30 Seasonal adjustment as a tool for analysing economic activity

The use of seasonally adjusted time series has long been customary in business cycle analysis. The Bundesbank started to publish seasonally adjusted statistics on a regular basis as long ago as 1963. Since 1968 it has been making such data available in the Statistical Supplements to the Monthly Reports of the Deutsche Bundesbank (Series 4). Other institutions have likewise been publishing seasonally adjusted business statistics for a fairly long while. Even so, it is often only the unadjusted figures and their change from the corresponding period of the previous year that are discussed in public. The reserve evident with regard to seasonally adjusted figures is presumably due in part to the fact that they are the outcome of statistical estimation procedures, whereas the unadjusted figures are considered to be ascertained objectively and therefore reliable.

Different seasonal adjustment methods, no matter how carefully they have been worked out, do not always yield identical seasonally adjusted figures if applied to the same time series. Even if the same seasonal adjustment method is applied, there may be major revisions, particularly towards the end of a time series, when new monthly or quarterly figures are included in the calculation and possible shifts in the seasonal movement are thus taken into account. Hence seasonally adjusted figures remain provisional for longer than unadjusted figures, which are also subject to revision.

However, the imperfections necessarily associated with seasonal adjustment should not be overrated. Experience has shown that most time series of economic data are subject to more or less pronounced seasonal fluctuations. If only the current changes in the unadjusted figures are observed, this may lead to a false assessment of the direction of the trend. Unemployment, for instance, increases every year during the winter months. Changes of this type do not necessarily permit conclusions to be drawn as to the cyclical trend, any more than does the decrease in unemployment during the spring or in the autumn. The attempt to solve the problem of seasonal fluctuations by analysing the changes in the unadjusted figures compared with the corresponding period of the preceding year is based on the notion that the seasonal factors are of the same magnitude in both the current year and the previous year. But a comparison with the previous year is of little informative value whenever the figure for the preceding

year was either particularly high or particularly low owing to special factors. Above all, however, it must be remembered that the change from the previous year's figure depends on developments over the last twelve months and not solely on those in the most recent past which are actually to be assessed. It would, for example, have been wrong to conclude from the fact that in the first few months of this year the cost-of-living index was below last year's level – i.e. that the rate of change from the same month of the previous year showed a minus – that the price trend at the consumer level was still pointing downwards. In fact, the seasonally adjusted monthly figures reveal that consumer prices started to rise as early as November last year, only the preceding decline was not yet fully offset.

Reliable conclusions about current economic trends and turning-points in the business cycle can be drawn with a relatively short time-lag only if the last few months of a time series are considered in the way they would have been in the absence of seasonal fluctuations. Whenever seasonal factors are present, this crucial information for short-term economic analysis can only be obtained by seasonal adjustment. Of course, a "seasonally adjusted" series cannot be expected to be completely "smooth". These series too usually show short-term fluctuations which are frequently attributable to one-off, mostly random influences, but which may also include imperfections in the seasonal adjustment procedure in individual cases. The seasonal adjustment method can only filter out the usual seasonal variations, i.e. those to be expected in normal circumstances, from the movements of the time series. The effect of irregular influences, by contrast, is still present in the seasonally adjusted figures. The greater the significance of such influences is, the less smooth the seasonally adjusted series can be. However, these irregularities include not only random disturbances of the course of the business cycle, but also often special movements which can be explained in economic terms, such as reactions to economic policy measures, the placing of large-scale orders and the effects of strikes or of exceptional weather. A sudden upward or downward swing in the seasonally adjusted figures provides evidence of such influences.

In the present article the seasonal adjustment method long used by the Bundesbank is outlined anew against the background of the experience gained in the last few years. It is intended to show which margins of uncertainty exist and how the method is applied in order to obtain results which are as informative as possible.

Rationale of the Census Method

Since 1970 the Bundesbank has been using the Census Method, which was developed by the US Bureau of the Census and is now being employed in many countries. Over the years the Bank has extended the initially used original X-11 version of this method in some respects by including some additional options for the user; this has made it possible to improve the results without changing the basic methodological structure. (Details are given in the annex to this article.) On the whole, the method has proved so successful that there has hitherto been no reason to change to one of the numerous new approaches which have been developed of late.

The Census Method was briefly described in these Reports in March 1970,[1] so that only its rationale and those of its stages which are of particular significance in the practical performance of the seasonal adjustment need be outlined here. It is based on the perception that, in principle, economic time series can be broken down into three components: the *trend* (which includes not only the long-term tendency but also cyclical fluctuations in the series level), the *seasonal component* (i.e. the fluctuations recurring every year with approximately the same strength) and the *irregular component* (which encompasses all the influences which cannot be explained by the trend and the seasonal component).[2] Firstly, the method permits the assumption that the original series is equivalent to the sum total of the three components. In this *additive* variant the absolute size of the seasonal and irregular fluctuations is considered to be independent of the trend level. (The weather-related rise in the number of unemployed in winter is thus largely independent of the level of this series.) Alternatively, a *multiplicative* relation is possible. In this variant it is assumed that the seasonal and irregular influences in the individual periods (months or quarters) are dependent on the

1 See "Seasonal adjustment by the Census Method" in Monthly Report of the Deutsche Bundesbank, Vol. 22, No. 3, March 1970, p. 37. A detailed description of the method is contained in Technical Paper No. 15, The X-11 Variant of the Census Method II Seasonal Adjustment Program, US Department of Commerce, Bureau of the Census, US Government Printing Office, Washington D.C. 1965.

2 Much of the irregular component can often be explained by working-day variations. For example, output or turnover in October is larger when that month has four weekends (and thus 23 working days) than when it has five weekends (and thus only 21 working days). This relationship can be quantified with the aid of regression equations and a separate working-day component can be estimated for each month. Seasonal adjustment is then performed on a time series from which these components have already been eliminated. For series with strong working-day influences, the quality of the seasonal adjustment depends heavily on the correct estimation of these influences. The Bundesbank's approach in this context is described in the annex.

trend level. (The seasonal rise in retail sales in December is all the greater, the higher the trend level is.) It has been found that in the great majority of cases the multiplicative version records the actual relationship more correctly. In the following sections, therefore, this type of relation between the components is assumed.

In the ideal case of a constant multiplicative seasonal movement, the seasonal fluctuations in every month or quarter correspond to a specific percentage, which remains unchanged over the years, of the trend. This ideal case hardly ever occurs, of course; in empirical series, in fact, the assumption is normally warranted that the seasonal fluctuations gradually change in percentage terms from year to year. It is in the ascertainment of these specific percentages, the *seasonal components* of the individual months (quarters), that the crucial problem of seasonal adjustment lies. Once the seasonal components have been determined, the seasonally adjusted figures can be directly computed with their aid from the observed figures.

The problem of seasonal adjustment is basically the same for quarterly figures as for monthly figures. There are versions of the Census Method for both types of series.

It has turned out to be a key advantage of the Census Method that it is based on a simple model which translates the rationale outlined above into concrete computing steps. Although the method consists of a long calculating process, the result is ultimately determined by only a few readily comprehensible stages. The easy intelligibility of these stages is useful in two respects: on the one hand, the user of the method can recognise to what extent the formal arithmetical operations chosen are appropriate to the actual case; and on the other hand, the results are easier to interpret.

According to the basic model of the Census Method, the seasonally adjusted series is ascertained in the following stages:

1. Determination of a *trend line* as a basis for measuring the seasonal fluctuations in the individual months.

2. Calculation of the percentage deviations of the unadjusted figures from the trend. These deviations include the seasonal component which is to be identified, as well as irregular influences superimposed on the trend and the seasonal component and the errors to be expected in estimating the trend. The deviations of the unadjusted figures from the trend are thus the seasonal components distorted by irregularities; they are therefore designated as *"unmodified" seasonal components* (see the chart opposite).

3. Approximate elimination of the irregular influences in the unmodified seasonal components by the calculation of weighted moving averages for months with the same name. This yields the *"final" seasonal components.*

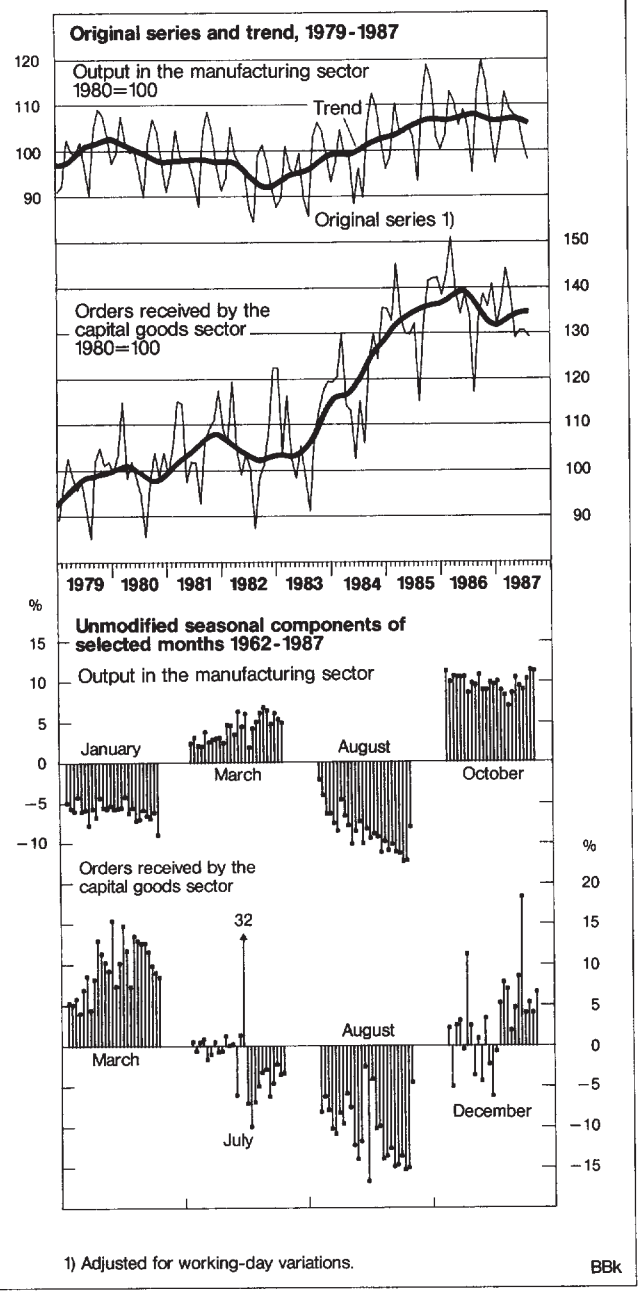
4. Calculation of the *seasonally adjusted series.*

Control of the method

By far the largest part of the calculating procedure serves to ascertain, with the aid of moving averages, a trend which is undistorted (as far as possible) for calculating the unmodified seasonal components. Nevertheless, it has been found in practice that the results depend less on the trend calculation than on the manner in which the final seasonal components are derived from the unmodified components. Economic time series are so diverse that the moving averages cannot be computed according to a uniform formula. Instead, a solution must be found which is appropriate to the special features of each individual series. The decision is easiest when the movement of the unmodified seasonal components warrants the assumption of stable seasonality on which only random irregularities are superimposed. In this case it is in principle sufficient to calculate an average of all the unmodified seasonal components for the month in question.

If the scale of the normal seasonal fluctuation changes, the irregular influences are much more difficult to eliminate. In this case a different *type of average calculation* may be appropriate for every time series and also for different months. Whether the moving averages for a certain month should be based on a few or on more unmodified seasonal components must be decided not only according to the pace at which the seasonality changes but also according to the size of the irregularities observed. The more the unmodified seasonal com-

Ascertaining the unmodified seasonal components in the Census Method



ponents fluctuate from year to year, the broader the base must be, i.e. the more unmodified seasonal components must be included in a moving average to achieve an adequate reduction of the irregular influences. This does not pose any problems as long as the unmodified seasonal components shift only gradually. If the seasonal behaviour changes relatively quickly, however, a narrower base would be required to record the actual seasonal influences correctly at the end of the series too. It may therefore be necessary to find a compromise between adequate smoothing and rapid adjustment.

With the standard options envisaged for normal contingencies, the seasonal adjustment programme uses moving averages over seven annual figures; for the last few years of the period of calculation, averages with narrower bases are used, the marginal values having greater weight. The final seasonal components at the end of the series are therefore normally corrected somewhat when new figures are included in the calculation, whereas there are hardly any changes for earlier periods. Subsequent changes to the seasonal estimate become smaller if longer moving averages (e.g. eleven years) are used.

If major irregularities cannot be adequately offset with the aid of the moving averages, they must be replaced in a suitable fashion as "extreme values". In the Census Method this is done by a procedure which initially uses formal criteria. Since the analyst often knows the causes of the more deviant figures in particular, he can check whether precisely those figures are eliminated in which exceptional factors (e.g. a strike) are being reflected. If this is not the case with the standard options, he has a chance to vary the yardstick for eliminating extreme values.

The choice of the options for the elimination of extremes and the determination of the degree of flexibility of the final seasonal components are the two most important decisions to be taken when employing the Census Method. Particularly at the recent end of the series, on which the current analysis of economic activity concentrates, estimation of the final seasonal component may be impaired by the use of inappropriate options. It should therefore always be checked whether the seasonal components, as ascertained, are in fact adequate estimates of the "normal" seasonal fluctuations, which, according to the objectives of the method, are to be eliminated from the original series.

First of all, this check can be carried out by comparing the final seasonal components with the unmodified ones and by looking at the results of the replacement of extreme values. This provides an indication of whether the degree of flexibility of the seasonal components and the replacement of extreme values must be modified. The chart on

page 33 shows that relatively stable seasonality can be assumed for industrial output in October, whereas a faster adjustment is appropriate in August. The use of a more flexible formula – e.g. the calculation of a moving average over three values only – would, however, presuppose the replacement of those unmodified seasonal components which deviate rather sharply from their neighbouring values by suitable figures. The example of orders received by the capital goods sector shows particularly clearly how possible distortions of the seasonal component can be prevented by eliminating extreme values.

To obtain an optimum seasonal estimate, *scope for discretion* must be deliberately exploited. Of course, this does not mean that the results are entirely discretionary; on the contrary, if the method is used appropriately, the scope originally available is systematically reduced. Not only will the intermediate results be considered in this context, they will also be linked up with information which cannot be elicited from the figures of the series. This may, for example, be knowledge as to whether the last figure of the series is likely to be revised and, if so, in which direction; whether special factors were at work in certain months; or whether facts are known (such as new holiday arrangements or changes in the law) which make a lasting change in the seasonal pattern probable.

In addition to such information on the series in question itself, comparisons with other related series are useful. Thus the comparison of an aggregate (e.g. new orders received by industry) with its components often yields valuable insights. If the seasonal adjustment is performed separately, marked deviations between the seasonally adjusted aggregate and the sum of its seasonally adjusted components suggest that the seasonal estimates for one or more series could be improved. Major differences in individual months can be examined selectively and reduced by changing the options used. If the index of orders received and the partial indices for domestic and foreign orders are adjusted for seasonal influences separately, the decision as to whether a specific figure in the overall index is to be considered an extreme value may be facilitated if a special movement can be detected in a partial series. Moreover, the plausibility of the seasonal estimation can be measured by comparison with other indicators too: in the case of industrial production, for example, by whether the data on capacity utilisation move in a similar fashion; or the extent to which seasonally adjusted construction output fits in with the data available on the weather, cement shipments or short-time working in the construction sector can be checked.

Even when a specific movement in the unmodified seasonal components can be explained objectively, there are some cases in which it is impossible to find a set of options which takes full account of the relationships. This problem arises if a series deviates too sharply from the model concept, according to which seasonal fluctuations which do not change at all, or at most change gradually, from year to year and irregular movements whose direction and magnitude change continually are superimposed on a smooth trend. If a given month in successive years is influenced in the same way by irregularities or if the normal seasonal fluctuation changes abruptly, rather than slowly, from one year to the next, then it becomes difficult to separate seasonal and irregular influences. Construction output, for example, may be adversely affected by particularly cold weather in the same month in three consecutive years. Except in the special case of stable seasonality, it is hardly possible to identify the relevant unmodified seasonal components as extreme values by means of the method; they are therefore included, at least in part, in the estimation of the final seasonal components and depress it at the end of the series, even though the lower construction output in that month is attributable not to a change in the normal seasonal pattern but to exceptional weather conditions recurring in several successive years. Seasonally adjusted output would thus be shown too high. By choosing as low a threshold as possible for eliminating extreme values and as long a moving average as possible, an attempt must be made to limit the incorrect estimation of the seasonal component; however, this cannot always be achieved completely.

Assessment of the margin of uncertainty

The examination of the intermediate results and the use of additional information not only make it easier to choose suitable control options, i.e. to adjust the major stages of the procedure in optimum fashion to each series. At the same time the user gains an idea of how regular the monthly movements were in the past and how accurate the

seasonal estimate can therefore be. He can assess approximately within which limits the "correct" seasonally adjusted value probably lies. This margin of uncertainty is much smaller than the range of results which the method may produce if the control options are utilised to their full extent. After all, many options can definitely be ruled out as not being appropriate.

The actual margin of uncertainty at the end of the series can be roughly assessed by the size of the oscillations in the seasonal movement in the latest few years. After taking account of the reasons why the latest unmodified seasonal components were above or below those of the preceding years, a picture can be obtained of the limits within which the normal seasonal movement is to be put. Such limits are of course not to be understood as an interval within which the "correct" value is to be expected with a definite, quantifiable degree of certainty. They may vary greatly from month to month within the same series and even in months with the same name in consecutive years, for example when a new seasonal pattern is to be expected but has not yet completely settled down.

The fact that the user of the Census Method can influence the result through the options is sometimes regarded as a disadvantage because, it is claimed, the seasonally adjusted figures thus contain a subjective element, whereas other methods which cannot be controlled in this way yield "objective" results. This view disregards the fact that the ascertainment of seasonally adjusted figures is necessarily a procedure in which certain assumptions, e.g. on the stability of the seasonal figure, are bound to be made. In methods without control options, these assumptions are all included in the instructions for the calculation, while in the Census Method the user can adapt them to the special features of a series. For example, in methods which offer no options, the function by which the unmodified seasonal components are smoothed is firmly predetermined or is varied within the method according to specific criteria; in the Census Method the user can choose from several options. This does not rule out the possibility of his accepting the standard version offered by the method or taking his decision on the basis of variables calculated by the method. In addition, however, he can take advantage of his economic expertise and deliberately take his decision in such a way that, particularly at the end of the series, the seasonal estimate is as correct as possible. He thus has a chance of achieving an improvement over "automatic" methods. A loss of informative value would only be likely if the control options were deliberately abused so as to manipulate the results by choosing the wrong options against the user's better judgement; it need not be stressed that this is out of the question in a method which must remain capable of being checked and substantiated.

The spread between the results of different control options shows which differences in the seasonally adjusted series may result from different assumptions, among which the user can choose. In the case of automatic methods, the only reason why such a spread does not become apparent is that a certain set of assumptions is defined from the outset. Hence the existing scope in the Census Method only makes the uncertainties basically inherent in seasonal adjustment manifest, but it is not an indication that this method is less reliable than others.

Updating the seasonal estimation

The Census Method not only calculates the final seasonal components up to the end of the time series but also forecasts the seasonal pattern (not the trend) for one year ahead. If additional original figures are adjusted for these extrapolated components, seasonally adjusted figures are obtained without it being necessary to perform the extensive calculation process once again. In view of the significance of the values at the end of the series for the analysis, the Bundesbank carries out a new seasonal estimation of all major series for control purposes if an additional series figure becomes known. Thus an additional unmodified seasonal component is always available for the latest month. This new information is of particular value when there have been major changes in the seasonal pattern in the recent past or when the unmodified seasonal components of the month in question have repeatedly been disturbed by special factors in previous years and therefore do not provide a clear picture of the current level of seasonality. Unless the additional figure itself is atypical, the forecast seasonal component can be confirmed or, if necessary, corrected by the new calculation. In the latter case, the component estimates for other months may change as well. The effects of a new estimation tend to be all the

greater, the shorter the moving averages are by which the unmodified seasonal components are smoothed.

It has been found in practice that in most cases it is not advisable to replace the previous seasonal estimation by the result of the control calculation. The deviations from the old calculation are often only small. Seasonally adjusted series are therefore recalculated only if twelve months have elapsed since the last estimation of the components, unless the current control calculations indicate that an earlier recalculation is desirable, for instance because of a major change in the seasonal figure.

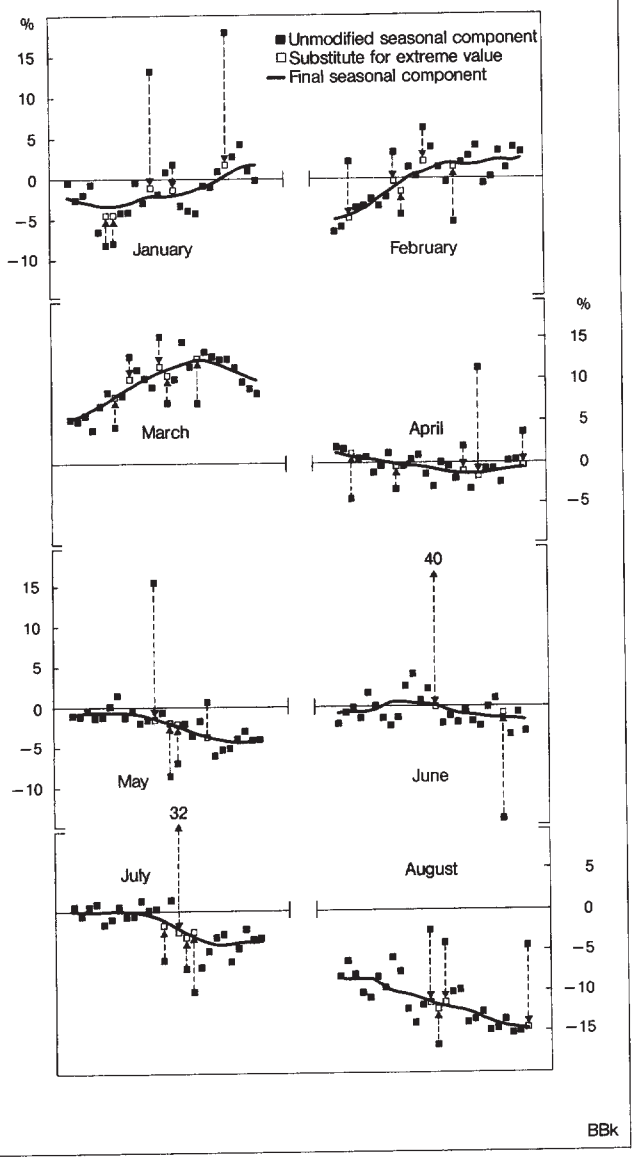
Example of determining the control options

In order to illustrate how the user can judge in a given case which control options are appropriate, the chart on page 37 shows the unmodified and final seasonal components for the index of orders received by the capital goods sector for several months. This series offers much less favourable preconditions for seasonal adjustment than do many other economic indicators which are characterised by a stable seasonal movement and comparatively few irregular factors. The series shown was chosen as an example because it displays both a comparatively strong irregular component with numerous extreme values and some distinct changes in the seasonal fluctuation, so that the problem of an appropriate smoothing of the unmodified seasonal factors is particularly pronounced. In the individual months the picture varies as regards both the distribution of the values and their change over time. Whereas, for instance, in January and February the unmodified seasonal components are dispersed rather widely from year to year, in May – apart from a few outliers – they move rather closely around a midway line. In some months, such as April and June, the seasonal level seems to have changed only slightly over time, while in others, for example March and August, distinct shifts are apparent.

In view of the pronounced irregular fluctuations, the seasonal components were smoothed relatively strongly for all months. The seasonal pattern seems to change only gradually; in this respect too a relatively slow adjustment appears to be justified. Nevertheless, doubts might arise as to whether the seasonal components calculated, say, for March and April at the end of the series are still appropriate. The fact that a certain shift between these two months in ordering activity was found in the preceding years initially suggests that a faster adjustment should be chosen. On the other hand, some indications imply that a more cautious change in the estimated seasonal level is advisable. The unusual cold spell in March 1987, which impaired activity in several economic sectors, may have resulted in a reduced inflow of orders to the capital goods sector. The particularly low level of orders reaching road vehicle manufacturers furthermore suggests that the March 1987 figure was depressed much more than that for April by the fact that some orders for catalytic converter vehicles originally planned for the beginning of this year were brought forward to the end of 1986 in connection with the tax relief for such vehicles. In March 1986, too, non-recurring special factors may have been at work. The relatively low figure at that time was mainly due to particularly sluggish foreign demand; a key factor in this was probably the shift in orders in connection with a change in central rates in the EMS that was originally expected for that month. Since the unmodified seasonal components for March used to fluctuate rather sharply in the past, it is not impossible, either, that the relatively uniform downward trend of the past few years has been more or less accidental. In all, therefore, the comparatively slow adjustment seems to be justified. The April 1987 figure appears to have been inflated by the fact that orders not placed in the first quarter of the year were made good then. This figure is thus rightly eliminated as an extreme value. If it is disregarded, the final seasonal component at the end of the series seems to be appropriate for April too.

The elimination of extremes which was performed in this example with the standard version appears to be satisfactory. Not all of the extreme values which were replaced can be put down as unambiguously to special factors as can, for example, the particularly high January 1983 figure, which was due to the investment grant scheme in force at the time. But also in the case of the other unmodified seasonal components which were eliminated by the method as being extreme, the substitutes ascertained are likely to favour the formation of an adequate average. Particularly at the end of the series, no case can be found in which disturbing extremes would have to be eliminated in addition

Determining the final seasonal components for orders received by the capital goods sector 1962-1987



or in which the substitutes ascertained seem to be inappropriate.

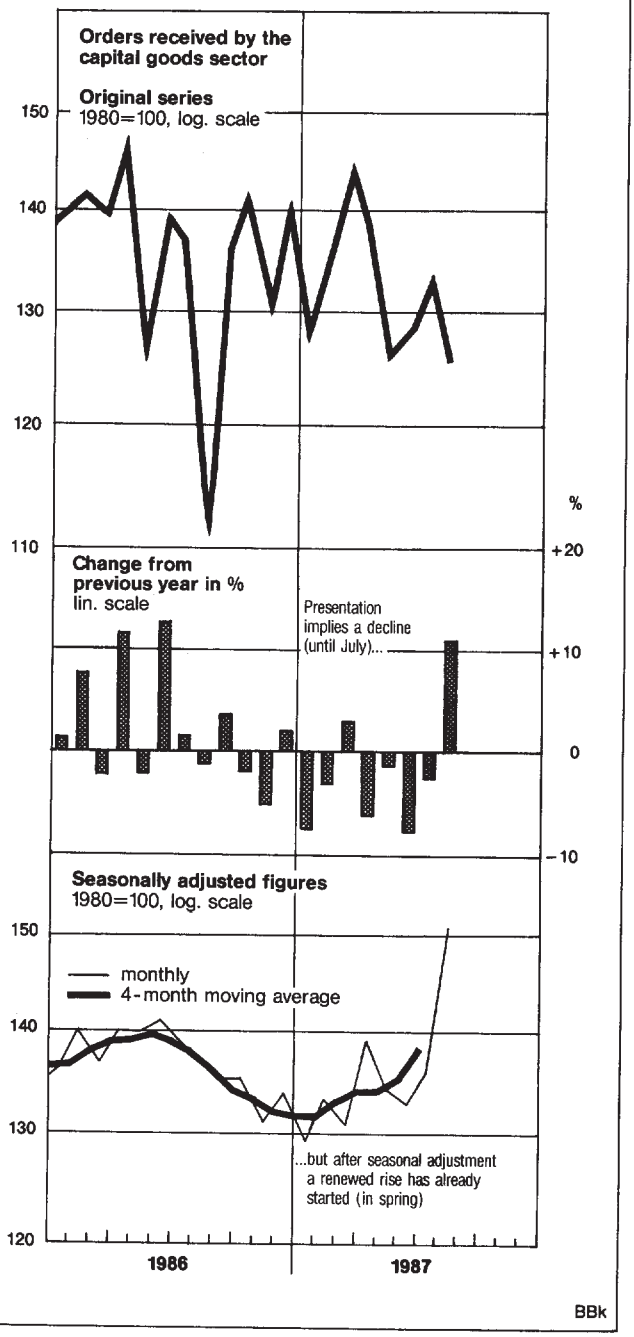
In spite of the fairly pronounced irregularity of the unmodified seasonal components in several months, the above chart shows that the margin within which the normal seasonal influence is to be sought generally comes to little more than 1 percentage point around the estimated seasonal component at the end of the series. The changes in the final seasonal components will also move within these limits in later recalculations. In individual cases, admittedly, somewhat larger deviations may occur. For March, for instance, it is not impossible that the decrease in the seasonal component observed in the last few years will continue or that the seasonal fluctuation will in future return to the level of the early eighties and that the last three values, which have been particularly low, will prove to be random deviations from this level. In the former case the final seasonal component would have to be put about two points lower and in the latter case about two points higher.

Interpretation of the results

When interpreting seasonally adjusted figures, such unavoidable uncertainties in estimating seasonality must be taken into account. A rise or fall in a seasonally adjusted figure by a few tenths of a point against the figure for the preceding month need not necessarily be the outcome of cyclical factors or non-recurring special influences. Both the latest figure and the previous month's figure may vary slightly if different options – which may be equally justified – are chosen or if the seasonality is recalculated later on. As a result, an equal level or even a change with inverse sign is possible between the two months. It is therefore advisable to view small month-on-month changes in the seasonally adjusted figures with caution and not to analyse them, expressed as an annual rate, as the current cyclical trend, as is often done, especially in the United States (where this approach may be more justifiable, given the larger economic area with a better offsetting of random fluctuations). For this reason the quarterly changes in the seasonally adjusted GNP figures in Series 4 of the Statistical Supplements to the Monthly Reports, for example, are shown rounded to the nearest half percentage point. On the other hand, steadier series – such as the cost-of-living index – more readily permit the conversion of shorter-term changes (over three or six months) to an annual rate.

Uncertainties in estimating the seasonality largely cancel out in most cases if viewed over several months. This is an advantage in the seasonal adjustment of quarterly figures. The mere combination of two monthly figures results in much more certainty in the analysis of cyclical trends because there are many seasonal movements which extend over two consecutive months. For instance, winter sales always take place in January and February but fluctuate from year to year

Alternative presentations for assessing cyclical developments



between these two months as a result of working-day variations; Easter falls in March in some years, but in April in others; in some years the summer holidays are concentrated more in July, in others more in August; and that part of the Christmas sales boom which is brought forward into November can vary from year to year – in each case to the detriment or advantage of the December figure. By combining the two successive figures, much of the irregular component is eliminated and the uncertainties in identifying the current seasonal component also tend to cancel out.

In time series with highly erratic movements, more monthly values have to be combined after seasonal adjustment – not only to smooth out random fluctuations but also to offset uncertainties in estimating the seasonality – than in the case of series with a comparatively weak irregular component. In the charts of the Statistical Supplement (Series 4), moving averages are therefore normally shown in addition to the monthly seasonally adjusted figures; the length of these moving averages is determined by the strength of the irregular component in the series concerned.

Such moving averages provide a sort of auxiliary line which reflects cyclical developments somewhat more reliably than the individual seasonally adjusted figures. Against this, however, a certain loss of topicality must be tolerated at the end of the series. This loss is all the greater, the longer the moving averages are. If only for this reason, it is advisable to show not only the moving averages at the end of the series but also the individual monthly figures from which they have been derived.

The adjacent chart shows that, in spite of the above-mentioned uncertainties, seasonally adjusted figures permit a much more reliable assessment of the economic situation than the original series or its changes from the previous year. According to the chart, the original series for orders received by the capital goods sector (a particularly important series for economic analyses) in the summer months of 1987 was distinctly lower than in spring this year and was also below the level of the second half of 1986; the changes from the same month of the preceding year were likewise negative (until July 1987). The seasonally adjusted series reveals, however, that the cyclical tendency has been pointing upwards since the spring; the downward movement of the original series was thus exclusively due to seasonal factors, and the negative figure in the year-on-year comparison was wholly attributable to the decline in earlier months.

It is sometimes proposed that the trend should be analysed instead of the seasonally adjusted figures. The idea behind this suggestion is probably that in any case seasonal adjustment only

pursues the purpose of bringing out the current underlying trend as clearly as possible by eliminating seasonal fluctuations. It is not kept in mind, however, in this connection that – as noted before – the monthly fluctuations in the seasonally adjusted figures include not only random movements but also in many cases detailed information which can be interpreted in economic terms and which is not discernible in the trend line. Above all, it is overlooked that the trend estimate is uncertain at the end of the series and therefore does not always provide a reliable picture of current tendencies. At turning-points in the business cycle, in particular, there are marked subsequent changes in direction. The seasonally adjusted figures, on the other hand, are far less susceptible to revision, because the seasonal behaviour changes comparatively little.

Annex

The Bundesbank works with its own variant of the Census Method which permits deviations from the X-11 variant in identifying and replacing extreme values and estimating the working-day components. The differences are outlined briefly below.

In its original version the X-11 variant of the Census Method identifies *extreme values* on the basis of the standard deviation of the irregular component, all months of a five-year moving period being taken into account in each case. In practice, however, it has often been found that the variability of the irregular component changes quite considerably from month to month. Specific factors which result in deviations from the normal seasonal movement are only at work in individual months or affect some months more strongly than others.

For example, the differing dates of the summer holidays result in the months of July and August being affected more strongly in some years than in others by cuts in industrial production due to the holidays; in the construction industry exceptional weather conditions cause considerable fluctuations in output only in winter. If – as in the X-11 variant of the Census Method – a uniform yardstick is applied to all months, in the months where the seasonal influence shows greater variability particularly many values will be classified as extreme and replaced. However, some of these values may well be within the usual margin of fluctuation for the month concerned. Conversely, in the months with smaller irregular influences distinct deviations from the normal seasonal level will not be treated as extremes merely because these deviations appear to be relatively small compared with those in the "uncertain" months.

The Bundesbank has therefore developed an option which permits the identification of extreme values as a function of standard deviations which are specific to the months concerned. In this way it prevents extreme values from bunching in particular months and the estimation of seasonality from being based too heavily on substitute values in those months. The determination of the seasonal components is thus made more reliable, particularly at the end of the series.

In the original version of the X-11 variant the *working-day component* is estimated by means of a multiple regression equation in which the irregular component is partly explained by the weekday pattern, i.e. by the number of Mondays, Tuesdays, etc. This approach involves two disadvantages: the first one is that the effect of public holidays is disregarded. If, for example, May 1 falls on a Wednesday, this day is counted just like a "normal" Wednesday in calculating the regression coefficients, and Easter Monday or Whit Monday is treated just like any other Monday. The second disadvantage of the multiple approach is that, for methodological reasons, the weights of the individual weekdays cannot be estimated with the necessary reliability. The weights are therefore not always plausible. For example, Tuesday may receive a distinctly greater weight than Thursday, without any objective reason for this being evident. This may result in the seasonally adjusted series showing implausible changes in a year-on-year comparison. If for instance the unadjusted figure for September is identical with that of the preceding year and the only difference between the two months is that the current September has one Thursday more and one Tuesday less than the previous year's September, then one would expect identity with the preceding year in the seasonally adjusted and working-day adjusted series as well. However, in the example given, a rise against the previous year would result on account of the working-day adjustment, although this rise would not be plausible because the number of working days is the same.

In order to remedy these shortcomings, the Bundesbank has developed a modified approach which as a rule uses only the number of working days in a five-day week (measured as the deviation from the long-term average of the month in question) as the explanatory variable for the irregular component initially ascertained. If, for instance, Easter falls in March, the number of working days in that month is correspondingly smaller and – unlike in the X-11 variant – the working-day component works out correspondingly lower, and thus offsets the decline in the level of the series caused by the smaller number of working days. This programme variant also permits the use of a second and third explanatory variable, through which other factors, such as the number of shopping days in the winter or summer sales, can be included.