Harmonization in the European Union:
A Review of some Technical Issues

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Abstract: This paper describes, mainly in outline, some of the technical issues concerning the biases that can arise in the construction of CPIs from the different concepts, methods and practices followed. The reliability and relevance of CPIs and their comparability across countries depends on their coverage, the various formulae used, the design and maintenance of samples of both prices and weights, the extent to which new goods are taken into the index and allowances that are made for any quality changes that occur with their introduction. In addressing these issues the European Union has anticipated many of the criticisms raised by the Boskin Commission. By seeking agreement on preferred practices or minimum standards together with a co-operative research programme among Member States including an investigation of scanner data, it has taken important steps towards the solution of many age old problems of CPI construction. The main outstanding issues are noted.

1. Introduction

On 7 March 1997 Eurostat published the first set of Harmonized Indices of Consumer Prices (HICPs) as required by Article 5 (1) (b) of the Council Regulation. This paper describes some of the issues that arose in the course of the programme of harmonization in the European Community.

2. Initial coverage

Article 3 of Commission Regulation (EC) 1749/96 defines the initial coverage of the HICPs in terms of a relatively new international classification of consumers' expenditure known as COICOP (Classification Of Individual COnsumption by Purpose), specially adapted for the HICPs, known as COICOP/HICP. Some difficult categories, including most health and educational services, are still not covered. A Regulation on extended HICP coverage, which will tackle these difficult areas is currently being prepared. Owner occupiers' shelter cost, expressed as imputed rents or mortgage interest payments, are not regarded as part of the inflationary process but consideration is being given to the inclusion of the net acquisition costs of new dwellings.

Issues

Extension of coverage beyond the obvious core of goods and services required agreement on the definition of inflation. Following arguments developed by Peter Hill the scope, or coverage in principle, was taken as "household final monetary consumption expenditure". Some commentators have suggested that the indices are seriously difficient on account of the incomplete coverage (in practice) assuming, by reference to some CPIs, this to be large and therefore important. Eurostat has pointed out that CPIs are an inappropriate reference and the significance of omissions depends on their relative price movement rather their size which, being net of reimbursements, will be small.

3. Newly significant goods and services

CPIs are frequently criticised for failing to include new products such as mobile phones and personal computers. The requirement in the Council Regulation (Art. 5(3)) to "maintain the relevance of HICPs" means that steps must be taken to ensure that these criticisms cannot be levelled against the HICPs. If some Member States add new products when they become a significant part of consumption but others fail to do so, it could lead to significant differences in the measured rates of inflation.

Article 4 of Commission Regulation (EC) 1749/96 is aimed at ensuring that HICPs keep broadly in step with each other and up-to-date in terms of market developments. In general, new products have to be incorporated in the HICP as soon they achieve a sales volume of over 1 part per thousand of total consumers' expenditure in the Member State. Eurostat is acting as an information exchange, informing each country of the products newly included in other countries' HICPs. Member States are required to build up a monitoring system for identifying newly significant goods and services from January 1997. Member States should make provision to identify new products and to report these to Eurostat. Where a new good is to be included and its price has risen from zero to a positive value, Annex 1 (see paragraph 13) illustrates the procedure to be followed.

Issues

The aim was to ensure that HICPs take account of products such as mobile phones and internet products. It was not, however, a simple matter to define these or to formulate practicable procedures by which they can be identified. The requirement remains to be clarified in the process of its operation.

4. Minimum standards for procedures of quality change

HICPs should measure "pure price change" unaffected by changes in the specifications of things which people buy. The prices taken for an HICP should therefore be adjusted for changes in the quality of the goods or services to which they relate. However, there is no universal agreement on just how this should be done and there are major differences between countries in actual practices. This is probably the largest single source of non-comparability.

Differences between HICPs may arise because the same change in the physical characteristics of an item are treated in quite different ways from one country to another. Such differences in practice do not "average out" across the goods and services covered by the indices; on the contrary, they are likely to cumulate to differences well in excess of 0.1 percentage points. Article 5 of Commission Regulation (EC) 1749/96 requires Member States to examine quality adjustment procedures and to avoid "automatic linking", which is equivalent to the assumption that the difference in price between two successive models is wholly attributable to a difference in quality. If a Member State always assumes that a price increase from one model to another is due to a quality change and, therefore, reflects no price change in the CPI, this "automatic linking" may lead to underestimation of inflation. Eurostat will assist in this process by setting up a database of quality change estimates provided both by Member States themselves and from other sources.

Member States are required to change procedures to ensure that automatic linking is not used from January 1997. Non-automatic linking may continue to be used, i.e. where it can be justified that the price difference between the item and its replacement is equal to the quality difference, or where a replacement is anticipated and a price observed for the item and its replacement at the same time (in the month when the link is made). Member States will need to be able to demonstrate that automatic linking is not used. Some selective monitoring of implicit and explicit quality adjustments will also be required to establish comparable good practices.

Issues

The very difficult problems of determining quality adjustments have yet to be solved. The requirements will focus attention on these problems as specific adjustments will have to be made in the large number of situations where linking has been used as the default option.

Eurostat will support a programme of work to design appropriate adjustments for changes in the quality of goods and services the prices of which are used in the production of specific HICP sub-indexes. It will focus on development of quality adjustments for selected high tech' goods and the establishment of information for inclusion in a Eurostat central database of quality adjustments. This work, it is hoped, will also be a prototype for further studies on other goods and services.

5. Missing prices

A widespread practice used in price estimation for CPIs is known as "carry-forward". Fieldwork price collection involves the observation of the price, usually each month, of a set of specified products in specified retail outlets. If, for any reason, a particular price cannot, or is not, collected, a common procedure is to simply use the price observed on the previous occasion - which may have been many months previously. The banning of this practice is achieved by requiring Member States to maintain their target samples from month to month; where prices are not observed they must be estimated by an appropriate procedure, and not by automatic carry forward of the last observed price. Member States should provide a statement of their "target sample". This is essentially the present planned number of prices that should be obtained along with summary information on the numbers of missing prices for which estimates are substituted and the estimation procedures.

Issues

It soon became evident that there is an urgent need for analyses of the extent of missing prices or the effects of different imputation procedures. Studies should be to enumerate and evaluate the various procedures used when prices are missing and others that might be used. Evaluation should take account of item replacement and quality adjustment issues. Ideally it should assess the scale of errors in actual estimates for missing prices but this would require some idea of what the "right answer" should be. An alternative approach might to make a qualitative assessment of the assumptions that underlie different imputation procedures. It would, for example, be inappropriate to assume that all prices go missing at random, though this may not lead to unacceptable errors at least for one month. The Regulation leaves the following questions to be answered:

a) What are "appropriate estimates" for missing (or non-observed) prices?

b) What limit should be set on the number of estimates used (missing prices) to ensure comparability?

6. Minimum standards for sampling

Statistical theory suggests that random sampling is desirable in order to avoid bias in a statistic. However, this is not easily achieved when it comes to the collection of prices for a CPI and most Member States follow sampling procedures which are referred to as purposive or representative. The decisions on which prices to collect may thus be determined by the degree of co-operation of retailers or by the inclinations of particular price collectors. While this may not seem to be good practice it is not easy to demonstrate that the resultant indices are non-comparable on this count. Only a few Member States make any attempt to compute sampling errors for their CPIs and none has any measure of bias. Studies commissioned by Eurostat into these matters indicated that the problem of comparability was particularly acute for sampling. They suggested that representative versus probability sampling could give large differences for item groups, though these were not significant on average. They also indicated that the number of elementary aggregates could have short term effects, whereas regional differences did not seem to be a problem.

The aim of Article 8 of Commission Regulation (EC) 1749/96 is to improve the reliability and comparability of HICPs by reducing errors that arise from different sample designs and practices. It requires that Member States should check their samples of prices as to their adequacy for the HICP and adjust sampling procedures as they judge necessary. Studies are being carried out to assess both sampling error and bias in HICPs and these will be used later to set appropriate limits on such errors. Member States should not simply assume that their target sample is adequate but are required to provide some evidence. However, due regard should be given to the weight attaching to any representative item(s).

Issues

The extensive use of purposive sampling means that there is no adequate theoretical frame by which to judge the reliability (representativity and precision) of HICPs. Standard errors have been computed for some CPIs and it is hoped to adapt the procedures used for HICPs in order to give an indication of variability as an aid to more efficient sample design. There is much to do if bias is to be understood and controlled. It is necessary to establish what combination of the numbers and specifications of elementary aggregates and the number of prices required within each elementary aggregate will provide an HICP of sufficient reliability.

7. Price indices for elementary aggregates

Article 7 of Commission Regulation (EC) 1749/96 concerns the formula to be used for the calculation of "elementary aggregates" - the lowest level of detail for which expenditure weights are known. Practices vary considerably between Member States, and the achievement of consensus was difficult. The arguments centred on two issues. The first was whether the detailed indices should be calculated by taking the ratio of the average price of items in a particular stratum, or whether to take the average of the ratios of those items. The second was how to define "average" in the above calculation; the arithmetic mean or the geometric mean. The regulation allows the use of the ratio of either arithmetic or geometric mean prices, but not the arithmetic mean of price relatives. Member States which use formulae other than the ratio of arithmetic mean prices or the ratio of geometric mean prices, should be in a position to demonstrate that the alternative(s) used meets the comparability requirement. Member States were not required to change the formula for the calculation of elementary aggregates for the indices before January 1997. However, they were free to do so and this was desirable.

The decision to rule out the average of price relatives formula was not taken on the grounds that it is generally accepted as wrong but rather that it does not give results which are "comparable" to those given by other formulae. Nevertheless, this is progress in that the decision will mean that future research can concentrate on the merits of these other formulae.

8.   Sub-indices of the HICP

The Council Regulation required a specification of the sub-indices to be produced and published along with the HICPs. Whilst the assessment of price stability under the convergence criterion primarily concerns the "all items" HICPs, the analysis of sources of inflationary pressure requires a sub-division of the HICP into component parts relating to different product groups. Commission Regulation (EC) 2214/96 defines a set of sub-indices of the HICP with common coverage that the Member States are required to transmit to Eurostat. The sub-indices are based on the classification COICOP/HICP. This is a major step forward for many users as the components of national CPI do not conform to a common classification.

Issues

Where a Member State cannot provide a sub-index the default option will be to exclude this category from the HICP. However, this is equivalent to imputing the general HICP as an estimate for the missing sub-index.   The overall HICP will remain unchanged, and relevant sub-aggregates will not be appropriately adjusted. If there were evidence that the price development of that missing sub-index were different from the overall HICP, then this default option would not give a satisfactory estimate. In that case alternative estimates should be used but a basis for such alternative will need to be established. Possible options might be to use some other sub-index of the HICP or the EICP (see para'14 below) for that sub-index but by what criteria can the choice be made?

The computation of price indices for major utilities such as gas, electricity and telephones was identified as an important source of potential non-comparability. Annex 1 (paragraph 10) stresses the need for the construction of sub-indices to be consistent with the overall indices.

9.   Common reference periods

There are three types of base period used in the construction of CPIs: the period from which the expenditures for weights are obtained ("weight reference period"); the period in which base prices are valued ("price reference period"); and the period in which the index base is set to 100 ("index reference period"). At present, there are differences between national CPIs in all these reference periods. For the HICP, the Council Regulation sets the index reference period as 1996 = 100. Since the HICPs are derived from national CPIs it was necessary to "re-reference" or "price-update" the HICP and its sub-indices to 1996; that is to express the movements in the HICP and its sub-indices by reference to the average level of prices in 1996, and subsequently to December 1996, December 1997, December 1998, etc. Re-referencing allows HICPs to be presented as if they were all computed in the same way and provides for the construction of indices for groups of Member States or the EU as a whole (see Annex 1).

Issues

The problem of aggregating CPIs with different references and reweighting frequencies brought out the computational advantages of the Laspeyres formula. The algebra in Annex 1 is not new but it provided some interesting insights.

10. Weights

The Council Regulation (Article 8(3)) requires that HICP weights are sufficiently up-to-date to ensure comparability whilst avoiding the cost of Household Budget Surveys more frequently than every five years. Article 5(3) further requires that implementing measures for maintaining the "reliability and relevance" of the HICPs be adopted. A regulation is being prepared to ensure that these requirements are met whilst imposing a minimum burden on MSs and allowing maximum freedom in the methods used.

The construction of reliable, relevant and comparable HICPs in a dynamic European economic context requires appropriate attention to both price changes and expenditure patterns which occur in response to changes in income, in technology, in marketing practices or in other factors affecting costs or quality. Although consumer price indices are fairly insensitive to changes in weights there is a need to give some guarantee that the weights used are adequate for the purpose. Imposing the cost of high precision for all weights by frequent and comprehensive up-dating is not acceptable in the absence of strong evidence that such up-dating is necessary for comparability. However, it is necessary to give some assurance that large differences in the frequencies of up-dating do not lead to non-comparability. This can be achieved by setting a minimum standard whereby weights can be based on reliable information on expenditure patterns for weight reference periods up to seven years prior to the current year as long as adjustments are made for significant changes in prices and volumes. Weights will be required to be reviewed and adjusted in the light of significant market and price developments sufficient to provide a reasonable guarantee that the resulting HICPs will be comparable, relevant and reliable.

The method of review will be left to MSs to decide and to justify but Eurostat has suggested that it is possible to develop quality control procedures which focus on those relatively few weights which will be critical for the comparability, relevance and reliability of the HICP. Annex 2 outlines Eurostat's proposed test. As a minimum the review should show that, where changes in the prices of specific goods and services have diverged from the movement of the all items HICP, procedures have been instituted for monitoring the weights of such items in order to ensure that they would not be significantly different from the relative expenditures for a reference period ending no later than two years before December of the current year. It is not required to take account of development in the latest two years although this will be desirable where major developments are known to have occurred.

Where a weight is identified as suspect, Member States should make an improved estimate and introduce an appropriate adjustment, where this would exceed the threshold effect of 0.1% points on the annual rate of inflation. What is an "appropriate" adjustment is for the MS to decide. Alternative estimates of relative expenditures will be subject to various sources of error, including short term and cyclic variations in actual or estimated expenditures. The aim is to ensure that the adjusted weights are the best estimates that can be made on the information available. The proposal does not require Household Budget Surveys more than every five years but would allow those Member States conducting small annual surveys to use the results of these to adjust weights where there is clear evidence of a change. It also allows information from National Accounts, market research and elsewhere to be taken into account.

The proposal provides a framework within which the quality of weights used for compiling HICPs can be monitored and improved where necessary, focusing on those weights which are most important for the main aspects of quality, comparability, relevance and reliability. It leaves open the option of requiring Member States to follow a common policy on the frequency of up-dating in the future in the light of developments in data sources e.g. under ESA or Household Budget Surveys, and possible agreement on the requirement for further harmonization.

Issues

The imperative to find a compromise between "fixed" and "chained" indices produced the interesting possibility of indices with partially updated weights. This idea of identifying and updating only critical weights has to be developed in the process of its application.

11. Rounding

Each month Member States will transmit the primary index series, i.e. the HICP and its sub-indices, to Eurostat correct to one decimal place, for example 99.5 or 102.4 taking 1996=100. In order to avoid excessive rounding errors, all derived statistics will be calculated from the definitive primary series. All derived statistics will be published to one decimal place. Thus annual average index numbers will be the sum of the twelve monthly figures (with one decimal place) divided by twelve and rounded to one decimal place. The 12 month change in this annual average shall however be based on the unrounded averages i.e. obtained directly from the primary series. The weights of the sub-indices of the EICP and the MUICP will be disseminated to a degree of detail of at least 1 in a 1000.

Issues

It may seem strange that the "simple" question of rounding has been resolved differently by individual Member States.

12. Retrospective revisions to the HICP

Some countries revise their CPIs after first publication others do not. The HICPs will in general be subject to retrospective revisions. However, it is recognised that during the crucial period for the decision on Stage III of Monetary Union it would be desirable to have no revisions to the calculation of the HICPs.

Issues

Revisions remain an issue because a great deal may depend on the actual final HICP figures. As with contractual indexation the decision process for monetary union requires a certainty that cannot be provided.

13. Geographic and population coverage of the HICP

Article 3 of Council Regulation (EC) n° 2494/95 states that: "The HICP shall be based on the prices of goods and services available for purchase in the economic territory of the Member State for the purposes of directly satisfying consumer needs. Questions concerning weighting shall be decided on by the Commission under the procedure laid down in Article 14.". Member States should for the HICP from January 1997 aim to extend the geographic and population coverage used for their CPI to include all households, regardless of income, resident in any part of the economic territory which is not covered at present. The treatment of the expenditure of non-residents, business and institutional populations should be the same as that for the national CPI until an agreement on a harmonized approach is reached. Eurostat will, as a matter of priority, seek ways of harmonising the treatment of non-residents, business and institutional populations which is evidently a source of non-comparability, with a view to proposing a Commission Regulation in 1997.

Issues

The issue of whether expenditure by foreign visitors on the economic territory of a Member State should be included in its HICP raises different problems against the background of economic and monetary union. Such expenditure is much more important for some than others. Whilst inclusion avoids double counting, and covers all prices directly influenced by domestic monetary policy, it raises considerable estimation problems. Some may argue that it is the impact of inflation on the national population that matters.

14. Other issues - scanner data

Eurostat attaches considerable importance to the possible use of scanner data for improving the comparability and reliability of HICPs and will be encouraging studies to this end. Such studies might consider the various ways in which scanner data might be used to investigate different issues in the compilation of HICP's for example:
- simulate different sampling procedures and to calculate their potential for errors;
- provide independent estimates as a control or for detection of bias in HICP sub-indices;
- define appropriate limits for the number of missing prices for which estimates are substituted and to compare the impact of different estimation procedures;
- analyse the impact of new items on the index;
- carry out research on procedures for quality adjustment;
- determine the impact of the point of time of the data collection within the month;
- analyse the use of different formulae for elementary aggregates.

15. The European Index of Consumer Prices (EICP).

The EICP is calculated as a weighted average of the HICPs of the 15 EU Member States. The index is computed as an annual chain index allowing for country weights changing each year. The weight of a Member State is its proportion of final consumption expenditure of households in the EU total. The values of final consumption expenditure in national currencies are converted into purchasing power standards (PPS) using the purchasing power parities of final consumption. The country weights used in 1997 are national accounts data for 1995 at 1996 prices. The European Economic Area Index of Consumer Prices (EEAICP) is calculated in the same way, with the inclusion of Iceland and Norway.

The task of aggregating MSs' HICPs to a European HICP is an exercise of measuring and aggregating the evolution of the inner values of all EU currencies in order obtain a corresponding measure of EU inflation. The final consumption expenditure in monetary transactions is the appropriate weight as it is commensurate with the coverage of the HICPs. It is right for Member States to be represented by their volume of consumption valued at standard prices relative to other MSs rather than by values which depend on financial and other factors even outside the EU. According to current Eurostat practice national weights for CPIs, IICPs and HICPs are converted using purchasing power parities (PPPs). Their use reduces the disturbing volatility of exchange rates and enables an additive and meaningful expression of each MS's relative importance in terms of final consumption expenditure, e.g. two countries with the same volume of consumption are given equal weights.

Issues

The aggregation of HICPs across countries raises issues of whether real or nominal exchange rates are the more appropriate. Consistency with aggregation across regions (or even outlet types) within a country, which use nominal exchange rates (of unity), may be one such issue; some countries use population to weight regions.

16. The Boskin report

Eurostat examined the report with particular interest, as its subject matter closely concerns the current CPI harmonization project. Eurostat's overall position is that Boskin is a welcome input to our current harmonization work, and the problems raised are already being addressed.

There are two major differences underlying the Boskin Report and the EU harmonization work. First, Boskin begins with the premise that the US CPI should be a "cost of living" index. Such an index (according to Boskin) compares the minimum expenditure required to achieve the same level of well-being (also known as welfare, utility, standard of living) across two different sets of prices. This is not a concept which many countries, including EU Member States (except Sweden), would be willing to use as the basis for the national CPI. Boskin does not make any strong arguments for it, but asserts that it is the appropriate concept to use for an index whose main use is to compensate the recipients of indexed federal programmes (social security benefits, retirement pensions etc.) for changes in the cost of living. Boskin thus treats the cost-of-living concept as the norm, and regards any deviations from it as a "bias". On the other hand, the HICP approach is geared more towards the measurement of "inflation" in the classical sense of a sustained rise in the general level of prices. This is more appropriate in the EMU context.

Second, Boskin is looking for improvements in the accuracy of the US CPI whereas the HICP project is aimed primarily at improving comparability between the HICPs of Member States: accuracy is obviously important, but where a choice has to be made it is comparability which takes priority, at least at the current stage of the project.

Given these two conceptual differences, it would clearly be wrong for the EU to follow the Boskin recommendations without very careful re-appraisal. Indeed, given the tremendous amount of work which Eurostat and the EU National Statistical Institutes have put into the HICP project since 1993, it is surprising that the Boskin Commission did not attempt to consult the EU (there is only one reference to recent European work). On the other hand, the report does address many of the problems which have been the subject of the Commission Regulations and in general follows the direction taken in these.

On specific technical issues, Eurostat's comments were as follows.

a) Frequency of updating weights: The "weakness" of the fixed basket concept does not apply with the same force to EU CPIs because the weights are updated more frequently than in the US (in some cases annually). Most Member States accept that frequent reweighting is desirable; the estimate of 0.15 percentage points bias accords with EU estimates.

b) Basic formula bias: Eurostat agrees with the main points raised by Boskin, and so do Member States. Changes are already being made by Regulation. The estimated bias of 0.25 percentage points is reasonable.

c) Treatment of quality change and new products: This is the most controversial part of the Boskin Report, and it is one to which the BLS have reacted with most vigour, rightly in Eurostat's view. Boskin estimates that the inadequate treatment of quality change adds about 0.6 percentage points to the "bias" of the US CPI. Eurostat and EU Member States would accept that the treatment of quality change in CPIs is probably the most important single contributory factor to differences in results. What Eurostat would not accept is Boskin's technique for estimating the bias, relying as it does on the panel members' best judgement of the values which consumers in general place on various market developments (such as the value of having swimming pools and air-conditioning in apartment blocks).

d) Treatment of new retail outlets: So far this has not been accepted by EU Members as a relevant issue. The Boskin comments may prompt a review of this position, but it is unlikely to be a priority.

Boskin made a number of specific recommendations, some of which have been accepted by the BLS, others not. Most are US-specific, but some could have relevance for the EU. For example, the idea of having two CPIs, one published monthly and the other published annually and revised historically, bears some relationship to what is now happening in the EU, with Member States in general retaining their own national CPIs (usually non-revisable) in addition to the new HICP which will be revisable. Another recommendation is for the establishment of a permanent advisory body to review progress on CPI methodological improvements. Most EU Member States already have some kind of CPI advisory body, and is considering Eurostat establishing an HICP Advisory Body which would help to guarantee the integrity, accuracy and relevance of the HICPs.

Annex 1

Computation formula for the HICP for 1997

1.   Member States will provide the HICP and its sub-indices starting with the index for January 1995. This provides users with 12-month changes from January 1996. For some Member States the early figures will correspond closely to the interim indices.

2   For the construction of the HICP and its sub-indices, Member States or Eurostat will need to "re-reference" the reference periods used in the national CPIs to 1996. That is, to express movements in the HICP and its sub-indices by reference to the average level of prices in 1996. Re-referencing is simply a scaling exercise which in itself has no effect in the measured rate of inflation.

3.   Changing the index reference period to the year 1996 = 100 involves division by the average of the index for 1996. For example, the HICP for February 1998 which currently has the year 1994 as index reference base is re-referenced to the year 1996 as shown in the following equation:

$$_{96}H_{F98} = \frac{_{94}H_{F98}}{_{94}H_{98}} = \frac{\sum W_{94}^{i} \; _{94}H_{98}^{i}}{\sum W_{94}^{i} \; _{94}H_{96}^{i}} \tag{1}$$

where $_{94}H_{F98}^{i}$ is the sub-index for the ith COICOP/HICP category taking 1994 = 100.

4.   The HICP must be expressed as a weighted average of the sub-indices. That is:

$$_{96}H_{F98} = \sum W_{94(96)}^{i} \; _{96}H_{F98}^{i} \tag{2}$$

This can be achieved by taking:

$$W_{94(96)}^{i} = \frac{W_{94}^{i} \; _{94}H_{96}^{i}}{\sum W_{94}^{i} \; _{94}H_{96}^{i}} \tag{3}$$

$$_{96}H_{F98}^{i} = \frac{_{94}H_{F98}^{i}}{_{94}H_{96}^{i}} \tag{4}$$

where the 1994 sub-indices and their weights are re-referenced to 1996. It follows:

$$_{96}H_{F98} = \sum W_{94(96)}^{i} \; _{96}H_{F98}^{i} = \sum \left\{ \frac{\overline{P}_{96} \; \overline{Q}_{94}}{\sum \overline{P}_{96} \; \overline{Q}_{94}} \right\} \cdot \left\{ \frac{P_{F98}}{\overline{P}_{96}} \right\} \tag{5}$$

In a strict Laspeyres index the weights would correspond to the expenditures actually covered by the required sub-indices of the HICP in 1996. That is:

$$_{96}L_{F98} = \sum W_{96}^i \; _{96}L_{F98}^i = \sum \left\{ \frac{\overline{P}_{96}\,\overline{Q}_{96}}{\sum \overline{P}_{96}\,\overline{Q}_{96}} \right\} \cdot \left\{ \frac{P_{F98}}{\overline{P}_{96}} \right\} \tag{6}$$

5.   Because the HICPs for the various Member States will be derived from national CPIs using different weight, price and index reference periods and different frequencies of updating weights, Eurostat plans to present them as if they were all computed in the same way. This involves re-referencing to 1996 (average of the year), and subsequently to December 1996, December 1997, December 1998, etc. The HICPs of all Member States may then be computed using the same formula. For example, the HICP for February 1998 with 1996 = 100, measuring through December 1996 and December 1997, will be given by:

$$_{96}H_{F98} =$$

$$= \sum W_{1(96)}^i \; _{96}H_{D96}^i \cdot \sum W_{2(D96)}^i \; _{D96}H_{D97}^i \cdot \sum W_{3(D97)}^i \; _{D97}H_{F98}^i$$

$$= \frac{\sum P_{D96}Q_1}{\sum \overline{P}_{96}Q_1} \cdot \frac{\sum P_{D97}Q_2}{\sum P_{D96}Q_2} \cdot \frac{\sum P_{F98}Q_3}{\sum P_{D97}Q_3} \tag{7}$$

where $Q_1 = Q_2 = Q_3 = \overline{Q}_{94}$ are the quantities consumed in 1994. This is equivalent to an HICP were the weight reference period is 1994 and the index reference period 1996:

$$_{96}H_{F98} = \frac{\sum P_{F98}\overline{Q}_{94}}{\sum \overline{P}_{96}\overline{Q}_{94}} = \frac{\sum \dfrac{P_{F98}}{\overline{P}_{94}} \cdot \dfrac{\overline{P}_{94}\overline{Q}_{94}}{\sum \overline{P}_{94}\overline{Q}_{94}}}{\sum \dfrac{\overline{P}_{96}}{\overline{P}_{94}} \cdot \dfrac{\overline{P}_{94}\overline{Q}_{94}}{\sum \overline{P}_{94}\overline{Q}_{94}}} = \frac{_{94}H_{F98}}{_{94}H_{96}} \tag{8}$$

Equation (8) is a ratio of an HICP for February 1998 to an HICP for the year 1996 with 1994 weights and an index reference period of 1994 = 100. In this case the December figures in equation (7) cancel out.

If, for example, in December 1997 the weight reference year changes from 1991 to 1996, that is $Q_1 = Q_2 = \overline{Q}_{91}$ and $Q_3 = \overline{Q}_{96}$, then it follows from equation (7):

$$_{96}H_{F98} = \frac{\sum P_{D97}\overline{Q}_{91}}{\sum \overline{P}_{96}\overline{Q}_{91}} \cdot \frac{\sum P_{F98}\overline{Q}_{96}}{\sum P_{D97}\overline{Q}_{96}} = \; _{96}H_{D97} \cdot \; _{D97}H_{F98}$$

$$= \frac{_{91}\hat{H}_{D97}}{_{91}\hat{H}_{96}} \cdot \frac{_{96}H_{F98}}{_{96}H_{D97}} \tag{9}$$

where, for example, $_{91}\hat{H}_{D97}$ is an index for December 1997 with 1991 as index, price and weight reference. The computation may still be computed as in equation (7).

6. The annual re-referencing described above has the added advantage that Member States can make changes to their HICPs in any December without introducing a discontinuity. In particular, new weights and/or new goods and services may be brought into the index. Likewise, the EICP and the MUICP can be computed. The system should accommodate any likely agreements on re-referencing sub-index or country weights as well as additional sub-indices and countries.

7. The re-referencing of the weights of the HICP to the year 1996 (and to any other reference period thereafter) uses the same reasoning as when Member States introduce a new weighting scheme for their CPI. Where a new sub-index needs to be introduced to the HICP, for example a sub-index for package holidays had to be included from December 1996, the following algebra shows how the new sub-index is introduced in December 1997 by changing the last link in equation (7):

$$ _{96}H_{F98} = {}_{96}H_{D96} \cdot {}_{D96}H_{D97}\left\{\sum_{i\neq n}W^i \cdot {}_{D97}H^i_{F98} + W^n \cdot {}_{D97}H^n_{F98}\right\} \tag{10} $$

where ${}_{D97}H^n_{F98}$ is the price index for the new good, e.g. package holidays. The first term in the bracket is the index without the new good but with weights re-scaled so that $\sum W^i + W^n = 1$. The W^i and W^n will be expenditures with quantities expressed at December 1997 prices. Those in the W^i will be from the weight reference period, e.g. 1994, whereas those for the new good may relate to 1997.

8. The introduction of a new charge for a good or service, for example a charge for bank cheques or motorway tolls, must be captured by the HICP. It is, in effect, a price increase from zero to a positive figure. Since for both points in time prices and quantities are observable, the data can be directly incorporated in the HICP.

9. Calculation of the HICP for 1995 with 1996 = 100:
Using equation (1) one can calculate forward from, say, 1994 but a calculation can also be expressed in terms of 1996 referenced weights from equation (7). For example:

$$ _{96}H_{J95} = \frac{_{94}H_{J95}}{_{94}H_{96}} = \frac{\sum W^i_{94}\,{}_{94}H^i_{J95}}{\sum W^i_{94}\,{}_{94}H^i_{96}} = \frac{\sum P^i_{J95}\,Q^i_{94}}{\sum \overline{P}^i_{96}\,Q^i_{94}} = \sum W^i_{94(96)}\,{}_{96}H^i_{J95} \tag{11} $$

This is straightforward as long as all the sub-indices are available. If any are missing the aggregation can be taken over those that are available using the corresponding weights scaled to 1.

Guidelines for the formula to be used for sub-indices; particularly those relating to Centrally Determined Prices

10. Article 9 of Council Regulation (EC) n° 2494/95 requires that the HICP "shall be a Laspeyres-type index, covering the categories of the COICOP international classification....". Though they may differ in detail, for example in the frequency of updating weights, the CPIs produced by Member States can be loosely described as Laspeyres-type indices. That is, indices in which the month to month movements in prices are measured as an average of price indices using expenditure weights which are an appropriate reflection of the pattern of consumption of, and the structure of prices paid by, the index population in the weight reference period. For 1997 Member States should construct HICPs using the same Laspeyres-type formula as the corresponding CPI. They should be weighted averages of sub-indices which also use the same Laspeyres-type formula.

11. Member States should satisfy themselves and, if required, Eurostat that their index formulae are applied consistently to all sub-indices. Member States should further ensure that their Laspeyres-type index formula is used consistently for the computations of indices below the level of sub-indices where weights are used, i.e. at or above the level of elementary aggregates. In particular, any price index where there are "centrally determined" prices should follow the same formula for computation as all other price indices within the HICP. These include price indices for such items as postage, telephones, national or local transport, gas, water and electricity and other situations where prices or price indices are obtained "centrally" or directly from suppliers such as major retail chains. Weights should reflect the pattern of expenditure by the index population where they are based on revenue data; they should, for example, reflect expenditure by the domestic household population and not by businesses. Eurostat will examine the effects on comparability where weights relate to the weight reference period as distinct from a more up-to-date period prior to changes in price structure. Relative expenditures or values should be used to weight price indices or price changes and relative quantities or volumes to weight or to average prices.

12. There will, however, be situations in which it is not clear how the formula should be applied. These will be considered by a Working Party of CPI experts and legislation may be necessary to remove inconsistencies in the application of the Laspeyres-type formula used by each Member State where these can lead to non-comparability with other HICPs.

13. Where a *new goods* (n) is to be included because its price has risen from zero to a positive value it must be introduced in the month when the price changes. Again the procedure may be understood most easily by viewing the index as the changing cost of a fixed basket rather than a weighted average of the price indices. That is, supposing that the new good is to be included in March 1997 (M97) from equation (7) we have:

$$_{96}H_{M97} = {}_{96}H_{D96} \cdot \frac{cost\ of\ reference\ basket\ at\ M97\ including\ P_{M97}^n\ \overline{Q}_0^n}{cost\ of\ reference\ basket\ at\ D96\ with\ P_{D96}^n = 0} \qquad (12)$$

where $\overline{Q}_0^n$ is the quantity of the goods acquired (at a zero price) in the reference period (*0*).

The cost of the basket at M97 is simply increased by the cost of buying the new item $P_{M97}^n\ \overline{Q}_0^n$ in March 1997. Estimating this additional cost may not be so simple but acceptable estimates should usually be possible. As a first approximation it is the proportion of current consumers' expenditure (covered by the index) on the new good.

In order to preserve the computational form (equation 7) the cost must be included within an appropriate sub-index. The index weights are unchanged. Thus we have, adding the new item in equation (12):

$$_{96}H_{M97} = {}_{96}H_{D96} \cdot \frac{\sum P_{M97}^i\ \overline{Q}_o^i + P_{M97}^n\ \overline{Q}_0^n}{\sum P_{D96}^i\ \overline{Q}_o^i} \qquad (13)$$

taking the new item *n* as part of sub-group *s* this becomes:

$$_{96}H_{M97} = {}_{96}H_{D96} \cdot \left\{ \frac{\displaystyle\sum_{i \neq s} P_{M97}^i \, \overline{Q}_o^i}{\displaystyle\sum P_{D96}^i \, \overline{Q}_o^i} + \frac{P_{M97}^s \, \overline{Q}_o^s + P_{M97}^n \, \overline{Q}_0^n}{\displaystyle\sum P_{D96}^i \, \overline{Q}_o^i} \right\} \tag{14}$$

$$_{96}H_{M97} = {}_{96}H_{D96} \left[\sum_{i \neq s} \frac{P_{M97}^i}{P_{D96}^i} \left\{ \frac{P_{D96}^i \, \overline{Q}_o^i}{\displaystyle\sum P_{D96}^i \, \overline{Q}_o^i} \right\} \right.$$

$$\left. + \left\{ \frac{P_{M97}^s}{P_{D96}^s} \right\} \left\{ \frac{P_{M97}^s \, \overline{Q}_o^s + P_{M97}^n \, \overline{Q}_o^n}{P_{M97}^s \, \overline{Q}_o^s} \right\} \left\{ \frac{P_{D96}^s \, \overline{Q}_o^s}{\displaystyle\sum P_{D96}^i \, \overline{Q}_o^i} \right\} \right] \tag{15}$$

That is:

$$_{96}H_{M97} = {}_{96}H_{D96} \left\{ \sum_{i \neq s} {}_{D96}H_{M97}^i \, W_{o(96)}^i + {}_{D96}H_{M97}^s \left(\frac{E_{M97}^{s+n}}{E_{M97}^s} \right) W_{o(96)}^s \right\} \tag{16}$$

The overall index may thus be calculated exactly as it would be without the new item but with a revised sub-index group (s) which includes the new item, its weight (W_o^s) remaining unchanged. The revised sub-index is:

$$_{D96}H_{M97}^{s+n} = {}_{D96}H_{M97}^s \left(\frac{E_{M97}^{s+n}}{E_{M97}^s} \right) \tag{17}$$

The terms in brackets is the increase in the cost of the sub-groups s as a result of the 0 to P_{M97}^n increase in the price of n.

Annex 2

Weights

1. HICP weights are inter-dependent. They are constructed along three main dimensions, commodity (specific good or service or combinations thereof), outlet (shop-type or sales point) and region (geographic location) and changing any one weight changes it in relation to all others but not the relationships between the others. The weight attaching to any elementary aggregate depends on all three dimensions and changing these weights necessarily changes the weights of all elementary aggregates in the overall HICP. Operationally these changes would normally be made automatically. Thus, for example, commodity weights may be changed at a national level without affecting the regional or outlet weights. Adjustments can therefore be made selectively, wherever they are deemed appropriate, without disturbing other weights.

2. Although ideally it is desirable to check all weights at frequent intervals the cost would not be justified. The requirement is therefore, each year, to check those weights which are judged to be the most critical for reliability and relevance, and hence for comparability, of the overall HICP. These are primarily the weights for sub-indices or their major components where there have been significant market changes along with divergent price movements. Significant market developments can be detected through the normal intelligence gathering that is part of the process of index construction. Significant (divergent) price developments can be detected from the prices collected for the index. Where there is evidence of significant developments in both the market and prices for a particular commodity then the relevant commodity weight should be examined against such information as can be obtained and an estimate of the appropriate weight made. The difference between the appropriate weight and the actual weight currently in use (expressed at the previous December prices) gives the appropriate adjustment.

Definition

3. "Critical weights" are defined as those weights which present a significant risk of affecting the comparability, relevance or reliability of the HICP given the actual divergence of the movement in the corresponding price index from the movement in the overall HICP over any 12 month period.

4. The HICP is defined as the weighted average of sub-indices

$$H = \sum W^i \ H^i \tag{1}$$

The change in the HICP over any period e.g. 12 months can be expressed in the same way where the weights are price up-dated or revalued to the start of the period and the price indices are measured from the start to the end of the period. Strictly, provided that there is no change in the weights over the period but approximately so if there is a change. We can take the summation of the index over any number of components and treat any sub-division of the result. If we consider two components

$$H = H^1 W^1 + H^2 W^2 \tag{2}$$

(where the first component may be the index and weight for personal computers and the second component is all other goods and services)

and suppose that there is an error $(+e)$ in the weight W^1 such that H is estimated as

$$\hat{H} = H^1 (W^1 + e) + H^2 (W^2 - e) \tag{3}$$

then the error in estimating H is from equation (3) minus equation (2)

$$\hat{H} - H = (H^1 - H^2)e \tag{4}$$

substituting for H^2 from equation (3) and putting $W^2 = 1 - W^1$ we have

$$\hat{H} - H = (H^1 - \hat{H}) \frac{e}{(1 - W^1 - e)} \tag{5}$$

5.   Thus, for example, if H^1 is 112 and $\hat{H}$ is 102, W^2 is 900 out of 1 000, then an error of 10 in a 1 000 gives an error in H of

$$\hat{H} - H = (112 - 102) \frac{10}{890} = 0.11\% \ points$$

That is, if the weight W^1 is overstated by 10 percent (as 110 instead of 100 in 1 000) then the HICP will be overstated by 0.1 percentage points. It is important to appreciate that this will be the case in very few instances.

6.   From equation 5 we can determine the maximum error allowed in a weight before a given deviation between a particular sub-index (or component index) and the HICP leads to an error of 0.1% points in the HICP. Thus we have

$$e^j_{max} = \frac{0.1(1 - W^j)}{0.1 + (H^j - \hat{H})} \tag{6}$$

or for a proportionate error

$$\left(\frac{e^j}{W_j} \right)_{max} = \frac{0.1(1 - W^j)}{W^j \left\{ 0.1 + \left(H^j - \hat{H} \right) \right\}} \tag{7}$$

These equations may be used to show where there is the highest risk of error in the HICP resulting from errors in the weights.

7.   Equations (6) and (7) are quite general applying to any sub-index (j) or an aggregation of sub-indices or to an elementary aggregate.

8.   In order to establish whether the HICP might be sensitive to a systematic effect across a large number of categories the test can be used to focus on the relevant categories. For example, the test can be applied to the set of sub-indices (or elementary aggregate indices) the prices of which have risen by a given number of percentage points faster than average. If the e^j is the error in the price

up-dated weight W^j, say for month t, and H and H^j are indices for month t + 12 with respect to t, then equation (7) can be used to test when the error in the change over a year in the HICP

$$\hat{H} - H \geq 0.1\% \ \ points$$

for the given grouping j of sub-indices. A maximum value for e_j, the weight error (i.e. absolute values 1, 2, 3 etc. parts per 1 000), will be obtained and the likelihood of this having been exceeded considered. Sampling errors in estimating weights from HBSs depend on the categories of goods and services. For the UK (HBS 10 000 households) standard errors range from around 2% for food sub-indices to around 6% for clothes and durables (14 percent for new cars). Non-sampling errors will be important in many cases. A 10 percentage point deviation in prices changes for the sub-grouping from the HICP ($H^j - H$) allows maximum errors e^j of around 7 to 10 for weights ranging from 300 down to 10 and below. At 300 the maximum error is 2%, at 50 the maximum error is 9% and both would be well in excess of the sampling errors though not in excess of two standard errors. If the price change deviation is only 5 percentage points then maximum allowable errors are doubled.

9.   The test can thus be designed to focus on either single critical weights, for say telecommunications, or on a set of weights to determine whether they may have given an under or over statement of inflation in the presence of the price movements that have actually occurred. The proposal is necessarily one for correcting errors after they have been made rather than preventing them from being made. It would, however, be open to Member States to use the test where divergent prices are expected and thus to anticipate the need for weight changes. The test will be developed as it is used in practice.

Annex 3

Legal acts on HICPs

1. Council Regulation (EC) No 2494/95, concerning harmonized indices of consumer prices, OJ No L 257/1, 27.10.1995.

2. Commission Regulation (EC) No 1749/96, on initial implementing measures for Council Regulation (EC) No 2494/95 concerning harmonized indices of consumer prices, OJ No L 229/3, 10.9.1996.

3. Commission Regulation (EC) No 2214/96, on the transmission and dissemination of sub-indices of the HICP, OJ No L 296/8, 21.11.1996.

4. Commission Decision (EC) of 9 September 1996 concerning implementing measures for the harmonized indices of consumer prices [ref. No C(96)2452].

5. Draft Commission Regulation (EC) No xxx/97 amending Commission Regulation (EC) No 1749/96 of 9 September 1996 concerning the coverage of the harmonized index of consumer prices.

6. Draft Commission Regulation (EC) No xxx/97 concerning minimum standards for the quality of HICP weights.

7. Draft Commission Regulation (EC) No xxx/97 amending Commission Regulation (EC) No 1749/96 of 9 September 1996 concerning the geographic and population coverage of the harmonized index of consumer prices.