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The Seasonal Adjustment of the Harmonised Index of Consumer Prices for the Euro Area: a Comparison of Direct and Indirect Methods

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SINTESI

Il contenuto di questo lavoro esprime solamente le opinioni degli autori: pertanto non rappresenta la posizione ufficiale della Banca d'Italia

Il lavoro è dedicato all'analisi della componente stagionale dell'indice armonizzato dei prezzi al consumo nei singoli paesi dell'euro e nella media dell'area e delle metodologie esistenti dirette a rimuoverne gli effetti. A tal fine vengono presi in considerazione due approcci alternativi. Il primo – *diretto* – consiste nello stimare tramite tecniche econometriche i fattori stagionali che influenzano l'indice a livello di area. Il secondo – *indiretto* – costruisce tale stima a partire dalle singole componenti nazionali dell'indice. La stessa alternativa si ripropone all'interno di ciascun paese tra indice generale e sue componenti settoriali o sub-indici: beni alimentari freschi e trasformati, beni non alimentari e non energetici, beni energetici, servizi.

La scelta di concentrare lo studio sull'indice armonizzato dei prezzi al consumo è dovuta alla centralità di tale indicatore nella determinazione delle linee di politica monetaria comune. In ottemperanza ai regolamenti stabiliti dalla Commissione Europea, ogni Istituto nazionale di statistica cura la costruzione dell'indice armonizzato relativo al proprio paese, l'Eurostat sulla base delle informazioni nazionali produce l'indice relativo all'area dell'euro nel suo complesso. Esso costituisce la misura dell'inflazione adottata dalla Banca centrale europea nella sua definizione di stabilità dei prezzi e che la Banca si propone di controllare.

Una prima verifica della presenza di effetti stagionali, cioè di variazioni dei prezzi che si ripetono con regolarità in certi mesi dell'anno, e una valutazione della loro entità è ottenuta regredendo le variazioni mensili degli indici su variabili dummy stagionali. I risultati – che confermano la presenza, nella maggior parte dei casi, di significativi effetti stagionali – sono ulteriormente suffragati dall'applicazione di metodi di stima della stagionalità più sofisticati. In particolare le tecniche utilizzate per l'identificazione e la rimozione della componente stagionale sono state quelle cosiddette *model based* la cui applicazione alle serie studiate è stata effettuata tramite il pacchetto statistico TRAMO-SEATS.

Le conclusioni a cui si perviene attraverso l'applicazione congiunta dei suddetti metodi sono le seguenti: effetti stagionali sono presenti in quasi tutti gli indici considerati e

sono responsabili di quasi un terzo della loro variabilità mensile; esistono lievi differenze tra paesi; l'indice dei prezzi dei beni energetici non sembra essere caratterizzato da movimenti stagionali.

Il confronto tra metodi diretti e indiretti di stima della componente stagionale è stato effettuato sia per i singoli paesi sia per la media dell'area (ottenuta ponderando gli indici nazionali con pesi basati sui consumi finali interni delle famiglie di ciascun Paese). In quest'ultimo caso si è proceduto considerando la disaggregazione geografica o alternativamente quella settoriale (cioè i diversi sub-indici). In letteratura non esistono ancora test statistici soddisfacenti che permettano un confronto tra i due approcci. Pertanto nel lavoro la comparazione tra metodi diretto e indiretto è stata effettuata avvalendosi di una pluralità di indicatori (spettro della serie al netto della stagionalità, significatività statistica delle differenze tra le componenti stagionali stimate, individuazione di differenze sensibili nella dinamica delle serie aggiustate, e altri). La conclusione è che, sia per le singole economie sia per la media dell'area, metodo diretto e metodo indiretto producono risultati sostanzialmente analoghi.

Una particolare enfasi, infine, è stata data alla scelta dell'indice più appropriato per l'analisi di breve e medio periodo dell'inflazione. In proposito – sulla base di argomentazioni statistiche e considerazioni di carattere economico – si propone di considerare come indicatore centrale l'indice armonizzato al netto di beni alimentari ed energetici. Questo indice, depurato della componente stagionale, appare fornire i segnali più affidabili sulle tendenze dell'inflazione; ovviamente, l'osservazione del suo andamento non si sostituisce a una più approfondita analisi economica. Nella parte finale del lavoro si mostra, attraverso un esempio concreto, quanto possa essere fuorviante affidarsi ai singoli dati destagionalizzati per valutare le tendenze dei prezzi. Si suggerisce pertanto di utilizzare gli indici destagionalizzati proposti tenendo ben presente la rilevanza che di volta in volta possono avere fattori temporanei o accidentali nel determinarne la dinamica. Anche per questo motivo viene privilegiato l'indice al netto della componente stagionale e non quello che esclude anche la componente irregolare (cioè il cosiddetto *ciclo-trend*), il quale potrebbe rimuovere troppa parte delle variazioni mensili dei prezzi impoverendo l'informazione congiunturale.

THE SEASONAL ADJUSTMENT OF THE HARMONISED INDEX OF CONSUMER PRICES FOR THE EURO AREA: A COMPARISON OF DIRECT AND INDIRECT METHODS

by Riccardo Cristadoro* and Roberto Sabbatini*

Abstract

In this paper we analyse the Harmonised Index of Consumer Prices (HICP), which plays a key role in the conduct of monetary policy in the euro area. Knowledge of the characteristics of the short-term evolution of consumer prices for each country and for their average is important for better monitoring and forecasting of inflation in the euro area. In this paper we seek to verify to what extent the short-term variability of HICPs can be explained by regular infra-year movements which we then attempt to estimate. We find evidence that seasonal movements characterise most price series, though some differences arise across countries and sub-indices.

The seasonal adjustment of these indices raises a number of important questions of aggregation. Considering euro-area averages adds a further dimension to this issue, since one has to consider not only the sum of components within each country, but also that across countries. The analysis focuses on the seasonal adjustment of the "core" index, which comprises non-food and non-energy goods and services, for each country and for the euro-area average. The seasonally adjusted core index is a key indicator for the short-term monitoring of inflation; this holds for countries and for their average. The analysis of recent figures confirms this indication.

Finally, we make some remarks on the use of seasonally adjusted measures in conjunction with other information useful in the short-term monitoring and forecasting of inflation.

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Contents

1. Introduction[1]

The prompt identification of turning points of inflation is crucial for the conduct of monetary policy. This is done by seeking to extract signals on underlying inflationary tendencies from a large array of indicators (European Central Bank, 1999b). Among these, the Harmonised Index of Consumer Prices (HICP) plays a key role since the European Central Bank (ECB) explicitly bases the concept of "price stability" (the fundamental aim of its policy) on this indicator. The ECB stability-oriented monetary policy strategy "is based on a quantitative definition of price stability, namely that an annual increase in the Harmonised Index of Consumer Prices (HICP) of below 2% can be considered as being compatible with this primary objective of monetary policy" (European Central Bank, 1999a).

In this paper we focus on characterising the short-term movements of consumer prices for each country and for the euro-area average. Information provided by the direct analysis of consumer price indices is affected by different sources of noise (erratic fluctuations, measurement errors, seasonal movements, and so on). Several techniques can be used to extract a "signal" from the observed phenomena, removing what can be regarded as pure "noise" (see Maravall, 1995 and Franses, 1998). In particular, an important element in our analysis is to establish whether part of the variability of prices can be attributed to seasonal factors, that is to a particular kind of noise that follows a fairly regular pattern over time. Broadly speaking, the objective of seasonal adjustment is "to remove the seasonal component without distorting the remainder (...). The predominant uses are those of short-term forecasting and policy analysis, where the implicit view seems to be that the seasonal

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component is of little interest, being not only exogenous to the economic system but also uncontrollable, yet predictable”[2].

The seasonal adjustment of a time series involves making several decisions, such as the method to be used, the best time span to be considered and the treatment of outliers and other fixed effects. If one deals with statistics at the euro-area level another crucial issue is the decision to proceed by seasonally adjusting euro-area aggregates directly (“direct” approach) or dealing first with national components (or sector components), which are then aggregated to compute seasonally adjusted (SA) indices for the euro area (“indirect” approach). This choice should be based on theoretical as well as on statistical grounds. The indirect approach guarantees consistency between the SA overall series and its components and this makes the monitoring of inflation easier. From a statistical point of view, little has been written on formal statistical tests that is helpful in choosing between a direct and an indirect method[3]. This is a difficult issue since the terms of the comparison are, by definition, unobservable components. In this paper we limit the analysis to the comparison of results obtained with alternative approaches. In particular we are interested in assessing whether different strategies lead to different interpretations of the short-term developments of inflation. Moreover, we decided to focus on the indicator which, in our view, is the most useful for monitoring inflation: the index excluding food and energy goods.

The paper is organised as follows: Section 2 discusses the data used in the empirical analysis, drawing attention to the method of aggregation of elementary indices used by Eurostat, which has some practical consequences for seasonal adjustment. Section 3 reports the results of a preliminary analysis of the seasonal behaviour of the HICPs to ensure that there is at least the presumption that seasonality contributes to characterising high frequency

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[2] Wallis (1974), p. 28.

[3] Recently Ghysels (1997) has proposed a way to compare direct and indirect seasonal adjustment in a two series case focusing on the final estimation error. A good general treatment of the problem can be found in Geweke (1976).

changes in HICPs. Section 4 briefly addresses the issue of the choice between the direct and the indirect method. In Section 5 we report the results of the empirical analysis and evaluate the seasonal adjusted measures obtained. Finally, Section 6 presents an example of the way in which SA measures can be used in the short-term monitoring and forecasting of inflation in conjunction with other indicators. The appendix shows how a finer disaggregation can produce better results in terms of the choice of the index to be analysed and of the seasonally adjusted measure obtained. This is done by comparing results obtained with the Italian HICP with those obtained with the Italian CPI, for which a less fine disaggregation is available.

2. The HICP dataset and the aggregation of sub-indices

The comparison of consumer price inflation across European countries requires the use of indicators which are not affected by differences in the methodology used to compute them in each country. To tackle this problem, Eurostat and the National Statistical Institutes (NSIs) have been working together over the last few years to harmonise methodologies and definitions[4]. Since 1997 Eurostat regularly publishes monthly figures for the "harmonised" index of consumer prices of European Union (EU) members. These series start in January 1995. The HICP index is based on the "Classification of Individual Consumption by Purpose" (COICOP) and data are released for about 80 elementary items, together with intermediate aggregates and 12 main categories of expenditure. Recently, data for the overall index, the 12 COICOP categories of expenditure and the main sub-indices - particularly useful in monitoring inflation[5] - have been made available for a longer time span (the starting year differs across countries; for most of them it is either 1987, as initially required by Eurostat, or 1992). The release of backdata has made it possible to investigate the seasonal behaviour of the HICPs. In this paper the empirical analysis focuses on the following components for each country and for the euro area (in brackets is the code used in the rest of the paper):

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[4] This issue was explicitly considered in the Maastricht Treaty and, accordingly, a project was undertaken by Eurostat to produce an HICP for each country belonging to the European Union (Eurostat, 1999a).

[5] See Bank of Italy, (1999a, 1999b).

1. Overall Index (B00)
2. Unprocessed Food (UNP)
3. Processed Food (PRO)
4. Non-farm and non-energy goods (NFE)
5. Energy goods (ENE)
6. Services (SER)
7. “Core” (G_S)

where the latter (G_S) is the weighted average of NFE and SER, computed using the Eurostat aggregation procedure described below.

When the analysis was conducted (May 1999), backdata for Luxembourg and Ireland were not yet available and those for other countries were still incomplete and subject to minor revisions. Therefore, we were only able to compute euro-area aggregates for 9 out of 11 countries (which account for 98.8 per cent of final consumption expenditure in the euro area) and from 1992 onwards (Table 1). In the rest of the paper we will denote the average computed on the entire group of 11 countries by E11 (this is the “official” overall index released by Eurostat) and that computed on 9 countries by E9. For the years in which official data are available for all countries (from 1995 onwards) the differences between the 1-month percentage changes in E11 and E9 are negligible, thus the latter can be considered a good proxy of the overall index for the euro area.

Despite major improvements in making the indices homogeneous, some differences still exist among European countries, in particular with respect to the frequency of the base-year changes and to the reference period for weights (see Eurostat, 1999a). This has prompted

Eurostat to implement a special procedure to aggregate elementary items into groups, categories of expenditure and the overall index, which permits the uniform treatment of weights across countries. This is done by proceeding *as if* the HICP were an annual chain index, with December as "reference period". For example, the overall index for country k in May 1998 is given by

$$(2.1) \qquad H_{5,98}^{k} = \frac{\sum_{j=1}^{N} w_{98}^{k,j} \cdot H_{5,98}^{k,j} / H_{12,97}^{k,j}}{\sum_{j=1}^{N} w_{98}^{k,j}} \cdot H_{12,97}^{k}$$

where $H_{mm,yy}^{k,j}$ is the index for item j in country k, month mm and year yy, $H_{mm,yy}^{k}$ is the overall index in the same period, N is the number of elementary items comprised in the overall index and $w_{yy}^{k,j}$ is the weight of item j in country k for year yy (that is, the expenditure on item j over total expenditure in percentage terms). In other words: first a weighted average of changes in the index of each item with respect to the preceding December is computed; then this average is "link-corrected" using the level of the overall index recorded in December of the previous year (that is, "re-chaining" the index)[6]. Eurostat also computes a "Monetary Union Index of Consumer Prices". The aggregation of national indices into a euro-area average requires a procedure similar to that outlined above and is based on national indices for elementary items, their corresponding weights and the country weights[7]. For the overall index of the euro area, Eurostat aggregates the national overall HICPs as follows:

$$(2.2) \qquad H_{5,98}^{EU} = \frac{\sum_{C=1}^{11} w_{98}^{C} \cdot H_{5,98}^{C} / H_{12,97}^{C}}{\sum_{C=1}^{11} w_{98}^{C}} \cdot H_{12,97}^{EU}$$

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[6] For details on the "link correction" and its relationship with chain indices see Eurostat (1999a) and Cristadoro and Sabbatini (1999).

[7] Country weights are computed on the basis of final private consumption for the E11 countries expressed in a common currency using the fixed parities established in December 1998.

where C denotes the country. For a generic sub-index, S, the formula used is (we still refer to the example of the index in May 1998):

$$(2.3) \qquad H_{5,98}^{EU,S} = \frac{\sum_{C=1}^{11} w_{98}^{C} \cdot \sum_{j\in S} w_{98}^{C,j} \cdot {H_{5,98}^{C,j}}\big/{H_{12,97}^{C,j}}}{\sum_{C=1}^{11} w_{98}^{C} \sum_{j\in S} w_{98}^{C,j}} \cdot H_{12,97}^{EU,S}$$

where $w_{yy}^{C,j}$ indicates the weight of item j in country C for year yy.

This aggregation procedure has a bearing on the analysis of seasonality, since Eurostat calculates the aggregates on the basis of elementary items, while we can only compute the national overall HICPs for period 1987-1994 by relying on the existing backdata (thus facing the non-additivity inconvenience of the chain index)[8]. Hence, when we consider an indirect seasonal adjustment method there might be an approximation error due to the different level of disaggregation used to calculate the overall index. To control for this potential source of error, we computed, for the period 1995-1998 (for which we have official aggregated sub-indices and elementary series), the overall national HICPs by aggregating the five sub-indices on which our analysis is based, and compared the results with the official data. Differences are reasonably small: they never exceed 0.05 for the levels of the series[9], and are equally very small if evaluated with respect to 1-month percentage changes[10]. Hence, we can proceed fairly safely in the empirical analysis of the seasonal patterns of the HICP series and try an "indirect" method for the E9 averages, since differences with the results obtained through a "direct" approach are not significantly affected by the chaining nature of the indices[11].

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[8] In brief, as extensively discussed in Cristadoro and Sabbatini (1999), in the case of a chain index results differ according to the level of aggregation of data which have to be added. The proper way to compute the overall index is to use elementary indices.

[9] HICPs are indices with an average value equal to 100 in 1996.

[10] Detailed results are available upon request from the authors.

[11] When SA series are aggregated into the overall index a technical complication concerns the choice of the series to be used for the link-correction. On the one hand, the reference to the SA series implies a

3. Is seasonality important to explain the short-term variability of HICPs?

Before proceeding with a more detailed analysis, an obvious question to ask is whether the contribution of seasonality to the short-term variability of consumer prices is important. Our experience with the Italian CPI suggests that clearly detectable seasonal movements affect most prices. A first look at the data reveals that this might also be the case for the HICPs.

A very rough way to assess the importance of seasonality in the price series is to regress their first differences on seasonal dummies (see Davidson and MacKinnon, 1992, p. 687)[12]. Results show that such regressors explain, on average, around one third of short-term variability in the overall HICPs (Table 2). These regressions also suggest that there might be differences across euro-area countries and between sub-indices within each country[13]. Turning to the euro area aggregates[14], results reported in Table 2 reveal that the aggregation has increased the percentage of month-to-month variability that can be attributed to seasonal variations captured by the dummies. In fact, for the overall E9 HICP, around 40 per cent of the variability is explained by the dummies (for the national HICPs it was roughly 30 per

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systematic difference between annual averages computed with reference to SA and not seasonally adjusted (NSA) data, but allows a proper computation of the rates of change. On the other hand, the use of the NSA series guarantees the same annual averages between the levels of the SA and NSA series, but leads to erroneous rates of change at the beginning of the year. Thus, in principle one should compute two SA series, depending on the use one makes of them.

[12] According to some authors, this model of seasonality is considered a “good approximation for many economic time series” (Miron, 1996, p.9) .

[13] For instance, in Portugal only 15% of total variation can be attributed to seasonality (though the percentage rises to around 30% allowing for a seasonal trend, that is for some degree of moving seasonality), while in the Netherlands 70% of total variation is due to seasonal movements captured by seasonal dummies (the percentage rises slightly allowing for a seasonal trend). In the case of Portugal this result has been affected by the fact that the revision of the index at the beginning of 1998 caused a break in the data.

[14] We computed E9 indices using the country-weights provided by Eurostat to aggregate national HICPs. They are based on final private consumption converted into a common currency and are released by Eurostat from 1992. They are computed using the fixed parities against the euro established at the end of 1998. For the previous years we followed the same approach. In order to make sure that the weighting scheme did not have a significant impact on our estimates, in a preliminary stage of the analysis we also examined the alternative consisting in converting, for the years 1987-1991, final consumption with the average annual ecu exchange rates recorded year by year. The choice does not result in large differences for the aggregated NSA series.

cent). Among sub-indices, it is confirmed that energy products move largely independently of seasonal factors, while processed food appears to be characterised to a greater extent by seasonality than the corresponding national sub-indices.

We also checked the previous results running TRAMO-SEATS and X12-RegArima on the same dataset, allowing for automatic identification of the best seasonal filter[15]. The overall quality of the seasonal adjustment performed has been assessed on the basis of the most telling tests produced by TRAMO-SEATS and by X12-RegArima (Cristadoro, Focarelli and Sabbatini, 1999). A synthesis of the results is provided in the Table 3, where a "poor" seasonal adjustment is denoted by "*X*" and an "acceptable" one by "*OK*". It turns out that it is always possible to find a "reasonable" seasonal filter for the overall HICPs as well as for the sub-indices for non-food and non-energy goods and for services. Furthermore, it appears that, in general, unprocessed food prices exhibit identifiable seasonal movements. On the other hand, for most countries, energy and processed food prices represent "problematic" cases, in the sense that they are characterised by a rather weak seasonal signal.

Three conclusions can be drawn from this preliminary analysis:

(i) a sizeable part of the short-term variability of the HICPs is explained by seasonal movements;

(ii) there are differences among countries. In particular, Portugal and the Netherlands show contrasting characteristics. However in most countries seasonality explains a roughly similar portion (30-40 per cent) of overall HICP variability.

(iii) the sub-indices exhibit fairly diversified behaviour as concerns seasonality: while some exhibit a clear seasonal pattern in most countries, others (in particular energy goods and processed food prices) do not seem to be characterised by this feature to the same extent.

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[15] The two programs are described, respectively, in Gomez and Maravall (1996) and Bureau of the Census (1998).

4. Direct versus indirect seasonal adjustment

The main issues one faces in estimating the seasonal component in the HICP of the countries of the euro area and of their average can be summarised as follows. Any time series (x_t) can be thought of as being composed of two (unobservable) components, one seasonal (s_t) and one non-seasonal (n_t)[16]:

(4.1) $$x_t = s_t + n_t .$$

There is no unique way to estimate the seasonal component of an aggregate index. Assume that (x_t) is composed of k elementary series (for simplicity, it is given by the *sum* of these sub-series), that is

(4.2) $$x_t = \sum_{j=1}^{k} x_{jt} .$$

The seasonal adjustment can be thought of as the application of a "suitable" linear filter[17], $F(B)$, to the observed series

(4.3) $$F(B)x_t = \hat{s}_t^d$$

where "*d*" stands for "direct" seasonal adjustment of the raw series and

(4.4) $$F(B) = \sum_{j=-m}^{m} \delta_j B^j , \qquad \text{with}^{18} \sum \delta_j^2 < \infty$$

where the backshift operator B is such that $B^j x_t = x_{t-j}$.

In the case of the "indirect" seasonal adjustment we have

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[16] To simplify the notation, we consider only additive decompositions.

[17] We restrict ourselves to linear symmetric filters, which are preferable to asymmetric ones since they do not induce phase shifts in the filtered series (see Maravall, 1995).

[18] The weights δ_j are real and do not depend on time. When they sum to unity we have a symmetric moving average filter.

(4.6) $$\hat{s}_{jt}^{d} = F_j(B)x_{jt}.$$

Overall, x_t can be decomposed either as

(4.7) $$x_t = \hat{s}_t^d + \hat{n}_t^d$$

where

(4.8) $$\hat{s}_t^d = F(B)x_t \text{ and } \hat{n}_t^d = [1 - F(B)]x_t$$

or as

(4.9) $$x_t = \hat{s}_t^i + \hat{n}_t^i$$

where

(4.10) $$\hat{s}_t^i = \sum_{j=1}^{k} F(B)x_{jt} \qquad \text{and} \qquad \hat{n}_t^i = \sum_{j=1}^{k} [1 - F_j(B)]x_{jt}.$$

In the context of the HICP of each country *j* runs over different sub-indices; at the euro area level, the aggregation across countries also has to be taken into account. More specifically, at the *national level* the SA overall index can be obtained either directly or by aggregating the five sub-indices previously introduced, seasonally adjusted when necessary. At the *euro area level* the same holds if one starts with euro not SA (NSA) sub-indices, ignoring the fact that they are themselves the result of the aggregation of the corresponding national indices. But when due consideration is given to this aspect things become more complex. In fact the following alternatives can be taken into account to estimate the SA index for the euro area:

(i) "*direct approach*": the seasonal component is estimated directly with respect to the raw E9 aggregate;

(ii) "*indirect approach applied to euro-area sub-indices*" (denoted by "indirect A"): the indirect approach is applied to the raw sub-indices for the euro area, which are first seasonally adjusted and then aggregated into the SA E9 index;

(iii) "*indirect approach applied to the corresponding national SA indices*" (denoted by "indirect B"): the indirect approach is applied with respect to the corresponding national series, which are first seasonally adjusted and then aggregated into the SA E9 index.

Clear-cut criteria for the evaluation of seasonal adjustment do not exist and there is a debate in the literature concerning the use of different approaches and the assessment of results[19]. Developing a formal statistical test to choose between the direct and the indirect methods is becoming important owing to the need to compute SA measures for the euro area. We do not pursue the construction of such a test here, since at this stage we are more interested in assessing the differences between results obtained by the two approaches, in particular, whether estimates obtained with the direct and indirect methods lead to a different interpretation of short-term developments in inflation. The matter is rather straightforward if no major differences between results arise, in which case the choice is essentially based on *a priori* preferences for one of the two methods[20]. Conversely, formal statistical tests are required when the estimated adjusted series differ significantly and the user can no longer be indifferent between results.

5. The estimation of the seasonal component for HICPs

5.1 Preliminary remarks

Over the last few years an intense debate, partly sponsored by Eurostat, finally focused attention on the comparison between two alternative methods for estimating the seasonal

[19] For a survey of different approaches to seasonal adjustment, see Franses (1998) and Hylleberg (1992).

[20] In this case one faces a trade-off between the operational burden of an indirect approach and the better analysis of inflationary tendencies obtained by splitting the overall SA variation into those of the components.

component of a time series embodied in TRAMO-SEATS and X12-RegArima (for a description of the two procedures, see Gomez and Maravall, 1996; Findley *et al*., 1998). We decided to rely on TRAMO-SEATS for the following reasons. First, the literature has increasingly stressed the importance of problems arising from the *ad hoc* nature of the filter used by X12, in particular the fact that it can lead to over or under-adjustment of the original series (see, among others, Maravall, 1995 and 1996 and Planas 1997b). By contrast, in the model-based approach the filters are derived directly from the characteristics of the series in question, thus avoiding this drawback. Second, some papers which compare results obtained with the two procedures, applied to series with very different stochastic structures, show that TRAMO-SEATS generally provides results that are either superior or equal to those obtained with X12-RegArima (see Cristadoro, Focarelli and Sabbatini, 2000). Third, our choice is in line with suggestions made by Eurostat (see Eurostat, 1999b), which uses TRAMO-SEATS for the seasonal adjustment of many series[21]. Finally, in the past one of the main reasons for the popularity of X11-Arima (of which X12-RegArima represents a development, now offering greater flexibility in the choice of the filters) was that it was implemented in a powerful and user-friendly routine and an interface was available for most statistical packages. This advantage no longer holds, since TRAMO-SEATS is also offered in a user friendly package[22].

The choice of the method is not the only issue one faces in decomposing a time series. Others concern the use of additive *vs.* multiplicative decomposition; the consideration of Easter and trading days effects; the detection and removal of outliers; the choice of the time

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[21] The same feeling was expressed at two international seminars (Rome, June 1998; Bucharest, September 1998) on this topic, which brought together the world's leading experts.

[22] Moving average filters such as those embodied in X12 have been proved to be optimal filters for a particular stochastic model (the airline with given parameter values, Cleveland and Tiao, 1976). Slight movements away from this model do not affect the properties of *ad hoc* filters, while far-reaching changes in the stochastic nature of the process can create problems. When a time series is well represented by the airline model, we can expect X12 to give results taht are generally similar to those obtained using SEATS. The airline model is actually a reasonable one in the majority of cases. In this sense, we believe that the choice of the method to be used is relevant in theory, though in practice differences are not too serious when economists try to interpret the data.

interval[23]. The software we adopted resolves most of these problems. In particular, tests are available for the log transformation of the original series, for the presence of Easter and trading days effects - which, however, seldom characterise consumer price series - and the detection of outliers.

The estimation strategy we followed is affected by the large number of series involved, which meant that a detailed study could not be performed on each of them. We started by running TRAMO-SEATS in the automatic mode[24], considering the maximum number of observations for each series. The quality of the decomposition was evaluated on the basis of the following statistics: first, the adequacy of the model was tested by the standard diagnostics on the estimated residuals[25]; second, we looked at the number of outliers detected (as a percentage of the number of observations) and at a statistic which is indicative of the amount of revision; finally, we checked whether the seasonal component estimated over the last two years was statistically different from zero in most months (this diagnostic is included in the output produced by SEATS).

When the above diagnostics were not satisfactory on the first run (fully automatic mode) we tried different solutions: (i) in case of failures in the test of normality of residuals, we changed the level of the threshold to detect the outliers (the VA parameters) in order to remove a larger number of them (we maintained the option not to remove outliers detected at the end of the estimation period); (ii) when an unsatisfactory model was identified by the automatic routine (for instance, a strongly “unbalanced” model or one for which the

[23] Whether to use the SA rather than the trend-cycle (TC) component is still an open question. In this paper we do not deal with this issue, focusing on the SA series. The main reason is that our experience has shown that when the elementary items of the index are available and the user has a some experience in the interpretation of SA data, it is better to maintain the information contained in the irregular component.

[24] First, we set the parameter RSA=6 to test for the presence of trading days effects (TD) and Easter effects (EE), which were not found; in this situation, the option RSA=3 is equivalent.

autocorrelation tests failed) a different one was tried (sometimes the "airline" model performed better than that selected by the automatic identification routine). Finally, in several cases the estimation interval was changed on the basis of graphical inspection of the residuals and the seasonal components: when they showed a clear structural break over the sample period, the seasonal adjustment was performed starting from a more recent period and this choice was further controlled by diagnostic checking[26].

5.2 The choice of the most appropriate indicator for short-term monitoring of inflation

Seasonally adjusted measures derived from consumer prices are used, together with other information, to monitor inflation. Given the different relevance of the various sub-indices in delivering information about future movements in headline inflation, the economic content of each price indicator, over and above other statistical considerations, must be taken into account. This aspect is often overlooked in the literature, whereas we think that it should play a central role. In this paper we try to overcome this limitation by focusing on the sub-index which we think provides the best measure for future developments of inflation, i.e. the so-called "non-food and non-energy price index". Its importance was underlined in the debate on the estimation of a *core inflation* measure. In very general terms, *core inflation* represents the part of the change in the overall index which is independent of those price changes with only a one-off impact on overall inflation, whose effects will therefore vanish in the medium term. The reason why prices of food and energy goods are excluded from the index when assessing its longer term developments lies in their higher volatility, due to irregular and transitory shocks. On the basis of a preliminary analysis this also holds for HICPs. The standard deviation computed with respect to the 1-month percentage changes of the NSA

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[25] In particular, the output produced by TRAMO includes a test of normality and two tests of the Ljung-Box type for serial autocorrelation of the residuals and the squared residuals. A test for serial correlation at seasonal frequencies is also available, although it has not been reported in the paper.

[26] In particular, in several cases we decided to start in 1992 for the following reason. First, this is the maximum common range for all series. Second, backdata might be unreliable estimates of actual HICPs (though we could not control for this factor); hence, shifting the beginning of the time span ahead was a way to reduce the relative importance of backdata. The more drastic solution of starting the estimation interval in January 1995, thus considering only actual data, was not feasible because time span to perform the decomposition of our series was too short.

series is, in general, higher for unprocessed food and energy products. In principle, these results might be affected by seasonal variations; however, results are similar for the corresponding SA series (Table 4). This means that seasonal adjustment does not remove this higher volatility which should therefore be attributed to shocks that do not follow a regular pattern.

A second reason to prefer the index net of food and energy products in monitoring inflation for monetary policy purposes was emphasized by Blinder (1997, p. 160) "As a central banker, I always preferred to view the inflation rate with its food and energy components removed as our basic goal. But not because these components are extremely volatile (...). The real reason was that the prices of food (...) and energy are, for the most part, beyond the control of the central bank".

In our view, a third reason to focus on seasonal adjustment of this core component is that a SA measure of the index comprising only services and non-food and non-energy goods enhances our ability to analyse the short-term dynamics of inflation. By contrast, together with a weaker seasonal signal, energy and food prices present a short-term dynamic characterised to a larger extent by factors on which exogenous information is available. This exogenous information can be used to anticipate likely movements in the series. For instance, in the case of energy prices, oil prices on international markets are a very useful source of information for short-term forecasting; the same holds for food prices, where the evolution of prices of agricultural commodities provides a guide to assessing future developments in this component. In both cases filtering to obtain SA measures is not necessary in order to have a clearer vision of the present situation[27].

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[27] Since elementary data on HICP are not available for the entire sampling period, it was not possible to compute a more satisfactory measure of core inflation that also excludes items whose prices are subject to government control. Hence we estimate the seasonal component of an index that comprises prices whose dynamics are not seasonal and are completely predictable on the basis of *ad hoc* information (see Appendix).

5.3 Empirical results

We now turn to the presentation of the main empirical results, dealing first with national HICPs and then with the indicators for the euro area. In both cases we compare the direct and the indirect approaches applied to the overall index and to the non-food and non-energy index.

5.3.1 National indices

The models finally chosen, together with the main accompanying statistics, are reported in Tables 5A-5C. The seasonal component can be estimated for most series[28]. The additive decomposition is nearly always chosen; moreover, the airline model is suitable for representing the stochastic characteristics of our series in more than 50 per cent of the cases (this result is in line with that obtained in an empirical work conducted by Eurostat, see Eurostat 1996). The estimation interval was changed (to 1992) on several occasions, with a general improvement in the diagnostics. Implicitly, this result might indicate the existence of some structural difference between backdata and official HICPs, though we did not pursue this issue in a more formal way. The percentage of outliers over the number of observations is rather low, with six exceptions (we considered a "high" number of outliers to be more than 5 per cent of the number of observations). The SA series can be estimated for both energy and processed food prices, despite the preliminary evidence presented in Section 3 which indicated a weak seasonal signal for these series. However, if the statistical significance of the seasonal component is taken into account a different conclusion can be drawn. The output of SEATS contains the confidence intervals of the seasonal component estimated over the last two years of the estimation period. Taking into account this statistic as well, it can be observed how the seasonality of processed food and energy prices is, in general, not significantly different from zero, whereas this is not the case for the other series.

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[28] In a few cases some of the tests fail, but the overall quality of the seasonal adjustment is satisfactory, as can also be seen from the regular shapes of plotted residuals and seasonal components (plots are available

Focusing on the core index and its components, the comparison between the SA and the NSA annualised 3-month percentage changes suggests that, in general, a much clearer signal is provided by the SA series (Figures 1A-1C)[29].

Turning to the comparison between direct and indirect methods, first we looked at differences between the SA series obtained with alternative approaches. With few exceptions, the results suggest that such differences are rather small for the overall index and the core index (see Figures 2 and 3 for the main countries of the euro area). The seasonal coefficients[30] differ only slightly in magnitude and their signs are preserved by the two methods; in other words, if one month is characterised by a negative seasonal effect using one method, the same holds for the other. These results are confirmed considering the SA series estimated with the direct approach as a benchmark and computing 95% confidence bounds around it. For the core index, the indirect SA series always lay within the bounds, with the exception of a few observations - less than 5% of the sample - for Belgium, Finland and France; analogous results hold for the overall index[31].

The choice between the two approaches is also affected by the regularity of the seasonal coefficients through the years, a highly desirable feature in short-term analysis. When these coefficients tend to vary sharply from one year to the other, it becomes very difficult and unreliable to use the information contained in them, in particular for forecasting purposes (see below). For our series, no sizeable differences across methods emerge in the regularity of the seasonal pattern through the years.

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upon request from the authors). In the tables we denoted the overall quality of seasonal adjustment by "low" when at least one important test failed, and by "high" when no tests failed.

[29] For the sake of simplicity, we present the results in terms of the 3-month percentage changes in the SA index (the levels might not provide a very clear signal; the 1-month percentage changes are too volatile to report in a figure).

[30] We prefer to look at these coefficients in terms of first differences, since the latter are easier to use in the economic analysis; they are obtained by subtracting the 1-month percentage variation of the SA series from the corresponding variation in the raw series.

To sum up, at the national level no major differences between a direct and an indirect approach arise for the overall and core indices. Hence the choice of approach can be based on the purpose of the analysis, trading off the richer information obtained with the indirect methods against the computational burden of their use[32].

5.3.2 Euro-area indices

Turning to series for the euro area, the seasonal component has been estimated for the overall index and all its sub-indices (Table 5C). Only in the case of energy prices is seasonality not significant (in the last two years). The airline model is almost always selected. Furthermore, comparison of these results with those obtained at a national level, shows that the aggregation of national data produces more regularly shaped consumer price series and seasonal components.

In order to compare the direct and the indirect approaches we followed the scheme introduced at the end of Section 4. That is, in addition to the direct approach we considered the indirect method applied to the raw sub-indices for the euro area ("indirect A") and the estimate of the seasonal component of the E9 aggregate based on the corresponding national SA indices ("indirect B"). Estimates obtained with the three methods are quite similar; this conclusion holds for the overall and the core indices (Figures 4A-4B). Moreover, no major differences arise in the regularity of the seasonal patterns through the years (Figures 5A-5B). Finally, the SA series, estimated following the two indirect approaches, lies inside the error

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[31] Figures are available from the authors upon request.

[32] In the case of Italy we can compare these results with those based on the analysis of the national CPI, whose basket is very similar to that of the HICP. In this way one can appreciate the improvement in the estimation of the SA series that derives from a richer and more detailed information set. The main difference between estimation of the seasonal components for the HICP and the CPI lies in the fact that for the latter index one can isolate administered prices and rents (for details, see Appendix 1).

bounds around the SA overall index obtained through the direct method. The seasonal factors for the euro-area sub-indices and for the overall index look quite regular; some evidence of evolving seasonality is only present for non-food and non-energy goods (Figure 6).

In conclusion, at the euro-area level similar estimates of the *SA overall index* and the *SA core index* are obtained by applying the indirect approaches to the SA E9 sub-indices or to the corresponding national SA indices, or considering the E9 aggregate series directly.

6. The use of SA series in the monitoring and forecasting of inflation

The statistical analysis of time series for policy purposes is aimed at answering - as stated by Maravall (1996, p.1) - two basic questions: where we are (a) and where we are heading (b) "… of course, forecasting provides the answer to (b). The answer to question (a) usually consists of an estimation of the present situation, free of seasonal variation; on occasion, variation judged transitory is also removed. Thus seasonal adjustment and trend estimation are used to answer question (a). For monthly macroeconomic series, it is often the case that seasonal variation dominates the short-term variability of the series".

In the following we try to illustrate how SA measures can be used for forecasting purposes in practice. In doing this one has to bear in mind that to make proper use of seasonally adjusted measures in the short-term monitoring and forecasting of inflation, one has to take into account all sources of information to avoid "traps" that might be hidden in the data[33]. This is even truer when the rate of inflation is low - so that small changes in a few prices can affect the headline inflation rate in a visible way - and inflation tendencies are assessed for all euro-area countries - so that the impact of country-specific policy measures can show up in the month-to-month variation of the HICP for the area as a whole.

6.1 Monitoring inflation

In order to answer the first question ("Where are we now?") the importance of SA measures can easily be shown with an example based on recent developments in HICPs in the euro area. The analysis of the non-food and non-energy index suggests that inflation in the area reached a low at the beginning of 1999, which was *not* signalled by the 12-month percentage changes, the most widely measure adopted in monitoring inflation (Figure 9). However, in the first quarter of 1999 various events helped to complicate the analysis of HICP dynamics. In particular, a major reduction in the prices of services in Germany, due to a cut in telephone charges, had a strong impact on the area-wide index. Furthermore, on the occasion of the "base-change" in some countries, new products and methods in the sampling procedures were introduced, partly following the Eurostat recommendation. For instance, in France the different treatment of sales produced a fall in prices in January, followed by a recovery in February. These movements had never been recorded in the past and as a consequence they were not captured by the estimate of the seasonal component. This example suggests that to make proper use of SA indicators one has to consider a broad information set to associate the SA measures with extraordinary one-off changes in the level of prices. In the previous example, the availability of disaggregated data and the knowledge of major events in each country made it possible to estimate irregular changes better than the automatic procedure for the detection of outliers. Relying on such procedures for the correction of outliers at the end of the sample is particularly dangerous (we risk confusing them with an actual change).

6.2 Forecasting inflation

The second question raised by Maravall ("Where are we going?") is more complicated. Short to medium-term price movements tend to be dominated by factors other than purely monetary developments. As a consequence, effective monitoring and forecasting of inflation

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[33] Warning against the dangers of data-driven inference - though in a rather different context - is provided, for instance, by Sullivan, Timmerman and White (1998, p.3), who observe that "Data with important outliers (...) are particularly prone to data-snooping biases".

requires a rather complex analysis of a variety of statistics and events that can either directly or indirectly affect price dynamics. The treatment of seasonality is an important step in assessing monthly price developments. Over longer horizons other methods provide better guidance: multivariate time series methods, large structural econometric models and judgmental assessment of likely developments in exogenous variables all contribute to forming a view of inflationary developments. In the following we describe how the estimated seasonal component can be useful for forecasting purposes, in conjunction with other information.

The first way to use SA indices implies that on the basis of the assessment of the underlying tendencies of inflation over the last few months (that is, once all sources of irregularities have been taken into account) one extrapolates the recent path of the index, using all other sources of information: seasonal movements, expected price changes with a large impact on the level of the index (they can derive, for instance, from changes in charges and VAT rate, typically known a few months ahead), other expected irregular changes which can be estimated on the basis of *ad hoc* information (for instance, an increase in car prices is sometimes known in advance).

Alternatively, the seasonal component can be used while bearing in mind a forecast for the average annual inflation (for instance, that provided by an econometric model). In this case the seasonal component is useful for deriving monthly data from annual forecasts, i.e. to draw a path for monthly inflation consistent with a constraint on its annual average. The comparison of the expected path with actual data, released month by month, is a very useful way to verify whether expectations are in line with actual data. In the presence of major differences between the actual and forecast inflation paths, a revision of the forecast for the whole year might become necessary together with a new evaluation of inflationary pressures. A key issue here is how to forecast the annual average. Typically, this is done on the basis of a structural econometric model.

7. Conclusions

Seasonally adjusted price indices are useful for short-term monitoring and forecasting of inflation. This paper focuses on the HICP, the most important indicator used by the European Central Bank to assess price stability. A preliminary analysis of the seasonal behaviour of these series suggests that:

(i) a sizeable amount of the short-term variability of the HICPs depends on seasonal movements;

(ii) there are differences across countries; the two extreme cases are Portugal, where only a small part of the total variation of the overall HICP can be attributed to seasonal factors, and the Netherlands, where seasonal movements are large;

(iii) with reference to the main sub-indices, for national series and euro-area aggregates unprocessed food, non-food and non-energy goods and services exhibit a clear seasonal pattern in most countries; by contrast, energy goods and processed food prices are less characterised by this feature.

Prior to the analysis of seasonality, we recognised that there could be problems of aggregation in our data arising from the "chain" nature of the HICP index and from the fact that data for the period prior to 1995 were released only for the main sub-indices. However, the analysis conducted with reference to the period in which the full set of official disaggregated data is available (1995-1998) showed that differences between the official data and those we were able to compute on the basis of the aggregated sub-indices were reasonably small. Hence, we could proceed fairly safely in the empirical analysis of the seasonal patterns of the HICP series and try an "indirect" method for the euro area.

At the *national level* the SA overall HICPs obtained with a direct method are very close to those estimated with an indirect approach. In the case of Italy, this confirms the analogous conclusion reached in previous empirical works on the CPI. An indirect approach can also be applied to the core index (i.e., that comprising non-food and non-energy goods and services).

On the one hand the indirect method permits analysis of the variations of the SA core index in terms of the movements in its SA components; on the other hand, it imposes an extra computation burden. Thus in the final choice there is a trade-off between operational costs and richer information provided by indirect methods.

At the *euro-area level*, the aggregate SA index (whether referred to the overall or core index) can be obtained by aggregating the corresponding national SA indices or by aggregating the E9 SA sub-indices. Differences with respect to results obtained by applying the direct method are small.

In the last part of the paper we showed how seasonally adjusted series can be usefully considered for monitoring and forecasting inflation, especially when they are used together with other measures and indicators of inflationary pressures. This points to the following consideration: in the analysis of inflation several indicators can be considered, each with its own information content; however, to obtain the best assessment, all these pieces of information should be used together.

Appendix
A comparison of seasonal adjustment of the CPI and HICP in Italy

The seasonal pattern of the Italian CPI has been investigated in previous empirical works (see, for instance, Banca d'Italia, 1998). More disaggregated data are available for this index than for the HICP. In particular, it is possible to distinguish (i) items subject to official price controls from the others and (ii) rents from the rest of services. The main differences between the CPI and the HICP basket essentially regard the different treatment of health services, education expenditures and package holidays (for details, see Cristadoro and Sabbatini, 1999 and Istat, 1999).

In order to compare SA series estimated for the two indices it is worth remarking that, in the case of the CPI, the seasonal adjustment is performed on series excluding prices subject to official controls; moreover, in the case of services, rents are considered separately from the other items. Consistently with the analysis presented in this paper, we will focus on the "core" components of the indices, that is on non-food and non-energy goods and services. To be consistent with estimates of their seasonal components obtained for the HICP, for each sub-index we compared the HICP series – seasonally adjusted - with two different SA CPI measures:

(i) the first is obtained by estimating the seasonal component for the CPI sub-indices on the basis of a series homogeneous to that computed for the HICP; for the two components considered that implies the computation of the following SA aggregates for the CPI:

SA services = <u>seasonal adjustment</u> of (unadministered prices + charges + rents)

SA non-food non-energy goods = <u>seasonal adjustment</u> of (unadministered prices + administered prices).

(ii) the second is obtained aggregating the seasonal and the non-seasonal parts for each CPI sub-index, that is:

SA services	= unadministered SA prices + NSA charges + SA rents
SA non-food non-energy goods	= unadministered SA prices + administered NSA prices.

In general, with the exception of February and July, no major differences emerge with reference to the non-food and non-energy goods index (Figure A1). By contrast, differences are more pronounced for services (Figure A2). They partly disappear when the CPI series is seasonally adjusted including rents and other administered prices. With reference to the core sub-index differences are small (Figure A3) and they do not affect the assessment of short-term inflationary tendencies.

Table 1

CHARACTERISTICS OF BACKDATA[1]

Country		Euro weights[2]	Overall index (B00)	Processed food (PRO)	Unprocessed food (UNP)	Energy goods (ENE)	Services (SER)	Non-food and non-energy goods (NFE)
Austria	AU	2.89	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12
Belgium	BE	3.99	1991.01-1995.12	1991.01-1995.12	1991.01-1995.12	1991.01-1995.12	1991.01-1995.12	1991.01-1995.12
Finland	FI	1.48	1990.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12
France	FR	21.05	1990.01-1995.12	1990.01-1995.12	1990.01-1995.12	1990.01-1995.12	1990.01-1995.12	1990.01-1995.12
Germany	GE	34.52	1985.01-1995.12	1985.01-1995.12	1985.01-1995.12	1985.01-1995.12	1985.01-1995.12	1985.01-1995.12
Italy	IT	18.81	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12
Netherlands	NL	5.13	1987.11-1995.12	1987.10-1995.12	1987.10-1995.12	1987.10-1995.12	1987.10-1995.12	1987.10-1995.12
Portugal	PO	1.82	1987.01-1995.12	1987.01-1995.12	1987.01-1995.12	1988.01-1995.12	1987.01-1995.12	1988.01-1995.12
Spain	SP	9.15	1992.01-1995.12	1992.01-1995.12	1992.01-1995.12	1992.01-1995.12	1992.01-1995.12	1992.01-1995.12
Total	E9	98.84						

Source: Eurostat.
(1) Based on backdata available in May 1999. - (2) 1999 weights released by Eurostat.

Table 2

THE SHORT-TERM VARIABILITY OF THE HICPS EXPLAINED BY SEASONAL DUMMIES (1)

Country	Starting year (2)	Overall index	Food			Energy goods	Non-food and non-energy items		
			Total	Processed	Unprocessed		Total	Services	Non-food and non-energy goods
Austria	1987	0.29 (0.39)	0.34 (0.46)	-0.01 (-0.05)	0.38 (0.53)	-0.02 (-0.03)	0.53 (0.59)	0.81 (0.83)	0.32 (0.51)
Belgium	1991	0.25 (0.37)	0.15 (0.32)	-0.03 (-0.05)	0.18 (0.33)	0.09 (0.06)	0.27 (0.38)	0.42 (0.47)	0.15 (0.24)
Finland	1987(3)	0.29 (0.35)	0.20 (0.29)	0.09 (0.21)	0.26 (0.39)	0.34 (0.31)	0.44 (0.43)	0.31 (0.33)	0.54 (0.55)
France	1990	0.27 (0.42)	0.39 (0.45)	0.20 (0.18)	0.35 (0.41)	0.07 (0.16)	0.45 (0.71)	0.26 (0.56)	0.53 (0.84)
Germany	1987	0.27 (0.35)	0.70 (0.71)	0.02 (0.02)	0.78 (0.78)	0.04 (-0.01)	0.47 (0.62)	0.52 (0.66)	0.18 (0.21)
Italy	1987	0.22 (0.36)	0.23 (0.31)	0.05 (0.16)	0.36 (0.40)	0.03 (0.08)	0.42 (0.51)	0.41 (0.49)	0.35 (0.43)
Netherlands	1987	0.69 (0.74)	0.06 (0.20)	0.02 (0.02)	0.04 (0.16)	0.00 (-0.03)	0.85 (0.91)	0.85 (0.87)	0.87 (0.95)
Portugal	1987	0.15 (0.32)	0.18 (0.28)	-0.01 (0.09)	0.14 (0.23)	0.05 (0.04)	0.17 (0.36)	0.38 (0.47)	0.17 (0.33)
Spain	1992	0.35 (0.46)	0.50 (0.51)	0.29 (0.37)	0.53 (0.52)	0.07 (0.05)	0.18 (0.33)	0.43 (0.53)	0.20 (0.24)
Euro area	1992	0.39 (0.48)	-	0.32 (0.35)	0.58 (0.60)	0.06 (0.02)	0.56 (0.63)	0.79 (0.83)	0.74 (0.82)

(1) Adjusted-R^2 of a regression of the first difference of each index on a constant and 11 seasonal dummies. In brackets is the adjusted-R^2 obtained by adding the interaction of seasonal dummies with a linear trend to the regressors (for details, see Davidson and MacKinnon, 1992, p. 687). - (2) The last period is always 1998.12. - (3) 1990 for the overall index.

Table 3

SYNTHESIS OF RESULTS OBTAINED WITH TRAMO-SEATS AND X12-REGARIMA
(automatic mode)[1]

TRAMO-SEATS

	AU	BE	FI	FR	GE	IT	NL	PO	SP
Overall	OK	OK	OK	OK	OK	OK	OK	X	OK
Processed food	X	X	X	X	X	X	X	OK	X
Unprocessed food	X	OK	OK	OK	OK	OK	OK	OK	OK
Energy goods	X	OK	X	X	X	X	X	X	X
Non-food, non-energy	X	OK	OK	OK	X	OK	OK	X	OK
Services	OK	OK	OK	OK	OK	OK	OK	X	OK

X-12-RegArima

	AU	BE	FI	FR	GE	IT	NL	PO	SP
Overall	OK	OK	OK	X	OK	OK	OK	OK	OK
Processed food	OK	X	X	X	X	X	OK	OK	OK
Unprocessed food	OK	X	OK	OK	OK	X	X	OK	OK
Energy goods	X	X	X	X	X	X	X	X	X
Non-food, non-energy	-	OK	OK	OK	OK	OK	OK	X	OK
Services	OK	OK	OK	OK	X	OK	OK	X	OK

(1) ‘X’ denotes “poor” seasonal adjustment; ‘OK’ denotes an acceptable one. The choice is based on the standard diagnostic reported in the two packages.

Table 4

STANDARD DEVIATION COMPUTED WITH RESPECT TO 1-MONTH PERCENTAGE CHANGES[1]

Country	Unprocessed food food (UNP)		Processed food food (PRO)		Energy goods goods (ENE)		Non-food and non-energy goods goods (NFE)		Services (SER)		Overall index (B00)	
Austria	1.79	(0.43)	0.34	(0.34)	0.79	n.a.	0.34	(0.17)	0.52	(0.14)	0.21	(0.13)
Belgium	1.55	(0.63)	0.17	n.a.	0.96	(0.90)	0.17	(0.14)	0.37	(0.22)	0.24	(0.14)
Finland	1.47	(1.00)	0.32	(0.31)	1.80	(1.52)	0.52	(0.28)	0.33	(0.21)	0.29	(0.23)
France	1.07	(0.69)	0.35	(0.29)	0.54	(0.52)	0.50	(0.13)	0.18	(0.11)	0.20	(0.14)
Germany	1.34	(0.56)	0.19	(0.17)	0.85	(0.82)	0.15	(0.11)	0.53	(0.19)	0.26	(0.13)
Italy	0.40	(0.28)	0.35	(0.34)	0.83	(0.78)	0.20	(0.15)	0.21	(0.16)	0.20	(0.16)
Netherlands	1.45	(1.27)	0.25	(0.21)	1.07	(1.09)	1.52	(0.15)	0.54	(0.14)	0.48	(0.18)
Portugal	1.19	(0.92)	0.56	n.a.	0.65	(0.56)	0.45	(0.36)	0.48	(0.29)	0.35	(0.25)
Spain	0.96	(0.60)	0.52	(0.37)	0.85	(0.66)	0.18	(0.15)	0.32	(0.18)	0.25	(0.16)

(1) The standard deviation is computed over the period 1992.2-1998.12. The standard deviation computed with respect to the NSA series is in bold; that computed with reference to the SA series is in brackets.

Table 5A

THE MAIN DIAGNOSTICS OF TRAMO-SEATS: AUSTRIA, BELGIUM, FINLAND[1]

Country[2]		Starting Year	Log transf.	ARIMA model	Normality[3]	Kurtosis[4]	A/c of residuals[5]	A/c of square residuals[5]	Percentage of outliers[6]	RMSE[7]	Significance of the seasonal components[8]	Overall quality of s.a.[9]
Austria (1987)	AU											
Overall index	B00	1987	no	(0,1,0)(1,0,0)	8.07	4.25	24.95 (23)	6.60 (23)	0.7 (1)	29.89	10	High
Processed food	*PRO*	*1992*	*no*	*(0,1,1)(0,1,1)*	*2.90*	*2.22*	*15.39 (22)*	*29.58 (22)*	*3.6 (3)*	*11.87*	*23*	*Low*
Unprocessed food	UNP	1992	no	(1,0,0)(1,0,0)	2.47	3.00	23.01 (22)	18.89 (22)	0.0	51.33	7	High
Energy goods	*ENE*	*1987*	*no*	*(0,1,1)(0,0,0)*	*3.72*	*3.08*	*15.84 (23)*	*38.31 (23)*	*4.9 (7)*	-	-	-
Core index	G_S	1992	no	(0,1,0)(1,0,0)	2.80	3.90	26.88 (23)	12.34 (23)	1.2 (1)	32.13	9	High
Services	SER	1992	no	(0,1,1)(0,1,1)	0.40	2.83	32.83 (22)	32.94 (22)	3.6 (3)	67.55	1	Low
Non-food, non-energy goods	NFE	1992	no	(0,1,1)(0,1,0)	1.64	2.89	19.93 (23)	22.90 (23)	3.6 (3)	32.47	5	High
Belgium (1991)	BE											
Overall index	B00	1991	no	(0,1,0)(0,1,1)	0.13	2.98	33.46 (23)	15.72 (23)	0.0	20.65	15	Low
Processed food	*PRO*	*1991*	*no*	*(0,1,1)(0,0,0)*	*2.47*	*3.53*	*18.59 (23)*	*26.18 (23)*	*0.0*	-	-	-
Unprocessed food	UNP	1991	no	(1,0,0)(1,0,0)	1.33	2.42	23.26 (22)	14.40 (22)	0.0	44.75	15	High
Energy goods	*ENE*	*1991*	*no*	*(0,1,1)(0,1,1)*	*2.03*	*2.55*	*25.99 (22)*	*29.23 (22)*	*1.0 (1)*	*0.98*	*8*	*High*
Core index	G_S	1991	no	(0,1,0)(1,0,0)	2.71	2.16	21.22 (23)	25.88 (23)	2.0 (2)	30.10	14	High
Services	SER	1992	no	(0,1,1)(0,1,1)	1.77	2.91	28.57 (22)	21.96 (22)	0.0	20.53	14	High
Non-food, non-energy goods	NFE	1991	no	(0,1,1)(0,1,1)	0.98	3.42	21.13 (22)	19.78 (22)	1.0 (1)	17.70	20	High
Finland (1987)	FI											
Overall index	B00	1992	no	(0,1,0)(0,0,1)	0.48	3.14	18.54 (23)	15.56 (23)	1.2 (1)	5.74	8	High
Processed food	*PRO*	*1992*	*no*	*(0,1,1)(0,1,1)*	*5.19*	*3.99*	*17.48 (22)*	*16.94 (22)*	*2.4 (2)*	*0.96*	*18*	*High*
Unprocessed food	UNP	1987	no	(0,1,0)(0,1,1)	0.78	2.62	18.53 (23)	17.72 (23)	0.7 (1)	16.28	8	High
Energy goods	*ENE*	*1992*	*no*	*(0,2,1)(0,1,1)*	*1.89*	*3.70*	*21.76 (22)*	*7.88 (22)*	*3.6 (3)*	*3.65*	*4*	*High*
Core index	G_S	1992	yes	(0,1,1)(0,1,0)	1.83	3.74	8.54 (23)	13.93 (23)	1.2 (1)	34.41	7	High
Services	SER	1992	yes	(0,1,0)(0,1,1)	0.53	3.43	19.73 (23)	17.19 (23)	4.8 (4)	28.26	11	High
Non-food, non-energy goods	NFE	1992	yes	(0,1,0)(0,1,1)	2.71	2.89	13.53 (23)	16.27 (23)	1.2 (1)	24.90	7	High

Bold characters indicate that the null hypothesis is rejected at the 10% confidence level.

(1) Parameter RSA is set equal to 3 (Gomez and Maravall, 1996); for a description of diagnostic checking included in TRAMO-SEATS, see Planas (1997b). Tests on residuals are from TRAMO. - (2) The starting year of the estimation is in brackets (the last period is always 1998.12). - (3) Bera-Jarque test for normality of residuals; the null hypothesis is that residuals are normal (critical value at the 5% confidence level is equal to 5.99; at the 10% confidence level it is equal to 4.61). - (4) In the case of the normal distribution the value is 3. - (5) Lijung-Box test for serial correlation; the null hypothesis is the absence of serial correlation (critical values: $chi(19)_{0.05}$=30.14; $chi(21)_{0.05}$=32.67; $chi(22)_{0.05}$=33.92; $chi(23)_{0.05}$=35.17; $chi(19)_{0.10}$= 27.20; $chi(21)_{0.10}$=29.62; $chi(22)_{0.10}$= 30.81; $chi(23)_{0.10}$=32.01). The degrees of freedom are in brackets. - (6) Percentage of outliers on the number of observations (the number of outliers is in brackets); 5% per cent is considered the maximum level acceptable. - (7) "Average percentage reduction in RMSE from concurrent adjustment" (i.e. percentage improvement from moving from once-a-year adjustment to concurrent adjustment; approximately, a level lower than 30% indicates that there is no point in having concurrent estimation). - (8) Number of months over the last 2 years in which the estimated seasonal component is not significantly different from zero (10% confidence level). - (9) Judgemental (based on diagnostics included in the table).

Table 5B

THE MAIN DIAGNOSTICS OF TRAMO-SEATS: FRANCE, GERMANY AND ITALY [1]

Country[2]		Starting year	Log transf.	ARIMA model	Normality[3]	Kurtosis[4]	A/c of residuals[5]	A/c of square residuals[5]	Percentage of outliers[6]	RMSE[7]	Significance of the seasonal components[8]	Overall quality of s.a.[9]
France (1990)	FR											
Overall index	B00	1990	no	(0,1,0)(0,1,1)	3.43	3.90	24.74 (23)	11.00 (23)	0.0	12.16	11	High
Processed food	*PRO*	*1992*	*no*	*(0,1,1)(0,1,1)*	*2.13*	*3.45*	*16.33 (22)*	*15.25 (22)*	*10.8 (9)*	*18.31*	*10*	*Low*
Unprocessed food	UNP	1990	no	(0,1,0)(0,1,1)	4.17	2.43	29.82 (23)	11.69 (23)	0.0	11.18	14	High
Energy goods	*ENE*	*1992*	*yes*	*(0,1,1,)(0,1,1)*	*2.91*	*3.17*	*19.41 (22)*	*22.26 (22)*	*6.0 (5)*	*5.64*	*16*	*Low*
Core index	G_S	1992	no	(1,1,0)(0,1,1)	1.16	3.59	22.41 (22)	24.86 (22)	1.2 (1)	28.85	7	High
Services	SER	1992	no	(0,1,1)(0,1,1)	4.39	3.32	26.70 (22)	22.60 (22)	3.6 (3)	33.88	7	High
Non-food, non-energy goods	NFE	1992	yes	(0,1,1)(0,1,1)	0.57	2.59	20.92 (22)	27.90 (22)	4.8 (4)	52.20	1	High
Germany (1987)	GE											
Overall index	B00	1987	no	(0,1,1)(0,1,1)	0.27	2.87	26.86 (22)	18.37 (22)	0.7 (1)	18.55	11	High
Processed food	*PRO*	*1992*	*no*	*(0,1,1)(0,1,1)*	*0.05*	*2.88*	*21.79 (22)*	*43.19 (22)*	*3.6 (3)*	*17.41*	*24*	*Low*
Unprocessed food	UNP	1987	no	(0,1,0)(0,1,1)	7.72	3.92	29.15 (23)	20.61 (23)	0.0	2.83	2	High
Energy goods	*ENE*	*1992*	*no*	*(0,1,1)(0,1,1)*	*9.27*	*3.67*	*27.35 (22)*	*22.22 (22)*	*1.2 (1)*	*1.18*	*14*	*Low*
Core index	G_S	1990	no	(0,1,1)(0,1,1)	1.28	3.39	20.33 (22)	32.06 (22)	3.7 (4)	28.09	9	High
Services	SER	1992	no	(0,1,1)(0,1,1)	0.47	2.79	23.08 (22)	12.03 (22)	2.4 (2)	24.75	3	High
Non-food, non-energy goods	NFE	1990	No	(0,1,1)(0,1,1)	2.57	3.47	30.05 (22)	32.09 (22)	0.9 (1)	8.65	13	High
Italy (1987)	IT											
Overall index	B00	1987	no	(0,2,1)(0,1,1)	1.06	3.25	16.99 (22)	25.73 (22)	0.7 (1)	6.1	8	High
Processed food	*PRO*	*1992*	*no*	*(0,2,1)(1,0,0)*	*2.86*	*3.02*	*15.21 (22)*	*23.80 (22)*	*9.6 (8)*	*7.33*	*24*	*Low*
Unprocessed food	UNP	1987	no	(0,1,1)(0,1,1)	0.43	2.65	39.59 (22)	26.86 (22)	0.0	6.96	13	Low
Energy goods	*ENE*	*1987*	*no*	*(0,1,1)(0,1,1)*	*0.94*	*3.38*	*33.33 (22)*	*29.59 (22)*	*2.8 (4)*	*5.76*	*14*	*Low*
Core index	G_S	1992	no	(0,1,1)(0,1,1)	0.46	3.11	20.78 (22)	20.99 (22)	2.4 (2)	3.19	6	High
Services	SER	1992	no	(0,1,1)(0,1,1)	3.39	3.59	25.94 (22)	20.68 (22)	1.2 (1)	1.00	1	High
Non-food, non-energy goods	NFE	1992	no	(0,1,1)(0,1,1)	3.39	3.59	25.94 (22)	20.68 (22)	1.2 (1)	1.00	10	High

Bold characters indicate that the null hypothesis is rejected at the 10% confidence level.

(1) Parameter RSA is set equal to 3 (Gomez and Maravall, 1996); for a description of diagnostic checking included in TRAMO-SEATS, see Planas (1997b). Tests on residuals are from TRAMO. - (2) The starting year of the estimation is in brackets (the last period is always 1998.12). - (3) Bera-Jarque test for normality of residuals; the null hypothesis is that residuals are normal (critical value at the 5% confidence level is equal to 5.99; at the 10% confidence level it is equal to 4.61). - (4) In the case of the normal distribution the value is 3. - (5) Lijung-Box test for serial correlation; the null hypothesis is the absence of serial correlation (critical values: $chi(19)_{0.05}$=30.14; $chi(21)_{0.05}$=32.67; $chi(22)_{0.05}$=33.92; $chi(23)_{0.05}$=35.17; $chi(19)_{0.10}$= 27.20; $chi(21)_{0.10}$=29.62; $chi(22)_{0.10}$= 30.81; $chi(23)_{0.10}$=32.01). The degrees of freedom are in brackets. - (6) Percentage of outliers on the number of observations (the number of outliers is in brackets); 5% per cent is considered the maximum level acceptable. - (7) "Average percentage reduction in RMSE from concurrent adjustment" (i.e. percentage improvement from moving from once-a-year adjustment to concurrent adjustment; approximately, a level lower than 30% indicates that there is no point in having concurrent estimation). - (8) Number of months over the last 2 years in which the estimated seasonal component is not significantly different from zero (10% confidence level). - (9) Judgemental (based on diagnostics included in the table).

Table 5C

THE MAIN DIAGNOSTICS OF TRAMO-SEATS: NETHERLANDS, PORTUGAL, SPAIN AND EURO AREA[1]

Country[2]		Staring Year	Log transf.	ARIMA model	Normality[3]	Kurtosis[4]	A/c residuals[5]	A/c square residuals[5]	Percentage of outliers[6]	RMSE[7]	Significance of the seasonal components[8]	Overall quality of s.a.[9]
Netherlands (1987)	NL											
Overall index	B00	1992	no	(0,1,0)(0,1,1)	0.73	2.88	18.81 (22)	14.35 (22)	0.0	12.90	3	High
Processed food	*PRO*	*1992*	*no*	*(0,1,1)(0,1,1)*	*0.10*	*3.18*	*12.13 (22)*	*11.19 (22)*	*0.0*	*8.30*	*22*	*Low*
Unprocessed food	UNP	1992	no	(0,1,1)(0,1,1,)	1.04	2.87	26.14 (22)	14.87 (22)	1.2 (1)	5.90	11	High
Energy goods	*ENE*	*1992*	*no*	*(0,1,1)(0,1,1)*	*0.50*	*3.36*	*22.98 (22)*	*22.16 (22)*	*8.4 (7)*	*28.33*	*7*	*Low*
Core index	G_S	1993	no	(0,1,1)(0,1,0)	1.38	2.65	22.31 (23)	13.09 (23)	0.0	36.66	1	High
Services	SER	1992	no	(0,1,1)(0,1,1)	1.23	2.54	19.90 (22)	16.33 (22)	2.4 (2)	29.21	2	High
Non-food, non-energy	NFE	1992	no	(0,1,1)(0,1,0)	2.23	3.78	29.45 (23)	20.93 (23)	0.0	36.28	4	High
Portugal (1987)	PO											
Overall index	B00	1992	no	(0,1,1)(0,1,1)	0.24	2.91	14.63 (22)	11.83 (22)	0.0	14.05	18	High
Processed food	*PRO*	*1992*	*no*	*(1,1,0)(0,0,0)*	*7.75*	*3.87*	*34.58 (23)*	*16.34 (23)*	*1.2 (1)*	-	-	-
Unprocessed food	UNP	1992	no	(0,1,0)(0,1,1)	2.24	3.30	22.96 (23)	25.85 (23)	0.0	4.08	14	High
Energy goods	*ENE*	*1992*	*no*	*(0,1,1)(0,1,1)*	*15.08*	*4.54*	*26.37 (22)*	*36.83 (22)*	*6.0 (5)*	*0.98*	*13*	*Low*
Core index	G_S	1992	no	(0,1,1)(0,1,1)	1.56	3.72	20.95 (22)	27.15 (22)	0.0	25.63	13	High
Services	SER	1992	no	(0,1,1)(0,1,1)	2.86	3.64	20.31 (22)	18.50 (22)	3.6 (3)	23.84	6	High
Non-food, non-energy	NFE	1992	yes	(0,1,1)(0,1,1)	32.36	6.28	22.23 (22)	18.11 (22)	10.8 (9)	32.04	10	Low
Spain (1992)	SP											
Overall index	B00	1992	no	(0,1,1)(0,1,1)	1.74	3.34	22.27 (22)	17.28 (22)	0.0	18.61	19	High
Processed food	*PRO*	*1992*	*yes*	*(0,1,1)(0,1,1)*	*3.88*	*3.78*	*25.84 (22)*	*31.14 (22)*	*3.6 (3)*	*27.84*	*12*	*High*
Unprocessed food	UNP	1992	no	(0,1,1)(0,1,1)	2.43	3.09	15.10 (22)	17.72 (22)	0.0	2.68	10	High
Energy goods	*ENE*	*1992*	*yes*	*(0,1,1)(0,1,1)*	*0.33*	*3.28*	*18.05 (22)*	*43.87 (22)*	*2.4 (2)*	*24.05*	*19*	*Low*
Core index	G_S	1992	no	(0,1,0)(0,1,1)	0.32	2.78	22.10 (23)	22.31 (23)	0.0	15.78	13	High
Services	SER	1992	yes	(0,1,1)(0,1,1)	1.26	3.13	13.60 (22)	12.08 (22)	1.2 (1)	27.56	8	High
Non-food, non-energy	NFE	1992	no	(0,2,1)(0,1,1)	0.65	2.75	25.74 (22)	17.08 (22)	2.4 (2)	6.45	16	High
Euro area (1992)	E9											
Overall index	B00	1992	no	(0,1,1)(0,1,1)	1.43	2.30	25.49 (22)	27.90 (22)	1.2 (1)	3.77	2	High
Processed food	*PRO*	*1992*	*no*	*(0,1,1)(0,1,1)*	*0.40*	*3.31*	*23.18 (22)*	*21.73 (22)*	*1.2 (1)*	*4.10*	*5*	*High*
Unprocessed food	UNP	1992	no	(0,1,1)(0,1,1)	3.28	3.00	26.13 (22)	15.21 (22)	1.2 (1)	10.17	4	High
Energy goods	*ENE*	*1992*	*no*	*(0,1,1)(0,1,1)*	*3.13*	*3.19*	*37.62 (22)*	*25.02 (22)*	*2.4 (2)*	*10.00*	*23*	*Low*
Core index	G_S	1992	no	(0,1,1)(0,1,1)	1.20	2.54	27.11 (22)	29.74 (22)	0.0	20.87	7	High
Services	SER	1992	no	(0,1,1)(0,1,1)	1.75	2.51	20.54 (22)	20.33 (22)	1.2 (1)	20.46	5	High
Non-food, non-energy	NFE	1992	no	(2,1,2)(0,1,1)	0.32	3.09	34.58 (19)	17.78 (19)	0.0	17.63	13	High

Bold characters indicate that the null hypothesis is rejected at the 10% confidence level.

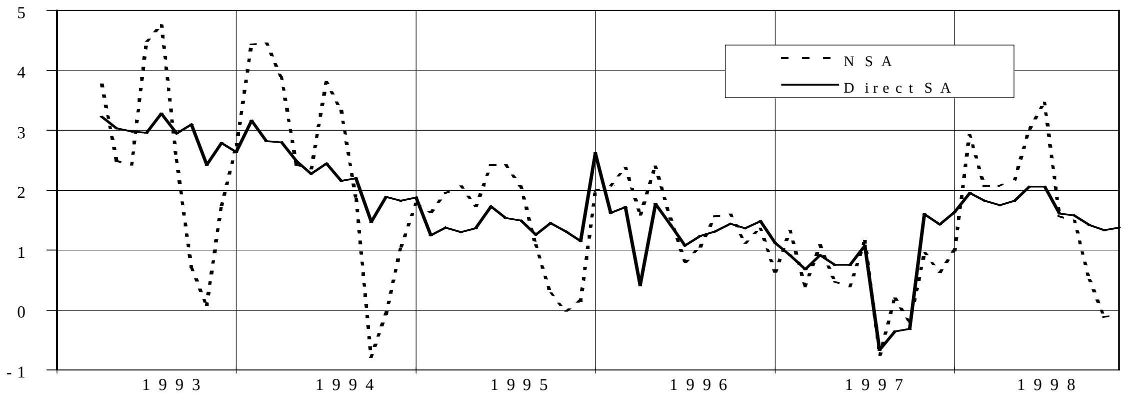
(1) Parameter RSA is set equal to 3 (Gomez and Maravall, 1996); for a description of diagnostic checking included in TRAMO-SEATS, see Planas (1997b). Tests on residuals are from TRAMO. - (2) The starting year of the estimation is in brackets (the last period is always 1998.12). - (3) Bera-Jarque test for normality of residuals; the null hypothesis is that residuals are normal (critical value at the 5% confidence level is equal to 5.99; at the 10% confidence level it is equal to 4.61). - (4) In the case of the normal distribution the value is 3. - (5) Lijung-Box test for serial correlation; the null hypothesis is the absence of serial correlation (critical values: $chi(19)_{0.05}$=30.14; $chi(21)_{0.05}$=32.67; $chi(22)_{0.05}$=33.92; $chi(23)_{0.05}$=35.17; $chi(19)_{0.10}$= 27.20; $chi(21)_{0.10}$=29.62; $chi(22)_{0.10}$= 30.81; $chi(23)_{0.10}$=32.01). The degrees of freedom are in brackets. - (6) Percentage of outliers on the number of observations (the number of outliers is in brackets); 5% per cent is considered the maximum level acceptable. - (7) "Average percentage reduction in RMSE from concurrent adjustment" (i.e. percentage improvement from moving from once-a-year adjustment to concurrent adjustment; approximately, a level lower than 30% indicates that there is no point in having concurrent estimation). - (8) Number of months over the last 2 years in which the estimated seasonal component is not significantly different from zero (10% confidence level). - (9) Judgemental (based on diagnostics included in the table).

Figure 1A

COMPARISON BETWEEN THE NSA AND THE SA SERIES ("DIRECT" METHOD) FOR THE <u>CORE INDEX</u>
(3-month percentage changes, annualised)

Austria

Belgium



Finland

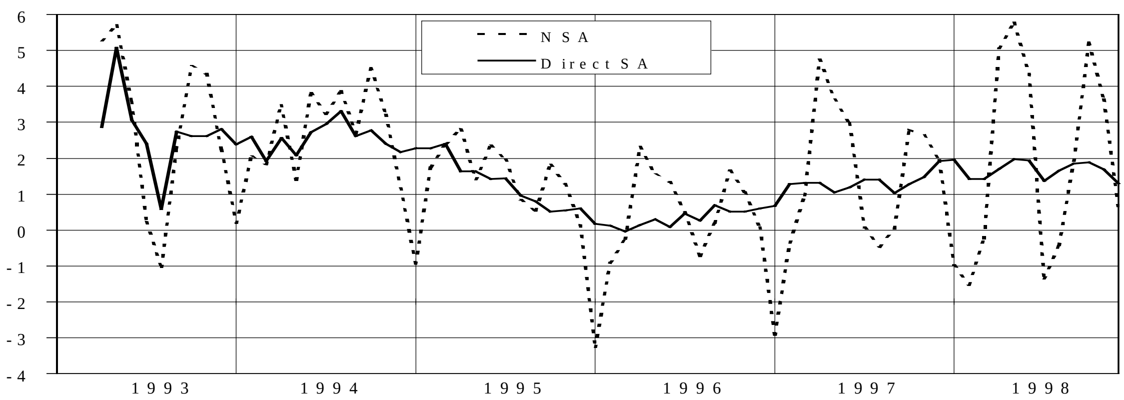
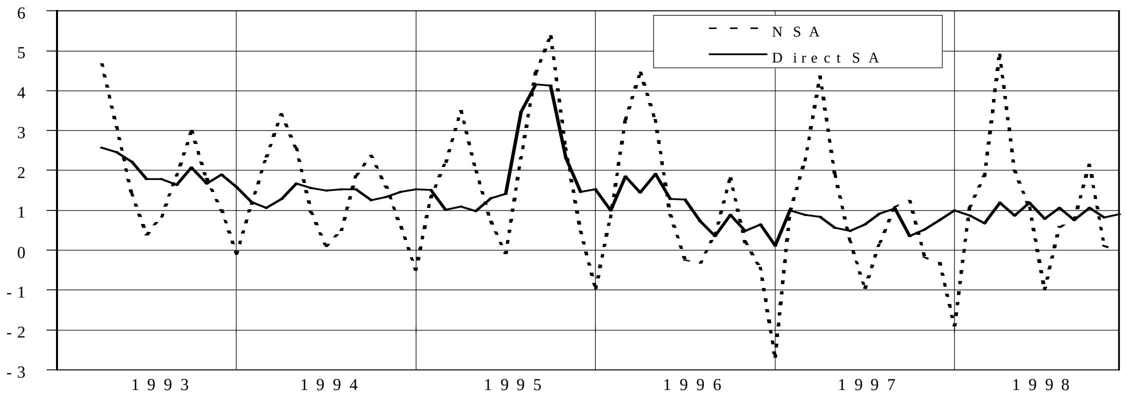


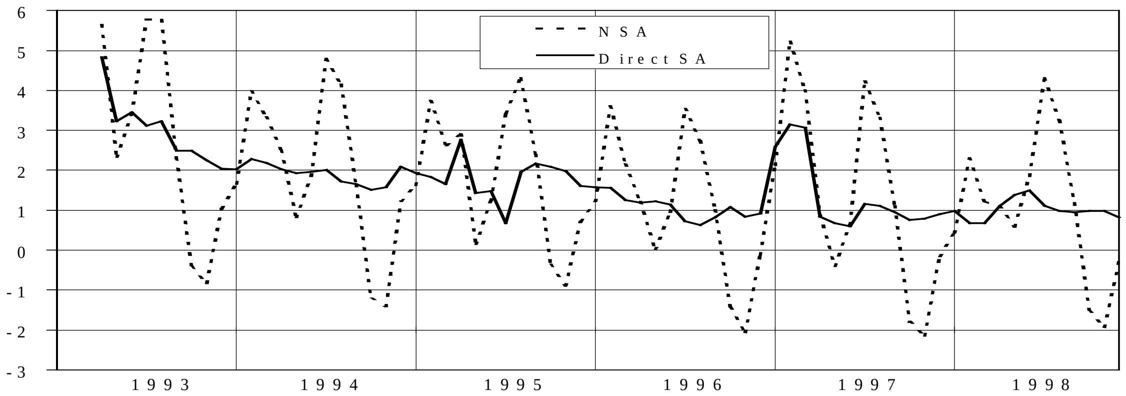
Figure 1B

COMPARISON BETWEEN THE NSA AND THE SA SERIES ("DIRECT" METHOD) FOR THE <u>CORE INDEX</u>
(3-month percentage changes, annualised)

France



Germany



Italy

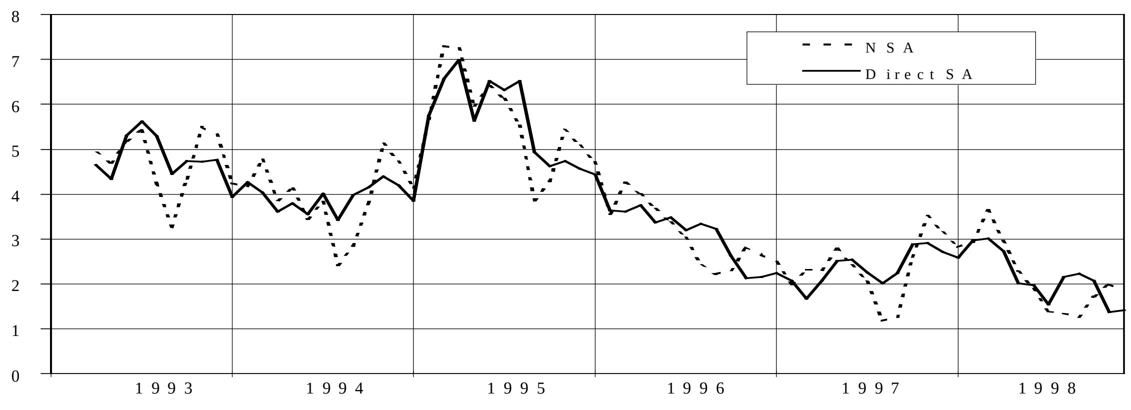
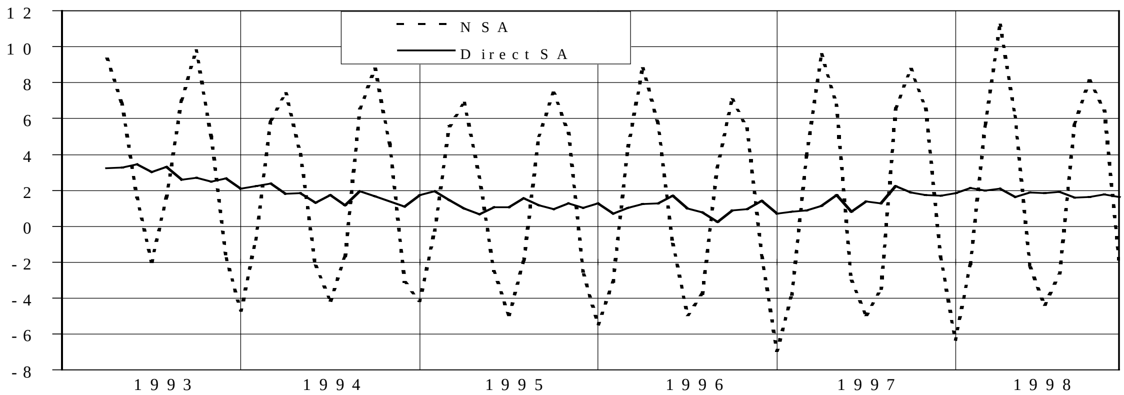


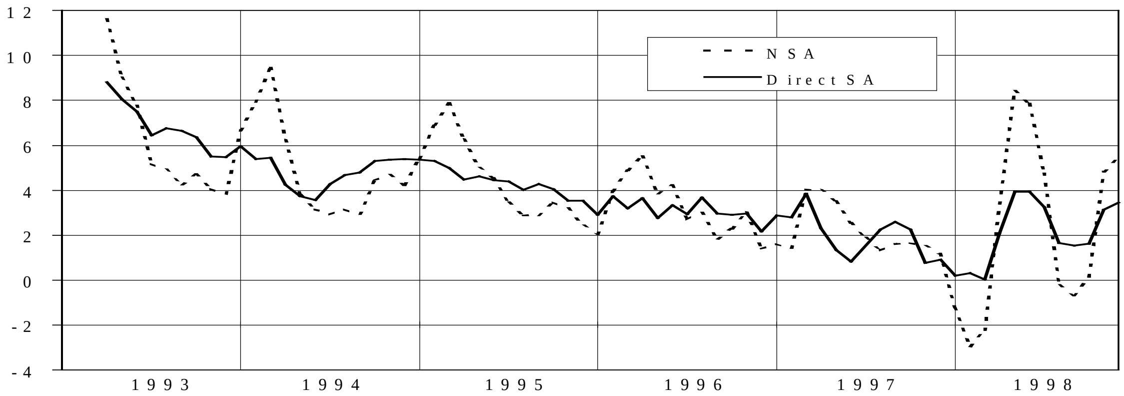
Figure 1C

COMPARISON BETWEEN THE NSA AND THE SA SERIES ("DIRECT" METHOD) FOR THE CORE INDEX
(3-month percentage changes, annualised)

The Netherlands



Portugal



Spain

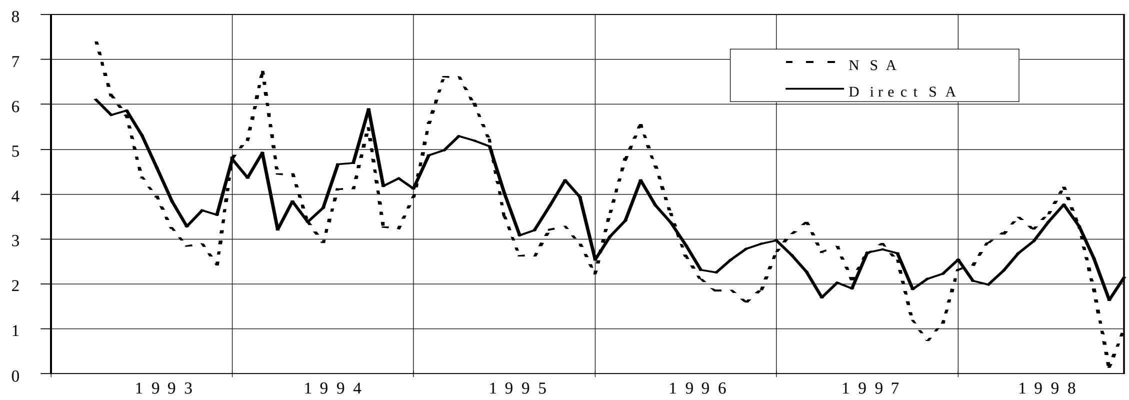
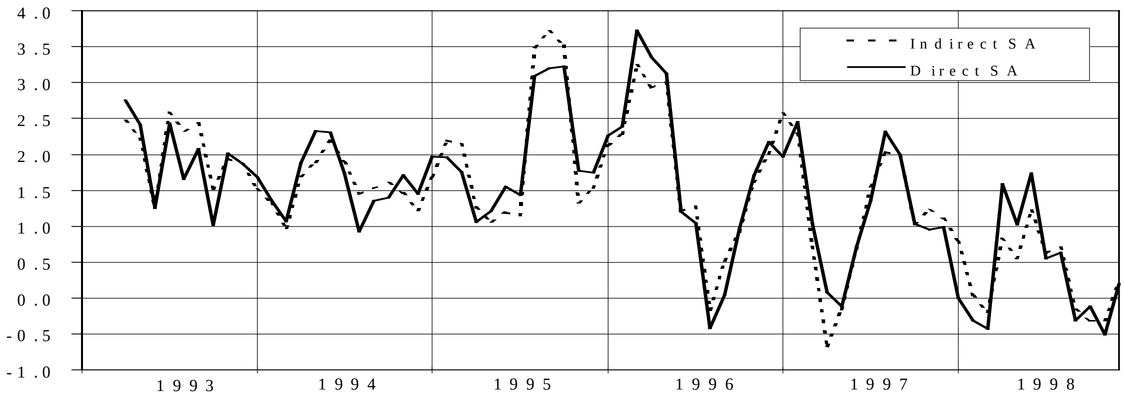


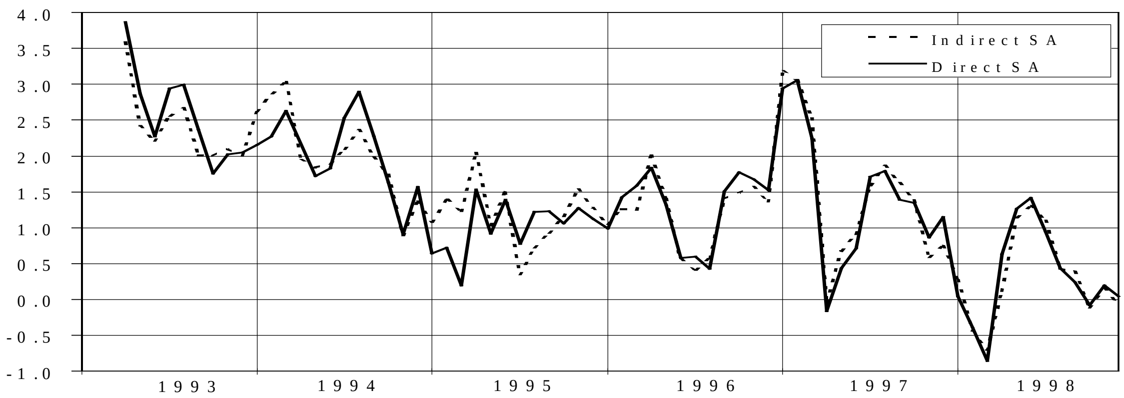
Figure 2

COMPARISON BETWEEN DIRECT AND INDIRECT SA SERIES FOR THE OVERALL INDEX
(3-month percentage changes, annualised)

France



Germany



Italy

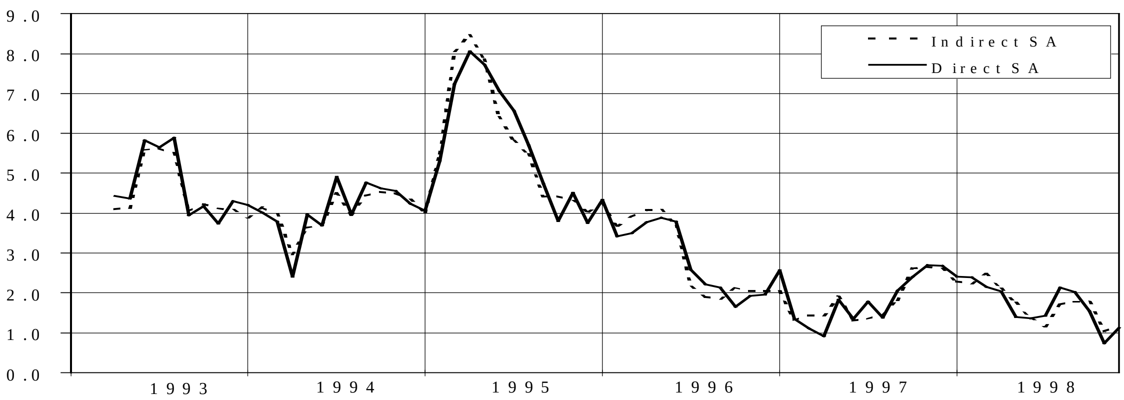
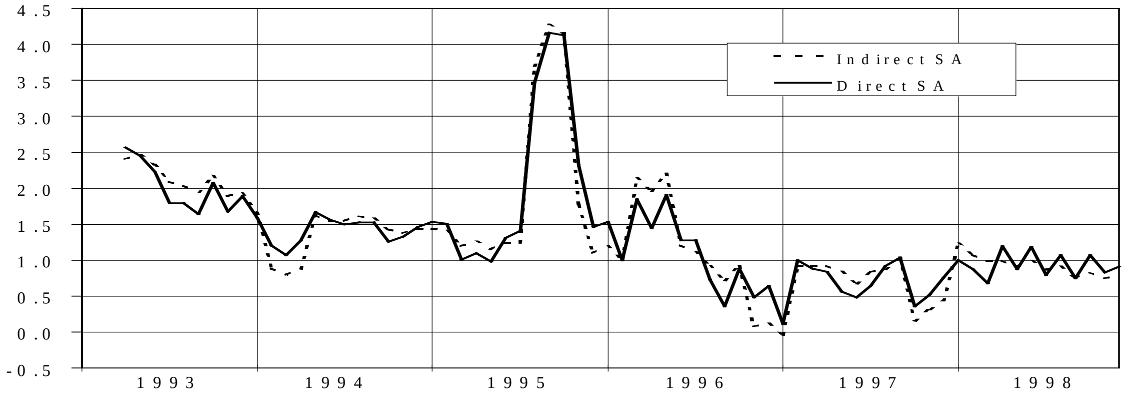


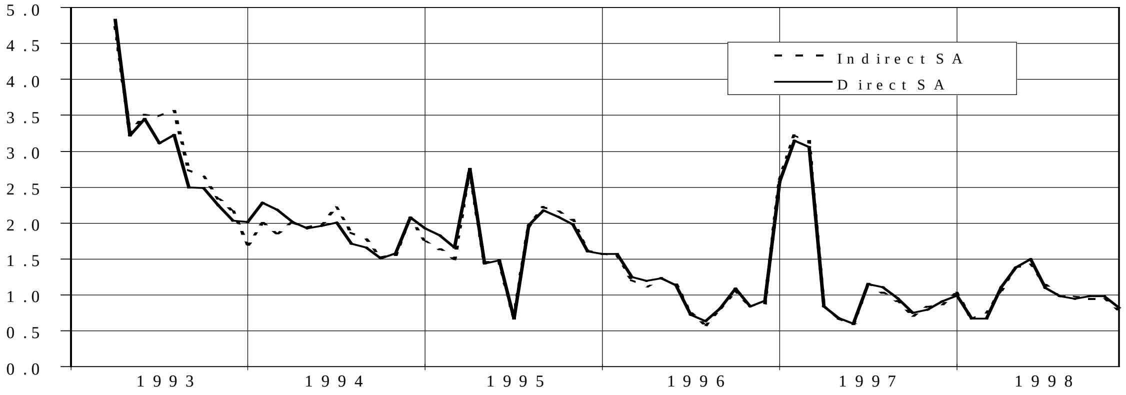
Figure 3

COMPARISON BETWEEN DIRECT AND INDIRECT SA SERIES FOR THE CORE INDEX
(3-month percentage changes, annualised)

France



Germany



Italy

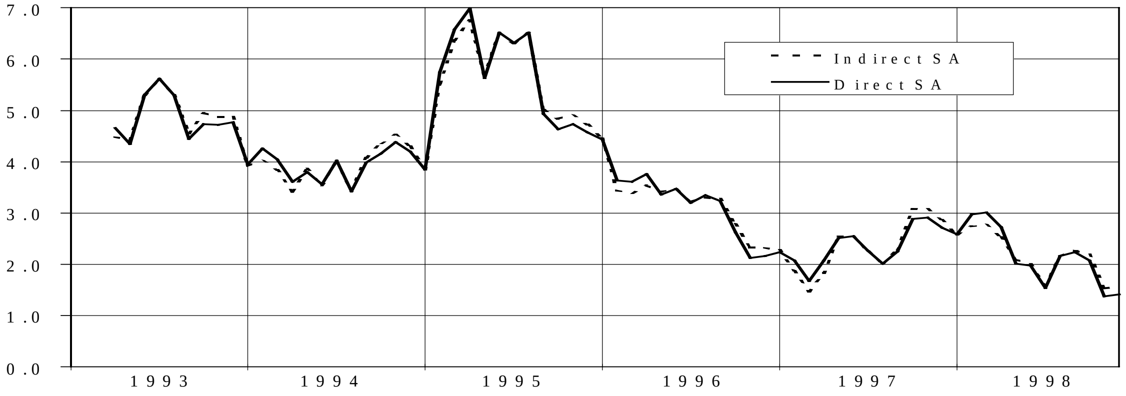
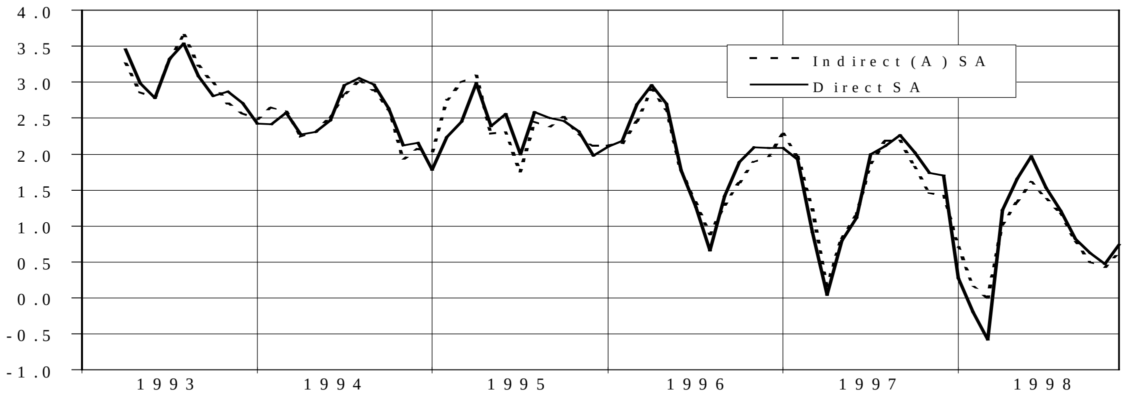


Figure 4A

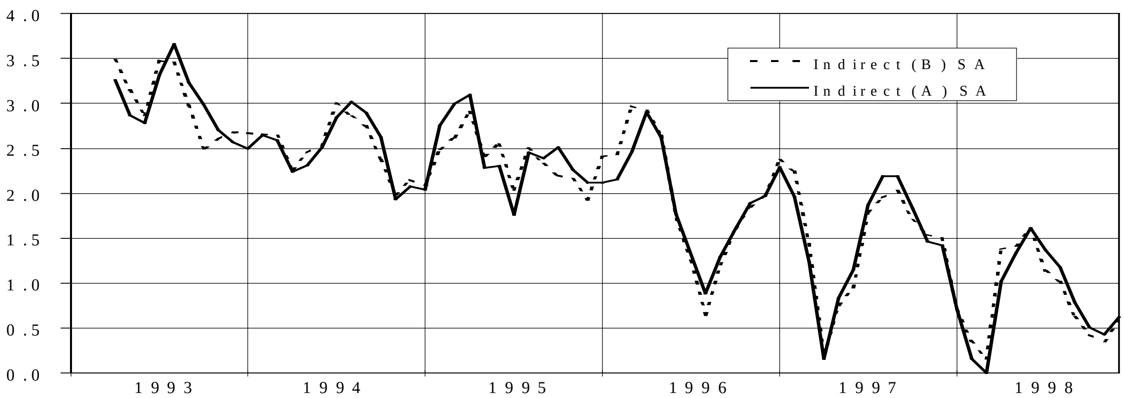
COMPARISON BETWEEN DIRECT AND INDIRECT SA SERIES FOR THE EURO AREA
(3-month percentage changes, annualised)

Overall index

Direct and Indirect A [(1)]



Indirect A and Indirect B[(2)]



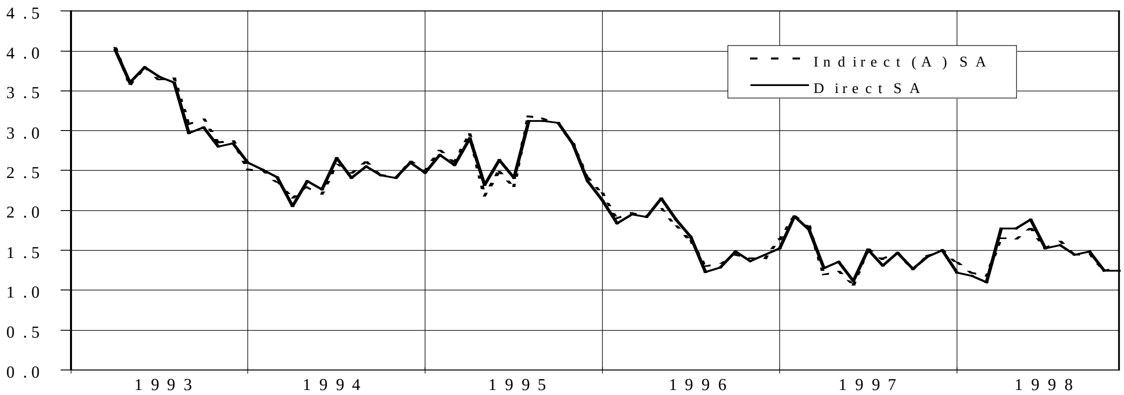
(1) "Indirect A" refers to the E9 SA overall index obtained by aggregating the E9 SA price indices for non-food and non-energy goods and for services. - (2) "Indirect B" refers to the E9 SA overall index obtained by aggregating the corresponding SA indices for each country.

Figure 4B

COMPARISON BETWEEN DIRECT AND INDIRECT SA SERIES FOR THE EURO AREA
(3-month percentage changes, annualised)

"Core" index

Direct and Indirect A[(1)]



Indirect A and Indirect B [(2)]

(1) "Indirect A" refers to the E9 SA core index obtained by aggregating the E9 SA price indices for non-food and non-energy goods and for services. - (2) "Indirect B" refers to the E9 SA core index obtained by aggregating the corresponding SA indices for each country.

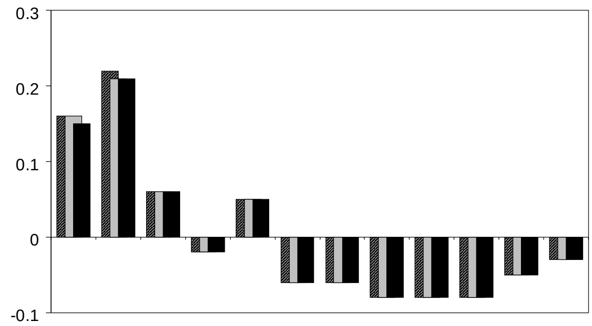
Figure 5A

COMPARISON BETWEEN THE SEASONAL COMPONENT ESTIMATED WITH THE DIRECT AND THE INDIRECT METHODS(1)

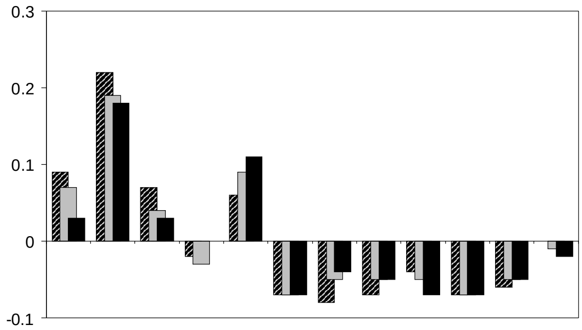
Overall index

Regularity of seasonal coefficients obtained with the three alternative methods(2)
(years: 1996-1998)

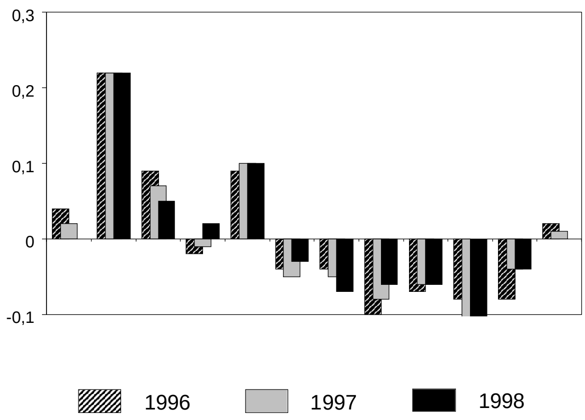
Direct



Indirect A

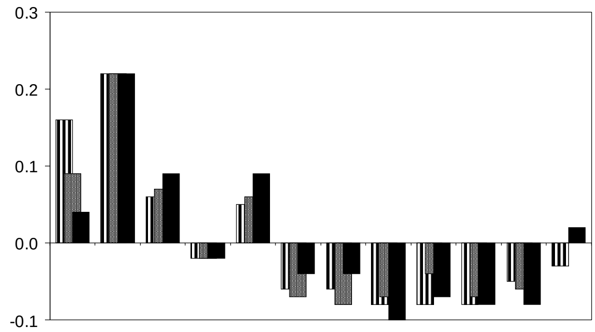


Indirect B

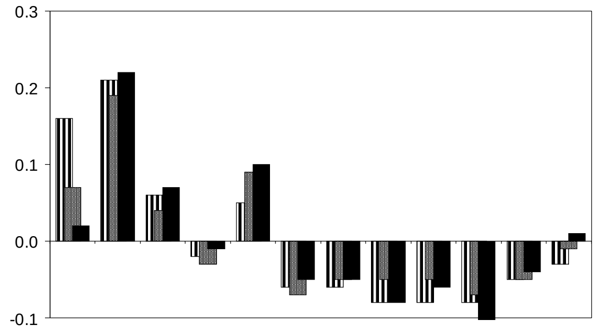


Comparison between the seasonal coefficients obtained with the three alternative methods(2)
(years: 1996-1998)

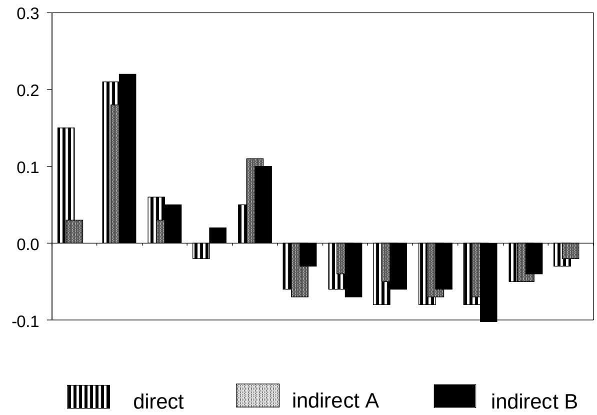
1996



1997



1998



(1) The "Indirect B" E9 SA overall index is obtained by aggregating the E9 sub-indices, SA separately; the "Indirect B" E9 SA overall index is obtained by aggregating the corresponding national SA overall indices. - (2) The seasonal coefficients are obtained by subtracting the one month percentage variation in the seasonally adjusted series from the corresponding variation in the raw series.

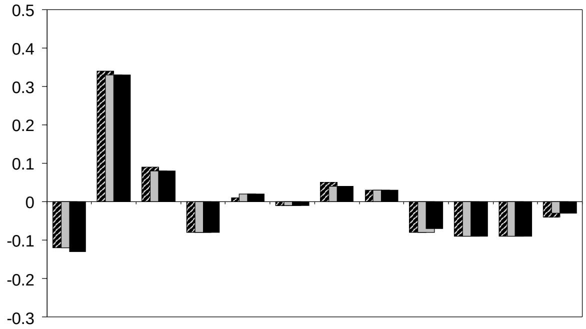
Figure 5B

COMPARISON BETWEEN THE SEASONAL COMPONENT ESTIMATED WITH THE DIRECT AND THE INDIRECT METHODS(1)

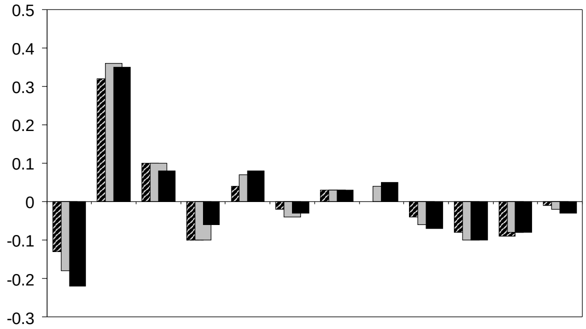
Core index

Regularity of seasonal coefficients obtained with the two alternative methods(2)
(years: 1996-1998)

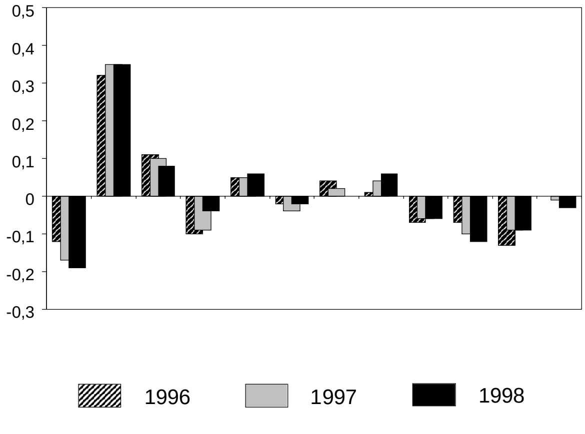
Direct



Indirect A

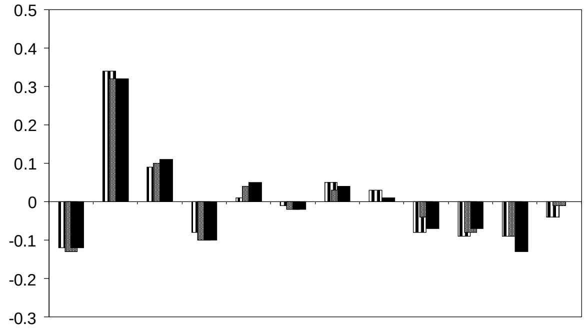


Indirect B

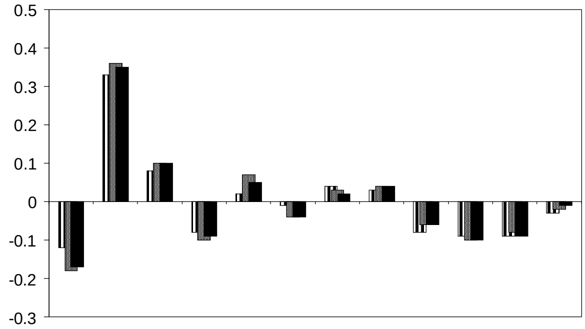


Comparison between the seasonal coefficients obtained with the two alternative methods(2)
(years: 1996-1998)

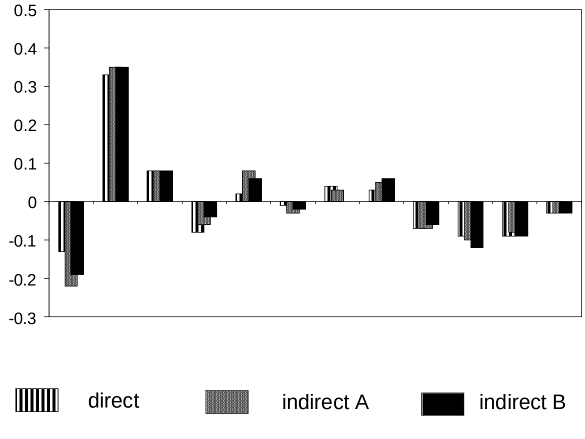
1996



1997



1998

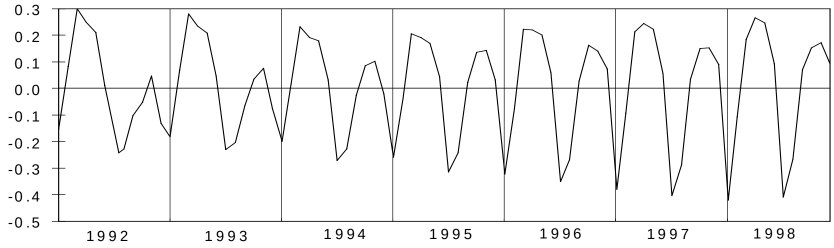


(1) The "Indirect B" E9 SA overall index is obtained by aggregating the E9 sub-indices, SA separately; the "Indirect B" E9 SA overall index is obtained by aggregating the corresponding national SA overall indices. - (2) The seasonal coefficients are obtained by subtracting the one month percentage variation in the seasonally adjusted series from the corresponding variation in the raw series.

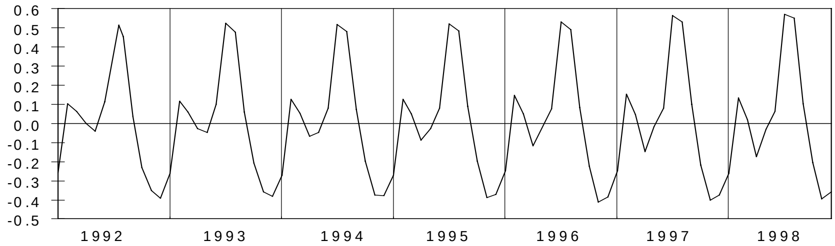
Figure 6

ESTIMATED SEASONAL COMPONENT OF THE E9 SUBINDICES

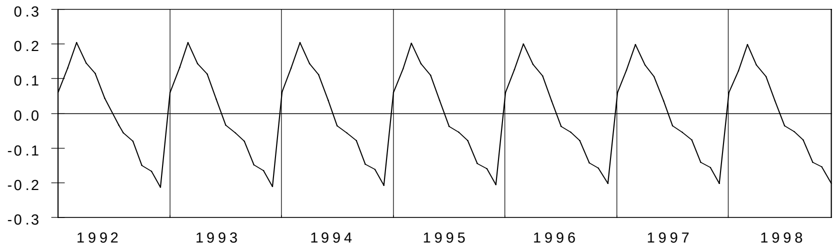
Non-food and non-energy goods



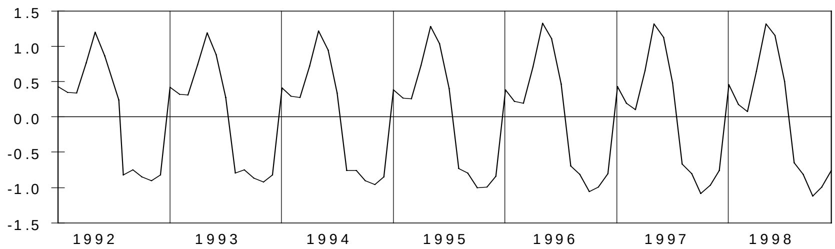
Services



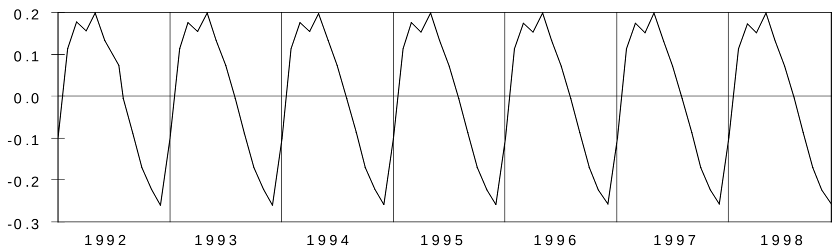
Processed food



Unprocessed food



Overall (1)

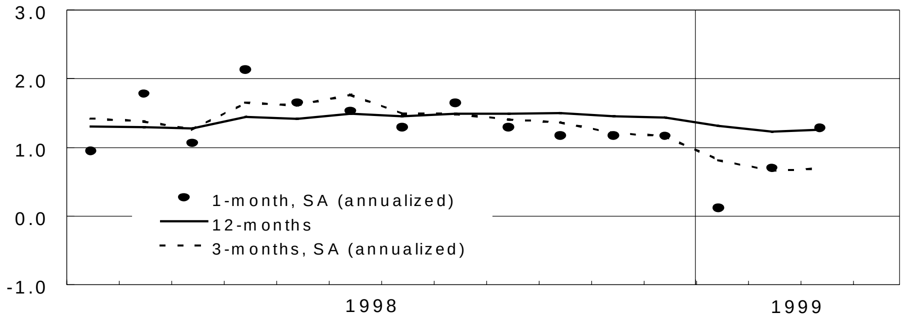


(1) Direct seasonal adjustment.

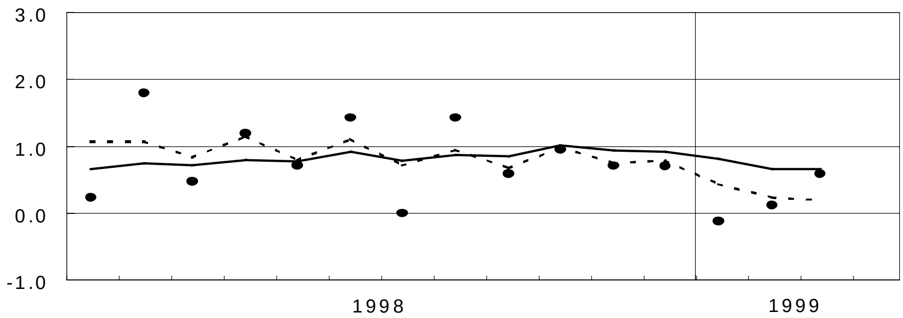
Figure 7

CORE INFLATION IN THE EURO AREA
(percentage changes)

Euro



France



Germany

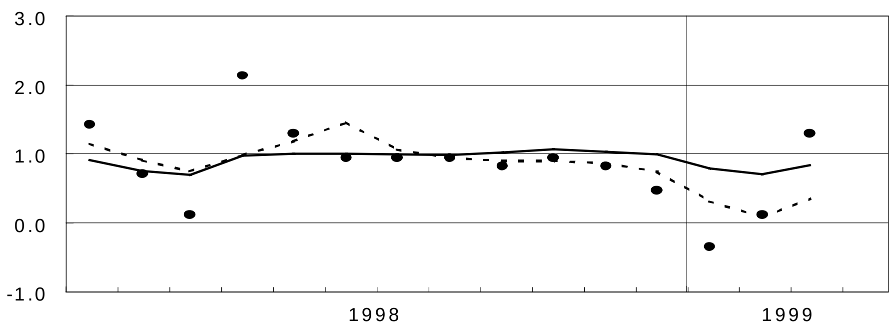
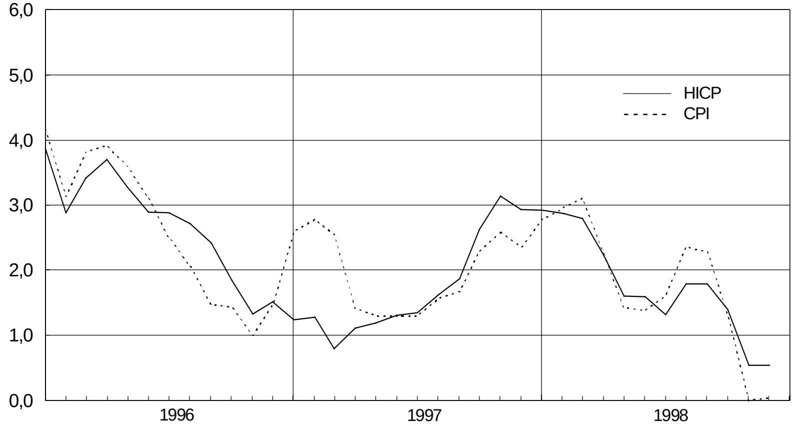


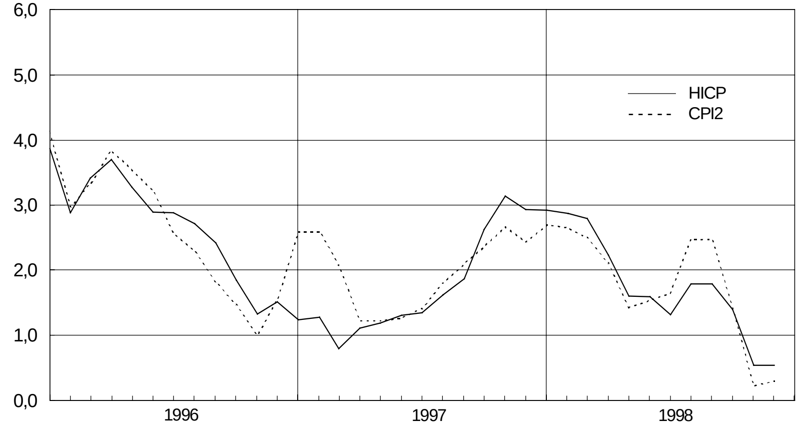
Figure A1

ITALY - NON-FOOD AND NON-ENERGY GOODS
Comparison between the HICP and the CPI
(3-months changes)

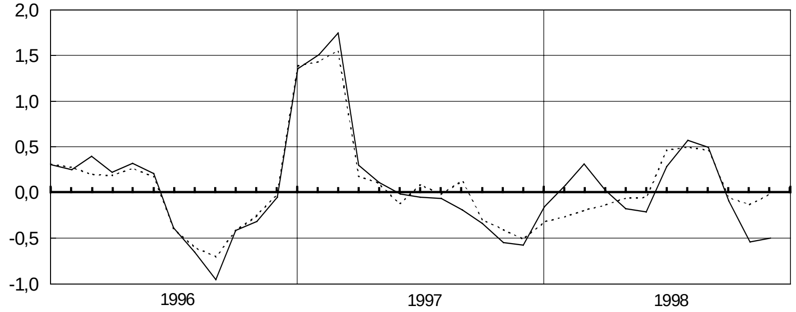
A1) CPI non-food non-energy goods are seasonally adjusted by distinguishing prices subject to official controls from the others



B1) CPI non-food non-energy goods are seasonal ly adjusted starting from the overall series



A2) Differences between the SA series of HICP and CPI (continuous line) and the raw series of HICP and CPI (dotted line)

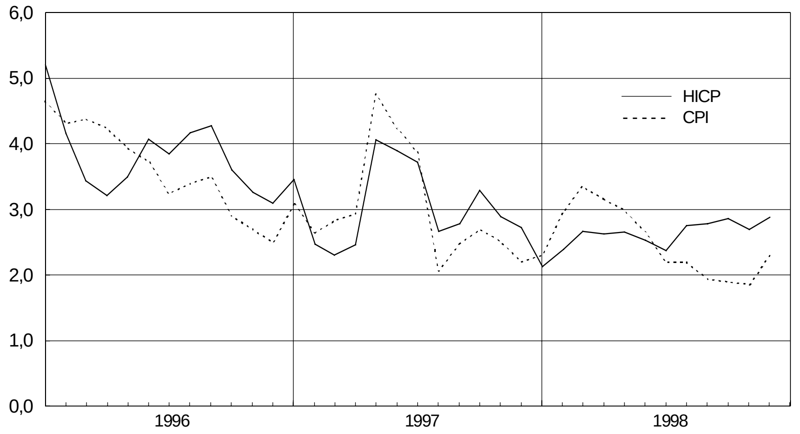


B2) Differences between the SA series of HICP and CPI (continuous line) and the raw series of HICP and CPI (dotted line)

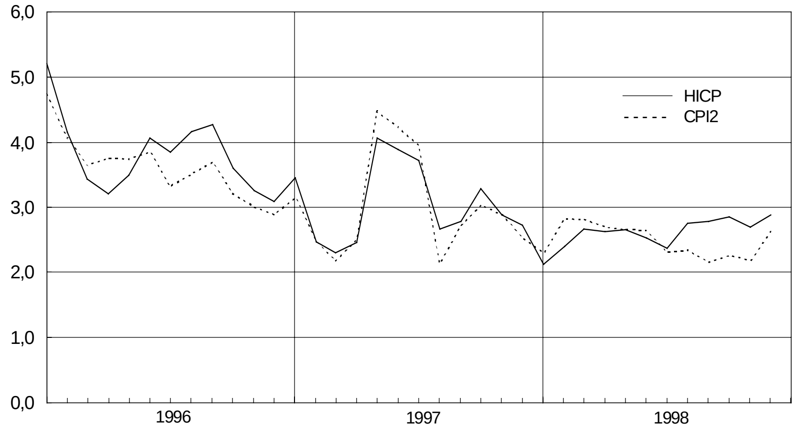
Figure A2

ITALY - SERVICES
Comparison between the HICP and the CPI
(3-months changes)

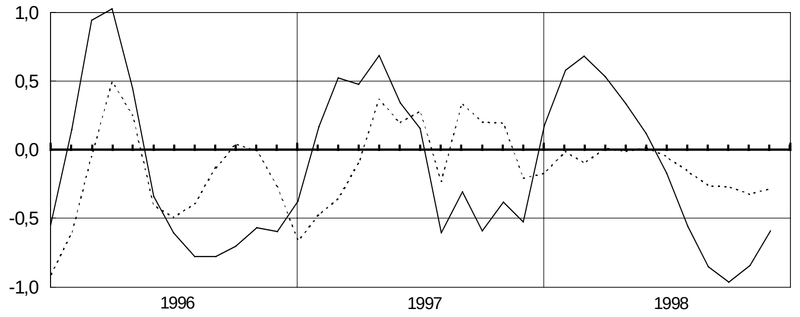
A1) CPI services are seasonally adjusted by distinguishing prices subject to official controls from the others



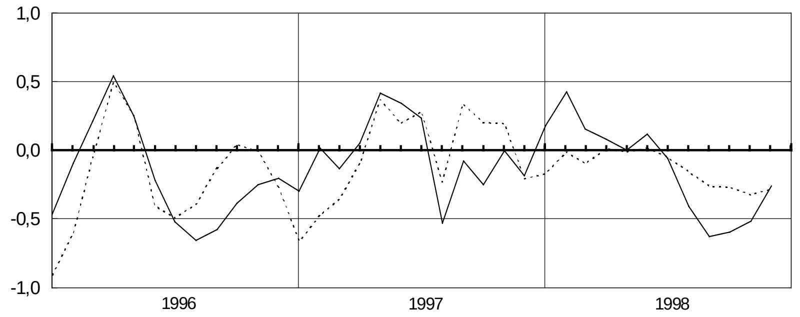
B1) CPI services are seasonally adjusted starting from the overall series



A2) Differences between the SA series of HICP and CPI (continuous line) and the raw series of HICP and CPI (dotted line)

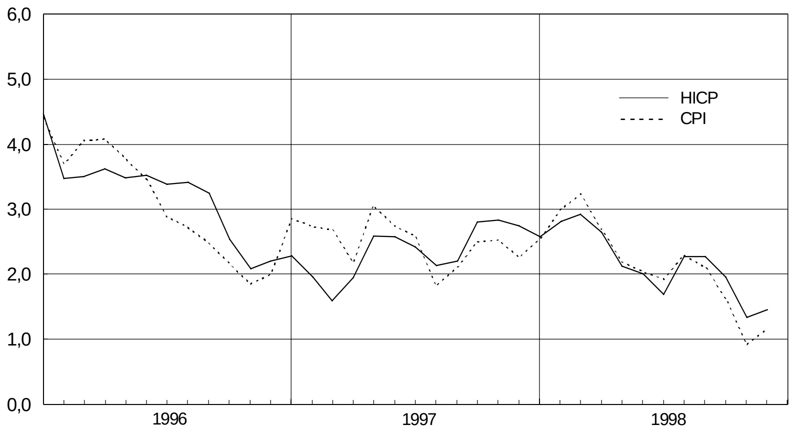


B2) Differences between the SA series of HICP and CPI (continuous line) and the raw series of HICP and CPI (dotted line)

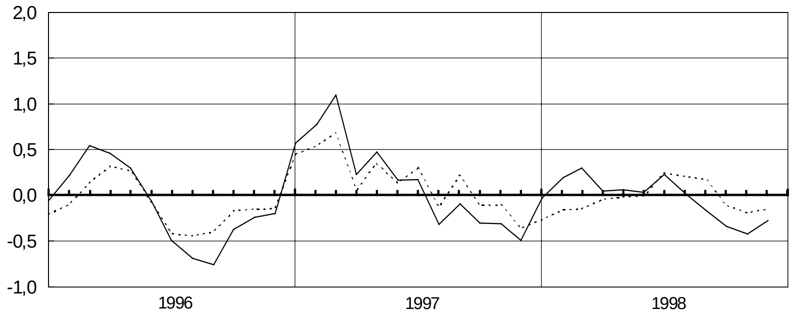


ITALY - CORE INDEX
Comparison between the HICP and the CPI
(3-months changes)

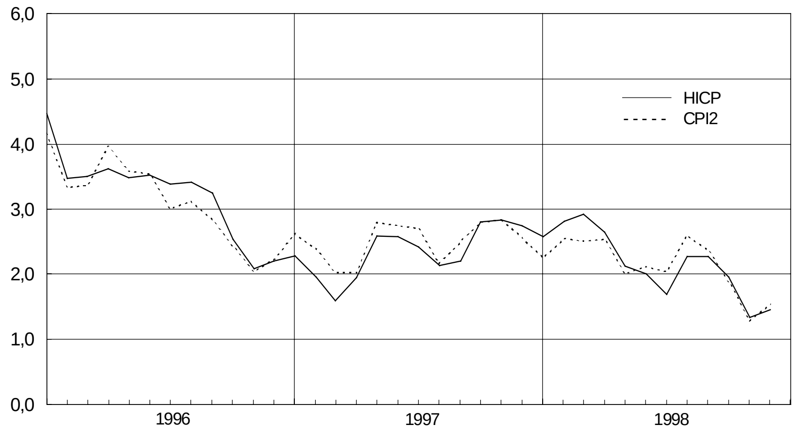
A1) CPI non-food non-energy items are seasonal ly adjusted distinguishing prices subject to official controls from the others



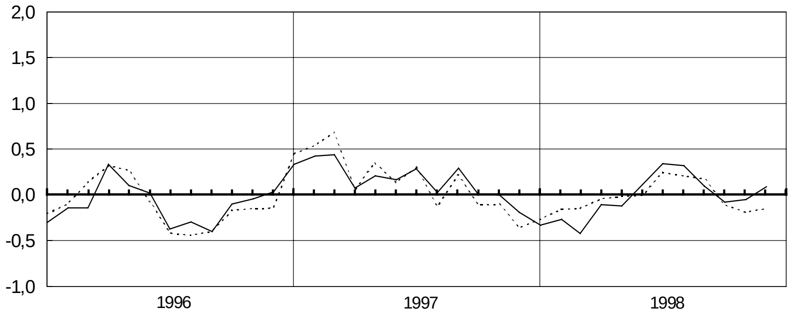
A2) Differences between the SA series of HICP and CPI (continuous line) and the raw series of HICP and CPI (dotted line)



B1) CPI non-food non-energy items are seasonally adjusted starting from the overall series



B2) Differences between the SA series of HICP and CPI (continuous line) and the raw series of HICP and CPI (dotted line)



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