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TASK FORCE ON SEASONAL ADJUSTMENT OF QUARTERLY NATIONAL ACCOUNTS

FINAL REPORT

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1. INTRODUCTION

Eurostat and the ECB established a joint Task Force in order to develop recommendations for a policy on seasonal adjustment for euro area and EU aggregates for quarterly national accounts (QNA). In June 2000, the Committee on Monetary, Financial and Balance of Payments Statistics (CMFB) supported this work and invited the Task Force to report back in 2001. Moreover, the work of the Task Force is covered under the Action Plan on EMU statistical requirements adopted in September 2000 which requests that the results of the Task Force are also reported to the Statistical Programme Committee (SPC).

A first interim report of the Task Force was submitted to the meeting of the CMFB in June 2001 [1]. The CMFB noted the report and invited the Task Force to present its final report to the meeting of the CMFB in January 2002, including a realistic timetable for implementation. [2]

Eurostat and the ECB jointly chaired the Task Force. Delegates from five NSIs (Spain, France, Italy, Netherlands and the United Kingdom) and two NCBs (Belgium, Germany) participated [3]. All national members are responsible for calculating seasonal adjustment of quarterly accounts. The Task Force held four meetings in February, April, July and December 2001.

According to its mandate, the Task Force has to submit recommendations for the compilation of euro area and EU adjusted QNA aggregates regarding:

- working day and trading day correction;
- seasonal adjustment and aggregation (i.e. the compilation of GDP aggregates);
- seasonal adjustment and time consistency (i.e. the identity between the annual sums of quarterly unadjusted and adjusted data);
- seasonal adjustment and revisions (i.e. the re-estimation of the trading day and seasonal components).

Moreover, the Task Force has to provide an overview of the national practices.

The Task Force considered existing international recommendation for the seasonal adjustment of national accounts, namely Eurostat's "Handbook on Quarterly National Accounts" (chapters 8 and 9) and the IMF

[1] Interim Report of the Eurostat/ECB Task Force on Seasonal Adjustment of Quarterly National Accounts, Item C.1.c of the agenda of the meeting of the CMFB on 28/29 June 2001.

[2] List of actions from CMFB meeting on 28/29 June 2001, point 8.

[3] The list of the TF members can be found in annex 6.

draft "Manual on Quarterly Accounts" (chapter 9). The group concluded that the existing recommendations are generally useful, but in several respects are either not fully consistent or are too vague. Eurostat intends to revise the chapter of its handbook in the light of the conclusions of the Task Force.

Eurostat's Management Committee (CD) decided recently on a new Eurostat policy for seasonal adjustment [4], with the main conclusion that all euro area and European aggregates should be calculated by direct adjustment of European aggregates by Eurostat. According to this, Eurostat *"took the decision now despite the fact that several groups (also a Eurostat internal one) are still working on this topic and discussions continue to take place in the CMFB and elsewhere. It considers the work of the sectoral TF currently dealing with QNA still to be useful, as it will lead to methodological convergence towards best practices within the ESS"*. The Task Force has finalised its report according to its initial mandate and provides a comparison and assessment of the indirect and direct method for QNA.

Unlike analogous documents on seasonal adjustment, the issue of the choice of the seasonal adjustment method (package) is not addressed in this report. All countries participating in the Task Force and all other EU countries use for QNA either a program version of the Census family or a version of TRAMO/SEATS. Though the seasonal adjustment part of the two programs differ substantially, the results differ, according to experience less, if they are applied in a similar manner. For the comparability of adjusted national accounts results, the points that are addressed in the mandate of the Task Force are likely to be more important than the choice between the two programs or different versions of the programs. For a comparison of the two methods readers might refer, inter alia, to recent publications by the ECB and Eurostat. [5]

In section 2 of this report, a review of national practices in the seasonal adjustment of QNA is given. In the following section, Eurostat current practices for the adjustment for the European and euro area aggregates are outlined. Section 4 introduces the ECB uses and needs for adjusted QNA. Section 5 and 6 detail the four points of the mandate and in particular the issue of working day adjustment and aggregation. Finally, in section 7, recommendations for harmonisation across EU countries and Eurostat, and a plan for their implementation conclude this report.

[4] Eurostat's policy in seasonal adjustment, Item C.1.a of the agenda of the meeting of the CMFB on 28/29 June 2001.

[5] "Seasonal adjustment of monetary aggregates and HICP for the euro area", European Central Bank, August 2000.

2. NATIONAL PRACTICES: COMPILATION OF QNA AND THEIR ADJUSTMENT FOR TRADING DAY AND SEASONAL EFFECTS

The Task Force surveyed the national accounts adjustment practices in EU Member States. The results are used to assess the comparability of national methods and to identify appropriate practices for European aggregates. Replies were received from 12 EU Member States. Not considered are Ireland and Greece, where the compilation of quarterly national account data started very recently and seasonal adjustment is not performed yet, and Luxembourg, for which quarterly national accounts are not yet available. The six sections of the questionnaire were:

1. Temporal disaggregation techniques and effects on QNA data
2. Trading day adjustment
3. Seasonal adjustment and aggregation;
4. Time consistency;
5. Seasonal adjustment and revisions;
6. Publication of seasonally adjusted data.

In this section only the main results are summarised. More details can be found in Annex 1.

2.1 Temporal disaggregation techniques and effects on QNA data

All 12 replying EU countries compile in the first step non-seasonally adjusted quarterly accounts and carry out seasonal adjustment in the second step. This method is also recommended by the draft IMF handbook for various reasons (e.g. raw data contain more information). There are, however, differences in the way non-seasonally adjusted results are compiled by the Member States. According to the ESA 95 Regulation (paragraph 12.04) "*they can be classified in two major categories: direct procedures and indirect procedures. Direct procedures are based on the availability at quarterly intervals, with appropriate simplifications, of similar sources as used to compile the annual accounts. On the other hand, indirect procedures are based on time disaggregation of the annual accounts data in accordance with mathematical or statistical methods using reference indicators which permit the extrapolation for the current year*".

Due to the time constraints under which quarterly accounts are compiled, the statistical sources are generally less complete and often different from the sources for annual accounts. Temporal disaggregation techniques are widely used, i.e. suitable monthly or quarterly indicators series are used to estimate quarterly national accounts "target" series. Most countries use the indirect method.

Depending on the available basic indicators and the techniques used for the estimation of components of the quarterly national accounts, the pattern of the estimated unadjusted national accounts target series may differ. This may also affect trading day and seasonal components of quarterly raw series. This issue, however, concerns the calculation of raw data rather than the adjustment practices. The issue of temporal disaggregation or, more generally, the way in which raw estimates are derived is not further considered in this report. The only particular aspect examined regards the use of these techniques in relation to trading day adjustment.

2.2 Trading day adjustment

Trading day adjustment is carried out by eight of the twelve countries (BE, DE, ES, FR, NL, AT, SE and UK). Italy intends to publish trading day adjustment by the end of 2002. As of now, coverage of quarterly trading day adjusted series for the euro area accounts for 75% of the euro area and 76% of the EU. After Italy has started trading day adjustment, the coverage will be almost 93 % (euro area) and 90% (EU) respectively. These shares refer to GDP results; the coverage of GDP components by trading day adjustment is often lower, because not all the Member States carry out trading day adjustment for all GDP components.

There are several similarities in the methods employed for trading day adjustment across the seven Member States concerned. In five countries trading day adjusted GDP totals are derived indirectly – i.e. via aggregation of trading day adjusted GDP components. In the Netherlands and Sweden GDP trading day effects are estimated directly on the GDP aggregate. In the Netherlands a more sophisticated method is used for GDP than for GDP components. All countries use the regression method for estimating trading day effects, i.e. no proportional adjustment is carried out. The adjustment is made in the pre-adjustment phase of the programs and it is prior to the seasonal adjustment. The adjustment is done for those variables for which there is statistical evidence and economic explanation of trading day effects.

However, some differences remain in addition to the mentioned differences in the coverage of GDP components. First, five countries (BE, DE, FR, NL, UK) derive trading day factors from indicator series at monthly frequency where it is possible (e.g. the trading day factor for quarterly value added for the production sector is compiled from three monthly trading day factors for monthly industrial production). Three countries (ES, AT, SE) always use quarterly series. This difference may be important, because more significant trading day effects can be derived from monthly data for statistical reasons (see section 5 for details). Second, the regressors used for trading day adjustment are different (one regressor or more, e.g. month-specific regressors). The calendar used for the regression is often country-specific considering national holidays (BE, DE, FR, NL for GDP only, AT, SE) whilst some countries (ES, UK, NL for series other than GDP) use the default calendars in the programmes. The discussion showed also that there are

differences in the way public holidays may effect economic time series in the EU countries. In some countries the practice is that public holidays are always "moved" to the following Monday (UK), or date-dependent public holidays are "compensated" by an extra leave day in the following week when they fall on a weekend (BE). In the other countries these practices do not exist. It can be expected that in the latter group of countries the potential trading day effects in quarterly accounts are higher, since the number of available trading days can vary more from year to year. Furthermore, some countries (BE, DE) also use sector-specific calendars to improve the adjustment (e.g. different calendars are used for production and retail trade turnover). Moreover, about half of the countries make further calendar adjustments, like Easter effect and leap year effect. In addition, the Netherlands adjusts GDP, construction and mining data for extraordinary temperature effects, a method that is not applied by other countries.

With relation to the temporal disaggregation techniques (see also the previous section), the ways of deriving trading day adjusted totals are basically two:

- the adjustment is made on the QNA target series (DE [6], ES, NL, AT and UK);
- the adjustment is made on the underlying monthly/quarterly indicators used to compile estimates of QNA components (FR and BE).

The two approaches are illustrated in the diagram below.

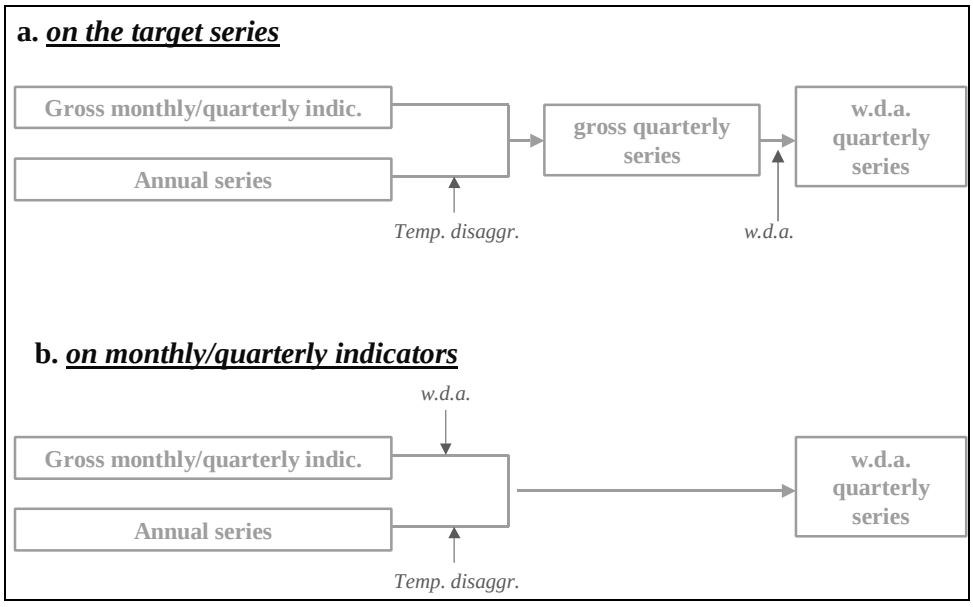

Figure 1: *Temporal disaggregation and trading day adjustment.*

[6] Trading day factors are derived from monthly indicators but the adjustment is made on the QNA target series.

The conclusion for this section is that an increasing number of EU countries - and in particular those with a high weight in the European aggregates - carry out trading day adjustment. To achieve a satisfactory country coverage, in particular the intention of Italy to implement trading day adjustment is important. Most small EU countries, however, do not plan to produce trading day adjusted results. Besides several similarities there are also methodological differences which are likely to have a measurable impact on the results. Most important are the calculation of trading day factors from monthly vs. quarterly series, the calendars used and the additional adjustment for other effects. Moreover, the coverage of GDP sub-components by trading day adjustment is not the same amongst countries and less complete than that of GDP.

2.3 Seasonal adjustment and aggregation

Eight out of twelve countries compile seasonally adjusted totals through the indirect method via aggregation of sub-components of the output, expenditure or income side. This avoids discrepancies between total s.a. GDP and the components used for aggregation (but does not preclude differences to other components unless a complete balancing is carried out). Only DK, DE, NL and SE adjust GDP results directly. DE allocates discrepancies between total and components to residual items such as changes in inventories; DK, NL and SE do not carry out this correction and accept discrepancies between GDP and components in the published figures.

Most countries replied that seasonal adjustment is carried out at a fairly detailed level , though not necessarily for the same series or for all series that are included in the quarterly transmission programme of ESA 95 between the Member States and Eurostat.

As far as the use of seasonal adjustment packages is concerned, countries are divided into two groups: in DK, DE, FR, NL PT, FI and UK the Census family (X-12 RegARIMA, X-11-ARIMA and X-11) is used, while in the remaining TRAMO-SEATS is used (ES, IT, BE, AT and SE).

The conclusion is that the indirect method is generally preferred and that most countries prefer to avoid any statistical discrepancy between adjusted aggregates and components. All countries produce a detailed set of adjusted results, although the level of detail differs. X-11/X-12 and TRAMO/SEATS versions are the only programs used by the Member States.

2.4 Time consistency

Regarding time consistency, a relatively homogenous picture across the Member States was observed. Time consistency is defined as the identity between the sum of four quarterly adjusted values and four quarterly

unadjusted values. All countries impose it also on adjusted data mainly for practical advantages for compilers and users.

Time consistency is imposed to all variables, which are adjusted. Differences exist, however, concerning the annual reference aggregates used. Time consistency for purely seasonally adjusted data is referred to the sum of the raw data in all countries. Time consistency for seasonally adjusted *and* trading day adjusted data is referred to raw data by ES and the UK, and to trading day adjusted data by DE, FR and NL. Though the quantitative difference of these practices is not very high, the latter practice is preferable, as the number of trading days normally varies from year to year and thus the annual totals of trading day adjusted and raw data should differ by definition.

The conclusion is that all Member States ensure time consistency, but that small differences in the technical details exist.

2.5 Seasonal adjustment and revisions

Differences in national practices exist. However, these differences are mainly in the treatment of historical data rather than new observations.

For the quarterly production of adjusted results, ten out of twelve Member States completely re-estimate the seasonal factors each time when a new observation is added to reflect the frequent changes in raw data (concurrent adjustment). The only exceptions are FI and DE, which prefer projected seasonal factors. They are however concurrently re-estimated, constantly monitored and possibly updated before the due time (four quarters), when significant differences between projected factors and concurrent adjustment occur. The difference to a concurrent adjustment is therefore not very high. In all cases, however, the options used in the adjustment are generally kept fixed along one year and revised annually together with the annual review of the ARIMA model in use.

The existing differences for revisions of historical data also reflect differences in the national revision policies for raw QNA.[7] In eight countries (DK, DE, ES, FR, NL, AT, PT and FI) the complete series are revised when seasonal adjustment is updated without any limitations to certain time periods. In the other four (BE, IT, SE and UK), revisions of seasonally adjusted figures are restricted to certain periods and linked, although in different ways, to the regular and occasional revisions of quarterly and annual raw data. BE does not revise adjusted figures for periods for which final annual estimates are published. IT, SE and the UK

[7] Eurostat currently carries out stocktaking of national revision practices for raw data and prepares a proposal for harmonisation in its National Accounts Working Party.

normally limit revisions to seasonally adjusted data to the most recent periods, but carry out longer revisions in longer time intervals when historical raw data is revised.

The conclusion from this comparison is that the practices for revision seasonal factors are basically comparable, but that differences concerning the treatment of revisions to historic quarterly results exist between the Member States.

2.6 Publication of seasonally adjusted data

With the exception of PT all 12 countries publish quarterly raw data (in BE and FR unadjusted results are available only on request). Pure seasonally adjusted results are released by six Member States (DK, DE, IT, NL limited to GDP, PT and FI). Seasonally and trading day adjusted results are published by eight countries (BE, DE, ES, FR, NL, AT, SE and UK). IT intends to do so from end 2002. Adjusted results are published in all cases at the same time as raw data is released.

The conclusion is that the differences in the publication policy for adjusted data are considerable and neither a complete set of trading day adjusted, of trading day and seasonally adjusted and of purely seasonally adjusted data exists for the euro area and EU countries.

3. CURRENT EUROSTAT PRACTICE FOR EU/EURO AREA SEASONALLY ADJUSTED QNA

3.1 Current practice

The procedure followed at present by Eurostat in compiling seasonally adjusted QNA is based on the available quarterly information and uses estimation techniques to derive the EU and euro area aggregates despite the lack of quarterly data for some Member States.

For each quarter, Eurostat publishes three releases of the quarterly seasonally adjusted GDP and main components of the expenditure and output side. The release of income results is planned for January 2002. The first release is published 65-75 days after the end of the reference quarter and covers only constant price figures, the second release is published 100 days after the end of the quarter, covering both current and constant prices. The third release is published 120 days after the end of the reference quarter, with the same detail as the second release.

The principle for deriving the seasonally adjusted quarterly figures is the same in the three releases, the only difference being the available quarterly information.

The methodology of compilation of euro area and EU seasonal adjusted QNA aggregates is based on a temporal disaggregation technique. Since not all the Member States publish quarterly results, the euro area and EU aggregates are derived according to an estimation procedure based on annual data and available quarterly data. The idea underlying the estimation approach is that the relationship valid on an annual level between the total of the euro area and EU and the annual total of the available quarterly countries is also valid on a quarterly basis (with some slight difference of the error structure of the underlying model). The quarterly aggregates of the euro area and EU are then derived from the parameters estimated in the annual model and the available quarterly indicator (i.e. the sum of the quarterly available figures of the Member States that compile quarterly accounts).

The estimation procedure is necessary because of two main reasons:

- some EU Member States do not regularly publish quarterly accounts;
- the legal deadline for the transmission of quarterly data is fixed at 120 days after the end of the reference quarter. Countries are supplying quarterly data between 30 and 120 days. This necessitates estimation procedures for the first and second releases.

At present, the quarterly euro area and EU seasonal adjusted aggregates are derived according to this estimation procedure by using as quarterly indicator the sum of the seasonally adjusted available figures transmitted to Eurostat. This means that the quarterly euro area and EU seasonally adjusted aggregates are a

mix of seasonally adjusted data, both in terms of the trading day correction and seasonal adjustment methods used. Such an approach can be defined as an indirect method based on non-fully harmonised figures supplied by Member States.

3.2 Shortcomings and advantages of the current practice

The main shortcomings of the current practice are:

- *Differences in national published results* - the published aggregates for the EU and euro area are a mixture of seasonally and seasonally/working day adjusted results;
- *Differences in national practices* - the detailed national practices for adjustment differ in several technical details. The methods used, the options chosen and the expected output differ;
- *Unavailability of supplementary information on European adjusted series* - supplementary information on seasonal adjustment, such as seasonal or calendar factors (historic or forecast), or on seasonal adjustment quality criteria, cannot be provided for European aggregates.

The main advantages of the current practice are:

- *Consistency with national data* - since European aggregates are derived from adjusted national data, the movements of national series are reflected in the European aggregates and full consistency between the two data sets is guaranteed;
- *Possible higher quality* - national seasonal adjustment is able to take account of a lot of additional, country-specific information;
- *Conceptual integrity* - unadjusted/calendar adjusted series do not necessarily exist on the same conceptual basis as the seasonally adjusted series.

4. ECB USER NEEDS FOR EURO AREA QUARTERLY NATIONAL ACCOUNTS

QNA are used by the ECB for two main tasks: economic developments monitoring (euro area and EU countries), and forecasting (euro area and euro area countries). The monitoring of the economic developments relies on the analysis of quarter on quarter growth rates (based on adjusted data) and on year on year growth rates (based on raw or trading day adjusted data). The forecasting is carried out through modelling based on long series (for which backdata are sometimes reconstructed internally in order to extend the length of the official series). The forecasting is carried out in close co-operation with NCBs which implies that parallel use of Eurostat sources and national sources for raw and adjusted QNA data for euro area aggregates and country data is made.

From the described use and features of the data, the following requirements can be deduced from the point of view of the ECB.

4.1 Data availability

Essential for the ECB is the availability of a complete set of gross (non adjusted) data and a complete set of seasonally and trading day adjusted data, for the euro area aggregates and all euro area countries. "Complete" refers both to a full coverage of *all euro area countries (and preferably all EU countries)* as well as to *all variables* from table 1 of the ESA regulation (see Annex 2), including the variables on employment and compensation. The requirement refers to *all* countries, because this is essential for comparisons across countries and for aggregation to euro area series. The requirement refers to basically *all* variables in table 1 of ESA, because the data is an integrated set of information on output, expenditures and income, which should be treated in a consistent way. [8] The requirement for trading day adjustment refers to those series, which show a clear trading day pattern, which is not the case for all QNA series. Important is, however, that all EU countries provide the same catalogue of trading day adjusted series, because otherwise the comparison may be flawed by trading day effects.

Moreover, desirable for ECB purposes are series which are only seasonally adjusted, and the seasonal and/or trading day adjustment *factors*, in particular one year ahead, for use in forecasting. In addition, the supply of sufficiently long series is needed in particular for econometric purposes.

[8] Not required are adjusted series for individual and collective consumption, for actual individual consumption as well as for population data covered in table 1 of the ESA 95 transmission programme.

4.2 Consistency between euro area and country results

Due to the close link between the analysis and forecasting of euro area country data and euro area aggregate results, a high degree of consistency between national data and euro area aggregates is essential. Noticeable differences between the weighted quarter-on-quarter growth rates of the euro area countries and the euro area aggregate would be a major drawback for all ECB uses of the data.

The adjusted euro area aggregates compiled by Eurostat are presently consistent with the underlying national adjusted data. The ECB is aware that the differences in adjustment practices have a negative impact on the coherency of the results for the euro area. However, the two factors - consistency and coherency - have to be balanced. Any future improvement and arrangement for the calculation of adjusted euro area QNA should ensure that a close link between country results and euro area results is preserved.

4.3 Harmonisation of adjustment practices

A necessary consequence of the close link between national results and euro area results in the analysis of adjusted QNA is that the results for the countries must be sufficiently comparable. The comparability of quarterly raw data that has been achieved by ESA 95 must not be destroyed by differences in the calculation of adjusted results. This concerns in particular the underlying assumptions and choices for the seasonal adjustment and trading day adjustment or other kind of pre-adjustment to the data, the links (or identities) in the adjustment data from the output, expenditure and income side; the consistency of the sum of quarterly data to the annual totals of the raw data, and the updating the seasonal factors and revision practices for adjusted results.

4.4 Consistency between data in current and in constant prices

The ECB uses both data in current and in constant prices. The adjustment procedures should ensure that no differences in the development of current and constant price aggregates may occur which are due to a different use of adjustment procedures (i.e. the ratio between the adjusted GDP in current and in constant prices should not result in an unexpected movement of the derived GDP deflator).

4.5 Documentation of national and euro area practices for adjustment

Finally, it is essential to record up-to-date information on practices in use for adjustment in the Member States. This information is currently not available at the EU level. It is particularly needed for the analysis of the results as long as differing practices for adjustment across the EU prevail and these differences may explain, at least to some extent, the differences in the development of national series.

5. THE CALENDAR AND WORKING/TRADING DAY ADJUSTMENT OF EU/EURO AREA AGGREGATES

5.1 Definition of calendar and working/trading day effects

In the classical decomposition model of a time series, the calendar component captures the differences determined by the calendar structure. The calendar component is often slightly moving and may disturb the stability of the seasonal component. There is no uniform and generally applied definition of the calendar component. For the purpose of this report, and in line with the treatment in seasonal adjustment software, the following two main effects can be distinguished:

- *Calendar effect*

  In a strict sense, the calendar effect is related to the variations of the economic activity around some special dates in the year, like Christmas or Easter, which have an impact on economic activity. While the Christmas effect on economic activity is always caught by the month of December/fourth quarter (therefore it is assigned to the seasonal component), the effect of Easter, as well as other moving holidays, may concern varying months or quarters (Easter can effect March or April, that is the first or the second quarter). For this reason, Easter and moving holiday effects require a special statistical treatment.

  A special calendar correction is the leap year correction.

  The calendar effect is normally caught via a quantitative translation of the effect on the different quarters or months caused by, for example, Easter. This effect is usually quantified by using specific variables that reflect the impact on the different quarters/months. For example, if the Easter effect is supposed to start 10 days before Easter and to stop the Saturday before Easter, and this 10-day period is divided between March (4 days), and April (6 days), the specific variables for the first and the second quarter will have a different weight (0.4 and 0.6, respectively).

- *Working day/trading day effect*

  If daily series were used to measure business activities, a possible result would be that the activity varies over the different days of the week. Since daily series are however rarely available, National Statistical Institutes deal with monthly and quarterly series. Each month and quarter embody a varying number of Mondays, Tuesdays, ... and Sundays and, consequently the business activity can vary accordingly.

  The working day effect catches the difference between the "working-days" (i.e. Monday, Tuesdays ,..., Friday) and the weekend days (Saturday and Sunday) according to the idea that the two patterns are

different. Moreover, in some cases the effect may differ amongst certain working days (e.g. between a Wednesday and a Friday).

Trading day adjustment and working day adjustment are often used as synonyms. This report follows the same practice.

5.2 Economic relevance of the working/trading day effect

The working/trading-day correction is an important step in the short-term analysis of time series. The different number of working/trading-days in a given period can influence a time series by several percentage points. The differing incidence of holidays and other causes of absence from work within a calendar period can have the same effect. Time series analysis for such purposes as monitoring the business cycle must therefore take this effect into account. Working/trading day correction is particularly important for flow series (e.g. household consumption). For series expressed as averages over a period, such as employment or labour force in national accounts, working/trading day effects are normally not relevant.

Only the correction of flow series for working/trading day effects offers the user the possibility of making meaningful comparisons of a given quarter with the same quarter in the previous year or with the previous quarter. When comparisons are extended from the national to the international levels, knowledge of these effects is all the more important. Corrections of these effects can only be done properly with detailed knowledge of the working/trading day calendars and of other working/trading day characteristics of particular countries.

5.3 Alternative techniques for the working/trading day correction

Two possibilities for working/trading day correction are represented by the proportional approach and the regression approach. The proportional method has often been demonstrated to over-adjust the working/trading-day effects. Preference should therefore be given to the regression approach including appropriate additional regressors for special holidays in a country.

There are two ways for identifying the working/trading day effect in the regression approach:

- identifying the effect directly on the target series;
- identifying the effect on the indicator (monthly or quarterly factors derived from the indicator) used in estimating the target series or closely related to the target series.

The second approach is preferable because of the precision that it offers, keeping in mind, especially, that the working/trading day effect is more significant on a monthly basis.

From a technical point of view, the working/trading day effect can be detected and treated either running the adjustment according to the default calendar, built-in the seasonal adjustment packages, or using a regression adjustment, adapted to national situations. The latter may improve the quality of the adjustment. Besides considering national holidays, it may include a split of regressors for certain periods of the year or weekdays as well as different regressors for different series (e.g. output and consumption). Moreover, if the working/trading day effect changes over time, a split of regressors in two or more sub-periods should be considered to improve the accuracy. For leap-year adjustment, standard adjustment procedures offer appropriate facilities for correction.

Another important issue concerns the relation between indicator frequency and expected accuracy in the results. In general, the working/trading day adjustment produces different results if applied on the same indicator but with different frequencies (e.g. monthly and quarterly). The reason for the differences in the monthly and quarterly estimates is that the number of working/trading days fluctuates more sharply and more frequently from month to month than it does from quarter to quarter (even compared with the respective year-on-year figures). Therefore it is not possible to distinguish between normal working day effects and irregular influences in the quarterly estimate. In order to obtain more accurate results, it is generally recommendable to perform the adjustment on indicators.

The example below shows the practical effects of the adjustment on monthly and quarterly series of German retail trade.

Example. The differing characteristics of monthly and quarterly estimation of working-day variations can be illustrated using data for German retail turnover from 1991 onwards. According to the results of a RegARIMA estimation based on monthly figures, one additional selling day in a month (and one Sunday/national holiday less) leads to an average increase in turnover of 2.4 %. The estimated coefficient is also statistically significant (t-value = 9.7).

If the monthly unadjusted figures are first combined to form quarterly data and the effect of an additional selling day is then estimated using a quarterly RegARIMA model, no correlation between the number of selling days and turnover can be found (parameter estimate 0.0%). The economic information provided by the quarterly estimate is that all days in a week have the same effect on retail turnover. Hence, the same amount of turnover is realised on Sundays/national holidays as on selling days. This result is not plausible because retailers in Germany are prohibited by law, which allows only a few exceptions, from opening on Sundays. The outcome of the quarterly estimate is, furthermore, statistically not significant (t-value=0.1).

5.4 Geographical aggregation of working/trading day factors

In deriving the calendar-working/trading day corrected series for the aggregates of the euro area and the European Union, three different approaches can be applied .:

a) Eurostat sums national working/trading day corrected data coming from Member States.

According to this approach, national working/trading day corrected data sent by Member States are summed up by Eurostat to obtain the working/trading day effect for the euro area and the European Union. All Member States have to supply raw and working/trading day corrected data to Eurostat.

- *Advantages:*

  - each Member State has a better knowledge than Eurostat of the calendar and working/trading day effects that affect its own aggregates. The pre-treatment made by Member States ensures a more accurate and detailed analysis of the calendar and working/trading day effect that is resumed in a better quality of the pre-treatment of the series used as input in the seasonal adjustment procedure.

- *Disadvantages:*

  - Eurostat's calculation depends on the co-operation of Member States; if the calendar-working/trading day corrected series are not transmitted by some Member States, the approach cannot be applied or must be modified;

  - the choice of the detail of the breakdown to which the approach should be applied has to be established (inconsistencies can arise because some Member States apply the calendar and working/trading day correction at a very detailed level whilst Eurostat deals with relatively aggregated series);

  - in case of differences of level of breakdown for the correction, a strategy for the aggregation of the calendar-working/trading day effect has to be established.

b) Eurostat adjusts national raw series and sums them up.

According to this approach, Eurostat directly applies the pre-treatment to national raw series by using the same general approach, integrated with the available information related to each country (for example, specific national calendars). All Member States have to supply raw data and, when available, specific information about national calendar-working/trading day effects.

- *Advantages:*

  - Eurostat applies the pre-treatment to national raw series according to a harmonised approach (the pre-treatment procedure is the same for all countries, except for the specific country related information).

- *Disadvantages:*

  - Eurostat has a limited knowledge of the specific national calendar-working/trading day effects, this can affect the quality of the pre-treatment;

- Eurostat applies the pre-treatment at an aggregated level, loosing the precision that some Member States can add by working at a detailed level.

c) Eurostat adjusts EU/euro area raw aggregate series.

According to this approach, Eurostat derives the calendar-working/trading day correction directly on the raw aggregates calculated by summing up the raw national series.

- *Advantages:*
  - coherence between raw and calendar-working/trading day corrected data;
  - a clear and coherent policy of derivation of the calendar-working/trading day correction for the euro area and the European Union aggregates;
  - full information about the correction made.
- *Disadvantages:*
  - less accurate quality in the calendar-working/day adjustment due to the less detailed information available at Eurostat;
  - - lack (to certain extent) of coherence with the national series.

5.5 Sectoral aggregation of GDP/trading day factors

If direct adjustment of EU/euro area aggregates is chosen, a further choice between two alternative approaches for deriving GDP adjustment can be followed: the direct and indirect approach by GDP components.

- *Direct approach*: the calendar-working/trading day effects are directly derived on GDP;
- *Indirect approach*: the calendar-working/trading day effects are derived as an aggregation of the same effects on the components of GDP. In practice the calendar-working/trading day corrected GDP is obtained as the sum of the corresponding corrected components.

The application of the direct or indirect approach in deriving the calendar-working/trading day corrected GDP is part of the philosophy that underlies the compilation of GDP. The indirect approach offers the possibility of applying a detailed calendar-working/day corrected to the single components at a disaggregated level and then summarise the effects via aggregation (a weighted aggregation).

5.6 Conclusions

At the euro area and European Union level the correction for working/trading days can be applied according to different approaches. Country based knowledge of the calendar-working/trading effect is extremely important for the quality of the correction to be made because of its precision. For this reason, in the compilation of the calendar-working/trading day corrected euro area and European Union series the approach (a), i.e. Eurostat sums national working/trading day corrected data coming from Member States, is preferred. This approach needs the national calendar-working/trading day corrected series.

If this is not the case, the practical approach is a mix between approach (a) and approach (b): the calendar-working/trading day corrected series for the euro area and European Union aggregates have to be compiled according to approach (a) and the available information. If some national calendar-working/trading day corrected series are not available, Eurostat has to apply to these missing series approach (b), i.e. Eurostat adjusts national raw series, and sum them with the available calendar-working/trading day corrected series directly transmitted by those Member States that compile them.

6. THE SEASONAL ADJUSTMENT OF EU/EURO AREA DATA

6.1 Introduction

Most of the European and euro area economic short-term indicators are computed either through *horizontal aggregation*, e.g. by country, or through *vertical aggregation*, e.g. by sector, branch or product. To obtain seasonally adjusted figures, three main strategies can be used:

- the **direct approach**: the European indicator is first computed by aggregation of the raw data and then seasonally adjusted;
- The **indirect approach**: the raw data (for example the data by country) are first seasonally adjusted, all of them **with the same method and software**, and the European seasonally adjusted series is then derived as the aggregation of the seasonally adjusted national series;
- The **mixed indirect approach**: each Member State seasonally adjusts its series and the European seasonally adjusted series is then derived as the aggregation of the adjusted national series.

Unfortunately, these strategies could produce quite different results. The choice between the first two approaches has been the subject of articles and discussions for decades and there is still no consensus on the best method to use. On the contrary, some agreement appears in the literature on the fact that the decision has to be made case by case following some empirical rules and criteria [9]. The last approach is often used and, as it cannot be derived from a simple adjustment, is rarely compared to the others.

The choice between the methods cannot be based on accuracy and statistical considerations only. To publish timely estimates, Eurostat must often work with an incomplete set of national data. The indirect approaches

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[9] See, for instance: Dagum, E.B. (1979), "On the Seasonal Adjustment of economic Time Series Aggregates: A Case Study of the Unemployment Rate", *Counting the Labor Force, National Common Employment and Unemployment Statistics, Appendix*, 2, 317-344, Washington; European Central Bank, *Seasonal Adjustment of Monetary Aggregates and HICP for the Euro Area*, August 2000; Lothian, J. and Morry, M. (1977), "The Problem of Aggregation; Direct or Indirect", Working Paper, Time Series Research and Analysis Division, Statistics Canada; D. Pfefferman, E. Salama and S. Ben-Tuvia (1984), "On the Aggregation of Series: A New Look at an Old Problem", Working paper, Bureau of Statistics, Jerusalem, Israel; Planas, C., Campolongo, F. (2000), "The Seasonal Adjustment of Contemporaneously Aggregated Series", Working paper, Joint Research Centre, European Commission; Rietzler, K., Stephan, S. and Wolters J. (2001), "Aggregation and seasonal adjustment: Empirical results for EMU quarterly national accounts", Allgemeines Statistiches Archiv, 85, pp. 367-386.

imply estimation of missing raw and seasonally adjusted data and therefore different models have to be estimated, checked and updated.

6.2 Direct versus indirect seasonal adjustment

A common (additive) decomposition of any observed time series X_t is the following:

$$X_t = TC_t + S_t + D_t + E_t + I_t$$

where $TC_t, S_t; D_t, E_t$ and I_t designate, respectively, the **trend-cycle**, the **seasonal**, the **trading-day**, the **Easter effect** and the **irregular** components. All these components are supposed to be unobserved. The seasonal component S_t and the calendar component $(D_t + E_t)$ are removed from the observed time series to obtain the seasonally adjusted series $A_t = TC_t + I_t$.

Any European indicator X_t computed by linear aggregation of N national indicators (N=15 for the European Union or N=12 for the euro area), can be expressed as:

$$X_{n,t} = TC_{n,t} + S_{n,t} + D_{n,t} + E_{n,t} + I_{n,t}$$

and:

$$X_t = \sum_{n=1}^{N} w_n X_{n,t}$$

where w_n denotes the weight of Member State n.

Three different seasonally adjusted series A_t of the European aggregate X_t can be computed, namely:

- $A^D{}_t$, i.e. the directly adjusted aggregate;
- $A^I{}_t$ is the aggregate computed via the indirect approach, i.e.

$$A^I{}_t = \sum_{n=1}^{N} w_n A_{n,t}$$

where all the national indicators $X_{n,t}$ are seasonally adjusted using a harmonised procedure.

- $A^S{}_t$ indicates the indirect, mixed seasonally adjusted series, calculated as sum of national data.

The mixed indirect approach is a quite popular strategy but, as it does not result from a simple seasonal adjustment process, it is scarcely studied by itself. The national seasonal adjustment policies can substantially differ in different ways:

- *methods are different*: countries use a model based approach or a non parametric approach;
- *software or release, implementing the method can itself differ*: in the countries which use a non parametric filter approach, X-11, X-11-ARIMA and X-12-ARIMA are currently in use; sometimes in the same institute different releases are used;
- *Member States may perform direct or indirect seasonal adjustments*;
- the strategy for the correction of calendar effects is usually not the same, the seasonal adjustments are not performed on the same time span, the treatment of outliers may differ etc.

All these differences show how it is difficult to compare, from the theoretical point of view, the mixed indirect seasonal adjustment to the direct and indirect ones. Furthermore, these three strategies are not the only possible ones. Combined approaches are also possible; for instance, a subset of the basic series can be first aggregated in one new component, this component and the remaining sub-series can then be adjusted and the adjusted aggregate derived.

As the seasonal adjustment is a non-linear transformation, only under some very restrictive conditions direct and indirect seasonal adjustment produce the same results.

The two approaches are equivalent only if the aggregate is an algebraic sum (for instance GDP), if the decomposition model is purely additive, if there is no outlier in the series and if the global filter used in the seasonal adjustment process is the same for all sub-components ,.

If the decomposition model is multiplicative, it could be shown that the equivalence of the two approaches requires for instance that there is no irregular, that the sub-series have identical seasonality patterns (or that the sub-series have identical or proportional trend-cycles) and that the filter used is the same for all sub-series. On the other hand, if the aggregate is a rate, any seasonal adjustment method that produces unbiased estimates will give different results [10].

[10] See Dagum, E.B. (1979), On the Seasonal Adjustment of economic Time Series Aggregates: A Case Study of the Unemployment Rate, *Counting the Labor Force, National Common Employment and Unemployment Statistics, Appendix*, 2, 317-344, Washington.

Reality is often much more complex:

- For most economic time series, the additive model is not the most appropriate and the series are adjusted using the multiplicative option. Such series may be converted into an additive model by a logarithmic transformation but this will not ensure the equivalence since the logarithm of a sum is not the sum of the logarithms.
- Outliers are frequently present in economic time series as the result of structural changes, anomalous conditions, external shocks etc.
- For model-based approaches, such as TRAMO/SEATS, the filter used for the seasonal adjustment is optimally derived from the models estimated for each series. This means that virtually a different filter is associated to each different series.

On the other hand, it may happen that sub-series are not very noisy, show a very similar trend-cycle or seasonal pattern and are affected more or less by the same external shocks. Under these conditions, the direct and indirect approaches could produce very similar results.

6.3 Advantages and drawbacks

The choice between direct, indirect and mixed indirect adjustment can be guided by some statistical or extra-statistical considerations or by some *a priori* desirable properties.

- **Additivity constraint**

Sometimes the additivity constraint plays an important role in some domains (quarterly national accounts, balance of payments) or has to be assured as the consequence of a legal act (external trade). Then the indirect or the mixed indirect approaches appear to be the only possible solutions. However, it must be considered that even in a direct approach it is possible to assure ex-post the additivity constraint by distributing the possible discrepancies. Various univariate or multivariate statistical techniques exist to compute these adjustment factors; alternatively, discrepancies may be allocated to a residual item. .

- **Some statistical considerations**

Most of the statisticians involved in seasonal adjustment agree on one point: if the sub-components do not have similar characteristics or if the relative importance of the sub-series (in terms of weight) is changing very fast, indirect adjustment should be preferred.

From the opposite point of view Dagum [11], if sub-series have convergent seasonal patterns and approximately the same timing in their peaks and troughs, the direct approach should be used. The aggregation will produce a smoother series with no loss of information on the seasonal pattern.

- **Consequences on production**

Eurostat calculates European and euro area aggregates from national data. As all Member States do not release national data at the same time, Eurostat has often to impute missing information using some modeling in order to publish timely figures. A direct approach might have some advantages, because of the reduced amount of estimation that is required.

6.4 Empirical criteria for the comparison between direct and indirect adjustment

To assess empirically the quality of the different approaches, some problems have to be solved. Firstly, the effect of the aggregation strategy must be isolated from the other numerous sources of variation. Secondly, quality indicators to be computed for the different approaches should be defined. Lastly, TRAMO-SEATS and X-12 RegARIMA do not provide the user with a common set of quality statistics.

6.4.1 Sources of Revisions

Seasonally adjusted figures are usually subject to revisions that can be the consequences of numerous causes. For example, at the European level, we can underline:

a. *imputation of national data*: when more national data become available, the preliminary estimates calculated by Eurostat must be updated and the raw and adjusted series have to be revised;

b. *usual sources of revisions due to the seasonal adjustment process*: adjustment policy (concurrent adjustment or use of projected seasonal factors), modification of the adjustment parameters, treatment of outliers, estimation of calendar effects, impact of new data etc;

c. *revisions due to the seasonal adjustment process at the national level*.

In order to analyze the differences in direct vs. indirect methods, it would be preferable to isolate the variations only due to this problem and therefore to work with quite stable time series and under stable assumptions. For instance, the series could be first cleaned from any calendar effect and outliers , the decomposition model could be fixed etc. Unfortunately, it is quite difficult to measure the relative importance of each source of revisions.

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[11] Again in Dagum (1979).

6.4.2 Quality Measures

There is no consensus on the measures to assess the quality of a seasonal adjustment, and that explains the large number of criteria one can find in the literature. Several aspects of the seasonal adjustment can be addressed and, for each of them, some criteria are defined.

a. Absolute/relative differences in adjusted series

To measure the differences between series computed according to different methods, the two following statistics can be computed:

Mean Absolute Percentage Deviation: $\frac{100}{N}\sum_{n=1}^{N}\left|\frac{A_t^D - A_t^I}{A_t^I}\right|$

Max Absolute Percentage Deviation: $100 \times MAX\left|\frac{A_t^D - A_t^I}{A_t^I}\right|$

These statistics can be calculated for each couple of possible approach (Direct-Indirect, Direct-Mixed indirect and Indirect-Mixed indirect), for the seasonally adjusted series, and the seasonal components. Moreover, the same statistics can also be computed for the results obtained using TRAMO-SEATS and X-12 RegARIMA.

b. Coherence of growth rates

Various seasonally adjusted series should deliver approximately the same message and their growth rates should have the same sign. To measure the degree of consistency in growth rates, two kinds of statistics are computed:

- global percentage of concordance between the direct and indirect series;
- rate of concordance between the seasonally adjusted series and the national adjusted series.

Inconsistencies in growth rates are detected when aggregates do not evolve as the majority, in terms of weight, of adjusted sub-series.

c. Quality statistics of the seasonally adjusted series

X-12-ARIMA proposes a set of M and Q-statistics to assess the quality of the seasonal adjustment. These statistics have been adapted when possible to the series computed with TRAMO/SEATS. Approximated components linked to the mixed seasonally adjusted series have been computed in order to calculate these statistics.

d. Roughness of the components

Dagum (2000) proposed two measures of roughness of the seasonally adjusted aggregates. The first one is the L_2 -norm of the differenced series:

$$R1 = \sum_{t=2}^{T} (A_t - A_{t-1})^2 = \sum_{t=2}^{T} (\nabla A_t)^2 .$$

The second one is based on the 13-term Henderson filter: the adjusted series is smoothed with the Henderson filter and R_2 is defined as the L_2 -norm of the residuals:

$$R2 = \sum_{t=1}^{T} (A_t - H_{13} A_t)^2 = \sum_{t=1}^{T} [(I - H_{13}) A_t]^2 .$$

The rationale of these measures of roughness is that the involved filters (the first difference operator and $(I - H_{13})$ are high-pass filters that remove most of the low frequencies components corresponding to the trend-cycle variations. In other words, these statistics measure the size of the deviations to a smooth trend, e.g. the size of an irregular component. This is the reason why Pfefferman et al. [12] suggested a measure of similarity between seasonally adjusted data and trend:

$$R3 = \sum_{t=1}^{T} (A_t - TC_t)^2 .$$

Indeed, there is no fundamental reason why a seasonally adjusted series should be as smooth as the irregular component, a characteristic of the series, is a part of the seasonally adjusted series.

Gomez and Maravall prefer to focus on the quality measures on the other components, i.e. the trend-cycle and seasonal component. The smoothness of the trend-cycle is measured by the L_2 -norm of the first and the second differences:

$$Mar1(TC) = \sum_{t=1}^{T} (\nabla A_t)^2 \text{ and } Mar2(TC) = \sum_{t=1}^{T} (\nabla^2 A_t)^2 .$$

e. Stability of the seasonally adjusted series

Even if no residual seasonality is detected, seasonal adjustment is unsatisfactory if adjusted values undergo large revisions when new figures become available. Frequent and substantial revisions cause data users to lose confidence in the usefulness of adjusted data. Such instabilities cannot be avoided when series are characterized by highly variable seasonal or trend movements. In any case, they must be measured and checked.

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[12] See D. Pfefferman et al. (1984), cit.

X-12 RegARIMA includes two types of stability diagnostics: sliding spans and revision histories. Some of these diagnostics are used here:

- mean and standard deviation of the absolute revisions after *k* periods;
- the two most important sliding spans A(%), percentage of dates with unstable adjustments, and MM(%), percentage of dates with unstable month-to-month percent changes.

f. Characteristics of the irregular component

The irregular component should not present any structure or residual seasonality. The irregulars derived from the various approaches are analyzed both with the TRAMO automatic modeling module and the X-12 RegARIMA software.

6.5 The empirical comparison of direct and indirect seasonal adjustment: geographical aggregation

To derive empirical results, the Quarterly Gross Domestic Product in volume for the whole economy of Belgium, Germany, Spain, France, Italy, Netherlands and Finland have been used [13]. The sample used ranges from 1985Q1 to 2000Q3. Since official figures for Germany are available only from 1991Q1, a basic back-recalculation has been performed by using ESA 79 pattern for the period prior to 1991Q1.

Before the ESA 95 regulation, some Member States (France, Spain) did not compile raw figures. This is mainly why the official euro area GDP series is derived from an estimation procedure based on available Member states seasonally adjusted data. In order to focus on the direct versus indirect problem only, we decided to compute a pseudo euro area GDP, not affected by these estimation procedure effects, by summing up the seasonally adjusted data of the seven available countries. This benchmark series (the so-called mixed series) ranges from 1991Q1 to 2000Q3, for a total of 39 observations.

All the tables and figures referred in the text can be found in the annex 3 of this report.

6.5.1 A first comparison between seasonally adjusted series

Figure 3.1 presents the mixed adjustment and the TRAMO/SEATS direct and indirect seasonally adjusted series. It is very difficult to detect a real difference between the three series (and it will be the same with the X-12 RegARIMA estimates). The numerical indicators displayed in Table 3.1 confirm this similarity. The

[13] At the time when the simulations for chapter 6.5 were produced, gross data for the EU countries was incomplete. Complete euro area and EU gross data were used for the comparison with currently published results in section 6.8 ..

mean absolute percentage difference between two estimates is less than 0.1% between direct and indirect, and close to 0.2% between the mixed and the other estimates.

The growth rates, which are in this case of greater interest, are also displayed, for both TRAMO/SEATS and X12 ARIMA, respectively in figure 3.2 and figure 3.3. Finally, figures 3.4 and show the relative difference of the mixed benchmark series with respect to the direct and indirect seasonal adjusted series obtained with TRAMO-SEATS and X-12 RegARIMA.

The key elements emerging from this set of pictures can be synthesized as follows:

- Direct and indirect adjusted series have a very similar behaviour, regardless to the software used;
- Largest differences are observed at the beginning of the comparison period. This can be due to the poor quality that the mixed series has in the early '90s, resulting from the lack of data for Germany before 1991Q1;
- The X-12-ARIMA estimates are closer to the mixed estimate than those obtained with TRAMO-SEATS. This is certainly a direct consequence of the use of the Census filter in the majority of Member States.

To complete this comparison, table 3.2 presents some descriptive statistics on the differences between growth rates of the various approaches. Differences close to zero with little variance indicate a good agreement between the different estimates. This is the case as all average differences are very small.

6.5.2 Concordance analysis of growth rates

Short-term analysts are mainly interested in the evolution of macroeconomic aggregates and therefore in growth rates of seasonally adjusted data. Tables 3.3 and 3.4 detail the cases of discrepancies between the various aggregates and with the sub-components, according to the software.

Direct and indirect estimates are not inconsistent in sign only in one case out of 62 observations: in 1997Q1 for X-12 RegARIMA and in 1992Q4 for TRAMO-SEATS. This leads to a high concordance rate (98.4%) between the two approaches. Furthermore, these discrepancies concern growth rates close to zero.

The discrepancies (table 3.5) are more numerous when comparing with the mixed approach even if the global concordance rate remains good. 1991Q3 and 1993Q2 are strong inconsistencies for any software and approach. In these cases, the mixed series show a slightly decrease (-0.020% and -0.001%) while direct and indirect approach show an increase (around +0.7%). Other inconsistencies concern smaller growth rates.

Table 3.6 presents the concordance rates between the various approaches, a statistic that summarizes the previous elements. Direct and indirect approaches present concordance rates that are quite similar to the

mixed approach ones. In conclusion, as 1997Q1 is the date of the last inconsistency, all the approaches give consistent messages for the last four years.

6.5.3 Quality measures of seasonal adjustments

A comparison between the various adjustments can be also made with respect to the so-called quality measures proposed by X-12 RegARIMA and here extended, where possible, to TRAMO-SEATS estimates and to the mixed approach. The results are presented in Table 3.7.

The M- and Q-statistics are commonly analyzed by statisticians in order to have a synthetic view of the performance of seasonal adjustment: a value greater than one, for any of these statistics, indicates a possible problem in the adjustment. In general, all the adjustments seem accurate according to these statistics, although with some differences and limitations.

6.5.4 Roughness measures

Roughness measures are presented in table 3.8 and are computed on seasonally adjusted series, trend-cycle and seasonal components. The smoothness of seasonally adjusted data is often considered one of the most important criteria from the user point of view. Nevertheless, it must be stressed that this criterion has to be interpreted with some care: the irregular component is an integral part of seasonally adjusted series and it may be disputed whether it is preferable having a more stable seasonality instead.

A first very simple conclusion we can draw from this table is that there is no clear evidence in favor of one of the approaches. If the mixed approach gives, on average, the smoother seasonally adjusted series and the smoother trend, it gives the worse results on the last three years of the series. The criteria computed on the series computed using X-12 RegARIMA and TRAMO-SEATS are contradictory, since using the former the direct adjustment should be preferred in most cases (8 out of 12) while using the latter the indirect should be preferred.

6.5.5 Time consistency

The time consistency usually requires the sum across one year of seasonally adjusted quarterly data to be equal to the corresponding sum in the unadjusted data. The same concept applies to population and unemployment data with the constraint replaced by an average. Even if there are no theoretical reasons to impose it, time consistency is generally required by users.

Imposing such constraints can reduce the quality of seasonally adjusted data. Moreover, the requirement that seasonally and trading day adjusted data sum up to the unadjusted ones is not correct even for an empirical point of view. Indeed, the sum of raw data, after a trading day correction is different from the sum of purely unadjusted data since the trading day effect does not sum to zero over the year. If time consistency is to be

imposed to seasonally and trading day adjusted data, the target series should be trading day adjusted totals. Imposing annual raw totals as constraints can reintroduce some spurious trading days effect on the seasonally and trading day adjusted data.

6.5.6 Revision analysis

Generally, data users prefer dealing with seasonally adjusted times series, which are revised as little as possible. Non revised seasonally adjusted figures can be obtain with purely asymmetric filters (e.g. Dainties), but with a possible serious drawback: a delay in the detection of turning points.

Table 3.9 presents the revisions of direct and indirect estimates obtained with the two pieces of software. In order to focus this analysis only on revisions induced by the seasonal adjustment process, in the simulations the *ARIMA* model and the decomposition model have been fixe. Moreover, revisions of raw data, which occur regularly, as new information became available, have not been taken into account.

It is useful to point out that in the case of indirect approach, analyzing the "revision properties of the filter" is a difficult concept since filters are obtained as a linear combination of possibly different filters. The analysis is more straightforward in the case of direct approach, where a unique filter is applied.

Once again, the results of X-12 RegARIMA and TRAMO-SEATS give two opposite indications: in the first case the indirect approach performs better both in terms of mean and variance of the revisions, whereas in the second this the opposite holds. The sliding span analysis does not reveal any stability problem for the various estimates that are therefore equivalent from this point of view.

6.5.7 Analysis of the residuals

An alternative way of assessing the quality of the results of the seasonal adjustment is based on the analysis of residuals (*estimated irregular component*). Any accurate seasonal adjustment is expected to produce residuals not showing any residual seasonality or, more generally, any pattern. If this holds, residuals should be stochastically independent and follow approximately a normal distribution, i.e. $N(0, s^2)$.

Adjustment residuals have been analyzed with TRAMO and X-12 RegARIMA. X-12 RegARIMA gives the possibility of testing for the presence of residual seasonality while in TRAMO an *ARIMA* model on the residuals is automatically selected; in this latter case, significant parameter estimates in the model can be interpreted as an indication of inadequate seasonal adjustment. The results are shown in table 3.10.

In general, residuals from indirect adjustment are modeled as non seasonal *AR*(1). However, residuals from direct adjustment are also modeled as seasonal *ARMA*. As far as the test of X-12 RegARIMA, residual seasonality is not found in any of the four estimates.

6.6 The empirical comparison of direct and indirect seasonal adjustment: sectoral aggregation

For this application, the euro area GDP at constant prices have been broken down into value added of six main industries (according to the NACE Rev 1 classification) and of a tax component. The seven components are:

1. Agriculture, hunting, forestry and fishing;
2. Total industry, excluding construction;
3. Construction;
4. Wholesale and retail trade;
5. Financial Intermediation;
6. Public administration;
7. Taxes minus FISIM.

The national raw series for each branch were summed up to obtain pseudo euro area aggregates [14] for the considered branch. The same operation was done with seasonally adjusted data to obtain the corresponding mixed aggregate. Data range from 1991Q1 to 2000Q4 (40 observations).

6.6.1 A first comparison between seasonally adjusted series

Figure 6 presents the mixed adjustment and the direct and indirect seasonally adjusted series. Similar to the geographical aggregation, it is very difficult to detect a real difference between the three series. The numerical indicators displayed in Table 3.11 confirm this similarity. The mean absolute percentage difference between two estimates is very small, and smaller than for the geographical aggregation case: less than 0.1% between direct and indirect, and close to 0.2% between the mixed and the other estimates.

The growth rates are displayed in figures 3.7 and 3.8. Finally, figures 3.9 and 3.10 show the relative difference of the mixed benchmark series with respect to the direct and indirect seasonal adjusted series, computed with TRAMO-SEATS and X-12 RegARIMA. In general, the conclusions are similar to those for the previous aggregation. Table 12 statistics confirm the good agreement between the different estimates: all average differences are very small, an in particular It has to be stressed that those observed for the direct adjustment are closer to the mixed approach than those from the indirect aggregation.

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[14] Because of the limited data availability, the exercise takes into account six countries only, namely Belgium, Germany, Spain, Finland, France and Italy. These countries represent more than 86% of the euro area GDP.

6.6.2 Concordance analysis of growth rates

Tables 3.13 and 3.14 detail the cases of discrepancies between the various aggregates and with the sub-components, according to the software. Direct and indirect estimates give an opposite evolution of the indicator for TRAMO-SEATS only, in three cases out of 62 observations. But these discrepancies concern growth rates close to zero. The discrepancies are more numerous when comparing with the mixed approach. The other large inconsistency is 1997Q1 in the results obtained with TRAMO-SEATS: the mixed series increases (+0.22%) when direct and indirect series decrease (-0.13% and -0.59%). X-12 RegARIMA performs better in terms of consistency with the mixed estimate.

The inconsistencies between the evolution of an aggregate and the majority of its components are presented in table 3.15 for the different methods and computer programs.

TRAMO-SEATS presents three inconsistencies for the indirect estimate and four for the direct estimate. 1997Q1 is perhaps the most important as five branches representing 74% of the euro area GDP where increasing when the direct and indirect estimates were quite strongly decreasing (-0.59% and -0.13%). X-12 RegARIMA estimates present four inconsistencies for each estimate. At least, the mixed approach presents just one inconsistency in 1995Q4.

Table 3.16 presents the concordance rates between the various approaches, a statistic that summarizes the previous elements. Direct and indirect approaches present concordance rates with the components close to 90%, that is a quite disappointing result.

One must also note that the different estimates give consistent messages for the last for years as 1997Q1 is the date of the last divergence.

6.6.3 Quality measures of seasonal adjustments

The M- and Q-statistics results are presented in Table 3.17. In general, all the adjustments seem correct according these statistics: all Q-statistics are smaller than 1. The direct adjustments do not present any problem; on the contrary, the indirect and mixed estimates present high values of the M8 and M10 statistics.

6.6.4 Roughness measures

Roughness measures are presented in Table 3.18 and refer to the seasonally adjusted series, the trend-cycle and the seasonal component. The indirect approach seems to give smoother seasonally adjusted series. If the mixed approach performs better on the whole series, it gives the worse results on the last three years of data. The direct approach, finally, gives smoother trend-cycles and seasonal factors.

A first very simple conclusion we can draw from this table is that, once more, there is no clear evidence in favor of either approach.

6.6.5 Revision analysis

Table 3.19 presents the revisions of direct and indirect estimates obtained with the two programs. For X-12 RegARIMA the indirect approach performs better both in terms of mean and variance of the revisions, whereas TRAMO-SEATS appears better as far as mean absolute revisions are concerned.

The sliding span analysis does not reveal any stability problem for the various estimates, which are therefore equivalent from this point of view.

6.6.6 Analysis of the residuals

Except for the direct approach, all the irregular estimates are modeled as seasonal *ARIMA*. X-12 RegARIMA, however, does not find any identifiable seasonality in any of the four estimates. No irregular estimate presents a residual calendar effect.

6.7 Preliminary conclusions on the statistical indicators

This empirical comparison shows that no strong evidences appear in favour of the direct or the (geographical or sectoral) indirect approach for compiling European aggregates. The criteria often lead to different conclusions, which might also be seen as an evidence for relatively small and insignificant differences between the direct and indirect methods. It should be noted, however, that all criteria used are purely statistical, i.e. practical considerations for using the direct or the indirect method were not included.

Since most of the statistical criteria cannot be applied to the mixed indirect adjustment, i.e. do not allow drawing a comparison to the currently published data, the following section contains a comparison of directly adjusted European results with these results.

6.8 The empirical comparison of direct and mixed indirect seasonal adjustment

Following the request that the CMFB raised in the course of the discussion of the interim report in July 2001, Eurostat presented a comparison of directly adjusted European aggregates with the currently published data. The results are reported in this section.

6.8.1 Settings for direct seasonal adjustment

The direct approach to seasonal adjustment of the euro area and European Union aggregates has been carried out by using both X-12 RegARIMA and TRAMO SEATS. The options used are generally the standard

parameters of TRAMO-SEATS and X12-ARIMA software. Specific tuning has been carried out if necessary[15].

The seasonal adjustment has been done simulating the conditions that most probably Eurostat will experience when applying the direct approach to derive the European aggregates. The following information has to be read bearing in mind such a consideration:

a. *calendar*: the default calendars have been used both in X12 and TRAMO SEATS. This choice has an important effect on the quality of the seasonal adjustment , in particular in the pre-treatment related to the working day correction.

b. *trading day correction*: the unavailability of Member States trading day corrected series (unavailability related to a normal production) limited a lot the quality of the trading day correction made on the basis of the default calendars.

c. *coherence with annual data*: the coherence with the sum of raw data over the year ("annual data") has not been forced because of the correction for trading days.

d. *balancing*: for the expenditure side, changes in inventories has been derived as difference between GDP (directly adjusted) and adjusted expenditure items; for the output side, the components have been seasonal adjusted, GDP has been fixed and the discrepancies have been distributed among the components.

6.8.2 Empirical comparison: detailed analysis of the estimates for 2001 Q2, third release.

The comparison has been carried out on the following set of data (in constant prices):

- GDP
- Expenditure side: available releases (starting from 2000Q4, second release, to 2001Q2, third release);
- Output side: 2001Q2 third release;
- Direct adjustment with X-12 RegARIMA as well as with TRAMO-SETAS;
- Comparison of these results with the currently published Eurostat results for the euro area (mixed indirect approach).

The comparison covers the period for which historical unadjusted data (i.e.; available at the release time) were available. Since the internal production of the expenditure raw items started some quarters ago while

[15] The options used for this exercised are summarised in annex 4.

the production of raw output data started quite recently, this explains the longer availability for the expenditure set of data.

Special attention has been given to the analysis of the last available set of data (2001 Q2, third release). Descriptive analysis related to revisions have been concentrated on GDP.

In this section, some results of the direct seasonal adjustment of GDP and expenditure components are commented. In particular the graphs of the data published by Eurostat and the seasonal adjusted data obtained using X-12 RegARIMA are shown in Annex 4. Corresponding results which were calculated with TRAMO-SEATS are not shown in the annex. The latter results often differed more from the currently published results, which may be explained by the wider use of X-11 and X-12. Moreover, results for the GDP output components which displayed similar differences to the published results are not shown here. Finally, results were also calculated for the EU-15 and show a similar pattern.

The results of the comparison for the euro area can be summarised as follows:

- euro area quarter on quarter GDP growth of the directly adjusted GDP differs from the published results in most quarters between 0.1 and 0.5 percentage points (p.p.). In two quarters (92q4/93q1) the differences are as high as one percentage point. This period was a cyclical turning point (see charts 4.1.a and b in the Annex)
- Smaller, but still ranging between 0.1 and 0.4 p.p. are the differences in the annual rates of GDP (charts 4.1.c and d).
- For the expenditure components the differences of the quarterly growth rates are higher than for GDP. Particularly high are the differences for gross fixed capital formation, for exports and for imports with differences exceeding one p.p. in several quarters (charts 4.2-4.6).

The differences between the direct and currently published QNA results in this comparison are significant and sometimes unexpectedly high. Possible reasons for this are:

- The direct adjustment included both a direct trading day adjustment at the euro area and a seasonal adjustment. Because trading day effects are more difficult to identify in euro area aggregates and are more difficult to identify in quarterly aggregates than in monthly indicator series, this might explain some of the differences. One evidence for this is that tests for trading day effects in the direct adjustment were often not significant, whilst national series contain significant trading day corrections.
- The options used for the seasonal adjustment of the direct adjustment may differ from the options generally used at the national level. One striking difference is the seasonal filters used in the direct

adjustment. This may explain some of the differences in series, which show a relatively unstable seasonal component and/or a high irregular component.

- The direct does not contain the adjustment for time consistency between quarterly and annual results. However, this difference is likely to explain only a very small part of the discrepancies.

7. RECOMMENDATIONS AND IMPLEMENTATION

7.1 Common Practices and recommendations to increase comparability

The recommendations outlined in this section aim at improving the comparability between the adjusted QNA of EU Member States as well as between the adjusted QNA of Member States and European aggregates compiled by Eurostat. Though Eurostat, according to its recent seasonal adjustment policy decision, regards a direct adjustment of European aggregates superior in the short-term, it announced that "this method will be used at least until the methods applied by Member States can be considered as sufficiently convergent for making use of nationally seasonal adjusted data to compile euro area and EU aggregates". Besides comparability, the second main objective of these recommendations are therefore to allow Eurostat to derive accurate EU and euro area aggregates from the national data. The recommendations also refer to the adjustment of euro area and EU aggregates.

7.1.1 General recommendations

(a) Seasonal adjustment of QNA should cover at least Table 1 of the ESA transmission programme. All series should be tested for the significance of seasonality and trading day effects and adjusted accordingly if these are present.

(b) Adjusted data complements raw data, but cannot replace the raw data.

(c) Seasonally adjusted results should be produced for current and constant price data and (implied) deflators by adjusting any two of these and deriving the third. Where the implied deflator is the derived one, care should be taken to prevent its path being affected by arbitrary differences in the separate seasonal adjustment of current and constant price data.

(d) Documentation on the practices adopted at national level (*metadata*) should be made available and follow a common format to be developed by Eurostat together with the NSIs and NCBs.

(e) There should not be a complete dependence on the automatic default options of the programmes. Seasonal adjustment and quarterly national accounts expertise should be used to verify and supplement decisions about the options used (e.g. for outlier treatment, model selection).

(f) For the sake of quality, Census X-12 RegARIMA and TRAMO-SEATS are recommended for seasonal adjustment [16].

7.1.2 Trading day and other pre-adjustment

(a) Trading day effects are defined as any working or trading day, calendar and moving holiday effect. Trading day adjustment removes these effects, but does not correct for the length of month effect.

(b) QNA data should be trading day adjusted (except the stock data on population and the labour force). The adjustment should be made for those variables for which there is a statistical evidence and economic explanation of trading day effect.

(c) In order to obtain accurate seasonal factors, the trading day adjustment should be performed prior to the seasonal adjustment.

(d) The regression approach with ARIMA-based error modelling is recommended for trading day adjustment. Where more appropriate information is available, a direct correction of the raw data for trading day effects may be made. Proportional methods should normally not be used.

(e) For trading day adjustment the following should be used to improve the accuracy of results:

- multiple regressors, in particular the split of regressors for certain periods of the year or weekdays;
- different regressors for different series (e.g. output and consumption);
- derivation of quarterly trading day factors from monthly indicator series;
- derivation of trading day factors for QNA aggregate series from QNA component series or from indicator component series.

(f) Trading day adjustment based on quarterly indicators or direct adjustment of quarterly national account components should be limited to the cases when monthly indicators are not available.

(g) Country-specific calendars should be used in the trading day adjustment to ensure more accurate results, taking into account countrywide and regional holidays if they may have a significant impact on the national result.

(h) Trading day adjustment should also include moving holiday adjustment as well as a correction for leap year effects. The length of the Easter effect should be tested and appropriately adjusted for. Other pre-adjustments (outliers and intervention variables) should be carried out to improve the estimate of the

[16] The transition period needed to change from other, currently used programs to one of the two recommended programs may exceed the general transition time of one year (see page 1, second bullet point).

seasonal and trading day component. They should be based either on information directly available or on a regression framework.

(i) All the effects estimated in the pre-adjustment phase should be clearly identified as separate components of the raw series. The final trading day adjusted series should only exclude the trading day component as well as Easter and leap year effects. The final trading day and seasonally adjusted series should exclude in addition only the seasonal component.

7.1.3 Seasonal adjustment

(a) Transmission to Eurostat should cover for Table 1 of the ESA transmission programme:

- raw data;
- seasonally and trading day adjusted data;
- seasonally adjusted data if trading day adjustment is not applied;

(b) Trading day adjusted data (except for the stock data on population and labour force) should also be transmitted to Eurostat (see also 5.1.5). Where countries are not able for technical reasons to supply trading day adjusted data , they should supply Eurostat with the relevant information needed to compile trading day adjustment (e.g. trading day factors, national calendar, other information).

(c) Eurostat disseminates these results as far as they are made public in the countries, together with corresponding aggregates for the euro area and EU.

(d) If discrepancies between adjusted GDP aggregate series and adjusted components exist, a separate series for the discrepancies should be transmitted to Eurostat in order to allow for the checking of the consistency of the results.

(e) Sufficient metadata and information on adjustment practices should be regularly transmitted to Eurostat. On request of Eurostat, countries shall provide the information necessary to evaluate the adjustments and comparability. Eurostat shall do the same for the European aggregates.

(f) Practices for seasonal and trading day adjustment should be transparent and documented. The Task Force proposes a common template for summary information on adjustment practices for publication.

7.1.4 Recommendations for European aggregates

In an ideal situation of fully comparable national seasonally adjusted figures, the aggregation of such data to obtain euro area and EU aggregates should be the more reasonable solution. Unfortunately, the current level

of comparability among seasonally adjusted data produced by NSIs and NCBs cannot be considered satisfactory.

In this context and waiting for an higher comparability of seasonally adjusted data produced by countries, Eurostat has decided to adopt a general policy based on the direct approach. This general policy must be implemented in the different domains of economic statistics taking into account the specificity of the data. Exceptions can be also envisaged according to data, which must fulfil some special consistency requirements (e.g. external trade figures).

Recommendation A– direct method

After a simulation study, Eurostat proposed to change the existing methodology for producing seasonally adjusted data according to its general policy. This study shows that there are no significant differences between the direct and the centralised indirect approach using a common software and strategy. By contrast, differences can be more relevant with the decentralised indirect approach, which corresponds to figures currently published by Eurostat. This can be explained by the lack of homogeneity of the national seasonal adjustment procedures in terms of pre-treatment, seasonal adjustment methodology and options as well as adopted revision policies.

Consequently, the direct approach has be retained for both geographical and sectoral aggregations. Distribution of discrepancies in the sectoral aggregation have been also envisaged in order to fulfil the accounting identities. The Eurostat view is that an optimal direct approach should be based on trading days adjusted data produced by countries. If not all countries agree on the transmission of trading day adjusted data, Eurostat will adopt a mixed strategy by using available trading-day adjusted figures completed by a Eurostat correction for the remaining figures.

The use of the direct approach will represent a considerable increase in terms of transparency and readability of seasonally adjusted figures for both euro area and EU. Moreover, a well-defined revision policy of seasonally adjusted data will be adopted and announced by Eurostat, further improving the quality.

Finally, new Eurostat figures will be easily reproducible since complete metadata for seasonally adjusted data will be produced showing the hypothesis and the set of options used by Eurostat.

Recommendation B– indirect method and better harmonisation of national methods

The ECB and several members of the Task Force (DE, FR, UK) acknowledge the potential gain in the supply of directly adjusted QNA, e.g. by the expected transparency of results, the consistency and practicability. However, the preconditions to introduce the direct approach are currently not met. Changes in the

publication practice for euro area GDP results must be very carefully examined, because quarterly GDP results for the euro area are one of the most important indicators for the monetary policy of the ECB. It is not obvious that the directly adjusted results would be of a higher quality than the adjusted results derived from sufficiently comparable national results. Moreover, the calculations presented to the Task Force underlined the practical difficulties in implementing the direct approach and more development work is necessary to improve the quality of the results.

The direct adjustment has one important drawback: all available empirical comparisons show that considerable differences in the results for euro area adjusted national accounts are possibly resulting from the aggregation method used. The differences in adjusted quarter on quarter growth rates may be as large as 0.2–0.5 p.p. for euro area GDP and differences of up to 1 p.p. for main GDP expenditure components. The discrepancies can be expected to be particularly large if the direct seasonal adjustment is not based on trading day adjusted input series from all countries. In this case even the annual growth rates may differ considerably. Differences of the observed magnitude would destroy the relationship between national GDP developments as published for the countries and the euro area results. The analysis of adjusted euro area results by the ECB and other users would be seriously affected by discrepancies of this size, particularly since it is often very difficult to explain why the discrepancies occur and which results are better. Monitoring, forecasting and econometric analysis would be confronted with many difficulties. In this case it seems to be likely that two euro area GDP results would be used in the economic analysis and in the public discussion in parallel damaging the credibility of the results.

It is therefore recommended that euro area aggregates continue to be calculated from nationally published adjusted results, at least for a sufficiently long transition period. This also implies that the recommendations for harmonisation of national practices are crucial for the quality of the European aggregates. Priority should therefore be given to their implementation before the change in the adjustment of European QNA aggregates is considered.

7.2 Issues in Member States

Although generally agreed that trading day adjustment should preferably be performed at a national level, existing practices in the compilation of quarterly national accounts make technically difficult complying with some of the recommendations listed under point 7.1.

Spain, France and United Kingdom, in particular, due to the methods used to compile adjusted data, are not able to supply this data without major changes in the current data production process, which would imply the development of adequate infrastructures and necessary training.

The main problem is represented by the balancing procedure of adjusted data, which is often a complex procedure combining information from different sources and different frequencies. In this procedure, adjusted series are often not directly a seasonal adjustment of the unadjusted series and not fully consistent with it. Trading day adjusted GDP may not be conceptually meaningful in this context.

Moreover, a non-technical issue preventing Member States from supplying purely trading day adjusted data is represented by the opposition to the direct adjustment by Eurostat, perceived as potentially less accurate than the one performed at the national level.

Finally, the publication of purely working/trading day adjusted data is regarded as potentially confusing for the public.

7.3 Issues for further consideration

In this section, practical/technical problems and organisational issues preventing a straightforward implementations of common practices are listed.

(a) The possible effect of annually chained QNA results on the recommendations concerning the accounting constraints and the relation of current and constant price data and deflator needs to be examined.

(b) Some Member States limit the time period for revisions of seasonal adjustment to the most recent quarters, but freeze historic data. A possible recommendation for the revision of historic seasonally adjusted data might be defined after the current discussion of a harmonised revision policy for raw QNA are finished.

(c) The transmission programme of the ESA 95 Regulation (Annex B of the regulation) does not contain any explicit requirement for adjusted data. In view of the required standardised transmission programme for seasonally adjusted data (and possibly trading day adjusted data), a revision of the ESA 95 transmission programme might be necessary.

7.4 Implementation plan and follow-up

Depending on the current national and Eurostat practices, implementation of the recommendations requires different changes to be made by some or all Member States and Eurostat. The Task Force suggests that a one-year implementation period for the changes proposed be foreseen. After the end of this year:

- the transmission programme of all Member States to Eurostat should comply with the proposals made in this Task Force Report;
- Eurostat's adjustment of QNA should follow the same rules;

- Eurostat and Member States will have compiled and published a standardised documentation of the adjustment practices and regularly update this.

After the end of the implementation period Eurostat should review its decision in favour of the direct adjustment and evaluate the advantages and disadvantages in the light of the harmonisation achieved by then. Eurostat will report on the results of this evaluation.

8. ANNEXES

Annex 1: Tables on national practices

Annex 2: ESA Table1 – Main aggregates required at quarterly frequency

Annex 3: Statistical criteria on direct and indirect adjustment -- charts and tables

Annex 4: Direct vs. indirect methods: seasonally adjusted series for the euro area

Annex 5: Draft documentation template for adjustment practices

Annex 6: The members of the Task Force

ANNEX 1. *Tables on national practices*

1. Temporal disaggregation techniques and effects on QNA data

	BE	DE	GR	ES	FR	IE	IT
1.1. *Use of temporal disaggregation techniques in the compilation of Quarterly National Accounts (QNA).*	YES	YES	***The compilation of Quarterly National Accounts started very recently. No seasonal adjustment is performed yet.***	YES	YES	***The compilation of Quarterly National Accounts started very recently. No seasonal adjustment is performed yet.***	YES
1.2. *Temporal disaggregation techniques are applied on:*							
a. output side	The value added is broken down into more than 30 activities among which 16 for the manufacturing industry.	Part of agriculture, forestry and fishing activities, part of production of intangibles.		Industry, construction and market services.	Production, intermediate consumption, taxes (d21), imports broken down into 40 branches.		All components.
b. expenditure side	- Households, NPISH and public consumption; - investments of corporates, investments in housings, public investments; - exports, imports.	Part of gross fixed capital formation in intangible fixed assets.		- Final consumption expenditure (households, NPISH, general government) - gross fixed capital formation (equipment, construction, other products).	All aggregates, broken down into 40 branches.		All components.
c. income side	Salaries, social contributions, taxes on production and imports, subsidies.	Part of property income.		Employment, compensation of employees.	All aggregates, for every institutional sector.		All components.
1.3. *Temporal disaggregation and trading day adjustment (t.d.a.).* *See also 2.1.*	T.d.a. of individual indicators used to derive QNA target series.	T.d.a. of derived target series.		T.d.a. of derived target series.	T.d.a. of individual indicators used to derive QNA target series.		*T.d.a. is not yet performed.* In the future, on the QNA target raw series.

	LU	NL	AT	PT	FI	DK	SE	UK
1.1.	***Quarterly National Accounts are presently not compiled.***	YES	YES	YES	NO	YES	NO	YES
1.2.								
a.		Value added of government sector.	All components.	All components.	--	All components.	--	Approx. 50% of government expenditure; capital consumption
b.		Consumption of fixed capital.	All components except exports and imports.	All components.	--	All components.	--	Approx. 50% of government expenditure; capital consumption; part of NPISH's expenditure; various other minor components.
c.			All components except gross operating surplus including mixed income (residual term).	*Not compiled at present.*	--	All components.	--	Capital consumption.
1.3.		T.d.a. of derived target series.	T.d.a. of derived target series.	--	--	*T.d.a. is not performed.*	--	T.d.a. of derived QNA series.

2. Trading day adjustment

	BE	DE	GR	ES	FR	IE	IT
2.1. *Adjustment of QNA data for trading day effect.*	YES On all components.	YES On almost all components except the distribution of national income, demographic and employment series.		YES On all components.	YES On all components (when statistically significant and economically understandable).		NO
2.2. *If NO, such correction is planned in the future.*	--	--		--	--		YES By the end of 2002.
2.3. *Test of significance of trading day component.*	Standard tests offered by s.a. software	Standard tests offered by s.a. software		Standard tests offered by s.a. software	F test on regression coefficients		--
2.4. *Derivation of GDP trading day factors.*	Indirectly via t.d.a. components.	Indirectly via t.d. factors derived from monthly indicators.		Indirectly via t.d.a. components.	Indirectly via t.d.a. components.		--

	LU	NL	AT	PT	FI	DK	SE	UK
2.1.		YES but limited to some components. GDP and some expenditure components and production components where trading day effects are significant.	YES On all components except demographic and employment series.	NO	NO	NO	YES On the output side components.	YES but limited to some components for which monthly data are available, namely: - ind. production; - exports/imports of goods; - retail sales.
2.2.		--	--	NO	NO	NO	--	--
2.3.		Standard tests offered by s.a. software.	Standard tests offered by s.a. software.	--	--	--	Standard tests offered by s.a. software.	Standard tests offered by s.a. software.
2.4.		Directly on the GDP.	Indirectly via t.d.a. components.	--	--	--	Directly on the GDP.	Indirectly via t.d.+s.a. components. Purely t.d.a. GDP is not available.

	BE	DE	GR	ES	FR	IE	IT
2.5. *Estimation of trading day factors.*	Regr. method 1 regressor.	Regr. method		Regr. method 1 regressor.	Regr. method 7 regressors		--
Comments / Special treatments.	The method may be refined later (multiple regressors).	December is modelled separately.			Sundays are treated differently of holidays. Summer months/quarters are modelled separately (*summer effect*).		
2.6. *Calendar used for the adjustment.*	Country and sector specific.	Country and sector specific.		Standard calendar in s.a. software (no national specific holidays).	Country specific calendars.		--
2.7. *Phase at which the t.d.a. is performed.*	In the pre-adjustment phase.	In the pre-adjustment phase.		In the pre-adjustment phase.	In the pre-adjustment phase.		--
2.8. *Further systematic calendar components removed from the final adjusted series.*	- Easter effect - Leap year effect.	- Easter effect - Leap year effect.		- Easter effect.			--
2.10. *Frequency of data mainly used to derive trading day factors.*	Monthly/Quarterly.	Monthly.		Quarterly.	Monthly.		--

	LU	NL	AT	PT	FI	DK	SE	UK
2.5.		Regr. method Total GDP: user defined calendar regressor Components: 6 regressors.	Regr. method The regressors depend on the statistical significance and theoretical content of the underlying time series.	-- --	-- --	-- --	Regr. method Internal regression with user defined regressors (changes in quarterly number of trading days, weighted for different industrial sectors).	Regr. method 6 regressors
2.6.		Total GDP: Country specific (deviations from standard calendar). Components: Standard calendar in s.a. software	Country specific calendar.	--	--	--	Country specific calendar.	Standard calendar in s.a. software
2.7.		In the pre-adjustment phase.	In the pre-adjustment phase.	--	--	--	In the pre-adjustment phase.	In the pre-adjustment phase.
2.8.		- Temperature degree days for total GDP and output of the sectors construction and mining.	- Easter effect; - Leap year effect; - Temperature degree for construction sector.	--	--	--	- Easter effect.	- Easter effect; - Leap year effect.
2.9.		Monthly.	Quarterly.	--	--	--	Quarterly.	Monthly.

3. Seasonal adjustment and aggregation

	BE	DE	GR	ES	FR	IE	IT
3.1. *QNA s.a. components.*	Total GDP and components (output, expenditure, income sides). *See 1.2*	Total GDP and components (output, expenditure, income sides).		Total GDP and components (output, expenditure, income sides).	Total GDP and components (output, expenditure, income sides).		Total GDP and components (output, expenditure, income sides).
3.2. *Derivation of s.a. GDP and components*	Indirect.	Direct (GDP and other time series). Indirect (Many time series).		Indirect.	Indirect.		Indirect.
3.3. *Level of detail for indirect method.*	*See 1.2.*	It depends on the particular case.		Aggregate level. - Expenditure side: 6 variables - Output and employment: A6 breakdown.	Very detailed level (40 branches) via output side in industrial branches and expenditure components in the other branches.		Very detailed level, i.e. at the maximum level at which estimates are conducted, i.e. 32 branches for value added, employment and compensation, 24 different kinds of consumption for private consumption.
3.4. *Presence of discrepancies between s.a. aggregates and components in published data.*	NO	NO Discrepancies are allocated to residual items (e.g. part of changes in inventories)		NO Discrepancies are corrected using ECOTRIM.	NO		NO
3.5. *Procedure for s.a.*	TRAMO-SEATS	X-12 RegARIMA		TRAMO-SEATS	X-11-ARIMA		TRAMO-SEATS

	LU	NL	AT	PT	FI	DK	SE	UK
3.1.		Total GDP and components (output, expenditure, income sides).	Total GDP and components (output, expenditure, income sides).	Total GDP and components (output and expenditure sides).	Total GDP and components (output, expenditure sides).	Total GDP and components (output, expenditure, income sides).	Total GDP and components (output, expenditure sides).	Total GDP and components (output, expenditure, income sides).
3.2.		Direct.	Indirect (GDP and other sensitive variables).	Indirect.	Indirect.	Direct.	Direct.	Indirect.
3.3.		--	Quarterly variables to be delivered according to ESA Table 1.	Aggregate level (All indicators used in temporal disaggregation models are seasonally adjusted).	Very detailed level.	--	--	Fairly detailed level. The level of detail is dependenton: – publication purposes – data sources – consistency considerations – considerations regarding the number of adjustments to monitor and re-analyse.
3.4.		YES	YES	NO	NO	YES	YES	NO
3.5.		X-11-ARIMA	TRAMO-SEATS	X-11	X-11-ARIMA	X-11-ARIMA	TRAMO-SEATS	X-11-ARIMA

4. Time consistency

	BE	DE	GR	ES	FR	IE	IT
4.1. *Existence of time consistency constraints between quarterly and annual totals.*	YES on raw, s.a. and t.d.+s.a. data.	YES on raw, s.a. and t.d.+s.a. data.		YES On raw, t.d.+s.a. and trend-cycle data.	YES On raw, s.a. and t.d.+s.a. data.		YES On raw and s.a. data.
Comments:	The effect on annual data is considered negligible.	Obtained by construction of the method. It has no effect on the most recent percentage changes of the (t.d.+) s.a. data from the previous period.					Users' need and to avoid the risk of having many estimates of the same aggregate.
4.2. *Variables on which the constraint is imposed.*	All variables.	All variables.		All variables.	All variables.		All variables.
4.3. *Reference aggregates for time consistency.*	Annual raw data.	For s.a. series: yearly sum of the unadjusted figures. For t.d.+s.a. series: yearly sum of the only trading day adjusted series.		Annual raw data.	For raw and s.a. series: annual raw data. For t.d.+s.a. series: yearly sum of the t.d.a. series.		Annual raw data.
4.4. *Time consistency requested by users:*	YES	YES		YES	YES		YES

	LU	NL	AT	PT	FI	DK	SE	UK
4.1. *Comments*:		YES On s.a. and t.d+s.a. data.	YES On raw data. No constraints are imposed on s.a. or t.d.a. data.	YES On s.a. data.	YES On raw and s.a. data.	YES on raw and s.a. data.	YES On raw data. Adjusted data is mainly used to compare with previous quarter (s.a.) or the same quarter the year before (t.d.a.).	YES On t.d.+s.a. data.
4.2.		All variables,	--	All variables.	All variables.	All variables.	All variables.	All variables
4.3.		Annual t.d.a. data.	--	Annual raw data.	Annual raw data.	Annual raw data.	--	Annual raw data.
4.4.		YES	YES	YES	YES	YES	YES	YES

5. Seasonal adjustment and revisions

	BE	DE	GR	ES	FR	IE	IT
5.1. *Estimation of seasonal factors.*	Concurrent (each period).	Projected seasonal factors (one year). A concurrent adjustment is run to monitor the adequacy of projected seasonal factors in use. If necessary, seasonal factors are updated before the reference time(one year).		Concurrent (each period).	Concurrent (each period).		Concurrent (each period).
5.2. *Further details on the revision of seasonal factors.*	Revisions linked to revisions in raw data. Revisions of models at a fixed period and re-estimation of the parameters each time the s.a. is run. When annual figures are revised (in October), quarterly figures are revised to ensure time consistency.	Revisions linked to revisions in raw data. For models and parameters are re-estimated each time that the s.a. is run to check the projected factors in use.		Revisions linked to revisions in raw data. Revisions of models and re-estimation of the parameters each time the SA is run. In the future, models will be revised only once a year.	Revisions linked to revisions in raw data. Annual revision of models and re-estimation of the parameters each time the SA is run.		Revisions linked to revisions in raw data. Annual revision of models and re-estimation of the parameters each time the SA is run.

	LU	NL	AT	PT	FI	DK	SE	GB
5.1.		Concurrent (each period).	Concurrent (each period).	Concurrent (each period).	Concurrent (each period).	Concurrent (each period).	Concurrent (each period).	Concurrent (each period).
5.2.		Revisions linked to revisions in raw data. Annual revision of models and re-estimation of the parameters each time the SA is run.	Annual revision of models and re-estimation of the parameters each time the SA is run.	Revision of models and re-estimation of the parameters each time the SA is run.	Revision of models and re-estimation of the parameters each time the SA is run.	Revisions linked to revisions in raw data.	Revisions of models and s.a. options used at fixed periods but re-estimation of factors every quarter.	Revisions linked to revisions in raw data. Annual revision of models and re-estimation of the parameters each time the SA is run.

	BE	DE	GR	ES	FR	IE	IT
5.3. *Revisions of t.d.a/s.a. data limited to recent quarters/years of the complete series.*	YES Revisions of s.a. (t.d.+s.a. in the future) data linked to the overall revision policy, i.e. quarterly figures for which a final annual estimate has been published are no longer revised.	NO S.a. series are entirely re-computed and published once a year or when factors are updated.		NO	NO Every new quarter, all quarters are allowed to change but, except in April, revisions are mostly confined to the most recent years. Annual data are revised for three years at the end of April of each year. In addition to the changes due to the raw annual series, all quarters change because of the re-estimation of the link between the indicators and the annual data and because or the re-estimation of the trading day correction.		YES Every new quarter, the quarters of the current year and those of the preceding two years are allowed to change, both for raw and s.a. data. When new annual totals becomes available, the quarters of the last four/five years may change due to new estimated parameters of the annual regressions. Annual data are revised for three years at the end of February of each year (i.e. in Feb. 2001 revisions have been made to 1997-1999). When historical revisions are introduced, all the quarterly data may be revised.

	LU	NL	AT	PT	FI	DK	SE	UK
5.3.		NO	NO	NO	NO	NO	YES Revisions only of current year, except when annual data is revised andthen applied to QNA raw data. Also the s.a. options are revised.	YES Revisions are mostly confined to the most recent years. There is usually one occasion a year when the previous whole year is open for revisions. Additionally, once a year historical revisions are made.

6. Publication of s.a. QNA data

6.1. *QNA data currently published.*	**BE**	**DE**	**GR**	**ES**	**FR**	**IE**	**IT**	**LU**	**NL**	**AT**	**PT**	**FI**	**DK**	**SE**	**UK**
raw data	×	×		×	×*		×		×	×		×	×	×	×
t.d.a. data	×*	×												×	
s.a. data		×					×		×**		×	×	×		
t.d. and s.a. data	×	×		×	×				×	×				×	×
trend-cycle	×			×								×			

6.2. *Planned changes.*	**BE**	**DE**	**GR**	**ES**	**FR**	**IE**	**IT**	**LU**	**NL**	**AT**	**PT**	**FI**	**DK**	**SE**	**UK**
raw data	×	×		×	×*		×		×	×		×	×	×	×
t.d.a. data	×*	×					×							×	
s.a. data		×					×		×**		×	×	×		
t.d. and s.a. data	×	×		×	×		×		×	×				×	×
trend-cycle	×			×								×			

*) on request.
**) only total GDP.

ANNEX 2. *ESA 95 Table 1: Main aggregates required at quarterly frequency*

CODE	LIST OF VARIABLES	Current prices	Constant prices
Value added and Gross Domestic Product			
B1G	1. Gross value added at basic prices	×	×
	Breakdown A6	×	×
D21-D31	2. taxes less subsidies on products	×	×
P119	3. FISIM	×	×
B1*G	4. Gross domestic product	×	×
Expenditure of the Gross Domestic Product			
P3	5. Total final consumption expenditure	×	×
P3	6. (a) Household final consumption expenditure (domestic concept) [2]	×	×
P4	6. (b) Household final consumption expenditure (national concept)	×	×
P3	7. Final consumption expenditure of NPISHs		
P3	8. Government final consumption expenditure	×	×
P31	(a) Individual consumption expenditure [3]	×	×
P32	(b) Collective consumption expenditure [3]	×	×
P4	9. Actual final consumption of households [3]	×	×
P41	(a) Actual individual consumption [3]	×	×
P5	10. Gross capital formation	×	×
P51	a) Gross fixed capital formation	×	×
	Breakdown Pi6	×	×
P52	b) Changes in inventories	×	×
P53	c) Acquisition less disposables of valuables	×	×
P6	11. Exports of goods (fob) and services	×	×
P7	12. Imports of goods (fob) and services	×	×
Income, Saving and Net Lending			
B5	13. Balance of primary income with the rest of the world	×	×
B5*G	14. Gross national income at market prices	×	(×)
K1	15. Consumption of fixed capital	×	×
B5*N	16. Net national income at market prices	×	×
D5,D6, D7	17. Net current transfers with the rest of the world	×	
B6N	18. Disposable income, net	×	(×)
B8N	19. National saving, net	×	
D9	20. Net capital transfers with the rest of the world	×	
B9	21. Net lending or net borrowing of the nation	×	
Population and Employment			
	22. Population and employment data		
POP	(a) Total population (1000)		
EUN	(b) Unemployed persons (1000)		
ETO	(c) Employment, national and domestic concept (1000)		
ESE	- self employed		
	Breakdown A6 (domestic concept)		
ESE	- employees		
	Breakdown A6 (domestic concept)		
D1	23. Compensation of employees, national and domestic concept	×	
	Breakdown A6 (domestic concept)	×	
D11G	a) Gross wages and salaries	×	
	Breakdown A6 (domestic concept)	×	

*) Transmission of national accounts data (Table 1) by Member States to Eurostat is required, according to the ESA95 Regulation, from end-April 1999 onwards, unless a derogation had been granted. Data should go back to 1980.

1) Published by Eurostat;
2) Not included in the ESA Questionnaire;
3) Only annual data mandatory according to questionnaire.

ANNEX 3. *Statistical criteria on direct and indirect adjustment -- charts and tables*

Indicator	Ind. vs Dir.		Best	Ind. vs Mixed		Dir. vs Mixed	
	T-S	X-12		T-S	X-12	T-S	X-12
Mean APD (SA)	0.082	0.193	Seats	0.192	0.162	0.232	0.182
Max APD (SA)	0.428	0.682	Seats	0.847	0.587	1.270	0.697
Mean APD (SA), Last 3 years	0.042	0.083	Seats	0.127	0.119	0.119	0.116
Max APD (SA), Last 3 years	0.160	0.172	Seats	0.319	0.299	0.302	0.412
Mean APD (TC)	0.147	0.156	Seats	0.250	0.165	0.199	0.165
Max APD (TC)	1.470	0.747	X12ar	0.889	0.996	1.465	0.758
Mean APD (TC), Last 3 years	0.064	0.037	X12ar	0.175	0.096	0.113	0.120
Max APD (TC), Last 3 years	0.133	0.060	X12ar	0.414	0.301	0.338	0.288
Mean APD (S)	0.082	0.169	Seats	0.193	0.162	0.232	0.203
Max APD (S)	0.427	0.578	Seats	0.854	0.590	1.286	0.879
Mean APD (S), Last 3 years	0.042	0.028	X12ar	0.127	0.119	0.120	0.131
Max APD (S), Last 3 years	0.161	0.069	X12ar	0.320	0.300	0.303	0.370

Table 3.1: *Absolute Percentage Deviation indicators (GDP geographical aggregation).*

Indicator	Dir. vs Ind.		Mixed vs Ind.		Mixed vs Dir.	
	T-S	X-12	T-S	X-12	T-S	X-12
Mean	-0.005	0.008	-0.027	-0.006	-0.017	0.001
Minimum	-0.770	-1.142	-1.118	-0.920	-0.706	-0.917
Maximum	0.459	0.742	1.339	1.182	1.040	0.780
Variance	0.036	0.163	0.189	0.122	0.120	0.104
Range	1.229	1.884	2.457	2.102	1.746	1.697

Table 3.2: *Differences in growth rates between the three approaches; GDP geographical aggregation.*

Direct vs Indirect

TRAMO-SEATS			X-12-ARIMA		
Date	Direct	Indirect	Date	Direct	Indirect
92Q4	0.016	-0.102	97Q1	0.095	-0.123

Mixed vs Direct

TRAMO-SEATS			X-12-ARIMA		
Date	Mixed	Direct	Date	Mixed	Direct
91Q3	-0.020	0.707	91Q3	-0.020	0.708
92Q3	-0.277	0.337	93Q2	-0.001	0.919
92Q4	-0.304	0.016	95Q3	0.087	-0.109
93Q2	-0.001	0.647	96Q4	0.209	-0.073

Mixed vs Indirect

TRAMO-SEATS			X-12-ARIMA		
Date	Mixed	Indirect	Date	Mixed	Indirect
91Q3	-0.020	0.686	91Q3	-0.020	0.124
92Q3	-0.277	0.123	93Q2	-0.001	0.273
93Q2	-0.001	0.643	95Q3	0.087	-0.192
			96Q4	0.209	-0.021
			97Q1	0.277	-0.123

Table 3.3: *Inconsistencies in growth rates between the three approaches; GDP geographical aggregation.*

Direct or Indirect, TRAMO-SEATS

Date	Direct	Indirect	Weights	BE	DE	ES	FR	IT	NL	FI
92Q4	0.016	-0.102	0.460	-1.73	0.31	-0.51	-0.18	-0.53	0.42	0.08

Direct or Indirect, X-12-ARIMA

Date	Direct	Indirect	Weights	BE	DE	ES	FR	IT	NL	FI
86Q1	-0.371	-0.036	0.589	-0.11	-0.49	0.16	0.44	0.03	0.28	-0.26
87Q1	-1.041	-0.308	0.550	-0.01	-1.75	1.77	0.31	0.35	-0.09	0.76
97Q1	0.095	-0.123	0.632	0.28	-1.18	1.37	0.38	0.17	0.77	0.83

Mixed Approach

Date	Mixed	Weights	BE	DE	ES	FR	IT	NL	FI
91Q3	-0.020	0.597	0.76	-0.75	0.33	0.44	0.63	0.28	-1.31

Table 3.4: *Inconsistencies in growth rates between aggregate and components; GDP geographical aggregation.*

	TRAMO-SEATS	X-12-ARIMA
Direct and Indirect	98.39	98.39
Direct and Components	98.39	96.77
Indirect and Components	100.00	95.16
Mixed and Direct	89.47	89.47
Mixed and Indirect	92.11	86.84
Mixed and Components	97.37	

Table 3.5: *Concordance rates (in %); GDP geographical aggregation.*

	TRAMO-SEATS		X-12-ARIMA		Mixed
Indicator	Direct	Indirect	Direct	Indirect	adjustment
M1*	0.013	0.033	0.033	0.059	0.011
M2*	0.021	0.094	0.077	0.101	0.034
M3*	0.000	0.000	0.000	0.000	0.000
M4	0.667	0.039	1.020	0.667	0.855
M5	0.200	0.200	0.200	0.200	0.200
M7*	0.443	0.548	0.347	1.075	0.542
M8	0.864	1.008	0.430	0.420	1.536
M9	0.340	0.290	0.262	0.306	0.318
M10	0.684	1.067	0.252	0.326	1.715
M11	0.311	0.309	0.215	0.223	0.660
Q	0.314	0.315	0.272	0.398	0.464

Table 3.6: *Quality measures; GDP geographical aggregation.*

	Tramo-Seats		X-12-Arima		Mixed		
	Direct	Indirect	Direct	Indirect	approach	Seats	X-12
R1 (SA)	9596.342	9509.841	10390.548	10890.316	8175.765	I	D
R1 (SA), Last 3 years	9518.236	9302.559	9326.906	9356.335	9692.888	I	D
R2 (SA)	0.148	0.150	0.218	0.216	0.106	D	I
R2 (SA), Last 3 years	0.102	0.089	0.057	0.059	0.093	I	D
R3 (SA)	0.125	0.260	0.234	0.269	0.106	D	D
R3 (SA), Last 3 years	0.093	0.074	0.057	0.066	0.093	I	D
Mar (TC, 1)	9098.199	8982.916	9503.725	9183.913	7604.240	I	I
Mar (TC, 1), Last 3 years	9200.785	9198.201	9251.772	9255.230	9467.014	I	D
Mar (TC, 2)	5684.150	6063.805	7071.701	5056.128	3410.656	D	I
Mar (TC, 2), Last 3 years	2090.540	1695.078	2336.268	2678.502	2758.085	I	D
Mar (S)	0.030	0.028	0.015	0.013	0.060	I	I
Mar (S), Last 3 years	0.016	0.018	0.006	0.007	0.055	D	D

Table 3.7: *Roughness measures; GDP geographical aggregation.*

Indicator	Tramo-Seats		X-12-Arima		Direct vs Indirect	
	Direct	Indirect	Direct	Indirect	Seats	X-12
Mean AR 1 qtr	0.170	0.215	0.156	0.089	D	I
Mean AR 2 qtrs	0.178	0.219	0.147	0.096	D	I
Mean AR 3 qtrs	0.191	0.237	0.194	0.089	D	I
Mean AR 4 qtrs	0.180	0.216	0.247	0.122	D	I
Mean AR 5 qtrs	0.195	0.239	0.266	0.150	D	I
Std AR 1 qtr	0.120	0.166	0.110	0.082	D	I
Std AR 2 qtrs	0.131	0.148	0.112	0.082	D	I
Std AR 3 qtrs	0.143	0.147	0.188	0.076	D	I
Std AR 4 qtrs	0.123	0.173	0.174	0.091	D	I
Std AR 5 qtrs	0.135	0.157	0.213	0.096	D	I
Sliding Spans						
A(%)	0.000	0.000	0.000	0.000	=	=
MM(%)	0.000	0.000	0.000	0.000	=	=

Table 3.8: *Absolute Revisions (mean and standard deviation in %) and Sliding Spans analysis; GDP geographical aggregation.*

Series	Model	pljung	dw	pnorm	ls	tc	ao	trad	east	Season ?
Seats Indirect	(1,0,0)(0,0,0)	0.042	2.008	0.055	0	1	0	Y	N	N
X-12 Indirect	(1,0,0)(0,0,0)	0.973	2.190	0.000	0	0	1	N	N	N
Seats Direct	(1,0,1)(0,0,1)	0.189	2.553	0.000	0	0	0	N	Y	N
X-12 Direct	(0,0,0)(0,1,1)	0.678	2.673	0.000	0	0	1	N	N	N

Table 3.9: *Analysis of the irregular components; GDP geographical aggregation.*

Indicator	Ind. vs Dir.		Best	Ind. vs Mixed		Dir. vs Mixed	
	T-S	X-12		T-S	X-12	T-S	X-12
Mean APD (SA)	0.112	0.057	X12ar	0.166	0.170	0.239	0.193
Max APD (SA)	0.409	0.219	X12ar	0.625	0.666	0.880	0.782
Mean APD (SA), Last 3 years	0.073	0.015	X12ar	0.150	0.180	0.217	0.184
Max APD (SA), Last 3 years	0.207	0.027	X12ar	0.358	0.374	0.372	0.387
Mean APD (TC)	0.156	0.109	X12ar	0.255	0.171	0.318	0.171
Max APD (TC)	0.437	1.445	Seats	1.070	0.603	1.360	0.830
Mean APD (TC), Last 3 years	0.109	0.018	X12ar	0.119	0.154	0.172	0.162
Max APD (TC), Last 3 years	0.190	0.072	X12ar	0.341	0.268	0.455	0.276
Mean APD (S)	0.183	0.139	X12ar	0.192	0.170	0.239	0.215
Max APD (S)	0.589	0.503	X12ar	0.817	0.671	0.888	0.767
Mean APD (S), Last 3 years	0.147	0.111	X12ar	0.173	0.180	0.217	0.193
Max APD (S), Last 3 years	0.344	0.225	X12ar	0.547	0.376	0.371	0.506

Table 3.10: *Absolute Percentage Deviation indicators (GDP aggregation by sector).*

Indicator	Dir. vs Ind.		Mixed vs Ind.		Mixed vs Dir.	
	T-S	X-12	T-S	X-12	T-S	X-12
Mean	0.007	0.003	-0.016	-0.005	-0.009	-0.002
Minimum	-0.457	-0.333	-1.308	-1.005	-0.820	-1.009
Maximum	0.649	0.231	1.222	1.297	1.020	1.000
Variance	0.057	0.013	0.202	0.132	0.100	0.098
Range	1.105	0.563	2.530	2.302	1.839	2.009

Table 3.11: *Differences in growth rates between the three approaches; GDP aggregation by sector.*

Direct vs Indirect

TRAMO-SEATS			X-12-ARIMA		
Date	Direct	Indirect	Date	Direct	Indirect
92Q4	0.022	-0.155			
95Q3	0.001	-0.165			
96Q4	-0.095	0.021			

Mixed vs Direct

TRAMO-SEATS			X-12-ARIMA		
Date	Mixed	Direct	Date	Mixed	Direct
91Q3	-0.102	0.139	91Q3	-0.102	0.504
92Q3	-0.265	0.161	95Q3	0.035	-0.200
92Q4	-0.344	0.022	96Q4	0.177	-0.085
96Q4	0.177	-0.095			
97Q1	0.222	-0.587			

Mixed vs Indirect

TRAMO-SEATS			X-12-ARIMA		
Date	Mixed	Indirect	Date	Mixed	Indirect
91Q3	-0.102	0.442	91Q3	-0.102	0.411
92Q3	-0.265	0.005	95Q3	0.035	-0.295
95Q3	0.035	-0.165	96Q4	0.177	-0.011
97Q1	0.222	-0.130			

Table 3.12: *Inconsistencies in growth rates between the three approaches; GDP aggregation by sector.*

Direct or Indirect, TRAMO-SEATS

Date	Direct	Indirect	Weights	AGRI	IND	CONS	RETA	FINAN	PUBL	TAXES
92Q4	0.022	-0.155	0.550	-1.20	-1.55	0.18	0.35	0.69	-0.06	0.27
95Q3	0.001	-0.165	0.433	0.36	-0.96	-1.78	-0.02	0.72	0.29	-0.55
96Q2	0.481	0.414	0.492	1.02	-0.62	5.36	-0.02	0.95	0.59	-0.70
96Q4	-0.095	0.021	0.598	-1.82	-0.14	-1.91	0.02	0.81	0.21	-0.13
97Q1	-0.587	-0.130	0.738	1.59	0.17	-4.68	0.10	-0.29	0.35	0.18

Direct or Indirect, X-12-ARIMA

Date	Direct	Indirect	Weights	AGRI	IND	CONS	RETA	FINAN	PUBL	TAXES
92Q3	-0.040	-0.201	0.622	1.72	-1.69	-1.78	0.01	0.64	0.67	-0.05
92Q4	-0.027	-0.181	0.746	-0.86	-1.88	0.06	0.17	0.50	0.00	1.32
96Q2	0.324	0.338	0.492	1.72	-0.44	4.15	-0.06	0.81	0.57	-1.00
96Q4	-0.085	-0.011	0.598	-1.00	-0.42	-1.85	0.16	0.72	0.21	-0.18

Mixed Approach

Date	Mixed	Weights	AGRI	IND	CONS	RETA	FINAN	PUBL	TAXES
95Q4	0.143	0.428	2.05	-0.35	-0.73	-0.18	0.91	0.57	-0.51

Table 3.13: *Inconsistencies in growth rates between aggregate and components, GDP aggregation by sector.*

	TRAMO-SEATS	X-12-ARIMA
Direct and Indirect	92.31	100.00
Direct and Components	89.74	89.74
Indirect and Components	92.31	89.74
Mixed and Direct	87.18	92.31
Mixed and Indirect	89.74	92.31
Mixed and Components	97.44	

Table 3.14: *Concordance rates (in %); GDP aggregation by sector.*

	TRAMO-SEATS		X-12-ARIMA		Mixed
Indicator	Direct	Indirect	Direct	Indirect	adjustment
M1*	0.229	0.168	0.021	0.064	0.013
M2*	0.700	0.399	0.049	0.195	0.035
M3*	0.000	0.000	0.000	0.000	0.000
M4	0.149	0.596	0.596	0.298	0.745
M5	0.200	0.200	0.200	0.200	0.200
M7*	0.074	0.107	0.558	0.082	0.204
M8	0.064	1.976	0.162	1.495	1.667
M9	0.049	0.395	0.093	0.290	0.266
M10	0.060	1.980	0.132	1.546	1.922
M11	0.055	0.136	0.101	0.132	0.584
Q	0.177	0.445	0.227	0.312	0.399

Table 3.15: *Quality measures.*

	Tramo-Seats		X-12-Arima		Mixed		
	Direct	Indirect	Direct	Indirect	approach	Seats	X-12
R1 (SA)	9301.613	8309.805	8414.494	8202.818	7644.791	I	I
R1 (SA), Last 3 years	8853.081	8671.489	8874.731	8856.221	8933.532	I	I
R2 (SA)	0.217	0.170	0.169	0.160	0.113	I	I
R2 (SA), Last 3 years	0.078	0.062	0.070	0.058	0.104	I	I
R3 (SA)	0.501	0.378	0.132	0.261	0.113	I	D
R3 (SA), Last 3 years	0.086	0.057	0.076	0.075	0.104	I	I
Mar (TC, 1)	6373.711	6420.732	7779.039	6691.505	7038.713	D	I
Mar (TC, 1), Last 3 years	8464.681	8600.983	8595.300	8638.942	8531.254	D	D
Mar (TC, 2)	2175.254	2615.100	6689.741	2597.599	3235.664	D	I
Mar (TC, 2), Last 3 years	2203.222	3431.977	2590.175	2892.075	2448.501	D	D
Mar (S)	0.002	0.015	0.005	0.012	0.049	D	D
Mar (S), Last 3 years	0.001	0.020	0.002	0.015	0.059	D	D

Table 3.16: *Roughness measures; GDP aggregation by sector.*

Indicator	Tramo-Seats		X-12-Arima		Direct vs Indirect	
	Direct	Indirect	Direct	Indirect	Seats	X-12
Mean AR 1 qtr	0.060	0.099	0.123	0.080	D	I
Mean AR 2 qtrs	0.068	0.115	0.128	0.099	D	I
Mean AR 3 qtrs	0.082	0.114	0.147	0.094	D	I
Mean AR 4 qtrs	0.071	0.133	0.148	0.112	D	I
Mean AR 5 qtrs	0.077	0.129	0.179	0.099	D	I
Std AR 1 qtr	0.083	0.058	0.207	0.064	I	I
Std AR 2 qtrs	0.085	0.064	0.214	0.075	I	I
Std AR 3 qtrs	0.085	0.073	0.262	0.072	I	I
Std AR 4 qtrs	0.081	0.066	0.219	0.073	I	I
Std AR 5 qtrs	0.090	0.107	0.262	0.073	D	I
Sliding Spans						
A(%)	0.000	0.000	0.000	0.000	=	=
MM(%)	0.000	0.000	0.000	0.000	=	=

Table 3.17: *Absolute revisions (mean and standard deviation in %) and sliding spans analysis; GDP aggregation by sector.*

Series	Model	pljung	dw	pnorm	ls	tc	ao	trad	east	Season ?
Seats Indirect	(1,0,0)(0,0,1)	0.960	1.873	0.003	0	2	2	N	N	N
X-12 Indirect	(0,0,0)(0,0,1)	0.237	1.975	0.298	0	0	3	N	N	N
Seats Direct	(1,0,0)(0,0,0)	0.702	2.211	0.039	0	1	1	N	N	N
X-12 Direct	(1,0,0)(0,0,1)	0.302	2.348	0.463	0	0	4	N	N	N

Table 3.18: *Analysis of the irregular components; GDP aggregation by sector.*

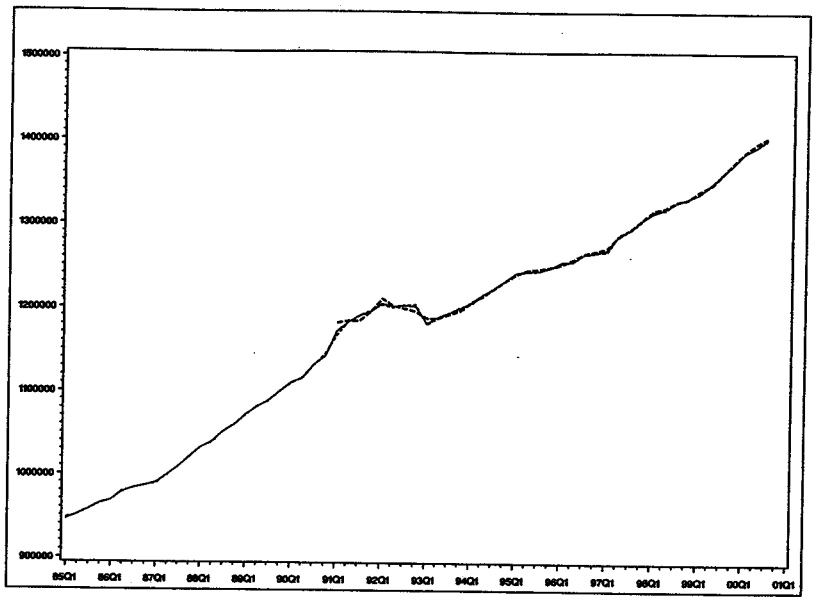

Figure 3.1: *Mixed (thick dashed line) and TRAMO-SEATS direct (thin dashed line) and indirect (solid line) adjustments; GDP geographical aggregation.*

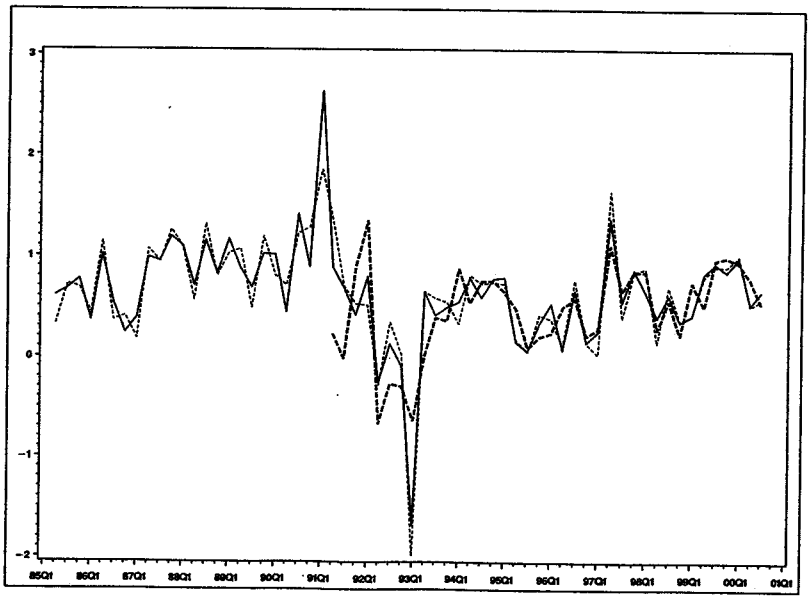

Figure 3.2: *Growth rates of mixed (thick dashed line), TRAMO-SEATS direct (thin dashed line) and indirect (solid line) adjustments; GDP geographical aggregation.*

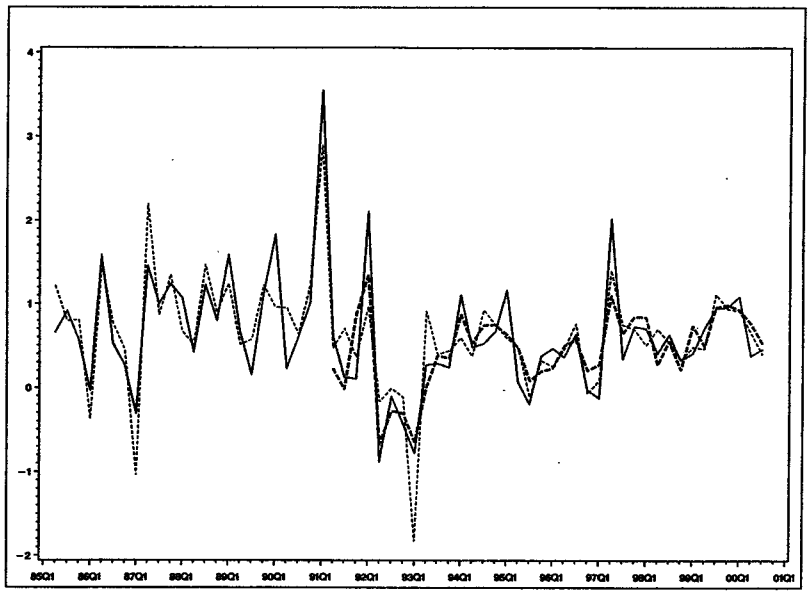

Figure 3.3: *Growth Rates of Mixed (thick dashed line), X-12 RegARIMA direct (thin dashed line) and indirect (solid line) adjustments; GDP geographical aggregation.*

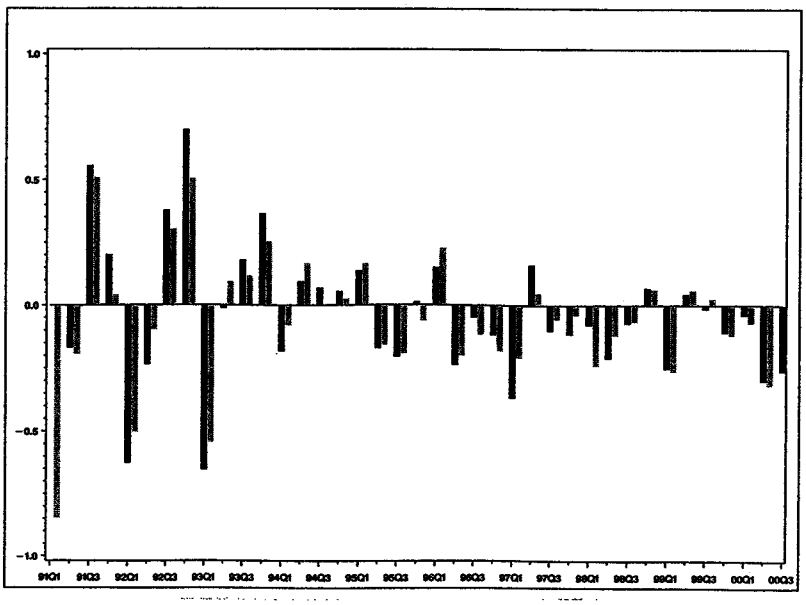

Figure 3.4: *Relative differences of mixed indirect aggregate versus direct (in black) and indirect (in grey) adjustments, GDP geographical aggregation. TRAMO-SEATS.*

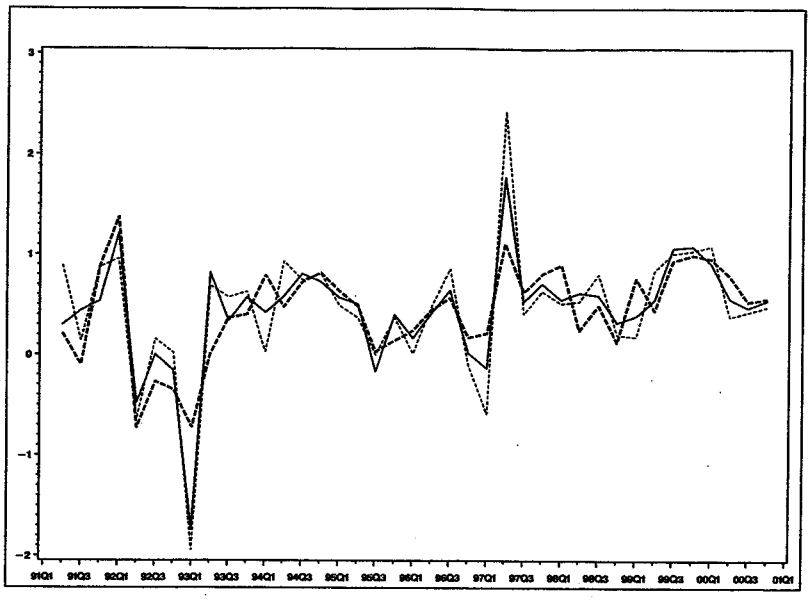

Figure 3.7: *Growth rates of mixed indirect (thick dashed line), TRAMO-SEATS direct (thin dashed line) and indirect (solid line) Adjustments; GDP aggregation by sector.*

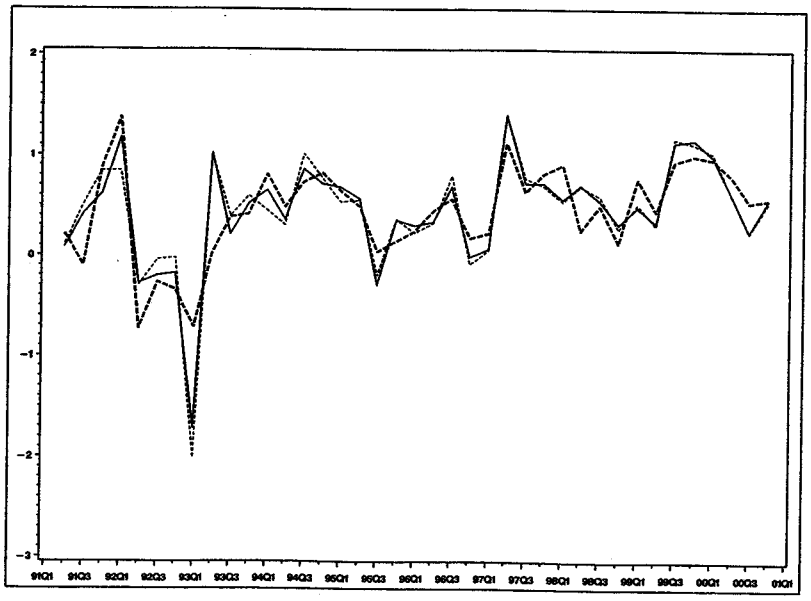

Figure 3.8: *Growth Rates of Mixed (thick dashed line), X-12 RegARIMA direct (thin dashed line) and indirect (solid line) Adjustments; GDP aggregation by sector.*

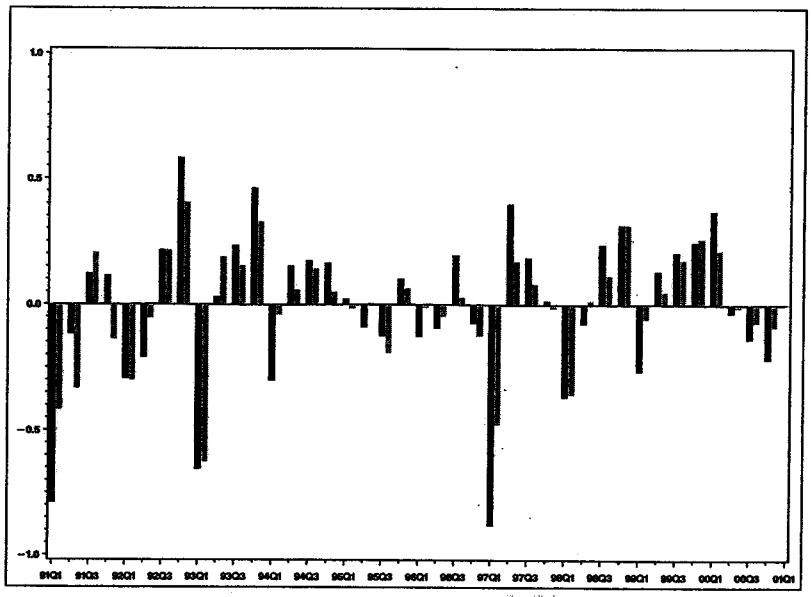

Figure 3.9: *Relative Differences of Mixed Aggregate versus Direct (in black) and Indirect (in grey) Adjustments, GDP aggregation by sector. TRAMO-SEATS.*

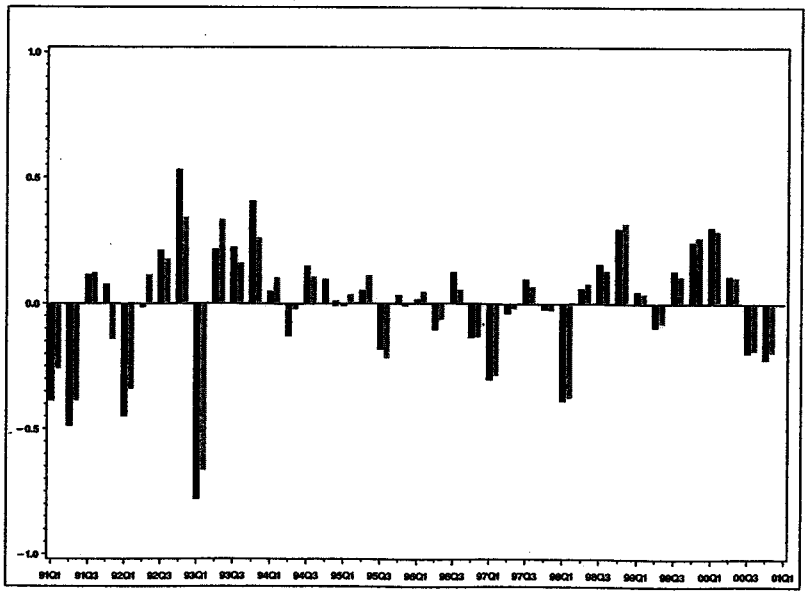

Figure 3.10: *Relative Differences of Mixed Aggregate versus direct (in black) and indirect (in grey) adjustments, GDP aggregation by sector. X-12 RegARIMA.*

ANNEX 4. *Direct vs. indirect methods: seasonally adjusted series for the euro area*

Parameters used for seasonal and working day adjustment:

- ***TRAMO-SEATS***

  - *ARIMA Model*

    A log-transformation is forced (LAM=0)

    Automatic identification and estimation of an ARIMA model with mean-correction (IMEAN=1). In order to do this, the program searches for regular polynomials up to order 3, and for seasonal polynomials up to order 1 (INIC=3). Moreover, it searches first for regular differences up to order 2 and for seasonal differences up to order 1. Then, it continues with the identification of an ARMA model for the differenced series (IDIF=3).

    The estimation is done using exact maximum likelihood method (INCON=0).

  - *Outliers*

    The automatic detection and correction of outliers concerns additive outliers, transitory changes Level shifts and innovations outliers are not taken into account (IATIP=1 and AIO=1).

    The critical value for outlier detection is 4.2 (VA=4.2).

    The outlier estimation method is the fast method of Hannan-Rissanen (IMVX=0).

  - *Regression*

    The program pre-tests for Easter effect (IEAST=-1).

    The duration of Easter-affecting period is 6 days (IDUR=6).

    No pretest is made concerning the correction for trading-day effects. Then, 7 regressors (#Mo-#Su, #Tu-#Su,…, #Sa-#Su) or 2 regressors(#(Mo,Tu,We,Th,Fr)-#(Sa,Su)*5/2 and a length-of-month correction are used and forced (ITRAD=7 or ITRAD=2). The length-of-month correction is: #(total days in month)-365.25/12.

- ***X-12 RegARIMA***

  - *ARIMA Model*

    A log-transformation is forced.

    Automatic selection and estimation of an ARIMA model with mean correction.

    The estimation is done using exact maximum likelihood method.

  - *Outliers*

    The automatic detection and correction of outliers concerns additive outliers and transitory changes.

    The critical value for outlier detection is 4.2.

    The outlier estimation method consists in adding outliers one by one. That means that when an outlier is detected, the appropriate regression variable is added to the model. The program then estimates the new model (the old model with the detected outlier added) and looks for an additional outlier. This process is repeated until no additional outliers are found.

  - *Regression*

    The program pre-tests for Easter effect (IEAST=-1).

    The duration of Easter affecting period is 6 days (IDUR=6).

    No pretest is made concerning trading-day effects.

  - *X11 Decomposition*

    The seasonal and trend filters are automatically chosen by the program.

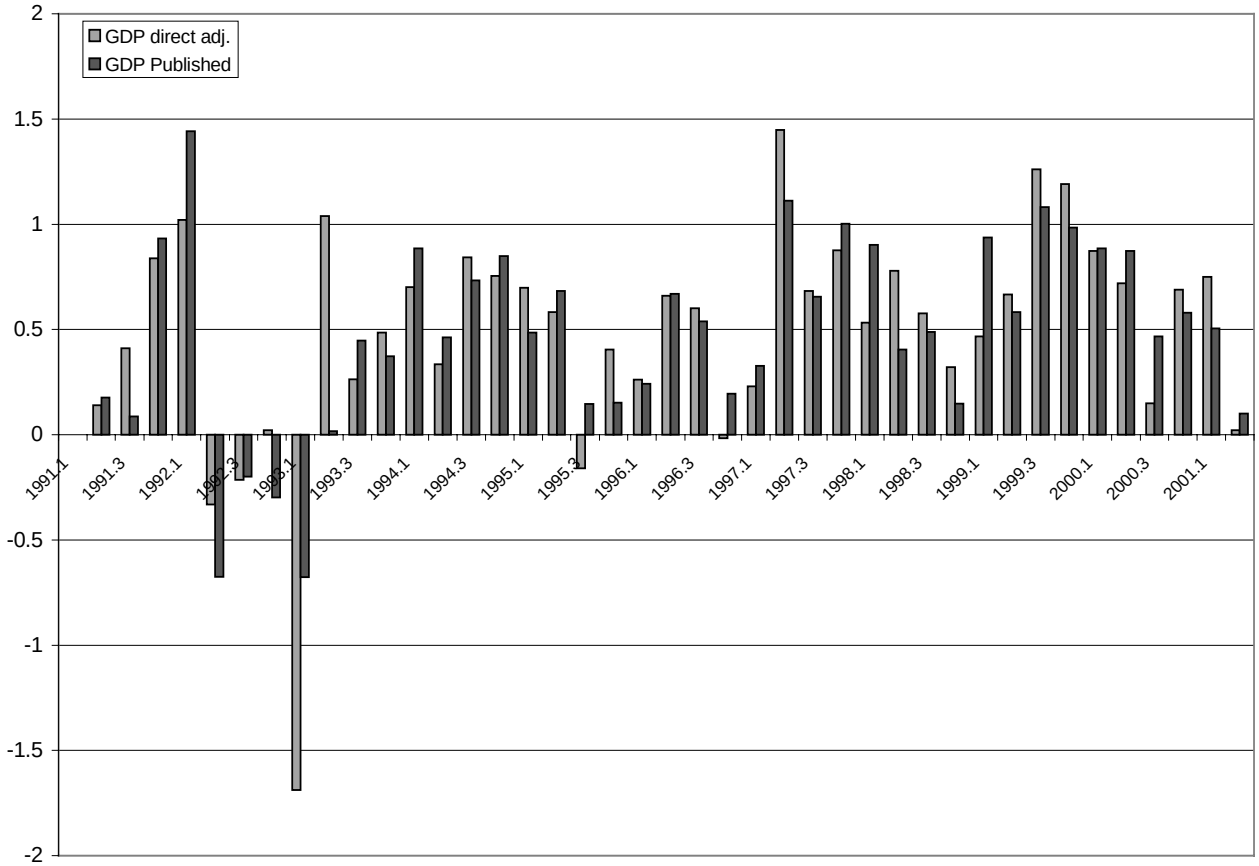

Figure 4.1.a.: *Real GDP quarter to quarter changes (published data vs direct adjustment -- X12)*

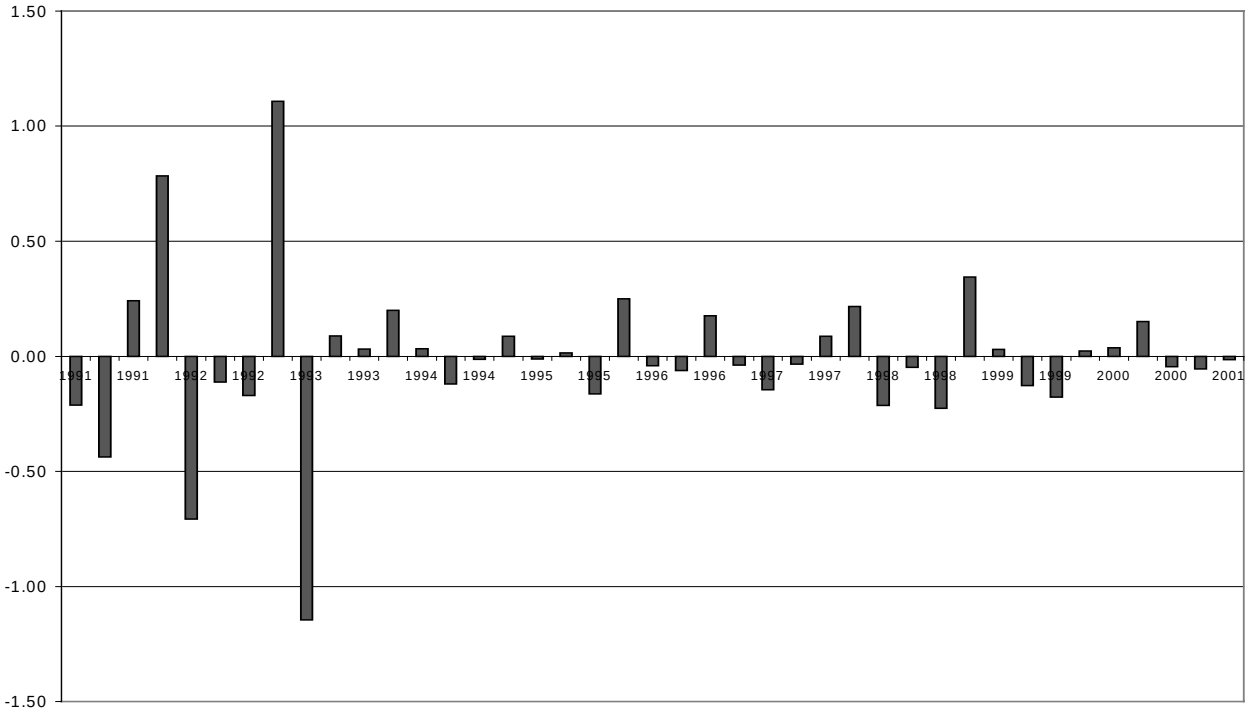

Figure 4.1.b.:*Differences in quarter to quarter changes in real GDP between published data and direct.*

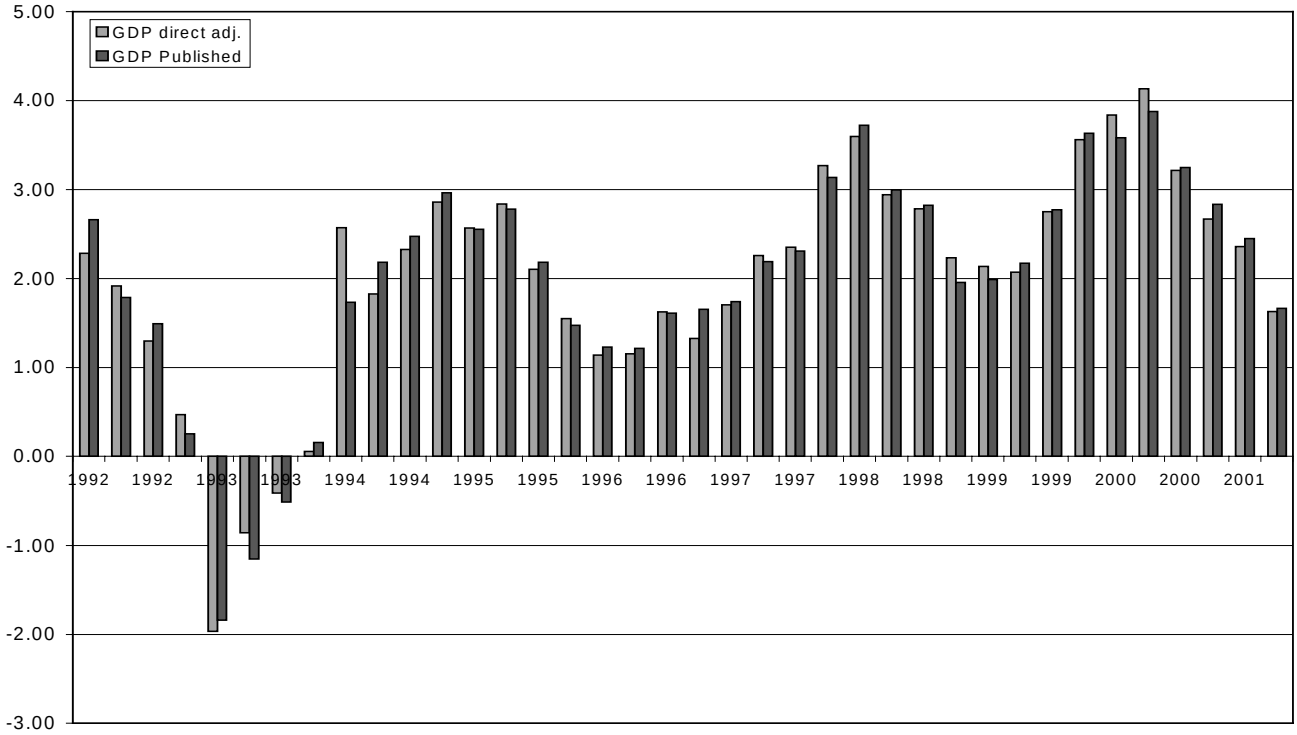

Figure 4.1.c.: *Real GDP annual percentage changes (published data vs. direct adjustment -- X12)*

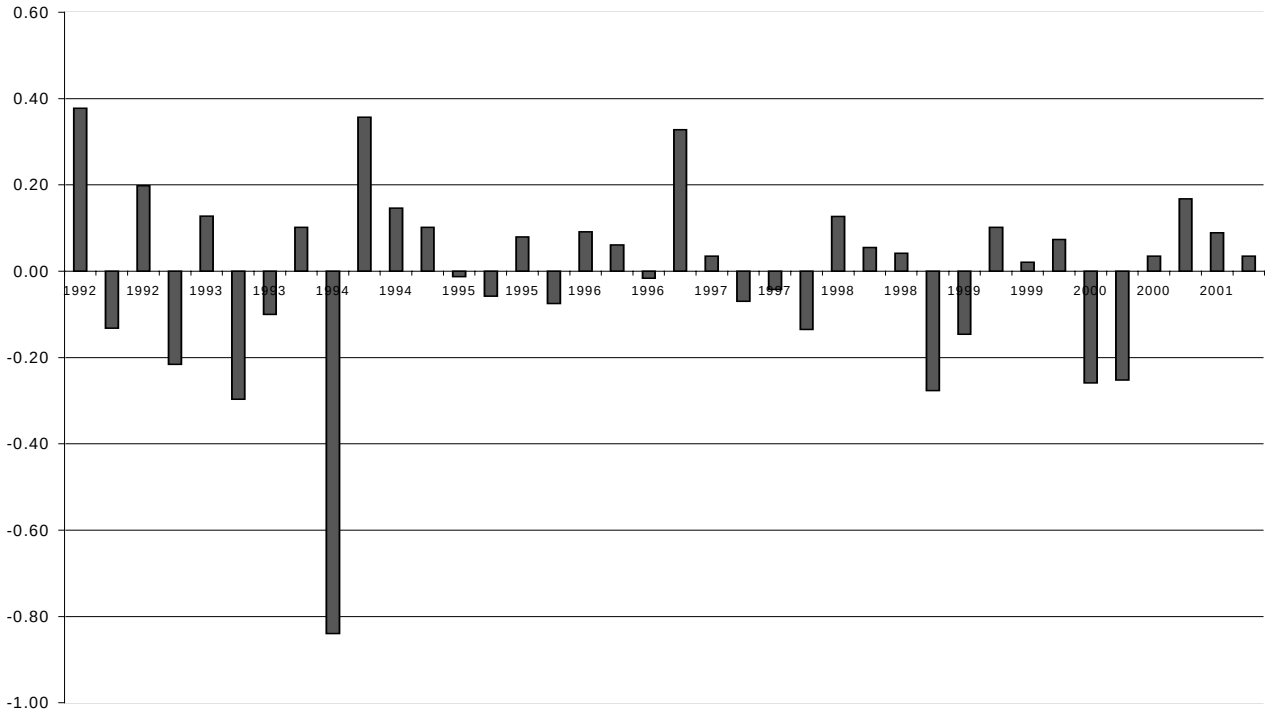

Figure 4.1.d.: *Differences in annual percentage changes of real GDP between published and direct adj.*

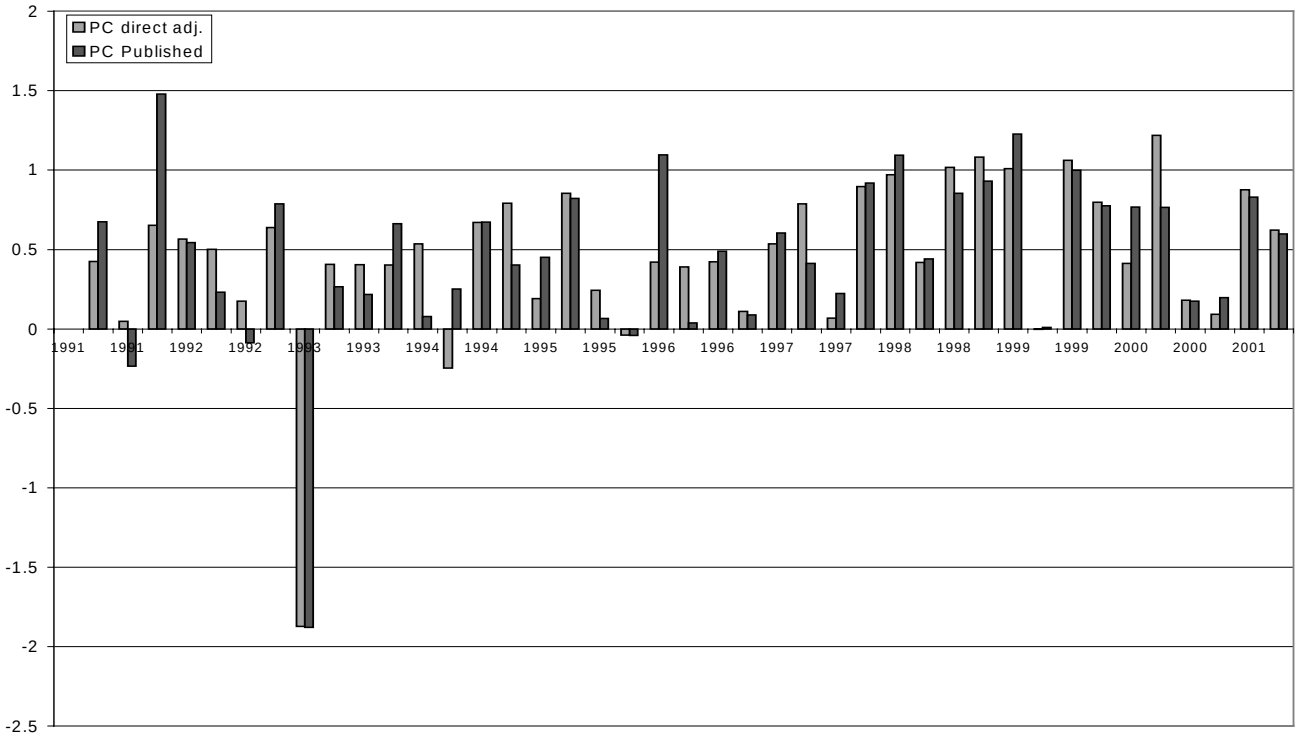

Figure 4.2.a.: *Private Consumption quarter to quarter changes (published data vs. direct adjustment).*

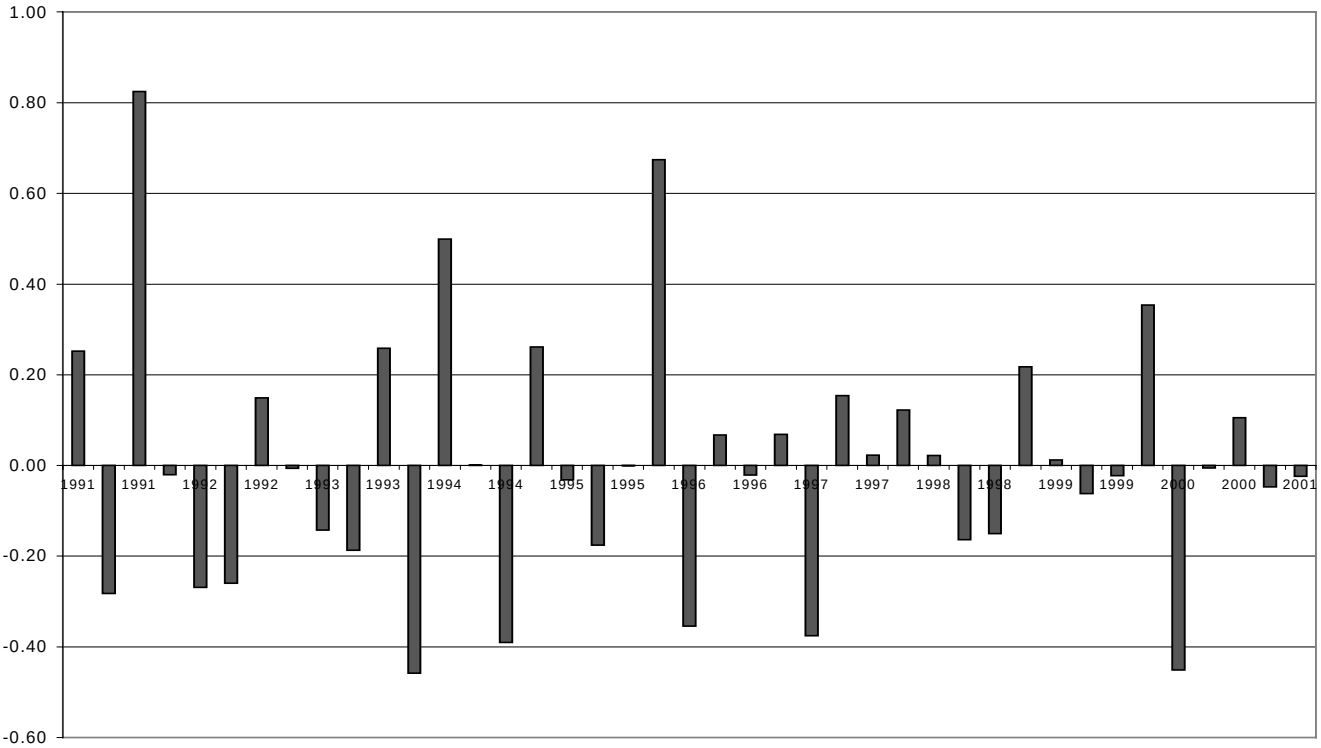

Figure 4.2.b.: *Differences in quarter to quarter changes in Private Consumption.*

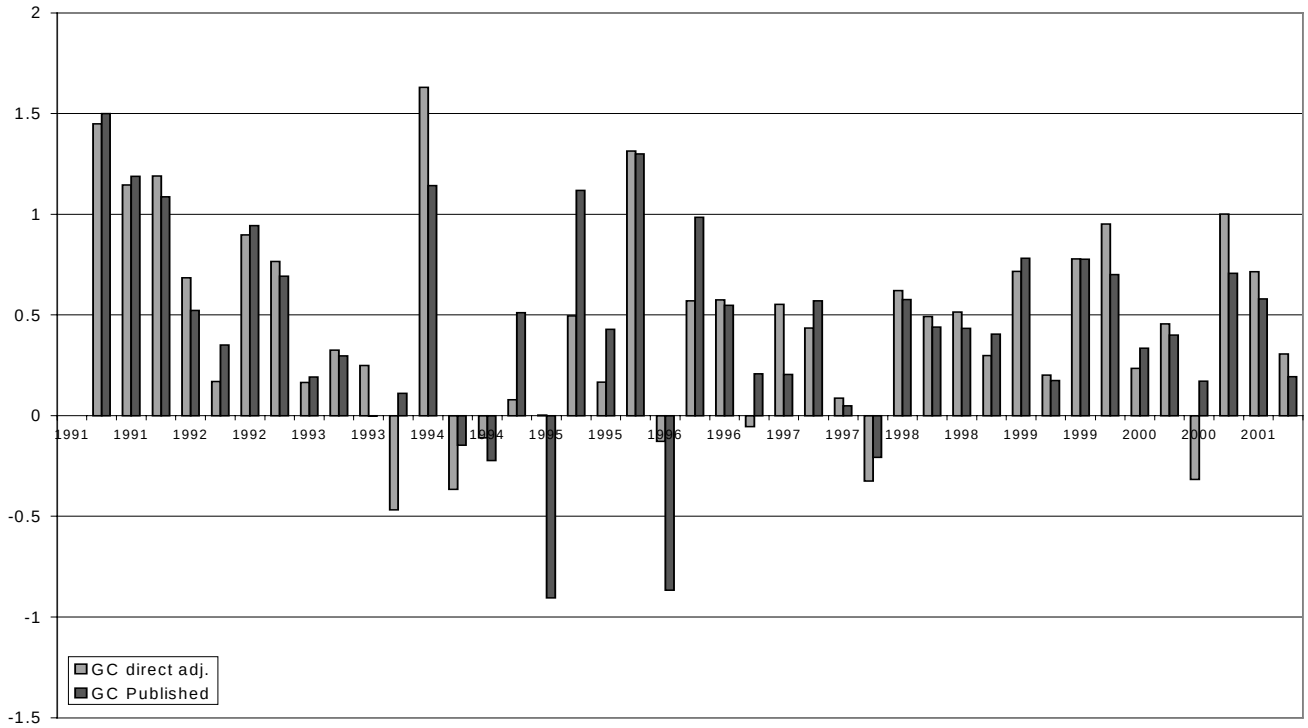

Figure 4.3.a.: *Government Consumption quarter to quarter changes.*

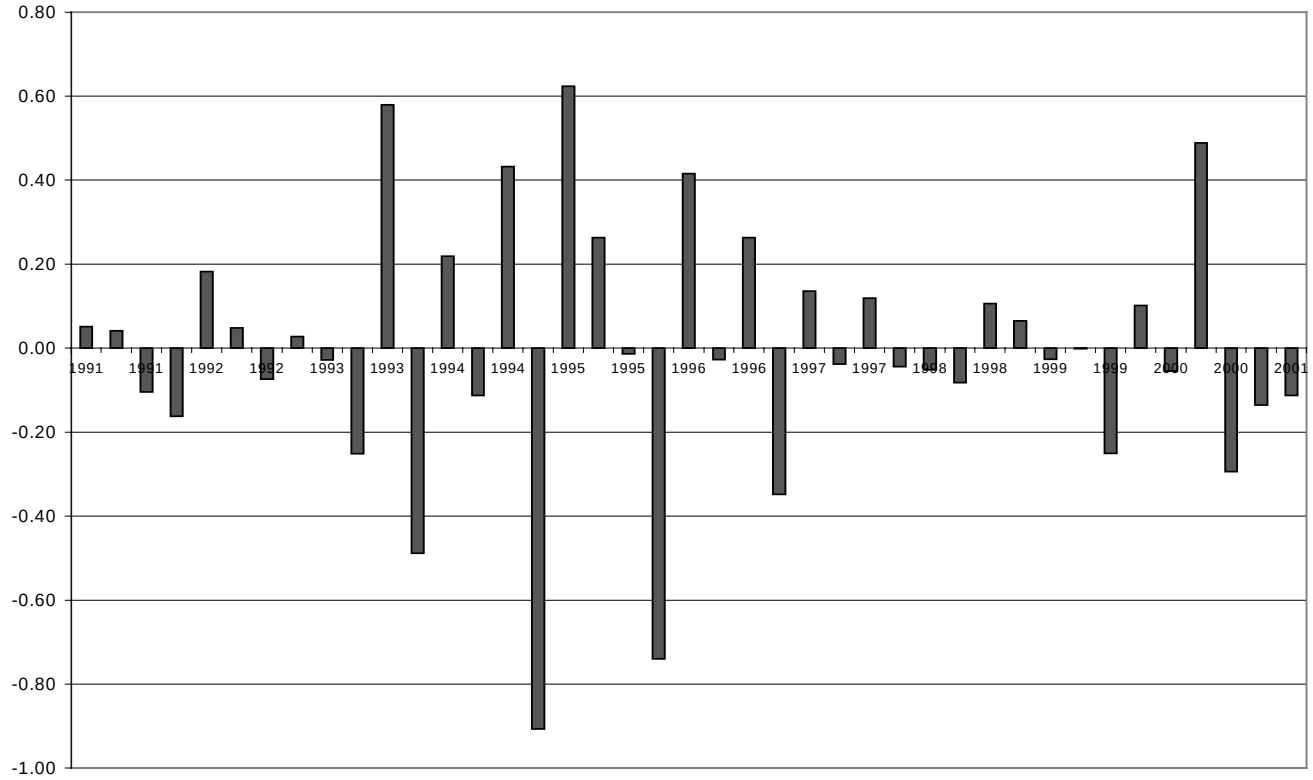

Figure 4.3.b.: *Differences in quarter to quarter changes in Government Consumption.*

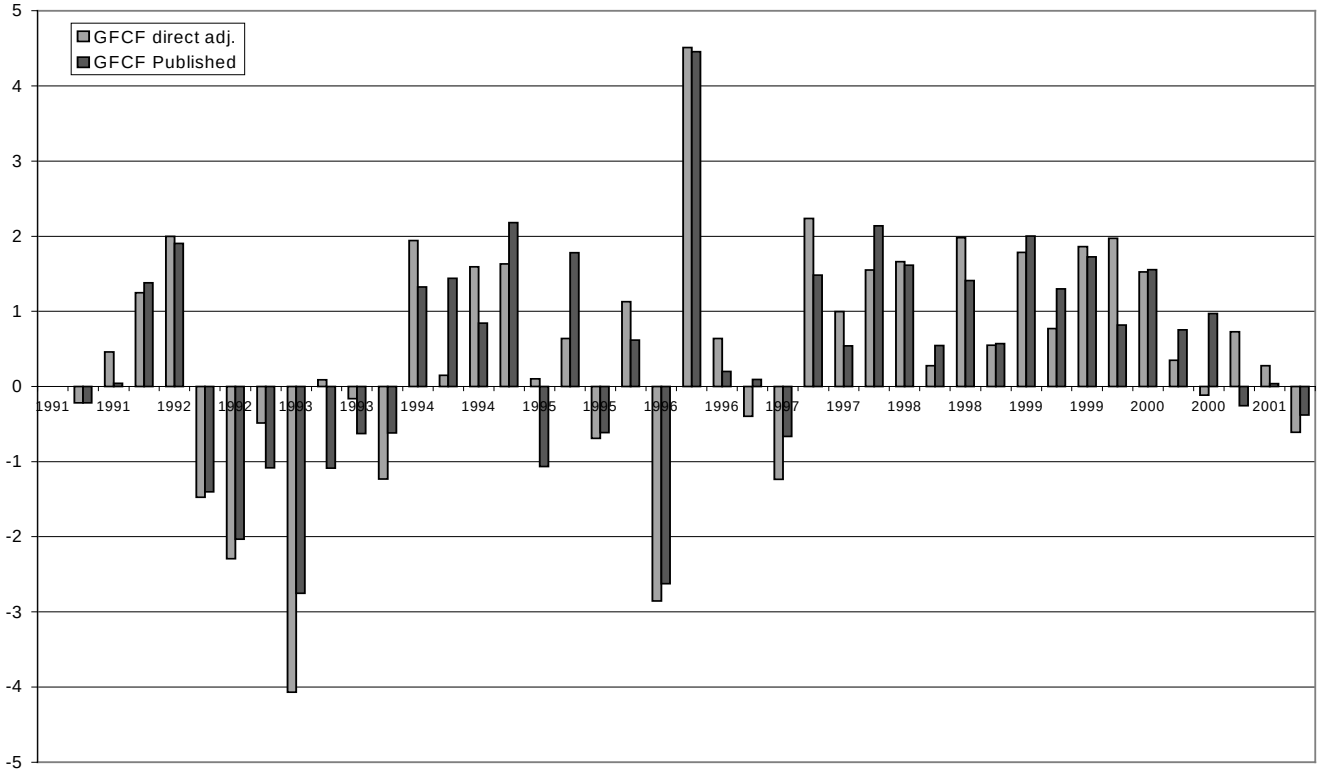

Figure 4.4.a.: *GFCF quarter to quarter changes.*

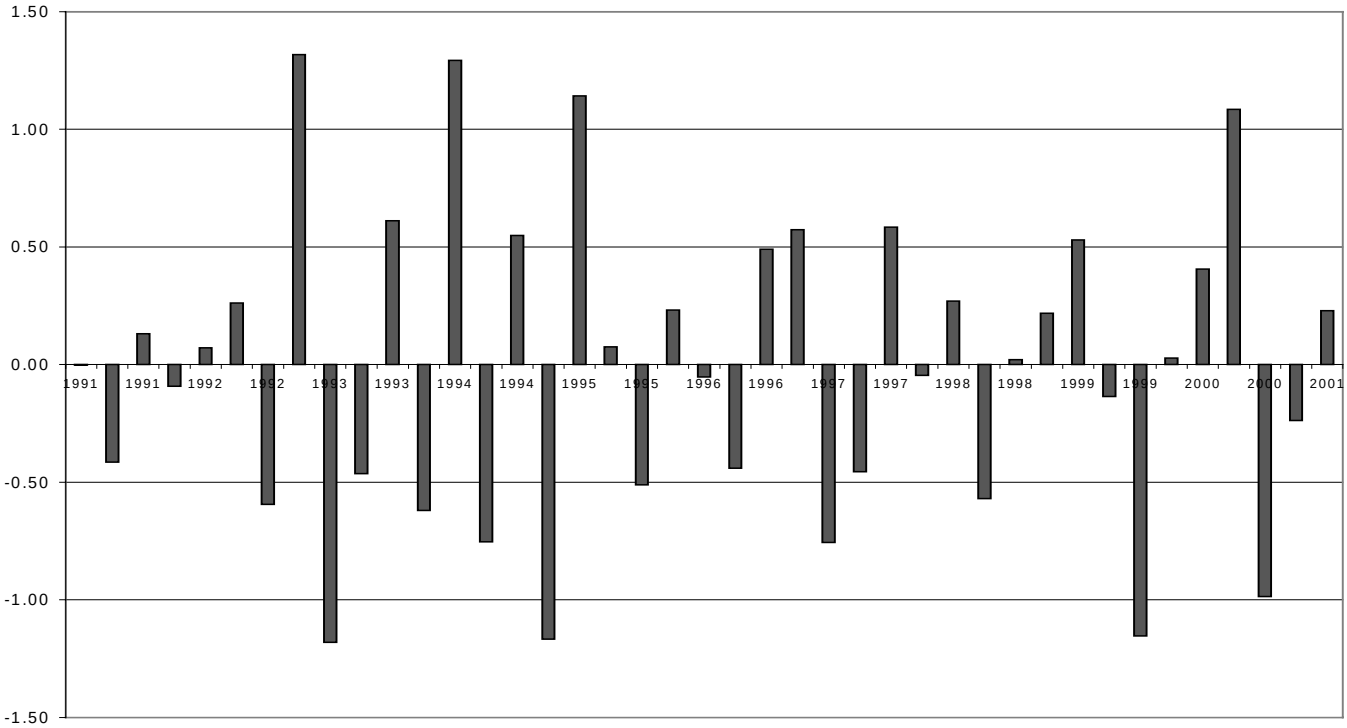

Figure 4.4.b.: *Differences in quarter to quarter changes in GFCF.*

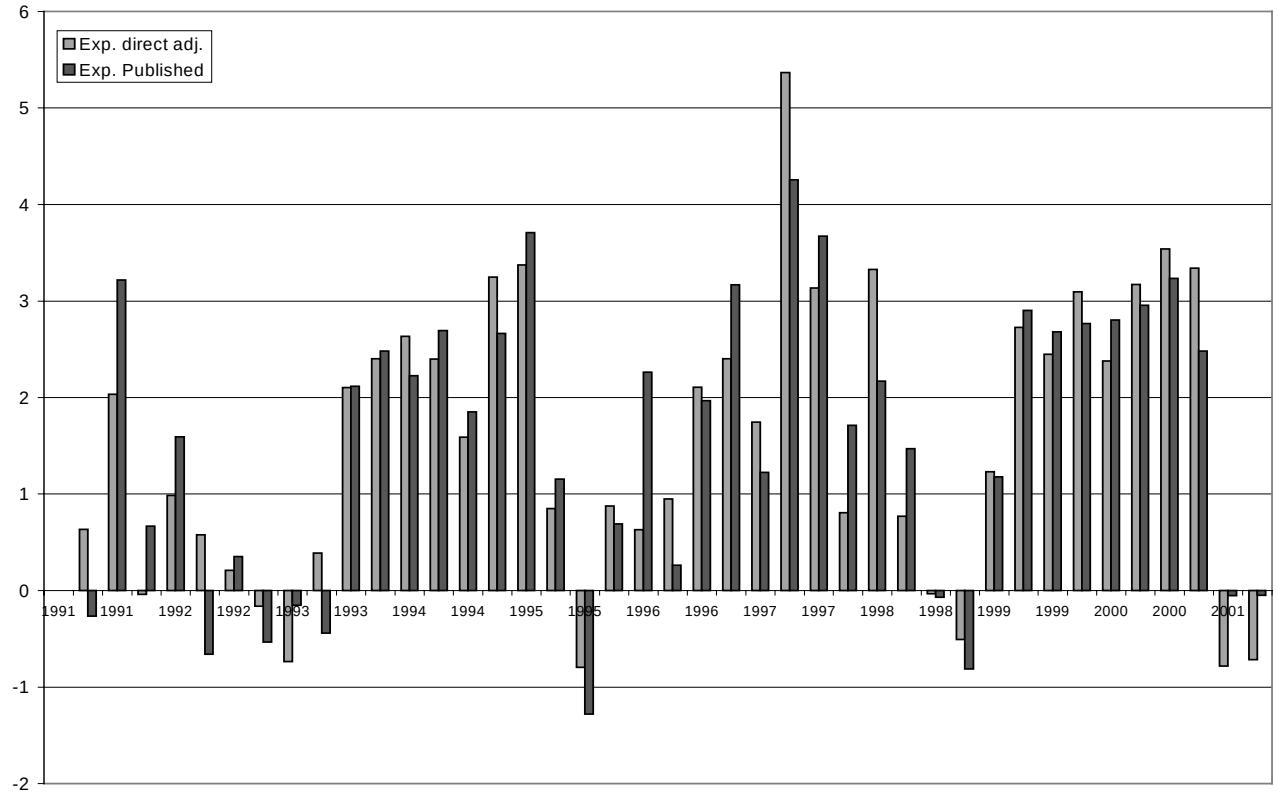

Figure 4.5.a.: *Exports quarter to quarter changes.*

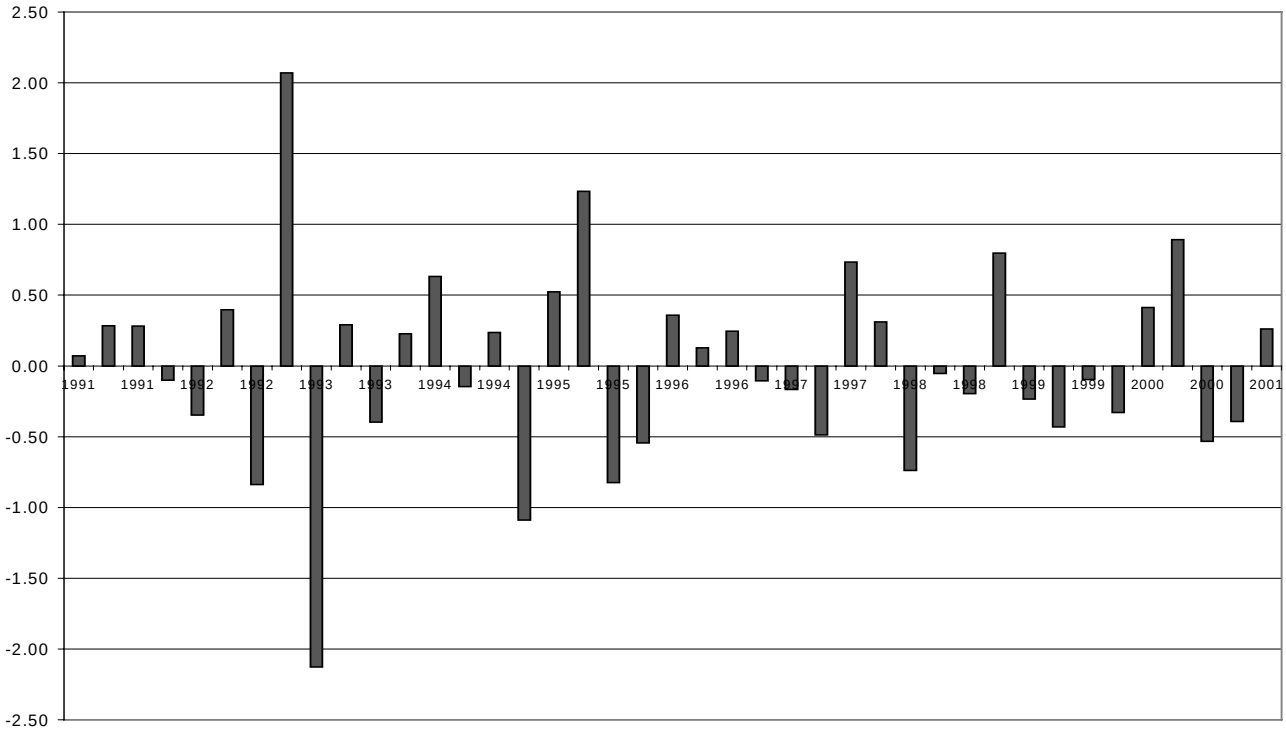

Figure 4.5.b.: *Differences in quarter to quarter changes in Exports.*

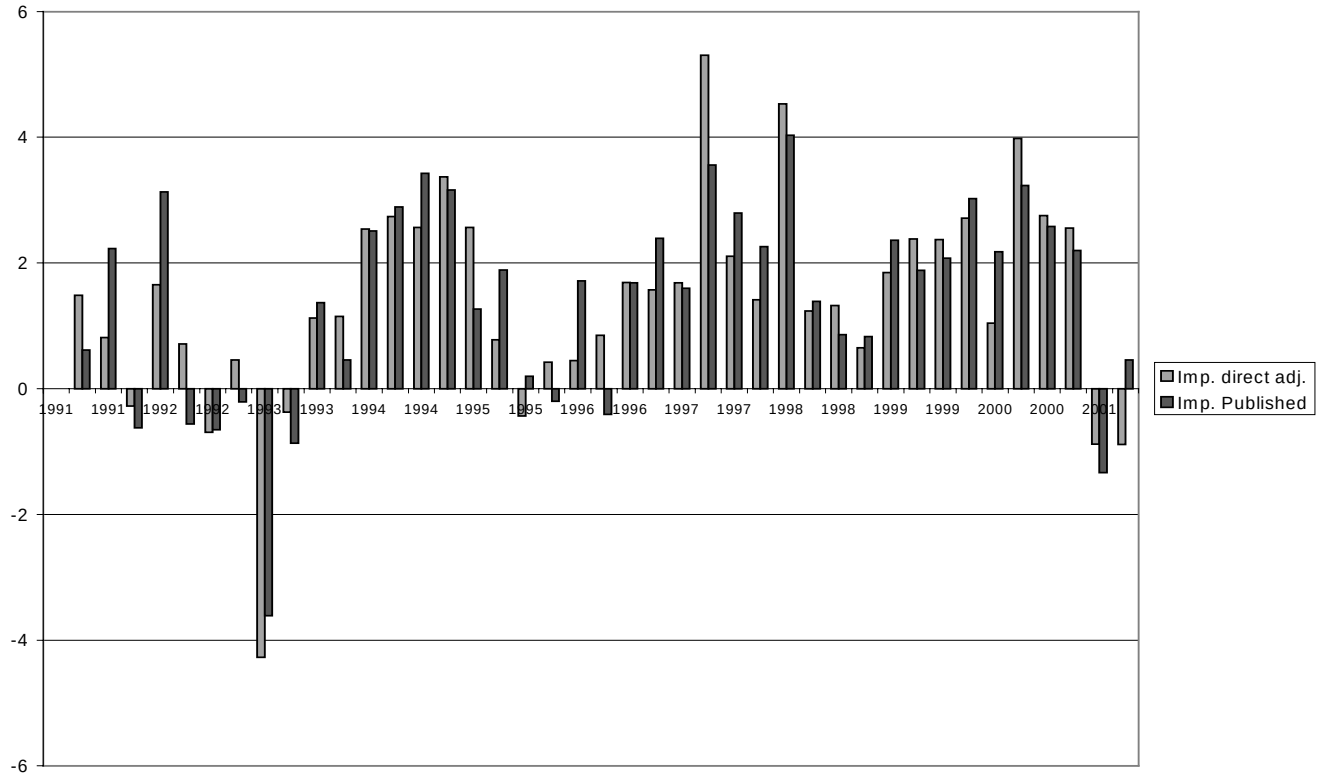

Figure 4.6.a.: *Imports quarter to quarter changes.*

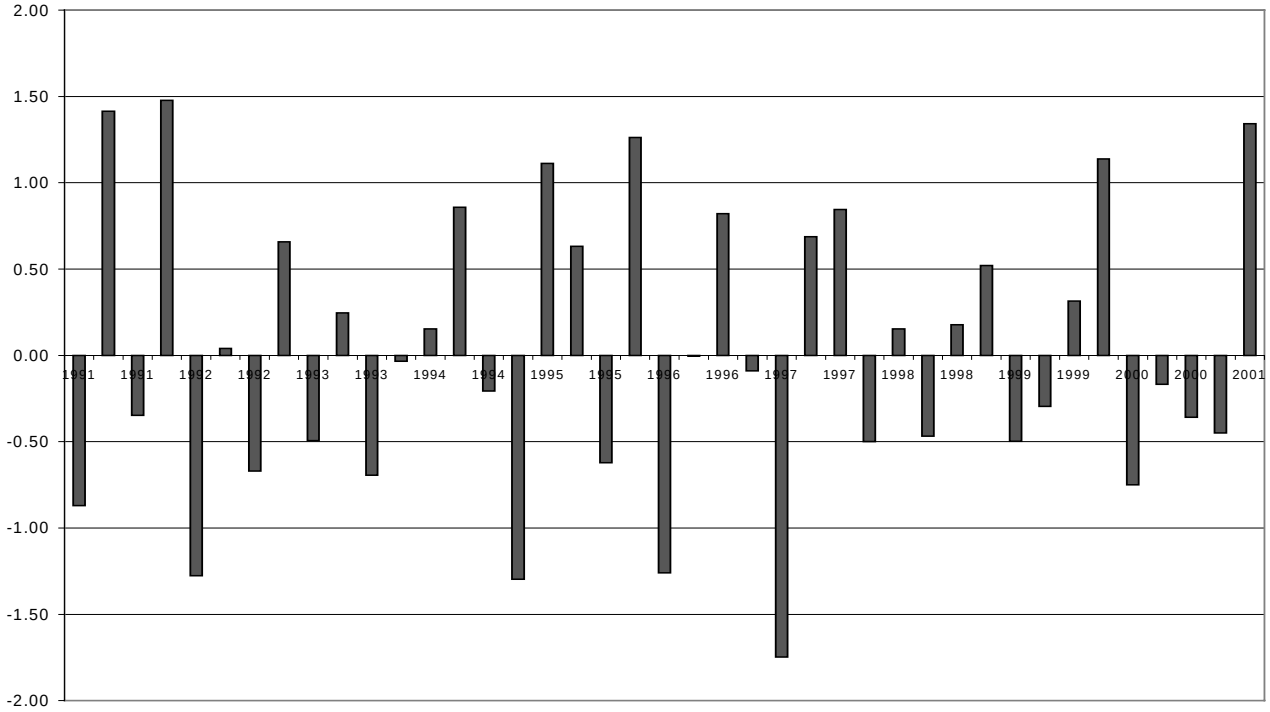

Figure 4.6.b.: *Differences in quarter to quarter changes in Imports.*

ANNEX 5. *Template for the documentation on adjustment practices*

METADATA TEMPLATE **SEASONAL ADJUSTMENT QUARTERLY NATIONAL ACCOUNTS**	
Country	
Contact Person	*name / institution /* *phone / e-mail / fax*
GENERAL INFORMATION	
Published series	*unadjusted: yes / no* *trading day adjusted: yes / no* *seasonally adjusted: yes / no* *trading day and seasonally adjusted: yes / no* *trend: yes / no*
Software used	*e.g. Census X-12-ARIMA or TRAMO/SEATS*
Publication	*title of hardcopy /* *on-line access source*
TRADING DAY ADJUSTMENT	
Trading day adjustment (incl. Easter effect)	*name series or groups of series*
No trading day adjustment	*name series or groups of series*
Calendar used for trading day adjustment	*country-specific (national holidays) / standard;* *series-specific / uniform*
OTHER PRE-ADJUSTMENT	
Additional pre-adjustment *)	*leap year / special effects*
Detection and replacement of outliers **)	*Kind of outliers*
Published adjusted series are adjusted for effects other than seasonal and calendar	*yes (which) / no*
SEASONAL ADJUSTMENT	
Aggregation of adjusted GDP	*direct adjustment of GDP / indirect adjustment via components* *comments:*
GDP Accounting identities	*yes (Output / Expenditure / Income side) / no*
Time consistency quarterly / annual	*yes (exists between which series) / no*
REVISION POLICY	
Model revision	*(concurrent / fixed intervals)*
Parameter / factor revision	*(concurrent / fixed intervals)*
Revision of adjusted published series	*(complete series / limited time range)*

*) Eliminated in the trading day adjusted and trading day and seasonally adjusted series.

**) In order to improve the seasonal and trading day effect estimate, not filtered out in the seasonally and/or trading day adjusted series.

ANNEX 6. *The members of the Task Force*

Gian Luigi Mazzi	*European Commission/Eurostat*	*Chairman*
Henning Ahnert	*European Central Bank*	*Chairman*
Roberto Barcellan	*European Commission/Eurostat*	*Secretary*
Stefano Nardelli	*European Central Bank*	*Secretary*

Yves De Lombaerde	*Banque Nationale de Belgique/ Belgische Nationalbank (Belgium)*
Robert Kirchner	*Deutsche Bundesbank (Germany)*
Enrique Martin Quilis	*INE (Spain)*
Corinne Prost	*INSEE (France)*
Giovanni Savio	*ISTAT (Italy)*
George Van Leeuwen	*CBS (The Netherlands)*
Simon Compton	*ONS (United Kingdom)*
Erikos Velissaratos	*European Central Bank*