2.2 Methodology of the ifo Business Survey

This chapter explains the basic methodological concepts of the ifo Business Survey. It provides information on the survey design, the survey modes, and the processing of the microdata into time series and indicators.

2.2.1 Survey Designs

Stefan Sauer

The design of a survey depends on its objectives. Therefore, before starting a survey, various fundamental and conceptual decisions must be taken. First, a distinction is made between one-time surveys and regular surveys with a fixed group of participants (e.g., firms, households, experts). These so-called panel surveys are the norm for ifo surveys. In the ifo Business Survey a fixed set of questions is asked every month to observe and analyze developments of various variables over longer periods. In addition to the monthly surveys, the ifo Institute also conducts quarterly, semi-annual, or annual panel surveys. One-off special surveys on a specific topic, on the other hand, tend to be the exception. Instead, one-off supplementary questions on current economic topics can be included in the regular surveys (see Section 4.13).

While the advantage of panel surveys is that developments of numerous variables can be observed both at the individual level of the participants and at the aggregated level, the establishment and maintenance of representative panels is labor-intensive. Full surveys of all German companies (or households or economic experts) are of course not practical, especially since participation in the ifo surveys is voluntary. The survey panels therefore constitute stratified samples from all German enterprises, covering all important economic sectors (professional representation) as well as a sufficiently large proportion of companies (company representation). It usually takes several years to build up a sufficiently large and stable panel. Even so, it often happens that participants don't participate actively in the survey over a longer period or no longer participate at all. To counteract this so-called non-response or panel mortality, constant panel maintenance by acquisition of new participants is necessary to keep the panel stable or expand it, and thereby to avoid systematic biases. Similarly, so-called selection effects that might lead to systematic biases of the results must be avoided. Therefore, the distributions of the companies according to regions, company size, and industries must roughly reflect the reality (see Section 2.7).

A second crucial pillar is the design of the questionnaire. The first step is to select topics and variables that reflect the objectives of the survey and to construct questions that promise interesting and meaningful results. The ifo Business Survey asks about variables that are important for business cycle analysis. It focuses on current developments as well as plans and expectations for the near future. There are many topics and variables of interest, but the processing effort for company surveys should not be unnecessarily high. Therefore, the number of questions should be limited. Furthermore, the questions can be grouped according to their importance and urgency. Less important questions should either not be included at all in the survey or asked at a lower frequency. The questionnaire of the ifo Business Survey, for example, was therefore divided into a standard part with questions that recur monthly and questions that are only asked quarterly, or once or twice a year.

Once a question program has been established, it should be changed as little as possible. Even minor changes in the wording of a question can lead to structural breaks in the corresponding time series because of the associated change in the companies' responses. If questions are changed or deleted, the corresponding time series can no longer be calculated.

Furthermore, there are some important rules regarding the design and formulation of the questions. On the one hand, a simple sentence structure must be used as well as understandable and common words. Beyond that, ambiguities or incomprehensible constructs, such as double negations, must be avoided. The questions should also be formulated as neutrally as possible to avoid unintentionally influencing the participants or pushing them towards an answer. The ifo Business Survey mainly focuses on qualitative questions with given answer categories instead of quantitative questions with numbers. This is mainly to minimize the effort of answering. The answers given must cover all possibilities and be mutually exclusive. Before conducting a survey for the first time, pre-tests with selected participants can be helpful to uncover possible problems in the questionnaire, such as incomprehensible questions.

2.2.2 Data Collection Channels

Artem Marjenko

There are different ways in which data can be collected in a survey. The most common are paper questionnaires, which are mailed or faxed to survey participants, e-mail questionnaires meant to be printed out[1], an online questionnaire, a social media survey, and phone and face-to-face interviews. When it comes to business surveys, paper, e-mail, and online questionnaires are typically used to collect data. This is true for the ifo Business Survey as well as for corresponding business surveys in most of the other EU countries; only in Italy and Spain phone interviews are also conducted. Table 2.1 summarizes the characteristics of these three data collection channels.

[1] Except for the fact that an e-mail questionnaire is transferred by e-mail to the recipient, it is in many ways similar to the paper questionnaire.

Table 2.1: Characteristics of different survey channels

	Paper questionnaire	E-mail questionnaire	Online questionnaire
Cost	Printing, mailing, data capturing cost (variable cost)	Printing and data capturing cost (variable cost)	Expenses for hardware, programming, and software licenses (fixed cost)
Access to survey reports	A limited number of survey reports is sent to survey participants by mail or fax	Many survey reports can be sent as e-mail attachments	All survey reports are accessible through the survey web portal
Space for additional ad hoc questions on the questionnaire	limited	limited	unlimited
Validation check for responses	Responses must be checked for accuracy and corrected if necessary	Responses must be checked for accuracy and corrected if necessary	Invalid responses can be prevented from even being entered
Data security	Fax transmission is not encrypted	e-mail and fax transmissions are not encrypted	Encrypted data transmission, password protected access to the survey web portal

Because of the many benefits that the online form provides, the ifo Institute constantly tries to convince survey participants to switch to this channel of data collection. This effort has led to a considerable increase in the share of online participants over the last years. Nevertheless, there is still a significant number of participants who prefer a classical paper questionnaire, as figures in Table 2.2 indicate. Some say that handling a paper questionnaire is more convenient, while others cite security concerns regarding the online process. Although the risk of data breach in the online process is rather low, the ifo Institute continues to provide the paper option to serve everybody's needs. Only some surveys – such as the ifo Business Survey in the insurance industry or the ifo HR Survey – are conducted solely online. Technological progress promises new ways to carry out surveys: Submitting data from mobile devices through a dedicated ifo survey app could be a future option.

Table 2.2: Share of responses submitted via different channels in the ifo Business Survey

	Paper questionnaire		E-mail questionnaire		Online questionnaire	
	2017	2022	2017	2022	2017	2022
Manufacturing industry	30%	19%	-	-	70%	81%
Wholesale and retail	49%	32%	-	-	51%	68%
Construction industry	60%	49%	-	-	40%	51%
Service sector	17%	1%	14%	12%	69%	87%

2.2.3 Aggregation of Micro-data into Time Series

Klaus Wohlrabe

Micro-data, i.e., the responses of the companies, are the backbone of the ifo Business Survey. In their raw form, they are used primarily in the context of research. Before the publication of the survey results, the micro-data need to be aggregated into time series. Only then does it make sense to interpret and use them in the context of business cycle analysis. One of the basic principles of aggregation in the ifo Business Survey requires that the answers first receive an individual weight. This weight represents the size of the company. In the ifo Business Survey, larger companies are given more weight than smaller ones. In a second step, industry and sector weights are assigned. Sectors that make a larger contribution to gross value added in the German economy are given a correspondingly higher weight.

As mentioned above, the majority of the regularly asked questions have three answer categories. There are different procedures for aggregating this type of data (see also Pesaran and Weale 2005). Since the introduction of the surveys in 1949, the ifo Institute has been using the balance methodology, which goes back to Anderson (1952b). The relative proportion of negative answers (the third category) is deducted from the relative proportion of positive answers (the first category). The neutral or central category is thus only indirectly taken into account. If, for example, 30% of the companies stated positive expectations, 50% unchanged (neutral), and 20% negative, the balance in this example would be +10, for which the relative share of 20% (negative) would be deducted from the positive share of 30%. The share of neutral answers of 50% would not be taken into account. The balance can accordingly be

Table 2.3: Balance statistic: An illustrative example

Firm	Answer	Weight	Response distribution		
			+	=	-
A	satisfactory	5		5	
B	well	2	2		
C	well	4	4		
D	bad	2			2
E	satisfactory	5		5	
F	well	2	2		
Distribution unweighted			3	2	1
Sum of the weights		20	8	10	2
Percentages (unweighted)		100%	50%	33.33%	16.67%
Percentages (weighted)		100%	40%	50%	10%

between -100 and +100. In the case of -100, all answers are negative and in the case of +100 all answers are positive. If the balance is positive, a (weighted) majority of the companies have chosen the corresponding category. Strictly speaking, this majority only applies to those companies that have not chosen the neutral category. In the example above, the neutral category is chosen most often. When interpreting the balance, it should be noted that a certain balance can result from different response behaviour. For example, a balance of +10 can result from a response variation of 10% (+), 90% (=), and 0% (-). Another possible distribution is 50%, 10%, and 40%. This list could be continued at will. The extent to which the responses are scattered is also a measure of the uncertainty of enterprises regarding a particular economic activity. The balance methodology can also be used for weighted answers. This is shown as an example in Table 2.3. The individual weights of the companies are accordingly used to calculate the relative shares. In the example, the unweighted balance is calculated as $50 - 16.67 = 33.33$, while the weighted balance is $40 - 10 = 30$.

Until March 2018, aggregation within the framework of the balance methodology was carried out in a ‘tree’ structure based on the official classification of economic activity of the German Federal Statistical Office (WZ2008). A section of this tree structure is shown as an example in Figure 2.1 for the manufacturing industry up to the three-digit level. The highest level, here the entire manufacturing industry, is the so-called 1-digit level. On the 2-digit level, well-known industries such as the automotive industry or mechanical engineering are listed. Below this level, the breakdown has different levels of aggregation, some of which extend to the 6-digit level. The aggregation of the answers within this tree structure takes place from bottom to top. Each company report is assigned to an economic branch at the lowest level of the hierarchy and receives an individual weight. In the manufacturing industry, this is determined by the number of employees. The balances are then aggregated to the next higher level according to their gross value added share. In the example in Figure 2.1, for example, the results of the machine tool industry and the manufacturers of gears and cogwheels (plus the other sub-sectors of mechanical engineering) are combined to form the balance for mechanical engineering. Finally, all balances at the 2-digit level are also aggregated to the total manufacturing industry with a weighting based on the shares of gross value added.

As intuitive as the aggregation according to the tree structure in Figure 2.1 is, it has some practical disadvantages. The company panel in the ifo Business Surveys does not remain constant over time: Companies leave or are newly registered. This also has an impact on the number of observations in individual branches of the economy. On the one hand, some areas may contain too few companies over time. The corresponding balance will then no longer accurately represent economic development. For example, balances based on fewer answers are more volatile than those with many answers. On the other hand, it is possible that the balance values tend to assume high (extreme) balance values such as +100. This may also distort the upper aggregates. Another important aspect is the fact that some answers cannot be taken into account at all because there are not enough enterprises to form a separate (sub-)aggregate.

Due to the above-mentioned points, the aggregation rules must be maintained and adapted on a permanent basis. In order to mitigate the problem somewhat, a change was made in 2018 in the allocation of micro-data to the balance calculation. Figure 2.2 shows an example of this. The most important difference is that balances from the 3-digit level are no longer used to calculate balances at the 2-digit level. This means that all micro-data assigned to mechanical engineering are directly included in the balance calculation of mechanical engineering with their company weight. This idea is propagated to the lower levels. All micro-data from the "machine tools" sector, for example, are used accordingly, independent of other 4- or 5-digits units below. This procedure makes it easier to maintain the aggregation scheme and minimize distortions from understaffed sub-aggregates. In addition, as all answers can be assigned to a 2-digit aggregate, they can be used at any time.

The time series calculated using the balance methodology on the basis of micro-data vary between the theoretical values of -100 and +100.[2] However, each time series can also be converted into an index, as is the case with the ifo Business Climate Index for Germany (Section 3.1). A base year is chosen and the corresponding average of the time series for that year is then set equal to 100. All observations are then converted relative to this value using a rule of three. The index calculation follows a tradition in the economic press, where indexation is used to improve the comparability of time series with different scales.

[2] They are also publicly available for analysis in this form.

Figure 2.1: Aggregation of micro-data until March 2018

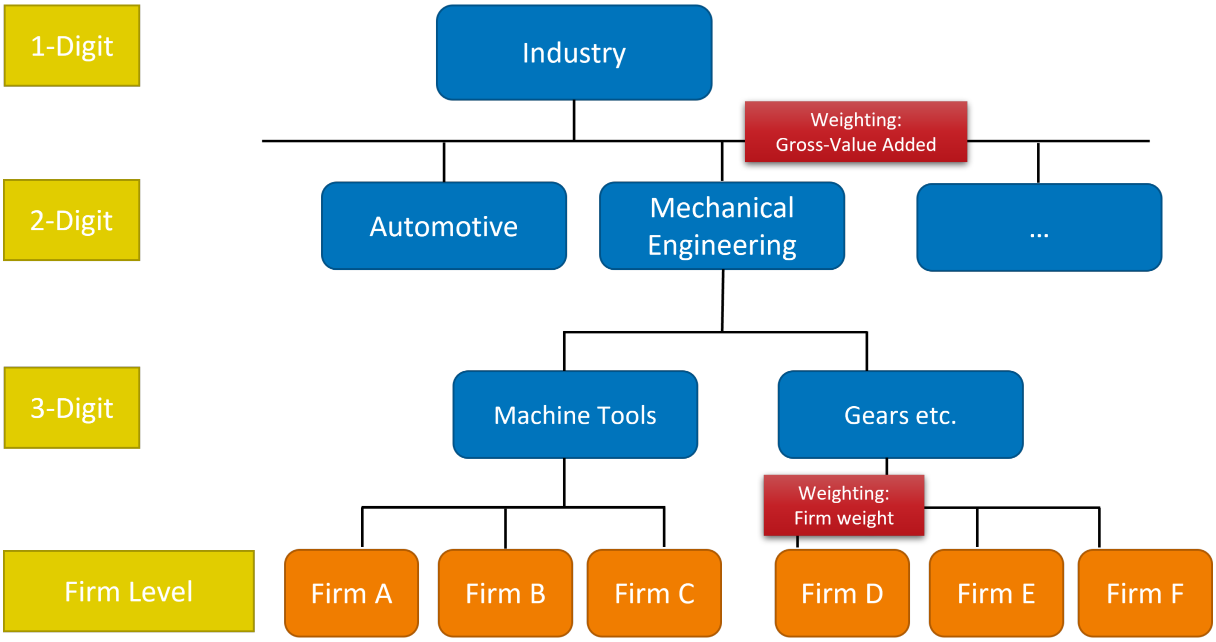
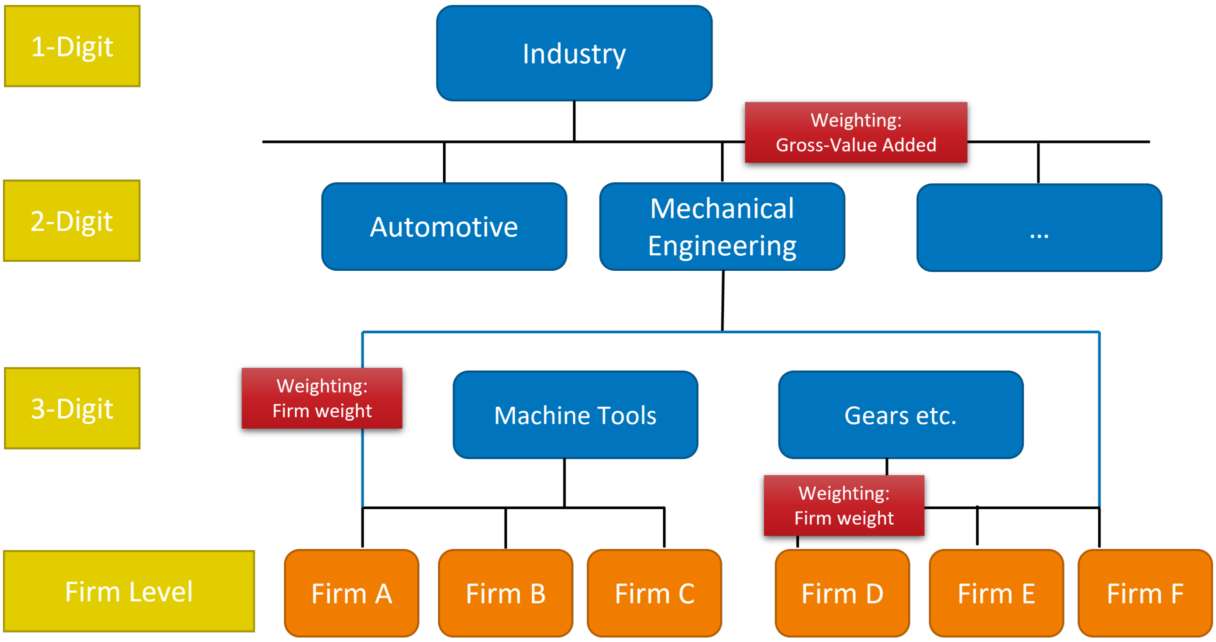


Figure 2.2: Aggregation of micro-data from April 2018



However, indexation is not without its drawbacks. For example, there is no natural reference value. For balances, this is the zero line. A positive balance corresponds to a positive economic development and vice versa. In an indexed series, it is sometimes incorrectly assumed that the reference value for a positive or negative development is 100. However, this only applies in a certain exceptional case, namely if the mean value was 0 in the base year. The reference value is given with the mean value of the base year, which is, however, difficult to read from a graphical presentation. It is therefore recommended to look primarily at the change in the ifo Business Climate Index for Germany or other indexed time series and to compare it with its historical mean.

Another drawback of indexation is that the levels of different indices cannot be compared with each other because their mean values in the base year are usually different. For example, if the index for wholesale is larger than the corresponding index for retail, it could be assumed that wholesale is economically better off. However, this interpretation only applies if the difference between the base year averages is smaller than the difference in the level of the indices. When comparing different time series from the ifo Business Survey, it is therefore recommended to consider the corresponding balances.

2.2.4 Seasonal Adjustment

Stefan Sauer

2.2.4.1 Introduction and Basic Approaches

In numerous economic time series, annual patterns are visible which overlap the interesting trend and cyclical structures. For example, the unemployment rate always peaks in the winter months, or retail sales increase significantly each year in the weeks before Christmas. Causes for such seasonal patterns can be, for example, weather differences or public holidays. To avoid wrong conclusions, these seasonal influences can be eliminated from the time series by seasonal adjustment. This is often necessary also for economic time series derived from surveys. This chapter explains the concept of seasonal adjustment and gives an outlook on its application for the ifo Business Survey.

A detailed summary of the historical development of seasonal adjustment procedures and their methodology can be found in Hylleberg (1992). The basic idea is to split the original time series (O) into systematic components and an irregular component and then to remove the seasonal component. Each of these components has different influences on the time series (Table 2.4). The systematic components in the original values of the time series are usually a trend component (T), reflecting the long-term evolution of the time series, and a business cycle component (C), reflecting cyclical movements with a period of several years. These two components are usually combined to form the so-called trend business cycle component (TC). In addition, the seasonal component (S), an annual effect, is also one of the systematic influences. The component model can either be extended by a weather component (W), which explains exceptional weather conditions or the different intensities of snow and frost in winter, and/or by a working day component (D), which considers the number of working days in a month or quarter. The irregular component (I) includes all previously unrecorded, mainly short-term and random influences on the time series.

Table 2.4: Components of economic time series

Components	Causes
Smooth trend cycle component	Long-term trends and economic movements
Seasonal Component	Annual recurring patterns
Weather component (optional)	Exceptional weather conditions
Workday component (optional)	Different length and working day composition of months/quarters
Irregular component	Short-term fluctuations, singular effects

The individual components can be related to each other in different ways. The most common model approaches are additive time series decomposition, in which the components add up to the original series value O_t at any time t, and multiplicative decomposition:

$$Additive\ \ decomposition: \qquad O_t = TC_t + S_t + (W_t) + (D_t) + I_t \tag{2.1}$$
$$Multiplicative\ \ decomposition: \qquad O_t = TC_t \cdot S_t \cdot (W_t) \cdot (D_t) \cdot I_t \tag{2.2}$$

A seasonally adjusted series then contains only the trend cyclical component and the irregular component after removing the seasonal component and, where applicable, weather and/or working day effects. In the additive model this is done by subtracting the seasonal component, and in the multiplicative decomposition by division.

Since it is not possible to observe the exact characteristics of the individual components of a time series, there is also no objectively correct component decomposition. As a result, there are many different seasonal adjustment procedures, some of which have major methodological differences. The so-called Census models developed by the U.S. Bureau of the Census, which are based on moving averages, are the most frequently used by statistical offices and other institutions worldwide. In Germany, these procedures are applied, among others, by the Bundesbank, the Federal Statistical Office, and for the time series of the ifo Business Survey.

2.2.4.2 X-13ARIMA-SEATS

The basic approach of the Census models was developed with the X-11-method (Shiskin et al. 1967), which was updated in the X-11 ARIMA method (Dagum 1980). The option of forecasts and backcasts from ARIMA models (Auto Regressive Integrated Moving Average) before the actual seasonal adjustment improved the properties at the edges of the time series. The ARIMA approach was further developed by the US Census Bureau in the X-12-ARIMA version, which offered additional diagnostic tools for assessing the performance of the seasonal adjustment. The latest version of the Census procedures is the X-13ARIMA-SEATS procedure (U.S. Bureau of the Census 2013), which is also used in the ifo Business Survey.

Seasonal adjustment with X-13ARIMA-SEATS is based on the following methodology: Apart from the choice of the linkage of the components (mostly additive or multiplicative), no explicit model specifications must be made. In a first step, the time series are extended at the edges by forecasts and backcasts using the ARIMA approach. This allows the seasonal adjustment to be carried out completely with symmetrical seasonal and trend filters, which helps to avoid the distortion of the results by asymmetrical filters. Before the actual seasonal adjustment begins, weather or working-day effects and extreme values – which could lead to an excessive influence of the irregular remainder and thus to distortions when determining the seasonal factors – can be eliminated from the time series using regression approaches.

The calculation of the time series components, which is the core of the seasonal adjustment, is based on various filtering methods using moving averages. First, the smooth component is estimated using a trend filter and removed from the time series, leaving only the seasonal and irregular components. These two components together are referred to as the raw seasonal component. From this raw seasonal component, a seasonal filter based on moving averages is used to eliminate the irregular component and to obtain an estimate of the seasonal component. By eliminating the seasonal component from the original time series, the seasonally adjusted time series is obtained. This procedure is repeated over several iterations until the final component decomposition and thus the seasonally adjusted time series is determined.

Finally, the X-13ARIMA-SEATS procedure offers various diagnostic instruments for the quality of the seasonal adjustment that provide indications of possible optimization potential in the selection of filters or other settings. Among other things, it is tested whether systematic patterns can still be identified in the adjusted series.

The Census procedures have numerous advantages. The various options for carrying out the individual steps offer a high degree of flexibility. At the same time, however, because of these numerous options the procedure is also sometimes criticised for a lack of clarity or even for a vulnerability to manipulation. Detailed documentation of the settings used is therefore fundamental.

Model Selection of the Component Decomposition

The component decomposition is usually chosen out of the two most common approaches: the additive or the multiplicative model. In the additive model, the individual components add up to the original time series. The seasonal components and the irregular remainder

Table 2.5: Basic features of the X-13ARIMA-SEATS procedure

	Steps	Method
1. Preparatory steps	Extending the time series for the avoidance of end point bias problems	ARIMA approaches
	Optional elimination of weather and calendar effects, treatment of extreme values	Regression approaches
2. Core process (iterative)	Estimating the trend-cycle component	Trend filters with moving averages
	Calculating the raw seasonal component	Elimination of the estimated trend-cycle component from the unadjusted time series
	Estimating the seasonal component	Seasonal filters with moving averages
	Calculating the seasonally adjusted time series	Elimination of the estimated seasonal component from the unadjusted time series
3. Quality diagnosis	Searching for eventually remaining seasonal or calendar effects	Statistical tests and spectral analysis
	Examining the appropriateness of the chosen model options	Calculation of various indicators

are therefore absolute deviations from the level of the trend economic component. In the multiplicative model, however, the original time series is presented as a product. The individual components reflect relative influences. A seasonal factor of 1.05 in one month would raise the time series level by five percent. The absolute increase thus depends on the current level of the time series. The multiplicative model therefore implies a relationship between the seasonal fluctuation patterns and the time series level. If no evidence for this can be found, the additive model offers the advantage of easier interpretation of the individual time series components. Furthermore, the multiplicative model can only be applied to time series with exclusively non-negative values. This is not the case, for example, for many time series of the ifo Business Survey.

Selection of Trend and Seasonal Filters

To approximate the smooth trend-cycle component, various filters based on moving averages are used (Ladiray and Quenneville 2001). Moving averages of a time series X_t can be written in the following form:

$$M[X_t] = \sum_{k=-p}^{+f} \theta_k X_{t+k}$$

Decisive for the result of the filtering process are the choice of the weights and the definition of the parameters p and f. Usually a symmetrical range is chosen ($p = f$). The whole range then contains an odd number of values. As a default setting for the moving averages, 13 values are selected for monthly data ($p = f = 6$) to filter oscillations with periods of less than one year from the time series. The 2x12 moving average is used in the first iteration stages. This minimizes the distortion caused by any extreme values present in the series. On the last iteration, however, a Henderson filter is used (Henderson 1916). The variability of this depends decisively on the selected range: The shorter the range chosen, the less smooth is the trend economic component. The weights of these filters are shown in Table 2.6.

The filter for the calculation of the seasonal component is also based on moving averages. Therefore, 12 sub-series are first formed from the raw seasonal component, in which the values of the same calendar months are combined (for quarterly values, four sub-series are formed accordingly). For the estimation of month-specific seasonal vectors, 3x3, 3x5, 3x9, and 3x15 moving averages are available as standard. In addition, a stable seasonal filter is available, which calculates the average of all values for the same month. It assumes that the seasonal pattern is constant and does not change over the years. The weights of various filters are shown in Table 2.7. The advantage of bigger ranges is a better stability of the results with less revisions. However, the risk of not eliminating all seasonal patterns from the series also increases.

Table 2.6: Moving averages for trend filters

Filter	2x12-moving average	13-term-Henderson-filter	9-term-Henderson-filter	7-term-Henderson-filter	5-term-Henderson-filter
θ_{t-6}	1/24	-0.019			
θ_{t-5}	1/12	-0.028			
θ_{t-4}	1/12	0.000	-0.041		
θ_{t-3}	1/12	0.066	-0.010	-0.059	
θ_{t-2}	1/12	0.147	0.118	0.059	-0.073
θ_{t-1}	1/12	0.214	0.267	0.294	0.294
θ_{t}	1/12	0.240	0.331	0.413	0.559
θ_{t+1}	1/12	0.214	0.267	0.294	0.294
θ_{t+2}	1/12	0.147	0.118	0.059	-0.073
θ_{t+3}	1/12	0.066	-0.010	-0.059	
θ_{t+4}	1/12	0.000	-0.041		
θ_{t+5}	1/12	-0.028			
θ_{t+6}	1/24	-0.019			

Table 2.7: Moving averages for seasonal filters

Filter	θ_{t-5}	θ_{t-4}	θ_{t-3}	θ_{t-2}	θ_{t-1}	θ_{t}	θ_{t+1}	θ_{t+2}	θ_{t+3}	θ_{t+4}	θ_{t+5}
3x3-Moving Average				1/9	2/9	3/9	2/9	1/9			
3x5-Moving Average			1/15	2/15	3/15	3/15	3/15	2/15	1/15		
3x9-Moving Average	1/27	2/27	3/27	3/27	3/27	3/27	3/27	3/27	3/27	2/27	1/27
stable filter	Average of all values with the same calendar month										

Treatment of Weather Influences

Many time series are closely related to weather conditions. Especially in the construction industry, but also in other sectors – such as the transport industry or some trade sectors – weather can be an important factor. The influence can be estimated with simple regression calculations using the number of rain-days in a month or other weather indicators as dependent variables (Hielscher and Enkelmann 2014).

However, critics of weather adjustment argue that the influence of the weather should remain visible in the seasonally adjusted time series, as it is a key determinant in the economic assessment. The Statistical Office of the European Union also specifies in its guidelines on seasonal adjustment that weather influences should not be suppressed in the adjusted series (Eurostat 2009). Most economic time series, such as the official statistics published by the Federal Statistical Office, are therefore published without weather adjustment. Also in the ifo Business Survey the weather adjustment has been waived.

Treatment of Working-Day Influences

The different number of working days in a month can be another influence in economic time series (Bell and Hillmer 1983), since they can have a significant impact on production, orders, or sales. Therefore, an adjustment for working days is often useful. The resulting time series are then independent of the length or composition of the months or quarters (number of Mondays, Tuesdays, etc., and number of working days, weekends, and public holidays).

As with the weather component, the workday component is calculated using a regression approach. This is usually done by using the number of working days per month or quarter as an independent variable.

2.2.4.3 Evaluation of the Seasonal Adjustment

Since the "true" seasonal component can't be observed in reality, the quality of a time series decomposition can only be assessed by means of comparative statistical criteria, such as the stability of the results or by analyzing the correlation with target time series (Goldrian and Lehne 1999). By definition, the most important characteristic of a seasonally adjusted time series is that it no longer contains any recognizable seasonal effects. In addition to purely graphical observations, which can already provide initial information about possible annually repeating structures, the results can be analyzed by spectral analysis or with an F-test for still existing seasonality (Higginson 1976). X-13ARIMA-SEATS, for example, performs these tests by default and issues a warning if necessary. The parameter settings of seasonal adjustment methods should therefore always be selected in such a way that no seasonal structures remain in the results.

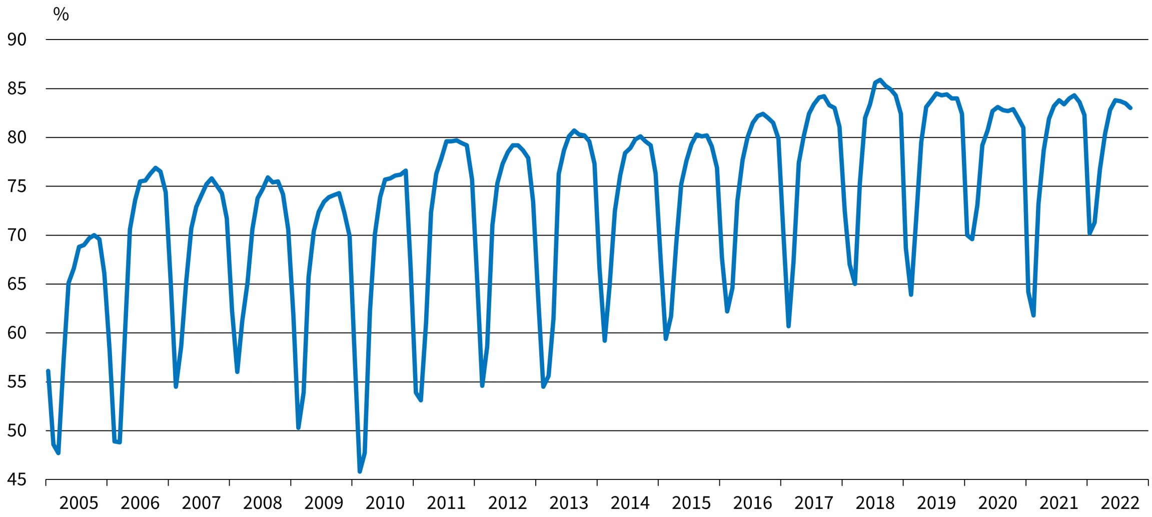
There are some further desirable characteristics of seasonal adjustment. For instance, economic indicators should not be subject to major revisions after publication and should contain clear indications of the economic cycle. In all seasonal adjustment procedures, changes in the adjusted series vary in strength if new values are included. However, as values should normally change as little as possible after their first publication, the suitability of a seasonal adjustment procedure is assessed on the basis of criteria that aim, among other things, at the extent of revisions caused by the inclusion of current series values. The adjustment process must therefore ensure a high degree of stability of the results. In particular, any economic trends or turning points initially indicated should not change afterwards. This means that if, for example, a value rises from one month to the next, this development should continue even after any revisions. Various comparative measures can be used to quantify the extent of the revisions. These are discussed by Schips and Stier (1975).

Although the stability is a criterion with high priority, the effects on the informative value and the forecasting characteristics of the time series should not be disregarded. In particular, the correlation with interesting target figures, for example in the context of economic forecasts, is of great importance. However, forecasting quality and stability are usually contradictory objectives. Therefore, a compromise must be found choosing the settings of the seasonal adjustment procedure. The importance of the two criteria has to be defined individually depending on the issue at hand.

2.2.4.4 Seasonal Adjustment in the ifo Business Survey

Many time series from the ifo Business Survey show a clear seasonal pattern. Figure 2.3 shows the capacity utilization in the construction sector which decreases noticeably each year during the winter months and begins to rise again to a considerably higher level in spring, when the weather conditions are more favorable for construction activities. Due to such seasonal patterns, seasonal adjustment is necessary for a better interpretation of the time series. Therefore, the ASA-II method has been used for decades (Danckwerts et al. 1970). In 2015, however, the seasonal adjustment method was changed to the previously described X-13ARIMA-SEATS method (Sauer and Wohlrabe 2015). This increases the comparability with official statistics, while offering the advantage of being able to respond more flexibly to the individual characteristics of different time series, such as changing seasonal patterns.

Figure 2.3: Capacity utilization in the construction industry before seasonal adjustment



Source: ifo Business Survey. © ifo Institute

The seasonal filters can be chosen individually for all time series. They are chosen as widely as possible to ensure the greatest possible stability of the series in terms of revisions, provided that no seasonal patterns can be detected after the adjustment. Even the seasonal filter, which assumes a stable seasonal pattern, also proves to be appropriate for some time series. The filter settings are reviewed regularly and can be easily adjusted if necessary for the case of changing seasonal patterns.

According to international standards, weather adjustment is no longer part of the adjustment process. Due to the detection of calendar effects in some time series, however, the seasonal adjustment also includes a working day adjustment, though these calendar effects are only detectable in some variables that refer to the current or previous month. The working day adjustment is therefore limited to the current business situation and the previous month's development of production and demand. Other variables, such as business expectations, production, or employment plans, which relate to future developments, do not have any visible working day effects and are therefore only seasonally adjusted.

Analyses of the adjustment procedure have revealed the excellent characteristics of the adjusted time series. These include a high stability in terms of revisions and a strong correlation with significant economic variables (Henzel 2015).