This module is part of the

Memobust Handbook

on Methodology of Modern Business Statistics

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Theme: Issues on Seasonal Adjustment

Contents

General section

1. Summary

Seasonal adjustment, which is a routine activity in statistical offices nowadays, and the connected mathematical background have been a subject of theoretical investigations for several decades. However, methods and tools of seasonal adjustment are still under development and perpetual debates focus on them. Furthermore, there is significant flexibility regarding applied adjustment settings and model selection, which may lead to subjective and ambiguous results. As the number of the series to be adjusted is rapidly increasing and the quality of official seasonally adjusteddata is increasingly important, the need of recommendations and guidelines is indisputable. ESS Guidelines on Seasonal Adjustment (2009) can be regarded as benchmark working material in this topic.

The goal of this module is to discuss important issues on seasonal adjustment, providing a guide on how to deal with them describing practices and giving some references to achieve further information. One of the most essential issue is providing temporal and cross-sectional consistency of time series. Although forcing consistency may hold disadvantages, it may be required to fulfil accounting constraints (as in the quarterly national accounts). Owing to statistical investigations and the available significant computer resources, nowadays, this task is much less demanding than it was a few years ago.

The module also focuses on the choice between indirect or direct approach to seasonally adjust time series derived as aggregation of other component time series. Choosing between these approaches is not obvious, comprehensive analyses have been performed in order to eliminate uncertainty. Practices and guidelines are described in the related subsection. Revision is also a crucial element of the seasonal adjustment: the updating of unadjusted data and the use of bilater filters lead to revise the seasonally adjusted data previously released undermining the credibility of the producer agencies.

The financial crisis seriously undermined the reliability of the results of seasonal adjustment. The seasonal pattern and the behaviour of time series may change significantly. Therefore, it is necessary to take the impacts of the crisis into consideration. Although, this aim is available through outliers and ramp effect, monitoring time series is also essential part of treatment.

Seasonal adjustment and the comparison with raw data are often subject of confusion among users. Consequently, the details of publication and communication policy is essential to prevent misunderstanding.

2. General description

2.1 Consistency issues

2.1.1 General introduction

Most of time series belong to a system of series classified by attributes. For example, labour force series are classified by province, age, sex, part-time and full-time employment; short-term statistics on industry (production, turnover, etc.) are aggregated according to the classification of economic activities. Therefore, economic statistics are often linked by a system of relationships (for example accounting), thus constraints should be satisfied (for instance, GDP as balance of the uses and resources account). Due to the different sample surveys, the ways of collecting data or the measuring equipment, it is challenging to ensure the consistency between the constraints and the observed variables. However, the discrepancies are usually the basis of confusion among users and criticism, according to Quenneville and Rancourt (2005). The adjustment of a set of data in order to satisfy a number of restrictions and remove any discrepancy is generally known as *reconciliation.* This method is entitled *balancing* in the aspect of national accounts (Di Fonzo and Marini, 2009; Dagum and Cholette, 2006). The statistical institutions are required to face this problem because they are often obliged to publish consistent sets of time series to fulfil legal regulations or common practices on statistics set by international institutions (UN, IMF, etc.).

The related restrictions can be of two types:

- *temporal* constraints: these require the consistency between the low-frequency aggregates and the high-frequency adjusted series.
- *contemporaneous(cross-sectional)* constraints, which assume the form of linear combinations of the variables which should be fulfilled in every observed period. In other words, this constraint requires that the values of the component elementary series add up to the marginal totals for each period of time (Dagum and Cholette, 2006). For example, if the system is classified by M industries (or sectors) and W provinces, the system must satisfy M sets of industrial cross-sectional constraints over the industries in each province.

The elimination of discrepancies between and within variables are handled by methods based on similar principles. The process of adjustment in time dimension is called *benchmarking* (or temporal disaggregation), while the former type of reconciliation is known as the balancing problem (Di Fonzo and Marini, 2009). These methods and the background are discussed in the following subsections.

2.1.2 Time consistency, benchmarking, and related techniques

Problem description

It is essential to provide the consistency of, for instance, sub-annual and annual industrial time series, or quarterly national accounts and the annual accounts in order to present clear view about the economy. This is entitled *time consistency*. The absence of it may confuse users.

Collecting large volume of comprehensive data with high accuracy is really expensive. As a result of this fact, annual or ten-yearly enterprise census provides them. These data are referred to benchmark and may be the basis of annual data. More frequent data, such as quarterly national accounts, also play important role in the economical and statistical system. However, they are less accurate compared with the comprehensive data as a result of the different sources of quarterly and annual data, sampling error, etc.

In general, *benchmarking* refers to techniques used to ensure coherence between time series data of the same target variable measured at different frequencies, for example, sub-annually and annually (Publications of Statistics Canada, 2009). The benchmarking problem arises because the annual sums of the sub-annual series are not equal to the corresponding annual values (due to the factors described above). In other words, there are annual discrepancies (d_m) between the annual benchmarks and the sub-annual values (Dagum and Cholette, 2006):

$$d_m = a_m - \sum_{t=t_{1m}}^{t_{Lm}} j_{mt} s_t\,,\ \ m=1,\dots,M$$

where t_{1m} and t_{Lm} are respectively first and last, sub-annual periods, t covered by the m-th benchmark, e.g., quarters 1 to 4, 5 to 8, and the j_{mt}s are the coverage fractions here assumed to be equal to 1, a_m, $m=1,\dots, M$ refers to the annual series and the sub-annual series are denoted by s_t, $t=1,2,\dots,T$. {1,2,…,T} refers to a set of contiguous months, quarters, days, etc., and {1,2,…,M} refers to a set of not necessarily contiguous periods, e.g., there may not be a benchmark every "year" (as it is described above). In some cases, benchmarks are available every second year, or even irregularly.

It is also important to note that the discrepancies are often expressed in terms of proportional discrepancies:

$$d_m = \frac{a_m}{\left(\sum_{t=t_{1m}}^{t_{Lm}} j_{mt} s_t\right)},\ m=1,\dots,M$$

Benchmarking also plays role in case of seasonal adjustment. In fact, seasonally adjusting monthly or quarterly time series causes discrepancies between the yearly sum of the unadjusted data series and the corresponding yearly sums of the seasonally adjusted series (Dagum and Cholette, 2006). There are several disadvantages of constrained equality in the annual sum, such as bias in the seasonally adjusted data or the non-optimality of the final seasonally adjusted data, see ESS Guideline (2009). As a consequence the application of any constraint should be avoided.

When users insist on temporal consistency or accounting constraints have to be fulfilled, seasonally adjusted series are then benchmarked to the yearly sums of the unadjusted series or to the yearly sum of the calendar-adjusted series, if significant calendar effects are present.

2.1.3 Methods to achieve time consistency: benchmarking methods

The method of benchmarking operates with the sum of modified sub-annual series in order to be equal to the corresponding benchmark. The formulation is the following:

$$a_m - \sum_{t=t_{1m}}^{t_{Lm}} j_{mt} \widehat{\theta}_t = 0,\ m=1,\dots,M$$

where $\widehat{\theta}_t$ is the benchmarked series. Several benchmarking methods are available. The simplest ones are the *prorating* and the *Denton method*, which are widely known.

<u>Prorating method (Dagum and Cholette, 2006)</u>

<u>Prorating</u> consists of multiplying the sub-annual values by the corresponding annual proportional discrepancies. If the benchmark is not available, the closest proportional discrepancies are used. As a consequence, the proportional corrections are $\widehat{\theta}_t / s_t$. The prorating method preserves the proportional movement within each year: $\widehat{\theta}_t / s_t - \widehat{\theta_{t-1}} / s_{t-1} = 0$. However, large discontinuities can emerge between the last quarter of a year and the first quarter of the following year, if the discrepancies are not uniform from year to year. For further details, see the module "Micro-Fusion – Prorating".

Example

It is worth considering a simple example (Quenneville and Rancourt, 2005). Suppose there are three observations y_0,y_1,y_2 such that y_1 and y_2 must add up to y_0. One way of reconciling the observed values of y_1 and y_2 with y_0 is prorating where the value of y_1 is set equal to $b_1=\frac{y_1 y_0}{(y_1+y_2)}$, the corrected value of y_2 is set equal to $b_2=\frac{y_2 y_0}{(y_1+y_2)}$, and so $b_1+b_2=y_0$.

Denton method

This is a quadratic programming method. The aim of this method is to make the quarterly data coherent with annual totals, while preserving all quarter-to-quarter changes as much as possible. According to the general solution (Denton, 1971), the adjusted values should be equal to the original values plus linear combinations of the discrepancies between the two sets of annual data.In the module “Macro-Integration – Denton’s Method”, a general overview about this method with examples is available.

There are related methods such as nonbinding benchmarking (these are not benchmarks in a strict sense, but simply low frequency measurements of the target variable) or interpolation, which are based on similar principles. These are also well-discussed in Dagum and Cholette (2006).

2.1.4 Indirect vs. direct adjustment

In practice, we usually examine the joint impact of more time series rather than a single given one. If a time series can be constructed as the sum of several time series it is called an aggregate series. An aggregate time series can be seasonally adjusted in two natural alternative ways:

- *Direct approach*: we produce the aggregated time series then we adjust it seasonally.
- *Indirect approach:* we apply the seasonal adjustment for components of time series (with the same method and software) then we sum the adjusted time series.

Apart from the methods above, there are further possibilities:

- *Spurious indirect approach:* This approach is applied only when it is unavoidable to calculate the aggregate series based on adjusted components which are generated in different ways (different approaches and software).*Example*: the described method realises when each European or Euro-zone state seasonally adjusts its series with its own method and strategy, and the European seasonally adjusted series is then derived as the aggregation of the adjusted national series (Astolfi, Ladiray, and Mazzi, 2001).
- *Mixed approach:* The methods described are not the only possible ones. A mixed approach is available. In this case, the method is based on subsets of the basic series, which are aggregated in one new component, this component and the remaining sub-series can then be adjusted and the adjusted aggregate derived by implication (Astolfi, Ladiray, and Mazzi, 2001).
- *Multivariate seasonal adjustment*. The multivariateseasonal adjustment consists of adjusting the series simultaneously,taking their covariance structure into account. Detailed mathematical background can be found in Birrell, Steel and Lin (2010).

Direct and indirect strategies could produce quite different results. While the aggregate is a linear combination of the components and the seasonal adjustment is a non-linear process, direct and indirect approaches *do not generally coincide*, except under special conditions (for instance, when the decomposition model is purely additive, or there are no outliers in the series).

Possible methods of the choice

In lack of general decision-making process concerning the between the methods, there are proposals. Examine the characteristics of the seasonal pattern in the component time series. If they show similar pattern then the direct approach is suggested. In spite of this, if the seasonal patterns of the different components show significant differences then one can suggest to use the indirect approach. However, the presence of residual seasonality is always to be checked in all of indirectly seasonally adjusted aggregates since the inadequately adjusted components can result in presence of residual seasonality.

Another way of model choice can be the following. It is possible to analyse the quality figures of the indirect and direct seasonally adjusted estimates (Astolfi, Ladiray and Mazzi, 2001). In this case one can examine, among other things, the smoothness of the components, revision rates, and analyses of the residuals.

The third way is to satisfy the user's requirements. On the one hand, users are interested in getting consistent and coherent outputs and therefore the indirect approach seems to be a good choice to avoid inconsistencies in data. On the other hand, the direct approach is favoured for transparency and accuracy.

Practice at statistical agencies

The choice between these methods is crucial, and has been the subject of articles and discussions for years. Theoretically, there are no guidelines to which of the methods is the best. The choice of method should depend on the system of series that is considered, according to Linde (2005) and Eurostat ESS Guideline (2009). According to ESS Guideline, the direct approach is preferred for transparency and accuracy, especially when component series show similar seasonal patterns. The indirect approach is preferred when components show seasonal patterns differing in a significant way.

Many national statistical institutes, such as Statistics Sweden or Statistics Netherlands (Bikker, Daalmans and Mushkudiani, 2010) prefer the direct approach to the indirect. The direct method was applied at Central Bureau of Statistics in Israel for composite series, but the indirect method has been adopted based on comprehensive studies linked to composite series and their components. However, aggregate series, such as national accounts, composite price index or manufacturing are still adjusted directly. As a consequence, the choice between direct and indirect approaches is a very complex issue and therefore, it is advisable to make a decision based on scrutiny.

2.1.5 Cross-sectional (aggregation) consistency, reconciliation

Problem description

While many economic data, for instance, national accounts are calculated based on an accounting system, the equality of the aggregate series and the sum of their components (along the whole length of time series) is desirable. The problems are the following:

- The additivity is not fulfilled as a result of the *non-linearity* (Xie and Elezovic, 2012) of the seasonal adjustment procedure. While time series resulting from aggregation of several sub-series can be seasonally adjusted directly or indirectly (Xie and Elezovic, 2012), the problem is the following in other words: there is discrepancy between the direct and indirect seasonally adjusted aggregates.
- The most important features of the dependence structure between the non-adjusted series should be preserved. However, there is *inconsistency* in the growth rates of related series after the seasonal adjustment (Xie and Elezovic, 2012).
- Lack of *coherence* in a system of time series because different accounting relationships are not preserved.

Methods to achieve aggregation consistency

- *Only indirect or only direct seasonal adjustment*: In this case, we apply one of the well-known seasonal adjustment methods discussed in the previous sub-section. The exclusive application of one of these methods is not preferable because it is difficult to maintain the quality of seasonal adjustment of the aggregate series.
- *Multivariate approaches*: This method operates either with structural time series models (further details are in Xie and Elezovic (2012) and Tsay (2005)) or coordinated seasonal adjustment. The approach based on structural time series models permits to derive simultaneously the seasonally adjusted series for the aggregate and the components. Coordinated seasonal adjustment entails an additive model and exactly the same filter applied to all series including in the contemporaneous constraints. This is unrealistic in practice, according to Xie and Elezovic (2012).
- *Reconciliation*: In case of reconciliation, all series are first seasonally adjusted (direct approach) and then the discrepancies are distributed according to some criteria. According to Statistics Canada, the contemporaneous constraint is satisfied while the distortion of reconciliation is minimised. Possible reconciliation methods:
    - *prorating;*
    - Denton method and methods derived from Denton's principle (Xie and Elezovic, 2012). Since Denton (1971), several extensions have been proposed (e.g., Di Fonzo and Marini, 2009). The extended approaches are also post-adjustment methods which can be computed based on the minimisation of special distance functions (distance means the closeness of the reconciled data to the original one).
    - *Regression model based on alterability coefficients* Quenneville and Rancourt (2005)*:* The prorating method can be performed via regression model as well. Let $y_1=b_1+e_1$, $y_2=b_2+e_2$, $y_0=b_1+b_2$, $e_1\sim(0,y_1)$, $e_2\sim(0,y_2)$, where $e_i\sim(0,y_i)$ means that the error has mean 0 and variance y_i. It is possible to obtain a simplified model by eliminating b_2:$y_1=b_1+e_1$, $y_0-y_2=b_1+e_2$. Assuminge_1 and e_2 are uncorrelated, the best linear unbiased estimate of b_1 is a weighted average of y_1 and y_0-y_2 where the weights are inversely proportional to the variances:

$$b_1=\left(\frac{1}{y_1}+\frac{1}{y_2}\right)^{-1}\left(\frac{y_0}{y_1}+\frac{y_0\text{-}y_2}{y_2}\right)=y_1\frac{y_0}{y_1+y_2}$$

The simple method is able to be applied to perform the results of the prorating method. However, the variance of the error associated with an observation can be artificially modified. In this case, let

$$e_1\sim(0,a_1y_1),\ e_2\sim(0,a_2y_2),\ y_0=b_1+b_2+e_0,\ e_0\sim(0,a_0y_0),$$

where $a=(a_0,a_1,a_2)$ is a known vector of alterability coefficients. These coefficients must take non-negative values. The general practice consists of setting the coefficients of variation equal to 1 for all series and 0 for unalterable series. The alterability coefficients could also reflect the relative reliability of the various series. In the seasonal adjustment, these coefficients may depend on the importance of the indicators and the quality of the seasonal adjustment. Seasonally adjusted data of better quality (often they are the result of manual interventions) should not be modified and discrepancies should be distributed on less important series or series automatically decomposed. Consequently, the alterability coefficients increase or reduce the covariance matrices of some of the series in the system, thus these series are more or less affected by reconciliation (Dagum and Cholette, 2006). In this case, it can be proved that

$$b_1=y_1+\frac{a_1y_1}{a_0y_0+a_1y_1+a_2y_2}\left[y_0\text{-}(y_1+y_2)\right]$$

$$b_2=y_2+\frac{a_2y_2}{a_0y_0+a_1y_1+a_2y_2}\left[y_0\text{-}(y_1+y_2)\right]$$

Prorating is useful in case of one-way classification, but higher dimensional tables of time series require regression based model in order to simplify the treatment.

2.2 Special Issues

2.2.1 Aggregation of seasonally adjusted chained indices

Chain-linking

In quarterly (in case of, for example, national accounts) or monthly (industry or commercial) estimations the chain-linking method has been applied for constant price calculations. The introduction of chain-linking was necessary because the previous year weights reflect the economic structural changes better than the fix base year weight structure. In case of quarterly time series, first constant price data are calculated at average prices of the previous year from current price data, and then the whole time series is chain-linked back to the beginning of the series with the help of indices. The time series thus produced is built on reference year prices (for example year 2005 prices), and the base year determining the structure is the previous year for all data of the time series, i.e., the base year annually differs. As a result, data of the time series at average prices of the reference year are **not additive** within the given quarter, i.e., the sum of sub-aggregates are not necessarily equal to an aggregate, therefore chain-linking has to be carried out in case of every time series (separately for sub-aggregates and aggregates).

Linking techniques for annually chain-linked quarterly data

According to the literature, three linking techniques are known:

- Annual overlap: the average annual prices of the previous year are used as weights for each of the quarters in the current year, with the linking factors being derived from the annual data.
- One-quarter overlap: one quarter of the year (e.g., the fourth quarter) is compiled at both the average prices of the current year and the average prices of the previous year. The ratio between the estimates for the linking quarter provides the linking factor.
- Over-the-year: all quarters are compiled at the average prices of both the current year and the previous year. The year-on-year growth rates are calculated and then linked together. This technique is not supported by Eurostat.

Seasonal adjustment must be carried out after chain-linking. Further details about this method are available in Task Force report (2008) and on the webpage of Statistics Estonia.

2.2.2 Revision

The revision of the seasonally adjusted data can be derived from two main sources: the revision of the unadjusted data or the seasonally adjusted data.

*The revision of the unadjusted data*is important because of the deficiencies in the system of data collection. For example, the data providers send the information after the deadline, or they send erroneous data. These data must be revised and this revision influences the adjusted data.

*The revision of seasonally adjusted data*is important for sake of a better estimation. All new incoming data conveys new information, by that we get more accurate estimation for the seasonal pattern.

Strategies to revise seasonally adjusted data

There are two extreme types of approach to handle with revisions: current and concurrent adjustment.

- *Current (or forward factor):* According to this adjustment, seasonal and calendar factors are revised only once in a time span (generally one year), when the last month or quarter becomes available. This implies that models, outliers and filters are periodically revised. Forecasted factors are used to derive the calendar and/or the seasonally adjusted data before the review.
- *Concurrent:* According to this adjustment seasonal and calendar factors are revised whenever a new or revised data is received. This implies that models, outliers and filters are always revised.

In practice, a compromise should be found between the current and concurrent adjustment: the former may provide a misleading signals at the end of time series, the latter may cause a significant instability in seasonally adjusted data.Two alternative approaches are suggested in the ESS Guidelines (2009):

- *Partial concurrent adjustment*: this method contains forecasting the seasonal factors and identifying the model for the next period. If a new or revised observation becomes available, we re-estimate the parameters of the model but the model is the same. This process takes the new information derived from the received data into consideration and intends to avoid significant revisions.

- *Controlled current adjustment*: The current adjustment is considered, but its results are internally compared to those derived from the partial concurrent approach, which is preferred when discrepancies between the two approaches are considered important (see ESS Guidelines (2009)). Since each series needs to be seasonally adjusted twice this adjustment is practicable only for a limited number of series.

<u>Horizon of the revision</u>

The revision policy has to contain the **horizon of the revision**. The entire seasonally adjusted time series may change by re-estimating the seasonal factors. The publication of this change is not obligatory but it is worth doing because of the transparency and accuracy. Hence, we have to find the optimum length of the revision period which is short enough not to confuse the users, but it is not too short in order to assure the reliability of the seasonally adjusted data. The issue arises what the explanatory power of a new observation is. If a new data affects only the last some years of the observation then it can be useful to limit the revision period. Therefore, according to ESS Guidelines (2009), the best alternative is to revise the seasonally adjusted data from 3-4 years before the beginning of the revision period of unadjusted data. Another acceptable practice is the revision of the entire time series irrespective of the revision on the unadjusted data. The general revision strategy applied at *Statistics Denmark* is that all series should at least be revised 13 months/5 quarters back in time. At the most, they should be revised 4 years back in time (Linde, 2005).

2.3 Treatment of the crisis

In 2008, when the economic downturn bursted out, the reliability and stability of the official seasonally adjusted and trend-cycle data became seriously undermined. Consequently, seasonal adjustment became not only more relevant, but much more difficult: the negative effect of the crisis significantly influenced the examined time series and it caused rapid changes in the earlier structure with the consequence of increasing the uncertainty of the data (in other words, it is required to handle more volatile data) (Ouwehand and Krieg, 2012). In similar circumstances, it is not obvious to decide whether the seasonal pattern changes based on the end of the time series. Therefore, the results of the seasonal adjustment are not only more uncertain than usual but they are accompanied by much larger revisions as well. An agreement about the treatment strategy of the crisis among statistical offices is still lacking because crisis may influence each time series in a different way. Although the European countries applied heterogeneous approaches to deal with the crisis in 2008-2009, it is possible to classify them according to some criterion. In particular, in accordance with the timing of the intervention on the seasonal adjustment specifications, it is possible to distinguish real time and ex-post treatments (Ciammola, Cicconi, and Marini, 2010).

- *Real time treatment* stands for methods which are applied in estimating the abrupt movements of the processes during the crisis. The most appropriate tool would be handling of outliers at the end of the series.
- *Ex-post treatment* requiring the inclusion of special intervention variables to model the effect of the crisis such as ramp effects.

The crisis became the basis of many studies and lectures about the available strategies and their effects.

The strategy applied at Statistics Netherlands incorporated several steps at Ouwehand and Krieg (2012). First of all, usual approaches were continued such as *concurrent with annual review* and *automatic outlier detection.* Moreover, issues as part of the pre-treatment process, such as setting outliers are also important ones. However, increased monitoring is also unavoidable. At the Hungarian Central Statistical Office, the standardised seasonal adjustment policy was supplemented during the global financial crisis. Beyond the conventional disquisitions, detailed analysis has been performed in each period paying special attention to the models and outliers. After all, the Office decided not to use level shifts in consecutive time periods in the concerned time series. In a study of Ciammola, Cicconi and Marini (2010) carried out with Italian series, the results of a real-time treatment method (based on some variants of the partial concurrent treatment) were compared with an ex-post treatment (based on the ramp effects). Ramp effect is a special intervention variable: it has a start and an end date allowing for a linear increase or decrease in the level of the series (see Figure 1).

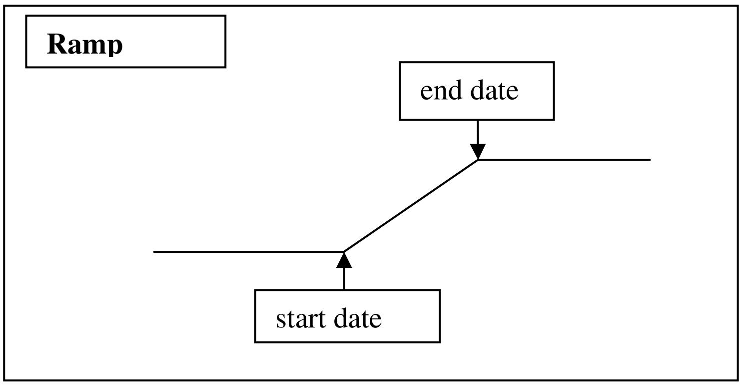

Figure 1: Ramp outlier

In Bell and Lytras (2013), ramp effects are considered to deal with the crisis, but a different procedure (based on the AICC information criterion) is used to set the beginning and the length of the ramps.

The common conclusion is that a carefully monitoring of seasonal adjustment is required in times of strong economic changes. Models should be closely reviewed by data producers as soon as new extraordinary data are detected in the raw series and special intervention variables could be used when regular (often automatically detected) outliers do not fit well the changes in time series.

Seasonal adjustment tools used by NSIs and other international organisations are capable to carry out outlier detection automatically.

In case of automatic outlier detection, level shifts and temporary changes may appear at the end of the time series as a result of the crisis. However, when several outliers are detected in a short time span, several disadvantages arise: firstly, it can be difficult to give an economic interpretation; secondly, these outliers can generate period-on-period growth rates with a very irregular pattern due to the fact that they are very close; finally, the application of level shift outliers implies permanent shocks that are not compatible with business cycle movements. The latter effect is mitigated through the use of temporary change, but the model forecasting ability could worsen. Another approach exclude any intervention as the trend is able to adapt to the long-time impact of the crisis.

Although, both level shifts and ramp outliers yield satisfactory results in terms of stability in parameter estimates, ramp outliers have many advantages, especially when the direct approach is used to seasonally adjust the aggregates. In fact it is difficult to explain to unprofessional users why the fallback derived from the use of level shift is concentrated in the periods where the outlier is identified. Furthermore, level shifts may fail in the "linearisation" procedure of time series preceding the decomposition. On the other hand, the main drawback in the use of the ramp effects is that they cannot be automatically detected and their features (the starting point and the ramp length) have to be set manually.

2.4 Data presentation, communication with users, and documentation

The estimations applied in seasonal adjustment are very complex issues. Hence, the responsible institutes such as Statistical Offices and National Banks have to undertake the task within seasonal adjustment, publish, and interpret the results in press releases.

According to ESS Guidelines (2009), data can typically be presented either in unadjusted, calendar adjusted, seasonally adjusted, or trend-cycle form. Apart from data, users can also be classified, according to OECD Handbook (2007):

- *general public:* they are usually not interested in technical details, thus they only need "basic" metadata;
- *informed users:* they need detailed information how the statistical program performing the seasonal adjustment was carried out, as well as statistics on the validity of the adjustment for specific series;
- *analytical users:* they need some of the results of the statistical program to reprocess them for their own use(s).

Discussions may focus on whether the unadjusted data should be published together with the seasonally adjusted data. The problem emerges due to the fact that two different time series linked to the same 'phenomenon' may confuse users. This uncertainty can be reduced by appropriate suggestions about which time series are recommended to be applied in different cases. However, if seasonally adjusted and unadjusted data are published apart from other data (such as series only adjusted for trading-day), then the risk of confusing the general public is significant.

Another question is whether it is advisable to publish the seasonally adjusted time series or the trend-cycle component. If the focus is on the underlying medium term movements, then trend-cycle estimates is the preferred form. According to the general recommendation, the focus of press release concerning the main sub-annual indicators should be on their appropriately seasonally adjusted version, but the original data should be sent to the users in any forms. In case of user's request, the offices can publish the trend-cycle or other components of the seasonal adjustment process but it has to be clear that the seasonally adjusted data are the most important figure for the short-term variation.

Month-on-previous month and quarter-on-previous-quarter growth rates for original series are not very informative unless seasonal effects are negligible. Consequently, statistical agencies seldom use them in their releases of indicators affected by seasonal fluctuations. The users and the media often focus on the year-on-year changes (YoY) which are the rates of change with respect to the same period of previous year. This should be applied to the original data and also to the calendar adjusted data if the latter are available. If necessary, special effects, e.g., the so-called base effect[1] contained in the base period should be highlighted when presenting YoY. Period-on-period growth rates and changes in level should be computed on seasonally adjusted time series, but in case of high volatility, it should be used with caution. When the seasonal component is not deterministic, the rate of change on original data and seasonally adjusted data can show conflicting signals, leading the general public and even some informed users to question the validity of the results. However, YoY change calculated on seasonally adjusted series is a common practice.

Moreover, the presentation of annualised level changes –$(1+\Delta_t)^{12}$ or $(1+\Delta_t)^4$, where Δ_t is the growth rate of one month or quarter (compared with the previous one) – is not recommended, because it can result misleading signals, especially for series displaying high volatility. Hence, where annualised changes are used, users should be provided with information regarding the possibility of misleading signals due to series volatility. Also, the annualised period-to-period growth rates are not recommended for the presentation of monthly or quarterly growth rates.

Beside the results, other important information can help the users to understand what the seasonal adjustment is all about. While the seasonal adjustment procedure is complex, it is recommended to explain it without presuming detailed mathematical and statistical background. This explanation should contain its benefits, its aims, and the steps of the process. "For the benefit of users requiring information about appropriateness of the seasonal adjustment method applied, statistical agencies should provide a minimum amount of information that would enable an assessment of the reliability of each seasonally adjusted time series."

The situation is different concerning with the analytical users. They especially need the availability of metadata. Hence, one should publish more detailed information about the applied methods, the most useful figures, the main specifics of the adjustment, outliers, expected problems of the adjustment and recommendations of data publications. For example, if the time series contain neither seasonal effect nor calendar effect then the data provider should publish the original time series as seasonal adjusted time series.

3. Design issues

4. Available software tools

5. Decision tree of methods

[1] A base effect occurs when the evolution of a variable's annual rate from month t to month t+1 varies because of the evolution of the variable's level 12 months before and not because of the variation ofthe variable's level between month t and t+1 (Banque centrale du Luxemburg, 2004).

6. Glossary

For definitions of terms used in this module, please refer to the separate "Glossary" provided as part of the handbook.

7. References

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Interconnections with other modules

8. Related themes described in other modules

1.

9. Methods explicitly referred to in this module

1. Micro-Fusion – Prorating
2. Macro-Integration – Denton’sMethod
3. Seasonal Adjustment – Seasonal Adjustment of Economic Time Series

10. Mathematical techniques explicitly referred to in this module

1. Interpolation
2. Extrapolation
3. Regression

11. GSBPM phases explicitly referred to in this module

1. GSBPM Phase 6.1, 6.2, 6.3

12. Tools explicitly referred to in this module

1.

13. Process steps explicitly referred to in this module

1. Data reconciliation
2. Benchmarking

These processes are also incorporated in the topics “Macro-Integration” and “Micro-Fusion”.

Administrative section

14. Module code

Seasonal Adjustment-T-Issues on SA

15. Version history

Version	Date	Description of changes	Author	Institute
0.1	21-11-2012	first draft	Attila Lukács	Hungarian Central Statistical Office
0.2	31-08-2013	second draft: changes based on reviews	Laszlo Sajtos	Hungarian Central Statistical Office
0.3	14-10-2013	third draft: changes based on reviews	Laszlo Sajtos	Hungarian Central Statistical Office
0.3.1	25-11-2013	version submitted to editorial board	Laszlo Sajtos	Hungarian Central Statistical Office
0.3.2	11-12-2013	preliminary release		
0.4	13-12-2013	minor improvements	Laszlo Sajtos	Hungarian Central Statistical Office
1.0	26-03-2014	final version within the Memobust project		

16. Template version and print date

Template version used	1.0 p 4 d.d. 22-11-2012
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