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Statistical analysis of cyclical fluctuations: the role of official statisticians

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STATISTICAL ANALYSIS OF CYCLICAL FLUCTUATIONS: THE ROLE OF OFFICIAL STATISTICIANS

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Abstract

Infra-annual macro-economic statistics represent nowadays a key tool for economic policy-making and business cycle analyses. The demand for timely and good quality infra-annual macro-economic statistics for the Eurozone has strongly increased since the advent of the monetary union in 1999. Although considerable progresses have been made over recent years in this area, further improvements are needed for many EU/Eurozone statistics as far as concerns timeliness, coverage, convergence of revision practices and policies, and appropriate length of time series. In effect, the traditional approach based on harmonisation has serious drawbacks, at least in the short-medium period, as it can induce breaks in the series and may cause delays in the provision of final estimates at the aggregated level, and difficulties can sharply increase in the near future as a consequence of the enlargement process of the EU. At this stage, statistical and econometric methods can play a greater role to get timely figures, long time series and even to construct new indicators. These methods, now an integral part of the Euro-TREND module of Eurostat's five annual program, can provide users with estimates until the usual process based on harmonisation will give more reliable and complete figures. This paper, after a review of the institutional framework, analyses projects and researches conducted by Eurostat in numerous fields relevant for business cycle analyses. Firstly, it examines the results of researches - backward calculation of time series, temporal disaggregation, nowcasting and revision analyses - oriented towards an improvement of specific dimensions of data quality. Secondly, it concentrates on some instruments aimed at improving the informative contents of infra-annual statistics, such as seasonal adjustment, business cycle estimation, identification of turning points, and construction of composite indicators of business cycles.

1. Introduction

Since its establishment in 1953, Eurostat has essentially focused its efforts on the release of structural and well-harmonised figures for the European Union. In effect, for a long time period the main statistical activity of Eurostat has consisted in the harmonisation of national statistics through a set of legal acts covering different areas. These acts were essentially concerned with structural statistics, and accuracy rather than timeliness has been the keyword of Eurostat's actions in the various fields of interest for a long time period. This approach was justified by the need to support relevant political decisions, *inter alia* the attribution of structural funds, and regional and agricultural intervention policies. Therefore, for a number of years short-term statistics were considered to be only a useful complement to structural statistics.

From the end of the eighties the situation gradually started to change. Due to the creation of a common market and the adoption of the Maastricht criteria, several legal

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acts concerning infra-annual statistics were adopted (e.g. Intrastat Directive, ESA95 and HICP regulations).

Long pressure towards improvements of the short-term statistical information system came from the requests of the European Central Bank (ECB), the DG ECFIN and other institutional and non-institutional users. In the meantime, the interest of financial market analysts and newspapers towards the statistics released by Eurostat increased, and with that the pressures for more timely, accurate and reliable statistics useful for short-term analyses and interventions.

Eurostat, as other international statistical agencies, has in the last years put a great effort in the definition and implementation of a quality framework for the statistics released. While the first step - the taxonomy of the term quality - has been completed by a clear understanding of what the term quality actually should mean in a statistical context, the second - the implementation of a quality framework - is still in due course, though important improvements has been obtained over the last years. Now it is quite common to speak about quality of statistics in terms of fitness for use, and define quality as a multi-dimensional concept (see Franchet and Grünewald 2002).

Eurostat is more and more concerned with the needs of users and it is doing a considerable effort to meet them. Even if the ECB and DG ECFIN are viewed by Eurostat as privileged users for their role of making monetary policies and monitoring the European economy, the needs of other institutional and non-institutional users are also carefully analised.

The system of infra-annual statistics represents now one of the main Eurostat's priorities and different actions have been taken in order to supply users with a wide range of statistics able to give a general overview of the economic behavior of both the Eurozone and EU-15, as well as all Member States economies.

Notwithstanding the numerous efforts made, an analysis of the availability of short-term information evidences some problems related to some specific aspects of data quality which are relevant for infra-annual statistics, in particular timeliness, length of time series, and availability of some key indicators for the Eurozone. Thus, in its conclusions of October 2001 relative to the statistical requirements in the Eurozone, the Ecofin Council noted that further improvements must be achieved in terms of timeliness of key indicators. In particular, the Ecofin Council said that, within the next five years, Eurozone statistics should attempt to emulate US standards of availability and timeliness.

Nowadays, Eurostat has a doubly challenging mission as far as concerns infra-annual statistics. Firstly, it has to provide users with a complete set of reliable short-term indicators for Member States as well as for the Eurozone and the EU. Secondly, it has to assist and help economic policy/decision makers as well as short-term economic analysts by focusing on main macroeconomic indicators in order to provide quasi-real time data estimates and high quality statistical analyses. The Eurostat activities in the field of short-term statistics has consequently been structured in two main pillars: Euroindicators services and the Eurotrend project. The objective of Euroindicators was to create, manage and improve a website devoted to business cycle analyses. The heart of Euroindicators website is Euroind database.

The objective of the Euroindicators, which represents the outcome of the Euro-SICS project launched by Eurostat in 1999, is to provide a comprehensive and detailed portrait of the short-term economic situation in the Eurozone, European Union, Member States as well as Acceding Countries. Euroind database contains several monthly and quarterly indicators and provides many breakdowns, such as by sector, product and country. As

stated in Ladiray and Mazzi (2000a) several quality problems still characterise infra-annual statistics, so that it is essential to go over the official statistics. At the moment, Euroind is intensively used by a number of institutional and non-institutional users and it is continuously improved. The Euroind quality is monitored by a number of synthetic parameters defined in the framework of a specific study made by Eurostat (see Sartori, 2001).

The Eurotrend project is explicitly dedicated to investigate topics having obvious and useful feedbacks on Euroind and the research activity on short-term statistics in general, such as backward calculation, nowcasting, construction of proxies for some unavailable indicators (see Ladiray and Mazzi 2000b). Moreover Eurotrend aims at creating a perceptive framework of the Eurozone economic momentum. In this light, topics such as seasonal adjustment, business cycle estimation and turning points detection has been extensively studied.

As such, the Eurotrend project constitutes a natural complement to traditional statistical activities of data production. It represents a *presidium* for analyses and researches explicitly devoted to improve the quality of basic infra-annual data series. Furthermore, as institutional and traditional actions undertaken to improve the quality of infra-annual statistics necessitate of a medium-long term period to be fruitful, especially in a complex and integrated system, Eurotrend can provide an important complement to more institutional actions.

The statistical actions launched by Eurostat in the last years to improve availability and timeliness of short-term statistics will be analyzed in this paper, whose plan is as follows. The next Section describes in some details the institutional framework, whose aims consist in putting into place measures (from more formal legal acts to simple gentleman agreements) with Member states in order to improve data quality of short-term statistics in various respects. Section 3 is dedicated to statistical methods which are directly used to improve the quality of infra-annual statistics and on which Eurostat is at the moment putting great emphasis within Eurotrend. Other mathematical and statistical methods to improve the data-presentation of infra-annual series are analyzed in Section 4. Section 5 briefly concludes.

2. The institutional role of Eurostat in the improvement of infra-annual statistics

Over recent years, the Commission, the Council, the ECB and the European Statistical System (ESS) as a whole have made very substantial improvements to the quality of statistics, notably with respect to their comparability, coverage, timeliness and coherence. In particular, since the signature of the Maastricht Treaty in 1992, several important initiatives have been undertaken to enhance European macro-economic statistics. Amongst these, we only cite the ESA 95 regulation which, since April 1999, has compulsed Member States to report national accounts data within a well-defined time schedule on both an annual and quarterly basis; high quality information for Harmonised Indices on Consumer Prices (HICP) in Member States has been produced since January 1997; in May 1998 the Council adopted a Regulation setting up a common framework for the production of short-term business statistics. All these legal acts are subject to a continuous improvement process.

Further improvements for infra-annual statistics are still particularly needed with respect to timeliness, frequency and coverage of data, the breakdown of statistics between Eurozone and non-Eurozone, the further harmonisation of methodologies and the acces-

sibility of statistical information. This Section reports on recent developments achieved on Eurozone statistics, the remaining weaknesses and the approaches taken to deal with them.

Although the considerable progress made over recent years, many EU/Eurozone statistics lack timeliness. The comparison with the best EU Member States and the United States is particularly striking. Moreover, the quality of some of these statistics has been criticised. In this respect, the Commission's main objective is to accelerate the release of a set of key EU/Eurozone infra-annual macro-economic statistics and to improve other quality features. These notably include complete statistical coverage, consistency between the different sets of data, the transparency of the methods applied, sound monitoring and detailed explanations of data revisions and the accessibility of statistical information.

To these ends, an important instrument used in the last years has been the so called EMU Action Plan. The Action Plan covers a number of areas for short-term statistics: quarterly national accounts, quarterly accounts for the government sector, statistics on labour markets, short term business statistics and statistics on external trade. For each Member State, the Action Plan has identified areas where progress is needed in the compilation of national indicators. A list of action points has been established for Eurostat and for each Member State (the National Action Plan). The Action Plans require Member States to accelerate the production of national data series to permit timely compilation by the Commission of reliable EU/Eurozone indicators. It also provides for improvements in other quality aspects. Progress on implementing the Action Plan is reported regularly to Ecofin. The Action Plan has created strong momentum for statistical improvements, and has already produced positive results, both in terms of coverage and timeliness, as stated by the progress reports yet finalised.

In parallel to the Action Plan, an intra-EU and EU-US benchmark study was carried out in September 2000. It confirmed that the Action Plan, although very substantial, might not be enough to match the US timeliness and best practices world-wide. A list of more focused infra-annual macro-economic indicators (the Principal European Economic Indicators or PEEIs) has therefore been set up by the so-called FROCH (FRiends Of the CHair) group, coordinated jointly by Eurostat and Statistics Sweden, with more challenging target release dates for EU/Eurozone indicators and other quality objectives together with milestones (see Table 1 below). The list of PEEIs and the related objectives will need refining over time, notably to accommodate developments on services statistics. The PEEIs on the list have been selected on the basis of the views of the ECB and the DG ECFIN too, and on results from the benchmarking exercises so as to fully reflect current user needs.

The Commission will compile and release PEEIs based on Member States' contributions. This does not mean that all Member States will have to produce representative indicators nationally with the same timeliness. But Member States, in particular those whose economy has the most significant impact on EU/Eurozone aggregates, are expected to contribute the information that will be needed to produce and release timely and representative indicators at EU/Eurozone level (the so called First for Europe principle). Other Member States are asked to do their best to supply this information as well. All Member States naturally remain free to release the indicators nationally, if they wish.

The Commission will disclose full information on the way in which each PEEI has been compiled through the Euroindicators website and Euroind database and aims to release EU/Eurozone indicators on the target dates indicated in Table 1. The achievement of this objective is to a large extent dependent on Member States fulfilling the commitments

they have made voluntarily (i.e. by means of gentlemen's agreements).

The Commission will develop a common dissemination platform with Member States for the dissemination of PEEIs. This platform will be a specific domain accessible through the Euroindicators website, and will cover both EU/Eurozone and national indicators. This approach implies greater responsibility for Member States regarding the quality and smooth functioning of the system. Member States will be directly responsible for the release and updating of their national indicators through the site, but this will have to be done in a way that appears consistent and co-ordinated to the users. They will have to give explanations on the status of their national indicators and the methodologies applied. The general aim is to permit the use of state-of-the-art technologies to reinforce co-operation, taking account of the subsidiarity and proportionality principles.

List of PEEIs, periodicity and target and actual delays

SET	INDICATOR	PERIODICITY	EU DELAY TARGET	EU DELAY ACTUAL
Set 1: Consumer Price Indicators				
1.1.	Harmonised Consumer Price Index: MUICP flash estimate	monthly	0	2
1.2.	Harmonised Consumer Price Index: actual indices	monthly	17	17
Set 2: National Accounts Indicators				
2.1.	Quarterly National Accounts: First GDP estimate	quarterly	45	NA
2.2.	Quarterly National Accounts: First GDP release with more breakdowns	quarterly	60	70/120
2.3.	Quarterly National Accounts: Household and Company Accounts	quarterly	90	NA
2.4.	Quarterly National Accounts: Government Finance Statistics	quarterly	90	100
Set 3: Business Indicators				
3.1.	Industrial production index	monthly	40	48
3.2.	Industrial output price index for domestic markets	monthly	35	35
3.3.	Industrial new orders index	monthly	40/50	Preliminary data
3.4.	Industrial import price index	monthly	45	NA
3.5.	Production in construction	monthly/ quarterly	45	75
3.6.	Turnover index for retail trade and repair	monthly	30	60
3.7.	Turnover index for other services	quarterly	60	Partial data
3.8.	Corporate output price index for services	quarterly	60	NA
Set 4: Labour Market Indicators				
4.1.	Unemployment rate	monthly	30	30
4.2.	Job vacancy rate	quarterly	45	NA
4.3.	Employment	quarterly	45	70/75
4.4.	Labour cost index	quarterly	70	90
Set 5: Foreign Trade Indicators				
5.1.	External trade balance: intra and extra for MU and EU	monthly	45	50

NA : not available (not published yet at EU level)

For each PEEI, ambitious objectives have been set up regarding timeliness and other quality aspects. Member States' commitments within this programme include transmitting contributions before specific deadlines. The information to be transmitted consists of output data contributing to the various PEEIs, together with a qualitative assessment, concise metadata (sources, methods and formulae) and explanations for significant revisions. Member States are also asked to participate actively in the studies and other work concerning PEEI, and in particular to join task forces where appropriate and to consider using the methodologies proposed by Eurostat where relevant. The commitments planned under this concerted approach on PEEIs are made voluntarily. This means that no new regulatory instruments are needed, as requests to Member States are based on either already existing EU legislation or on voluntary arrangements (generally referred to in the statistical field as "gentlemen's agreements"). Naturally, Member States will still have to comply with EU legislation that concerns data related to the indicators. Where the timeliness objective set by EU legislation is less stringent than the PEEI objective, the latter should be pursued on the basis of a "gentlemen's agreement".

Despite these strengths, several weaknesses in the system have surfaced occasionally. These include large revisions to data for some countries, raising questions about the quality of the data; a lack of information and transparency on some figures and transactions, and the late transmission of EDP notifications by some Member States. Efforts have already been made to remedy and prevent these shortcomings, but they need to be continued with increased vigor.

3. Improving data quality through statistical techniques

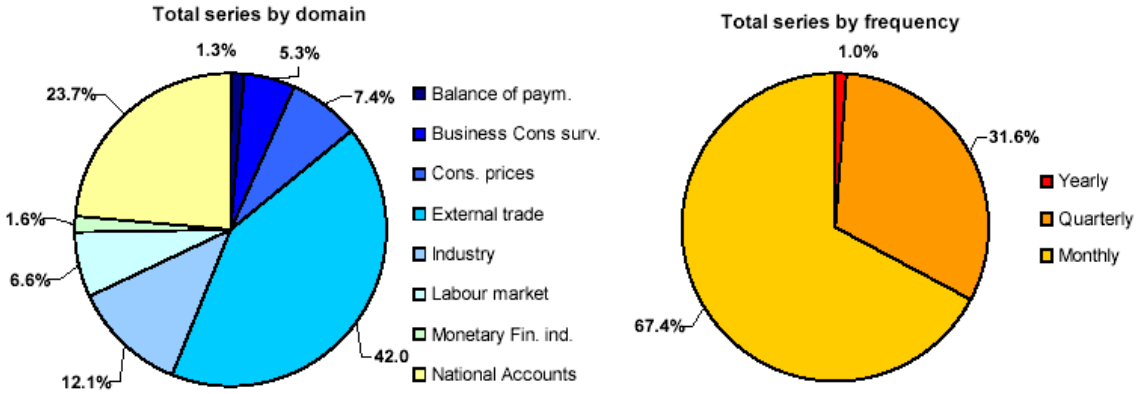
The traditional instruments depicted above has two serious drawbacks. Firstly they can generate breaks in series, for example, when a new country joins the European Union. Secondly they generally cause delays as the various national institutes do not release the basic statistics at the same time. Moreover, the compilation of a new statistical indicator is often likely to be a long and difficult task and no series are generally available for years. On the other hand, the demand for timely and long time series is increasing greatly from different users. As the usual process based on harmonisation cannot quickly fulfill these new needs, Eurostat is changing its strategy: statistical methods and econometric models are now playing a greater rule to get timely figures, long time series and even to construct new indicators. These models will provide users with estimates until the usual process, based on harmonisation, can give more reliable figures. Moreover, some other statistical analysis will be carried out on some important indicators to make interpretation and analysis easier for economists.

The Eurotrend project was launched within Eurostat in 2000 in order to explore these new directions. Its activity is mainly based on the Euroind database discussed above, but focuses on a few important macroeconomic indicators at the Eurozone level. The idea behind Eurotrend is to use statistical and econometric modelling techniques to arrive at figures for Europe that can be used by short-term analysts, pending results derived from the usual process based on harmonisation.

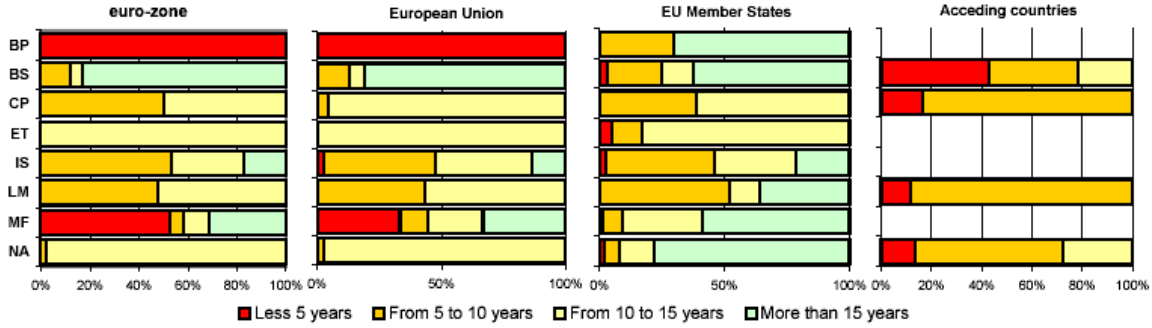
Ideally Euroind database aims at providing series spanning over 15 years , that is covering at least two complete economic cycles, and real time updated. 20.4% of the active series of the database cover 15 years or more, and 72.1% cover 10 years at least. Unfortunately the situation is much less satisfactory for the Eurozone. The situation varies substantially from one domain to the other. Even if it is difficult to evaluate the punctuality of the series in the Euroind database it appears clearly that there are several delays on the updating

of the database which cumulate themselves with a well known production delays (lack of timeliness). Backward recalculation and flash estimates of data for this area have become a priority for Eurostat as discussed below. Moreover, the pressure from users to obtain data with a higher frequency for macroeconomic indicators requires the use of sophisticated interpolation and extrapolation techniques.

Weights of domains and frequencies of the series in the Euroind data base



Length of the series by area in the Euroind data base



Length of time series in the Euroind data base

	Less than 5 years		5 to 10 years		10 to 15 years		More than 15 years	
	N	%	N	%	N	%	N	%
European aggregates and EU Member States								
Balance of payments	31	10,2	81	22,9	0	0,0	192	63,2
Business and Consumer surveys	24	2,7	181	17,4	106	12,0	571	64,7
Consumer prices	2	0,2	423	27,5	694	62,0	0	0,0
External trade	450	4,5	1 020	9,7	8 525	85,3	0	0,0
Industry, commerce and services	61	2,2	1 218	31,4	882	32,4	558	20,5
Labour market	0	0,0	649	33,8	228	17,9	395	31,1
Monetary and Financial indicators	26	13,8	14	8,0	50	26,6	98	52,1
National accounts	65	1,6	222	5,3	1 095	27,0	2 667	65,9
TOTAL	659	3,2	3 808	18,6	11 580	56,4	4 481	21,8
Acceding countries, Norway, US and Japan								
Business and consumer surveys (Sou	177	42,7	159	40,1	79	19,0	0	0,0
Consumer prices	93	14,7	540	50,0	0	0,0	0	0,0
Labour market	35	10,6	265	47,3	30	9,1	0	0,0
Monetary and financial indicators	1	7,7	3	20,0	2	15,4	7	53,8
National accounts	102	8,1	693	37,5	307	24,5	153	12,2
TOTAL	231	10,4	1 501	67,3	339	15,2	160	7,2

3.1 Temporal disaggregation

It is often said that the analysis of business cycle should be conducted on time series spanning a sufficiently long time, with a golden rule given either by a minimum of two complete business cycles (10 years or more of sample), or by a sufficient number of observations to conduct efficient statistical analyses. For the problems analysed above, in many situations these conditions are not fulfilled by many series. The problem at hand can be circumvented, at least partially, by the use of temporal disaggregation/benchmarking techniques. Their use have been advocated in the conclusions of the Task Force on benchmarking exercise of EU-USA statistics in order to improve, among other things, timeliness. These techniques interpolate or distribute economic time series observed at low frequency into compatible higher frequency data using or not related time series, and can also be useful for extrapolation of the target series over the sample period. Temporal disaggregation/benchmarking techniques can also increase data quality through their use in terms of forecasting the actual series according to the evolution of the indicator series observed at the higher frequency (Chow and Lin, 1971). Their use can be also relevant in backcasting exercises discussed below as they provide a valid instrument for balancing purposes.

While interpolation refers to the estimation of missing observations of stock variables, a distribution problem occurs for flow and time averages of stock variables. In the distribution case, for example, the problem concerns the estimation of intra-period values for a given time series subject to the constraint that their sums (or averages) equal the aggregates over the lower frequency.

The need for temporal disaggregation can stem from a number of reasons other than those mentioned above. For example national statistical agencies, due to the high costs involved in collecting the statistical information needed for estimating national accounts or other statistics, could decide to conduct large sample surveys only annually. Consequently, quarterly (or even monthly) data could be obtained through an indirect approach, that is by using related quarterly (or monthly) time series as indicators of the short-term

dynamics of the annual (or quarterly) aggregates. As another example, econometric modelling often implies the use of a number of time series, some of which could be available only at lower frequencies, and therefore it could be convenient to disaggregate these data instead of estimating, with a significant loss of information, the complete model at the level of the lower frequencies. Again, the construction of composite indicators of business cycle (see below) requires the use of monthly time series, but some variables (such as GDP) can be only available at the lower frequencies. Then, these series are properly disaggregated before being used following the traditional approach.

Temporal disaggregation has been extensively considered in the econometric and statistical literature and numerous solutions have been proposed. Broadly speaking, two alternative approaches have been followed:

1) methods which do not involve the use of related series but rely upon purely mathematical criteria or time series models to derive a smooth path for the unobserved series;

2) methods which make use of the information obtained from related indicators observed at the desired higher frequency.

The first approach comprises, amongst others, the model-based methods (Stram and Wei 1986; Wei and Stram 1990) relying on the $ARIMA$ representation of the series to be disaggregated (e.g., see Eurostat, 1999, for a survey and taxonomy of temporal disaggregation methods).

The latter approach includes, amongst others, the adjustment procedure due to Denton (1971) and the methods proposed by Chow and Lin (1971), Fernández (1981) and Litterman (1983).

Two important extensions of traditional approaches to temporal disaggregation has received some attention in the last years. The use of state space models for temporal disaggregation, originally due to Harvey and Pierce (1984), has been further developed in the framework of structural time series models by Durbin and Quenneville (1997), Harvey (1989), Harvey and Chung (2000) and Moauro and Savio (2003). The use of a multivariate approach (notably in the field of structural time series models) in this context allows empirical research to overcome some weaknesses of traditional approaches, namely the hypotheses of weak exogeneity of the variable to be disaggregated and the existence of a behavioral relation between the series. As stated by Harvey (1989), none of these assumptions are necessarily fulfilled in current practices.

Another promising line of research in this field consists in the introduction of dynamic paths in the univariate econometric relation between the target and the indicator series. These researches have received some attention in these lasts years, for example in the works by Gregoir (2002), Salazar, Smith and Weale (1997), Di Fonzo (2002) and Santos Silva and Cardoso (2001). Other important lines for research are non-linear transformations of the series (Pinheiro and Coimbra, 1993) and non-linear transformations and dynamic specification of the model (Weale et al., 1994).

It is under study the possibility to extend the program Ecotrim developed by Eurostat to introduce in it some of the major disaggregation methods appeared recently in the literature, notably the multivariate SUTSE approach and the dynamic regression framework. This study is likely to receive support from the OECD. Empirical applications of temporal disaggregation techniques to themes relevant for our purposes have received attention in recent years at Eurostat and now are in the process to be finalised. We only cite here the estimation of a monthly disaggregation for quarterly GDP at the Eurozone level, with preliminary results discussed in Astolfi, Ladiray, Mazzi, Sartori and Soares (2001).

A similar approach has been used to build a monthly indicator of Construction, but the results are still under evaluation due to the lack of stability and timeliness of the original series. Under this conditions, the results of simulation are dramatically affected, so that it is impossible at the present to finalise this important work.

3.2 Backward calculation

The need for economic time series homogeneous and, at the same time, defined over the longest possible period is a central issue for statisticians, econometricians and economic analysts. Unfortunately, due to changes in definitions and/or new basic data availability, the available series very often, show inconsistencies and breaks in their dynamic profile. In other cases the partial availability of the information could actually prevent the calculation of the series. In most of these cases, estimation techniques which make use of all the available information to get 'reasonable' estimates of the series of interest can offer a valid solution, whose quality and usefulness are strictly linked to the amount of basic information processed and to the way in which the various 'pieces' of information are combined.

Eurostat is currently working with GRETA ASSOCIATI in the framework of backward calculation for a set of relevant economic variables for the Eurozone: quarterly GDP and its main components on the expenditure side and on the supply side; Industrial Production Index and its disaggregation by main industrial groupings (MIGs); Industrial turnover index; Total employment; Deflated retail trade index; Producer price index; Unemployment.

As far as possible, the objective has been to carry out the retrapolations of the above series back to 1970 with the greater level of detail. Covered periods and other information on the series analysed are reported in the Table at the end of this Section.

The problem of backward calculation can be formally put in the following way. Let us consider a time series $\{y_t\}_{t=0}^{t=T}$ available from time 0 to time T, and a set of related variables $\{X_t\}_{t=0}^{t=T}$ available from time $M > 0$ to time T, which can include y_t observed at different, generally lower, frequencies (e.g. annual instead of monthly) and/or proxies for y_t, observed at various frequencies. We define back-recalculation (alternatively named as back-calculation, back-casting, back-forecasting, retrapolation or backward calculation) of y_t the process that reconstructs y_t in the range $-M$ to -1 using the information contained in $\{X_t\}_{t=0}^{t=T}$.

A number of possible alternative methodologies can be used for back-calculating a time series, from simple univariate interpolation and/or extrapolation up to very complex statistical models. The back-recalculation of a time series requires several steps, the first being the search for the relevant related information and their statistical analysis. The other points are: choice of the retrapolation approach (and comparison of direct versus indirect strategies); statistical testing of the available related series; model choice; and finally the back-calculation.

An important point to be noted is that the statistical features of the relevant information and the relation between the target series and the available information set drastically affect the choice of the model.

Then, we cannot suggest a general specification to back-forecast a series but we point only to a set of necessary steps to be considered.

For these reasons, the methodology used varies case-by-case, though the philosophy chosen generally belongs to the regression approach, possibly without an $ARIMA$ structure on residuals. Multiple step procedures have been used intensively by combining

direct and indirect reconstructions, together with the appropriate use of disaggregation (balancing) techniques.

Searching for related information and statistical analysis This point involves the analysis of the various relevant sources. Assume we are interested in the back-calculation of GDP for the Eurozone at the quarterly level. The relevant information matrix can include: the Eurozone GDP at an annual level; the Eurozone member countries GDP both at quarterly and annual level; moreover, relevant information could be recovered from quarterly and annual GDP series in ESA79 systems for both the Eurozone and the member states.

In this respect, the various statistical sources have been the Euroind and NewCronos data-bases. Additional information have been obtained from other European Community sources, such as DG ECFIN, and the ECB. Moreover, other international organisations have provided relevant data, amongst them the OECD. Finally, the National Statistical Institutes (NSIs) and the National Central Banks have been considered as possible sources of information. Additional data have been obtained from data providers, such as Datastream.

Given the matrix of proxies obtained from alternative sources, a first analysis should point to any differences in the their definitions from the various sources. It may be the case that the definition of the series used by Eurostat does not coincide with the one of the OECD or of NSIs. The discrepancies, if any, must be identified and taken into consideration before the choice of the model.

A descriptive, at least graphical, analysis has been carried out. It is aimed at pointing to changes in the base years for indices and series defined in real terms. Moreover, it can highlight structural breaks or changes in the variable definitions that have not been translated into a complete revision of the data-sets. These can influence the model choice, discarding reconstructions on the levels in favour of back-recalculations based on the growth rates or vice versa.

A further step involves statistical testing. In particular unit root and cointegration tests have been considered. Cointegration is a desirable property in this context. It points to the reliability of the indicators and allows their use for back-recalculation. A lack of cointegration should be considered as evidence of a biased indicator that should not be used at all. Finally, time reversibility has been checked (Ramsey and Rothman 1996). This property is useful since it enables modelling a series reversing its time scale. Then, as stated later, it is desirable in a back-recalculation framework.

Choosing the approach Two different approaches should be used, the indirect approach and the direct approach. The indirect approach requires the preliminary estimation of the missing data for each Member State, or for most of them, and the subsequent aggregation of the national series in order to estimate the Eurozone aggregate. The direct approach requires the estimation of the Eurozone aggregate starting from an incomplete set of national data and then the estimation of the entire European aggregate using the available information.

The choice between these two approaches depends on the available information at the national and Eurozone level. After searching for relevant information, a choice between an indirect or a direct approach would be made. The evaluation must be considered when the series has certain characteristics. In fact, generalising the concept, the distinction between the direct and indirect retrapolation exists only when the series is obtained by aggregation of at least two components. This is the case of any Eurozone variable, which is obtained by a weighted average or a sum of member countries series. Moreover, the distinction can be applied for the GDP of, say, Austria, which is by definition given by

the sum of Private consumption, Gross fixed capital formation, etc.. The direct approach should be considered whenever the information about the series are sufficient and reliable enough to perform a back-calculation (as an example, the GDP of Eurozone can be directly recovered if we consider the OECD Eurozone GDP series as a reliable indicator). Alternatively, the indirect approach should be used (it may be the case that Austrian series of GDP components are more reliable that the GDP series itself).

It should be noted that the indirect approach requires the use of a larger amount of information, which gives robustness to the back-calculation. Finally, mixed approaches can be considered: in this case a first step will involve a retrapolation of the relevant components, and a second step will concern the direct reconstruction given the results of the previous estimations*.

Model choice Here we distinguish among a set of alternative situations influencing the set of usable models.

a) *y_t is not available in the range $(-M,-1)$ at the desired frequency but at a lower one and at least one indicator is available at the desired frequency in the range $(-M,-1)$*

This case consists in a problem of constrained retrapolation in which the lower frequency observations of y_t act as a benchmark. The models and procedures to be applied in this context are those considered in the time series disaggregation literature discussed above.

b) *y_t is not available in $(-M,-1)$ at any frequency, y_t and the set of related indicators (if available) are time reversible*

This is an ideal situation. Time reversibility allows for the use of a number of models in a forecasting framework. Moreover, the availability of one (or more) related indicators provides a trajectory for the future (the past in the original series) evolution. The class of the available models includes univariate methods like the ARMA models and a group of specifications that can be represented by a regression approach: simple OLS with or without ARMA residuals, ARMAX and ADL models, error correction representations. In the following we consider the advantages and disadvantages of the various cited models.

Univariate methods (ARMA models)

Let us suppose that no additional information is available except for the data of the (incomplete) time series of interest. In principle, provided that a good fit can be obtained, the estimates could be drawn from a forecast of the series modelled through an $ARMA(p,q)$ process fitted on the reversed series*.

Regression methods

Sometimes the dynamic patterns of y_t and X_t in the overlapping period show a tendency to move together. In such cases, it is quite natural to use a linear model linking the

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*The pro-rata estimation is another option at disposal, but it has to be considered only for indirect reconstructions and in a multi-step approach. This method could be used when the coverage of the available data at the aggregate level or the coverage obtained through the approaches mentioned above, is quite high and no auxiliary information useful to reconstruct the remaining missing data are available.

The pro-rata estimation strategy consists in the recursive application of two estimation steps:

1. First, for a series at the desired breakdown, the aggregate value is estimated using the available, contemporaneous country data and the country shares calculated over the nearest time period for which all country data (for that series) are available;

2. The basic country missing values are thus estimated as a proportion of the previously estimated aggregate series.

*However, this simplistic solution should be avoided whenever the back-calculation range $(-M,-1)$ is longer than the sum of AR and MA orders. In fact it is known that the point forecasts after $p+q$ steps converge, and are not significant apart for their tendency.

variables and then calculate the conditional (or linear) expectation of the unobserved variable as a function of the available data set. The general model can be written as $y_t = f(X_t) + \epsilon_t$ where f is a generic algebraic function and ϵ_t is the usual white noise term, but can also have an ARMA representation. An adequate parametrization of the function f allows for the recasting in a regression formulation of various models. In fact, ARMAX and ADL models can be represented by a dynamic regression. Moreover, recalling that the ECM models can be represented by an ADL, also the cointegration case (if it is supported by the data) is contemplated . Finally, the set of related indicators can also include deterministic variables such as a trend or seasonal dummies.

c) *y_t is not available in $(-M, -1)$ at any frequency, y_t and the set of related indicators are time irreversible*

The lack of time reversibility sensibly restricts the range of the useful models, as we will see in a few examples. In the following we deal with the models considered in the previous point, highlighting the motivation for their usefulness (or uselessness) for a backward calculation.

Univariate methods (ARMA models)

The ARMA models can be expressed in the following alternative way (backward form): $(1 - \phi_1 F - \ldots - \phi_p F^p) z_t = (1 + \vartheta_1 F + \ldots + \vartheta_p F^q)\epsilon_t$, where z_t is a stationary process (obtained, for example, by a suitable transformation of y_t such as first difference, logs,...). This equation can then be used to forecast past values of the series. The parameters of the backward $ARMA$ form are obtained by estimating the traditional $ARMA$ model and then applying the coefficients on the time-reversed observations. However, their use in providing long horizon back-forecasts cannot be sustained, since the results may be unreliable. Let us assume the model is of the form $z_{t-1} = \phi_1^{-1} z_{t-1} + \epsilon_t$ and we reverse the model obtaining z_{t-1} as a function of z_t. Given the stationarity of the estimated $AR(1)$ parameter, the back-forecasts will necessarily diverge to $\pm\infty$ depending on the sign of ϕ_1^{-1} (since $|\phi_1| < 1$ we have that $\left|\phi_1^{-1}\right| > 1$) unless we estimate a non-stationary model. Assume now that we fitted a simple ARMA(1,1) model. We reverse again the model obtaining $z_{t-1} = \phi_1^{-1} z_t + \vartheta_1 \epsilon_{t-1} + \epsilon_t$. Besides the known divergence caused by the AR component, we must evidence that the MA part will disappear in the back-forecasts, a fact that can be justified by the substitution of the residuals by their unconditional mean but that add unreliability to the back-calculation. Therefore, the use of ARMA terms should be avoided.

Regressions methods

For similar reasons the dynamic specifications discussed above should be avoided as well. One could rule out all the models which consider a dynamic in y_t, leaving only representations that are static or that allow for lagged related indicators. These regression models could be generalised with ARMA terms in the residuals, however this should be carefully considered. In fact, residual correlation points to a model misspecification, while MA terms could be used only to improve the estimation of regression coefficients.

A further remark concerns the use of the levels or of some transformation of the variable to perform the back-recalculation. In principle, the use of the levels can be justified provided they are stationary, otherwise some differences of log-returns should be considered. The log-transformation can be applied for two reasons: reducing the scale of the series, or with the idea of performing the regressions on growth rates (logarithmic returns). The problem concerns then the choice of the amplitude of the differentiation: should a first difference represent the best choice or could we alternatively consider a fourth difference for quarterly series and a twelfth difference for monthly variables?

There is no clear answer. The choice must be made on a case-by-case analysis and must be supported by unit root tests. Moreover, an economic justification can be added: annual growth rates could be used for series that do not show clear seasonal patters or for cases where the annual growth rate is more significant or has a better economic interpretation compared to a monthly or quarterly growth rate. In addition, the over-differentiation problem must be considered. In fact, the seasonal difference should not be used if the differenced series will evidence moving average behaviour up to the seasonal order.

A problem strictly connected with the choice of the correct differentiation order is to the presence of cointegration among variables. Time irreversibility prevents the use of ECM or ADL models. Therefore, modelling the levels, the first difference for I(1) series or the seasonal difference for seasonally integrated series, will necessarily produce autocorrelated residuals. In any of these situations the effects of using a miss-specified model should be evaluated case-by-case, using the directions of the following section.

An objection to this approach may be the lack of dynamic in the model or the lack of the error correction when we model the delta-log. In this case, the deletion of ECM may be justified if the related coefficients are small and if the long-run equation provides small corrections (relatively to the growth rates). This behaviour can be seen as a further justification of the use of a static model. Whenever two or more alternative models are available to perform the back-calculation we face the problem of determining the preferred specification. We suggest performing the comparison analysing the power of the various model within an in-sample comparison. In such a case standard comparison tests of forecasts have been used together with a set of distance measures between the true series and the back-forecasts. Whenever the alternative models have provided very close results the choice has been to consider a combined back-cast.

The data backward calculated during the project and the periods for which the estimations have been carried out are reported in the Table below.

Series	Freq.	Actual time span	Retrapolated sample
Industrial production index and MIGs	M	1985:01-present	1970:01-1984:12
GDP, GVA and components	Q	1991:01-present	1970:01-1990:04
Industrial turnover index	M	1995:01-present	1975:01-1994:12
Consumer prices index (HICP)	M	1990:01-present	No retrap.
Consumer prices index (CPI)	M	1960:01-present	No retrap.
Deflated retail trade index	M	1995:01-present	1970:01-1994:12
Producer prices index	M	1981:01-present	1970:01-1980:12
Unemployment	M	1991:06-present	1970:01-1991:05

3.3 Nowcasting techniques and early estimation of Europen aggregates

The idea is to provide users with initial estimates before the results of the usual calculations for the indicator are available. This problem is of course similar to the problems of retropolation, mentioned earlier, and to forecasting in general. The statistical tools are thus the same: univariate forecasting models, dynamic regression or transfer function models, VAR models, and non-linear models.

Eurostat is currently working with the NIESR on a comparative analysis of these various techniques for providing quick estimates. An important step in this project relates the Euroarea data to a US timetable. The project starts with the consideration

that data on industrial production, GDP and producer prices are published considerably later in the Euroarea than in the United States as the following Table shows.

Release lag for some key aggregates

Country / Aggregate	US	Euroarea	France	Germany	Italy
Industrial production	15	45	41	40	45
GDP	24	45	50	45	40
Producer prices	10	38	30	27	28

This project is to explore whether using auxiliary data available, would be possible to produce estimates with the same timetable of United States. It is, in fact, always possible to produce estimates using modelling methods of one sort or other. The key question is whether estimates generated using plausible techniques are likely to be reliable enough to make Eurostat comfortable releasing them and users happy of using them.

The main auxiliary variables available to the required timetable are the business survey results produced by DG ECFIN. They are published at the end of the month to which they relate and thus the estimates produced using them would be available with no delay. For the production of estimates of quarterly GDP growth two months' industrial production figures are available fifteen days after the end of the quarter. These have been included in our data set, so that the estimates of GDP would be available with a delay of fifteen days. Use is also made of data on oil prices and the Euroarea real exchange rate available in real time. All possible models have been explored which could be constructed using relevant survey variables and the other auxiliary variables. The best performing model (identified by a standard statistical criterion) has been selected and used to make a prediction of one period ahead. The exercise has been repeated recursively so as to be able to identify the performance of forecasts generated using the model which would have been selected at each point in time. This provides a realistic guide to the performance of the models without the element of hindsight so often present when models are assessed on the basis of in-sample performance. The simulation has been conducted using the survey data as published. They are seasonally adjusted using a programme, the DAINTIES, which is not very well known and quite out of date. We have also looked at the performance of our models when the data are adjusted using Tramo-Seats, a widely-used seasonal adjustment package. The results are summarised in the Table below. It should be noted that if, for industrial production and producer price movements, rolling quarterly growth figures were published instead of monthly variables, then the reported standard errors would be likely to fall to $1/\sqrt{3}$ of the values reported. On this basis it is likely that early estimates of producer price movements would be suitable for publication.

Forecast errors for nowcasting

Variable	Original Data	Tramo-Seats	Original Data	Tramo-Seats
	RMSE (%)		RMSE (%) of Rolling Quarterly Estimates	
Industrial production	0.61	0.61	0.35	0.35
GDP	0.33	0.27	-	-
Producer Prices	0.22	0.22	0.12	0.12

Starting from institutional framework discussed above and in the context of the general improvement of quarterly European accounts, Eurostat has recently developed a methodology for the compilation of a flash estimate of quarterly GDP for the euro-zone and the European Union at 45 days after the end of the reference quarter. The Eurostat project have greatly benefited from the results of a project on flash estimates of quarterly national accounts co-ordinated and supervised by Eurostat in the framework of the European Union Fifth Research Programme. This project have analysed feasibility and suitable methods to produce a flash estimate and proposes a methodology for compiling flash estimates at the European level. In accordance with the results of this project, the identification of a suitable method for the estimation of the Eurozone and the European Union GDP went through the following steps:

- definition of the target variable;
- analysis of the available information;
- choice of a methodology of flash estimates and model building;
- nowcasting performance analysis.

An indirect approach to the compilation of the European GDP has been taken into consideration using Member States data as a basis of constructing indicators. Nevertheless, the direct approach compilation has also been analysed and the results evaluated.

The target variable for the flash estimate is the quarterly growth rate on the previous quarter of GDP for the euro-zone and the EU, seasonally adjusted, constant prices 1995, as published by Eurostat. The choice of the growth rate on the previous quarter is in line with the objective of describing short-term movements of the economy. Furthermore, the quarter on quarter growth rate is the main indicator on which Eurostat's news releases focus.

Several different sources of basic information are available within a reasonable delay after the end of the reference quarter. The available information is made up by:

- the figures compiled by the National Statistical Institutes in the context of quarterly national accounts as far as they are available 40-45 days after the end of the quarter (countries' flash estimates);
- the figures estimated by other institutes like Central Banks, short-term analysis institutes, etc. (but well recognised at the national level);
- other basic statistics normally compiled by National Statistical Institutes and usually available at higher frequency than quarterly (for example, index of industrial production, retail sales, prices, employment, external trade, etc.).

In accordance with the Eurostat methodology for the regular estimates of the European quarterly national accounts aggregates and on the basis of the results coming from the "Flash Project", flash estimations at country level are considered the best indicator for the nowcasting of the Eurozone and the European Union GDP. For this reason, in the estimation process priority is given to countries flash estimates. For those big Member States that are not producing flash GDP estimates, related indicators are used. Countries flash estimates and indicators are combined for estimating GDP in the context of a regression model based approach (similar to the approach of the first regular estimation).

The related indicators have been chosen following a step by step process: 1) A first list of indicators suitable to produce the flash estimate has been identified by economic reasoning, requiring that the indicators show a close correlation to the dependent variable; 2) Selection, inside the list, of the most suitable indicators on the basis of a bivariate pairwise analysis of correlation with the target variable.

An analysis of the indicator correlation with GDP was the leading criterion in choosing the indicators. The analysis was performed in order to identify those indicators most suitable for the GDP flash estimation of the European aggregates, as a complement of the GDP flash estimates available at 45 days at country level. A bivariate strategy has been applied and indicators have been sorted according to their degree of correlation with GDP.

As previously mentioned, the indirect method of estimation of the European aggregates (i.e., using the sum of GDP of the countries as indicator) has been chosen in building the flash estimates. This was considered the most suitable choice, ensuring the possibility of using all the available data transmitted by Member States and the methodological coherence with the regular quarterly national accounts estimation procedure currently used by Eurostat. Indeed flash estimates for Germany, Greece, Italy, the Netherlands and the United Kingdom are available within 45 days. For those major countries that do not yet produce a GDP flash estimate, suitable related indicators have been used. Such indicators were required to satisfy the following criteria: 1) availability at 40-45 after the end of the reference quarter; 2) economic meaningfulness with respect to quarterly GDP; 3) official availability: preference has been given to official statistics; 4) statistical correlation with the target variable.

The final model was specified according to both statistical and economic considerations. In particular the criteria applied were the following: a) statistical meaningfulness of the model; b) simplicity of the model; c) possible economic interpretation of the model; d) use of all the relevant available information; e) coherence with the methodology applied for the first regular estimate of Eurostat.

The selection process showed that the best model for the flash estimation of the GDP growth rate (constant prices and seasonally adjusted) for the Eurozone and the European Union, compiled according to the indirect approach, is based on the available GDP flash estimates for Germany, Italy, United Kingdom, the Netherlands and Greece (constant prices, seasonally adjusted) and other indicators, mainly industrial production indices (seasonally adjusted), for France and Spain (GDP flash estimates are not yet available).

In order to assess the performance of the model, a simulation under real conditions has been done. The flash estimate figures for GDP of Germany, Italy, the Netherlands and the UK (and only recently Greece), usually available within 45 days from the end of the reference quarter, together with the indicators for France and Spain have been used to produce a flash estimate of the European GDP under real conditions. The nowcasting performance of the models has been tested by comparing the flash estimation with the 'traditional' Eurostat estimations over nine quarters from 2000Q4 to 2002Q4, both for the Eurozone and the European Union. Results are quite satisfactory: as far as quarterly growth rates are concerned (Q/Q-1), the root mean squared error (RMSE) calculated by comparing the first Eurostat estimate (60-70 days) with the flash estimate is 0.04% both for the euro-zone and the European Union. The success rate in predicting an acceleration/slowdown of the growth is satisfactory: 8 out of 9 cases for both the euro-zone and the European Union (compared with the 60-70 days estimate). The forecasting performance remains almost unchanged when results are compared with the second and third

release of Eurostat estimates (100 and 120 days). The model is also good in capturing annual growth rates (Q/Q-4): the root mean squared error calculated with respect to the first Eurostat estimate is around 0.10 for both European aggregates and it becomes even smaller with respect to the second and third estimates.

3.4 The analysis of revisions and revision policies

A well known feature of most economic data released by national and international statistical agencies is that they often undergo a process of revision once timely but initial figures have been published. For example, preliminary data can be based on an incomplete and/or provisional set of information, which are successively and regularly updated as new information become available (routine revisions). Furthermore, from time to time, additional and more unusual revisions taking place at infrequent and irregular intervals can also occur, such as those generated by changes in the methods, classifications and sources used (occasional revisions).

The nature and extent of data revisions have been the object of a continuous interest by the literature. Both economists and statisticians have focused their interest on the impacts of the revision of data on relevant issues of econometric modelling, such as parameter estimations, simulations and forecasts.

An important line of research considers revisions as generated by measurement errors, whose statistical characteristics would be fruitfully analysed by statistical agencies to reduce the effects of subsequent revisions. In effect, such studies have pointed out that the analysis of revisions can provide a basis both for assessing the accuracy of provisional in relations to final estimates, and for improving the methods of estimation used to compile provisional data.

In recent years, revisions have become a cause of major concern for a number of reasons. Frequent and large-size data revisions can force economists, analysts and policy makers to continuously update their analyses and, in some cases, revise their interpretation of economic phenomena. Even 'noisy' changes can be considered as disturbing, particularly if the revision process concerns a key figure on which policy decisions, funding, and other assistances are based. In this respect, it is important to distinguish between statistical revisions and suspect – perhaps politically motivated – revisions in the data provided. For international statistical agencies, the problem of revision can be even of greater importance. In fact, data produced can be subject to revisions not only because of changes in the basic data obtained from member countries, but also because some data produced – such as aggregates – requires the availability of a complete information set. In many situations, gaps are filled in by estimation techniques, which are subsequently updated as the 'true' information become available.

National and international agencies have become more sensible to the problem of data revisions, and some important steps have been made in the central field of harmonising the revision process. The identification and acceptance of a common platform for revision or, in other words, a common revision policy, is now considered to be at the centre of the agenda of many meetings and working groups.

One of the main points of criticism of is the high frequency of revisions in the European aggregates and the absence of a common European revision policy, namely a guidance for governance in official statistics at both the national and international level. In this respect, the Short-Term Statistics Working Party of Eurostat has proposed a number of guidelines for the adoption of a common revision policy, indicating which data can be subject to revisions, when corrections should in principle be done, and procedures to be followed for normal statistical data revisions.

The FROCH group has recently put the emphasis on the necessity to establish a common set-up for revisions of the PEEIs to be adhered to by Member States, and has indicated the urgency of a joint document by Eurostat and the ECB containing, *inter alia*, an overview of Member States revision practices and their calendars for the first release and subsequent revisions.

The Working Party on National Accounts of Eurostat has in the last months discussed more times about the need of a more corporate strategy for revision policy of both annual and quarterly national accounts. A questionnaire has been sent to Member States on practices actually followed to identify differences and commonalities.

A similar questionnaire has been finalised by our unit and is to be circulated early within Eurostat. The questionnaire aims at providing insights into the data revision practices and policies followed not only in Member States but also in the various Sectoral Units of Eurostat responsible for the collection of STS and the estimation of the European aggregates for a number of key short-term economic statistics.

Time-series of revisions must be tested in order to discover if they show any systematic behaviour. Eurostat is attaching a great importance to this type of analysis. In chapter 15 of the Handbook of Quarterly National Accounts (Eurostat 1999) a strategy for the analysis of revisions is described and, as far as possible, applied in the context of the Euroind data base daily updated by Eurostat. This strategy can be generalised to all types of short-term series. The proposed approach derives from the studies of Patterson (1992), Di Fonzo, Pisani and Savio (2002) and many others.

The analysis of revisions is structured into two steps: a) statistical analysis; b) econometric analysis. Regarding the statistical analysis of revisions, summary statistics can be used for various comparisons between preliminary and final estimates. In the chapter 15 of the Handbook of quarterly national accounts (Eurostat 1999) two types of errors are considered: 1) relative errors, giving information on the accuracy of preliminary estimates of levels; 2) - absolute errors, used to evaluate the accuracy of preliminary growth rates. Proposed indices of accuracy of the preliminary estimate of levels are relative measures, such as Mean relative errors and Standard deviation of the relative errors, whilst indices of the accuracy of the preliminary growth rates are, e.g., Mean errors and Standard deviation of the absolute error.

Clearly these measures can not be considered as reliability measures of provisional estimates. However they permit to evaluate if revisions are always (or almost always) of the same sign. If it would be the case, a correction of preliminary estimates should be needed.

Regarding the econometric analysis of revisions, econometric analyses and tests can be conducted on both successive versions or vintages of data. In our approach, it is recommended to conduct the analysis on vintages for reasons linked to their greater homogeneity. The last available vintage of data is assumed to be the final one. Most econometric techniques use tests borrowed by the rational expectation theory. In this context preliminary estimates are considered as different forecasts of the final vintage, conditional on the available information at the time they are made. Consequently, tests of the rationality of the expectations can be used to asses the accuracy of provisional estimates. The following test are proposed in our approach:

1) Test for lack of bias which means that the mean of revisions should be zero;

2) Test for weak efficiency which means that revisions should be unforecastable from the information available at time t. This information comprises the preliminary vintage itself and a constant term. Hence, efficient use of this information would improve the

initial vintage as a predictor of the final one. Weak efficiency is a sufficient but not a necessary condition for unbiasedness.

3) Test of orthogonality which means that revisions should be unforecastable from all the relevant variables available at time t. All the available information can include: past history of the revisions process, the phase of business cycle, the dynamic of the inflation process, the period in which the preliminary estimate is made, etc.

Wince orthogonality is a particular case of weak efficiency, it is the most restrictive test proposed. These test permit to access the randomness of the revision process but they can not be considered as exhaustive. In fact another relevant and advisable property is the cointegration of successive vintages of data. The absence of cointegration means that a non stationary variable (of a combination of these) has been omitted between the preliminary and the successive vintage. This omission can be due to different factors like: measurement errors in the preliminary estimates, their accumulation over the time, use of unrepresentative data, incomplete sampling, etc. This explains the importance of testing the hypothesis that there exists a stationary linear combination of two vintages. At this point it is important to clarify the relationship between cointegration and rationality. The preliminary vintage could be a biased and inefficient predictor of the final one, but the two could well be cointegrated. Thus, cointegration is necessary, but not sufficient, for unbiasedness and efficiency. This is obvious because cointegration pertains with long-term movements. Two series could be cointegrated but they could have different business cycle behaviours. This consideration leads as to the last important point of our scheme for the analysis of revisions. We need to investigate the similarity of vintages in terms of serial correlation common features (SCCF). Successive vintages will have SCCF if it is possible to define a linear combination of their cycles which does not contain any cyclical component. In other words we need to test if a linear combination of the first differences of vintages is a white noise.

4. Improving the informative content of the data

Here we consider area on which Eurostat has dedicated efforts in recent years and which directly pertain to what can increase the informative content of the data released, most notably in the field of what is commonly named as 'data presentation'. In this context, we will refer to seasonal adjustment and business cycle estimation issues.

4.1 Seasonal adjustment

The ECB and Eurostat recently presented their recommendations on seasonal adjustment (ECB, 2000 and Eurostat, 2000). The positions of the two institutes are very similar. These points of view now has been put to the Member States, which as a rule use different methods, sometimes even within the same institute. Two problems should be mentioned here:

- Tramo-Seats and X12-Regarima are the software packages that are recommended in the reports. Empirical studies have shown that the choice of one or other method is not clear-cut and depends, amongst other things, on the seasonally-adjusted indicator. Although Eurostat recommends using Tramo-Seats for the seasonal adjustment of a large number of series, the performances of the two software products needs to be evaluated and compared for the main macroeconomic indicators.

- Seasonal adjustment of European series, calculated by aggregating the national series, can in theory be carried out in four different ways: a) seasonal adjustment

of aggregated raw series (direct approach); b) aggregation of seasonally adjusted national series (indirect approach); c) aggregation of national series seasonally adjusted by the Member States (mixed indirect approach); d) simultaneous seasonal adjustment of national series (multivariate approach).

The differences in the four approaches, and in the derived components, correspond to the differences in the information set which is considered in the information process (see Campolongo and Planas, 2000, for a theoretical overview on this subject). Some empirical studies have shown that differences in multivariate versus univariate approaches are relatively small. The empirical results show that direct and indirect approaches produce equivalent results only under very restrictive assumptions, i.e. when no trading day or outlier correction is made, the decomposition is additive and no forecast are produced (see Ladiray and Mazzi, 2003). In practice, such conditions are met rarely and the differences in the series produced under the two rules can be significant depending on the series concerned. Some criteria to discriminate between direct and indirect approach can be put forward : smoothness of seasonally adjusted series, minimisation of revision errors, stability of seasonal component, quality assessment of seasonal adjustment, analysis of the irregular component and out-of-sample forecast accuracy.

A comparison between the direct and the indirect approach has been presented by Astolfi, Ladiray and Mazzi (2000) and Ladiray and Mazzi (2003) with reference to the Eurozone GDP. The results obtained show that the direct approach produces smoother figures than the indirect one. This comparative analysis will be extended in all relevant areas to assess a common seasonal adjustment strategy for Eurozone figures. Among all other theoretical considerations, the direct approach seems to be preferred, in particular when estimation and nowcasting are carried out. The use of a direct approach implies the lost of the additivity between national data and Eurozone totals. Users should be aware of this situation. From the producers point of view, it is essential to verify continuously that Eurozone seasonal adjusted figures, directly obtained, deliver the very same message.

Anyway, there is no clear choice and comparative studies still need to be done. Evaluation criteria have been put forward: minimised revisions, smoothing of seasonally adjusted series, stability of seasonal component, predictive power of seasonally adjusted series, etc..

Some countries favour the aggregation of national series that have been seasonally adjusted by the Member States. The advantage of this method is that it retains the additivity of seasonally adjusted series. But this is hampered by the fact that the Member States generally do not use the same method: the seasonally adjusted series for Europe can thus be tainted by these different types of filter. It is highly recommended that Member States could move towards an harmonisation of seasonal adjustment practices. These should include not only the convergence of the methods but also several other aspects, such as: trading day correction, revisions, consistency between seasonal adjusted and not seasonal adjusted totals, etc.

Another important line of research is the seasonal adjustment of qualitative surveys collected by the DG ECFIN within the framework of the Joint Harmonised EU Programme of Business and Consumer Surveys. In a recent project, conducted within a working group composed of representatives from the Commission (DG ECFIN, Eurostat), the ECB and the OECD and related to an assessment of seasonal adjustment methods for business and consumer surveys, Eurostat has focused its attention on three important aspects, namely: a) whether deterministic/stochastic seasonal components have to be considered as common features of the time behaviour of these surveys; b) whether an indirect or a direct approach for seasonal adjustment should be preferred when the series

contains a seasonal component; c) whether significant differences arise in the outcomes when different seasonal adjustment procedures are chosen (see Mazzi, Savio and Soares, 2003).

Seasonally adjusted data for balances can be obtained by following two main approaches. The first (direct approach) is at present used by the DG ECFIN and consists in obtaining first the balances in raw form, and then in applying the seasonal adjustment procedure to each country. Aggregates for Eurozone and European Union are than obtained through a weighting procedure. On the contrary, the indirect approach derives the seasonally adjusted balances - for example in case of 'three answer' surveys - from the difference between seasonally adjusted positive and negative answers. In the last case, the sum of the seasonally adjusted answers is likely to be not equal to 100. Then, for example, the 'plus', 'equal' and 'minus' signs should be constrained to be equal to the accounting identity before being used for any successive analysis.

With reference to the first point, it can be noticed that though the respondents are explicitly asked to abstract from seasonal movements in forming their judgements, a well known common feature of surveys series is the presence of a seasonal component.

This evidence has been advocated in support of the notion that seasonal fluctuations are not independent of the trend and cyclical parts of the time series (see Franses 1996). The seasonal dynamics in the qualitative surveys reflect the seasonality in the quantitative series they should mimic (for example, orders, turnover and production) even though seasonality should be, broadly speaking, weaker.

Another important point to be raised is that business surveys are, by construction, bounded series. Then, the variances associated to the trend and seasonal components should not, in principle, go to infinity, thus eliminating a source for stochastic movements in these components. Anyway, what we are really covering in most situations is a small piece of the underlying true stochastic process. Then, the question naturally arises of to what extent we can describe the surveys as being characterised by stochastic trend and seasonal movements. In this respect, we have conducted preliminary analyses on the level series by performing the extension to the monthly case of the test originally suggested in a quarterly context by Hylleberg *et al.* (1990), namely the testing procedure developed by Beaulieu and Miron (1993). The results obtained by applying these test to a number of monthly series show that the data fail to reject in 68.6% of the cases a unit root at the zero frequency, and in almost all the series we fail to reject at the 5% level a root at some of the seasonal frequencies. Therefore, although the presence of seasonal roots seems to be stronger than that of a root at the zero frequency, the application of the seasonal operator $\blacksquare_{12}$ seems to be in almost all cases not completely justified. Furthermore, this result seems to seriously question the rightness of the use of the so-called airline model for the seasonal adjustment of qualitative surveys.

Concerning the other two questions, it has been found that the use of a direct approach seems to give quite reliable results in terms of stability of estimates, smoothness, concordance of components and data revisions. Of the two software for seasonal adjustment analysed, the Tramo-Seats package gives, on average, more reliable results in terms of roughness, concordance and quality of the seasonal adjustment, while the X12-Regarima performs better in terms of data revisions. The information lost due to aggregation following the direct approach is, in most cases, negligible. That is likely to be due to the similarities of the seasonal components among the different answers given by respondents. Given the results obtained, the use of an indirect approach to seasonal adjustment can be equally followed. In that case, the greater information given to users has to be bal-

anced with the necessity to fulfill the usual aggregation constraints. These can be easily introduced into the estimates by using standard multivariate disaggregation techniques well know in the literature.

Another important line of research is the role of seasonal adjustment in the measurement of business cycle both from the classical and the deviation cycle perspective. For the former, one could aim at evaluating the uncertainty in the detection of turning points arising from the application of different seasonal adjustment techniques and, possibly, different aggregation procedures. For the latter one investigates ways of assessing how and how much different seasonal adjustments affect the level (reliability in terms of revision errors) of output gap estimates.

Preliminary results obtained within studies conducted by the Eurotrend project seem to confirm that, regarding the Eurozone quarterly GDP spanning the sample from 1980 to 2003, the impact of seasonal adjustment can be substantial in the identification of turning points, as evidenced in the Table reported below. In particular, a complete cycle seems to be missing if one uses Tramo-Seats as seasonal adjustment package instead of the X12-Regarima software, and some turning points are shifted using the indirect instead of the direct seasonal adjustment aggregation scheme.

Turning points in the quarterly GDP for the Euroarea, classical cycle

	Tramo-Seats		X12-Regarima	
	Direct	Indirect	Direct	Indirect
Through	1981q1	1981q1	1981q1	1981q1
Peak	1992q3	1992q1	1992q1	1992q1
Through	1993q1	1993q1	1993q1	1993q1
Peak	-	-	2001q1	2001q1
Through	-	-	2001q3	2001q4

Another important aspect of seasonal adjustment, namely the performance and the quality of the different adjusting procedures when the series span a short time period, is at the core of another project developed by Eurostat. In effect, most of the filters actually used for seasonal adjustment are asymmetric. Under these circumstances, quality statistics tend to be flawed by the use of too few observations, i.e. revisions are bigger when new data are progressively added to the time series, the presence of outliers is likely to greatly worsen the overall performance of the econometric models, etc.. In this respect it is widely recognised that seasonal adjustment should be performed using a sample period of at least 5 years. Unfortunately, that is not always the case in current practices. In the context of the statistical activities carried out by Eurostat, in a number of situations the infra-annual statistics for the most scrutinised aggregates by users and policy makers – i.e. the EU and Euroarea aggregates – seldom span a sample of more than 10 years. That situation can arise for a number of reasons, amongst them we cite breaks in the component (country-specific) series, changes in the base year for constant price evaluations, changes in the definitions, sources and methods used for the compilation of the micro-aggregates. In the next future another important element will have an impact on the problem here at hand, namely the enlargement of the EU for the entrance of the new 10 Acceding Countries.

This project tries to shed some lights on the issue of the dependency of the results of seasonal adjustment on the length of infra-annual time series. The issue seasonal

adjustment/length of time series is studied with reference to both real (external trade statistics, national accounts, industrial production indices) and simulated data sets. The performances of the two programs Tramo/Seats and X12-Regarima have been analysed and compared by considering appropriate quality statistics indicators, such as revision errors and sliding spans, residual whiteness, M-statistics, stability of the final models and results.

Our preliminary conclusions are that both programs suffer for a deterioration of quality indicators for the seasonal adjustment of progressively shorter time series, but that this deterioration is more pervasive with the Tramo-Seats program rather than with X12-Regarima program. A theoretical explanation of this evidence could be found in the fact that model-based approaches, such as Tramo-Seats, suffers of model instability, which worsen revision errors and general indicators of performance of the locally preferred model.

4.2 Business cycle estimation, dating and detection of turning points

The business cycle has an importance in the popular debate which can tend to run ahead of the problems in measuring it. For example, before discussing whether there is a European business cycle, or whether output is above or below its trend, we must confront the logically prior step of the appropriate way of measuring the business cycle or, equivalently, the trend level of output.

Business cycle analysis has thus developed into a prominent sub-discipline and, accordingly, there is a vast literature on the subject. Among the variety of different questions that have been treated in this context two important ones stand out, namely how a cycle should be extracted from a given data series and, more generally, how the turning points of the cycle should be identified. Many different measures of the business cycle have been proposed in the literature. Indeed there is a fundamental dichotomy between so-called "growth" and "classical" business cycles. This distinction reflects the fundamental dichotomy between so-called "growth" and "classical" business cycles. Eurostat, in conjunction with the NIESR, recently turned its attention to two questions: a) Is there a European business cycle, and how do national business cycles relate to this? b) How should we measure the 'output-gap', i.e. the difference between actual and potential output?

Synchronisation of business cycles In this project an eclectic approach has been taken within the current debate considering a range of different measures of the business cycle. These measures are assumed to be complementary, in the sense that they may all provide relevant information about the state of the business cycle. A comparison has been carried out among the complementary measures of the business cycle in an empirical application to the Eurozone business cycle. It is important to reconsider the question of Eurozone convergence as the literature has not yet reached a consensus on whether Eurozone business cycles have converged. Differences are explained in part by the use of different data. Other reasons, however, include the use of different methods of both identifying business cycles and gauging convergence.

The starting point is the controversy initiated by Artis and Zhang (1997, 1999) and Inklaar and de Haan (2001). While Artis and Zhang (1997, 1999) conclude that European business cycles have become more synchronised, Inklaar and de Haan (2001), using the same but updated data, reach the opposite conclusion. The evidence that sparked this controversy has been re-considered and in so doing some important stylised facts about the nature of the Eurozone business cycle have been assessed. The work has been

characterised by the following five developments.

(a) Using the same raw data as Artis-Zhang and Inklaar-de Haan, again appropriately updated, one can identify business cycles using a range of trend-cycle decompositions, as well as by parametric and nonparametric turning point rules. This is in contrast to the selective de-trending methods considered by Artis-Zhang and Inklaar-de Haan. This lets us ascertain whether inference on convergence is contingent on the measure of the cycle.

(b) In order to test whether Eurozone business cycles actually have converged, and there is evidence for a common cycle, the distribution of bivariate correlation coefficients between the 12 countries' business cycles has been analysed. This extends previous work that has tested for convergence, in a similar manner by focusing on correlation, but has not considered the entire distribution, instead focusing on the mean correlation coefficient or particular bivariate correlation coefficients. The distribution based measure of convergence is related to the economic growth literature, specifically the concepts of β and σ convergence; see Quah (1993, 1996).

(c) Since one can imagine the situation where Eurozone business cycles, for example, are uncorrelated but are moving 'closer' together, due to less pronounced cyclical volatility, the further step consisted in the examination of whether Eurozone business cycles have moved closer together over time. Specifically, a measure of closeness the root mean squared difference between the Eurozone growth business cycles is proposed, expressed as a percentage of potential or trend output.

(d) The evolution of the estimates over time using a series of rolling windows has been considered, rather than just two or four windows of fixed width as in Artis-Zhang and Inklaar-de Haan.

(e) A measure of uncertainty associated with our estimates has been provided by estimating the correlation coefficients using a generalised method of moments estimator.

The empirical findings about the Eurozone are that, although empirical inference about individual Eurozone business cycles is found to be sensitive to the measure of the business cycle considered, the proposed measure of convergence between the Eurozone business cycles exhibits common features across the alternative measures of the business cycle. Interestingly, it is found that there have been periods of convergence, identified by the distribution tending to unity, and periods of divergence. Although further data are required to corroborate the story, there is evidence to suggest that the Eurozone has entered a period of convergence after the clear period of divergence in the early 1990s in the aftermath of German unification and at the time of the currency crises in Europe. This is encouraging for the successful operation of a common monetary policy in the Eurozone.

In a rather different approach, a similar topic has been addressed by Ladiray and Mazzi (2001), Ladiray and Soares (2001), and Astolfi and Mazzi (2002). The results obtained in all these three studies using Business and consumer surveys, GDP and Industrial production index, seem to confirm that convergency is improving in the last periods.

In another recent study on business cycles in the Eurozone (Ladiray and Mazzi, 2001), the authors have found a strong evidence of cyclical synchronisation in the Eurozone, with ten countries out of twelve presenting a correlation greater than 0.9 with the overall cycle. Further, a cluster analysis on the 13 estimated cycles has revealed 4 different groups, two of these for Finland and Ireland separately, and two groups for the remaining countries, the first composed by France, Greece, Italy and Luxembourg, the second one by Austria, Belgium, Germany, Spain, the Netherlands and Portugal.

Output gap measurement and turning points chronology Regarding the second question, namely how should we measure the 'output-gap', i.e. the difference between actual and

potential output, both multivariate and univariate measures of the output gap have been considered. It is widely recognised that multivariate estimators offer a more economic interpretation to the output gap as they essentially combine the estimators of the growth cycle with additional economic information. The Phillips Curve, for example, suggests that inflation data contain information about the output gap while Okun's Law suggests unemployment is important. These economic variables may contain useful information about the supply side of the economy and the stage of the business cycle. Three multivariate models have been analysed: (i) unobserved components models, (ii) Hodrick-Prescott models, and (iii) structural VAR models. A simulated out-of-sample experiment has been used in this context to analyse the real-time performance of these alternative output gap estimators, as well as some representative univariate estimators. The real-time behaviour of output gap estimates is of importance given that policy-makers require estimates in real-time. Across a range of widely used univariate and multivariate estimators of the output gap we we have found significant differences between real-time and final output gap estimates for the Eurozone - real-time estimates are unreliable. As the future becomes the present, output gap estimates are revised. It is not just in the US that real-time measurement of the output gap is difficult. Nevertheless, the change from univariate to multivariate measures of the output gap does lead to real time estimates better correlated with the final estimates. Adding 'economic information' appears to help. The correlation of two univariate and five multivariate estimators of the output gap computed in real-time against the final estimates is summarised in the Table below. Note that even for a given measure the correlation is sensitive to the specification chosen. This is illustrated for the SVAR with no cointegration where two numbers are reported, the first for a VAR with lag order one, the second for a higher order VAR: SVAR estimates of the output gap are sensitive to the lag order chosen. An important finding is that a low lag order, as is typically selected by information criteria such as the BIC, can lead to implausible looking output gap estimates. Given the unreliability of real-time output gap estimates for the Eurozone, this begs the question, should we be surprised by this unreliability? As forecasters know, the fact that forecasts are wrong does not mean they are misleading or useless. If within the bounds of what was expected the forecast can remain useful, similarly for output gap estimates which we view analogously to a forecast.

To capture fully the uncertainty associated with the real-time estimates, or forecasts, of the output gap, density forecasts have been constructed. Density forecasts of the realisation of a random variable at some future point in time provide an estimate of the probability distribution of the possible future values of that variable. Two approaches have been used to construct density estimates of the output gap in real time. The first relies on a state-space representation for the output gap estimator while the second quantifies the degree of uncertainty through forecasting. One important finding is that the real-time measures of uncertainty do not prove to offer reliable indications of the degree of uncertainty associated with real-time estimates. This provides a serious challenge to users of output gap estimates.

Finally, given that output gap estimates are frequently used to forecast inflation, one could examine whether the unreliability of output gap estimates in real-time impacts upon the quality of forecasts. In this respect, it has been found that, although real-time output gap estimates often have little forecasting power over inflation relative to simple autoregressive alternatives, this does not appear to be due to the unreliability of output gap estimates but rather the difficulties of forecasting inflation *per se*.

The correlation of real-time estimates with final estimates

Model	Correlation
Hodrick-Prescott	0.273
Univariate unobserved components	0.179
Bivariate unobserved components	0.457
Bivariate Hodrick-Prescott	0.688
Trivariate unobserved components	0.455
SVAR - no cointegration	0.901 and 0.153
SVAR - cointegration	0.575

An application of the multivariate Hodrick-Prescott (HPMV) filter to the estimation of the Euro area output gap has been carried out in a joint project with the OFCE. The analysis investigates the impact of using alternative economic relationships on the output gap estimates of the Euroarea. The comparison with the univariate HP filter have shown that this can significantly modify the appreciation of the output gap level of the Euroarea in some specific periods. The study proposes also to estimate the HPMV models with the methodology adopted for the estimation of state-space models. This strategy provides an alternative to the calibration of the parameters and allows to assess the reliability of the HPMV output gap estimates. Estimated weights associated to the economic relationships in the optimisation program of the HPMV are generally coherent with the calibrated values usually retained in the literature. The assessment of the reliability of the alternative output gaps and of the revision properties have shown a substantial superiority of some HPMV models over the univariate HP filter. Another important finding of this project is that the integration of macro-economic information generally improves the accuracy of the inflation forecasts.

In another project with OFCE, an analytical framework for the estimation of potential output and output gaps for the Euroarea is used by combining multivariate filtering techniques with the production function approach. The potential advantage of this methodology consists in combining a model-based approach to estimate potential output with explicit statistical assumptions concerning the estimation of the potential values of the components of the production function.

The need for a cycle turning point chronology is now widely recognised by experts and practitioners of economic analysis. As an example of application, it may help to compare the cycles among countries or to point out the links between the cycles and diverse macroeconomic aggregates. However, it turns out that the most important use of the turning point chronology consists in establishing a reference cycle dating for a given country or an economic area. Regarding the US, the NBER's Business Cycle Dating Committee is widely recognised as the authority for determining peaks and troughs in the classical business cycle. In other countries, in our context in the Eurozone, there is no official dating of business cycles and therefore reference dates, which could be considered as a benchmark, are not available for theoretical and empirical studies.

The definition of a turning point chronology is now a central theme for Eurostat, which started some years ago a project with GRETA ASSOCIATI and COE aimed at identifying turning points for a number of key indicators of economic activity.

During the project a comparison has been made among different methods for identification of turning points, namely univariate *versus* multivariate methods and parametric *versus* non parametric approaches. Further, the effects of aggregation and seasonal adjustment and the detrending methods used have been studied in great detail by applying

the various procedures to the Industrial Production, GDP and Employment data. The final chronology, extended to both classical and growth cycles, is synthesized for the Eurozone in the following Table.

Turning points chronology

Phase	Industrial production		GDP	
	Class. cycle (M)	Growth cycle (M)	Class. cycle (Q)	Growth cycle (Q)
Trough		1971:11		
Peak	1974:04	1974:01		
Trough	1975:05	1975:06		
Peak		1976:11		
Trough		1978:03		
Peak	1980:02	1980:02		
Trough	1981:01	1981:01		1981:01
Peak	1981:10	1981:10		1981:04
Peak			1982:02	
Trough	1982:12	1982:12		1982:04
Trough			1983:02	
Peak		1985:11		1985:04
Trough				
Trough		1987:10		1987:02
Peak				
Peak	1992:01	1992:01	1992:01	1992:01
Trough				
Peak				
Trough	1993:05	1993:06	1993:01	1993:03
Peak				
Trough				
Peak		1995:02		1995:01
Trough				
Peak				
Trough		1996:10		1996:04
Peak		1998:02		1998:01
Trough		1999:04		1999:01
Peak	2000:12	2000:11		2000:03
Trough	2001:12			
Trough		2002:02		

5. Conclusions

The availability of good quality Eurozone statistics is essential for the co-ordination of economic policies, the assessment of convergence and the conduct of monetary and fiscal policies. This particularly applies to infra-annual macro-economic statistics, which represent a key instrument for business cycle analyses and short-term economic interventions. Over the last years, the Commission, the Council, the ECB and the ESS as a whole have made substantial improvements to the quality of statistics, notably with respect to the comparability, coverage, timeliness and coherence.

Notwithstanding these efforts, the limitations of the current procedures for calculating European aggregates are evident, especially where data freshness and revisions are concerned. There is a risk that the imminent enlargement of the European Union and the

Eurozone could aggravate these problems. The use of econometric models in response to economists' needs for business cycle analyses offers an interesting and promising alternative.

The quality of the Euroind database has shown a marked improvement thanks to the help of many users and researchers. At the moment, tremendous efforts are being made to cut the time it takes to supply national and European data. The Eurotrend project is still in its start-up phase, but concrete results have yet been achieved and now wait for a routine application to everyday statistical life.

Undoubtedly, one of its tasks will be to inculcate a new sense of short-term analysis within Eurostat and to promote at the international level researches and activities on infra-annual statistics. The organisation of an annual Colloquium on business cycle is just posed in this context. Several studies have been launched in various relevant fields. Eurostat plans to make rapid progresses on the various subjects referred to in this paper, and to do so with an open mind and with a genuine desire for transparency.

Several of the results presented in the paper, such as back recalculation and flash estimates as well as estimates if high frequency data, could become with a short delay an integral part of the Eurostat production system and of its dissemination portal for infra-annual statistics, the Euroindicators website. Such results need to be officially approved by Eurostat before being disseminated.

Other results, such as estimation of output gaps and the turning points chronology, can represent a very useful starting point in an open and constructive discussion with our economic partners, such as DG ECFIN and ECB. Their dissemination could be also envisaged in the future, but for it we need not only the agreement of Eurostat but also the agreement of the above mentioned partners.

Several projects need to be further developed, namely the definition of harmonised policies for seasonal adjustment, revisions and estimation techniques for the aggregates. More sophisticated researches - estimation of multivariate leading indicators for the most relevant real economic variables, construction of a multivariate chronology of turning points, real-time detection of turning points - need further developments. The extension of convergence and synchronization studies also represents an activity to which Eurostat is giving high priority. Most of the tools developed in the context of the Eurotrend project could be fruitfully used by Member States to improve their statistical production and to enhance the informative content of short-term statistics. In this perspective, Eurostat is going to elaborate several tool boxes, freely available for official statisticians and researchers, in important area of business cycle research.

Users will have a major role to play in improving our European system of infra-annual indicators. The success of all these approaches will depend to a large extent on the full cooperation and active participation of the Member States, research centers and academics. In the medium-long term period, for the European Statistical System to become a centre of excellence a quantum leap is needed.

This will be best achieved, *inter alia*, through implementing the First for Europe Principle with Member States focusing on the provision of the information required for compiling timely and high quality European statistics.

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