Tools and Practices for Business Cycle Analysis in European Union
EC Fifth Framework Program
SCA Project IST-1999-12654

BUSY PROGRAM

USER-MANUAL

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Foreword

BUSY is a shared-cost action within the Information Society line of 5th Framework Programme (project IST-12654). The project final objective was to help in improving the knowledge of cycles in EU economies by implementing a software tool able to guide official statisticians through the main steps of a standard business cycle analysis, in an organised and informative way. The project development has put the emphasis on statistical properties, on the reliability of methods, and on how suited is each method in the case of European economies and to the data typically available in NSI's.

BUSY is led by the Institute for the Protection and Safety of the Citizen, Joint Research Centre, the European Commission, Ispra, with the partnership of

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2 INE (Spanish NSI, Madrid), E. Quilis, A. Cristobal, A. Abad
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4 ISTAT (Italian NSI, Roma) F. Bacchini, P.Anzini, F.Polidoro, G. Bruno, E. Otranto

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The BUSY program and related documents are downloadable at
www.jrc.cec.eu.int/uasa/prj-busy.asp

INSTALLATION

1. Local installation

For local installation of BUSY, create a directory, say TEMP, expand in this directory the file BUSY.ZIP, and execute SETUP.EXE. The program is installed in the default directory PROGRAM FILES\BUSY; the output file of the program will be written in PROGRAM FILES\BUSY\OUTPUT, and the default path for savings will be PROGRAM FILES\BUSY\SAVED. To execute the program simply follow the steps: "Start->Programs->BUSY->BUSY". For version updates, first uninstall the previous one and delete the directory PROGRAM FILES\BUSY.

2. Network installation

The directory NETINSTALL contains the file "netinstall.exe" which is a small program for installation of BUSY in a network. To do this, first, BUSY should be installed in the server, and then each user should execute the program netinstall.exe from his or her own PC (the program resides in the server). The only information the user should supply is the name of the local destination directory of BUSY on the user PC. In this PC several directories will be created (OUTPUT, GRAPH, BIN,) where the BUSY output files will be written.

PART 1: OVERALL PROGRAM DESCRIPTION

The BUSY program makes available a selection of statistical techniques designed for conducting business cycle analysis on a possibly large set of time series.

Two types of statistical procedures are offered. The first is an NBER-type of analysis that is based on descriptive statistics such as cross-correlations, coherences and phases of the cross-spectra and Bry and Boschan dating procedure (see Bry and Boschan, 1971). The second is based on dynamic factor models, following the work by Forni et al. (1999, 2000). Both are aimed at building composite indices that are leading, coincident or lagging with respect to a reference series. These composite indices are the main support of the business cycle analysis.

The analysis takes place after the series have been transformed so as to be second- moment stationary. Several stationary transformations are proposed. Input data can be either in human readable or in Excel formats. The series do not need to have all the same sample. Computational results are displayed in an HTML file that can be read either in BUSY, Excel or with whatever Web-browser. The composite indices produced and the list of turns are exportable either in Excel or in human readable file.

The user-manual is organised as follows. Section 2 overviews the preliminary data-transformations offered. Sections 3 and 4 briefly present the main business cycle procedures implemented, i.e. the NBER approach and the dynamic factor models. Section 5 lists the references that have been the most important to the development, and Section 6 gives the user-instructions. The instructions are given first for the most general proposes, then for the NBER-type of analysis and finally for the use of the dynamic factor model module. In each case, the use of BUSY is illustrated with an example and the output is commented.

1 DATA-TRANSFORMATION

The techniques implemented for business cycle analysis rely in first place on second moment analysis. It is hence assumed that the series are second-order stationary - i.e. with mean and auto-covariances that are finite and do not depend on time. Because most economic time series do not satisfy these conditions, they need to be transformed. Let $\mathbf{x}_{\mathbf{it}}$ be a time series with sample length T, i.e. i=1,…, N, .t=1, …,T. Besides a log-transformation that serves at the cases where the series variance increase together with the mean, BUSY proposes three types of filtering operations according to the general expression:

$$\mathbf{z}_{\mathbf{it}} = \nu(\mathbf{L})\mathbf{x}_{\mathbf{it}} = \sum_{\ell=-\mathbf{m}}^{\mathbf{M}} \nu_{\ell} \mathbf{x}_{\mathbf{it}+\ell} \qquad (1)$$

where **L** is the lag operator.

1. <u>First-order difference</u>: trivially, $\nu(\mathbf{L}) = \mathbf{1 - L}$ so $\mathbf{z}_{it} = \mathbf{x}_{it} - \mathbf{x}_{it-1}$: only the growth of the series is considered, the most simple detrending operation.

2. <u>Annual difference:</u> annual growth is considered instead of period-to-period, so $\nu(\mathbf{L}) = \mathbf{1 - L}^{\mathbf{MQ}}$ where **MQ** denotes data periodicity, i.e. 4 for quarterly series, 12 for monthly ones.

3. <u>Hodrick-Prescott filter</u>: This filter has been designed by Hodrick and Prescott (1997) as a detrending tool. The filter is $\nu(\mathbf{L}) = \dfrac{\lambda}{(\mathbf{1}-\mathbf{L}^{2})(\mathbf{1}-\mathbf{L}^{-2})+\lambda}$ where λ is the inverse signal to noise ratio, i.e. the ratio of the variance of the innovations in the short-term component to the variance of the innovations in the long-term component. For quarterly series, typical values are λ=1600, 400. Trivially, the larger λ the smoother the long-term components. See also Harvey and Jaeger (1993).

The Hodrick-Prescott filter is implemented using the algorithm described in Burman (1980). Users are also offered the possibility to extend the series with forecasts. These are computed with a AR plus drift model whose order is selected according to the AIC. When forecasts are used, the algorithm is modified like in Kaiser and Maravall (2000).

4. <u>Baxter-King filter</u> Instead of removing the long-term component of the series, it is possible to directly extract movements whose periodicity lies within a certain range. This can be done using the so-called band-pass filters. Typical ranges of periodicity for business cycle analysis are [6,32] for quarterly data, [18,96] for monthly data, corresponding in both cases to fluctuations with periodicity in the range 1.5 to 8 years.

Baxter and King (1999) proposed a popular band-pass filter that preserves movements within any given range of periodicity [a,b]. For a given filter length K, i.e. M=m=K, the Baxter-King filter has weights given by:

$$\nu_{\mathbf{k}} = \frac{\sin \mathbf{kb} - \sin \mathbf{ka}}{\mathbf{k}\pi} - \frac{\mathbf{1}}{\mathbf{2K+1}} \sum_{\mathbf{k=-K}}^{\mathbf{k=K}} \frac{\sin \mathbf{kb} - \sin \mathbf{ka}}{\mathbf{k}\pi}$$

Users can set the range of periodicity [a,b] together with the filter length, *K*.

In the original Baxter and King (1999) paper, filtered values are obtained for periods *K+1* to *T-K*. BUSY overcomes the lack of filtered values for the first and last K periods in two different ways. The first procedure, that is actually the default one, consists in modifying the filter for the end-of sample values. The modification is such that an asymmetric approximation to the filter is worked out under the constraint that the frequency transfer function of approximation has two roots at the 0 frequency. This procedure will be subject of a forthcoming note. The second option offered consists in extending the series with AR forecasts, like with the Hodrick-Prescott filter.

5. Linear detrending: Finally, BUSY also proposes the possibility of removing a linear deterministic trend.

Once the series are made second-order stationary, the analysis can start. The first possibility is to use an NBER-type of approach.

2 NBER-TYPE OF ANALYSIS

The NBER-approach relies on descriptive statistics and on the detection of turning points. It is based on a large amount of empirical experience, as it has been developed since the 1940's. It has proved to be well suited to the analysis of the US business cycle. Although it is a heuristic approach, it is now a reference for macroeconomists (see for example Zarnowitz, 1992).

The main point is to analyse the behaviour of a dataset with respect to a reference series and to build composite indices by aggregating series that have a similar behaviour. On the basis on descriptive statistics and on turning point analysis, series are classified into leading, coincident and lagging and series that belong to the same category are then aggregated into composite indices. The analysis supposes that one series has been set as the reference series; typical examples of reference series are GDP or Industrial Production Indices.

2.1 Descriptive statistics

The descriptive statistics used are essentially bivariate. Let $\mathbf{z}_{1t}$ be the reference series. Three different statistics are produced:

2.1.1 Cross-correlations with reference series:

$$\rho_{1i}(\mathbf{k}) = \frac{\mathbf{Cov}(\mathbf{z}_{1t}, \mathbf{z}_{it-k})}{\sqrt{\mathbf{Var}(\mathbf{z}_{1t})\mathbf{Var}(\mathbf{z}_{it})}} \tag{2}$$

for i=1,…,N. The BUSY output file displays the contemporaneous cross-correlation and the maximum cross-correlation together with its lag. Notice if that maximum is found for k positive, then this indicates a leading behaviour of series *i* with respect to series 1. All cross-correlations are visible in graphics.

2.1.2 Coherence with reference series

The cross-spectrum between series 1 and *j* is given by

$$\mathbf{f}_{1j}(\omega) = \frac{1}{2\pi}\sum_{k=-\infty}^{\infty}\rho_{1j}(\mathbf{k})\mathbf{e}^{-i\omega k} \tag{3}$$

where ω is a frequency within $[-\pi,\pi]$ and $\rho(\mathbf{k})$ denotes the cross-covariances of lag k. As the cross-covariances are not symmetric, the cross-spectrum takes in general complex values. The squared coherence is defined as the ratio of squared modulus to the product of the spectrum of the reference series and of the j-th series according to:

$$\mathbf{Coh(w)^2} = \frac{\left|\mathbf{f}_{1j}(\omega)\right|^2}{\mathbf{f}_{11}(\omega)\mathbf{f}_{jj}(\omega)}$$

When estimating spectra and cross-spectra, a smoothing is performed according to:

$$\bar{\mathbf{f}}_{1j}(\omega_{\ell}) = \sum_{m=-M}^{M}\mathbf{W(m)}\mathbf{f}_{1j}(\omega_{\ell+m}) \tag{4}$$

The term $\mathbf{W(m)}$ is known as the spectral window. A lag window could have been introduced directly in (3), the result being equivalent. Two optional spectral windows are proposed: Bartlett or Parzen. For further details, see for example Fuller (1992, p.384), Priestley (1981, pp.432-444). Notice that coherences are bounded between 0 and 1.

The coherence between each series and the reference can be seen in graphs. BUSY also produces in the output file the squared coherences as averages over range of frequencies or periodicities. For business cycle analysis, economists are usually interested in the periodicity range 1.5 to 8 years, so high coherences within this period is an evidence that the series contains an information about the cyclical behaviour of the GDP.

2.1.3 Mean delay

Since the cross-spectrum has in general complex values, it can be written in polar coordinates as:

$$\mathbf{f_{1j}(\omega) = \left|f_{1j}(\omega)\right| e^{-iPh(\omega)}}$$

where **Ph(ω)**, the argument of the cross-spectrum, is the phase of the j-th series on the first one. The mean delay is defined as the ratio **Ph(ω)/ω**: it measures the lags in the movements of a series with respect to another one. Consider for example the relationship $\mathbf{y_t = x_{t-2}}$. It can be seen that the cross-spectrum between $\mathbf{y_t}$ and $\mathbf{x_t}$ is

$$\mathbf{f_{xy}(\omega) = f_{xx}(\omega) e^{-2i\omega}}.$$

Since $\mathbf{f_{xx}(\omega)}$ is real, it is seen that **Ph(ω)=2ω** and that the mean delay is **Ph(ω)/ω=2**, that is $\mathbf{y_t}$ lags $\mathbf{x_t}$ by two periods, or in other words $\mathbf{x_t}$ is leading by two periods. Positive (negative) values imply that the j-th series is leading (lagging) with respect to the reference one. BUSY reports the mean delays in average over ranges of periodicity.

For further references, see for example Harvey (1981) and Brockwell and Davis (1991).

2.2 Turning points

The turning point detection procedure is based on the one built by Bry and Boschan (1971), with some updates and adaptation to the case of quarterly series. The procedure can be described as follows.

1. The original Bry and Boschan procedure starts with a detrending moving average. As our series have already been detrended either via first-order difference, Hodrick-Prescott or Baxter-King filtering, that first stage is skipped as irrelevant.
2. On the transformed series, a Spencer moving average is applied in order to obtain the so-called Spencer curve. The Spencer moving average is defined as:

$$\mathbf{\nu(L) = \frac{1}{320}\begin{bmatrix} 74 + 67(L + L^{-1}) + 46(L^2 + L^{-2}) + 21(L^3 + L^{-3}) + 3(L^4 + L^{-4}) - 5(L^5 + L^{-5}) - \\ -6(L^6 + L^{-6}) - 3(L^7 + L^{-7}) \end{bmatrix}}$$

At both ends of the series, following the original procedure, the data are extended assuming that the growth rate of the first (last) 4 observations is constant in the previous (next) seven periods.

3. The stationary series is corrected for outliers. Outliers are identified as the points that lie outside the range $\mathbf{[\bar{z}_{it} - \alpha\sigma(z_{it}), \bar{z}_{it} + \alpha\sigma(z_{it})]}$, where $\mathbf{\bar{z}_{it}}$ denotes the sample mean of the I-th series and $\mathbf{\sigma(z_{it})}$ the sample standard deviation. Outlying points are replaced by their

equivalent on the Spencer curve. Passing the Spencer moving average on the outlier-corrected series yields an outlier-corrected Spencer curve.

4. For monthly data, a 2x12 centred Moving Average (MA) is applied on the outlier-corrected data in order to obtain the "first cycle" curve. For quarterly series, 2x4MA are used instead. The use of 2x12 or 2x4 MA instead of 4-term or 12-term is recommended as both are symmetric and hence do not cause any phase shift in output.

5. A first set of potential turning points are searched for in the MA12 or 2x12MA filtered series, and it is used to look for the corresponding turning points on the Spencer curve. The turning points are looked for in the interval [t-nterm,t+nterm] where the default is nterm=5.

6. A minimum phase length of 1.25*MQ periods, MQ denoting data periodicity - i.e. 4 or 12 for quarterly or for monthly series, from a peak (trough) to a peak (trough) is imposed. The succession peak-trough is checked and imposed if necessary.

7. The Months for Cyclical Dominance (MCD), i.e. the minimum month-delay for which the average of absolute deviations of growth in Spencer cycle is larger than that in the irregular component is computed. Then, the outlier-corrected series is passed through a moving average of length MCD. A new set of turning points is looked for on the basis of the complementary turning points that have been found on the Spencer curve. Again the succession of turns and minimum distance of 1.25*MQ from peak to peak or from trough to trough are imposed.

8. These last set of turning points are cleaned by removing the turns found in the first six or last six observations, and by imposing a minimum phase length - i.e. distance peak (trough) to trough (peak) of 5 observations.

The OECD phase average trend procedure is not implemented because the data should already have been detrended.

The turning points found in the reference series are produced together with the leads and lags of those found in the other series. Several descriptive statistics such as average lag, median lag and about the phases and length of the cycle found are given. The transformed series together with the turns can be seen in graphics.

2.3 Classification and composing

On the basis of the results of the previous operations, a classification of the series as leading, coincident and lagging can be operated. That classification should be performed manually by the users. In order to help users, we briefly develop below some guidelines:

1. Check that the series has some coherence with the reference one at the business cycle frequencies. Low coherence indicates a very idiosyncratic behaviour. Such series would not be much useful in explaining the common movements in the dataset, they can be let unclassified. A possible threshold is 0.4.

2. Similarly, check the maximum cross-correlation value: series that have maximum cross-correlation with the reference series lower than a threshold should be excluded from the analysis. Again, a reasonable threshold can be 0.4.

3. For those series with large enough coherence and cross-correlations with the reference series, check the mean delay in the business cycle frequency range and the lag where the maximum cross-correlation is found. Several cases can occur, the most straightforward being:

    i. The maximum cross-correlation is the contemporaneous one and the mean delay is less than one in absolute value: this can be seen as strong evidence for a behaviour that is coincident with the reference series.

    ii. The maximum cross-correlation occurs between lags 1 and 3 and the mean delay is between 1 and 3: there is some evidence for a behaviour that leads that of the reference series.

    iii. The maximum cross-correlation occurs between lags -1 and -3 and the mean delay is between -1 and -3, there is some evidence for a behaviour that lags that of the reference series.

It is good to supplement these prior opinions with the check of the turning point occurrences with respect to the reference series ones. This will also be of help for all those cases where the evidence will not be that crystal-clear.

The series belonging to the same group can then be aggregated in order to produce a composite index that is a candidate for describing the common cycle movements in the data set. <u>A good procedure is to re-run the descriptive statistics on them including the detection of turns, so as to check that the candidate index behave as expected.</u>

See also Altissimo et al. (1998).

3 DYNAMIC FACTOR MODELS

Factor models, or index models, are an alternative to the heuristic NBER approach. These models consider that a common force drive the dynamics of all variables. This common force, also known as common factor, is typically of low dimension and is not directly observed because every macroeconomic variable embodies some idiosyncratic noise or short-term movements. Factor models clean from every variable from these idiosyncratic movements and estimate the common component in every series. The operation of classification and of aggregation take then place on the variables cleaned of idiosyncratic movements, i.e. on the series common component.

Because it is computationally more suited to the case of large data set, BUSY implements non-parametric versions of the factor models (for parametric version, see for example Sargent and Sims, 1977, Stock and Watson, 1993). Non parametric factor model can be either static (see Stock and Watson, 2002) or dynamic (see Forni et al., 1999, 2000). The advantage of considering the dynamic version is that the classification of the series with respect to the reference one is a by-product of the decomposition procedure. It is this approach that BUSY proposes. An important feature of dynamic factor models is that they provide a statistical framework for a business cycle analysis in large-scale data sets where all the different steps of the analysis are nested into a unified theoretical setting.

As described by Forni et al. (1999, 2000), the generalised dynamic factor model assumes that N second-order stationary variables denoted $\mathbf{z_{it}}$, i=1, …,N observed at time t share q orthogonal common factors $\mathbf{y_{1t}}$,…, $\mathbf{y_{qt}}$. Let $\mathbf{Z_t}$ and $\mathbf{Y_t}$ denote the N × 1 vector of observations and the q × 1 vector of unobservable common factors, respectively. Writing $\mathbf{C_q(L)Y_t}$ the linear projection of $\mathbf{Z_t}$ on the space generated by $\{\mathbf{y_{1t}},…, \mathbf{y_{qt}}\}$, the vector of observations verifies:

$$\mathbf{Z_t} = \mathbf{C_q(L)Y_t} + \boldsymbol{\zeta}_\mathbf{t} = \boldsymbol{\chi}^\mathbf{q}_\mathbf{t} + \boldsymbol{\zeta}_\mathbf{t} \qquad (4.1)$$

where $\boldsymbol{\zeta}_\mathbf{t}$ is a N × 1 vector of possibly cross-correlated idiosyncratic components and the N × 1 vector $\boldsymbol{\chi}^\mathbf{q}_\mathbf{t}$ contains the common part of the series. Orthogonality between common factors and idiosyncratic parts implies the spectral density matrix (sdm) relationship

$$\boldsymbol{\Sigma(\omega)} = \boldsymbol{\Sigma}^\mathbf{q}_{\boldsymbol{\chi}}\boldsymbol{(\omega)} + \boldsymbol{\Sigma}_{\boldsymbol{\zeta}}\boldsymbol{(\omega)} \qquad (4.2)$$

where $\omega \in [-\pi, \pi]$ is a frequency and $\Sigma(\omega)$, $\Sigma_{\chi}^{q}(\omega)$, $\Sigma_{\zeta}(\omega)$ are the sdm of the series, of the common and of the idiosyncratic parts respectively.The vector of common parts, χ_t^q, can be estimated using the dynamic principal components developed in Forni et al. (1999,2000) as summarised below.

Let us denote $\mathbf{p}_j(\omega) = \{p_{j1}(\omega)\mathbf{,...,} p_{jN}(\omega)\}$ the j-th eigenvector of the N × N sdm matrix $\Sigma(\omega)$ associated with the j-th eigenvalue $\lambda_j(\omega)$, the eigenvalues being classified in descending order. The N vectors $\mathbf{p}_j(\omega)$, j=1,…,N, represent an orthonormal system of eigen vectors for $\mathbf{I}_N$. It can be checked that the projection of $\mathbf{Z}_t$ on the first *q* eigenvectors verifies

$$\chi_t^{q^*} = \mathbf{K}^q(\mathbf{L})\mathbf{Z}_t \tag{4.3}$$

where the N × N matrix of filters is such that

$$\mathbf{K}^q(\mathbf{L}) = \mathbf{p}_1(\mathbf{L}^{-1})'\mathbf{p}_1(\mathbf{L}\ ) + ... + \mathbf{p}_q(\mathbf{L}^{-1})'\mathbf{p}_q(\mathbf{L}\ )$$

Under certain assumptions, Forni et al. (2000) showed that $\chi_t^{q^*}$ is a consistent estimator of χ_t^q. The N × N matrix of polynomials $\mathbf{K}^q(\mathbf{L})$ is computed first in the frequency domain as:

$$\mathbf{K}^q(\omega) = \mathbf{p}_1(\omega)'\mathbf{p}_1(\omega\ ) + ... + \mathbf{p}_q(\omega)'\mathbf{p}_q(\omega\ )$$

For instance the ij-th entry in the matrix $\mathbf{K}^q(\omega)$ is

$$\mathbf{K}_{ij}^q(\omega) = \mathbf{p}_{1i}(\omega)'\,\mathbf{p}_{1j}(\omega\ ) + ... + \mathbf{p}_{qi}(\omega)'\mathbf{p}_{qj}(\omega\ )$$

In practice, $\mathbf{K}^q(\omega)$ must be evaluated over a finite number of frequencies. Following Forni et al. (1999, 2000), we denote M, the number of frequencies in $(\mathbf{0,\pi})$ where the spectral density matrix is computed, so over $[\mathbf{0,2\pi}]$ the following 2M+1 frequencies are considered:

$$\omega_1 = 0, \omega_2 = \frac{2\pi}{2M+1}, ..., \omega_{2M+1} = 2M\frac{2\pi}{2M+1}.$$

By computing the matrix $\mathbf{K^q(\omega)}$ at the 2M+1 frequencies above, the weights of the polynomial $K_{ij}^q(L) = \sum_{k=-M}^{M} K_{ijk}^q L^k$ that loads the j-th variable for the estimation of i-th common component can be recovered by inverse Fourier Transform as in:

$$K_{ijk}^q = \frac{1}{2M+1} \sum_{k=0}^{2M+1} K_{ij}^q(\omega_k) e^{ik\omega_k}, \tag{4.4}$$

Using this methodology BUSY estimates the common component and the idiosyncratic part in every series, the decomposition being such that:

$$\mathbf{Z_t} = \chi_{\mathbf{t}}^{\mathbf{q}^*} + \zeta_{\mathbf{t}}^*$$

The common components obtained can be saved in output.

The classification of all series according to the behaviour the common parts with respect to that of the reference series is performed by computing the mean delays in the first row of the common components spectral density matrix, namely $\Sigma_\chi^q(\omega_1)/\omega_1$. For example, if the mean delay is between -1 and 1, meaning between one period lead and one period lag, then the series is classified as coincident. Conversely, if the mean delay is higher than 1 (-1), than the series can be classified as leading (lagging) by more than one period. The building of composite indexes is based on the common parts of all series, similarly to NBER-type of approach. Also, because the common component of every series is cleaned of idiosyncratic short-term noise, the dating of turns can be improved when performed directly on the common components.

There are several parameters in this procedure. First of all, the choice of *q,* the number of factors, is not a trivial issue. Forni et al. (1999, 2000) propose to check the behaviour of the first *q* eigenvalues when the cross-section dimension expands to infinity, and a graphical tool for that it offered in BUSY. This graphic is a good support because, if there are q common factors in the data set, then only the first q eigenvalues should have a divergent behaviour.
A common practice is to select *q* so that a large enough proportion of the series variance is explained. Typical thresholds are between 50% and 70%. BUSY allows to set that proportion and, of course, to directly set the number of factors.

Finally, M, the number of frequencies considered, must be selected. Forni et al. (1999, 2000) propose round(√T/4), T being the number of observations. It is the default value implemented.

4 REFERENCES

ALTISSIMO F., D. MARCHETTI and G.P. ONETO (1999): "New Coincident and Leading Indicators for the Italian Economy", Bank of Italy, mimeo.

ALTISSIMO , F. (2000), `Coincident and leading indicators of the business cycle: a dynamic principal component approach", Bank of Italy, mimeo.

BAXTER M. and R.G. KING (1999) "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series", *Review of Economic and Statistics*, 81, 4, 575-593, (also NBER WP 5022, 1995).

BROCKWELL, P.J. and DAVIS, R.A. (1991), *Time Series: Theory and Methods*, 2nd edition, Springer Verlag: New York.

BRY G. and C. BOSCHAN (1971), "Cyclical Analysis of Time Series: Selected Procedures and Computer Programs", NBER Technical Paper 20.

BURMAN, J.P. (1980), ``Seasonal Adjustment by Signal Extraction", *Journal of the Royal Statistical Society*, Ser. A, 143, 321-337.

FAYOLLE, J. (1993), "Décrire le cycle économique", *Observations et diagnostic économiques*, Revue de l'Office Francais des Conjonctures Economiques, 45, pp 161-185.

FORNI M., M. HALLIN, LIPPI M. and L. REICHLIN (1999), "Reference Cycles: the NBER Methodology Revisited", ULB, Brussels, mimeo.

FORNI M., M. HALLIN, LIPPI M. and L. REICHLIN (2000), "The Generalised Dynamic Factor Model: Identification and Estimation", *Review of Economics and Statistics,* 82, 4, 540-554.

FULLER, W.A. (1996), *Introduction to Statistical Time Series*, 2nd edition, John Wiley & Sons: New York.

HARVEY, A.C. (1981), *Time Series Models*, Phillip Allan Publishers: Oxford.

HARVEY, A.C. AND A. JAEGER (1993), "Detrending, Stylised Facts and the Business Cycle", *Journal of Applied Econometrics*, 8, 231-247.

HODRICK R. AND PRESCOTT E. (1997), "Post-war business cycles: an empirical investigation", Journal of Money, Credit and Banking, 29, 1, 1-16.

KAISER, R. and MARAVALL, A. (1999), "Estimation of the Business Cycle: a Modified Hodrick-Prescott Filter", *Spanish Economic Review*, 1, 2, 175-206.

PRIESTLEY, M.B. (1981), *Spectral Analysis and Time Series*, Academic Press.

SARGENT T.J. AND C.A. SIMS (1977) "Business Cycle Modelling Without Pretending to Have Too Much A Priori Economic Theory", in Sims C.A. eds., *New Methods in Business Research*, Minneapolis, Federal Reserve Bank of Minneapolis.

STOCK J.H. AND M.W. WATSON (2002), "Diffusion indexes", *Journal of Business and Economic Statistics*, 20, 2, 147-162.

STOCK J.H. AND M.W. WATSON (1993), "A Probability Model of the Coincident Economic Indicators", in Lahiri, K. and G.H.Moore (1993), *Leading Economic Indicators: New Approaches and Forecasting Records*, Cambridge University Press: New York.

ZARNOWITZ W. (1992), *Business Cycles: Theories, History, Indicators and Forecasting*. Chicago: University of Chicago.

Related project deliverables:
The current product has been developed following the 5 preliminary studies that are available at www.jrc.cec.eu.int/uasa/prj-busy.asp

ABAD A., CRISTÓBAL A. AND QUILIS E. (2000), "Economic Fluctuations, Turning Points, And Cyclical Classification", Instituto Nacional De Estadistica, Madrid.

ANZINI P. AND F. POLIDORO, (2000), "Overview of National Bureau of Economic Research methods to build composite indexes: from the empirical methods to Stock and Watson model", Istituto Nazionale di Statistica, Rome.

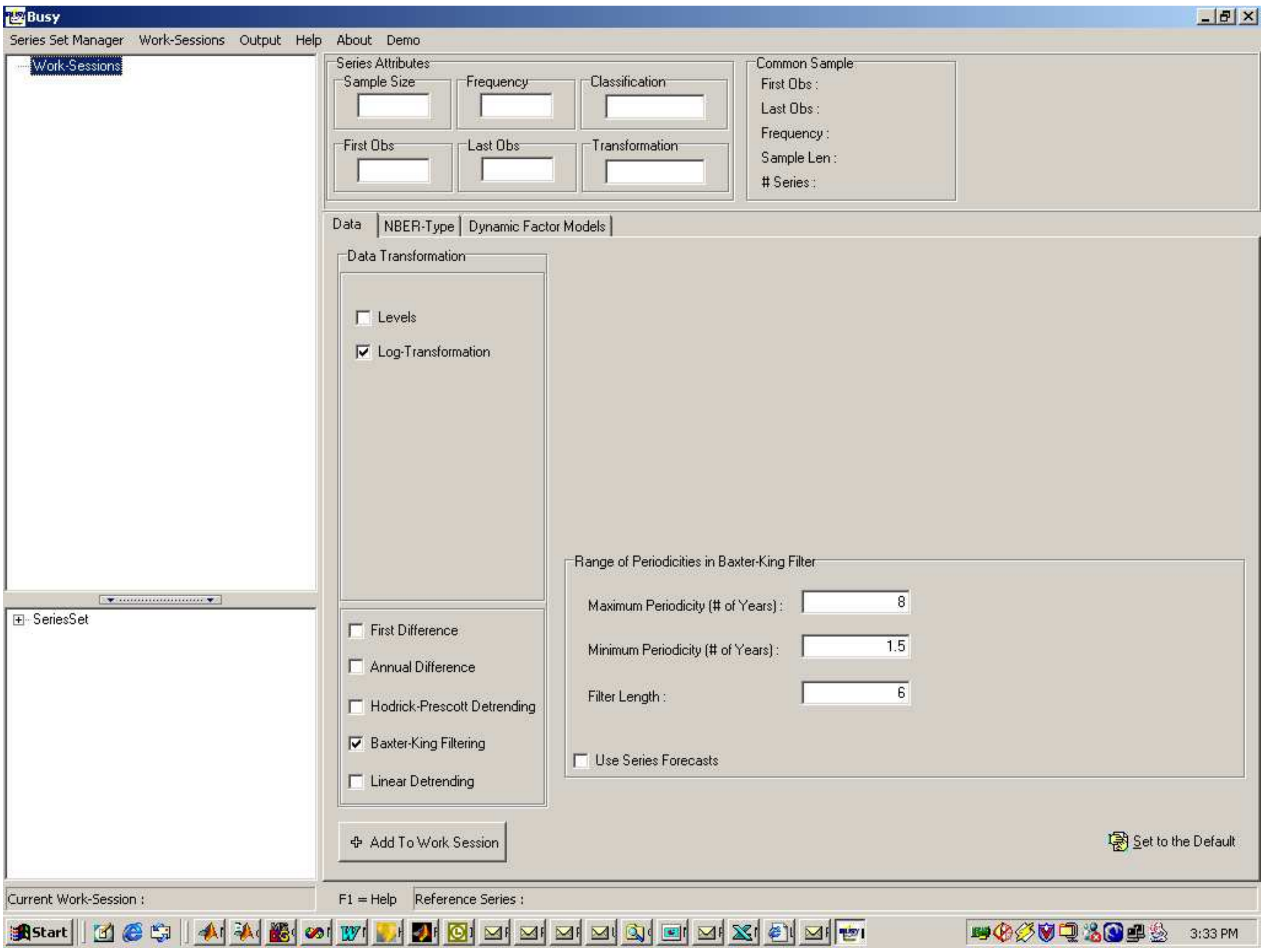
FIORENTINI G., AND C.PLANAS (2000), "Early detection and forecasting of turning points", Joint Research Centre of European Commission, Ispra.

E.CUDEVILLE AND S.GREGOIR (2000), "Economic Composite Indicators: Methodology of Compilation and Validation", Institut National de la Statistique, de l'Economie et des Entreprises: Paris.

FIORENTINI, G. C.PLANAS (2000), " General BUSY software design", Joint Research Centre of European Commission, Ispra.

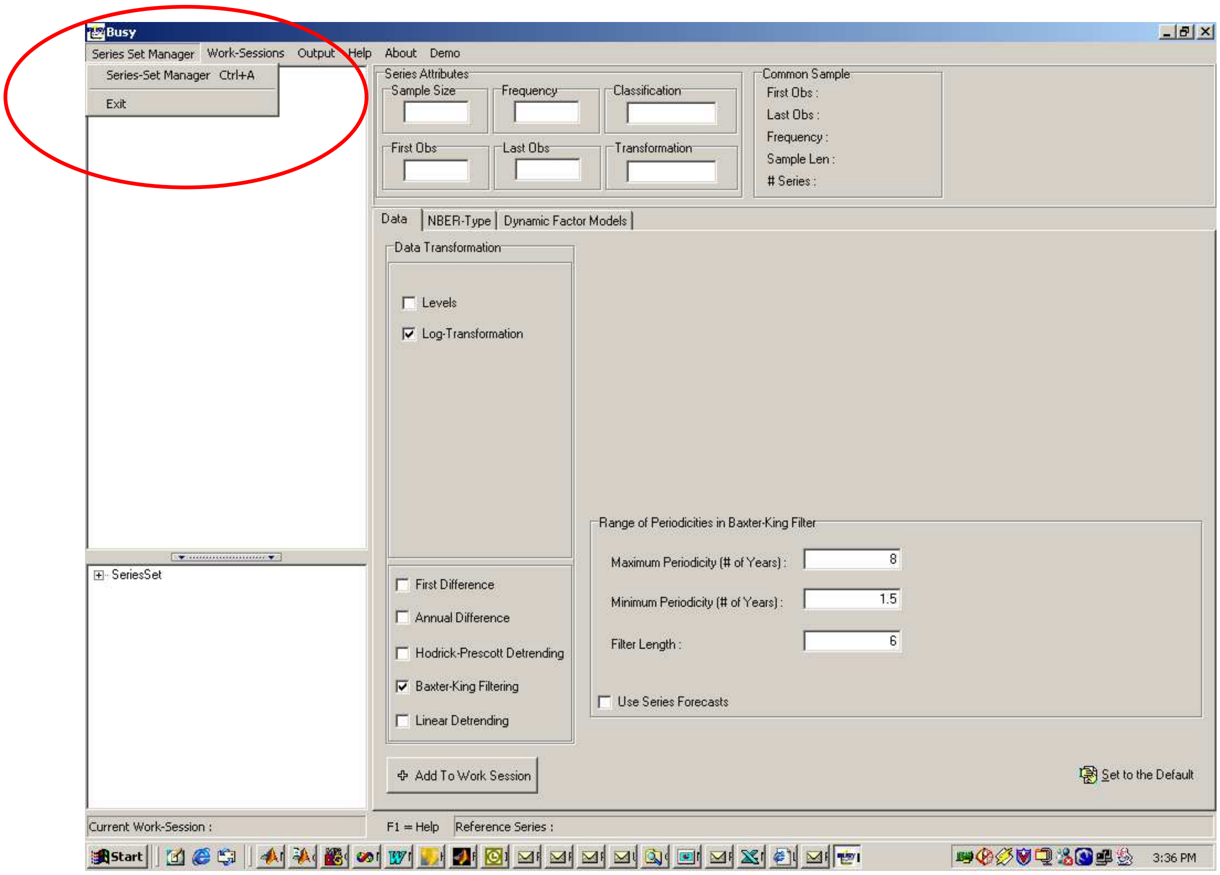
PART 2: USER INSTRUCTIONS

5 GETTING STARTED

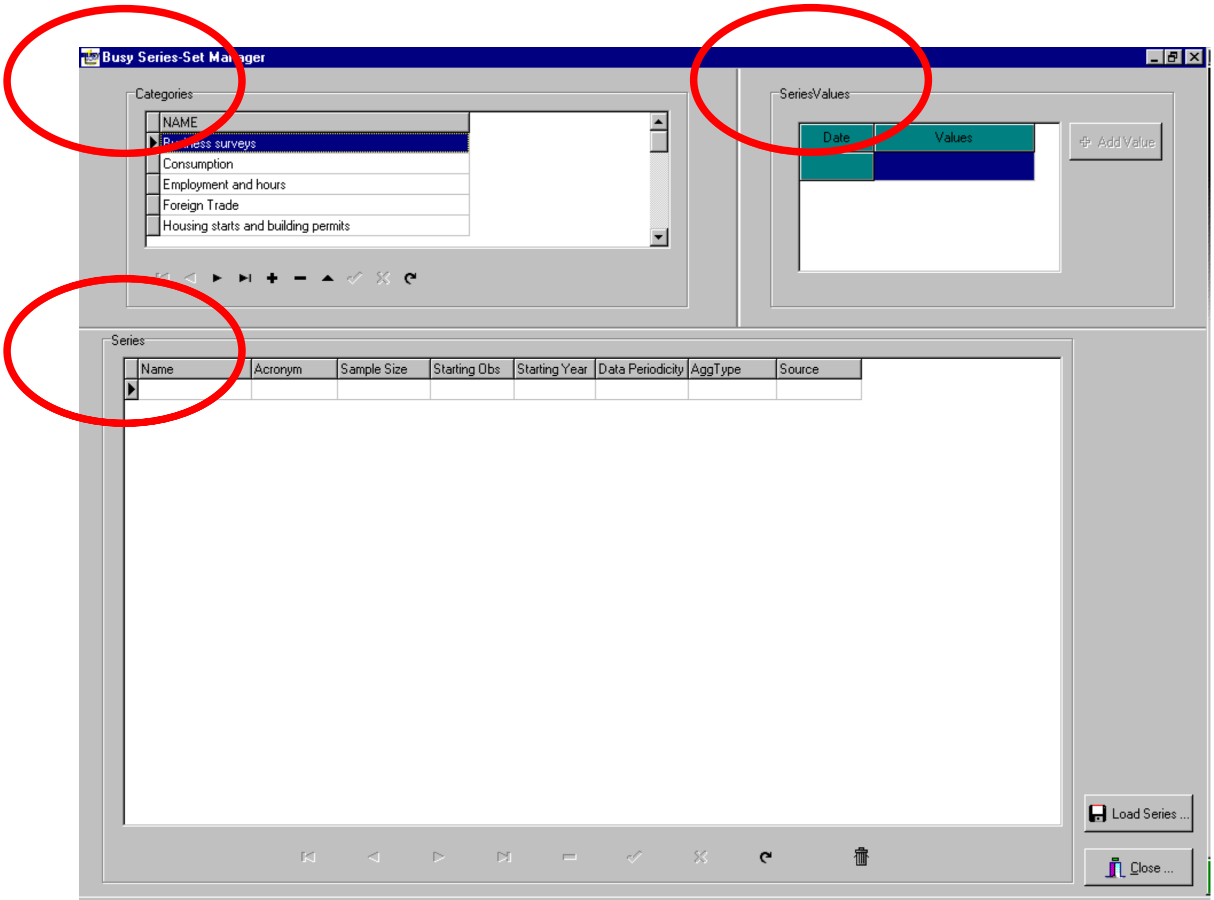


When running the BUSY.EXE file, the screen above appears. On the left side, you can see two different areas: Work-sessions and Series-set. Series-set is the database: Users must start with loading series into the database. You can load series into the database and manipulate them using the Series Set manager, as displayed on next page.

The series set manager is accessible by Alt-S and selecting "Series-Set Manager" and also with the short-cut Ctrl-A. It organises all operations on the database. A copy of the menu can be seen on next page



5.1 The Series Set Manager



The Series Set Manager serves at manipulating series in the database. The screen above is that seen on the first call, when no series has yet been loaded. It can be seen that there are three fields entitled Categories, Series, and Series values. The series set manager also gives the possibility to load series by pressing the button Load Series.

The field "Categories" displays a list of category for socio-economic variables: it is a tool made available in order to organise the data if needed. Every category can be deleted by highlighting and pressing ▬ . In that case all series belonging to that category will be removed from the database together with the category name. Categories can be added by pressing +, typing text, and pressing ✔ for entering data. Existing categories-names can be edited using ▲ and entering the new text using ✔ . The cross ✕ is used for cancelling the edit-mode. Finally the arrows ◀ and ▶ below the table move the cursor up and down the table.

5.1.1 Load Series

Select the category to which you wish to direct the series and press the button Load series. The series loaded will belong to that category, but that can be modified (see 6.1.4).

5.1.2 Input data format

BUSY reads data that can be either in human readable or in Excel files. The data format can be:

*.bpf, where bpf stands for BUSY Partial Format, and
*.bcf, where bcf stands for BUSY Complete Format

With the bpf format, the files contain only numbers. All series must have the same number of observation, so what is actually loaded is a matrix. The series must be displayed in columns, every column being one series. The series name corresponds to the filename plus an integer that corresponds to the number of the column.

With the bcf format, the datafiles embody numbers plus information on the series. The series must be displayed in the following way:

```
Series name
Starting year starting period data-periodicity
xxx  [observation #1]
xxx  [observation #2]
...
$
Series name
Starting year starting period data-periodicity
xxx  [observation #1]
...
xxx  [last observation]
```

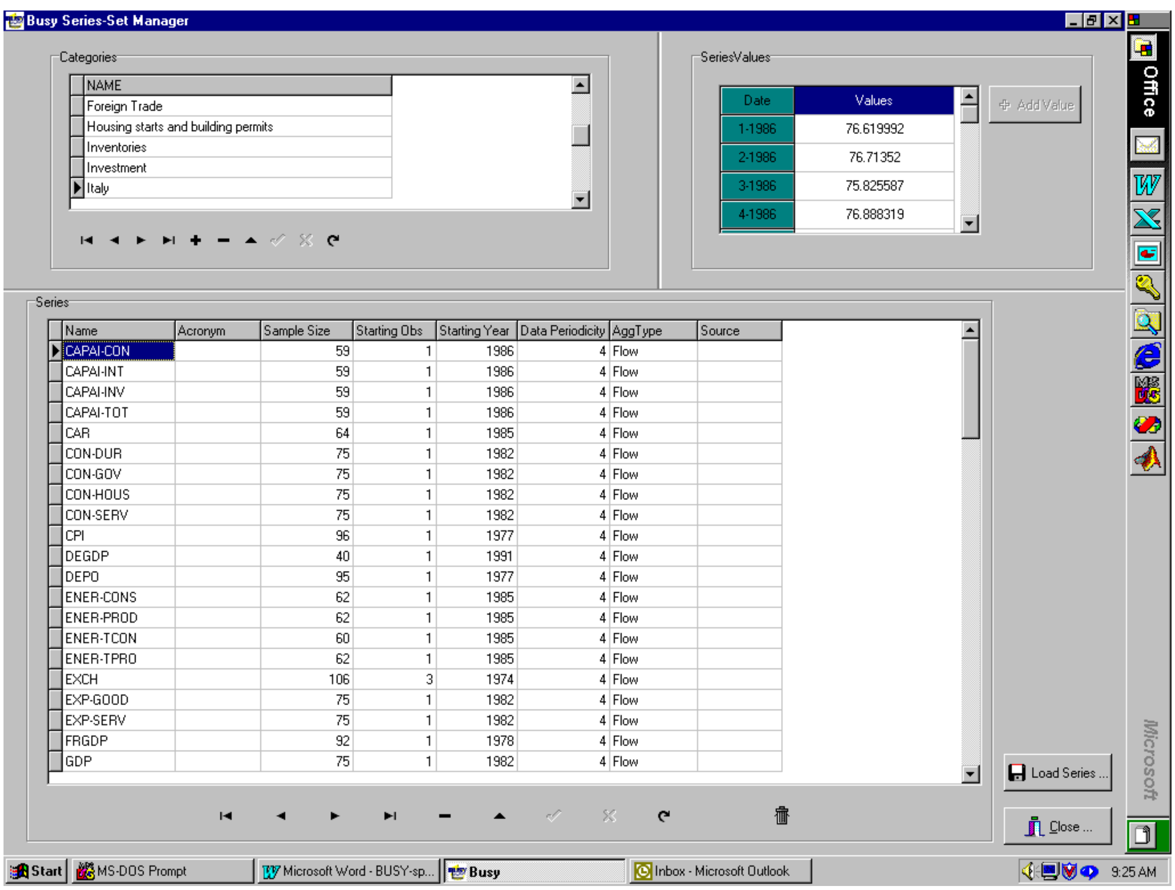
Notice that the series are separated by the symbol "$". With the bcf format, series can have different number of observations and different sample dates. Together with the possibility of inputting series names, this is the main advantage of the bcf format.

In any case, more than one file can be inputted. Excel files can be read with any of the two formats above. **<u>If an Excel file is used for importing a BCF formatted file, then it is necessary that all numbers in the file lie in the first column.</u>**

For example, the file ITALY.BCF that includes 69 series describing the Italian economy is partially reproduced below:

GDP
1982 1 4
341379.66
340857.77
•
•
•
483139.44
484031.57
488066.75
$
IPI-TOT
1981 01 4
84.402332
86.222606
• • •

Examples of inputs files can be seen in the folder C:\Program Files\BUSY\Series. Once the file ITALY.BCF is loaded, the following screen can be seen:



The data do not necessarily have the same sample size and the same periodicity. The symbols at the bottom of the field Series make possible some manipulations as in 5.1.1.

BUSY does not treat missing observations, so series with missing observations cannot be inputted. Users are advised to use the program TRAMO for preliminary treatment of series with missing observations. TRAMO is downloadable at www.bde.es .

Examples of input files can be found in the subdirectory SERIES of the folder where BUSY is installed. Four files can be seen: example1.bcf and example1.bpf for human readable files, ex1bpf.xls and ex1bcf.xls for Excel files.

5.1.3 Modify category assignment

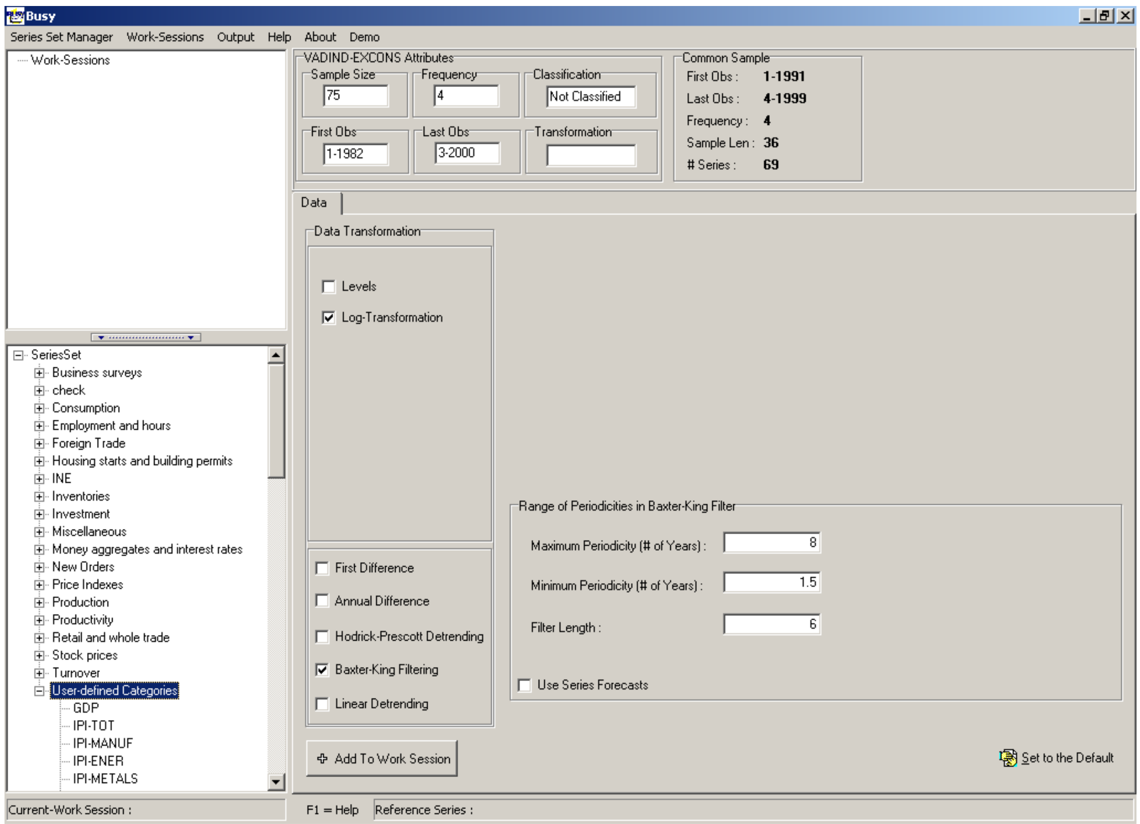
Users can modify the category to which a series belongs by highlighting the series name in the table Series Set of the Series set manager and pressing the right mouse-button. Two options will appear: *Move* and *Clone and Move*; use this last if you wish to make the series belong to several categories.

5.1.4 Aggregation

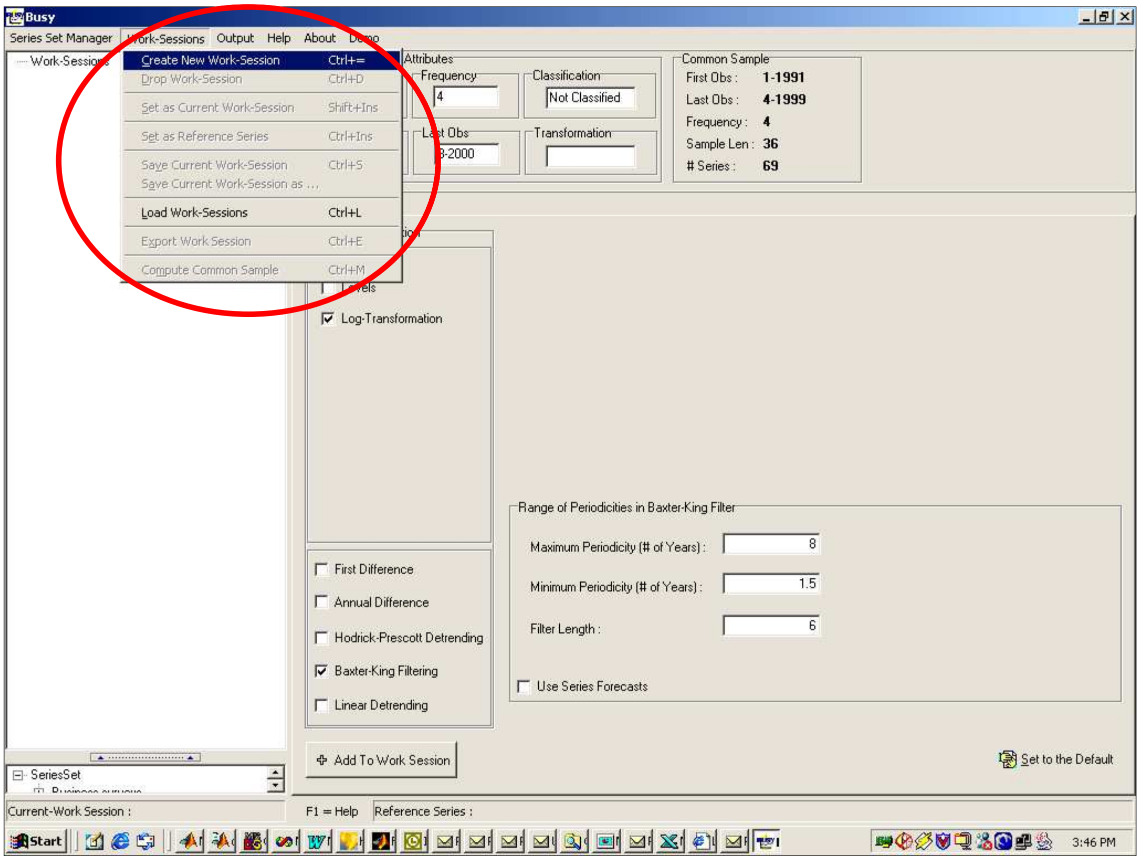
The seventh column of the table entitled Series in the Series Set Manager is Aggregation - see the menu above. When the series do not have the same periodicity, they are transformed so as to all have the same periodicity. The transformation is such that all have the lowest periodicity in the data set. For example, if there are both monthly and quarterly series, then all series are made quarterly. There are three possibilities for that transformation: flow, stock and end of period. Flow leads to cumulate over periods: for example the sum of the three months of every quarter if a monthly series is to be made quarterly. With the stock attribute, averages over periods are taken, so it would be the average of the three months of the quarter. If the attribute End of Period is used, then only the last figure of the period is taken, for example the third month of the quarter.

You can modify the aggregation scheme of every series using View transformation summary in the work session (see Section 5.2.2, p.29).

The Close button enables users to leave the Series Set Manager: all series are now visible of the Series Set sheet:



5.2 Work-session



For starting the analysis, users must first either create a new work-session or load a previously saved work-session. A work-session can either be created using **Create a New Work-Session** in the Work-Session menu or loaded using **Load Work-Session**, still in the Work-Session menu. It is possible to have several work-sessions opened. In that case users must tell BUSY which one is active by highlighting and pressing Alt-W + **Set as Current Work-session** (or Shift-Ins). The current work-session is marked with a right-hand-side blue arrow.

Other possible operations regarding work-sessions are Drop (Ctrl-D), Save as and Export (see Alt-W menu) - see next page.

Once a work session is created, it must be fed with a data set. To do this, users must return to the Series Set.

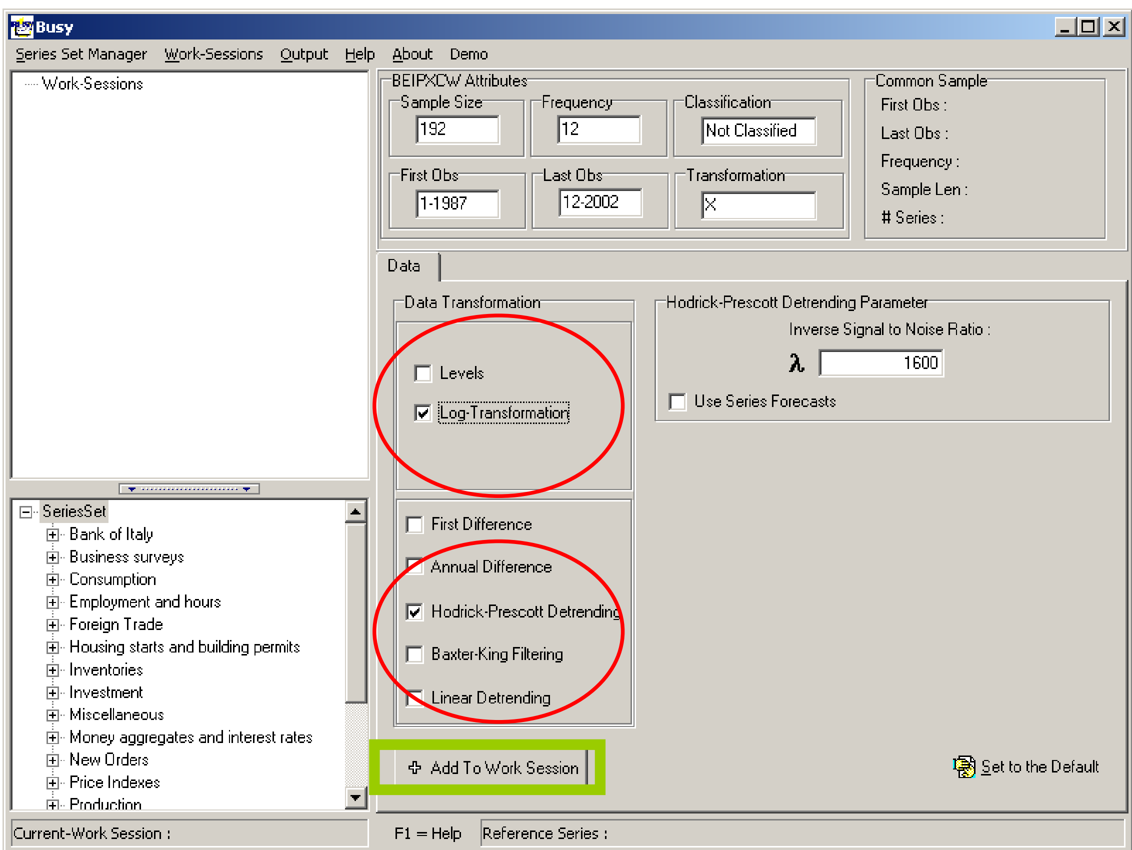
5.2.1. Passing series to Work session - data transformations

For passing series from the Series Set to the Work Session, three operations must be performed.

1) At least one work session must be opened. If more than one work session is opened, then set as active the targeted work-session using Alt-W -Set as Current Work session or Shift+Ins.

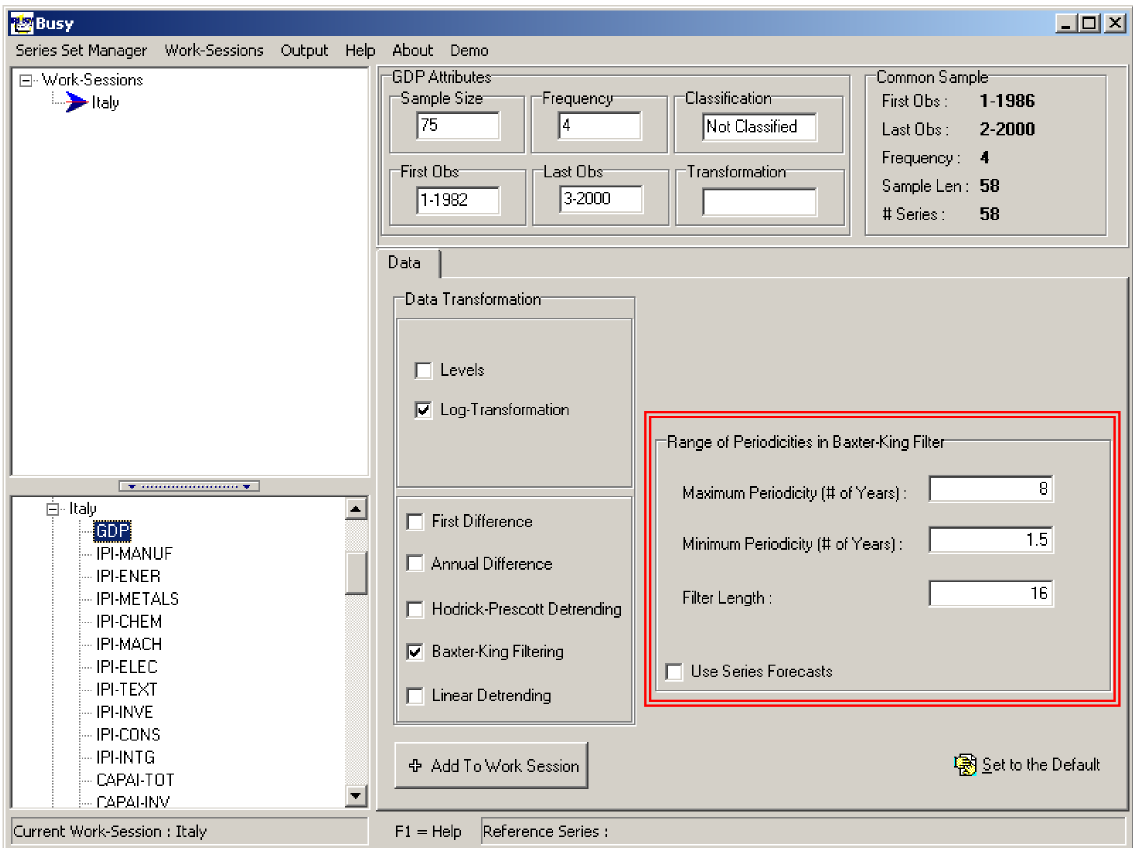
2) As business cycle analysis is performed on series that are made second-order stationary by data-transformation, you must first **select the data transformation** that will be applied to the series. See below 6.2 Data transformation.

3) Once a data transformation has been selected, in the Series Set sheet select either the categories or the series you wish to pass to the work session and press the button **Add to Work Session**.



In case the series have different periodicity - i.e. quarterly and monthly series, the series with higher periodicity (i.e. monthly) are transformed so that their periodicity becomes the lowest one (i.e. quarterly in the example). For the aggregation procedure, see 6.1.5.

Users must choose the data-transformation to be applied to the series before sending them to the work session. The aim of this transformation is to make the series second-order stationary. In order to have a homogenous data set, the same stationary-inducing transformation is applied to all series.



After the preliminary choice to log-transform or not the series (LX or X), users are offered the choice to apply a first difference (DLX or DX), a first difference at annual lags, the Hodrick-Prescott de-trending filter (HPLX or HPLX), the Baxter-King filtering procedure (BKLX or BKX) and a linear detrending. You can always use none of the transformation if you believe that your series is stationary. The parameters for the HP and BK transformation are the following.

- For Hodrick-Prescott detrending, users are asked to enter the **inverse signal to noise** ratio, as can be seen in the screen displayed on previous page. This parameter sets the proportion between the variance of the innovations in the stationary component and the variance of the innovations in the trend of the series. Typical values for quarterly series are 1600 and 400, the higher the parameter the smoother the trend.

- For Baxter-King filtering, users are asked to **enter the range of periodicities** [min. period, max. period] and the filter length. The screen in previous page reproduces the relevant box. For example for quarterly series [6,32] means that all movements with periodicity between 1.5 year and 8 years will be kept in output, the other movements being discarded. The length of the filter is given in one direction, as the filter is symmetric: the longer the filter the closer it is to the ideal band-pass filter, but the more forecasts and backcasts are needed at the series ends. These forecasts and backcasts are computed using autoregressive models whose lengths are automatically selected via the AIC criterion.

Notice that the series must also be free of seasonality, since the seasonal periodicities are outside the range of movements of interest for analysing the business cycle. For facilitating the treatment of seasonality, BUSY gives to possibility to export series into a file that can be used as input by the seasonal adjustment program TRAMO-SEATS (see Gomez and Maravall, 1996; available at www.bde.es). This option is accessible from the work session with the right mouse-button after the relevant series have been highlighted.

The references for the routines implemented are:

Baxter M. and R.G. King (1999) "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series", Review of Economic and Statistics, 81, 4, 575-593 (also NBER WP 5022, 1995).

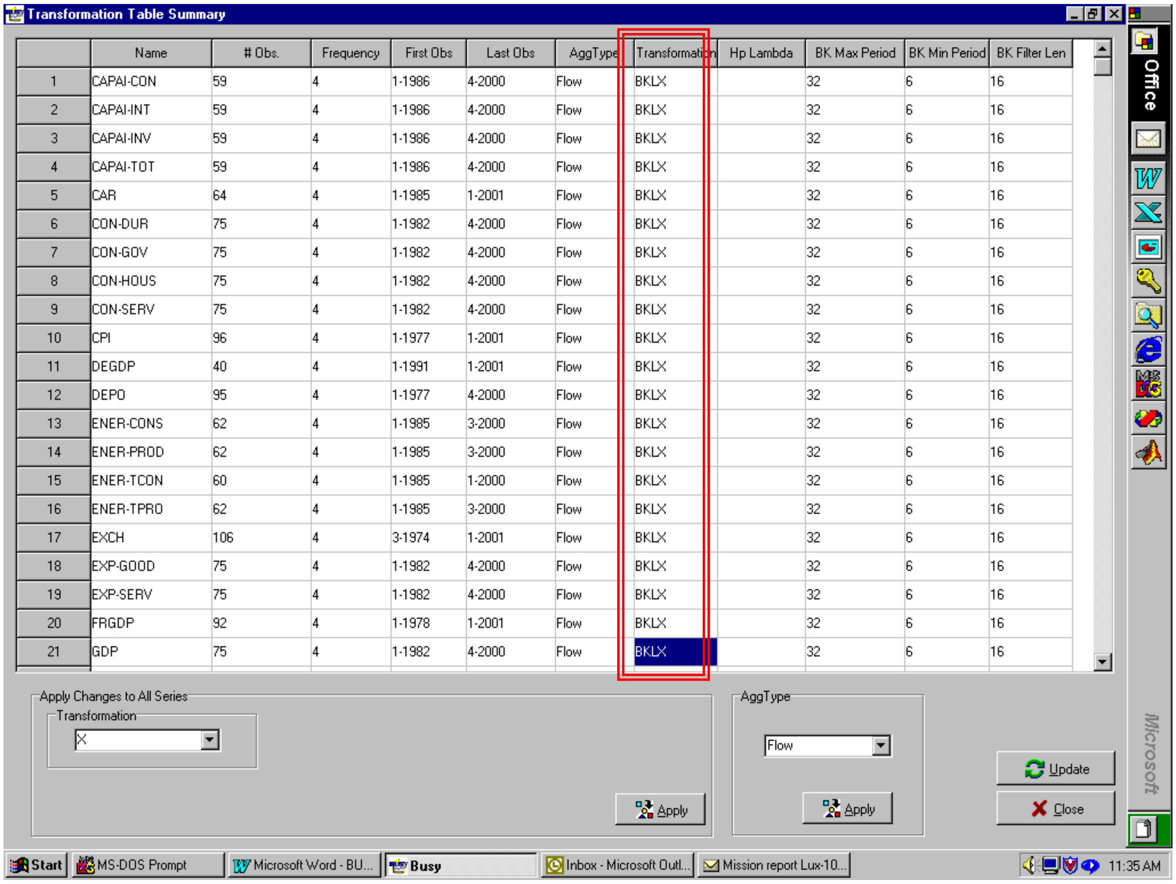
Hodrick R. and Prescott E. (1997), "Post-war business cycles: an empirical investigation", Journal of Money, Credit and Banking, 29, 1, 1-16.

Kaiser, R. and Maravall, A. (2000), "Long-term and short-term trends: the Hodrick-Prescott filter revisited", mimeo, Bank of Spain.

Gomez V. and Maravall, A. (1996), "Programs TRAMO-SEATS: Instructions for the user", working paper 96/28, Bank of Spain.

5.2.2 View data transformation summary

This table can be seen by highlighting the work session heading, pressing the right mouse-button and selecting View Transformation Summary. This table concerns all the data loaded into the work-session.



	Name	# Obs.	Frequency	First Obs	Last Obs	AggType	Transformation	Hp Lambda	BK Max Period	BK Min Period	BK Filter Len
1	CAPAI-CON	59	4	1-1986	4-2000	Flow	BKLX		32	6	16
2	CAPAI-INT	59	4	1-1986	4-2000	Flow	BKLX		32	6	16
3	CAPAI-INV	59	4	1-1986	4-2000	Flow	BKLX		32	6	16
4	CAPAI-TOT	59	4	1-1986	4-2000	Flow	BKLX		32	6	16
5	CAR	64	4	1-1985	1-2001	Flow	BKLX		32	6	16
6	CON-DUR	75	4	1-1982	4-2000	Flow	BKLX		32	6	16
7	CON-GOV	75	4	1-1982	4-2000	Flow	BKLX		32	6	16
8	CON-HOUS	75	4	1-1982	4-2000	Flow	BKLX		32	6	16
9	CON-SERV	75	4	1-1982	4-2000	Flow	BKLX		32	6	16
10	CPI	96	4	1-1977	1-2001	Flow	BKLX		32	6	16
11	DEGDP	40	4	1-1991	1-2001	Flow	BKLX		32	6	16
12	DEPO	95	4	1-1977	4-2000	Flow	BKLX		32	6	16
13	ENER-CONS	62	4	1-1985	3-2000	Flow	BKLX		32	6	16
14	ENER-PROD	62	4	1-1985	3-2000	Flow	BKLX		32	6	16
15	ENER-TCON	60	4	1-1985	1-2000	Flow	BKLX		32	6	16
16	ENER-TPRO	62	4	1-1985	3-2000	Flow	BKLX		32	6	16
17	EXCH	106	4	3-1974	1-2001	Flow	BKLX		32	6	16
18	EXP-GOOD	75	4	1-1982	4-2000	Flow	BKLX		32	6	16
19	EXP-SERV	75	4	1-1982	4-2000	Flow	BKLX		32	6	16
20	FRGDP	92	4	1-1978	1-2001	Flow	BKLX		32	6	16
21	GDP	75	4	1-1982	4-2000	Flow	BKLX		32	6	16

This table displays information about series and the **transformations that have been applied**. For every series you have the possibility to modify the aggregation type (if relevant) by double clicking in the column Aggregation at the line of the relevant series. Similarly, double clicking in the column Transformation at the line of the relevant series enables you to change the transformation that has been applied to the series. You can also modify the parameters of the transformation simply by double-clicking in the relevant case.

Below the table you can see two buttons: Apply and Update. The first can be used if the modifications to the transformation or the aggregation type must be applied to the all series. If the data-transformation or the parameters of the data-transformation are changed, then Update must be pressed for refreshing the table.

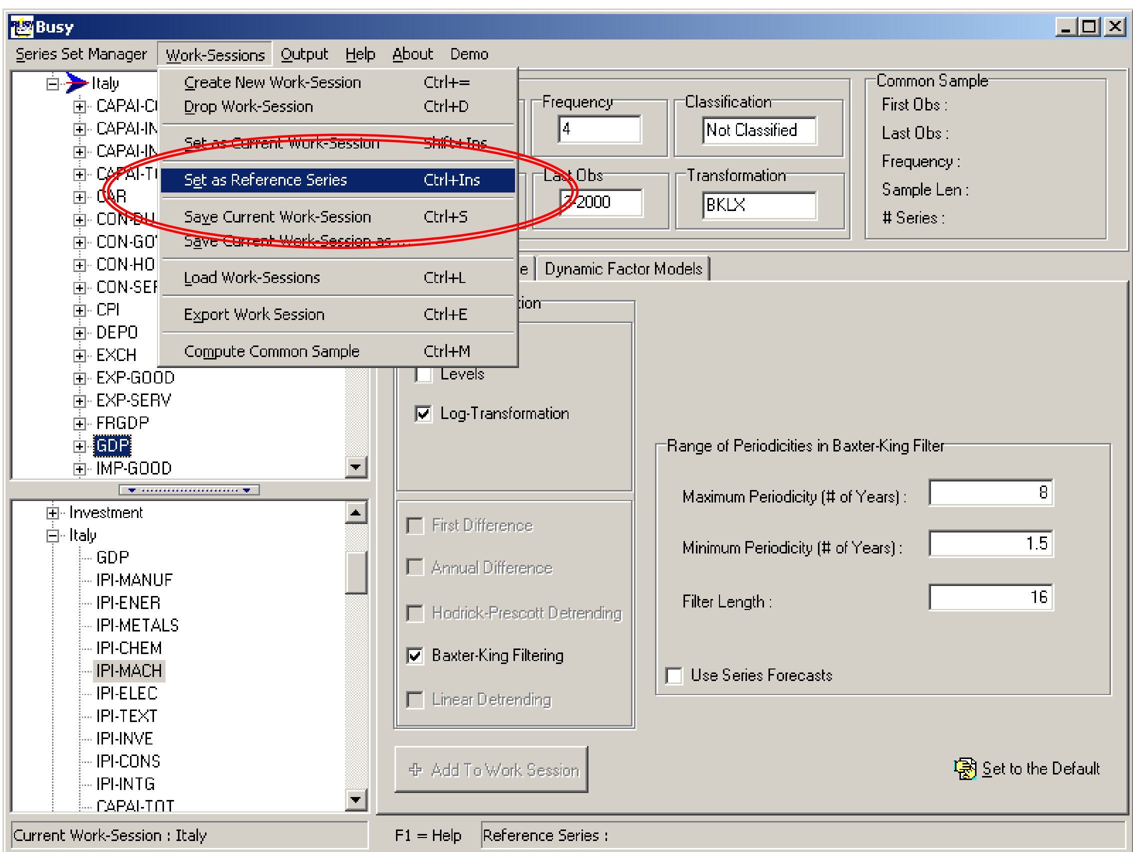
If only a subset of series is highlighted, the option View Selected Data Transformation summary appears when pressing the right-hand side mouse taste. This is like View transformation summary, but information is displayed only for the highlighted series.

5.2.3 Export series

Any series in the work-session can be exported to human-readable or Excel files by highlighting them and pressing the right mouse-button. This is useful, for example, to export composite indicators produced by BUSY.

5.2.4 Select reference series

The business cycle analysis procedures implemented in BUSY use a reference series. This is **necessary** for classifying series as leading, lagging or coincident before composing indices. Hence, the analysis can start only after the reference series has been selected. **Select a reference series by highlighting it and pressing Alt-W + Select as Reference Series** or the short cut Ctrl-Ins, as described in the screen display below.



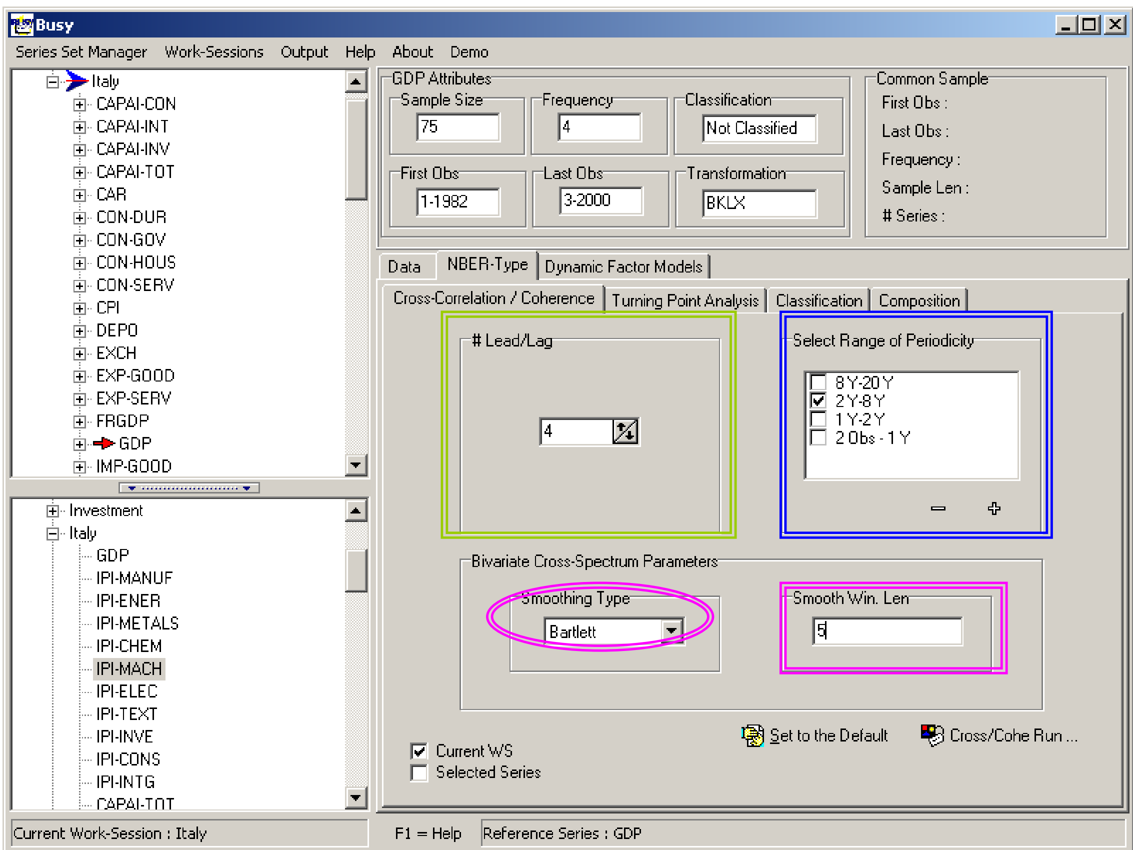
Most often the reference series is the GDP. The analysis can start only when a reference series has been selected. Two sets of procedures are then proposed for developing a business cyclw analysis: NBER-type and dynamic factor models.

6 NBER-TYPE OF ANALYSIS

6.1 Overview

BUSY module entitled "NBER-type" produces several descriptive statistics that serve to classify series with respect to the reference one. The descriptive statistics offered are cross-correlations, coherences, mean delay and turning point analysis. According to the results of these descriptive statistics, data can be manually classified as coincident, leading or lagging with respect to the reference series and eventually aggregated into candidate composite indices. As can be seen on the next menu, there are four sub-menus proposed: cross-correlations/coherences, turning point analysis, classification and composing.

6.2 Cross-correlations / coherences



The field entitled "Lead/Lag" proposes the maximum number of leads and lags to consider when computing the cross-correlations with the reference series.

For the computation of coherences and phases, users can insert the period ranges over which coherences and phases will be averaged. The range of periodicity proposed is used for example in Altissimo et al. (1998). Pressing "+", users can insert any other relevant range.

These last two statistics require to compute spectra and cross-spectra. User can choose which type of smoothing window to use, namely Parzen or Bartlett type, and the length of that window. The number entered is understood as one-directional length.

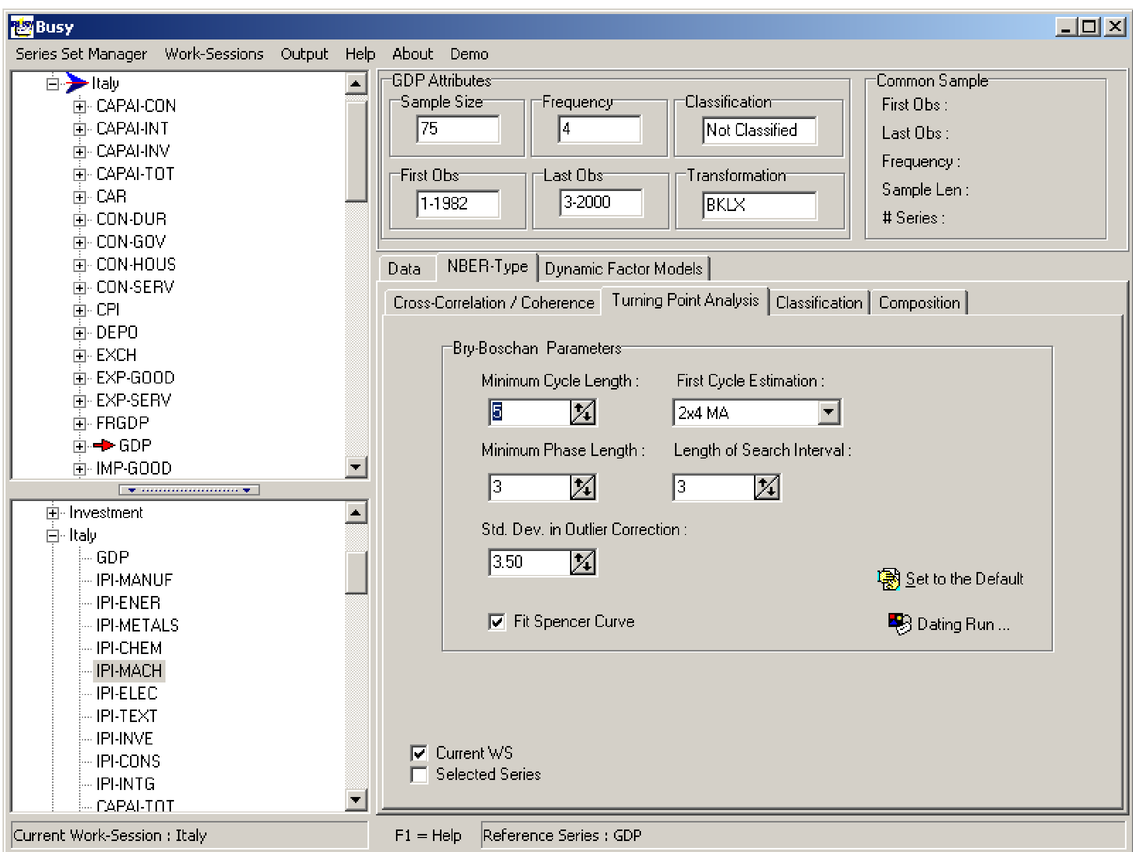
All these bivariate statistics are computed over the sample that is common to the reference series and to every series. The procedures implemented are those that have been described in Section 2.1 Descriptive Statistics. The general references used are:

Fuller, W.A.: (1991) Introduction to Statistical Time Series, Wiley, NewYork.

Priestley, M.B.(1989) Spectral Analysis and Time Series, Academic Press, London

6.3 Turning point analysis

The turning point procedure proposed is based on the one built by Bry and Boschan (1971), with some updates related to the free parameters and to the adaptation of some linear filters involved for the case of quarterly series.



The input screen shows five boxes:

1. Minimum Cycle Length: minimum distance between a peak (trough) and the next peak (trough).
2. First Cycle Estimation: use of 2x4 for quarterly series or 2x12 moving average for monthly series when computing the first cycle estimate.

3. Minimum Phase Length: minimum time-distance between a peak (trough) and a trough (peak).
4. TP look interval. Letting nterm denote the corresponding parameter, the turns are detected as local extreme into time interval [t-nterm,t+nterm].
5. Standard deviation in Outlier correction: points outside of [Mean - Parameter x Std Dev., Mean + Parameter x Std Dev] are treated like outliers.

The procedure implemented is that described in Section 2.2. References are:

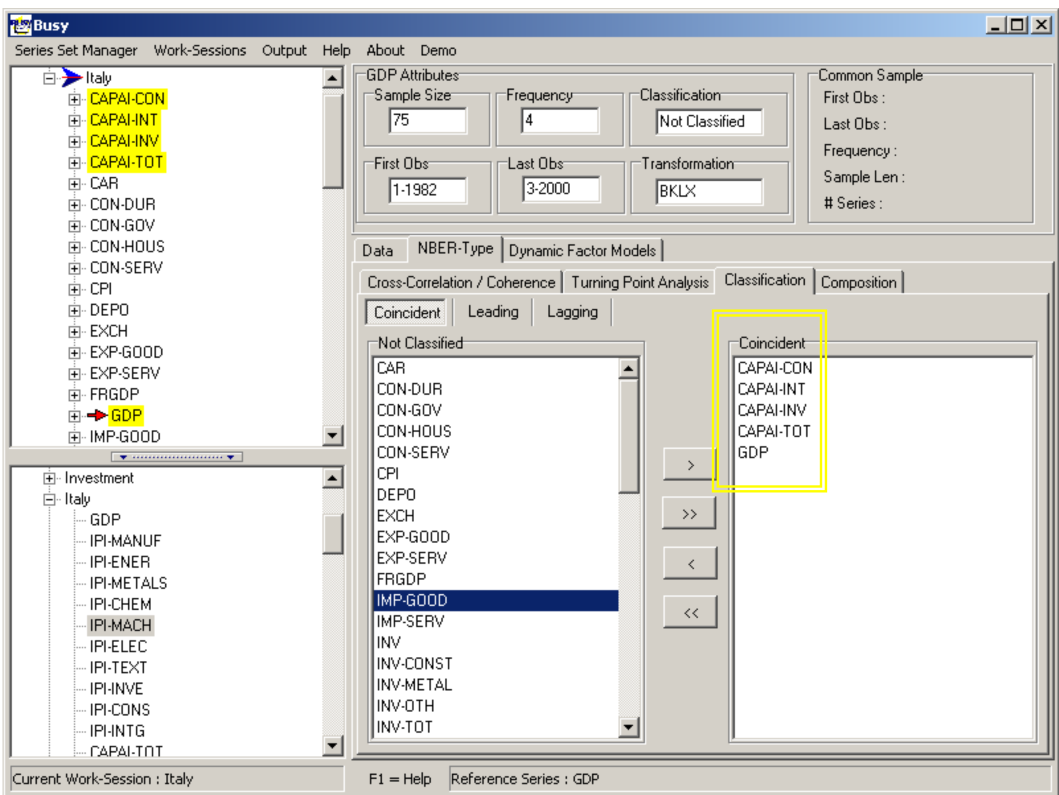
Boschan C. and Bry G. (1971) "Programmed selection of cyclical turning points", in Cyclical Analysis of Time Series: Selected Procedures and Computer Programmes, NBER.

Fayolle, J. (1993) "Decrire le cycle economique", Observations et diagnostics economiques, Revue de l'OFCE, 45, 161-197.

OECD (1987), "OECD Leaqding indicators and business cycle in members countries1960-1985", OECD Main economic Indicators, Sources and Methods, n.39.

6.4 Classification

This screen helps you in classifying the series in four different groups leading, coincident and lagging with respect to the reference series. The fourth group embodies the not-classified series.



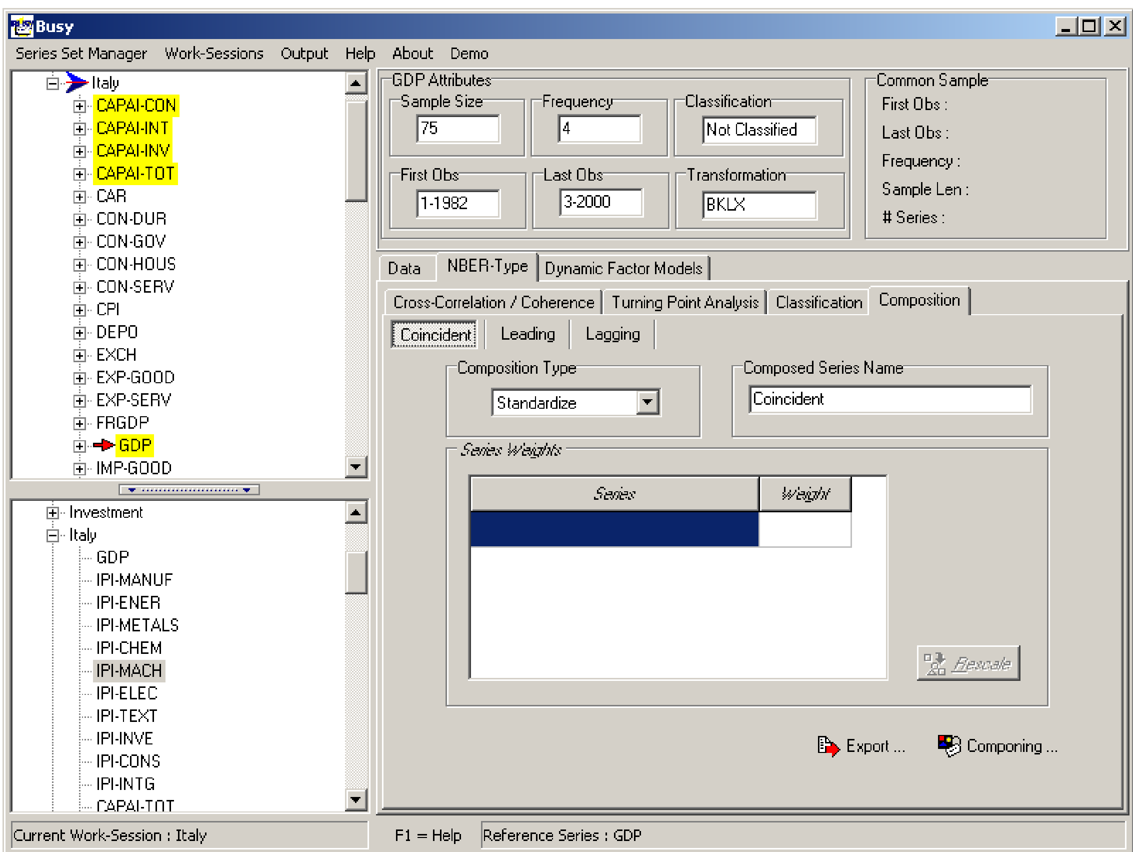
For classifying series, select the target category -i.e. coincident, lagging or leading, then highlight the series to be classified in the column entitled Not classified and press the right-arrow button. The series names in the work-session take different colours according the group to which the series belong. For declassifying series, select the category, highlight the series to be de-classified on the right-hand side column and press the left-arrow button.

That classification should be done on the basis of the results of the descriptive statistics plus turning point analysis. See 6.6 NBER-type of analysis: example and output.

For each category, composite indices can be built using the Composing facility.

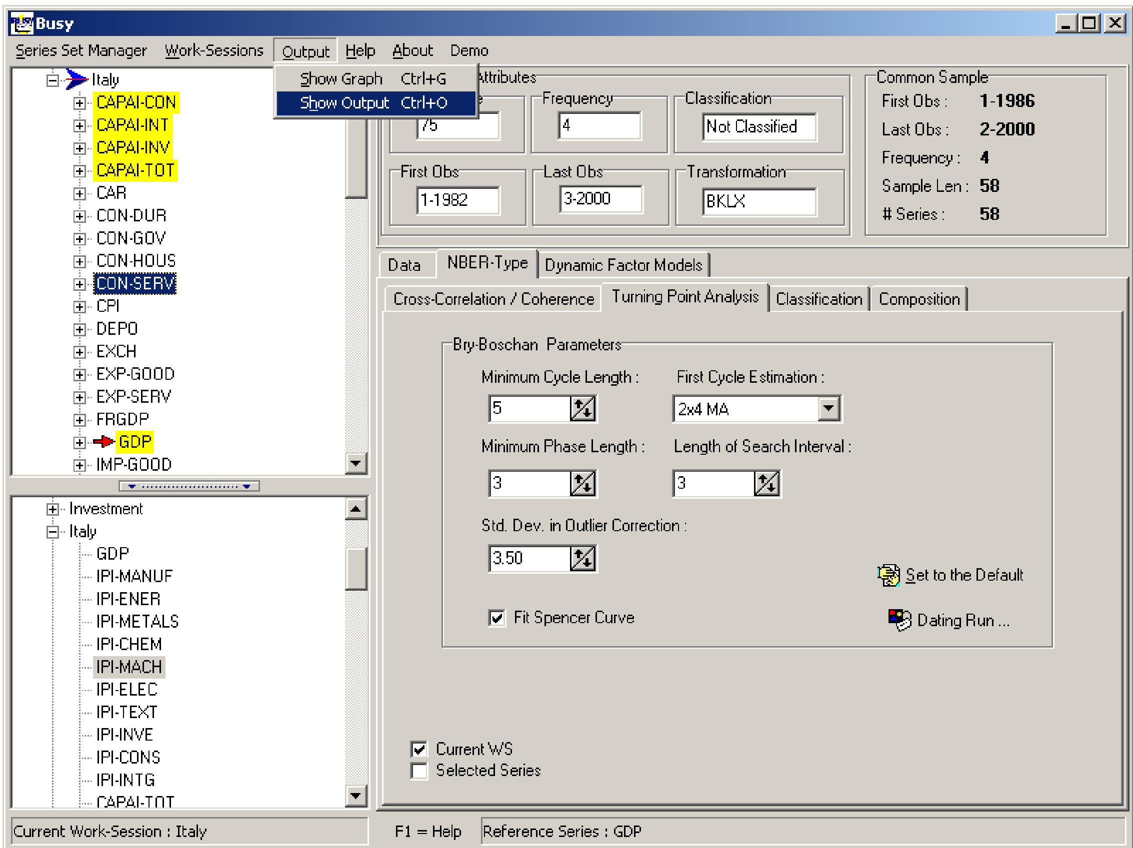
6.5 Composing

There are two options for the building of composite indices. The first is simply to average the series in each category after centering and standardising them -i.e. **all are divided by their standard deviation in order to have a unit variance**. They are actually the stationary transformed series that are aggregated. The second possibility is to input the weights of the aggregation directly. This can be done using the option Weighted in the field Composition Type. Once the button Composing is pressed, the composite index is created and added to the work session. An export facility into either Excel or text file is also offered with the button Export. The composition menu can be seen below.



6.6 Output overview

When the NBER procedures have run, the output is written in a folder named Saved that is a sub-directory of the folder where BUSY has been installed. The output is written under the filename BUSY.htm, and it can be read in Excel as an html-file. The results can also be seen in BUSY using the menu Output facility. The results discussed below are obtained after a run with the input file ITALY.BCF that embodies 58 series describing the Italian economy.



Selecting Show Output leads to the display of an Html-table (see next page).

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Busy Output

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Table 1.1 : Bivariate statistics

Table 2.1 : Turning point analysis

Table 2.2 : Turning Point Sequences

Table 2.3 : Analysis of cycles

Table 1.1: *Bivariate statistics with the Reference Series : GDP*

Series	Characteristics		Coherence	Average Spectrum	Mean Delay	Cross-correlation		
	Transf.	Freq.	2 Y-8 Y	2 Y-8 Y	2 Y-8 Y	r_0	r_{max}	t_{max} (1)
CAPAI-CON	BKLX	4	0.69	0.45	0.10	0.81	0.81	0
CAPAI-INT	BKLX	4	0.47	0.44	0.87	0.62	0.68	1
CAPAI-INV	BKLX	4	0.42	0.46	0.48	0.62	0.63	1
CAPAI-TOT	BKLX	4	0.61	0.45	0.55	0.74	0.76	1
CAR	BKLX	4	0.13	0.44	-0.65	0.35	0.35	0
CON-DUR	BKLX	4	0.49	0.44	-0.52	0.67	0.67	0
CON-GOV	BKLX	4	0.03	0.45	4.42	-0.08	0.23	4
CON-HOUS	BKLX	4	0.66	0.45	-0.34	0.78	0.78	0
CON-SERV	BKLX	4	0.45	0.46	0.05	0.65	0.65	0
CPI	BKLX	4	0.06	0.46	-4.65	-0.06	-0.41	4
DEPO	BKLX	4	0.16	0.43	6.27	-0.34	-0.38	-1
EXCH	BKLX	4	0.09	0.46	6.41	-0.26	-0.35	-2
EXP-GOOD	BKLX	4	0.29	0.44	0.94	0.49	0.49	0
EXP-SERV	BKLX	4	0.03	0.42	-5.50	-0.08	-0.24	2
FRGDP	BKLX	4	0.57	0.46	-0.29	0.73	0.73	0

The left-hand side column gives a fast access to the tables produced. Scrolling downwards on the right-hand side gives access to the full output. This table gives different messages.

Table 1.1 presents a summary of the descriptive statistics coherence, phase, cross-correlations. The coherence indicates the strength of the co-movements between the reference series, i.e. GDP, and every series of the data set. The most important range of periods is 2 years-8 years, where the business cycle is supposed to have its periodicity. For example, we can see that the series Capacity Utilisation in Industry - Construction (CAPAI-CON) and Consumption – Housing (CON-HOUS) has strong commonality with the Italian GDP over the business cycle frequencies. On the other hand the Italian CPI and GDP do not seem to be very much linked over the business cycle frequencies.

The phase - what is actually reported here is the mean delay, measures instead the lead/lag relationship between the GDP and every variable. Coherence and phase are reported on average over the range of periodicity selected. Positive values indicate that the variable is leading with respect to the reference one, and negative values indicate a lag with respect to the reference series. Close to zero values indicate instead a coincidence of movements. For instance, it can be seen that Capacity Utilisation in Industry - Construction and Consumption of Services (CON-SERV) are strongly coincident with GDP.

The cross-correlations between the reference series and the other ones are reported in the last three columns. Only the contemporaneous and the maximum value together with its time of occurrence are reported. If a maximum cross-correlation is found for strictly positive lag in the variable, then is evidence for a leading behaviour of the series with respect to the reference one.

Table 2.1 presented below reports the turns found in the reference series and the delays in the timing of occurrence of the turns in the series.

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Busy Output

Home
Table 1.1 : Bivariate statistics
Table 2.1 : Turning point analysis
Table 2.2 : Turning Point Sequences
Table 2.3 : Analysis of cycles

Table 2.1 : *Turning point analysis: leads and lags with respect to the reference series : GDP*

	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Peak	Trough	Nber of extr
Reference Series	**Q4-1986**	**Q1-1990**	**Q1-1991**	**Q1-1992**	**Q3-1993**	**Q3-1995**	**Q4-1996**	**Q1-1998**	**Q1-1999**	
CAPAI-CON	+5	-3	-	-	0	-1	0	-1	0	0
CAPAI-INT	+5	0	-	-	-3	-1	-1	0	0	0
CAPAI-INV	+2	0	-	-	-1	-1	0	-1	-1	-1
CAPAI-TOT	-	0	-	-	-1	-1	0	-1	0	-1
CAR	-1	-3	0	+1	-	-	-2	-2	-	-1
CON-DUR	0	-	-	+1	0	-4	-2	-2	-	-1
CON-GOV	-	-6	-6	0	-	-	-4	+1	+1	-1
CON-HOUS	0	-	-	0	0	-1	-2	+2	+3	-1
CON-SERV	-	-	-5	-1	-1	-1	+4	-	-	-1
CPI	+6	-	-	-1	+3	+2	-	-	+1	-2
DEPO	-	-	-	-	-	+4	-6	-	-3	-2
EXCH	+3	-3	+4	+5	-	-	-1	-2	-1	-1
EXP-GOOD	+1	-1	-	-	-3	-1	-1	0	+1	-1
EXP-SERV	-1	+2	+2	+3	-	-	-2	-2	-	-1
FRGDP	+1	0	-	-	0	-2	+1	+7	-	-1
IMP-GOOD	-	-4	-4	0	0	-1	-1	0	-	0
IMP-SERV	+6	+2	+2	+2	0	+1	0	+3	-	0
INV	-	-	-5	-3	0	+1	0	+5	-	0
INV-CONST	+4	-	-	0	+5	+3	-	-	-1	-1

Negative (positive) numbers mean that the turn in the series has occurred earlier (latter) than in the reference series. Notice that in this example, the turns detected in the Italian GDP are in agreement with those found in Altissimo et al. (1999) and in Fiorentini and Planas (2001) using a dynamic factor approach.

Table 2.2 reports some descriptive statistics about the delays in the turning point occurrences.

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Table 1.1 : Bivariate statistics

Table 2.1 : Turning point analysis

Table 2.2 : Turning Point Sequences

Table 2.3 : Analysis of cycles

Table 2.2 : *Analysis of turning point sequences with respect to the reference series : GDP*

	Average Lag at			Median Lag at		
w.r.t Reference Series	**P**	**T**	**All**	**P**	**T**	**All**
CAPAI-CON	-1.67	1.25	0.00	-2.00	0.00	-0.50
CAPAI-INT	-0.33	0.25	0.00	-0.50	-0.50	-0.50
CAPAI-INV	-0.67	0.00	-0.29	-1.00	-0.50	-1.00
CAPAI-TOT	-0.67	-0.33	-0.50	-1.00	-0.50	-0.50
CAR	-1.33	-1.00	-1.17	-2.50	-1.50	-1.50
CON-DUR	-1.67	-0.67	-1.17	-3.00	-1.00	-1.00
CON-GOV	-1.67	-3.00	-2.33	-3.00	-5.00	-2.00
CON-HOUS	0.33	0.25	0.29	-0.50	0.00	0.00
CON-SERV	-1.00	-0.67	-0.80	-1.00	-3.00	-1.00
CPI	0.50	3.33	2.20	0.50	2.00	1.50
DEPO	4.00	-4.50	-1.67	4.00	-4.50	-4.50
EXCH	0.00	1.25	0.71	-2.50	1.00	-1.00
EXP-GOOD	-0.67	-0.50	-0.57	-1.00	0.00	-1.00
EXP-SERV	1.00	-0.33	0.33	0.00	-1.50	0.50
FRGDP	1.67	0.67	1.17	-1.00	0.50	0.50
IMP-GOOD	-1.25	-1.67	-1.43	-0.50	-2.50	-1.00
IMP-SERV	2.00	2.00	2.00	2.00	1.00	2.00
INV	1.00	-1.67	-0.33	-1.00	-2.50	0.00

Finally, Table 2.3 reports statistics about the cycles in every series. The table is displayed on next page. The average length of cycles spanning from peak to peak, spanning from trough to trough and of phases spanning from peak to trough and from trough to peak are displayed. It gives information about the symmetry in the cyclical dynamic. No srong asymmetry can be seen in the cycle in the Italian GDP over the time period 1986-1 2000-2.

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Table 1.1 : Bivariate statistics

Table 2.1 : Turning point analysis

Table 2.2 : Turning Point Sequences

Table 2.3 : Analysis of cycles

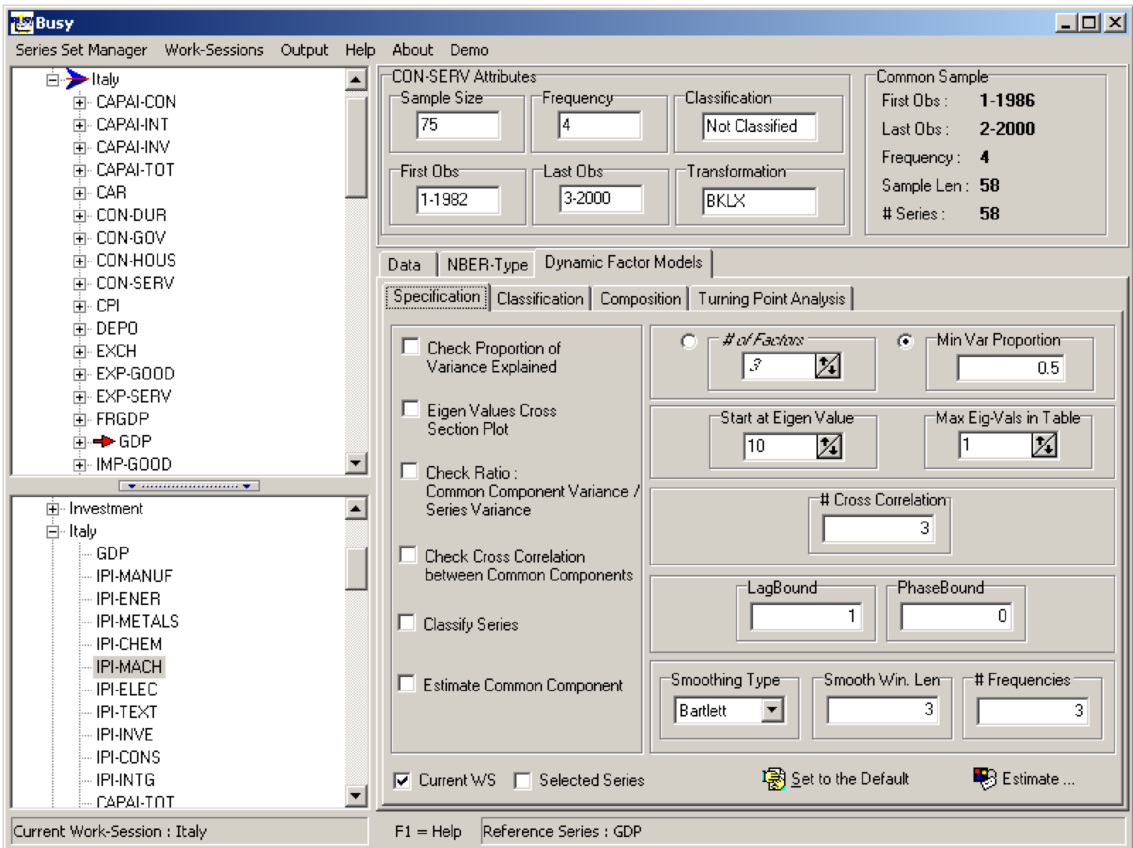
Table 2.3 : *Analysis of cycles with respect to the reference series : GDP*

Phases and cycles average duration				
	P to T	**P to P**	**T to P**	**T to T**
Reference Series	**4.75**	**10.00**	**7.50**	**11.50**
CAPAI-CON	8.00	13.67	5.33	14.00
CAPAI-INT	6.00	14.00	8.00	14.00
CAPAI-INV	7.67	15.00	7.67	14.67
CAPAI-TOT	8.00	15.00	6.00	11.00
CAR	11.50	16.00	7.00	19.00
CON-DUR	6.00	10.00	10.33	18.50
CON-GOV	7.67	19.00	10.00	19.00
CON-HOUS	5.00	12.50	12.33	16.67
CON-SERV	9.00	16.00	8.00	15.50
CPI	11.50	17.00	10.50	21.50
DEPO	6.00	10.00	5.00	12.00
EXCH	9.67	16.00	5.33	14.33
EXP-GOOD	7.33	16.00	9.00	15.67
EXP-SERV	9.00	13.50	8.67	19.00
FRGDP	11.00	19.00	9.67	19.50
IMP-GOOD	5.00	11.33	7.00	12.50
IMP-SERV	4.00	10.33	7.50	10.67

7 DYNAMIC FACTOR MODEL

This module gives access to the approach developed by Forni et al. (1999, 2000) that has been detailed in Section 3. There are four main screens: specification, classification, composition and turning point analysis. The first is presented below.

7.1 Specification



As can be seen, users can choose between six operations, none of them being exclusive, and can tune eight options.

7.1.1 Check proportion of variance explained

If selected, BUSY produces a table that shows at every frequency considered the proportion of variance explained by up to QMAX factors. Typically, the number of factors, say Q, is selected so that between roughly 50% and 70% of the total variance is explained. The box entitled Max. number of eigenvalues in table allows users to enter QMAX for the table above. The default value QMAX=10. Users can also select the number of common factors in the data set with using the box entitled # of Factors.

7.1.2 Eigen values cross section plot.

If selected, BUSY produces a plot of all eigenvalues against the cross-section section dimension. BUSY starts with computing NSTART eigenvalues of the spectral density matrix evaluated on the subset of the NSTART first series. Then the cross section dimension is increased to NSTART+1 and the NSTART eigenvalues are recomputed. And so on increasing the cross section dimension one series by one until the full data set. A plot of the NSTART eigen values against the cross section dimension is then produced - see Output-Graph . If Q common factors are present into the data set, it is expected that Q eigenvalues show an explosive behaviour.

The box entitled Start at eigenvalues enables users to enter NSTART.

See also FORNI M., M. HALLIN, LIPPI M. and L. REICHLIN (2000), "The Generalised Dynamic Factor Model: Identification and Estimation", Review of Economics and Statistics, 82, 4, 540-554.

Warning! If the number of series is large, then this operation can be time-consuming, since the spectral density matrix would be evaluated N-NSTART times.

7.1.3 Check ratio common component variance over series variance

If selected, BUSY produces a table that displays for every series the ratio of the common component variance over the series variance. Series that have a strong commonality with the data set have a high ratio (close to 1), while series that are almost independent of the others will have a low ratio. This last type of series is not very useful for the analysis of commonality, so it is advised to discard them. That table is thus a help to the variable selection. Notice that the ratios obviously depend on the number of common factors used in the analysis: the higher the number of factors, the higher the ratios.

7.1.4 Check cross-correlations between common components

If selected, BUSY produces a table (Table 3.3) that displays for every series the cross-correlations between its common component and the common component of the reference series. If a series common component has small cross-correlations with the reference series common component, and that the aim of the analysis is to describe and anticipate the reference series, then it is advisable to discard such series from the analysis. That table thus also helps in the variable selection.

The box entitled Max. number of cross-correlations enables users to enter the maximum number of cross correlations to check.

If $\mathbf{x}_t$ is the reference series and $\mathbf{y}_t$ a series of the data set and if both are standardised, Table 3.3 displays the estimate of $\mathbf{E}[\mathbf{x}_t \mathbf{y}_{t-lag}]$, so high correlations at positive lags indicates a leading behaviour of variable $\mathbf{y}_t$ with respect to the reference variable.

Warning!!! BUSY imposes the constraints that the maximum number of cross-correlations reported is less or equal to the number of frequencies where the spectral density matrix is evaluated.

7.1.5 Classify series

If selected, all series are automatically classified as leading, coincident or lagging with respect to the reference variable. The classification is operated by checking the slope of the phase (or mean delay) of the cross-spectra between the common components of every series and of the reference series. That slope is computed at the first frequency used in the spectral density estimation as $\Sigma_{\chi}^{q}(\omega_1)/\omega_1$. The classification obeys to the rule:

- Leading series if Mean delay < -Lagbound
  The series common components anticipate the reference series common component by more than Lagbound periods.
- Lagging series if Mean delay > Lagbound
  The series common component lags the reference series common component by more than Lagbound periods.
- Coincident series if -Lagbound < Mean delay < Lagbound

7.1.6 Estimate common components

If selected, BUSY estimates the common components. There are two related options that are mutually exclusive: either to enter the number of factor using

- Set number of factor
  or specify a minimum proportion of variance that should be explained
- Set Min. Proportion of Variance to Explain
  In this last case, BUSY automatically chooses the number of factors.

Notice that the common component of series that are in phase opposition with the reference series (for example GDP and Unemployment) is reversed, i.e. multiplied by –1. A series is classified in phase opposition if its cross-spectrum with the reference series is less than PhaseBound at the 0-frequency. The default value is 0: this amount to say that series are classified in phase opposition when the sum of its cross-correlations with the reference series at all leads and lags is negative.

7.1.7 Other input parameters

Users have also the choice of selecting several options related to the estimation of the spectral density matrix of the data set:

- The Type of smoothing window for spectral density estimates. The choice is between Bartlett or Parzen window.
- The Smoothing Window Length i.e. the number of covariances used in calculating the spectral density matrix.
- The Number of frequencies M in $(0,\pi)$ where the spectral density matrix will be evaluated. I If T is the time dimension of the data set, Forni et al. (2000) recommends M = round(sqrt(T)/4). Notice that the total number of points in $[0, 2\pi]$ is 2M+1.

The dynamic factor model approach runs on the sub-sample that is common to all variables of the data set.

Output overview

Like for the NBER output, the results are visible either using Output - Show output on the menu bar or opening the BUSY.HTM file in Excel. The following tables are displayed.

Table 3.1 shows the proportion of variance explained at the different frequencies considered. The spectral density matrix is here evaluated at M=5 frequencies in (0,π) and 2 common factors are used.

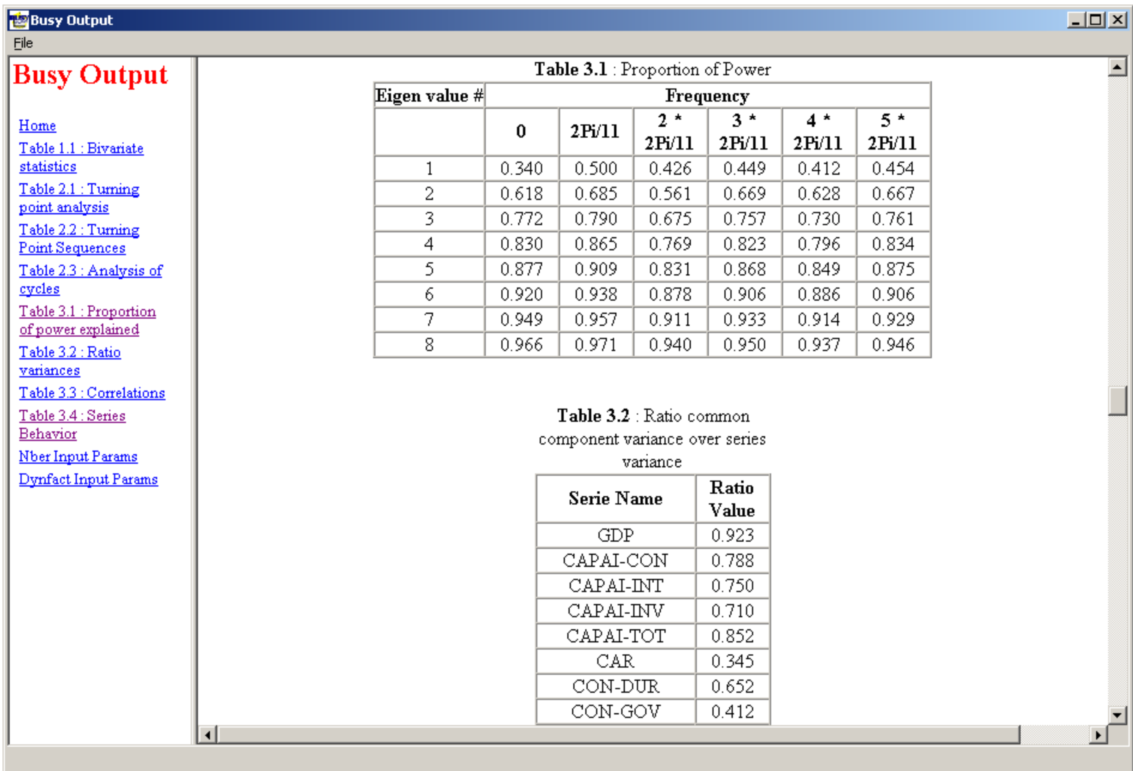


Table 3.1 : Proportion of Power

Eigen value #	Frequency					
	0	2Pi/11	2 * 2Pi/11	3 * 2Pi/11	4 * 2Pi/11	5 * 2Pi/11
1	0.340	0.500	0.426	0.449	0.412	0.454
2	0.618	0.685	0.561	0.669	0.628	0.667
3	0.772	0.790	0.675	0.757	0.730	0.761
4	0.830	0.865	0.769	0.823	0.796	0.834
5	0.877	0.909	0.831	0.868	0.849	0.875
6	0.920	0.938	0.878	0.906	0.886	0.906
7	0.949	0.957	0.911	0.933	0.914	0.929
8	0.966	0.971	0.940	0.950	0.937	0.946

Table 3.2 : Ratio common component variance over series variance

Serie Name	Ratio Value
GDP	0.923
CAPAI-CON	0.788
CAPAI-INT	0.750
CAPAI-INV	0.710
CAPAI-TOT	0.852
CAR	0.345
CON-DUR	0.652
CON-GOV	0.412

Table 3.2 displayed on next page shows the ratio common component variance over series. The scroll-bar must be used for a full display. It can be seen on that screen that capacity utilisation in industry series have a strong commonality with the data set. On the other hand, Car Registration, Bank Deposits and Exports of Services are almost idiosyncratic. These variable can be removed from the analysis.

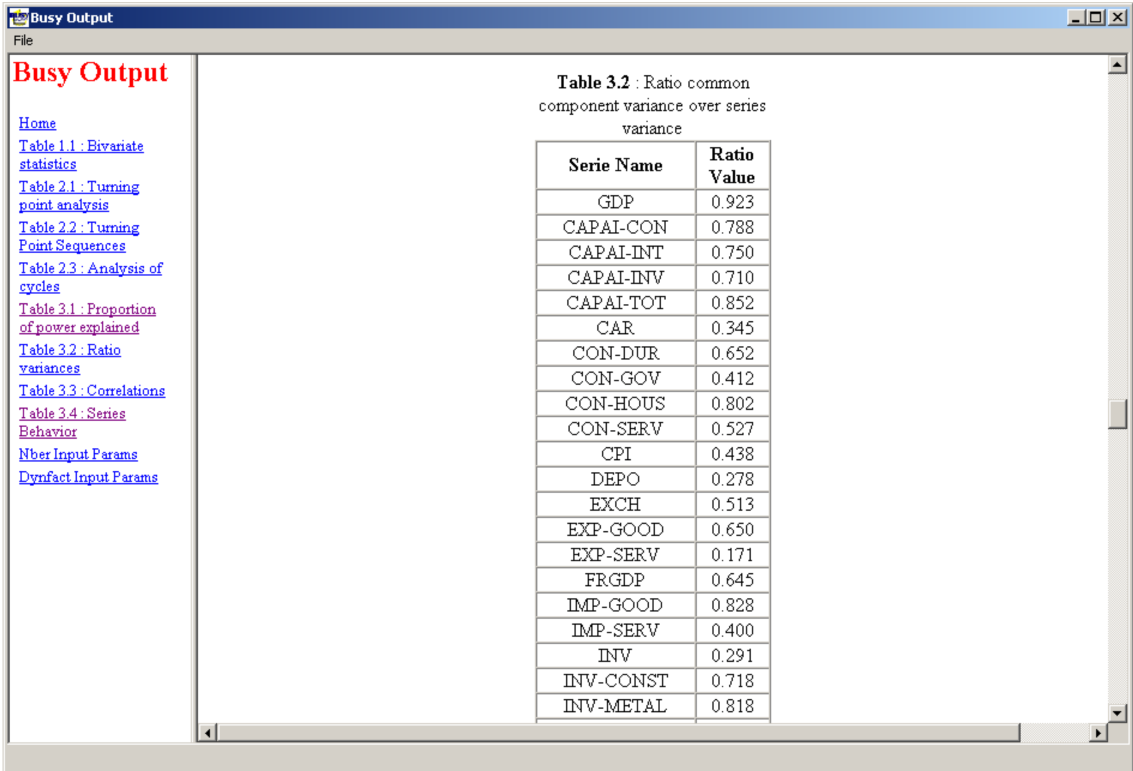


Table 3.2 : Ratio common component variance over series variance

Serie Name	Ratio Value
GDP	0.923
CAPAI-CON	0.788
CAPAI-INT	0.750
CAPAI-INV	0.710
CAPAI-TOT	0.852
CAR	0.345
CON-DUR	0.652
CON-GOV	0.412
CON-HOUS	0.802
CON-SERV	0.527
CPI	0.438
DEPO	0.278
EXCH	0.513
EXP-GOOD	0.650
EXP-SERV	0.171
FRGDP	0.645
IMP-GOOD	0.828
IMP-SERV	0.400
INV	0.291
INV-CONST	0.718
INV-METAL	0.818

Table 3.3 in next page shows the cross-correlations between the common component of the series and the common part of the reference series. High cross-correlation at positive (negative) lag is an evidence of a leading (lagging) behaviour with respect to the reference series. It is seen that most of series has a behaviour that is coincident with GDP, with the highest correlation occurring contemporaneously. Government consumption, CON-GOV, is in phase opposition, as most of the cross-correlations are negative. It is lagging GDP, like the consumer price index (CPI), the import of services (IMP-SERV), and the investment in construction industry (INV-CONST). Finally, the Export of Services (EXP-SERV), Industrial Production Index for Chemistry (IPI-CHEM), for Consumption Goods (IPI-CONS) and for electrical goods sectors (IPI-ELEC) are slightly leading GDP although EXP-SERV has opposite fluctuations.

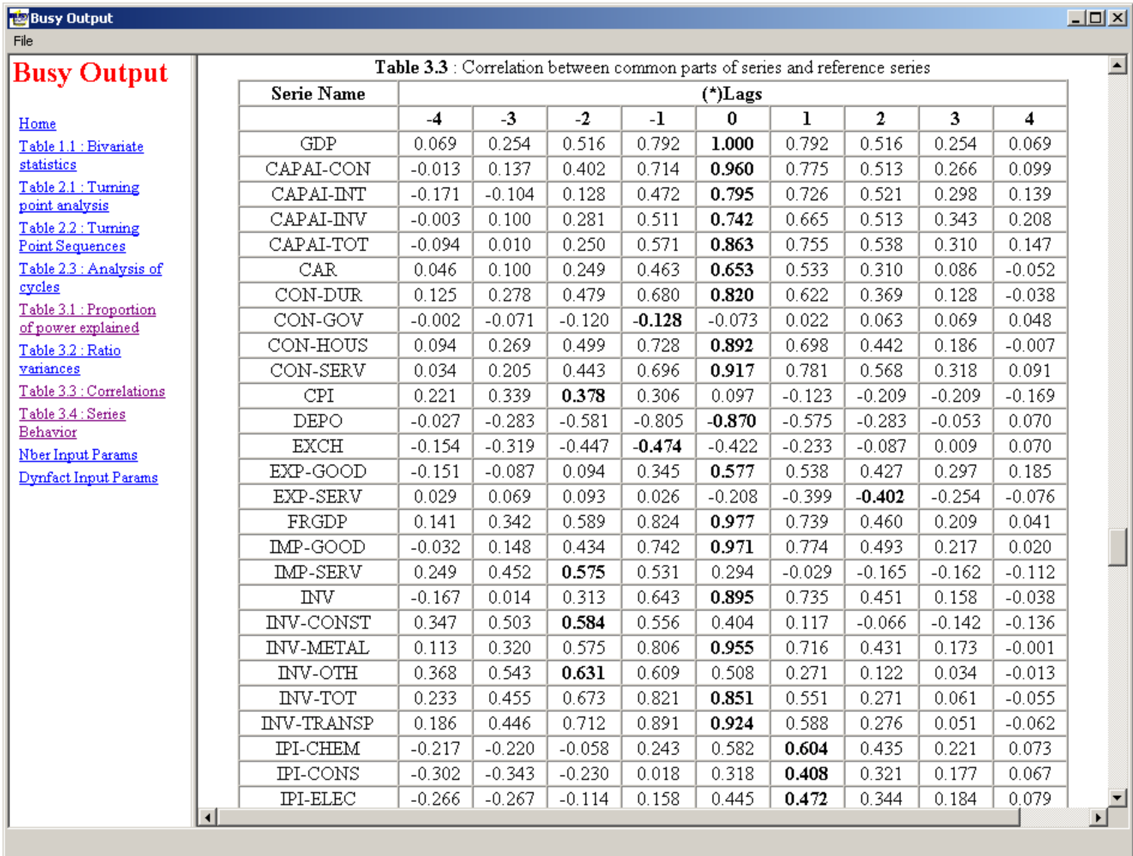
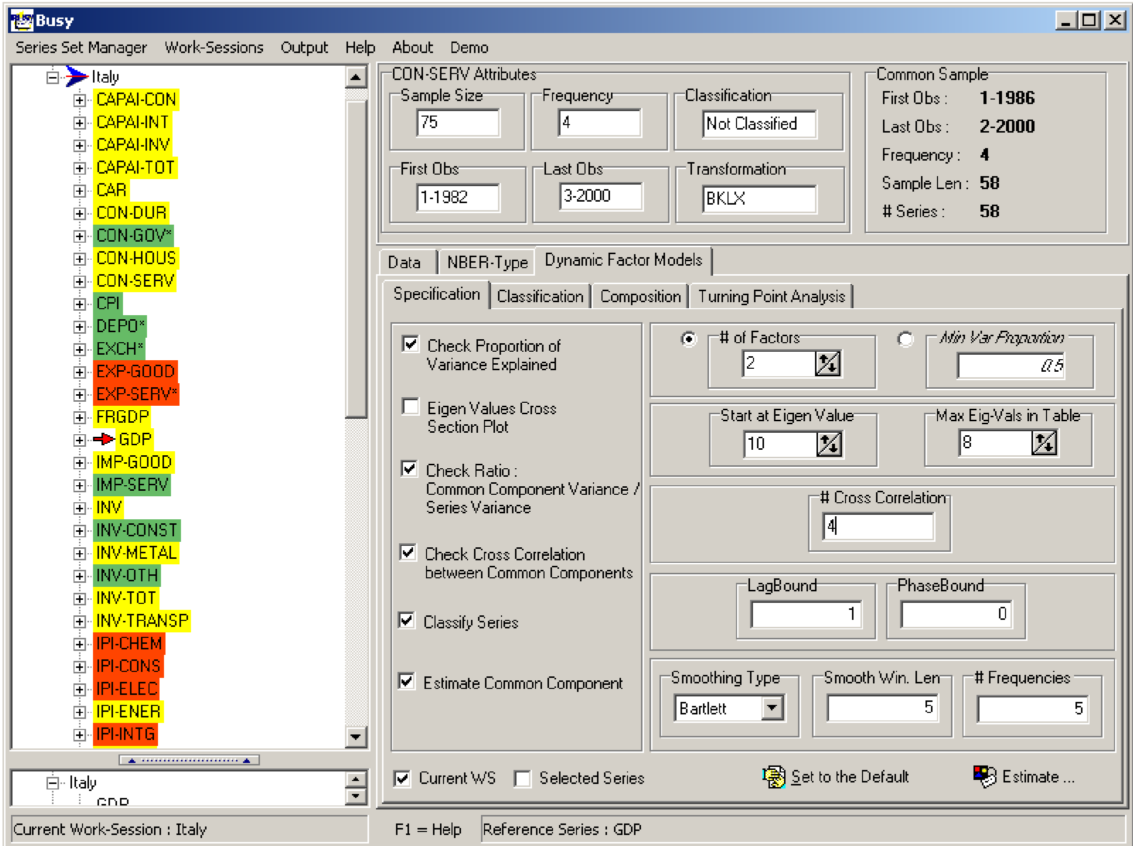


Table 3.3 : Correlation between common parts of series and reference series

Serie Name	(*)Lags								
	-4	-3	-2	-1	0	1	2	3	4
GDP	0.069	0.254	0.516	0.792	**1.000**	0.792	0.516	0.254	0.069
CAPAI-CON	-0.013	0.137	0.402	0.714	**0.960**	0.775	0.513	0.266	0.099
CAPAI-INT	-0.171	-0.104	0.128	0.472	**0.795**	0.726	0.521	0.298	0.139
CAPAI-INV	-0.003	0.100	0.281	0.511	**0.742**	0.665	0.513	0.343	0.208
CAPAI-TOT	-0.094	0.010	0.250	0.571	**0.863**	0.755	0.538	0.310	0.147
CAR	0.046	0.100	0.249	0.463	**0.653**	0.533	0.310	0.086	-0.052
CON-DUR	0.125	0.278	0.479	0.680	**0.820**	0.622	0.369	0.128	-0.038
CON-GOV	-0.002	-0.071	-0.120	**-0.128**	-0.073	0.022	0.063	0.069	0.048
CON-HOUS	0.094	0.269	0.499	0.728	**0.892**	0.698	0.442	0.186	-0.007
CON-SERV	0.034	0.205	0.443	0.696	**0.917**	0.781	0.568	0.318	0.091
CPI	0.221	0.339	**0.378**	0.306	0.097	-0.123	-0.209	-0.209	-0.169
DEPO	-0.027	-0.283	-0.581	-0.805	**-0.870**	-0.575	-0.283	-0.053	0.070
EXCH	-0.154	-0.319	-0.447	**-0.474**	-0.422	-0.233	-0.087	0.009	0.070
EXP-GOOD	-0.151	-0.087	0.094	0.345	**0.577**	0.538	0.427	0.297	0.185
EXP-SERV	0.029	0.069	0.093	0.026	-0.208	-0.399	**-0.402**	-0.254	-0.076
FRGDP	0.141	0.342	0.589	0.824	**0.977**	0.739	0.460	0.209	0.041
IMP-GOOD	-0.032	0.148	0.434	0.742	**0.971**	0.774	0.493	0.217	0.020
IMP-SERV	0.249	0.452	**0.575**	0.531	0.294	-0.029	-0.165	-0.162	-0.112
INV	-0.167	0.014	0.313	0.643	**0.895**	0.735	0.451	0.158	-0.038
INV-CONST	0.347	0.503	**0.584**	0.556	0.404	0.117	-0.066	-0.142	-0.136
INV-METAL	0.113	0.320	0.575	0.806	**0.955**	0.716	0.431	0.173	-0.001
INV-OTH	0.368	0.543	**0.631**	0.609	0.508	0.271	0.122	0.034	-0.013
INV-TOT	0.233	0.455	0.673	0.821	**0.851**	0.551	0.271	0.061	-0.055
INV-TRANSP	0.186	0.446	0.712	0.891	**0.924**	0.588	0.276	0.051	-0.062
IPI-CHEM	-0.217	-0.220	-0.058	0.243	0.582	**0.604**	0.435	0.221	0.073
IPI-CONS	-0.302	-0.343	-0.230	0.018	0.318	**0.408**	0.321	0.177	0.067
IPI-ELEC	-0.266	-0.267	-0.114	0.158	0.445	**0.472**	0.344	0.184	0.079

A good practice is to isolate the series that are mostly idiosyncratic and those that are not much correlated with the common part of GDP and to restart the analysis with these series excluded.

Notice that BUSY has proceeded to an automatic classification of the series: the yellow series are those found coincident with GDP, the red the leading ones and the green for the lagging ones.



The classification of every series is also reported in Table 3.4, together with the series in phase opposition. Within the work session, the series found in phase opposition are displayed with a * besides their names. We reproduce Table 3.4 on the next two pages in order to show the type of results that one can expect.

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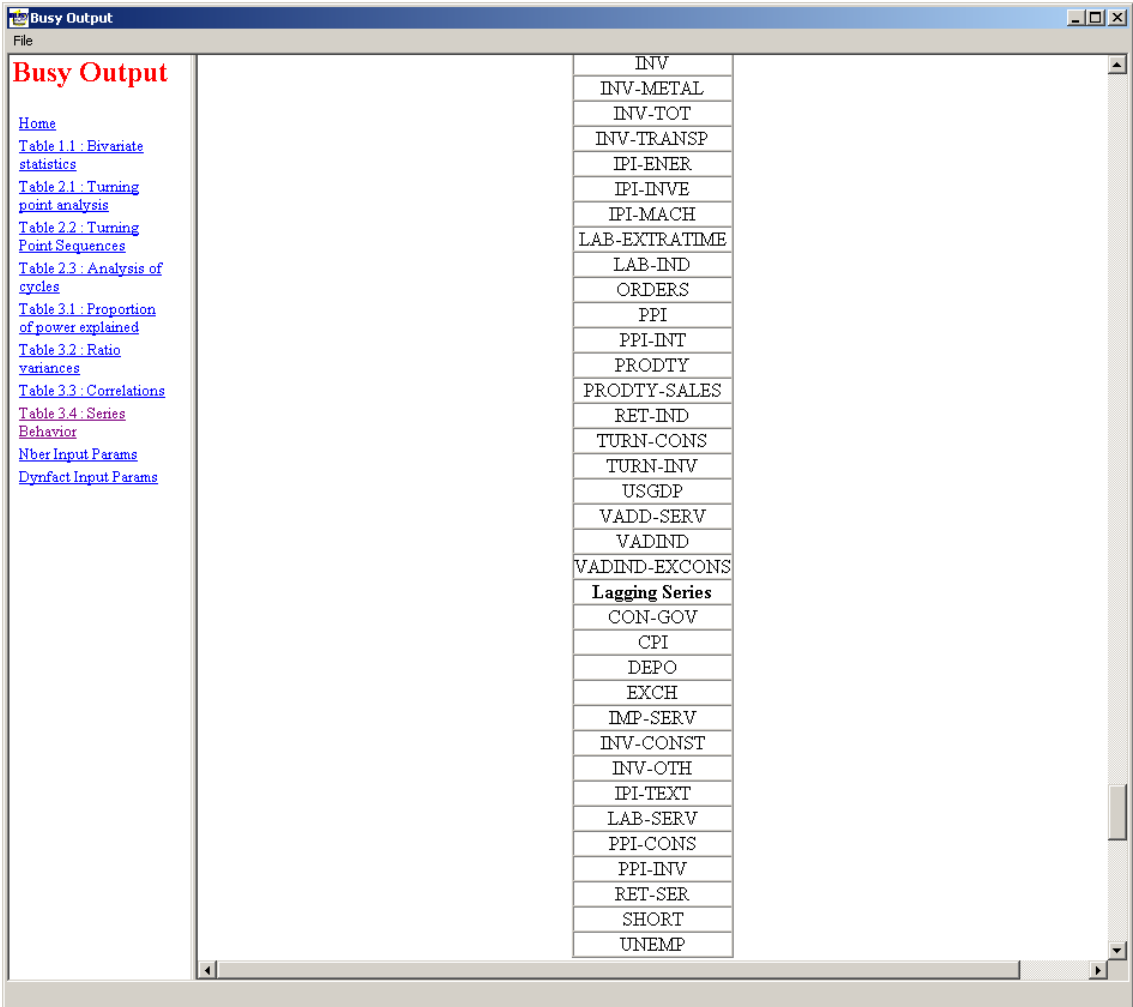
Table 3.4 : Series Behavior
Nber Input Params
Dynfact Input Params

Table 3.4 : Series behavior with respect to reference series

Phase Opposition
CON-GOV
DEPO
EXCH
EXP-SERV
IPI-TEXT
TURN-CONS
UNEMP
Leading Series
EXP-GOOD
EXP-SERV
IPI-CHEM
IPI-CONS
IPI-ELEC
IPI-INTG
IPI-MANUF
IPI-METALS
NEWORD
TURN-IND
TURN-INT
UKGDP
Coincident Series
CAPAI-CON
CAPAI-INT
CAPAI-INV
CAPAI-TOT
CAR
CON-DUR
CON-HOUS
CON-SERV
FRGDP
IMP-GOOD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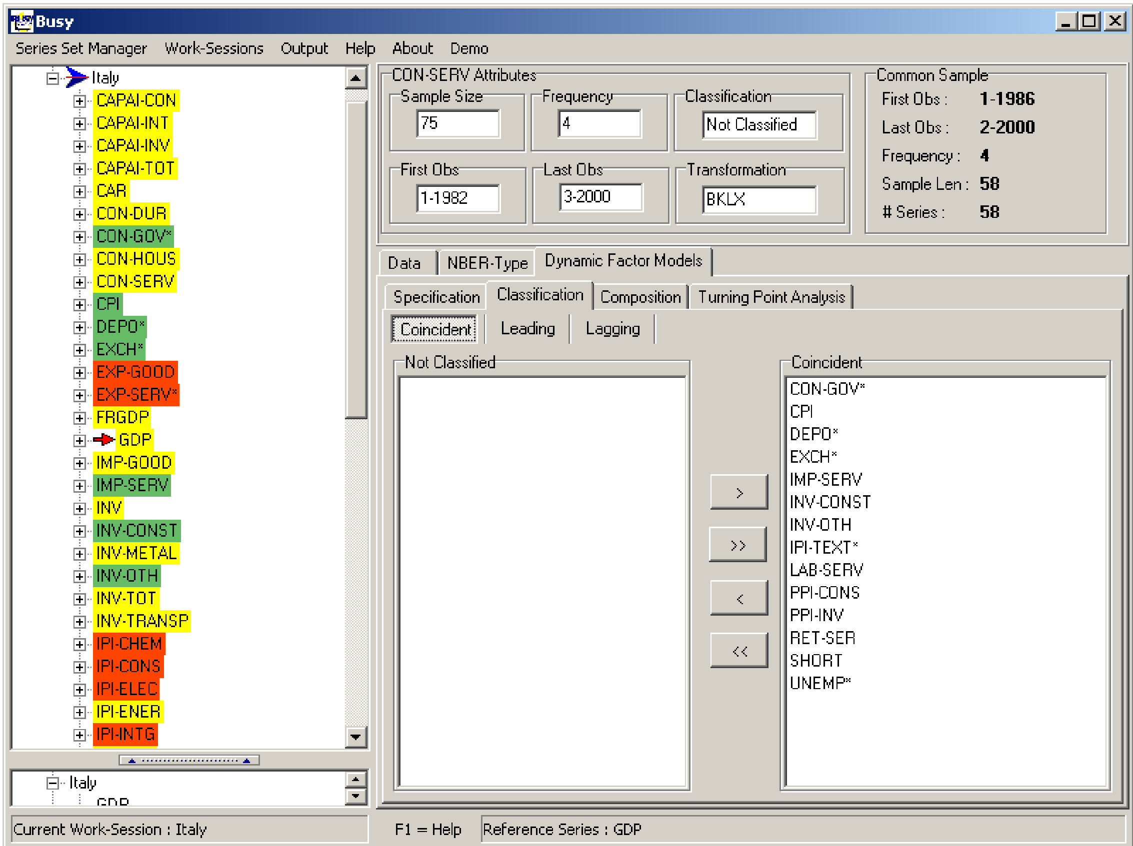
Nber Input Params
Dynfact Input Params
INV
INV-METAL
INV-TOT
INV-TRANSP
IPI-ENER
IPI-INVE
IPI-MACH
LAB-EXTRATIME
LAB-IND
ORDERS
PPI
PPI-INT
PRODTY
PRODTY-SALES
RET-IND
TURN-CONS
TURN-INV
USGDP
VADD-SERV
VADIND
VADIND-EXCONS
Lagging Series
CON-GOV
CPI
DEPO
EXCH
IMP-SERV
INV-CONST
INV-OTH
IPI-TEXT
LAB-SERV
PPI-CONS
PPI-INV
RET-SER
SHORT
UNEMP

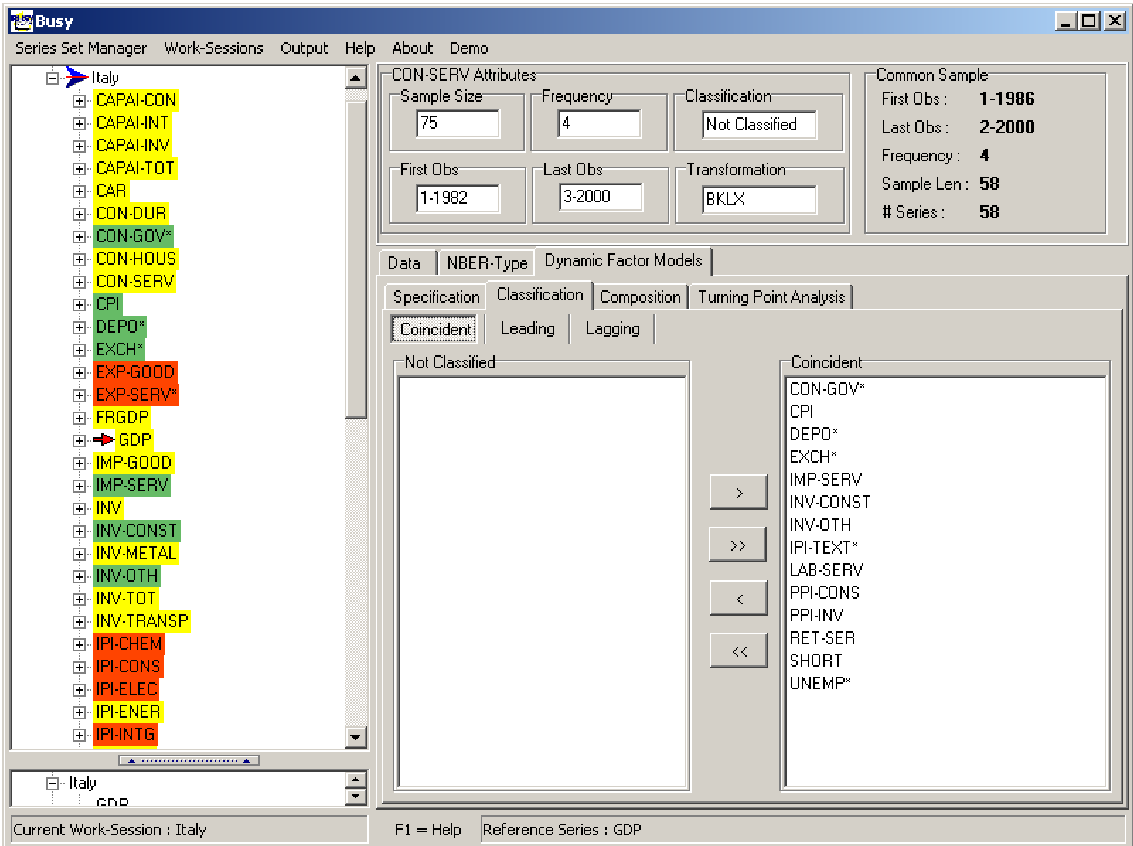
7.2 Classification

The classification that is obtained automatically can be modified using the panel Classification that is reproduced below.



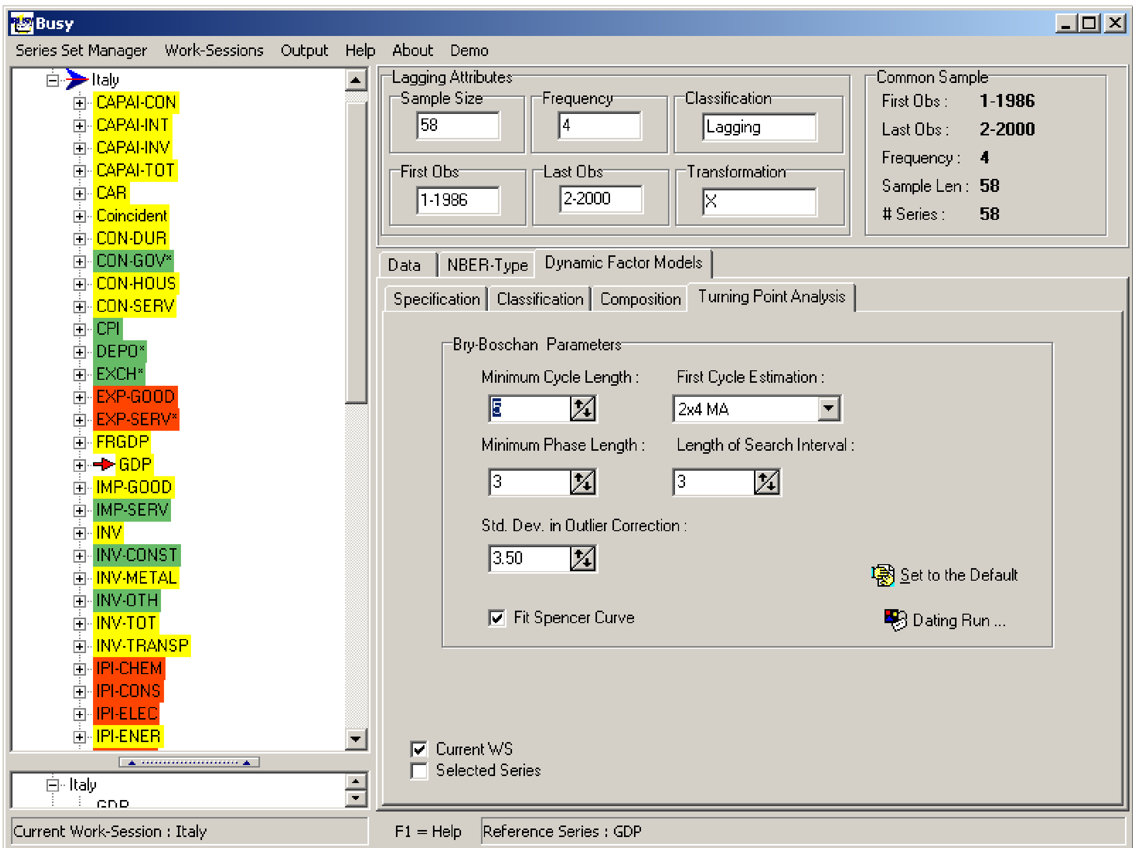
7.3 Composition

The panel Composition enables users to build leading, lagging and coincident indices by aggregating the series previously classified. The Export facility allows the saving of the compsite indices.



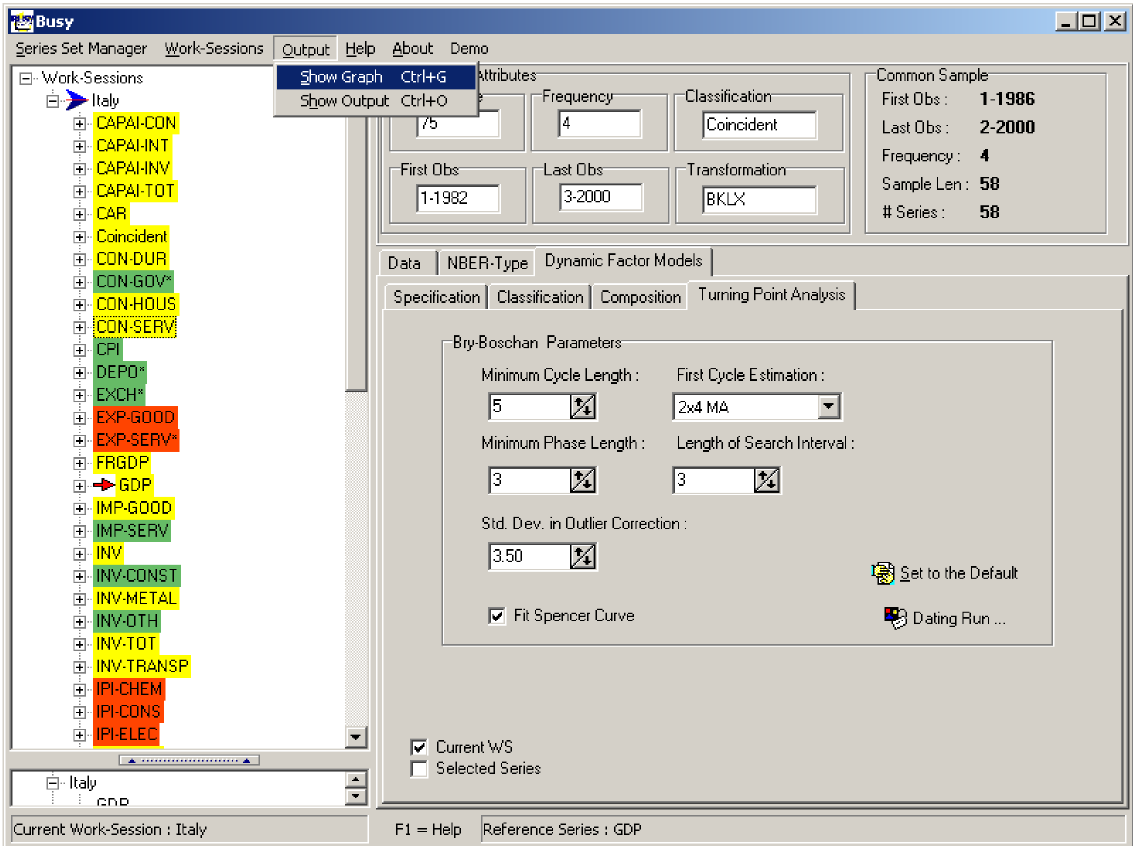
7.4 Turning point analysis

A turning point analysis can be run on the common part of the series and on the composite indices using the panel Turning Point Analysis. It is still the Bry and Boschan procedure, like for NBER-type of analysis, apart that here it is run on the series cleaned on idiosyncratic movements.

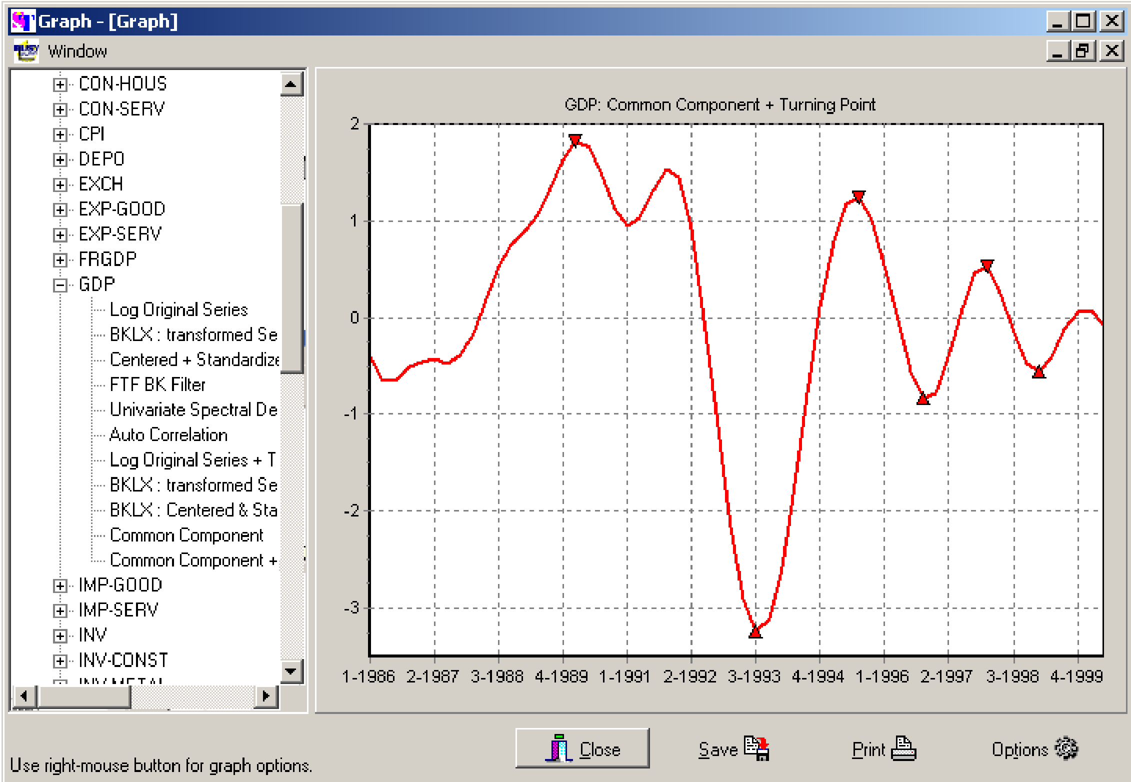


8 GRAPHICS

Graphics are accessible via Output-Graph or Ctrl-G.



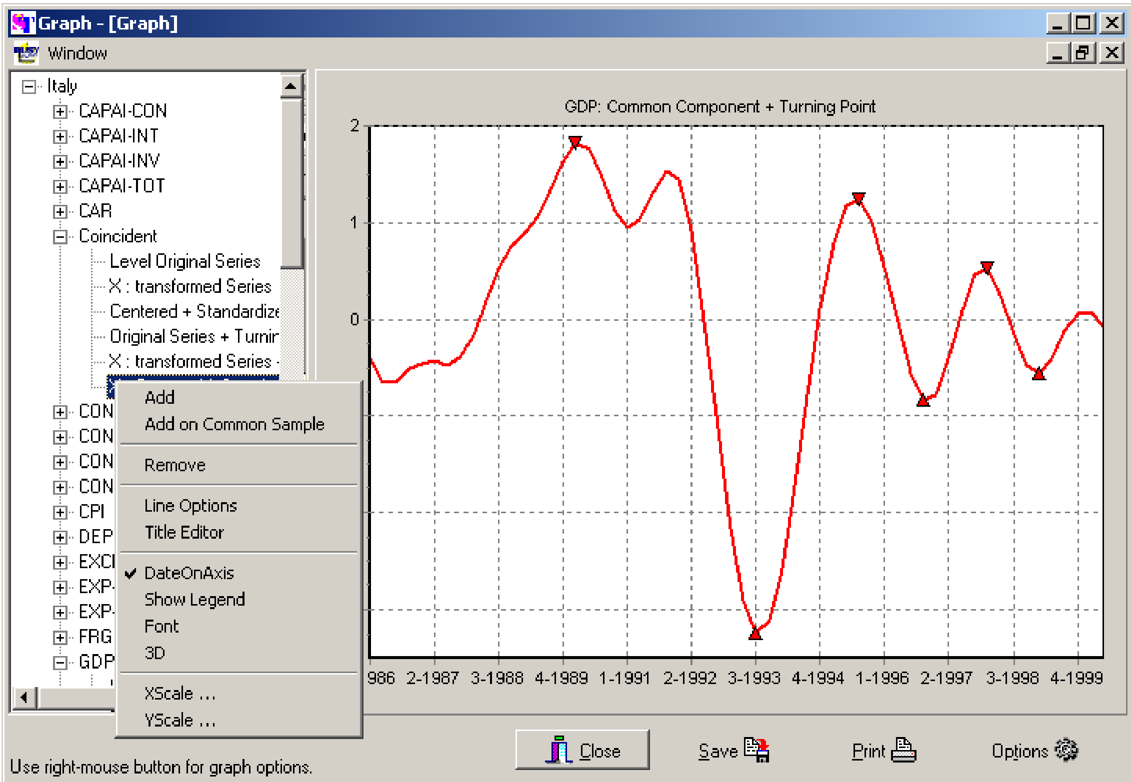
Double clicking on a series produce the graphs.



The Window menu on the upper-left corner allows users to organise the graphics according to:

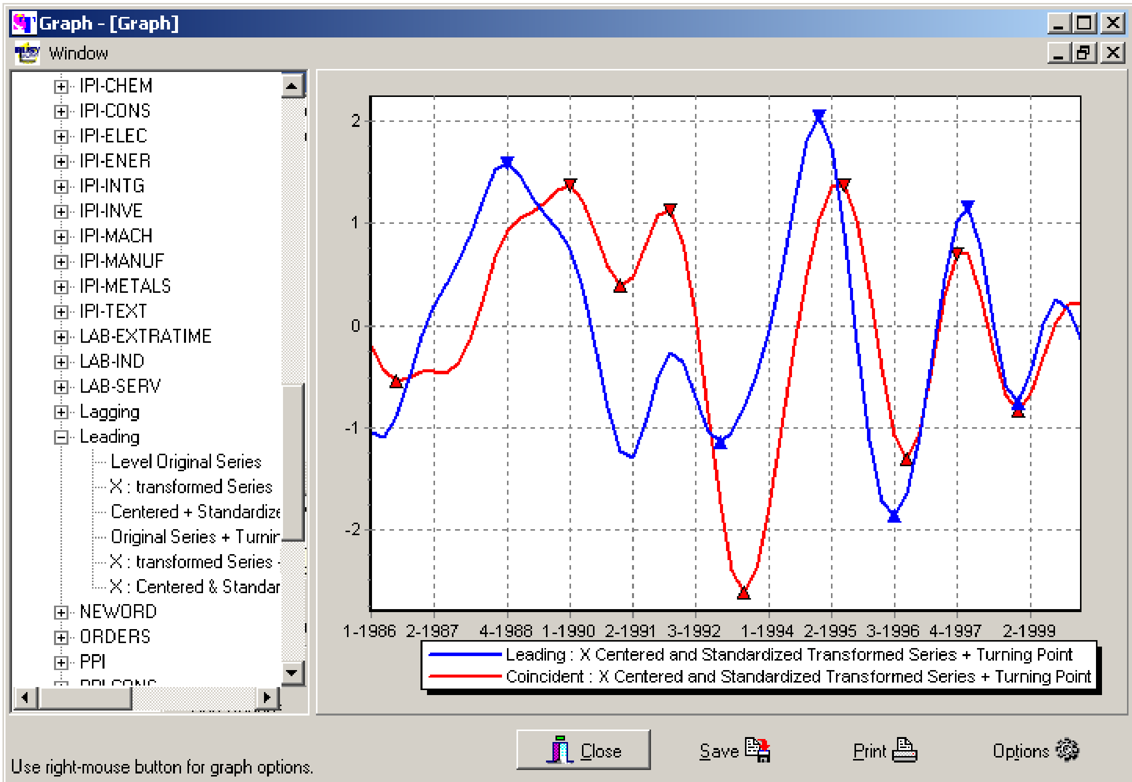
- New Window creates a new frame for the graphics
- Tile creates a new window for every plot
- Cascade overwrites current plot

For every graphics, several facilities are offered via **<u>the mouse right-button </u>** as in:



- Add produces overlays. Care! the sample dates are not necessarily the same.
- Add on Common Sample produces overlays over the sample that is common to the two series. An example is displayed on next page.
- Remove allows to delete plots in overlay
- Lines options gives control on the design of points, on line type, on color and on line width.
- Title editor gives the possibility to edit the graph title.
- Dates on axis makes the X-axis labeled in sample dates instead of number of observations.
- Show legend produces a label for the plot.
- Font controls the text in title and legend
- 3D produces a 3 dimension plot.
- X-axis and Y-axis give control on the minimum and maximum value of each axis.

The option Add on common sample enables users to overlay plots.

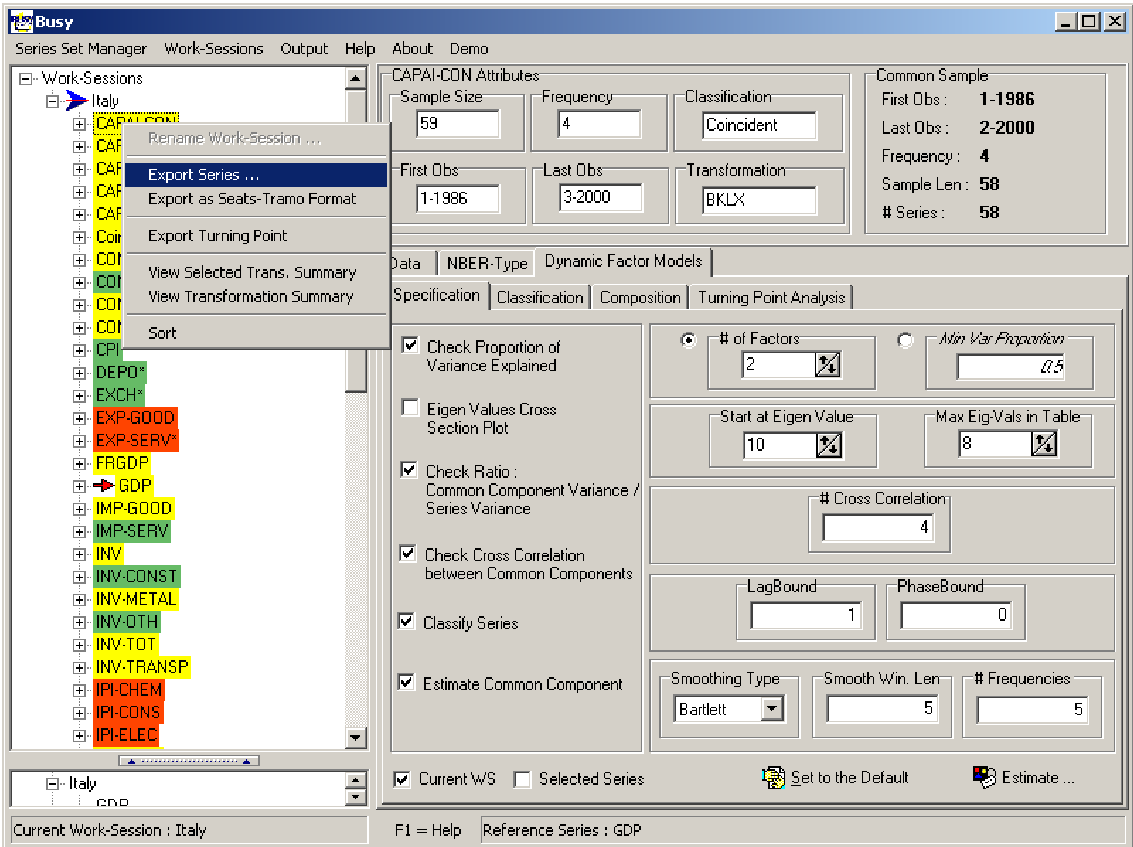


Zooming is possible by clicking on a graph and **drawing a box with the mouse right-button** held pressed.

As can be seen on the bottom line of the screen above, two functionalities are offered: **Save** and **Print**. The number of graphs printed on every page can be set using **Options.** Graphic files can be saved either in the Window Meta Type format (wmf) or in a bitmap (bmp) format.

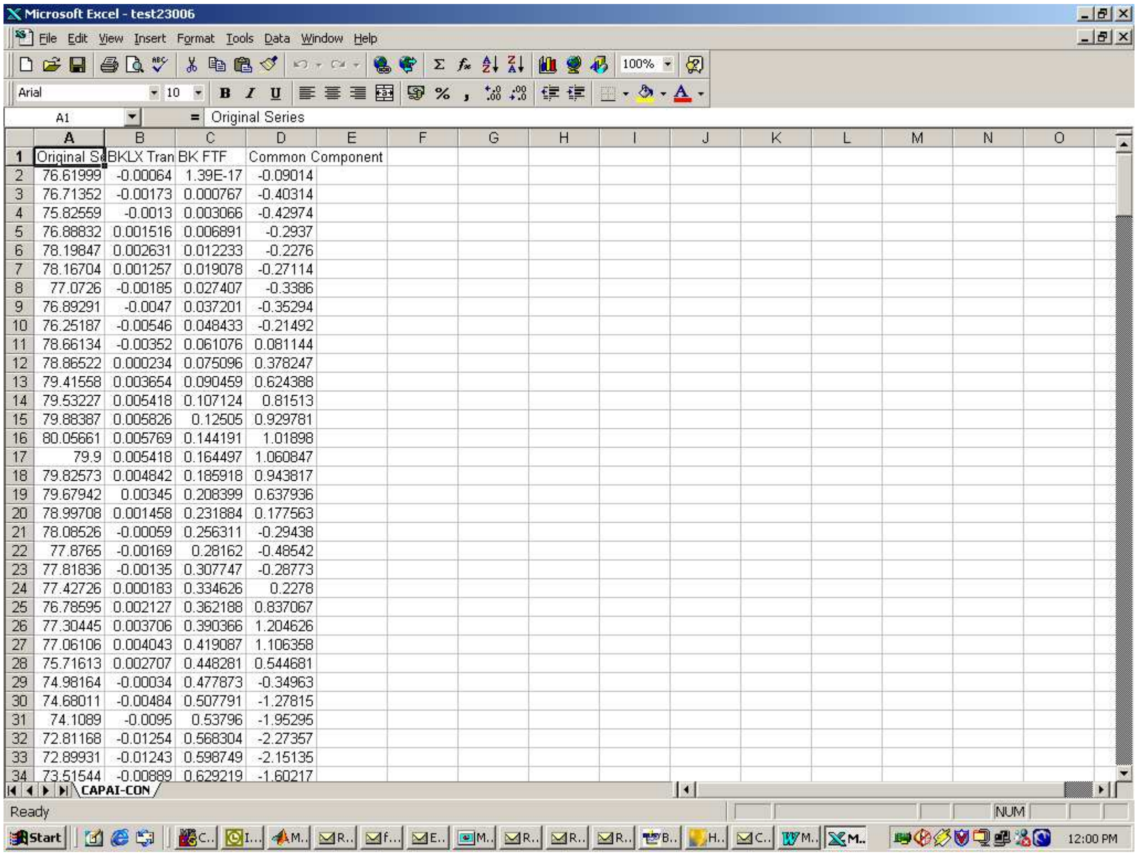
9 EXPORT SERIES AND TURNING POINTS DATES

All series available in the current work session including those computed by BUSY such as transformed series, cross-correlations, cross-coherence, common component can be exported in Excel files. First the series for which the export is wished must be highlighted. Then pressing the right mouse-button yields:



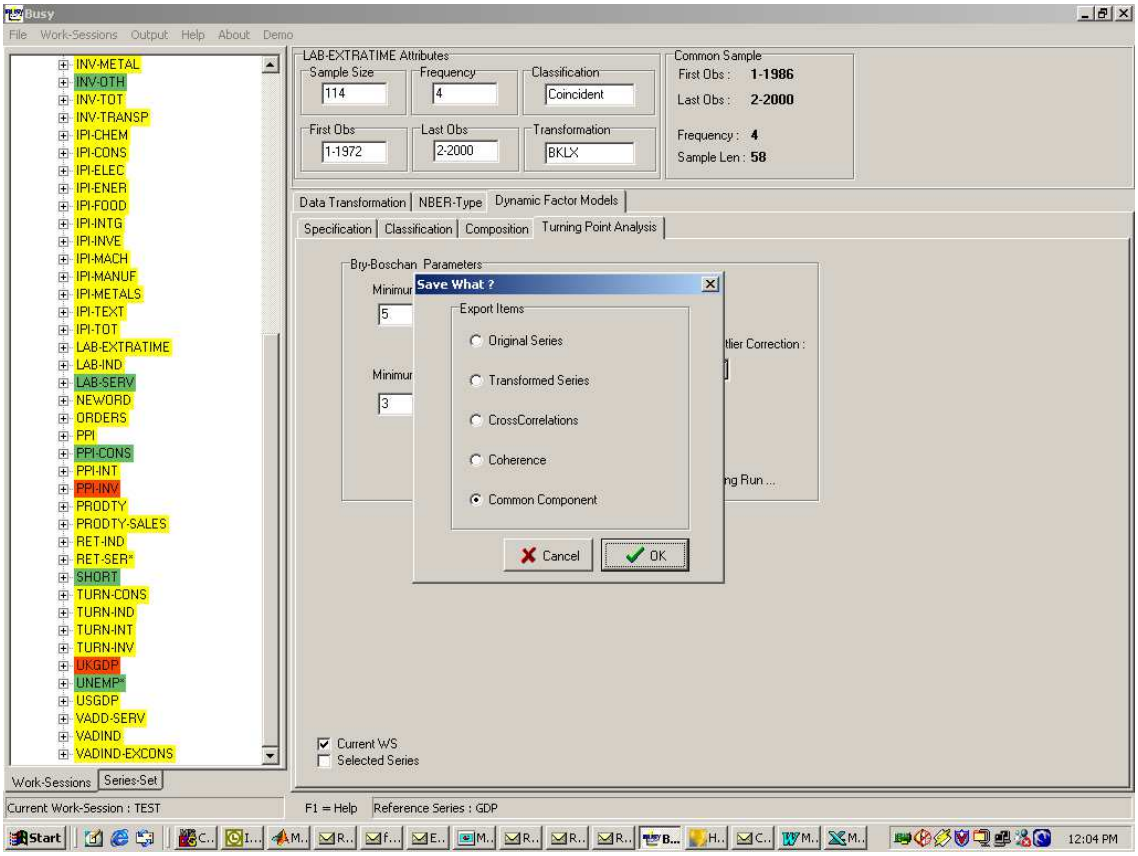
whereby the export facility is proposed. If only one series is highlighted, then all entry in the series folder are saved in a Txt or Excel file such as the one displayed on next page.

Turning points dates can also be exported in a text file simply by pressing the mouse right taste to to select the option Export Turning Points.

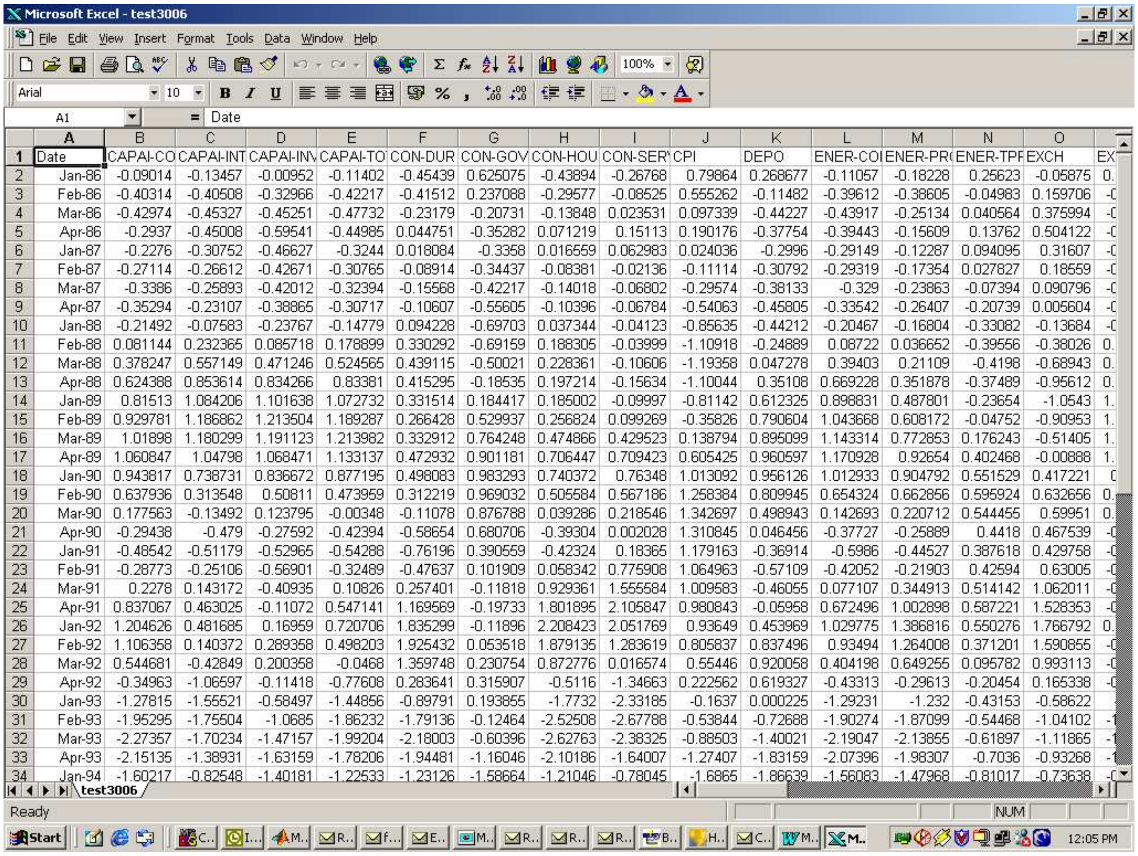


	A	B	C	D
1	Original Se	BKLX Tran	BK FTF	Common Component
2	76.61999	-0.00064	1.39E-17	-0.09014
3	76.71352	-0.00173	0.000767	-0.40314
4	75.82559	-0.0013	0.003066	-0.42974
5	76.88832	0.001516	0.006891	-0.2937
6	78.19847	0.002631	0.012233	-0.2276
7	78.16704	0.001257	0.019078	-0.27114
8	77.0726	-0.00185	0.027407	-0.3386
9	76.89291	-0.0047	0.037201	-0.35294
10	76.25187	-0.00546	0.048433	-0.21492
11	78.66134	-0.00352	0.061076	0.081144
12	78.86522	0.000234	0.075096	0.378247
13	79.41558	0.003654	0.090459	0.624388
14	79.53227	0.005418	0.107124	0.81513
15	79.88387	0.005826	0.12505	0.929781
16	80.05661	0.005769	0.144191	1.01898
17	79.9	0.005418	0.164497	1.060847
18	79.82573	0.004842	0.185918	0.943817
19	79.67942	0.00345	0.208399	0.637936
20	78.99708	0.001458	0.231884	0.177563
21	78.08526	-0.00059	0.256311	-0.29438
22	77.8765	-0.00169	0.28162	-0.48542
23	77.81836	-0.00135	0.307747	-0.28773
24	77.42726	0.000183	0.334626	0.2278
25	76.78595	0.002127	0.362188	0.837067
26	77.30445	0.003706	0.390366	1.204626
27	77.06106	0.004043	0.419087	1.106358
28	75.71613	0.002707	0.448281	0.544681
29	74.98164	-0.00034	0.477873	-0.34963
30	74.68011	-0.00484	0.507791	-1.27815
31	74.1089	-0.0095	0.53796	-1.95295
32	72.81168	-0.01254	0.568304	-2.27357
33	72.89931	-0.01243	0.598749	-2.15135
34	73.51544	-0.00889	0.629219	-1.60217

If instead a group of series is highlighted, then only one entry in all the series folder is saved: that is, either transformed series, or common component, or etc… When pressing Export series, users are asked to choose which entry is to be saved in a screen the one displayed in next page.



Choosing Common Component, the following Txt or Excel file is created:

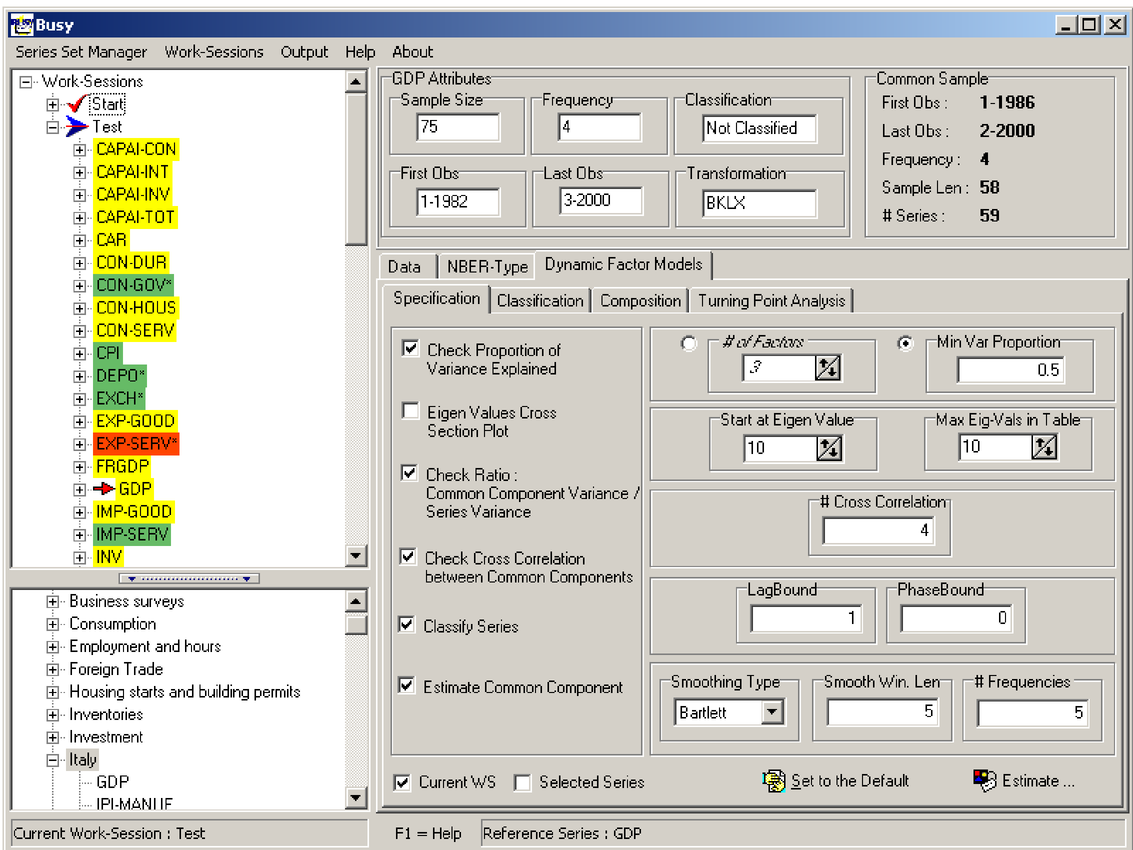


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Date	CAPAI-CO	CAPAI-INT	CAPAI-INV	CAPAI-TO	CON-DUR	CON-GOV	CON-HOU	CON-SER	CPI	DEPO	ENER-COI	ENER-PR	ENER-TPF	EXCH	EX
2	Jan-86	-0.09014	-0.13457	-0.00952	-0.11402	-0.45439	0.625075	-0.43894	-0.26768	0.79864	0.268677	-0.11057	-0.18228	0.25623	-0.05875	0.
3	Feb-86	-0.40314	-0.40508	-0.32966	-0.42217	-0.41512	0.237088	-0.29577	-0.08525	0.555262	-0.11482	-0.39612	-0.38605	-0.04983	0.159706	-0
4	Mar-86	-0.42974	-0.45327	-0.45251	-0.47732	-0.23179	-0.20731	-0.13848	0.023531	0.097339	-0.44227	-0.43917	-0.25134	0.040564	0.375994	-0
5	Apr-86	-0.2937	-0.45008	-0.59541	-0.44985	0.044751	-0.35282	0.071219	0.15113	0.190176	-0.37754	-0.39443	-0.15609	0.13762	0.504122	-0
6	Jan-87	-0.2276	-0.30752	-0.46627	-0.3244	0.018084	-0.3358	0.016559	0.062983	0.024036	-0.2996	-0.29149	-0.12287	0.094095	0.31607	-0
7	Feb-87	-0.27114	-0.26612	-0.42671	-0.30765	-0.08914	-0.34437	-0.08381	-0.02136	-0.11114	-0.30792	-0.29319	-0.17354	0.027827	0.18559	-0
8	Mar-87	-0.3386	-0.25893	-0.42012	-0.32394	-0.15568	-0.42217	-0.14018	-0.06802	-0.29574	-0.38133	-0.329	-0.23863	-0.07394	0.090796	-0
9	Apr-87	-0.35294	-0.23107	-0.38865	-0.30717	-0.10607	-0.55605	-0.10396	-0.06784	-0.54063	-0.45805	-0.33542	-0.26407	-0.20739	0.005604	-0
10	Jan-88	-0.21492	-0.07583	-0.23767	-0.14779	0.094228	-0.69703	0.037344	-0.04123	-0.85635	-0.44212	-0.20467	-0.16804	-0.33082	-0.13684	-0
11	Feb-88	0.081144	0.232365	0.085718	0.178899	0.330292	-0.69159	0.188305	-0.03999	-1.10918	-0.24889	0.08722	0.036652	-0.39556	-0.38026	0.
12	Mar-88	0.378247	0.557149	0.471246	0.524565	0.439115	-0.50021	0.228361	-0.10606	-1.19358	0.047278	0.39403	0.21109	-0.4198	-0.68943	0.
13	Apr-88	0.624388	0.853614	0.834266	0.83381	0.415295	-0.18535	0.197214	-0.15634	-1.10044	0.35108	0.669228	0.351878	-0.37489	-0.95612	0.
14	Jan-89	0.81513	1.084206	1.101638	1.072732	0.331514	0.184417	0.185002	-0.09997	-0.81142	0.612325	0.898831	0.487801	-0.23654	-1.0543	1.
15	Feb-89	0.929781	1.186862	1.213504	1.189287	0.266428	0.529937	0.256824	0.099269	-0.35826	0.790604	1.043668	0.608172	-0.04752	-0.90953	1.
16	Mar-89	1.01898	1.180299	1.191123	1.213982	0.332912	0.764248	0.474866	0.429523	0.138794	0.895099	1.143314	0.772853	0.176243	-0.51405	1.
17	Apr-89	1.060847	1.04798	1.068471	1.133137	0.472932	0.901181	0.706447	0.709423	0.605425	0.960597	1.170928	0.92654	0.402468	-0.00888	1.
18	Jan-90	0.943817	0.738731	0.836672	0.877195	0.498083	0.983293	0.740372	0.76348	1.013092	0.956126	1.012933	0.904792	0.551529	0.417221	0
19	Feb-90	0.637936	0.313548	0.50811	0.473959	0.312219	0.969032	0.505584	0.567186	1.258384	0.809945	0.654324	0.662856	0.595924	0.632656	0.
20	Mar-90	0.177563	-0.13492	0.123795	-0.00348	-0.11078	0.876788	0.039286	0.218546	1.342697	0.498943	0.142693	0.220712	0.544455	0.59951	0.
21	Apr-90	-0.29438	-0.479	-0.27592	-0.42394	-0.58654	0.680706	-0.39304	0.002028	1.310845	0.046456	-0.37727	-0.25889	0.4418	0.467539	-0
22	Jan-91	-0.48542	-0.51179	-0.52965	-0.54288	-0.76196	0.390559	-0.42324	0.18365	1.179163	-0.36914	-0.5986	-0.44527	0.387618	0.429758	-0
23	Feb-91	-0.28773	-0.25106	-0.56901	-0.32489	-0.47637	0.101909	0.058342	0.775908	1.064963	-0.57109	-0.42052	-0.21903	0.42594	0.63005	-0
24	Mar-91	0.2278	0.143172	-0.40935	0.10826	0.257401	-0.11818	0.929361	1.555584	1.009583	-0.46055	0.077107	0.344913	0.514142	1.062011	-0
25	Apr-91	0.837067	0.463025	-0.11072	0.547141	1.169569	-0.19733	1.801895	2.105847	0.980843	-0.05958	0.672496	1.002898	0.587221	1.528353	-0
26	Jan-92	1.204626	0.481685	0.16959	0.720706	1.835299	-0.11896	2.208423	2.051769	0.93649	0.453969	1.029775	1.386816	0.550276	1.766792	0.
27	Feb-92	1.106358	0.140372	0.289358	0.498203	1.925432	0.053518	1.879135	1.283619	0.805837	0.837496	0.93494	1.264008	0.371201	1.590855	-0
28	Mar-92	0.544681	-0.42849	0.200358	-0.0468	1.359748	0.230754	0.872776	0.016574	0.55446	0.920058	0.404198	0.649255	0.095782	0.993113	-0
29	Apr-92	-0.34963	-1.06597	-0.11418	-0.77608	0.283641	0.315907	-0.5116	-1.34663	0.222562	0.619327	-0.43313	-0.29613	-0.20454	0.165338	-0
30	Jan-93	-1.27815	-1.55521	-0.58497	-1.44856	-0.89791	0.193855	-1.7732	-2.33185	-0.1637	0.000225	-1.29231	-1.232	-0.43153	-0.58622	
31	Feb-93	-1.95295	-1.75504	-1.0685	-1.86232	-1.79136	-0.12464	-2.52508	-2.67788	-0.53844	-0.72688	-1.90274	-1.87099	-0.54468	-1.04102	-1
32	Mar-93	-2.27357	-1.70234	-1.47157	-1.99204	-2.18003	-0.60396	-2.62763	-2.38325	-0.88503	-1.40021	-2.19047	-2.13855	-0.61897	-1.11865	-1
33	Apr-93	-2.15135	-1.38931	-1.63159	-1.78206	-1.94481	-1.16046	-2.10186	-1.64007	-1.27407	-1.83159	-2.07396	-1.98307	-0.7036	-0.93268	-1
34	Jan-94	-1.60217	-0.82548	-1.40181	-1.22533	-1.23126	-1.58664	-1.21046	-0.78045	-1.6865	-1.86639	-1.56083	-1.47968	-0.81017	-0.73638	-0

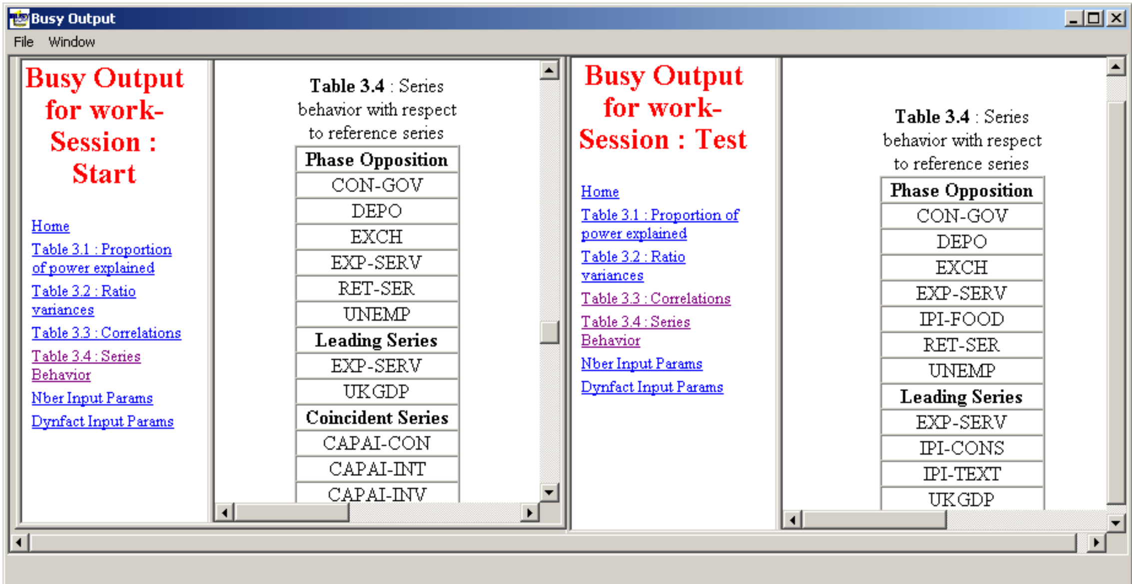
We can read the common components that have been computed for all series.

10 VISUALISING THE OUTPUT AND GRAPHICS OF SEVERAL WORK SESSIONS

This facility allows to read contemporaneously the output files of different work session and to overlay graphs of elements of different work sessions. This is particularly useful as it allows user to check the effect of different parameter choices or the results obtained with different data vintage. In order to activate this option when for instance two work sessions are opened, it is enough to **highlight the one that is not active and to press Ctrl-F4** before opening the output or graphics files. The screen will be like in:



The menu Output – Ouput Files will then display:



Similarly, the graphics will make available all entries in both work sessions: