Economic and Social Council

Economic Commission for Europe

Conference of European Statisticians

Group of Experts on National Accounts

Twenty-second session
Geneva, 25-27 April 2023
Item 7 of the provisional agenda
Real-time indicators and nowcasting

GDP Flash Estimate and GDP Nowcast: An R-Shiny App for GDP Estimation

Prepared by the German Federal Statistics Office[1]

Summary

In recent years DESTATIS has been publishing a GDP flash estimate 30 days after the end of the quarter and a purely model-based GDP nowcast 10 days after the end of the quarter for internal use. Since spring 2020, the GDP flash estimate and nowcast have been facing new challenges related to the ongoing corona pandemic, supply and material bottlenecks, price increases, and the war in Ukraine. GDP Flash estimate and GDP nowcast: An R-Shiny app for GDP estimation by DESTATIS presents a new tool developed to cope with these additional uncertainties. The application allows to carry out the model estimations more flexible, faster and less error-prone manner than before. It permits loading a comprehensive set of indicators that can be expanded if new indicators become available. Furthermore, it is possible to test various estimation scenarios based on previously defined models of the GDP sub-aggregates. The application also includes a variety of graphical evaluation options to analyse the estimated GDP, production- and use-side components and the underlying monthly economic indicators

---

I. Scope of the R-Shiny App

1.   Since the second quarter of 2020, the Federal Statistical Office has been publishing gross domestic product (GDP) as a GDP flash estimate 30 days after the end of the quarter. For this publication, expert estimates for production and expenditure side are supplemented by econometric estimates[2]. In addition, a purely model-based GDP nowcast is estimated 10 days after the end of the quarter for internal use (see Dickopf, Janz and Mucha, 2019). After an initial feasibility study in 2019, the econometric model as well as the estimation tool for the nowcast has been continuously further developed.

2.   Since spring 2020, the GDP estimates (flash estimate and nowcast) have been facing new challenges. The corona pandemic, supply and material bottlenecks, price increases and the Russian war of aggression in Ukraine have led to increasing estimation uncertainties for the time series econometric models of GDP flash estimate and GDP nowcast (see Ackermann, Dickopf and Mucha, 2021). To cope with these additional uncertainties, we started to develop an R-Shiny app as a graphical user interface for the estimation process. With this new tool, it is possible to carry out the model estimations more flexibly, faster and less error-prone than before. The app allows loading a comprehensive set of indicators that can be expanded if new indicators become available. Furthermore, it is possible to test various estimation scenarios based on previously defined models of the GDP sub-aggregates. The app also includes a variety of graphical evaluation options to analyse the estimated results of GDP, its production and use side-aggregates and the underlying monthly economic indicators. Other features as e.g. an integrated revision analysis could be added in the future.

3.   This contribution will first explain the underlying econometric approach. Then, we present the main functionalities and some application examples of the R-Shiny app that is used internally by the Federal Statistical Office for the econometric part of the GDP flash estimate and for the GDP nowcast.

II. Econometric Approach

4.   We estimate the quarterly gross domestic product following the bottom-up structure of the detailed GDP calculation. Therefore, estimated values for aggregates of GDP are calculated first and then aggregated to form one overall GDP result for the production side, and one for the expenditure side. Thus, the results of the production and expenditure approach are determined independently. The basis of the calculations on the production side is the gross value added in currently 15 aggregated economic sectors, plus taxes on goods and less subsidies on goods (see Table 1, first column). In order to increase the estimation precision in trade (section G) and to better assess the impulses of each of the three subsections, trade has been divided into its three subsections G45, G46 and G47. Thus, trade (section G) is estimated indirectly as the sum of the estimates of the three subsections. This procedure is also planned for other aggregates on both the production and the expenditure side (e.g. private consumption expenditure). On the expenditure side, we estimate 9 aggregates (see Table 1, second column) and manually add an assumed value for changes in inventories and acquisitions.
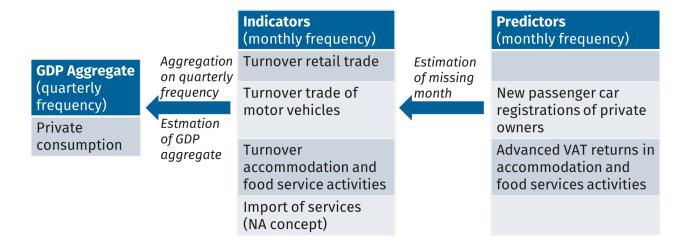
---

[2] Following the Delphi method (see appendix Figure 7)

Table 1
Estimated components of GDP

Production side		Expenditure side
NACE Section	*Economic Area*	
A	Agriculture, forestry and fishing	Private consumption expenditure
B	Mining and quarrying	General government expenditure
C	Manufacturing	Gross fixed capital formation, Machinery and equipment
D	Energy supply	Gross fixed capital formation, Buildings
E	Water supply, sewerage, waste management and remediation activities	Gross fixed capital formation, Other products
F	Construction	Export of Goods
G	Wholesale and retail trade, sale and repair of motor vehicles and motorcycles	Export of Services
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	
G46	Wholesale trade, except of motor vehicles and motorcycles	
G47	Retail trade, except of motor vehicles and motorcycles	
H	Transportation and storage	Import of Goods
I	Accommodation and food services	Import of Services
J	Information and communication	
K	Financial and insurance activities	
L	Real estate activities	
M, N	Business services	
O, P, Q	Public services, education, health	
R, S, T	Other services	
	Taxes on products	
	Subsidies on products	

5.   The individual aggregates and subsections are estimated using bridge equations. If suitable indicators are available for an aggregate, these are included in the corresponding model as external regressors. Currently, up to six indicators are included for each aggregate. Most indicators are available on a monthly basis, while GDP aggregates are available on a quarterly basis. Therefore, the monthly indicators are aggregated to quarterly frequency for estimation. At the time of the estimation, normally only one to two monthly values of the underlying indicators for the current quarter are available. The missing monthly values have to be estimated before aggregating to quarterly frequency (Eurostat, 2016). The two steps of the procedure are summarized for the example of private consumption in Figure 1. The estimation of missing monthly values might include up to three predictors as external regressors, if available.

6.   Methodologically, ARIMA models with external regressors are used for the individual estimates in both steps. Seasonality in the time series is considered within the modelling, and indicators and predictors are adjusted for seasonal effects.

Figure 1
Estimation steps, example private consumption

III. Features: Application

A. Menu and Data Input

7. The menu bar on the left allows to switch between different parts of the estimation and to choose several options which will be explained in the following sections.

8. On the first page "Dateneingang", four data files need to be selected for upload as input for the estimations:

- Steuerungsdatei: In this file the estimation models with respect to external regressors for the aggregates and all indicators are described.

- Datensatz Indikatoren: This file contains the time series of all possible indicators and predictors in monthly frequency.

- Datensatz Entstehung: This file contains the time series of all production side aggregates.

- Datensatz Verwendung: This file contains the time series of all expenditure side aggregates.

9. The menu bar allows to set the start date of the model estimation ("Start Modellkalibrierung"), to set the quarter to be estimated ("Aktuelles Quartal"), to manually set the value for inventories and acquisitions and to choose the time interval to be displayed in the graphical outputs.
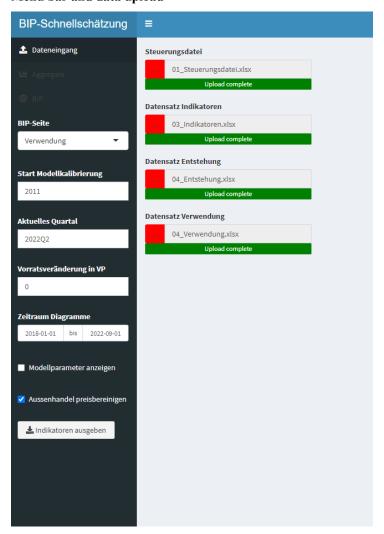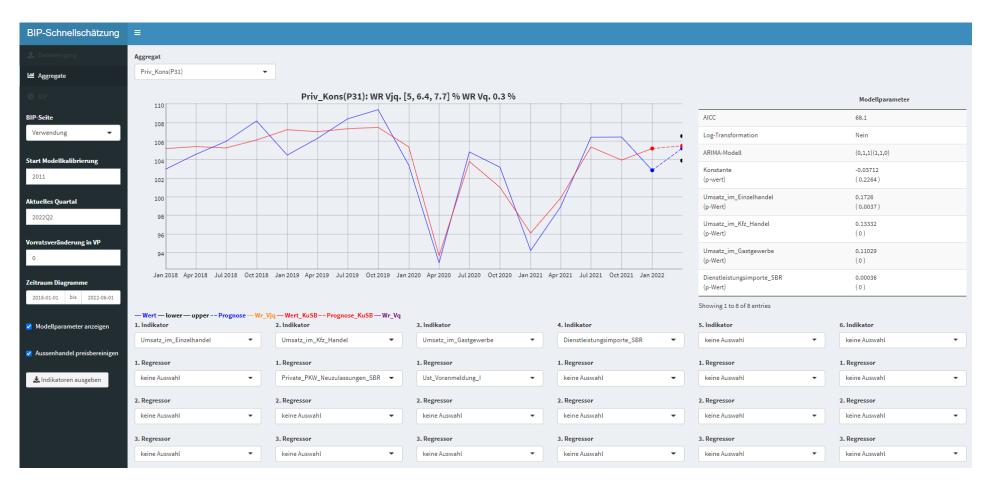
Figure 2
Menu bar and data upload

B. Selection of approach and aggregate: example private consumption expenditure

10. The list in the menu under "BIP-Seite" allows to switch between production or expenditure approach. In the example in Figure 3, the expenditure approach ("Verwendung") is chosen.

11. If the second menu point "Aggregate" is selected, output appears on the right panel. In the header of this panel, a drop-down menu allows to choose between the aggregates of the selected GDP approach. The example in Figure 3 shows the output for private consumption expenditure.

12. The graph displays the chain index for unadjusted (blue line) and seasonally adjusted (red line) data. The nowcasts for both series are displayed as dots at the current edge of the time line. On the left hand of the graph the estimated model is printed.

13. Below, drop-down menus show the indicators for private consumption and their predictors as given by the input file "Steuerungsdatei" and described in Figure 1. The drop-down menus allow to change the indicators and their predictors in a flexible way by choosing from the time series set given in the file "Datensatz Indikatoren". To facilitate the analysis and choice of indicators and predictors, the time series are displayed graphically below the menus as shown in Figure 4. Additionally, the estimated models can be displayed (see Figure 5).

Figure 3
Estimation of private consumption expenditure

Figure 4
Estimation of indicators for private consumption expenditure

Figure 5
Estimation of indicators for private consumption expenditure, including display of estimated model

C. Calculation of GDP

14. If the estimation models of all aggregates of one GDP side, here the expenditure approach, are chosen, the calculation of aggregated GDP for the expenditure side can be displayed be selecting the third point "BIP" in the menu bar and clicking the button "BIP rechnen" at the top of the right panel. Then, the right panel is showing a graph with unadjusted (blue) and seasonally adjusted (red) GDP (see Figure 6). In addition, a table under the graph summarizes the estimates for GDP and all aggregates, giving level estimates as well as growth rates and confidence intervals for the aggregates. Final estimation models for each aggregate can be displayed below.

15. The same procedure is to be applied to obtain estimates for the production approach of GDP.

16. The last button in the menu bar allows to print the estimates for each approach to an Excel-file.

IV. Advantages and further development

17. For our regular quarterly nowcast and flash estimation, the R shiny app has the following advantages:

- It provides a compact graphical representation of the estimated GDP aggregates and the indicators used for them.

- The inclusion of new (digital) data in the existing data set and testing of this data indicators and predictors is easy and quick. It allows to adjust estimation models in a flexible way, which is especially helpful in times of crises or other unusual economic developments

- The user interface does not only allow fast and easy adoption of models, but also helps to understand and interpret economic interdependencies thanks to the visualization of the time series employed in the estimation.

18. Our plans for further development of the app in the future comprise two areas. First, we envisage to include a (pseudo) out-of-sample analysis within the application. The estimation errors of a given estimation model could be calculated and displayed to provide the user with an additional criterion to select the best possible model inside the application. Second, we plan to increase the depth of calculation for more than one aggregate.

Figure 6
Estimation of GDP for expenditure side

Literature

Ackermann, Dickopf and Mucha (2021). Flash und Nowcast: Schnellschätzungen des Bruttoinlandsprodukts in der Corona-Pandemie. In WISTA – Wirtschaft und Statistik, Ausgabe 4/2021.
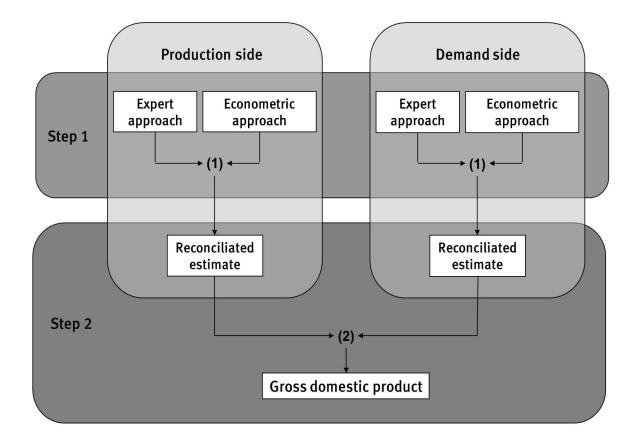
Dickopf, Janz and Mucha (2019. Vom BIP-Flash zum BIP-Nowcast: Erste Ergebnisse einer Machbarkeitsstudie zur weiteren Beschleunigung der BIP-Schnellschätzung. In: WISTA Wirtschaft und Statistik. Ausgabe 6/2019.

Eurostat (2016). Overview of GDP flash estimation methods. In: Eurostat statistical working papers. p. 15 ff.

Appendix

Figure 7
Delphi-method-style three-pillar-model to obtain a reconciled quarterly GDP at t+30