profile of these series lays well below the aggregate HICP.

Medium variability and non linearity (BB)

In considering the remaining 336 series classified in the main cluster B it is possible to find a first domain composed by series (8.6% of the total) showing a moderate variability - the double or more with respect to cluster A - associated with remarkable fluctuations. Clusters BB1 and BB2 are in fact characterised by lower scores on the second component. R^2 is relatively low while the variability of the monthly rates is very high: both clusters contain the series with the highest short term variability.

In particular, cluster BB2 (1.3% of the series) is characterised by fluctuations and quite irregular seasonal patterns. The average variability of yearly changes in BB2 triples that registered in cluster BB1 (7.3% of the total), which is characterised by a regular seasonality. The series included in BB2 are in fact more variable, not only with regard to the levels of the indices but also to their yearly and monthly changes. Both BB clusters show on average a weaker inflationary profile with respect to the aggregate HICP (especially BB2).

Medium variability and time-linear dynamics (BC)

A marked linear evolution with time (R^2 is on average relatively high, near to 0.7) is shown in clusters BC1 (4.9% of the series) and BC2 (9.5%). Their variability is similar or slightly higher with respect to cluster BB1. The sub-indices in BC1 are more volatile, with a slightly lower R^2. Lag 1 autocorrelation is in both clusters very high. The yearly rates are more irregular in BC1 while the variability of monthly changes is significantly lower as compared to BB. These series, and in particular those in BC1, have an upwards dynamics significantly stronger as compared to the aggregate HICP.

High variability (BD)

The clusters BD1 and BD2 include as a whole 3.8% of the series all characterised by very large movements: *CV* is on average over 20% and the relative range is over 70%. Series in BD2 are characterised by large fluctuations in the yearly rates. On the contrary those in BD1 denote a remarkable downward trend: these sub-indices have an R^2 very close to one and a negative time-linear trend, whose regularity is witnessed by the comparatively smaller variability of monthly and yearly changes. On the other side, the yearly growth rates in BD2 are much higher *vis-à-vis* the aggregate HICP, and they come along with large fluctuations both on monthly and yearly rates.

Table 6 - Average indicators by cluster

INDICATOR	Clusters								
	A1	A2	A3	BB1	BB2	BC1	BC2	BD1	BD2
	FIXED BASE INDEX (BASE: AVERAGE 2005=100)								
CV	4.0	4.4	2.4	6.6	11.8	11.8	7.5	20.9	24.4
RQrange	6.2	7.2	3.1	9.0	16.4	16.2	11.1	34.4	31.3
RGini	4.6	5.0	2.6	7.3	13.1	13.0	8.1	24.1	26.9
RMad	3.0	3.4	1.4	4.1	7.7	7.5	4.6	17.1	12.3
RRange	13.4	14.9	9.1	27.3	53.8	42.4	23.8	72.4	95.7
R^2	0.91	0.93	0.41	0.34	0.22	0.66	0.76	0.98	0.74
A_1	-0.67	-0.86	-0.83	-0.47	-0.49	-0.94	-0.95	-0.82	-0.88
A_{12}	-0.12	0.02	0.02	-0.15	-0.20	0.08	0.04	0.02	0.09
	YEARLY CHANGE MOVING BASE INDEX								
CV	1.2	1.2	2.1	3.4	9.4	8.4	4.5	3.8	17.5
RQrange	1.7	1.7	2.9	4.0	11.9	12.5	6.5	5.4	28.6
RGini	1.3	1.3	2.3	3.6	10.5	9.1	4.8	4.2	19.4
RMad	0.7	0.7	1.2	1.9	5.6	4.7	2.3	2.5	10.8
RRange	4.4	4.4	8.0	15.7	41.6	30.0	14.9	14.4	64.3
D2	2.0	2.3	3.0	4.2	10.0	10.7	5.5	16.3	26.3
D1	0.1	-0.3	-1.8	-0.8	-1.5	5.1	1.9	-15.9	16.6
	MONTHLY CHANGE MOVING BASE INDEX								
CV	0.8	0.5	0.9	5.5	9.6	2.8	1.3	1.4	6.1
RQrange	0.3	0.5	0.8	4.8	10.9	2.0	0.6	1.4	4.6
RGini	0.6	0.5	0.9	5.8	10.5	2.5	1.0	1.5	5.8
RMad	0.1	0.2	0.4	2.2	5.3	1.0	0.2	0.6	2.2
RRange	4.3	3.0	5.5	26.5	47.9	16.4	8.3	7.4	35.1
M	0.45	0.86	0.86	0.94	0.98	0.80	0.71	0.98	0.88

Source: Elaborations on Eurostat HICP data base

5. The analysis of elementary aggregates

5.1. Heterogeneity of sub-indices

The country series referred to a same elementary aggregate are often positioned in separate clusters, and this is one of the aspects which appear as more interesting in order to target further improvements in harmonisation. If we consider the less detailed partition in two clusters (A and B), it is possible to identify only 25 elementary aggregates (slightly more than one out of four) whose national series are all concentrated in a same cluster (almost exclusively in cluster A) while the remaining 69 are split in the two clusters (see Table 7) and are thus characterised by the existence of some heterogeneous patterns in national series.

If we consider the further partition in four clusters, 24 elementary aggregates still belong to a same cluster while, at the opposite, 13 aggregates are separated in more than two distinct clusters. The most detailed partition in nine clusters shrinks to two the number of elementary aggregates whose national series all belong to a same cluster, while 44 aggregates are split in more than three clusters.

Table 7 - Splitting of elementary aggregates into clusters

COUNTRY SERIES	Partitions		
	2 clusters	4 clusters	9 clusters
All in the same cluster	25	24	2
In two clusters	69	57	15
In three clusters		13	33
In four clusters			34
In five clusters			8
In six clusters			2
Total aggregates	**94**	**94**	**94**

In order to derive a measure of the heterogeneity within each elementary aggregate *j*, it is proposed here an indicator based on the Euclidean distance (*ED*) of each series from the centre of the corresponding elementary aggregate on the space determined by the first *Q* principal components. Country distances have been then averaged in order to obtain the mean quadratic distance within each aggregate. In particular:

$$ED_j^q = \sum_g \sqrt{\sum_{q=1}^{Q} \left(c_{qjg} - \bar{c}_{qj}\right)^2} \tag{18}$$

where c_{qjg} are the coordinates on the principal factor q of the series for COICOP j in country g, while:

$$\bar{c}_{qj} = \frac{\sum_g c_{qjg}}{n_g} \tag{19}$$

are the coordinates of the centre of COICOP class j on factor q, derived as an unweighted average of country coordinates.[30] Furthermore, n_g is the number of countries taken into consideration ($n_g = 14$).

Table 8 ranks the most heterogeneous aggregates. In particular, "passenger transportation by air" and "package holidays" seem to represent by far the sectors in which the behaviour of the national series is the most heterogeneous. Transports by sea and inland waters also show high heterogeneity; the same applies to hi-tech and books, to clothing and to some goods and services related to housing. Fruit and vegetables are also in this list of heterogeneous cases, like accommodation, hospital services and many public utilities.

[30] Other distance measures have been tried, all bringing roughly the same results.

Table 8 - The 25 elementary aggregates with the highest heterogeneity

DESCRIPTION	ED	DESCRIPTION	ED
Passenger transport by air	6.04	Garments	3.01
Package holidays	5.01	Vegetables	3.00
Hospital services	4.06	Electricity	3.00
Clothing materials	4.04	Equip. for the reception, recording and reproduction	3.00
Heat energy	4.04	Shoes and other footwear	2.09
Passenger transport by sea and inland waterway	4.02	Books	2.08
Photographic and cinematographic equip. and optical instr.	4.01	Education	2.07
Gas	3.09	Refuse collection	2.07
Liquid fuels	3.06	Other articles of clothing and clothing accessories	2.06
Accommodation services	3.04	Water supply	2.06
Information processing equipment	3.03	Jewellery, clocks and watches	2.05
Gardens, plants and flowers	3.01	Fruit	2.04
Sewerage collection	3.01		

Source: Elaborations on Eurostat HICP data base

How can we find an explanation for heterogeneity? Does it derive from differences in the actual behaviour of national markets? Or is it generated by some methodological reason revealing a lack of harmonisation, for example in sampling design, stratification, elementary aggregation, replacements, weighting etc?

This analysis can help to focus on strong disharmony due to sampling issues, where it can hardly be explained by differences in the functioning of national markets. Nevertheless, it cannot be straightforwardly assumed that high homogeneity is synonymous of sound methodological harmonisation. For instance, restaurants make up the most homogeneous aggregate (Table 9), although the task of estimating the corresponding sub-index is rather difficult. High homogeneity also concerns some foodstuff (i.e. meat, wine, bread, etc.), fuels (which mainly obey to the international markets and whose prices can be quite easily observed with a zero influence of replacements). Cars are also in this group of homogeneous aggregates, due the smooth behaviour of the estimates based on list prices.[31]

[31] NSIs may in fact be adopting similar but not methodologically correct designs, as it may happen for example with cars, where list prices are widely used instead of actual bargain prices. The use of the latter would probably induce heterogeneity in the behaviour of the indices (De Gregorio 2010).

Table 9 - The 25 elementary aggregates with the lowest heterogeneity

DESCRIPTION	ED	DESCRIPTION	ED
Restaurants, cafés and the like	0.07	Materials for the maintenance and repair of the dwelling	1.03
Pets and related products	0.09	Fuels and lubricants for personal transport equipment	1.03
Spare parts for personal transport equipment	1.00	Food products not elsewhere classified	1.03
Cultural services	1.00	Cleaning, repair and hire of clothing	1.03
Meat	1.00	Motor cars	1.03
Wine	1.01	Services for the maintenance and repair of the dwelling	1.03
Maintenance and repair of personal transport equipment	1.01	Non-durable household goods	1.03
Bread and cereals	1.01	Mineral waters, soft drinks, fruit and vegetable juices	1.04
Appliances for personal care	1.01	Tools, equipment and miscellaneous accessories	1.04
Motor cycles, bicycles and animal drawn vehicles	1.02	Recreational and sporting services	1.04
Newspapers and periodicals	1.02	Miscellaneous printed matter and stationery materials	1.04
Sugar, jam, honey, chocolate and confectionery	1.02	Milk, cheese and eggs	1.04
Canteens	1.02		

Source: Elaborations on Eurostat HICP data base

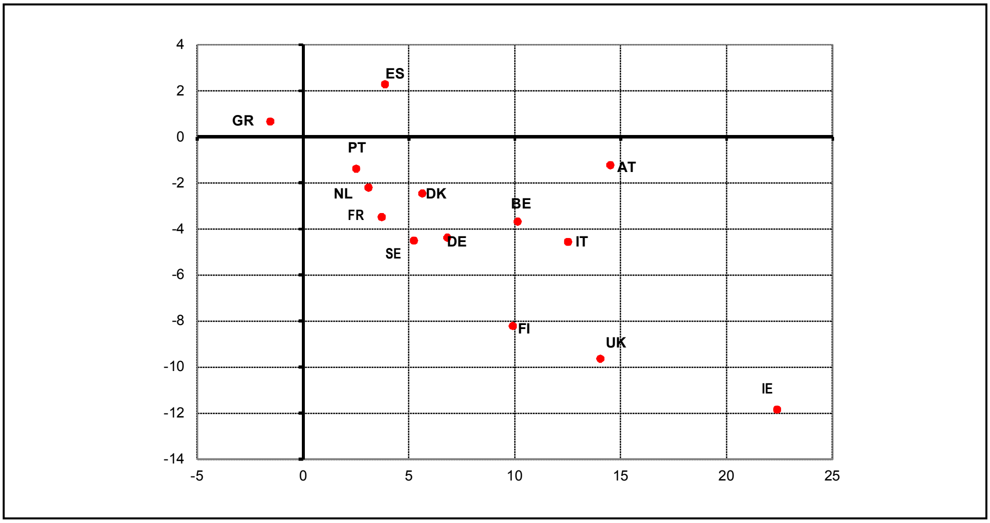
5.2 Some case studies

The possible reasons that lay behind the lack of homogeneity may concern the behaviour of national markets or the approach to sampling, or both. Three different cases are here presented: air transport, where heterogeneity seems to derive from specific methodological issues; package holidays, where a different sort of methodological differences appears; electricity, where the peculiarity of national markets seems to prevail over methodological explanations.

Passenger transportation by air

National indices provide very different pictures of air transports across the EU. This can be visualised in the two dimensions space given by the first two components (Fig. 2). Countries appear all distributed along the diagonal running from north-west to south-east. With the only exception of Greece and Spain, all countries have positive coordinates on the first principal component and negative on the second. The series with a higher variability in the level of the index appear influenced by short term fluctuations and in some cases by seasonal behaviours. Greece is the only country with a negative coordinate on the first factor: its sub-index moves discretely and remains constant for several months (nearly one year). Spain, whose sub-index has a relatively low variability, is the only case of positive coordinate on the second component: in fact it has a time-linear pattern, with an upward trend. The remaining countries all show very sharp monthly changes and fluctuations: the differences among them mainly concern the intensity of movements.

Figure 2 - The coordinates of HICP series for air transports on the space given by the first two principal components, by country



Source: Elaborations on Eurostat HICP data base

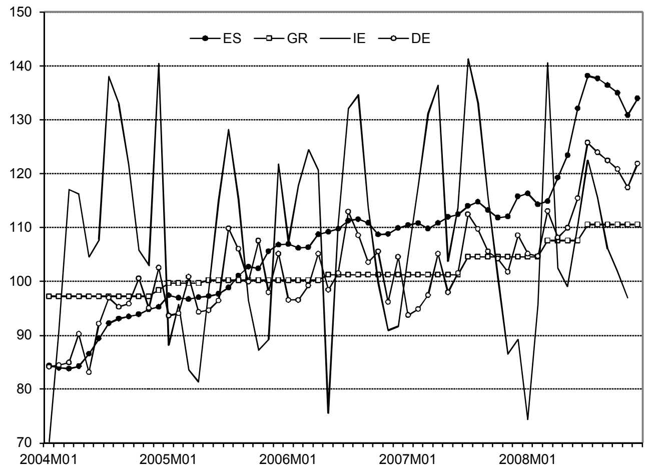
Nevertheless, such heterogeneous behaviours look quite implausible and this impairs the explanatory power of any euro area or EU average for the price index of this sector. Several elements might help to explain them. The characteristics of national markets may play some role: the market power of incumbent national carriers may vary across countries, as well as the barriers to entry and the degree of penetration of low cost carriers. Some differences might occur if the size of the country, that is the existence of a national market, is taken into consideration. Nevertheless competition and the appearance of new operators has taken place almost everywhere in Europe, and especially in the lower segments, like those accounted for by low cost operators. This has brought everywhere competitive pressures and shorter term pricing policies. For this reason, it is hard to maintain that in the EU coexist markets where price dynamics are contemporarily those shown in figure 3.

It seems likely that the lack of homogeneity within this elementary aggregate cannot be satisfyingly explained on the basis of structural differences in national markets: this is quite evident if we compare Greece and Ireland although it might be also interesting to explain the differences among less heterogeneous series. Methodological explanations are very probably playing a major role. Although the literature on CPI methodology for this sector is quite small[32] and cannot help much, it is easy to guess that these explanations may involve the sampling design: namely, the size and selection of the sample, the use of sampling stages and stratified designs, the price collection technique, the methods for replacements and elementary aggregation, the implicit hypotheses concerning the elasticity of consumer behaviours. Some answers to easy questions may clarify things. For example: how many airlines are included in the sample? And on how many routes? Which prices are followed?

[32] See for example Lent at al. 2005, Good et al. 2008.

The official prices, or the actual prices, or those derived from purchase simulations on the internet? How does it take place the selection of a route? Which types of destinations were considered in the sample? How is it defined the stratification? How is it considered the presence of a plurality of offers on the same route? Are the prices from different carriers directly compared?

Figure 3 - HICP series for air transports for Spain, Greece, Ireland and Germany (Jan 2004-December 2008) (base: average year 2005=100)



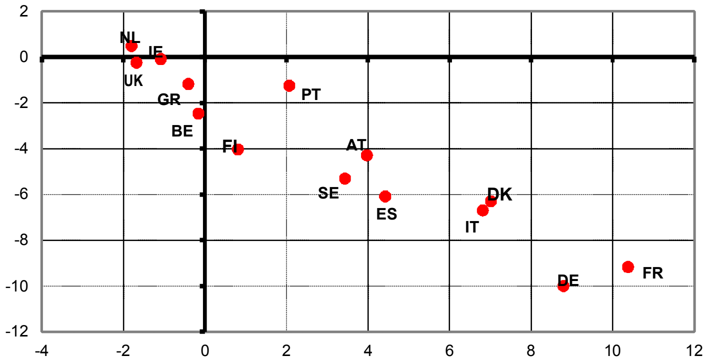
Source: Elaborations on Eurostat HICP data base

It is evident that quite different approaches coexist, and that there is a wide scope for harmonising them within the existing HICP legal basis. Moreover, this market has been given a great deal of attention from the EU Commission, for instance for what concerns transport policy, competition and passenger rights: one might ask whether the HICP is adequate to describe this market and to drive policies. The answer seems negative, but at the same time many elements are at hand in order to bring on the necessary improvements and a common view on the criteria to be used to provide these estimates.

Package holidays

The case of package holidays looks at least in part similar to air transport. Countries tend to be positioned on the diagonal north-west/south-east, although the scale of figure 4 is significantly reduced. Five countries have negative scores on the first principal component, and they all show similar patterns: very smooth index as in the case of Ireland, UK and The Nederland's, with some fluctuations as in the case of Belgium and Greece which have a negative coordinate on the second component. On the contrary, the rest of the countries show fluctuations and seasonality which become particularly strong in the case of Germany and France.

Figure 4 - The coordinates of HICP series for package holidays on the space given by the first two principal components, by country



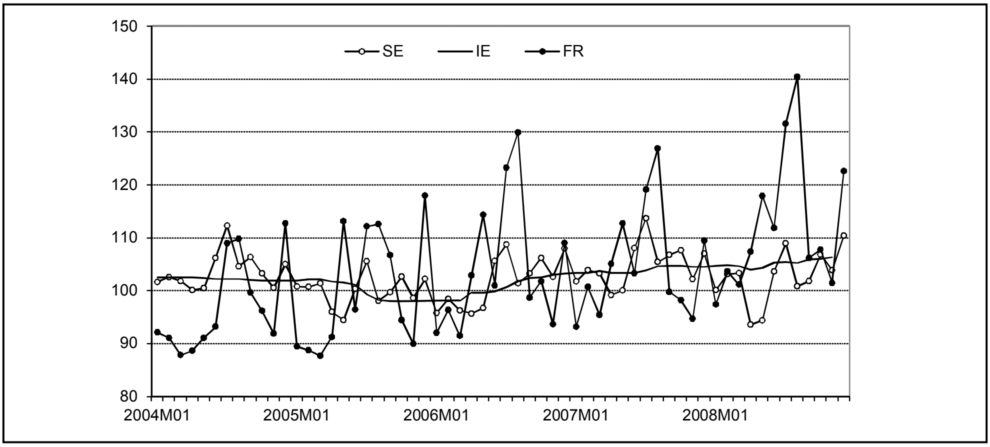
Source: Elaborations on Eurostat HICP data base

If we look at the behaviour of the series (Fig. 5), it is possible to appreciate the large differences in the estimated price dynamics. It looks very unlikely to attribute them to the working of national markets: foreign destinations are in fact very similar across European tour operators. Methodological aspects are certainly playing an all but secondary role: in particular, the way in which the sub-indices account for the seasonal nature of pricing in this sector appears to be a relevant issue. The use seasonal baskets[33] may explain the absence of fluctuations in the behaviour of some indices. Other sources of heterogeneity may derive from the treatment of missing observations and from the possibly different imputation techniques adopted to treat seasonal products. A lack of harmonisation may also concern the type of stratification and sample size. Differences may arise on the management of replacements, which appear to be quite frequent in this market: the adoption of overlap or bridged overlap on one side, and direct comparisons or other imputation techniques on the other, may bring sharply different results in terms of overall variability. A common approach, and in particular a proper common definition of consumption segments, might help considerably to harmonise estimates.[34]

[33] On the seasonal basket approach followed in Ireland in the case of package holidays, see CSO (2003). On the treatment of package holidays in the Italian HICP see De Gregorio et al. (2008), p.28-29.

[34] Having a good price index for this aggregate has also some importance for policy. Package holidays have in fact been the object of the focus of EC policies, especially concerning consumer protection. Common rules to be followed by tour operators in order to protect consumers were defined since 1990 within the normative body on package travel, package holidays and package tours. See EC (1999, 2007b).

Figure 5 - HICP series for package holidays for Sweden, Ireland and France (Jan 2004-December 2008) (base: average year 2005=100)

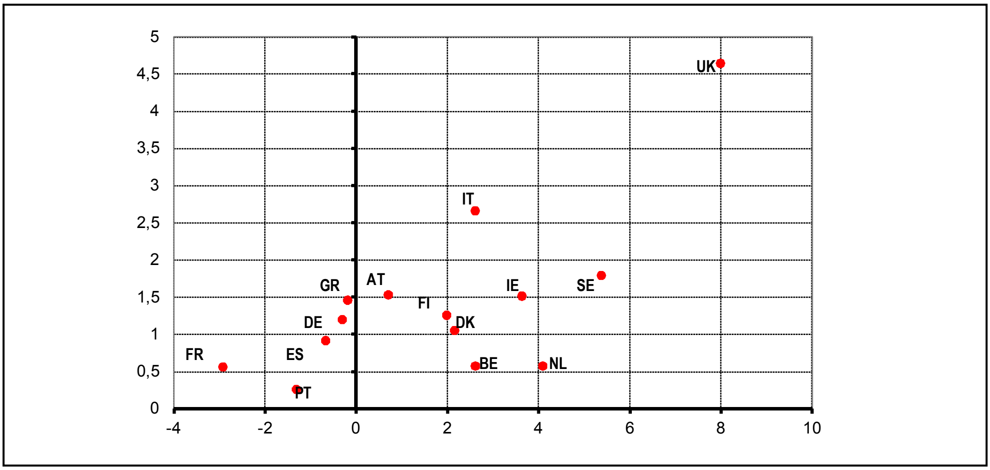


Source: Elaborations on Eurostat HICP data base

Electricity

In the case of electricity, countries all show positive scores on the second component, with indices that generally change smoothly and with time-linear patterns (Fig. 6). Five countries have negative values on the first component: in particular the French index moves discretely and remains constant for very long periods; something similar happens to the series of Portugal, Spain, Greece and Germany. Although discrete shapes seem to prevail, other countries show more variability, mainly due to a higher frequency of their movements and a more regular (upward) trend. The highest overall variability is shown by the UK series, where the sub-index shows a regular upward trend with a major fluctuation towards the end of 2008 (Fig. 7).

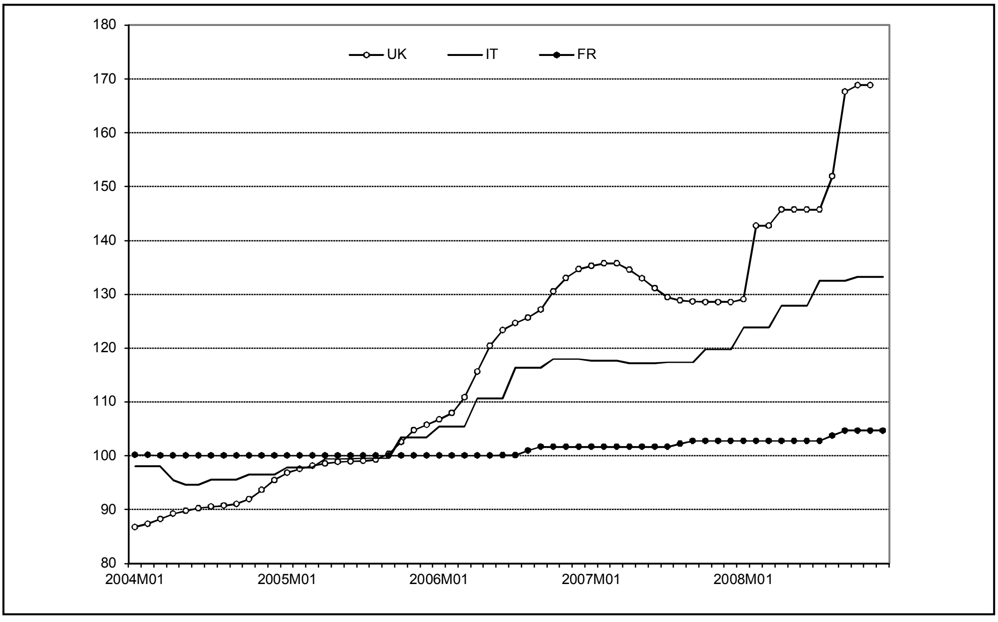
Figure 6 - The coordinates of HICP series for electricity on the space given by the first two principal components, by country



Source: Elaborations on Eurostat HICP data base

An accurate description of national features in electricity markets may be very helpful in explaining the differences in the behaviour of these series. From 1996 the EC has agreed for liberalisation, and since then a constant monitoring of the market has been provided. In 2007 the Commission has proposed further liberalisation. In the meantime several cases have been analysed by the European antitrust authority.[35] As a consequence, in some countries pricing in the market for electricity has, at least partly, a legal basis. Often consumers can choose between the regulated market and the liberalised one, where structurally different tariff structures usually are applied: differences in the behaviour of sub-indices might thus be determined by differences in the degree of regulation or by other structural differences that keep on existing on national markets. It follows that electricity is likely to be affected to a lesser extent by methodological heterogeneities, at least as compared to air transport or package holidays. Nevertheless, the issue of harmonisation is anyway crucial since the lack of homogeneity in the series may also be partly attributed to differences in sampling design and in particular to a different degree of coverage of the different segments of the whole market. The use of consumer profiles appears a promising perspective, even more if we consider the increasing use of non linear pricing (for instance, differentiated hourly tariffs).

Figure 7 - HICP series for electricity for United kingdom, Ireland and France (Jan 2004-December 2008) (base: average year 2005=100)



Source: Elaborations on Eurostat HICP data base

[35] For an overview of EC electricity policy see http://ec.europa.eu/competition/sectors/energy/electricity/electricity_en.html. See also the sector inquiry, started in 2005 and presented in 2007 (EC, 2007a).

Conclusions

Monetary policy is progressively losing its exclusivity in the use of consumer price statistics, since multiple uses of CPI data concerning industrial policies and consumer markets monitoring are rapidly gaining ground. This brings important challenges to the role of price indices as a valid support to such policies, since the main focus shifts from the aggregate price index to its components, defined with a high level of detail and regularly disseminated by NSI's and EUROSTAT. This implies the need to guarantee the methodological soundness of such indices and a reasonable ground for comparability: in the case of the EU, where the HICP project has been developed since 1996, the need of comparability is an increasingly crucial issue.

Given this premise, two quite interlocked subjects have been focussed in this paper: first of all, the classification of the dynamic behaviour of the almost one hundred sub-indices from which the HICP monthly estimates are compiled; secondly, the evaluation of whether it makes sense to compare across countries the series referred to a same elementary aggregate and to average them by groups of countries (e.g., to obtain the index for air transports in the euro zone or the EU).

By considering the monthly HICP series referred to 14 countries and nearly one hundred elementary aggregates in the period 2004-2008, it results that almost three quarter of the series are very homogeneous and show monthly profiles which are very near to the corresponding national HICP, with very flat and nearly time-linear patterns. The remaining sub-indices demonstrate more vivacity. Less than 10% of the series shows some seasonality and nearly 20% some irregular time-linear evolution. Strong and very strong variability is concentrated in less than 4% of the sub-indices. This picture should reflect the differences in the functioning of the numerous consumer markets covered by the HICP, and in many cases it really does: housing or clothing show in general a much higher variability than, for instance, furniture or tobacco.

Nevertheless, it is quite frequent to meet heterogeneous paths in the national series referred to a same aggregate: it can be said that about one half of the elementary aggregates present some heterogeneity across countries. Should this heterogeneity be generated by different approaches to the production of the estimates and not by underlying differences in the respective markets, it has to be recognised that the use of sub-indices may give in some cases small support or even wrong messages if used to build or evaluate industrial and market policies. The homogeneity and heterogeneity of national series are not in itself a signal of something that is going wrong in the process of HICP harmonisation. Nevertheless, the areas where it can be found a larger lack of homogeneity deserve a deeper investigation.

The cases of air transports and package holidays are paradigmatic of a lack of methodological harmony. For both markets it may be fruitful to work in order to induce common approaches to the estimates by NSIs: it appears clear enough that not all the differences among countries can be explained on the basis of local, market specific, features. Electricity, although it shows a strong differentiation in the behaviour of country series, is on the contrary a market where national regulatory frameworks are probably very important in determining price dynamics. It can be expected that some of these structural difference might fade away with time if European policies will spur the convergence of national markets.

At the opposite side, it must be recognised that a high homogeneity of the series referred to a same elementary aggregate does not necessarily mean that the sub-indices are perfectly harmonised and methodologically coherent. For example, a complex market like the one for new cars, where smooth series are common to all the countries, is probably treated by most member states in the same way, following list prices and thus avoiding all the perturbations in bargain prices which are induced by dealers' policies. Moreover, the frequent turnover of models, which can be seen as a potential source of variability, is often neutralised by the frequent use of overlapping technique for replacements.[36]

The main question at this point is: does the aggregation of sub-indices across countries make sense (for instance at EU or euro zone level)? This question is likely to have, at least in some cases, a negative answer, as it happens for air transport and package holidays. In order to avoid this, it seems reasonable to provide a common framework to manage sampling issues, especially because all these data are provided freely to any user and this implies that they are deemed to be representative and statistically founded. Furthermore, a great deal of consumer markets is the object of explicit EC policies, concerning competition, consumer protection and other sector specific issues.

Policy issues are, on the other side, a very important tool in the definition of the approaches adopted to design the proper methodological framework for estimating price changes. It appears in fact fruitful to base them on a sound analysis of market mechanisms, on supply and demand side and on the expected impact of policies.

As concerns the methods adopted for this analysis, they can be enriched with other sets of indicators which may be deemed to be useful to better discriminate the behaviour of the indices. This enrichment may be obtained by means of an increase in the number of indicators, exploiting more thoroughly the tools offered, for instance, by time series analysis.

[36] See De Gregorio (2010).

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