The changeover from the seasonal adjustment method Census X-11 to Census X-12-ARIMA

Since the beginning of the 1970s the Deutsche Bundesbank has been using the Census X-11 method developed by the U.S. Bureau of the Census to seasonally adjust time series. It is now the most widely employed technique in the world. In the last few years, the Bureau has extended the programme by incorporating recent developments in the field of time series analysis. These developments were made possible, in part, by advances in data-processing technology. At the present time the new programme, known as X-12-ARIMA, is being used by the European Central Bank to deseasonalise the monetary aggregates for the euro area, which have been published in the ECB Monthly Bulletin as well as in other sources since July 1999.

The new methodology has several advantages over its predecessor, which the following article describes in detail; on the whole, the differences between the seasonally adjusted time series obtained fall within a relatively narrow range. The Bundesbank will be changing over to Census X-12-ARIMA in the near future. A first application of the new methodology is envisaged for the aggregates of the national accounts, beginning with the first-quarter figures for the year 2000. These are to be followed, in stages, by the different monthly economic indicators.

Seasonal adjustment as a tool of economic analysis

Economic developments obscured by seasonal effects

Economic trends cannot, as a general rule, be inferred from direct inspection of the unadjusted values of monthly or quarterly time series. The reason is that in most economic time series differences between successive unadjusted values reflect – *inter alia* – seasonal effects that obscure the underlying economic trend. If, for example, production in the manufacturing sector falls from June to July, the July decline cannot automatically be equated with an economic slowdown since cutbacks in production are normal at the beginning of the summer holidays. The purpose of seasonal adjustment is to eliminate effects that can under normal circumstances be expected to recur at definite times each year; it makes it easier to compare the values of a time series with one another, irrespective of when they occur during the year.

Informative value of year-on-year comparison limited

If the most recent value is compared with the corresponding value a year ago, it is possible to obtain, as an approximation, a time series free of seasonal fluctuations. However, an approach based on a year-on-year comparison suffers from the defect that the rate of change obtained using the two values would include the economic developments of the preceding twelve months. Thus, if the business cycle were to have changed momentum during these twelve months – or if a turning-point in business activity were to have been reached – a year-on-year comparison would be ill-equipped to identify the underlying economic trend at the current end of the time series, i. e. in the last three or six months.

Calendar effects

The recent year-on-year decline of 4.7 % in the unadjusted industrial production figure for July 1999 fails to reflect even the economic developments of the last twelve months adequately, however: a considerable decline was to be expected simply by virtue of the fact that there was one less working day in July 1999 than in July 1998. Like periodic seasonal effects, "calendar effects", which are attributable to variations in the calendar and which affect economic flow data in particular, can be estimated from previous observations in the time series and eliminated. Admittedly, the resulting series, now adjusted for seasonal and calendar variations, allows the desired underlying trend to show through more clearly; even so, differences between the successive values of most seasonally adjusted time series will be caused just as much by irregularities in business activity and other irregular effects as by the business cycle itself. The former include not only random disruptions of business activity but also special factors such as large-scale orders, strikes, and short-term changes in behaviour brought about by government policy measures. Similarly, the effects of unusually strong or weak seasonal fluctuations, e. g. the consequences of extreme weather conditions or atypical holiday constellations, are to be included in the irregular component.

Irregular effects

Trend-cycle component extremely uncertain at end of series

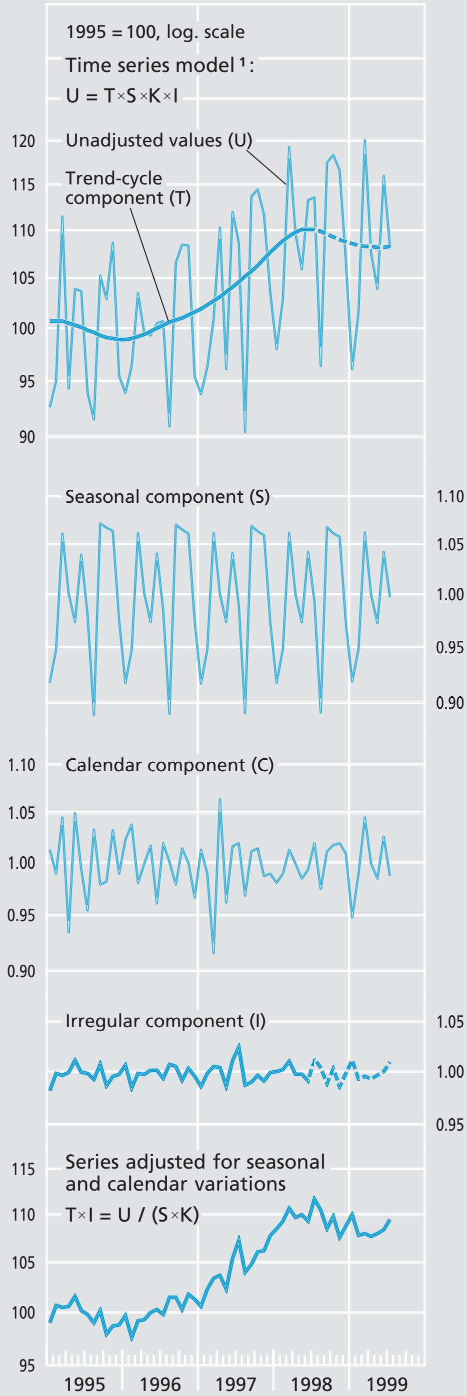
The trend-cycle component, also commonly referred to as the "smooth component" or simply as "the trend", can be identified only after these irregular fluctuations have been removed. Although, theoretically, it is the best suited of all time-series components for the analysis of business cycles, in practice it is seldom used to monitor current economic developments. The main reason for its neglect is that the trend component cannot be estimated without using time-series values for the period subsequent to that for which a trend value is to be calculated. The estimation of such future values is subject to great uncertainty since the preceding values of a series offer no consequential information for the prediction of imminent economic turning-points. Thus forecasting methods typically proceed on the assumption that the most recent basic trend observed in the series will persist. Although this assumption proves roughly true for many periods, it stands in the way of a reliable diagnosis, especially at a particularly sensitive juncture in economic policy-making: when a cyclical turning-point appears at the current end of the series, the estimated trend values at first present a systematically distorted picture, since they continue to point in the direction of the former, now invalidated trend; it is only after a lag of several observation periods that the change in trend finally comes to light. Trend values are therefore unsuitable for monitoring the most recent economic developments.

Seasonally adjusted data better suited for the analysis of current business cycle

By contrast, the use of seasonally adjusted series – where appropriate, adjusted for calendar variations as well – has proven useful for the analysis of current business activity. Since the effects of calendar variations and the set of conditions determining seasonal patterns (e. g. the length of the months, the average difference in temperature between the summer and winter months, the regulations and behavioural patterns determining economic activity) change only very gradually,

Decomposition of a time series into its components

Production in the manufacturing sector



1 Instead of a multiplicative decomposition into components, an additive model is sometimes preferred: U = T + S + C + I.

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the seasonal and calendar effects at the current end of the series – unlike the trend values – may be estimated with relative reliability. This is why a seasonally adjusted series exhibits greater stability in its end values than does the trend and why it is able to provide information concerning possible turning-points in the business cycle after a comparatively minor delay. Still, seasonally adjusted values reflect not only the trend but also irregular effects. Thus the determination of current economic trends on the basis of seasonally adjusted data continues to presuppose a sophisticated understanding of economics. Seasonal adjustment can offer only a tool for analysing current economic activity.

Reasons for the changeover to X-12-ARIMA

X-12-ARIMA: an enhanced version of X-11

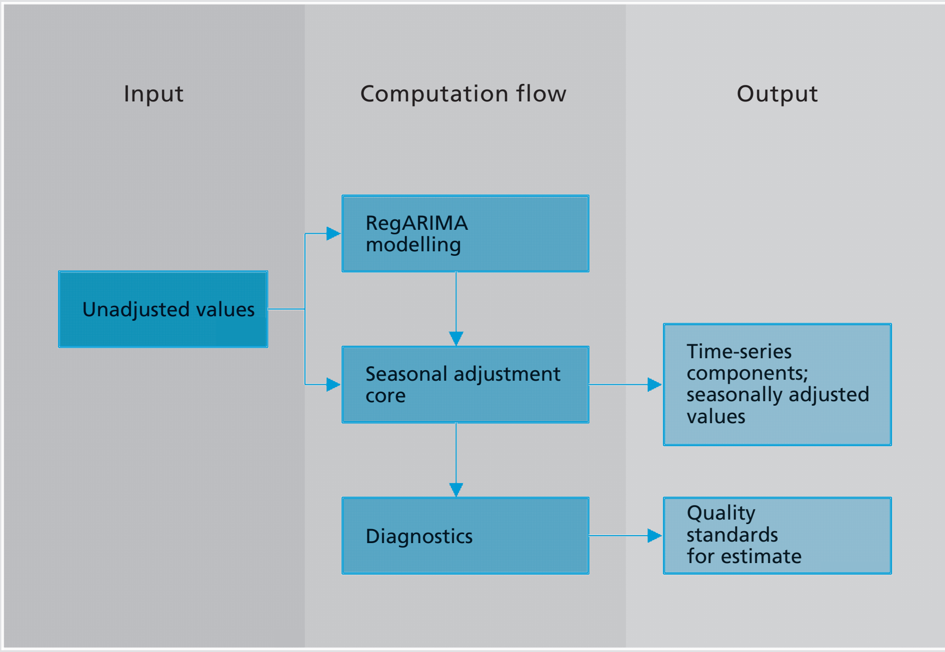
Since 1970 the Bundesbank has been using the X-11 variant of the Census Method II developed by the U.S. Bureau of the Census to estimate seasonally adjusted data; it is arguably the best known and most often used programme for the seasonal adjustment of time series in the world today. The last time the basic structure of this method, the Bundesbank's extensions of it and its concrete applications were discussed at length was in the October 1987 issue of the Monthly Report.[1] In the last few years, there have been numerous enhancements, spurred, in part, by practical experience and, in part, by new statistical estimation methods made possible by advances in data-processing technology. The U.S. Bureau of the Census has incorporated many of these developments in its new seasonal adjustment programme X-12-ARIMA.[2]

Programme overview

The seasonal adjustment programme X-12-ARIMA consists of three parts that build upon one another.[3] At the beginning of the programme stands the part – not to be found in X-11 – which generates mathematical models of the unadjusted series using the RegARIMA technique; this technique combines the tools of regression analysis with the ARIMA (autoregressive integrated moving average) approach. Mathematical criteria are used to characterise certain properties of the time series; this information can, in turn, be employed in the second part for specifying the seasonal estimation procedure. Calendar effects may also be estimated and extreme values identified. The second part of the programme basically consists of the old X-11 programme and is used for seasonal adjustment. If calculations have already been carried out in the RegARIMA part, the estimation of the seasonally adjusted series proceeds from the results of the first part; if not, the unprocessed unadjusted values enter the second stage directly as input. The third part of the programme is equipped with several new

1 Deutsche Bundesbank, Seasonal adjustment as a tool for analysing economic activity, Monthly Report, October 1987, pages 30–39.
2 A detailed description may be found in: R. Kirchner (1999), Auswirkungen des neuen Saisonbereinigungsverfahrens Census X-12-ARIMA auf die aktuelle Wirtschaftsanalyse in Deutschland, Discussion paper, Economic Research Group of the Deutsche Bundesbank, to be published shortly.
3 For more details see D. Findley, B. Monsell, W. Bell, M. Otto, and B.-C. Chen (1998), New Capabilities and Methods of the X-12-ARIMA Seasonal-Adjustment Program, Journal of Business and Economic Statistics, Vol. 16, pages 127–152 as well as U.S. Department of Commerce, Bureau of the Census (1999), X-12-Arima Reference Manual, Version 0.2.3.

Structure of X-12-ARIMA



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diagnostics to test the quality of seasonal and calendar effect adjustment.

Theoretical improvement in the wake of ...

The new Census programme X-12-ARIMA thus represents a genuine extension of the X-11 method: not only does the new programme include X-11 as one of its parts but it also offers adjustment options and diagnostics that are not available in X-11. The diagnostics yield extensive information that can be applied *inter alia* as objective criteria when choosing among an extended range of possibilities (or options) for calculating intermediate data, controlling the flow of the programme's execution, and specifying the estimation procedures. It follows from this fact alone that the substitution of X-12-ARIMA for X-11, provided that the former is used as intended, can have no drawbacks but only advantages.

... programme extension

... new options for ...

New options, in particular, may be expected to yield improvements in the computation of seasonally adjusted data. In keeping with this, X-12-ARIMA makes it possible to estimate calendar effects using RegARIMA models (in the first part of the programme). If no use is made of this option, calendar effects may alternatively be obtained using the X-11 procedure in the second part of the programme. Compared with the old method, the new programme has the advantage that it is based on less restrictive premisses and thus reduces the danger of systematic estimation biases. The RegARIMA approach thus allows for a more reliable calculation of intermediary data adjusted for calendar effects.

... calendar effect adjustment

... treatment of extreme values

Large fluctuations may be observed in many economic time series that have their origin in exceptional circumstances (e. g. large-scale orders, untypical weather conditions, statistical disruptions in the series). If the time-series model used for estimation purposes did not assign such outliers to the irregular component or, where abrupt changes in level are involved, to the trend, the estimation of seasonality and thus of the seasonally adjusted series would be distorted. Experience has shown that severe distortions are especially likely at the end of a series. The proper detection and replacement of outliers is thus critical to ensuring the quality of seasonal adjustment.

In addition to X-11 techniques,[4] X-12-ARIMA has at its disposal RegARIMA procedures for handling extreme values. These procedures not only enable it to determine (unlike the X-11 method) whether data are to be deemed extreme or not but also to discriminate among different types of outlier: individual outliers that are limited to a particular period (e. g. large-scale orders in the "orders received" statistics), changes in level (e. g. the effect of a rise in the mineral oil tax on the consumer price index), and irregular effects that occur abruptly but are slow to dissipate (e. g. a drop in demand following a price increase that levels off over time). The programme's capability for distinguishing among different types of outliers allows it to construct models of economic processes consistent with their causes and thus to provide more reliable estimates of seasonally adjusted data.

Special estimation problems at the end of the series

The current end of a time series poses special problems for the seasonal adjustment of data. The reason is that both the observations prior to the period under review and the subsequent unadjusted values are needed to estimate the seasonal pattern, which changes over time (usually gradually) and which is supposed to represent the "usual" seasonal effects for that period. Thus the estimation of the seasonal component for a certain period is predicated, in general, on there being an equal number of observed values both for the time preceding and for the time following the period under review. In the process of estimation, the values in the central part of that time span are given more weight than those observations that lie farther outside. The seasonally adjusted values in the centre of the time series are derived using symmetric moving averages (or filters). Towards the end of the series X-11 uses asymmetric filters instead, which are increasingly dependent on those observed values preceding the series value of interest. This, in turn, may lead to revisions of seasonally adjusted data. As new unadjusted values are added to the series, the value that had once been at the end of the series shifts its position relative to the current end and moves towards the centre of the series; the result is that during this process the formula for calculating the seasonally adjusted value for the period under review is continually changing as different filters are used.

Use of ARIMA models reduces size of revisions

If, however, it were possible to estimate future unadjusted values in a fairly reliable

4 Deutsche Bundesbank, Seasonal adjustment as a tool for analysing economic activity, Monthly Report, October 1987, pages 30 to 39.

fashion, the idea of having different filters at the end and at the centre of the series could be dispensed with; the unadjusted series could then be extended hypothetically to include the forecasted values, and the same filters that had been used for the centre of the series (or at least similar ones) could be used to obtain the "last" seasonally adjusted value. Optimal forecasts of the unadjusted values are possible using the ARIMA models.[5] Time series that are extrapolated in this way and are subsequently adjusted using symmetric (or at least not such extremely asymmetric) filters show, on average, smaller deviations between the estimated values at the end of the series and the final seasonally adjusted data (available only after several years) than do series which are adjusted without forecasting the unadjusted values and using only asymmetric filters.

New diagnostics for the optimisation of seasonal adjustment

In addition to the new adjustment options for calculating seasonally adjusted data, X-12-ARIMA includes a variety of new diagnostic tools. Many of these diagnostics issue warning messages when seasonal adjustment with the underlying options is not appropriate. Such warnings are intended to prompt the user to check the options selected and, if necessary, to change them. A comparison of the different quality standards associated with particular parameter settings may serve as a heuristic aid for the optimisation of seasonal adjustment. The information gained helps make the process of seasonal adjustment more objective by reducing the amount of free choice involved in selecting one of these programme settings. In the following, one of the new diagnostics, revisions analysis, is used to estimate the effects which the changeover from X-11 to X-12-ARIMA will have on the analysis of current economic developments.

Comparison of the results obtained using X-11 with those of X-12-ARIMA

Revisions analysis as a methodological basis of comparison

Automated procedure

In order to measure the actual extent of the enhancements made possible by the new options, revisions may be automatically computed for a given period, using the Census X-12-ARIMA programme. These revisions are quantified first by determining the percent deviations of the initial estimates at the end of the particular series from the relevant final seasonally adjusted data, which are available after several years, and then by taking the arithmetical mean of the absolute value of these deviations. The magnitude of the revisions may be considered a measure of seasonal adjustment quality on the grounds that the less the initial estimates deviate from the final adjusted values (assuming them to be meaningful), the more accurate the estimate at the end of the series is likely to be.

Revisions analysis as an approximation

The Bundesbank's data adjustment practices, however, prevent automated revisions analysis from quantifying the effects of the planned changeover from X-11 to the new Census programme X-12-ARIMA in more than an approximate manner. Automated re-

5 See G. Box and G. Jenkins (1970), Time Series Analysis, Forecasting and Control, San Francisco, pages 126 – 170.

visions analysis presupposes, for example, that the seasonally adjusted series is reestimated every time a new unadjusted value is added. By contrast, the Bundesbank usually calculates the seasonal and calendar components only once a year, at the same time forecasting the seasonal and calendar effects for the following year. As long as seasonal patterns change only gradually, this procedure is adequate. However, unforeseen disruptions of, or changes in, the seasonal pattern can always occur; thus, with the addition of each new, unadjusted value, each of the time series published by the Bundesbank is reexamined in order to determine whether the available information favours rejection of the seasonal pattern forecast. Only when this proves to be the case does the Bundesbank reestimate seasonal fluctuations.

Period under review

In order to obtain up-to-date information on the magnitude of the revisions, the period under review must be extended to include the most recent data. At the same time, a certain minimum distance from both ends of the series (in general, a period of approximately five years) must be preserved if final adjusted values are to be obtained. In addition, the period in which the initial estimates are compared with the final ones should span at least five years in order to counter possible distortions of the results caused by isolated and atypical value constellations. Thus only those times series may be used for revisions analysis that comprise at least fifteen years (5 + 5 + 5). Shorter series are unsuitable for revisions analysis; these include the series for eastern Germany (and hence the series for Germany as a whole), which generally begin in 1991, and the series for the main groups of the manufacturing sector as defined by the new Europe-wide harmonised classification of economic activities, which also begins with 1991.

Empirical findings

Strong time-series dependence for revisions

The results of the revisions analysis presented in the adjacent table indicate that the magnitude of the revisions for seasonally adjusted data are largely independent of whether RegARIMA models are used or not but strongly depend on the characteristics of the time series in question. Thus revisions for seasonally adjusted time series with minor fluctuations (such as price indices, data for the money stock M3 or for employed persons) are substantially smaller than revisions for time series which include especially pronounced fluctuations (such as the construction output index, which reflects variations in weather conditions).

Comparison of data obtained with and without the aid of RegARIMA models

The revisions for X-11 may be calculated in two different ways: the initial seasonally adjusted data obtained using X-11 may be compared either with the final values derived using this programme or with final values computed with the aid of the RegARIMA part (columns 2 and 3). Differences in the final values obtained using these two programmes are attributable to slight deviations in their estimates of calendar effects and/or to differences in the detection and replacement of extreme values. These revisions, measured against different reference values, are usually of comparable magnitude. The size of all revisions decreases, however, if the seasonally

Revision of seasonally adjusted data for western Germany

Mean of absolute deviations as a percentage of final estimate *

			Initial estimate							
			without RegARIMA model (= X-11)		using RegARIMA model, with forecasting horizon in years					
					0	1	2	3	4	5
			Final estimate							
Time series	Estimation period	Period for revisions analysis	X-11	using RegARIMA model						
Column	0	1	2	3	4	5	6	7	8	9
Gross domestic product, real 1	01.1980–04.1998	01.1985–04.1993	0.29	0.29	0.25	0.24	0.23	0.23	0.22	0.22
Production index										
Manufacturing sector	01.1980–12.1998	01.1985–12.1993	0.47	0.54	0.30	0.30	0.30	0.30	0.30	0.30
Basic goods and producer goods sector 2	01.1980–12.1994	01.1985–12.1989	0.60	0.69	0.50	0.45	0.44	0.44	0.44	0.44
Capital goods sector 2	01.1980–12.1994	01.1985–12.1989	0.61	0.65	0.44	0.44	0.44	0.43	0.43	0.43
Consumer goods sector 2	01.1980–12.1994	01.1985–12.1989	0.53	0.57	0.28	0.30	0.30	0.31	0.31	0.31
Food, drink and tobacco sector 2	01.1980–12.1994	01.1985–12.1989	0.68	0.63	0.66	0.56	0.55	0.54	0.55	0.55
Construction sector 1	01.1976–12.1998	01.1981–12.1993	2.76	2.80	2.12	1.97	1.91	1.88	1.88	1.87
Orders received index										
Manufacturing sector										
Domestic orders	01.1980–12.1998	01.1985–12.1993	1.18	0.91	0.73	0.68	0.68	0.69	0.69	0.69
Basic goods and producer goods sector 2	01.1980–12.1994	01.1985–12.1989	0.59	0.73	0.51	0.49	0.49	0.50	0.50	0.50
Capital goods sector 2	01.1980–12.1994	01.1985–12.1989	1.86	1.93	1.11	1.07	1.11	1.15	1.18	1.12
Orders from abroad	01.1980–12.1998	01.1985–12.1993	0.87	0.78	0.74	0.70	0.69	0.69	0.70	0.71
Retail turnover, excluding turnover of motor vehicles 1, 2	01.1975–12.1994	01.1980–12.1989	0.42	0.41	0.37	0.36	0.36	0.36	0.36	0.36
Foreign trade										
Exports	01.1970–12.1989	01.1975–12.1984	0.63	0.73	0.58	0.59	0.60	0.61	0.60	0.60
Imports	01.1970–12.1989	01.1978–12.1982	0.78	0.84	0.50	0.48	0.48	0.47	0.47	0.47
Employed persons	01.1981–12.1998	01.1986–12.1993	0.11	0.11	0.10	0.08	0.08	0.08	0.08	0.08
Unemployed 3	01.1980–12.1998	01.1985–12.1993	0.91	0.93	0.87	0.72	0.73	0.73	0.73	0.73
Price indices										
Export prices 4	01.1970–12.1998	01.1978–12.1990	0.14	0.16	0.09	0.08	0.07	0.07	0.07	0.07
Producer prices of industrial products 5	01.1975–12.1998	01.1983–12.1990	0.08	0.10	0.06	0.05	0.05	0.05	0.05	0.04
Consumer price index 6	01.1975–12.1998	01.1983–12.1990	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04
Money stock M3 7	01.1975–12.1998	01.1980–12.1993	0.15	0.21	0.13	0.12	0.12	0.12	0.11	0.11

* Average of the absolute values of the percent deviations from seasonally adjusted data. — **1** Revisions analysis based on data adjusted for working-day variations. — **2** The long series reflecting the older classification of economic activities end in 1994. — **3** Additive decomposition. — **4** From 1991 Germany as a whole. — **5** Sold on the domestic market. — **6** All households. — **7** End-of-month figures, statistical changes have been eliminated. From June 1990 Germany as a whole.

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adjusted data at the end of a particular series are estimated using RegARIMA (without forecasting) instead of X-11 (column 4 in comparison with column 3). This decline in the magnitude of revisions reflects differences in the relative stability of their respective calendar estimates (assuming adjustment of the data for calendar variations) and in the detection and replacement of extreme values.[6] Since the final estimated values obtained using RegARIMA models promise (for the theoretical reasons just discussed) to offer a more accurate picture of economic developments than the final X-11 data, they are taken as a basis for analysing revisions in the following.

Specific results

The effect that the use of the RegARIMA model for seasonal adjustment has on revisions varies from one time series to another (columns 3 and 4). The reductions that are obtained in average revisions using the RegARIMA approach range from hardly noticeable to 0.3 percentage points. The revisions, however, decrease to a greater degree in the case of the data pertaining to the domestic orders received by the capital goods sector and to the construction output index.

Forecasting horizon

The forecasting horizon for a RegARIMA model is that time period for which RegARIMA forecasts of the unadjusted values are generated. Thus a RegARIMA forecasting horizon of 0 years implies that the possibility of compiling a forecast has been forgone, with the result that seasonal adjustment at the ends of a particular series is based only on asymmetric filters. A RegARIMA forecasting horizon of 1 year implies, in turn, that the original series is extended by one year with the values forecast by the RegARIMA model and that the asymmetric filters are applied to the end of the now extended series; and so on. A forecasting horizon is considered optimal (assuming an appropriate choice of adjustment options) for a particular time series if its revisions are of the minimal size.

The optimal forecasting horizon for almost all time series is one year or more; thus revisions and hence uncertainties in the estimation of seasonally adjusted values at the end of the series can be reduced by extending the time series with RegARIMA forecasts. On the other hand, it is not always advisable to extend long-range RegARIMA forecasts indefinitely: once the smallest revision value has been reached, some time series will again begin to show larger and larger revisions, the farther the forecasting horizon is extended. Thus, in order to minimise the revisions that have been derived empirically for some economic time series, it can sometimes prove useful to apply the asymmetric X-11 filters again to the end of an original series that has been extended with only a few estimated values. Other empirical studies on the use of ARIMA

6 In order to avoid inconsistencies in the way the extreme values are treated in the RegARIMA part and in the subsequent X-11 part and in order to prevent the resulting RegARIMA forecasts from being suboptimal, the RegARIMA procedure specifies that the same values (in the final estimation) always be identified as extreme and be replaced. By contrast, the addition of new unadjusted values requires that the outliers in the X-11 adjustment programme must always be determined anew in the course of a revisions analysis. As a result, the data obtained using the RegARIMA part have been presented in a too favourable light. However, even disregarding this assumption, the actual improvements to be achieved using the RegARIMA procedure are likely to be at least half as large as the figures in the table would indicate. For more details see R. Kirchner (1999), *op. cit.*

models in conjunction with X-11 confirm this finding.[7]

Extent of the decrease in revisions achieved using forecasting

In general, only slightly better results were obtained using RegARIMA models with optimal forecasting horizons than were obtained using the same models without forecasting (column 4). Only in the case of the data concerning construction output was there an average improvement of approximately one-quarter percentage point; given the large fluctuations in the seasonally adjusted series, however, the difference is relatively unimportant. By contrast, the improvement shown in the data for the unemployed (slightly more than 0.1%) is clearly more informative. Improvements in almost all the other times series amounted to less than 0.1 percentage point and are of very limited value for the analysis of current business activity.

Improvements in general

For most of the real economic times series treated here, the reduction in revisions that was achieved by using RegARIMA models for outlier detection and replacement and for calendar and seasonal effect adjustment in general varies between roughly one- and three-tenths of one percentage point. The differences were larger for time series with pronounced irregular effects (caused in the case of construction output by unusual weather conditions or in the case of orders received by the capital goods sector by large-scale orders). The deviations are smaller in the case of time series that are subject to only minor fluctuations (employment, money stock M3,

Seasonally adjusted data obtained using X-11 and X-12-ARIMA

1995 = 100, log. scale

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7 See, for example, E. Dagum (1988), A Guide for the Installation and Execution of the Microcomputer Version of X11ARIMA/88, Statistics Canada.

price indices). In none of the cases under review did the changeover to the RegARIMA version of seasonal adjustment have adverse consequences. This was true even when RegARIMA models with a constant forecasting period of one year (the standard setting for the X-12-ARIMA programme) were used instead of RegARIMA models equipped with the optimal forecasting horizon for each series. Thus nothing argues against using this standard forecasting horizon to adjust time series that could be captured adequately with the aid of RegARIMA models but are too short to be analysed with respect to their revisions behaviour (e.g. all series for eastern Germany and for Germany as a whole that begin in 1991 as well as the data compiled in accordance with the new, Europe-wide harmonised classification of economic activities, likewise available only from 1991 on).

X-12-ARIMA offers no new picture of economic activity

The differences between the seasonally adjusted data obtained using X-11 and those obtained using X-12-ARIMA fall within a relatively narrow range; they are only slightly larger, as a rule, than the modifications made when reestimating the seasonal pattern each year using X-11. Thus, as far as the analysis of economic developments is concerned, the changeover from Census X-11 to X-12-ARIMA will not in principle entail any major revisions of previously published data. If, however, new diagnostics lead, in the case of time series not considered here, to the selection of other data adjustment options (e.g. the substitution of an additive approach for a multiplicative one or the use of other seasonal filters), the differences could prove to be more substantial.

Schedule for the changeover to X-12-ARIMA

At the present time, the Bundesbank is adapting the Census X-12-ARIMA programme for the routine production of seasonally adjusted data. Starting with the reporting period for the first quarter of the year 2000, data concerning GDP and its components are to be adjusted using the new procedure and published in that form. The monthly economic indicators are to follow in stages. Since the results previously obtained with the aid of Census X-11 differ only marginally from those of X-12-ARIMA, the fact that, for a time, some indicators will be adjusted using X-12-ARIMA while others continue to be adjusted using X-11 will have no influence on the analysis of current business activity.