Methodological manual

Seasonal and working day adjustment of Swiss foreign trade data

Seasonal and working day adjustment of foreign trade data

Imprint

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Working day adjustment
Method that takes account of the influence of individual working days (e.g. number of thursdays per month) and other calendar-related effects. the aim is the comparability of one period with the same period of the previous year. The technically correct term is "calendar adjustment", as the adjustment is not restricted to effects related to the number of working days only, but also includes the impact of Easter for example. However,the term "working day adjustment" is used here for comprehensibility reasons.

Seasonal adjustment
adjusted for the number of working days and excluding seasonal fluctuations. It allows for the comparison of previous periods.

Trend cycle
the trend after the elimination of seasonal fluctuations and irregular components (all random disruptive factors that cannot be interpreted).

RegARIMA models
combination of a regression model with an ARIMA model. The error term of the regression model thus follows an ARIMA process.

1 Introduction

Economic activity fluctuates over time. Seasonal factors, vacation days and public holidays play an important role in a year, thereby complicating the interpretation of economic transactions over a year. If a comparison of the first quarter with the same period a year earlier shows a decline in imports, is this for economic reasons or due to the impact of the Easter holidays? Does the August drop in exports relative to July indicate an economic downturn or is it merely a seasonal effect? Seasonal adjustment aims to identify and eliminate regular and recurring fluctuations. Monthly and quarterly results can thus be compared, which makes it possible to interpret the evolution.

Imports and exports are also subject to calendar effects and seasonality. Consequently, monthly and quarterly data is likewise seasonally and working day adjusted. The principles and methods used for pre-treatment and seasonal adjustment, the revision policies and the presentation of data are described below.

2 Policy

The working day and seasonal adjustment procedure is harmonised internationally only to a certain extent. Therefore, the working day and seasonally adjusted evolution of Swiss exports can be compared with that of German exports, for example, only to a limited degree. As the method used can have a major impact on the results and thus their interpretation, the procedure for Swiss foreign trade statistics is based on the guidelines of Eurostat, the statistical office of the European Union[1], as well as on the methodology of other national statistical offices. This document is structured in line with the EU guidelines, whereby the main aspects for the working day and seasonal adjustment of Swiss foreign trade statistics are listed.

3 Pre-treatment

The aim of seasonal adjustment pre-treatment is to ensure a reliable estimate of the seasonal and calendar components (see section 4). Data outliers are identified and corrected during pre-treatment for that purpose. Calendar effects, i.e. the months' different properties (length, number of working days, etc.), are also taken into account and adjusted during pre-treatment.

Pre-treatment is carried out with RegARIMA modelling, i.e. linear regression with ARIMA error terms. Outliers and calendar effects thus flow into the model as regressors and can have both significant and insignificant effects.
Pre-treatment generally distinguishes between a detailed and an automated procedure. The relevant influencing factors for pre-treatment are determined for the detailed procedure using statistical parameters as well as economic and calendar-based information. Pre-treatment is reviewed in detail and non-automatically at least once a year for the time series of the most

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[1] Eurostat: ESS Guidelines on Seasonal Adjustment, 2015

important product groups. The remaining time series are subject to automatic pre-treatment, which is corrected individually in the event of anomalies regarding a time series.

The following table contains the decisive aspects of pre-treatment, which are discussed below:

Table 1: Pre-treatment overview

Aspect	Approach
Working day/calendar adjustment	Swiss calendar taking account of the impact of individual working days, leap years and Easter; adjustment with RegARIMA
Other calendar-related or weather effects	Not taken into account
Outliers	Determination of outliers and level shifts; adjustment with RegARIMA

Working day/calendar adjustment

Working day adjustment with the RegARIMA method takes account of all influences attributable to calendar changes. These include the number of working days in a specific month and the date of holidays.

The influence of the **Swiss calendar** is estimated and eliminated per month. A distinction is made between working days and free days in the process; e.g. 1 August is a public holiday. Each weekday influences the results to a varying degree and is thus allocated its own effect. This influence varies according to the product group and trading partner. For example, the number of Mondays worked in a month has a positive impact on imports of machinery, whereas the number of Fridays plays a minor role. As expected, the number of Saturdays has a dampening effect, as fewer people work that day and the production and transport of goods are thus reduced.

The impact of **holidays** which do not fall in the same month every year is evaluated specifically. In Switzerland, this concerns the Easter holidays, which fall in either March or April. Moreover, the length of the month of February is taken into account, with an extra day (29 February) being added in a leap year.

Other calendar-related or weather effects

In addition to the calendar effects mentioned in the previous section, the impact of bridging days and school holidays can also be integrated into pre-treatment. Workers with schoolchildren take vacation days more frequently in these periods, which impacts production activity. However, it is difficult to determine these effects; for example, Swiss school holidays are not set at federal level and instead fall at different times in the different cantons.
Even the effect of the weather can be included. For example, the construction industry is affected by the duration of the cold weather. However, this effect is not established in advance and is difficult to determine just like bridging days and school holidays.
Consequently, neither of the effects described above is taken into account during the pre-treatment of foreign trade figures.

Outliers

Individual outliers and level shifts are identified and excluded from the model for determining seasonality. These outliers can arise as a result of economic events, errors in the unadjusted

data or methodology changes. These factors are included again for determining the model components.

4 Seasonal adjustment

The following table lists the most important aspects of seasonal adjustment, which are discussed below:

Table 2: Overview of seasonal adjustment

Aspect	Approach
Seasonal adjustment procedure	X-12-ARIMA
Software	"Seasonal" package in "R"
Temporal consistency	Not ensured
Consistent aggregation (direct/indirect approach)	Standard: direct Total Swiss imports and exports: indirect

Seasonal adjustment procedure

The X-12-ARIMA (**A**uto**r**egressive **I**ntegrated **M**oving **A**verage) procedure utilised was developed by the US Census Bureau and is used for the seasonal adjustment of economic time series. It is used by numerous other statistical offices, e.g. the Federal Statistical Office (FSO) in Switzerland.

Seasonal adjustment procedure

Regarding the seasonal adjustment procedure, the parametric approach stands against the non-parametric approach. Both approaches are recommended in the Eurostat guidelines and neither is explicitly preferred over the other.
The parametric approach identifies the components with a smoothing process. The X-12-ARIMA method, for example, uses moving average filters. In contrast, TRAMO/SEATS[2] is part of the non-parametric family of seasonal adjustment, which applies a model for estimating the components.

Software

Solely open source software, available free of charge, is used for the working day and seasonal adjustment of Switzerland's foreign trade data. The "Seasonal"[3] package in "R", which serves as an interface to the X-13ARIMA-SEATS software of the US Census Bureau, is used.

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[2] TRAMO/SEATS stands for: "Time series Regression with ARIMA noise, Missing values and Outliers" / "Signal Extraction in ARIMA Time Series"
[3] The "Seasonal" package was originally developed for estimating Swiss gross domestic product (GDP) in the State Secretariat for Economic Affairs (SECO) and stands out for its exceptional ease of use.

Consistent aggregation (direct/indirect approach)

When time series are adjusted at several aggregation levels, either the direct or the indirect approach can be used. The direct approach defines a separate seasonal adjustment model for each series. A group's results are not consistent with those of its sub-groups because of the varying impact of working days and the occurrence of outliers, etc. The indirect approach avoids this problem of inconsistency, as the sub-groups' adjusted results are used for calculating the adjusted results of their corresponding upper group.

The foreign trade statistics methodology generally pursues the direct approach, as the most accurate model can thus be selected per time series. The indirect approach is selected for total imports and total exports to ensure better communication and comprehensibility of the results. Consequently, the adjusted results at total level correspond to the sums of the most important product groups. However, this does not apply to the results by trading partner. This is explained in detail below.

Table 3: Direct and indirect approach

Series (imports and exports)	Approach	Consistency of aggregation
Total	Indirect	Adjusted results of the total consistent with the most important product groups
Product groups	Direct	No consistency between the sub-groups' adjusted results
Trading partners	Direct	No consistency between the sub-groups' adjusted results

The unadjusted results for total exports and total imports correspond to the sum of the sub-groups by product i (see appendix for a definition of i components):

$$O_t = O_{1t} + O_{2t} + ... + O_{pt} = \sum_{i=1}^{p} O_{it}$$

with O_t: Original value of total exports or imports
with O_{it}, i= 1,2,….,p: Original value of component i   (1)

For the adjusted results, the consistency of the sums with the total result is forced. In other words, the seasonal effects are not identified in the grand total itself when calculating total exports and total imports (direct adjustment); instead, they are assessed indirectly at the level of the most important product groups. Then, the sectors' adjusted results are added to the grand total:

$$C_t = \sum_{i=1}^{p} C_{it}$$

with A_t: Working day adjusted value of total exports or imports
with A_{it}: Working day adjusted value of component i

$$S_t = \sum_{i=1}^{p} S_{it}$$

with S_t: Seasonally adjusted value of total exports or imports
with S_{it}: Seasonally adjusted value of component i   (2)

$$T_t = \sum_{i=1}^{p} T_{it}$$

with T_t: Trend value of total exports or imports
with T_{it}: Trend value of component i

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The unadjusted results for total exports and total imports correspond likewise to the sum of the sub-groups by trading partner j (countries or continents):

$$O_t = O_{1t} + O_{2t} + ... + O_{qt} = \sum_{j=1}^{q} O_{jt}$$

with O_t: Original value of total exports or imports
with O_{jt}, j= 1,2,..,q: Original value of component j   (3)

However, this consistency of the sums of the components with the total result is not ensured for the adjusted results:

$$C_t \neq \sum_{j=1}^{q} C_{jt}$$

with C_t: Working day adjusted value of total exports or imports
with C_{jt}: Working day adjusted value of component j

$$S_t \neq \sum_{j=1}^{q} S_{jt}$$

with S_t: Seasonally adjusted value of total exports or imports
with S_{jt}: Seasonally adjusted value of component j   (4)

$$T_t \neq \sum_{j=1}^{q} T_{jt}$$

with T_t: Trend value of total exports or imports
with T_{jt}: Trend value of component j

The results obtained using the direct and indirect approach are illustrated in the figure below using the example of exports for aggregation by product group:

Figure 1: Direct and indirect seasonal adjustment of exports
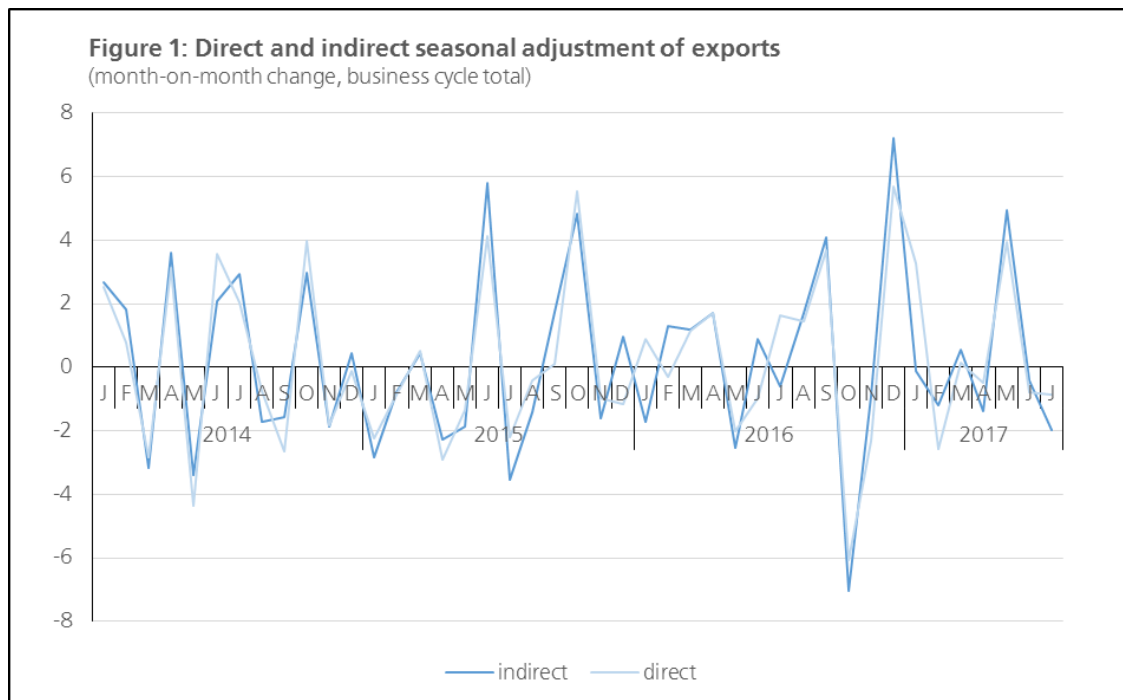(month-on-month change, business cycle total)

Figure 1 shows that the overall evolution that emerges with direct and indirect adjustment is very similar even if major differences occur for individual periods.

Time consistency

The adjusted and unadjusted data is inconsistent in terms of time. Consequently, the unadjusted annual results do not correspond to the working day and seasonally adjusted annual results. The following formula for a specific group k shows this:

$$O_{kT} = \sum_{t=1}^{n} O_{kt} \neq \sum_{t=1}^{n} C_{kt} \neq \sum_{t=1}^{n} S_{kt}$$

with T: Year
with t = 1,2,…,n; only for months: n=12, for quarters: n=4

(5)

5 Revision policies

The following tables list the revision principle aspects, which are discussed below:

Table 4: Overview of revision policies

Aspect	Approach
Revision period	Back to the first period (1997)
Concurrent vs. current adjustment	Mixed form: partial concurrent adjustment

Length for routine revisions

Seasonally adjusted data is available back to 1997. The data is revised on a monthly basis back to the first period.

Concurrent vs. current adjustment

Modifying the models, filters, outliers and further factors for seasonal adjustment impacts the revisions of seasonally adjusted data. The possibilities for defining the models, filters and outliers and for estimating the regression parameters and factors lie between the following two extremes:

> **Concurrent adjustment**
> for each estimate, i.e. monthly, at the same time as the revision of unadjusted data
> **Current adjustment**
> periodic review carried out at set times

A mixed strategy called **partial concurrent adjustment** is applied for foreign trade statistics data. The models, filters, outliers and calendar regressors are completely reviewed once per year. They can even be adapted on a monthly basis in the event of extraordinary changes. In contrast, the corresponding parameters and factors are re-estimated with the latest data each month.

6 Seasonal adjustment accuracy

The seasonal adjustment results are checked for accuracy and reliability and the seasonal adjustment specifications are adapted where necessary. This check is carried out in detail for the most important product groups every year. In addition, a risk-based validation is performed on all time series on a monthly basis.

7 Data presentation issues

Data availability

The working day and seasonally adjusted data is calculated for total trade, selected product groups according to their nature and selected trading partners. In contrast, no adjusted data is available at tariff heading level. However, the results exist only for the business cycle total. That does not include gold bars and other precious metals, coins, precious stones and gems, works of art and antiques, as those goods are of little significance for the economic development.

Working day and seasonally adjusted results are available for nominal and real indices, as well as for unit value index from January 1997 in the form of monthly and quarterly time series.

The following three components are prepared:

- ➢ Working day adjusted results
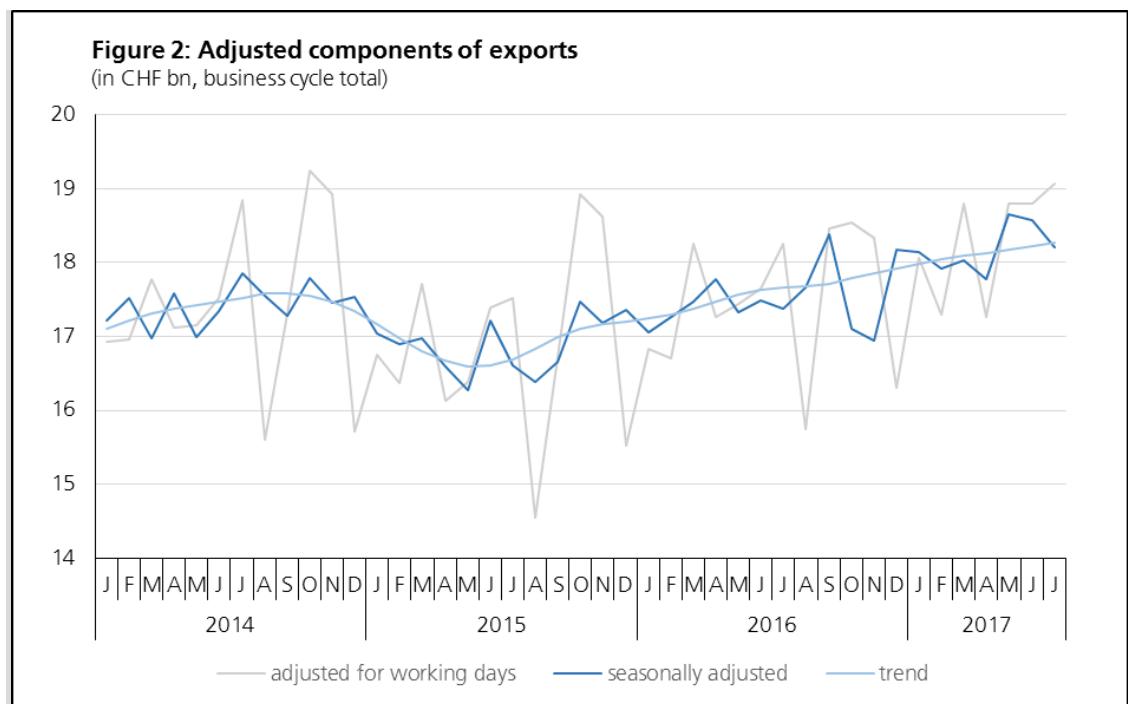- ➢ Seasonally adjusted results
- ➢ Trend cycle

Components of a time series and their application

In general, economic activity reacts positively to the number of working days and negatively to the number of vacation days and public holidays. This adjustment allows for a much more meaningful interpretation of the results (especially for year-to-year comparisons).

Short-term seasonal fluctuations are eliminated in the seasonally adjusted data. Such an adjusted series can be used for both analysing the past and forecasting. Moreover, these series are relevant for period-to-period comparisons.

The trend cycle reflects the long-term evolution. The seasonally adjusted trend moves around this trend cycle in the form of unpredictable cyclical fluctuations.

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Figure 2: Adjusted components of exports
(in CHF bn, business cycle total)

Publication

The working day and seasonally adjusted foreign trade figures are published in the following forms:

➢ Comments on the latest results are provided in press releases.
➢ The results of the most important product groups and trading partners from January 1997 can be found on the website.
➢ Index for the groups by nature of goods from January 1997 can be found in the Swiss-Impex database of foreign trade statistics.

Appendix

Table 5: Product groups for calculating total exports

Series (exports)	Number of the nomenclature by nature of goods
Forestry and agricultural products, fisheries	01
Energy sources	02
Textiles, clothing, shoes	03
Paper, articles of paper and products of the printing industry	04
Leather, rubber, plastics	05
Products of the chemical and pharmaceutical industry	06
Stones and earth	07
Metals	08
Machines, appliances, electronics	09
Vehicles	10
Precision instruments and equipment	11.1
Watches	11.2
Jewellery and household goods made from precious metals	11.3
Various goods such as musical instruments, home furnishings, toys, sports equipment, etc.	12

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Table 6: Product groups for calculating total imports

Series (imports)	Number of the nomenclature by nature of goods
Forestry and agricultural products, fisheries	01
Energy sources	02
Textiles, clothing, shoes	03
Paper, articles of paper and products of the printing industry	04
Leather, rubber, plastics	05
Products of the chemical and pharmaceutical industry	06
Stones and earth	07
Metals	08
Machines, appliances, electronics	09
Vehicles	10
Precision instruments, clocks and watches and jewellery	11
Various goods such as musical instruments, home furnishings, toys, sports equipment, etc.	12