

BV 4.1 - Methodology and User-friendly Software for Decomposing Economic Time Series

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BV4.1 – Methodology and User-friendly Software for Decomposing Economic Time Series

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Introduction

In Germany the decomposition and the seasonal adjustment of economic time series with the BV procedure have a long tradition. In the late sixties the mathematical bases were developed at the Technical University Berlin and the German Institute for Economic Research (DIW). Shortly after (1972) the Federal Statistical Office (DESTATIS) established a first practicable version of the procedure to provide the general public with information on major business-cycle indicators. Since 1983 BV4 has been used, a further development by DESTATIS. BV4 turned out to be very suitable for German official statistics.

Brief outline of the concept and the mathematical strategies of BV4.1

In the course of 2004, BV4 was replaced by the new version BV4.1 with methodological improvements concerning the estimation of outliers and calendar effects. In addition, the user himself can now specify explanatory variables, which are to be considered with the analysis (Speth, H.-Th. (2004)).

The first part of the BV4.1 procedure is the identification of (potential) additive outliers. It is based initially on the assumption that within sufficiently short moving time intervals with fixed length M - the so-called basic spans - the time series is the realisation of a normal stationary process. If the difference between an observation and the determined (conditional) expected value is more than a certain fixed multiple TAU (sigma limit) of its standard deviation, then the observation is regarded as an outlier.

In the second part of the procedure the integrated estimation of outliers, calendar effects and of the effects of series specific user-defined variables is accomplished. Based on the general additive model for time series decomposition

$$O = T + S + C + U^+ + E + R,$$

“filtered” by the linear BV4.1 filter F for trend-cycle and seasonal adjustment, this is done using the following linear regression model

$$F(O) = F\left(\sum_{i=1}^h \mu_i T_i\right) + F\left(\sum_{i=1}^k \nu_i S_i\right) + \sum_{i=1}^l \alpha_i F(C_i) + \sum_{i=1}^m \beta_i F(U_i^+) + \sum_{i=1}^n \gamma_i F(E_i) + \varepsilon$$

(T_i = trend-cycle regressors, S_i = seasonal regressors, C_i = calendar regressors, U_i^+ = series specific user-defined regressors, E_i = series specific outlier dummy regressors according to the outliers identified at step 1, ε = error term, R = residual component). Because

$$F\left(\sum_{i=1}^h \mu_i T_i\right) \approx 0 \text{ and } F\left(\sum_{i=1}^k \nu_i S_i\right) \approx 0,$$

the model used for the estimation of the model parameters α_i , β_i , γ_i (i.e. the components C , U^+ and E) is

$$F(O) = \sum_{i=1}^l \alpha_i F(C_i) + \sum_{i=1}^m \beta_i F(U_i^+) + \sum_{i=1}^n \gamma_i F(E_i) + \varepsilon^*.$$

The method of estimating the parameters is that of ordinary least squares.

In the last part the procedure proceeds with the estimation of the trend-cycle and the seasonal component of series O , based on the time series adjusted for outliers, calendar effects and the effects of the user-defined variables $O^* = O - \hat{C} - \hat{U}^+ - \hat{E}$ ($= T + S + R^*$). This is done using fixed linear filters (fixed filter approach) derived from different component-specific local (moving) regression models, where locally the trend-cycle and the seasonal component are approximated by polynomials and trigonometric functions. The model parameters are estimated by the method of weighted least squares.

Due to the local (quasi-dynamic) modelling approach BV4.1 is very efficient in modelling changing seasonal time series structures. The trend-cycles are depicted plausibly in terms of economic points of view. Because BV4.1 is a fixed-filter approach on principal the results do not depend on the respective user. Due to the linear filters used by the BV4.1 procedure the components of partial series add up to the corresponding component of the aggregate series (i.e. there is no difference between indirect and direct analysis). Another feature of BV4.1 is the low cost-benefit ratio. To produce high-quality results, the user of BV4.1 requires neither a special training or even expert knowledge nor long-term experiences in dealing with the procedure.

The software BV4.1, Version 1.1

In February 2006 a new version of the corresponding software BV4.1 was published.

System requirements of the software: Windows PC (Windows 4.0 / Windows 98 and later versions). The software supports the file formats EXCEL, ACCESS, CSV and SQL Server.

With BV4.1 the user can analyse monthly and quarterly time series. The maximum length of the analysis period is 360 periods (data). The minimum length is 60 periods for monthly and 17 periods for quarterly series. The user has the possibility to choose up to 15 user-defined explanatory variables which are considered with the analysis. BV4.1 offers 3 options for modelling calendar effects: trading day component, working day component (not counting Saturdays) and working day component (counting Saturdays). Alternative the user can use a user-defined calendar input. Another improvement of the new version is the possibility to treat or treat not All Saints' Day as an holiday.

The analysis runs are controlled by a user-friendly graphical user interface (GUI). The menu-driven handling makes the use of the software very comfortable and easy. In case of mistakes in the input file or difficulties during the analysis the user provides information by error messages. Also the software offers the possibility of mass production of time series decompositions and seasonal adjustments. If there is a collinearity problem between the regressors, the software will modify the choice of the regressors by itself to guarantee that the program runs smoothly and will inform the user about the modification.

The software offers 2 variants to run the analyses. The first variant is to use the input file to provide BV4.1 with all information about the time series and the analyses to be performed. The second variant is to use the input file to provide BV4.1 with information about the time series and to use the GUI to provide BV4.1 with the information on the analyses to be performed.

Furthermore there is the possibility of so-called successive analyses (i.e. analyses where the analysis periods are successively extended by one additional observation). This option is useful for examining such revisions of analysis results due to the BV4.1 procedure itself.

The user has various possibilities of graphic evaluations of the results. The user can himself determine the contents of a diagram with up to 4 components resulting from one or more time series decomposition. If successive analyses were carried out it is possible, too, to generate special diagrams. For the components resulting from successive analyses only the last two figures of each component are displayed.

The output of BV4.1 analyses contains information for each time series analysis detailed on the analysis options, the identified outliers, the estimates of the model parameters and the complete results of the time series decomposition and the seasonal adjustment. For some components (e.g. original series, trend-cycle, seasonally adjusted series) the percentage change is calculated.

The user can generate output files for the further processing of the results: series specific files with the complete results of the time series decomposition and the seasonal adjustment plus selected percentage changes, series specific files with a reduced number of components, adjusted series and selected percentage changes and some component specific files if more than one series was analysed.

BV4.1 is a freeware. You can download it from the following website:

http://www.destatis.de/download/mv/spbv41produktb_e.pdf

Reference

Speth, H. - Th. (2004): *The BV4.1 Procedure for Decomposing and Seasonally Adjusting Economic Time Series*, Methodenberichte 3 (ed. Federal Statistical Office)
<http://www.destatis.de/mv/e/methueb.htm>