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Business cycle extraction of Euro-zone GDP: direct versus indirect approach

1

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INDEX

Business cycle extraction of Euro-zone GDP: direct versus indirect approach.

by

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1 Introduction

The analysis of cyclical behaviour of the main macro-economic variables is one of the major topics in the field of short-term analysis. A correct identification of relevant cycles allows the identification of turning points and also, in a multivariate framework (leading indicators) to anticipate and forecast them. In the last three years there was an increasing interest in those types of analysis applied to a new economic subject such as the Euro-zone. Many different studies have recently been published on this issue (see Marcellino Stock Watson 2000 Artis et al. 1999) essentially oriented to synthesise the information coming from a large number of variables by means of statistical techniques such as Dynamic Factor Analysis of Dynamic Principal components. On the other side, the NIESR in co-operation with Eurostat investigated the issue of cyclical synchronisation between the Euro-zone and its components (see Blake et al. 2000).

One open point of discussion, which is more or less implicitly presented in many of the paper mentioned above (see in particular Marcellino et al. 2000), is whether it is more useful to consider the Euro-zone as whole or to proceed with country by country estimates. In other words the dilemma is between aggregating analyses made separately for each Member State (indirect approach) of the Euro-zone or to work directly on Euro-zone aggregated data (direct approach). This can be viewed as a geographical extension of the well-known problem of the choice between performing statistical filtering at aggregated or desegregated levels. We can start from the consideration that there is no definitive theoretical assessment in favour of one of them. Decisions can be taken on the basis of empirical evidences as well as from time-consuming practices. In this paper we address the problem of comparing the two main approaches mentioned above in order to define good strategies of estimation of business cycle for the Euro-zone. It is generally recognised that short-term analysts prefer to work with seasonal adjusted data so as to eliminate all infra-annual fluctuations, which could prejudice a correct identification of the turning points. For this reason we try to put together two different aspects of time series decompositions which have generally been treated as separated issues: seasonal adjustment and business cycle extraction.

Our strategy is the following:

- We perform seasonal adjustment and we compare the relative performance of direct and indirect approach with the help of on a number of statistical criteria.
- To the derived seasonal adjusted figures of the previous step we apply a linear filter as proposed by Baxter and King to extract the business cycle.
- Compare direct and indirect estimated cycles essentially in a graphical way.

Our analysis is based on GDP figures in volume from 1985Q1 to 2000Q3.

The paper is organised as follows: in section 2 we briefly discuss the issue of direct and indirect seasonal adjustment. In section 3 we examine alternative methods for business cycle extraction. In Section 4 we present our empirical analysis. Section 5 concludes.

2 Seasonal adjustment: direct versus indirect.

Currently Eurostat estimates of Quarterly GDP are based on seasonally adjusted data as produced by Member States. As it is well known, methods and strategies of seasonal adjustment adopted at national level differ significantly. Therefore the Eurostat estimates can be considered as spurious ones, which merge working day and non-working date adjusted data, as well as data obtained using X11, X12 or Tramo Seats. Because of this, our first step concerns the production of more homogeneous and consistent seasonal adjusted figures for Euro-zone GDP. In this perspective, two alternative strategies can be taken into account:

(i) "*direct approach*": the seasonal adjustment procedure is applied directly to the aggregated series;

(ii) "*indirect approach*": the seasonal adjustment procedure is first applied to the raw sub-series, which are then aggregated.

Unless specific conditions are fulfilled (see Campolongo and Planas 2000), the results provided by the above two approaches differ. In a simplified way, we can say that if neither pre-treatment nor forecast is performed, the direct and indirect approaches give the same results when an additive decomposition model is chosen.

If the performance of direct and indirect approaches have to be compared, both methods should exhibit some desirable features such as smoothness, stability of the outcome, etc. Anyway, it should also be kept in mind that the different criteria could influence each other in such a way that if one criterion improves, another could become worse: for example, there is a trade-off between stability and ability to detect turning points.

In order to assess the performance of direct and indirect methods, various criteria were proposed in literature. Among the others, we found of particular interest the papers form Dagum (1979), Lothian

and Morry (1977), Ghysels (1997) Findley et al. (1998) den Butter and Fase (1991), Planas and Campolongo (2000) Gómez (2000) Otranto and Triaccia (2000) Cristadoro R. Sabbatini R. (2000).
On the basis of these works, we choose some empirical criteria to assess the performance of both approaches, namely:

2.1 Graphical comparison

As a preliminary comparison between direct and indirect seasonal estimations, a graphical inspection can be carried out in order to verify whether the two methods exhibit a similar detection of turning points.

2.2 Analysis of sign concordance

Growth rate signs of the two series can be compared for the whole sample. A measure of the concordance could be given by the ratio of growth rate values with the same sign in the same period on the total of observation minus one.

2.3 Smoothness comparison

Dagum (1979) proposed two measures of roughness of the seasonally adjusted aggregates. The first one is the L_2-norm of the differenced series: $R_1=\Sigma^{T}_{t=2}(A_t-A_{t-1})^2=\Sigma^{T}_{t=2}(\Delta A_t)^2$. The second one is based on the 13-term Henderson filter: the adjusted series is smoothed with the Henderson filter and R_2 is defined as the L_2-norm of the residuals: $R_2=\Sigma^{T}_{t=1}(A_t - H_{13}A_t)^2=\Sigma^{T}_{t=1}[(I_t - H_{13})At]^2$. The rationale of these measures of roughness is that the involved filters (the first difference operator and $I - H_{13}$) are high-pass filters that re-move most of the low frequencies components that correspond to the trend-cycle variations. In other words, these statistics measure the size of the deviations to a smooth trend, e.g. the size of an “irregular component”. This is why Pfefferman *et al*.(1984) suggested a “natural” third measure, a measure of similarity between seasonally adjusted data and trend: $R_3 =\Sigma^{T}_{t=1}(A_t-TC_t)^2$.

2.4 Statistical tests of randomness and absence of residual seasonality in irregular components

The autocorrelation function and partial autocorrelation function can be computed in order to verify the absence of seasonality in the residual component. Modified Ljung-Box test can be used to verify the absence of significant correlation at seasonal lags. It is also important to test the absence of any systematic component in the autocorrelation function of the residual, which could be represented by a significant first order autocorrelation. The von Neumann test can be used to verify the hypothesis of non-significance of the first order autocorrelation. More generally, the randomness of the irregular component must be tested. A global Ljung Box test can be used to verify this hypothesis.

2.5 Quality of seasonal adjustment

The quality assessment is performed according to eleven well-defined measures implemented in X-12 regArima, which can be easily generalised to other methods. Those measures are purely descriptive and based on empirical criteria for a more detailed description of these criteria see Kenvill Ladiray (2000).

2.6 Historical analysis of revisions

This criterion is used in X-12-ARIMA, where a set of empirical measures of revisions, such as sliding spans and revision history diagnostics are derived for the two alternatives. In general, the preferred alternative is that which produces a more stable seasonally adjusted series in terms of revisions. The set of measures on which the choice is based is descriptive (average absolute percentage of revisions, month-to-month percentage changes, etc.). Planas and Campolongo (2000) have developed a similar rule –however, this is based on typical inference testing tools of the model-based approach. They suggest the minimisation of total revision errors as a criterion. Within the model-based approach, the distribution of the revision errors can be specified in analytical form, directly derived from the ARIMA model used for signal extraction, and inference on them is possible.

In this paper we do not consider the issue of the choice of the seasonal adjustment methods to be used. We simply decided to use X-12 regArima, particularly since it allows us to obtain, without any external intervention, a full satisfactory comparison between the direct and indirect approach.

In our specific context, seasonal adjusted data are produced essentially to be an input for further statistical analysis in the field of business cycle extraction. In the empirical analysis presented in section 4, we will pay particular attention to some features such as smoothness and invariance of turning points, whereas other aspects such as stability of the outcome will be considered as additional suitable characteristics.

3 Business cycle extraction

Once seasonal adjustment has been performed, the next step consists of the identification and extraction of the business cycle. Before analysing in detail this problem, a general consideration can be put forward: in section 1 it has been explained that business cycle analysts typically prefer to work on seasonally adjusted data because they are characterised by a more regular behaviour which describes the short term movements of the economy. Nevertheless, some methods for extracting business cycle can be applied to seasonally adjusted as well as to raw data. From a purely theoretical point of view, the two approaches should be equivalent. In reality, due to the shortness of our sample series and because seasonal data are quite often too erratic or noised, to apply the same filter to raw data and to seasonal adjusted ones does not produce the same results. This issue will be presented in section 4 where the cyclical component extracted from unadjusted data will be used to discriminate between the two alternative estimates based respectively on direct and indirect approach starting from seasonal adjusted data.

When facing this issue, different cycle extraction methods can be found in the literature available. Among the others, the most frequently used techniques are the Baxter and King filter, Hodrick Prescott filter, First difference filter and Henderson.

3.1 First difference filter

This method is clearly the easiest to use. It is essentially a de-trending method that only indirectly shows a cycle without any reduction of the original noise. Consequently, it gives a very raw approximation of cyclical fluctuation. It is well known that when the data are nearly integrated, it can produce an over de-trending at zero frequency with some bias of the cyclical estimation. In addition, if the data are stationary, the use of differentiation can produce spurious fluctuations, which could mislead users.

3.2 Henderson filter

This filter has been proposed to obtain an estimation of both trend and cycle components. It is an integral part of the X-12 programme designed to smooth time series. Saying its length is n and denoting $l=(n-1)/2$ then H(B) can be written as:

$$H(B)y_t=\Sigma h_i B^i y_t$$

The weights h_i can be obtained by setting $m=(n+3)/2$ from the formula:

$$h_i = 315\frac{\left[(m-1)^2-i^2\right]\left[m^2-i^2\right]\left[(m+1)^2-j^2\right]\left[\left(3m^2-16\right)-11j^2\right]}{8m\left(m^2-1\right)\left(4m^2-9\right)\left(4m^2-25\right)}$$

This expression given is Macaulay (1931), also reproduced in Dagum (1985) and Bell and Monsell (1992). Standard lengths of the filter are 9, 13, 17 or 23 terms for monthly time series, or 5 and 7 terms for quarterly series, depending on the level of smoothness desired. In practice, the Henderson filter is not directly applied to the series under analysis but to the seasonally adjusted transformations since its gain is not zero at seasonal frequency. Because this filter estimates both trend and cycle components together, the extraction of purely business cycle components can be obtained only after a de-trending procedure.

In addition, the cycle component obtained by the two-step procedure described above is not perfectly congruent with the business cycle definition given by the NBER due to the differences in the length determination

3.3 Hodrick Prescott filter

The Hodrick Prescott filter has been designed to directly divide the trend and cyclical components in an additive way:

$y_t = y^t_t + y^c_t$

The application of the HP filter involves the minimisation of the variance of the cyclical components subject to a penalty for the variation in the second difference of the growth component.

$$\left\{y_t^g\right\}_{t=0}^{T+1} = \mathbf{arg\,min} \sum_{t=1}^{T} \left[\left(y_t - y_t^q\right)^2\right] + \lambda\left[\left(y_{t+1}^g - y_t^g\right) - \left(y_t^g - y_{t-1}^g\right)^2\right]$$

Harvey and Jaeger (1993) studied the basic properties of the HP filter finding that it is asymptotically equivalent to the optimal filter trend estimation for the flowing process:

$y_t = \mu_t - \varepsilon_t$

Where $\varepsilon_t \sim \mathrm{NID}(0, \sigma^2_\varepsilon)$ is the irregular component and the trend component mt is defined by

$\mu_t = \mu_{t-1} + \beta_{t-1}$

$B_t = \beta_{t-1} + \zeta_t$

With $\zeta_t \sim NID(0, \sigma^2)$. Bt is the slope of the process and zt is independent of the irregular component. Some shortcomings of this filter have been shown by Guay and ST-Amant (1997) who show that the following assumptions are unlikely to be satisfied in practice.

(1) Transitory and trend components are not correlated with each other. This implies that the growth and cyclical components of a time series are assumed to be generated by distinct economic forces, which is often incompatible with business-cycle models - see Singleton (1988)- for a discussion.

(2) The process is integrated of order 2. This is often incompatible with priors on macroeconomic time series. For example, it is usually assumed that real GDP is integrated of order 1 or stationary around a breaking trend.

(3) The transitory component is white noise. This is also questionable. For example, it is unlikely that the stationary component of output is strictly white noise. King and Rebelo (1993) show that this condition can be replaced by the following assumption: an identical dynamic mechanism propagates changes in the trend component and innovations to the cyclical component. However, the latter condition is also very restrictive.

(4) The parameter controlling the smoothness of the trend component is appropriate. Note that the ratio of the variance of the irregular component corresponds to that of the trend component. Economic theory provides little or no guidance as to what this ratio should be. While attempts have been made to estimate this parameter using maximum-likelihood methods -see Harvey and Jaeger (1993) - it appears difficult to estimate with reasonable precision.

In addition, it must be noted that this filter produces only indirectly the estimation of cyclical components since its objective is to provide a good estimation of the trend.

3.4 Baxter and King filter

In a famous paper, Baxter and King (1995) proposed a finite moving-average approximation of an ideal band-pass filter based on Burns and Mitchell's (1946) definition of a business cycle. This is characterised as a set of fluctuations in the range of 1.5 to 8 years. The Baxter King filter is designed to pass through components of time series with fluctuations between 6 and 32 quarters while removing higher and lower frequencies. When applied to quarterly data, the band-pass filter proposed by Baxter and King takes the form of a moving average.

$$y_t^f = \sum_{h=-12}^{12} a_h y_{t-h} = a(L)y_t$$

where L is the lag operator. The weights can be derived from the inverse Fourier transform of the frequency response function (see Priestley 1981). Baxter and King adjusted the band-pass filter with a constraint that the gain is zero for all frequencies outside the selected band. This constraint implies that the sum of the moving average coefficients must be zero. When using the BK filter, a number of quarters are sacrificed at the beginning and the end of the time series, depending on the chosen length of the definition adopted for the business cycle. In order to reduce the loss of data at the beginning and at the end of the sample, truncated versions of the filter can used. Alternatively, it is possible to previously forecast and backcast the series in order to always use the full version of the filter.

The main problem of this filter is that we need to have a sufficiently clear idea of the fluctuations we want to show in order to set the most adequate parameters of the filter.

Clearly the list of methods presented above is far from exhaustive. More sophisticated approaches based on multivariate analysis can be used as suggested by King Watson (1996). Alternatively, approaches directly derived from the macroeconomic theory such as those proposed by Cochrane (1994) and Blanchard and Quah (1989) could be investigated. Since our analysis is typically restricted to an univariate case, and taking into account the considerations already made on the different methods, we decided to concentrate our attention on the filter proposed by Baxter and King.

4 Empirical Analysis

Business cycle analysis can be conducted with reference to many different key variables. In many studies (see Blake et al. 2000) the attention has been put on the Industrial production index because series are monthly, sufficiently long and due to the fact that a large amount of economic variability derives from the fluctuations of this indicator. Nevertheless, it is also generally recognised as at least some of the services sectors are characterised by cyclical movements. For this reason, it has been decided to concentrate our attention on GDP in volume for the Euro-zone and its Member States.

4.1 Data description.

Our data set covers the period from 1985Q1 to 2000Q3. Euro-zone estimates are obtained by summing up all available countries with the exception of Austria, Ireland, Portugal, due to the insufficient length of those series. Luxembourg is also missing because it does not compile quarterly National Accounts. The decision of ignoring Euro-zone estimates produced by Eurostat comes from the fact that a real comparison between the direct and indirect approach is possible only in the case where the total is the sum of all its components. It is important to observe that since German figures are only available from the first quarter of 1991 onwards, it has been necessary to produce a retrapolation back to 85Q1 by using the growth rates from old National Account series (ESA79). By using this method, the levels we obtained can be judged as absolutely arbitrary. Nevertheless, has demonstrated by Astolfi, Barcellan and Mazzi (2001), ESA79 and ESA95 figures are generally co-integrated and characterised by common features following the Vahid and Engle (1993) definition. In this way it is possible to assume that the reconstructed cyclical pattern is sufficiently realistic and correct.

4.2 Comparison of alternative seasonal adjustment strategies

In this section we present the main results obtained in comparing a direct seasonal adjustment of the Euro-zone aggregate to an indirect approach based on the utilisation of the same methods for all Member States. In this case, the Euro-zone seasonal adjustment series is obtained by summing up seasonal adjusted figures from Member States. Both direct and indirect approaches to seasonal adjustment of the aggregated series were performed using at the same time Census X12-Arima as well as Tramo–Seats packages. Tables from A1 to A3b in the annex show the raw Euro-zone data; direct Euro-zone seasonally adjusted data and indirect ones, the latter obtained respectively for X12Arima and Tramo-Seats. We named with a letter “a” the estimate obtained by applying X12Arima and a letter “b” the one from Tramo-Seats. Figure 1a and 1b show the original series and the two seasonal adjusted ones. At first sight it seems that, as the global pattern, the direct and indirect seasonal adjusted series appear to be almost equivalent when obtained by applying a homogeneous methodology (in turn X12Arima or Tramo-Seats).

Figure 1a Euro-zone GDP: SA data from X12 Arima (direct and indirect) and raw data, 1985Q1 2000Q3

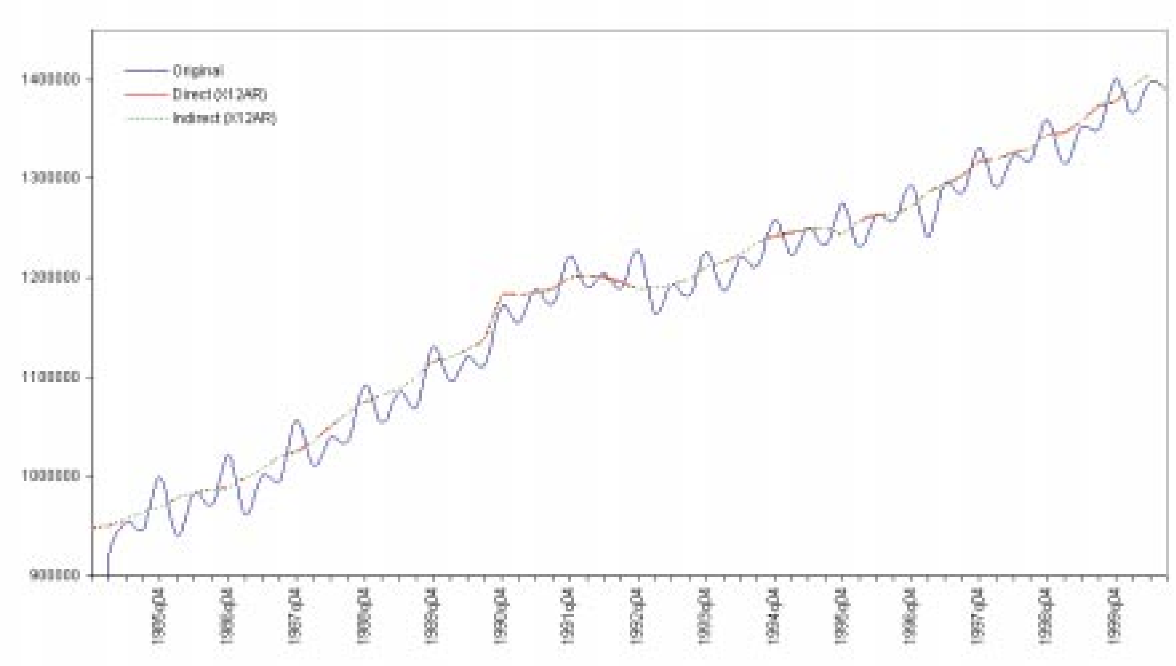
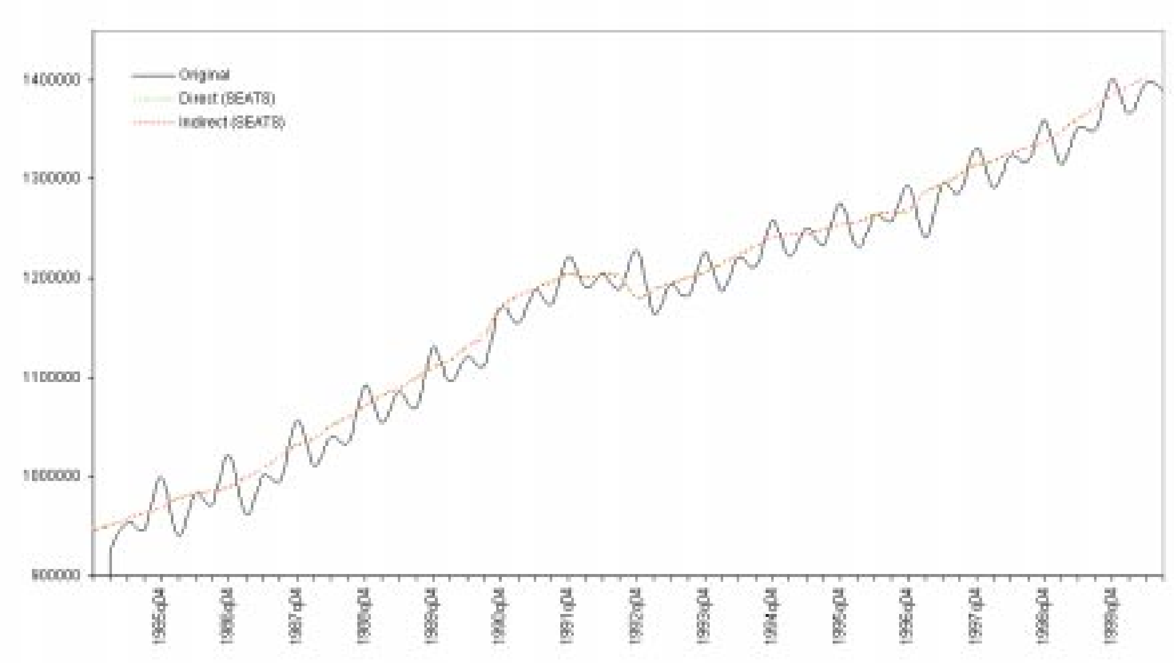


Figure 1b Euro-zone GDP: SA data from Tramo-Seats (direct and indirect) and raw data, 1985Q1 2000Q3



Since graphical analysis cannot be considered as particularly helpful in deciding between the two approaches, a deeper investigation is needed.

Therefore, a further step in our comparison of the results coming from the direct and indirect approach is represented by the analysis of the sign concordance of growth rates. What we can expect in the case where the two approaches were equivalent is a perfect sign and size concordance. If this is not the case, we can measure the concordance as the ratio of growth rates having the same sign on the total of observation minus one. As shown in tables 1a and 1b, the level of concordance sign is quite high (98.4%) both for X12Arima and Tramo-Seats approaches.

Table.1a Sign concordance analysis of the growth rates (X12Arima)

Direct	Indirect	Number of observations	Percentage
Concordance (both increase or decrease)		61	98.4%
Increase	Decrease	1	1.6%
Total		62	100%

Table.2a Sign concordance analysis of the growth rates (Tramo-Seats)

Direct	Indirect	Number of observations	Percentage
Concordance (both increase or decrease)		61	98.4%
Increase	Decrease	1	1.6%
Total		62	100%

Both methodologies record only one case of inconsistency. Despite the apparent concordance in using the two approaches, if we have a deeper look in to the results we see that, when using X12Arima, it is the second quarter of 1991 to show a sign discordance, whereas Tramo-Seats presents its inconsistency in 1992Q4. This can be regarded as the first signal of the non-equivalence in the use of seasonal adjustment procedure.

It is anyway useful to notice that measure presented here does not investigate the size of the growth rate, so that the dimension represented by the amplitude of the fluctuation is not taken into account.

In order to assess the degree of smoothness of our series, which is one of the main requirements as explained in section 2, we are now proposing three different roughness tests (R1, R2, and R3), briefly presented from a computational point of view in Section 2. Table 2a and 2b shows the results of these three measures of smoothness. The following conclusions can be drawn:

- R_1 computed on both series as a whole and for the last three years privileges the direct approach for the last three years and the indirect one for the whole series in the case of X12. When using Tramo-Seats, the indirect is always preferred (Table 2a and 2b);
- R_2 gives the same results of R_1 for X12 whereas for Tramo Seats it prefers the direct one for the whole series confirming the result of R_1 for the last three years;

- R_3 always prefers the direct approach for X12 Arima and confirms R_2 results for Tramo-Seats.

Table 2a Measures of Roughness for Seasonally Adjusted Series, X12Arima

Measures	Direct		Indirect		Percentage Change	
	Full Series	Last 3 Years	Full Series	Last 3 Years	Full Series	Last 3 Years
R1 (SA)	10396.646	10674.679	10387.259	10915.793	0.09%	-2.26%
R2 (SA)	0.194	0.159	0.193	0.168	0.52%	-5.66%
R3 (SA)	0.158	0.164	0.202	0.182	-27.85%	-10.98%

Positive percentage changes indicate that the indirect seasonally adjusted composite is smoother than the direct seasonally adjusted composite.

Table 2b Measures of Roughness for Seasonally Adjusted Series, Tramo-Seats

Measures	Direct		Indirect		Percentage Change	
	Full Series	Last 3 Years	Full Series	Last 3 Years	Full Series	Last 3 Years
R1 (SA)	9596.342	9518.236	9509.842	9302.559	0.90%	2.27%
R2 (SA)	0.148	0.102	0.15	0.089	-1.35%	12.75%
R3 (SA)	0.125	0.093	0.26	0.074	-108.00%	20.43%

Positive percentage changes indicate that the indirect seasonally adjusted composite is smoother than the direct seasonally adjusted composite.

A complementary assessment of the relative performance of the two approaches is supplied by the standard Quality measures produced by X-12 Arima. In the light of the needs of the present work, we also applied, where was possible, the some criteria to the results offered by Tramo-Seats. Table 3 shows those measures. All of them are in the range from 0 to 3 with an acceptance region from 0 to 1. The following elements can be underlined:

- all the measures calculated for the direct approach lie in the acceptance region;
- M8 and M10 for the indirect are outside the acceptance region both for X12Arima and Tramo-Seats results;

Table 3 Euro-zone GDP in volume: Comparative Monitoring and Quality Assessment Statistics

	Monitoring and Quality Assessment Statistics		X12Arima		Tramo-Seats	
			Direct	Indirect	Direct	Indirect
1.	The relative contribution of the irregular over one quarter span	M1*=	0.018	0.035	0.013	0.033
2.	The relative contribution of the irregular component to the stationary portion of the variance	M2*=	0.035	0.056	0.021	0.094
3.	The amount of quarter to quarter change in the irregular component as compared to the amount of quarter to quarter change in the trend-cycle	M3*=	0.000	0.000	0.000	0.000
4.	The amount of autocorrelation in the irregular as described by the average duration of run	M4=	0.431	0.667	0.667	0.039
5.	The number of quarters it takes the change in the trend-cycle to surpass the amount of change in the irregular	M5=	0.200	0.200	0.200	0.200
6.	The amount of moving seasonality present relative to the amount of stable seasonality	M7*=	0.538	0.545	0.443	0.548
7.	The size of the fluctuations in the seasonal component throughout the whole series	M8=	0.390	1.838	0.864	1.008
8.	The average linear movement in the seasonal component throughout the whole series	M9=	0.261	0.376	0.340	0.290
9.	Same as 8, calculated for recent years only.	M10=	0.353	1.935	0.684	1.067
10.	Same as 9, calculated for recent years only.	M11=	0.288	0.610	0.311	0.309

Another step of our comparison consists of assessing the relative performance of direct and indirect approaches in terms of stability of the outcome. Users of seasonally adjusted data would like to manage time series without any revision when new observation became available. This is possible with the usage of purely asymmetric filters (regression approach) which, unfortunately gives a systematic bias in the estimation of the non-seasonal component. In other words, there is a trade off between accuracy and revisions. Users should define a threshold of acceptance for their priority (e.i. accuracy) and than, conditionally on that, choose the approach, among all the possible ones, that gives the best result for the other property (e.i. revision). Since accuracy is essentially for business cycle porpoises, we *a priori* exclude all approaches with zero revision by concentrating our attention on those, as X12 and Tramo-Seats, which theoretically have no bias at least in the central part of the series. Here we present a statistical analysis of our second best priority represented by the stability of the outcome of seasonally adjusted data. Table 4 shows a comparison of revisions based on their mean and standard deviation. It is important to note that, in order to obtain only the revision effect caused by seasonal filters, it has been decided to fix, during the simulation, all remaining parameters. Moreover, the behaviour of seasonally adjusted data is normally perturbed by the revision of raw ones, which occur regularly, as new information became available and at certain well-specified date in the year. From the table 4 it emerges that in the case of X12 the indirect approach seems to perform better, whereas in the case of Tramo Seats the opposite occurs with respect to both mean and standard deviation criteria. By comparing the two direct approaches, it is possible to observe that Tramo -Seats performs better in terms of mean, whereas X12 is preferable by taking into account the standard deviation. Regarding the comparison of the two indirect approaches, the one coming form the application of X12 seems to be always preferable.

Table 4 Euro-zone GDP in volume: Comparative summary statistics of the revision

Absolute revision	X12Arima		Tramo-Seats	
	Direct	Indirect	Direct	Indirect
Mean AR 1 qtr	0.195	0.122	0.170	0.215
Mean AR 2 qtrs	0.193	0.132	0.178	0.219
Mean AR 3 qtrs	0.216	0.123	0.191	0.237
Mean AR 4 qtrs	0.225	0.128	0.180	0.216
Mean AR 5 qtrs	0.229	0.15	0.195	0.239
Std AR 1 qtr	0.114	0.08	0.120	0.166
Std AR 2 qtrs	0.108	0.083	0.131	0.148
Std AR 3 qtrs	0.122	0.083	0.143	0.147
Std AR 4 qtrs	0.140	0.118	0.123	0.173
Std AR 5 qtrs	0.181	0.156	0.135	0.157
A(%)	46.154	90.476		
QQ(%)	7.843	12.048		

It is also useful to point out that in the case of indirect approach we are working with a sort of linear combination of different filters which are not necessary the same so that it is really difficult to talk about revision properties of the filter in this specific case. The situation is much clearer in the case of direct approach, where only one filter is applied.

The last step of our comparison is the analysis of the residuals. The estimated residual components are intended to represent the theoretical irregular part of the series, which is by definition an i.i.d. N $(0,\sigma^2)$. Whiteness tests of the residual components can be performed in order to assess the absence of any significative autocorrelation structure. Moreover, we decided to run an automatic identification of moltiplicative seasonal Arima model (p,d,q)*(P,D,Q) by using Tramo. By doing that, we obtained additional useful information concerning, in the case of no whiteness of the residuals, their stochastic structure. Table 5 shows the results of this automatic identification. Concerning X12, it is possible to observe that in the non-seasonal part of the Arima model, is identified an MA(1) structure for both approaches. By contrast, the seasonal part of the Arima model is completely white, which is for the indirect adjustment in slight contradiction with the M8 measure proposed above. The situation is more complex for the residuals produced by Tramo-Seats. The non-seasonal part of the direct adjustment is characterized by an ARMA(1,1) which means that at least a part of the systematic component was left in the irregular component. By contrast the indirect

adjustment is characterized by an AR(1) which is anyway not a good sign since the AR part of the stochastic process generally represents its inertia. Concerning the seasonal part, we observe an MA(1) in the case of direct adjustment, meaning that there is a seasonal component left in the irregular, whilst the indirect approach shows a white seasonal part. In the same table we also display the presence of outlier and the residual effect of trading day and Easter. This comparison seems to indicate that outlier are still present in the direct adjustment from X12 as additive ones and the indirect adjustment of Tramo -Seats as Transitory Changes. Residual effects of trading day are observed in the indirect adjustment of Tramo Seats whereas residual effects appear in the direct from Tramo-Seats.
Apart from the outlier situation, the residuals of direct and indirect adjustment produced by X12 are quite similar, which is an additional element in favour of the evidence that the two type of adjustment are quite similar. By contrast in the case of Tramo-Seats, the characteristics of the residual differ considerably, showing that the effect of the model based filter can be quite different when applied directly to the aggregate or individually component by component.

Table 5 Analysis of the residuals

Series	Model	pljung1	pljung2	dw	pnorm	aols	ls	tc	ao	Trad	east
X12 dir	(0,0,1)(0,0,0)	0.696	0.199	2.00	0.002	Y	0	0	2	N	N
X12 ind	(0,0,1)(0,0,0)	0.635	0.176	2.38	0.000	N	0	0	0	N	N
T.S. dir	(1,0,1)(0,0,1)	0.189	0.927	2.55	0.000	N	0	0	0	N	Y
T.S ind	(1,0,0)(0,0,0)	0.042	0.903	2.00	0.055	Y	0	1	0	Y	N

4.3 Business cycle extraction

The same aggregation problem encountered in the case of seasonal adjustment will persist when extracting the business cycle. As mentioned in section 3, given the particular characteristics of the Baxter and King filter it should be theoretically possible to extract directly the cycle from non-seasonally adjusted data. In this case the dilemma between the direct and indirect approach would not exist since the aggregate cycle would, by definition, just the sum of the desegregated ones. Nevertheless, raw data can imply problems in terms of excessive noise of the series and this is the reason why it is often preferred to work starting from seasonal adjusted data.

To extract the cycle, we had to set a length for the filter in order to display the fluctuation we were interested in. Based on the experience of the last years, we decided to choose a filter based on a centred 24 terms moving average. A second important decision has been taken in terms of treatment of the first and last part of the sample due to the loss of data implied by the use of the ordinary version of Baxter and King filter. Since the extension of the series using the ARIMA model does not provide very useful information due to the inadequacy of those models in forecasting turning points, we decided to use a progressively truncated version of the Baxter and King filter in order to lose just one data at the beginning and at the end of the sample period. Table A6 presents the weight structure used for the full 24 terms filter as well as for its different truncated versions.

Figure 2a Euro-zone GDP in volume: business cycle extraction from SA series - direct vs. indirect X12Arima

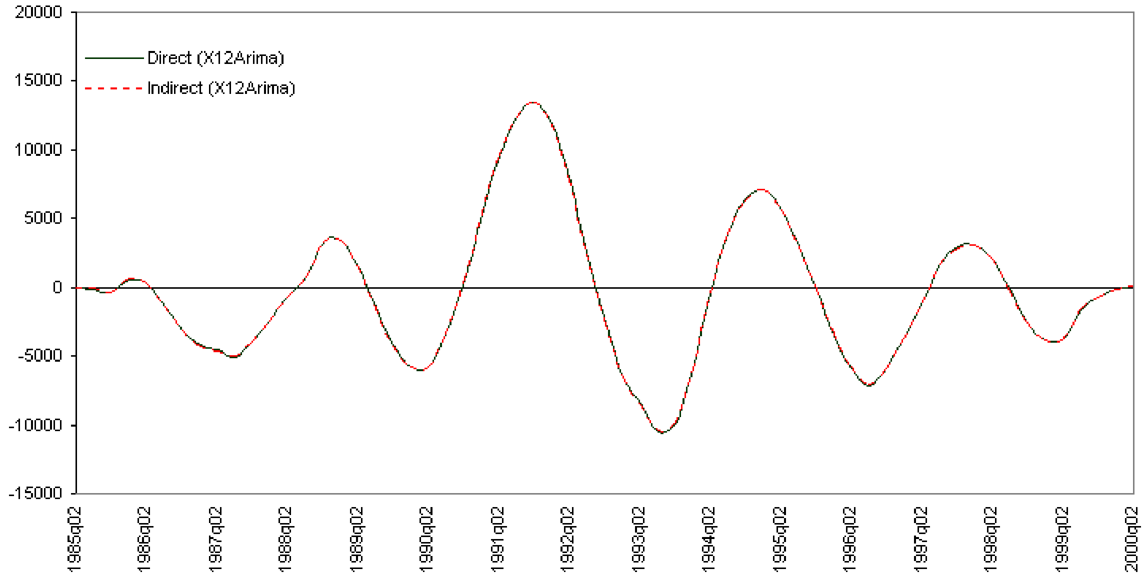
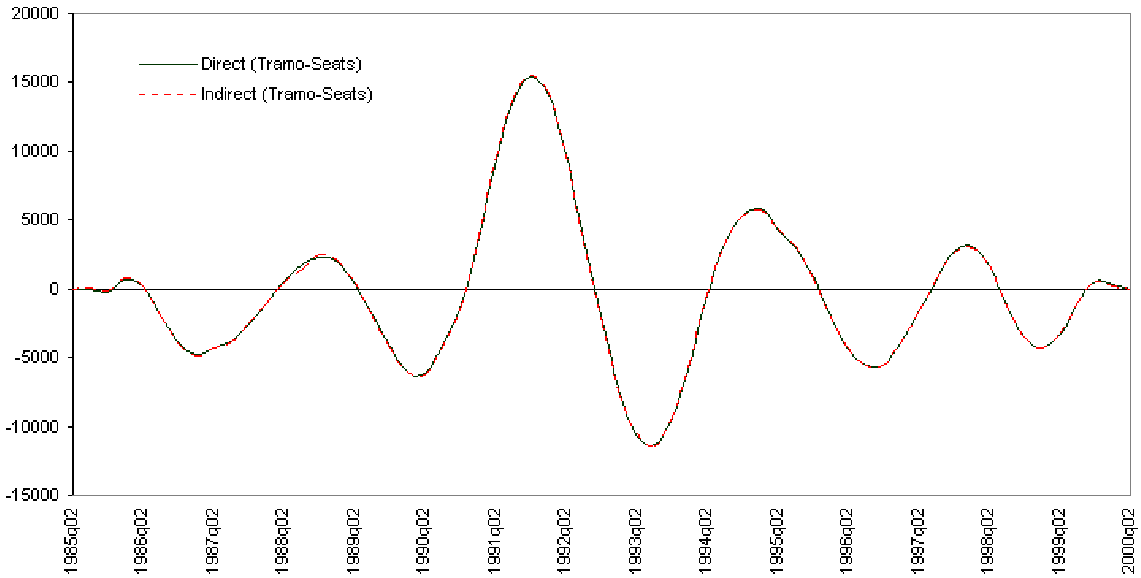


Figure 3a and 3b show the results obtained by applying the Baxter and King filter to both seasonally adjusted series derived according to direct and indirect approach coming for X12Arima and Tramo-Seats. Estimated values for the cycles can be found in Table from A7a to A8b. A number of considerations can be put forward:

- Cycles extracted from direct or indirect seasonal adjustment procedure do not differ significantly;
- All the series display with good evidence the upswing and downswing recorded at the beginning of the 90s;
- The number of cycles is approximately the same. The only difference consists in the assessment of the behaviour of the cycle in the period covering the end of 1999 and the beginning of 2000.
- The average length of the cycles is approximately the same;
- Peaks are always in phase;

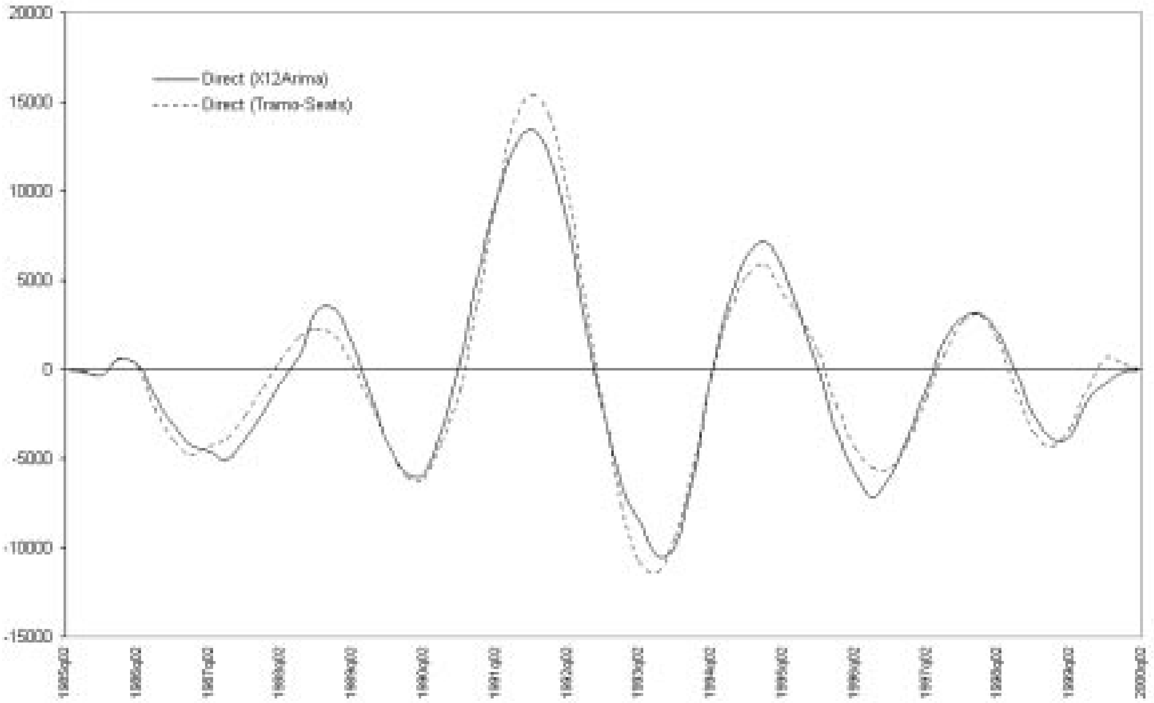
Figure 2b Euro-zone GDP in volume: business cycle extraction from SA series - direct vs. indirect Tramo-Seats



In this context it is very difficult to find conclusions on the relative performance of the two approaches proposed before. One possible additional element, which could be helpful in suggesting some conclusions, is represented by the comparison of two estimated cycles coming from different seasonal adjustment methodology.

Figure 3 shows the comparison of the cycle extracted from seasonal adjusted data obtained with the direct approach using both X1éArima and Tramo-Seats. The comparison evidences that turning points are generally synchronised with the exception of the downswing in 1987 where the Tramo-Seats series anticipates of two quarters the one coming from X12Arima. The particularly cold winter of 1987 can be regarded as a possible cause of such a lack of phase being treated in a different way by the two seasonal adjustment programmes, with some consequences also in the non-seasonally structure of the data. In the remaining cases, the cyclical pattern coming from X12 and Tramo-Seats is almost equivalent: it has to be recorded, as already mentioned above, that: in the final part of the series, the two cycles slightly differ, due to the presence of a peak in 1999Q4 in the cycle coming from Tramo Seats which is absent in the X12 cycle. This can be due to the different structure of asymmetric filters used by X12 and Tramo-seats in the final part of the series, which can have an influence also in the non-seasonal structure.

Figure 3 Euro-zone GDP in volume: business cycle extraction from SA series - direct X12Arima vs. direct Tramo-Seats



5 *Conclusions*

In this paper we have compared two alternative approaches for removing seasonality and extracting relevant cyclical fluctuations from Euro-zone data. The first one, based on the so-called direct approach, implies working at an aggregate level (the Euro-zone as whole) only. In contrast, the second one was based on the removal of the seasonality country by country in order to obtain aggregated seasonally adjusted figures by summing up seasonal Member State figures. In this case the cycle was extracted directly by the sum of the seasonally adjusted data which is equivalent to extracting it for each country and then aggregating it. For the seasonal adjustment, the result obtained do not provided a clear message in favour of one of the two approaches, both for X12Arima and Tramo-Seats.

Baxter and King cycle is sufficiently neutral to the different seasonal adjustment approaches and methods, even if some minor discrepancies have been recorded. In this contest the choice between the direct and indirect decomposition of time series became a more political operational problem. Direct approach is clearly more transparent and operation easier than the indirect one. Moreover, results obtained from an indirect adjustment cannot be shown because they could be different from national official seasonal adjusted figures. Direct seasonal adjustment can be also view as an optimal starting point for further statistical elaboration such as the construction of flash estimates, leading indicators and so on. Finally, the use of X12 and Tramo-Seats seems to have no significant influence on the cycle extracted with Baxter and King filter. Nevertheless, when additional information will become available, it will be useful to compare the behaviour of both in order to verify whose performance has to be preferred. This analysis can be of particular interest due to the fact that short term analysts are mainly interested in the most accurate description of recent evolution.

Appendix A

Table A1 Euro-zone GDP in volume NSA, from 1985Q1 to 2000Q3

Year	Quarter				Total
	1st	2nd	3rd	4th	
1985	920726.	954234.	946362.	998704.	3820026.
1986	940615.	983901.	971666.	1021777.	3917959.
1987	962409.	1002062.	995313.	1056036.	4015820.
1988	1010793.	1040482.	1035651.	1092771.	4179696.
1989	1054041.	1085892.	1069597.	1130656.	4340187.
1990	1096191.	1121745.	1111768.	1171789.	4501493.
1991	1155125.	1188475.	1173602.	1221939.	4739141.
1992	1190324.	1205313.	1188970.	1228063.	4812670.
1993	1164588.	1193490.	1182546.	1226079.	4766702.
1994	1186923.	1220508.	1211853.	1258987.	4878270.
1995	1222401.	1250382.	1233912.	1275400.	4982095.
1996	1231575.	1263499.	1257708.	1292999.	5045782.
1997	1241871.	1296057.	1286158.	1331286.	5155372.
1998	1291469.	1323787.	1318569.	1359204.	5293029.
1999	1315349.	1352241.	1350224.	1400938.	5418752.
2000	1366675.	1397822.	1389374.		4153870.

Table A2a Euro-zone GDP in volume SA: Direct Approach X12Arima, from 1985Q1 to 2000Q3

Year	Quarter				Total
	1st	2nd	3rd	4th	
1985	948608.29	950785.69	956868.4	964396.38	3820658.8
1986	969490.87	978736.89	983511.64	987351.43	3919090.8
1987	988600.49	999376.29	1007739.1	1021029.3	4016745.2
1988	1025620.1	1036428.5	1051170.6	1064361.8	4177581
1989	1075256.4	1081413.8	1088923.2	1100469.7	4346063.1
1990	1116594.9	1119661.9	1128551.9	1137430.8	4502239.4
1991	1183446.2	1183244.1	1185120.8	1189252.7	4741063.7
1992	1199739.6	1202506.3	1200992.8	1196263.8	4799502.5
1993	1189205.9	1190446.0	1192815.8	1198749.2	4771216.8
1994	1211192.2	1215100.0	1224332.9	1235823.2	4886448.3
1995	1242420.4	1245992.0	1249310.7	1250550.4	4988273.5
1996	1244057.0	1257695.2	1263751.0	1265240.9	5030744.2
1997	1271670.0	1287843.7	1293663.5	1303719.2	5156896.4
1998	1317837.4	1319451.7	1326580.2	1330014.7	5293884.0
1999	1344309.5	1346716.4	1358411.2	1373050.6	5422487.8
2000	1378175.3	1394320.1	1406184.5		4178679.8

Table A2b Euro-zone GDP in volume SA: Direct Approach Tramo-Seats, from 1985Q1 to 2000Q3

Year	Quarter				Total
	1st	2nd	3rd	4th	
1985	947324.8	950372.0	957225.1	963809.2	3818731.1
1986	968016.2	979123.5	982674.2	986654.7	3916468.6
1987	988399.1	998952.1	1008359.3	1021050.4	4016760.9
1988	1032139.7	1037957.4	1051670.6	1060104.9	4181872.6
1989	1071031.2	1082512.4	1087752.4	1100738.6	4342034.6
1990	1109609.6	1117437.2	1131107.1	1145612.7	4503766.6
1991	1166909.9	1182618.6	1190974.5	1197237.2	4737740.2
1992	1203328.3	1199880.9	1203927.4	1204124.3	4811260.9
1993	1180201.6	1187836.1	1194730.0	1201229.6	4763997.3
1994	1205201.9	1215009.4	1223837.7	1232939.8	4876988.8
1995	1241870.9	1244010.7	1244650.2	1249862.2	4980394.0
1996	1254538.2	1255907.1	1265564.9	1267334.7	5043344.9
1997	1267660.5	1288537.9	1293524.6	1304413.8	5154136.8
1998	1315960.5	1317844.4	1327117.0	1331946.6	5292868.5
1999	1337546.0	1348267.1	1360502.0	1372769.5	5419084.6
2000	1386587.1	1393636.4	1401591.6		4181815.1

Table A3a Euro-zone GDP in volume SA: Indirect Approach X12Arima, from 1985Q1 to 2000Q3

Year	Quarter				Total
	1st	2nd	3rd	4th	
1985	947680.4	951111.9	957361.0	964387.7	3820541.0
1986	969007.4	979058.9	983585.4	986953.8	3918605.5
1987	988295.8	999789.3	1007618.5	1020820.4	4016524.0
1988	1024921.0	1036870.0	1051462.8	1064191.3	4177445.0
1989	1074704.7	1081861.1	1089083.7	1100837.7	4346487.2
1990	1115412.9	1120157.9	1129355.1	1137572.2	4502498.1
1991	1182899.9	1183762.5	1185588.7	1188744.2	4740995.2
1992	1199584.5	1203080.3	1200381.6	1195707.7	4798754.1
1993	1189335.5	1190815.2	1192369.8	1198753.7	4771274.2
1994	1211202.5	1215218.5	1224274.3	1235514.2	4886209.5
1995	1242675.6	1246281.4	1248956.1	1250895.5	4988808.6
1996	1244112.5	1257928.2	1264103.8	1265054.3	5031198.7
1997	1271860.6	1287928.7	1293289.9	1303484.7	5156563.9
1998	1318005.2	1319543.4	1325805.9	1330614.6	5293969.1
1999	1343917.9	1346392.0	1358024.9	1374698.2	5423033.0
2000	1376948.6	1393930.8	1405983.4		4176862.8

Table A3b Euro-zone GDP in volume SA: Indirect Approach Tramo-Seats, from 1985Q1 to 2000Q3

Year	Quarter				Total
	1st	2nd	3rd	4th	
1985	945089.1	950816.6	957250.0	964648.8	3817804.5
1986	968162.3	978011.6	983223.7	985564.6	3914962.1
1987	989350.2	999083.6	1008541.0	1020559.3	4017534.1
1988	1031764.2	1039029.8	1051041.3	1059694.7	4181530.1
1989	1072081.1	1081498.8	1088883.6	1099973.3	4342436.9
1990	1111092.9	1116019.0	1131810.1	1141885.2	4500807.3
1991	1171908.9	1182305.8	1190421.9	1195322.1	4739958.7
1992	1204814.3	1201556.2	1203035.9	1201805.6	4811212.1
1993	1181525.8	1189126.4	1193992.4	1199889.5	4764534.1
1994	1206432.6	1215909.5	1223073.8	1232553.1	4877969.1
1995	1242250.6	1244148.3	1244825.5	1248914.0	4980138.4
1996	1255515.2	1256380.4	1264708.4	1266526.7	5043130.7
1997	1269699.6	1287089.6	1294124.5	1305371.3	5156285.0
1998	1313850.7	1319048.1	1327185.8	1331881.1	5291965.7
1999	1337395.3	1348490.3	1361059.8	1372621.4	5419566.8
2000	1386183.7	1393400.8	1402540.9		4182125.4

Table A4a Euro-zone GDP in volume SA-Direct Approach X12Arima: Growth rate, from 1985Q2 to2000Q3

Year	Quarter			
	1st	2nd	3rd	4th
1985		0.229537	0.639756	0.786731
1986	0.528257	0.953699	0.487848	0.390417
1987	0.126505	1.090006	0.836805	1.318815
1988	0.449625	1.053835	1.422394	1.254909
1989	1.023579	0.572642	0.694413	1.060358
1990	1.465295	0.274674	0.793992	0.786756
1991	4.04555	-0.01707	0.158599	0.34865
1992	0.881805	0.23061	-0.12586	-0.39376
1993	-0.58999	0.104279	0.199067	0.497428
1994	1.038002	0.322642	0.759841	0.938495
1995	0.533834	0.287469	0.26635	0.09923
1996	-0.51924	1.096268	0.481501	0.117896
1997	0.508128	1.271845	0.451904	0.777307
1998	1.082917	0.122497	0.540256	0.258902
1999	1.074785	0.179044	0.868398	1.077684
2000	0.37323	1.171461	0.850912	

Table A4b Euro-zone GDP in volume SA-Direct Approach Tramo-Seats: Growth rate, from 1985Q2 to2000Q3

Year	Quarter			
	1st	2nd	3rd	4th
1985		0.32167	0.721093	0.687828
1986	0.436498	1.14743	0.362645	0.405068
1987	0.176794	1.067688	0.941708	1.258589
1988	1.086068	0.563654	1.321172	0.801991
1989	1.030681	1.071976	0.484059	1.193856
1990	0.805913	0.705437	1.223326	1.282425
1991	1.859023	1.346179	0.706559	0.525847
1992	0.508763	-0.28649	0.337242	0.016355
1993	-1.98673	0.646881	0.580375	0.544022
1994	0.330686	0.813764	0.726603	0.743734
1995	0.724374	0.172305	0.051406	0.418752
1996	0.374121	0.109116	0.76899	0.139843
1997	0.025707	1.646924	0.387005	0.841824
1998	0.885202	0.143158	0.703619	0.363917
1999	0.420392	0.80155	0.907454	0.901689
2000	1.006549	0.508392	0.570823	

Table A5a Euro-zone GDP in volume SA-Indirect Approach X12Arima: Growth rate, from 1985Q2 to2000Q3

Year	Quarter			
	1st	2nd	3rd	4th
1985		0.362096	0.657027	0.733971
1986	0.4790289	1.037294	0.462334	0.342462
1987	0.1359747	1.16296	0.783086	1.310205
1988	0.4016969	1.165849	1.407387	1.210552
1989	0.9879233	0.665898	0.667608	1.079257
1990	1.324008	0.425403	0.821063	0.727594
1991	3.984595	0.072927	0.154268	0.266155
1992	0.9119141	0.291418	-0.22432	-0.38936
1993	-0.5329253	0.124415	0.130548	0.535395
1994	1.0384795	0.33157	0.745204	0.918084
1995	0.5796318	0.290159	0.214614	0.155286
1996	-0.542252	1.110483	0.490933	0.075195
1997	0.5380272	1.263352	0.416262	0.788287
1998	1.1139783	0.116701	0.474598	0.362698
1999	0.9997888	0.1841	0.864	1.22776
2000	0.1637047	1.233322	0.864645	

Table A5b Euro-zone GDP in volume SA-Indirect Approach Tramo-Seats: Growth rate, from 1985Q2 to2000Q3

Year	Quarter			
	1st	2nd	3rd	4th
1985		0.606026	0.676624	0.772913
1986	0.3642261	1.017325	0.532923	0.238085
1987	0.3841071	0.983821	0.946605	1.19165
1988	1.0979149	0.704198	1.156031	0.823317
1989	1.1688631	0.878452	0.682827	1.018449
1990	1.0108971	0.443351	1.414954	0.890174
1991	2.6293109	0.887175	0.686459	0.411635
1992	0.7941172	-0.27043	0.123151	-0.10227
1993	-1.6874457	0.643283	0.409213	0.493895
1994	0.5453106	0.785532	0.589208	0.775044
1995	0.7867791	0.152759	0.054435	0.328439
1996	0.528557	0.068907	0.662862	0.143766
1997	0.2505201	1.369619	0.546571	0.869073
1998	0.6495778	0.395579	0.616943	0.353772
1999	0.4140199	0.829598	0.932113	0.849459
2000	0.9880587	0.52064	0.655959	

Table A6 Baxter and King Filter: Weight Structure

t	Moving average weights											
	BK_MA (3)	BK_MA (5)	BK_MA (7)	BK_MA (9)	BK_MA (11)	BK_MA(13)	BK_MA (15)	BK_MA (17)	BK_MA (19)	BK_MA (21)	BK_MA (23)	BK_MA (25)
-12	0	0	0	0	0	0	0	0	0	0	0	0.009
-11	0	0	0	0	0	0	0	0	0	0	-0.023	-0.024
-10	0	0	0	0	0	0	0	0	0	-0.036	-0.034	-0.035
-9	0	0	0	0	0	0	0	0	-0.021	-0.017	-0.015	-0.016
-8	0	0	0	0	0	0	0	0.001	0.004	0.008	0.010	0.009
-7	0	0	0	0	0	0	-0.003	-0.003	-0.001	0.003	0.005	0.004
-6	0	0	0	0	0	-0.052	-0.052	-0.052	-0.049	-0.046	-0.043	-0.044
-5	0	0	0	0	-0.125	-0.116	-0.115	-0.115	-0.113	-0.109	-0.107	-0.108
-4	0	0	0	-0.174	-0.146	-0.137	-0.136	-0.137	-0.134	-0.130	-0.128	-0.129
-3	0	0	-0.161	-0.111	-0.084	-0.074	-0.074	-0.074	-0.071	-0.067	-0.065	-0.066
-2	0	-0.092	-0.028	0.022	0.050	0.059	0.060	0.059	0.062	0.066	0.068	0.067
-1	-0.019	0.043	0.107	0.157	0.185	0.194	0.195	0.195	0.197	0.201	0.203	0.202
0	0.038	0.099	0.164	0.214	0.241	0.251	0.251	0.251	0.254	0.258	0.260	0.259
1	-0.019	0.043	0.107	0.157	0.185	0.194	0.195	0.195	0.197	0.201	0.203	0.202
2	0	-0.092	-0.028	0.022	0.050	0.059	0.060	0.059	0.062	0.066	0.068	0.067
3	0	0	-0.161	-0.111	-0.084	-0.074	-0.074	-0.074	-0.071	-0.067	-0.065	-0.066
4	0	0	0	-0.174	-0.146	-0.137	-0.136	-0.137	-0.134	-0.130	-0.128	-0.129
5	0	0	0	0	-0.125	-0.116	-0.115	-0.115	-0.113	-0.109	-0.107	-0.108
6	0	0	0	0	0	-0.052	-0.052	-0.052	-0.049	-0.046	-0.043	-0.044
7	0	0	0	0	0	0	-0.003	-0.003	-0.001	0.003	0.005	0.004
8	0	0	0	0	0	0	0	0.001	0.004	0.008	0.010	0.009
9	0	0	0	0	0	0	0	0	-0.021	-0.017	-0.015	-0.016
10	0	0	0	0	0	0	0	0	0	-0.036	-0.034	-0.035
11	0	0	0	0	0	0	0	0	0	0	-0.023	-0.024
12	0	0	0	0	0	0	0	0	0	0	0	0.009

Table A7a Euro-zone GDP in volume: Cycle extracted from SA data with the Direct Approach X12Arima, from 1985Q2 to 2000Q2

Year	Quarter			
	1st	2nd	3rd	4th
1985		-28.2911	-140.773	-381.65
1986	582.86392	279.5454	-1442	-3140.92
1987	-4226.0101	-4569.2	-5055.1	-3895.05
1988	-2407.4474	-763.506	724.2582	3275.689
1989	3425.4974	1443.248	-1466.85	-4210.91
1990	-5811.4871	-5813.2	-3423.44	520.1812
1991	5244.6058	9508.628	12354.6	13491.83
1992	11894.321	7976.872	2521.338	-2592.83
1993	-6558.799	-8469.17	-10470.5	-9899.25
1994	-5869.4522	-431.121	3880.912	6383.109
1995	7141.0445	5648.999	2993.588	-133.395
1996	-3486.9747	-5852.61	-7125.79	-5897.16
1997	-3690.0115	-966.349	1663.603	2936.755
1998	3125.9601	2086.062	-174.585	-2592.13
1999	-3855.9268	-3735.06	-1655.73	-768.49
2000	-114.27661	31.00805		

Table A7b Euro-zone GDP in volume: Cycle extracted from SA data with the Direct Approach Tramo-Seats, from 1985Q2 to 2000Q2

Year	Quarter			
	1st	2nd	3rd	4th
1985		-27.5704	-39.0755	-314.491
1986	615.04311	166.1782	-2118.91	-3976.69
1987	-4802.3262	-4302.27	-3859.89	-2545.72
1988	-1043.1895	504.2758	1778.711	2286.102
1989	1879.9131	267.7863	-1881.64	-4186.53
1990	-6029.2137	-6106.32	-4095	-1109.81
1991	3763.9837	9387.142	13824.49	15390.67
1992	14152.033	9786.828	3686.926	-2420.54
1993	-7639.7955	-10777.5	-11363.7	-9345.39
1994	-5430.774	-507.399	3263.257	5294.683
1995	5861.3946	4232.361	3009.835	907.8303
1996	-2002.1465	-4367.15	-5562.56	-5519.45
1997	-3993.8304	-1559.36	816.2495	2674.768
1998	3055.5753	1690.704	-1197.31	-3540.07
1999	-4277.9049	-3297.16	-946.082	597.0524
2000	300.8483	-6.56259	0	0

Table A8a Euro-zone GDP in volume: Cycle extracted from SA data with the Indirect Approach X12Arima, from 1985Q2 to 2000Q2

Year	Quarter			
	1st	2nd	3rd	4th
1985		-20.4111	-61.1244	-320.812
1986	703.0662	304.9363	-1400.88	-3179.7
1987	-4320.7767	-4635.8	-5039.05	-3962.34
1988	-2453.2366	-739.16	791.5924	3273.268
1989	3421.8437	1456.184	-1499.17	-4289.67
1990	-5831.8923	-5818.77	-3357.9	621.2846
1991	5368.4042	9597.739	12436.89	13483.55
1992	11817.585	7832.848	2440.096	-2648.7
1993	-6606.4553	-8505.16	-10409.4	-9853.36
1994	-5858.1879	-403.407	3865.415	6308.101
1995	7097.663	5637.895	3000.726	-94.7435
1996	-3379.559	-5774.29	-7017.98	-5857.94
1997	-3709.8143	-1014.7	1681.885	2837.857
1998	3034.9087	2003.563	-215.946	-2588.75
1999	-3792.8118	-3676.73	-1534.75	-679.938
2000	-117.83331	35.71174		

Table A8b Euro-zone GDP in volume: Cycle extracted from SA data with the Indirect Approach Tramo-Seats, from 1985Q2 to 2000Q2

Year	Quarter			
	1st	2nd	3rd	4th
1985		-5.11426	65.55101	-111.539
1986	785.19262	233.5825	-2050.43	-4026.45
1987	-4853.7484	-4336.37	-3788.35	-2420.9
1988	-1064.523	419.1809	1475.083	2462.611
1989	2049.3479	446.2858	-1950.26	-4243.86
1990	-6066.5673	-6219.05	-4297.44	-1189.48
1991	3920.1611	9596.563	13897.78	15566.53
1992	14212.309	9724.322	3427.457	-2566.87
1993	-7754.5949	-10553.4	-11456.6	-9337.29
1994	-5341.4911	-354.195	3244.303	5240.031
1995	5739.5442	4318.326	3076.201	744.2157
1996	-2025.6524	-4266.62	-5530.22	-5564.18
1997	-3980.5506	-1493.86	818.0206	2608.212
1998	2956.0458	1731.133	-1220.59	-3498.46
1999	-4271.961	-3185.9	-987.941	532.6584
2000	219.88981	-13.9315	0	0

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