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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

Quarterly National Accounts – Manual for Austria

Description of Applied Methods and Data Sources

(Revised Version)

Jürgen Bierbaumer-Polly, Sandra Bilek-Steindl

Research assistance: Martina Einsiedl, Christine Kaufmann

April 2017

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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG
AUSTRIAN INSTITUTE OF ECONOMIC RESEARCH

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Commissioned by Statistics Austria
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Abstract

The Austrian Institute of Economic Research (WIFO) has compiled the official Austrian Quarterly National Accounts since many years. This publication reflects the current state of the Austrian QNA compilation framework, covering both the QNA Flash Estimates (released at the end of the first month following the reference quarter) and the regular release (published at the end of the second month following the reference quarter).

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Preface

Since the last published version of the *Austrian Quarterly National Accounts* (QNA) description (see *Scheiblecker et al.,* 2007) many changes in the compilation of the QNA figures have occured. One source of revisions reflects changes in the regulatory framework. These are primarily the switch from the European System of Accounts 1995 version to ESA 2010 (in the Austrian context: ESVG 1995 to ESVG 2010) in the year 2014 and the preceding implementation of the new NACE Rev.2 classification scheme of economic activity (in the Austrian context: the switch from ÖNACE 2003 to ÖNACE 2008 in 2011). Other changes are due to general updates and improvements in the QNA compilation process, either on the methodology side or on the data-input side.

This publication reflects the current state of the Austrian QNA compilation framework and replaces *Scheiblecker et al.* (2007). It follows the structure of the description of the 2007 version very closely.

Chapter 1 Overview of the system of quarterly national accounts

This chapter gives an overview and can be read independently of the following. As for that, repetitions in the following chapters are quite intended in order to allow the given structure of the report.

1.1 Organisation and institutional arrangements

Whereas in Austria annual national accounts (ANA) are set up by *Statistics Austria*, quarterly national accounts (QNA) as well as flash estimates are compiled by the *Austrian Institute of Economic Research* (*WIFO*). *WIFO* is a private non-profit institution, independent in the choice of methods and data, which is laid down by the statutes of the Institute of May 6, 1952, rev. May 28, 1996. These statutes were deposited with the Austrian register of articles of association under no. XV-63.

The compilation of the quarterly national accounts is ordered and to a great extent financed by Statistics Austria. As the publication of the quarterly national accounts is a public service and therefore in the interest of all relevant stakeholders, it is also partly financed through stakeholder funding. Flash estimates are ordered and funded as a whole by the Austrian Ministry of Finance.

Austria's QNA subscribe to the *IMF's Special Data Dissemination Standard Plus* (*SDDS Plus*)[1] and also agree on the *European Statistics Code of Practice*[2].

1.2 Publication timetable, revisions policy and dissemination of QNA

First estimates, henceforth called QNA flash estimates, are released at the latest at the end of the first month following the reference quarter (approximately t+30). The exact date of publication is coordinated between the national statistic institutes of the EU member states and *Eurostat* to guarantee the simultaneous publication of the results. This release further fulfills the requirements of the Austrian participation in the *IMF's Special Data Dissemination Standard*. Second estimates, henceforth called regular estimates, are released at about 60 days (t+60) after the end of the reference period at the latest. Publication dates are presented at the release page under http://konjunktur.wifo.ac.at/index.php?id=70&no_cache=1.

Revisions for the most recent quarters take place with every new publication of quarterly figures. But these revisions reach back only up to the quarter which follows the most current year published in the ANA by *Statistics Austria*. As flash estimates do not cover the total dataset, their revisional content is limited to that.

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[1] The *Special Data Dissemination Standard* (*SDDS*) and its extension *SDDS Plus* was established by the *International Monetary Fund* (*IMF*) to guide members that have, or might seek, access to international capital markets in the provision of their economic and financial data to the public. For more details see http://dsbb.imf.org/Default.aspx.

[2] The Code is based on 15 principles concerning the institutional environment, statistical processes and outputs. It aims to ensure that statistics produced within the European Statistical System (ESS) are not only relevant, timely and accurate but also comply with principles of professional independence, impartiality and objectivity. For more details see https://www.statistik.at/web_de/ueber_uns/aufgaben_und_grundsaetze/european_statistics_code_of_practice.

The regular publication (t+60) replaces the results of the flash estimates. At the time of setting up flash estimates, a revision of the results of the regular calculation of the previous quarter takes place.

Once a year, new benchmark annual data become available as published by *Statistics Austria*. New econometric relationships are estimated on an annual basis for all benchmark years available for the past. Hence, all the quarters get revised. In Austria, this procedure is usually done at the same time as calculations for the dataset of flash estimates of the second quarter (by the end of July) are conducted. To complete the dataset, these revisions for the remaining data are done within the regular dissemination of the second quarter (by the end of August).

1.3 QNA compilation approach

In principal, the Austrian QNA follow a top-down approach, where annual figures are broken down by appropriate indicator series of higher frequencies. This is also known as the benchmarking approach. Balancing is not based on supply-use tables (SUT), but some aggregates of the expenditure side of GDP (e.g. fixed capital formation in machinery and equipment) are estimated by the commodity flow method, ensuring implicitly some supply-use consistency.

1.4 Balancing, benchmarking and other reconciliation procedures

In Austria, data on output (production side) are in general more reliable than that of the expenditure or income side. This is true for ANA as well as for QNA. Therefore, GDP is mainly determined by the production side of national accounts. A mismatch between the production and expenditure side is recorded as statistical discrepancy in ANA and QNA. The size of this discrepancy is used as an indicator for balancing both sides. This balanced GDP fully determines the income side with 'Gross operating surplus and gross mixed income' (B.2g + B.3g)[3] calculated as the residual, so that on the income side no statistical discrepancy is shown.

As some components of the expenditure side are estimated by a simplified version of a commodity-flow approach, some consistency between supply and use is considered implicitly. In Austrian QNA the balancing process is done for values at current prices and for price changes determined by expenditure side components, as no series for chained inventories exists.

In Austria, benchmarking can be seen as the general approach for distributing annual figures over quarters and for extrapolating beyond the time horizon of annual data. The decision for choosing the benchmarking approach in QNA is based on the fact that ANA is formed on a host of single series, which are either not available on a quarterly or monthly frequency or their publication lags too far behind to be considered in the compilation of the QNA. For

[3] In the European System of Accounts (ESA) framework particular codes are assigned to individual items of the accounting system. Balancing items, for example, are appreviated with 'B' following a sequential number. In the case of gross values a 'g' is added as well. For sector accounts, an appreviation 'S' is used followed by a number, e.g. 'S.1 Total economy' or 'S.13 General government'.

benchmarking, two methodical approaches basically exist: Purely mathematical as well as statistical benchmarking techniques, where the distribution of annual to quarterly figures relies on their statistical relation at annual frequency.

1.5 Volume estimates

In order to derive volume estimates, in a first step price changes reflected in ANA are chain-linked for deriving index series. This annual index series is broken down to quarters by benchmarking techniques using theoretically related indicator series available at subannual frequencies showing a statistically significant relationship. After this application of quarterly price index series, a further benchmarking procedure is necessary in order to assure time consistency of resulting volume estimates. This benchmarking procedure is somewhat different for all components of the production side, where value added is not directly derived but as the difference between output and intermediate consumption. In this case, output prices are benchmarked as described before with a consecutive transformation of their benchmarked values by a benchmarked net quota in order to derive volume estimates (indirect double deflation). Resulting estimates are benchmarked with their annual equivalents. Following this, a value added inflator is derived directly in order to derive value added at current prices.

1.6 Seasonal adjustment and working day correction

In addition to original (i.e. uncorrected) data, seasonally and working day adjusted data are published. Generally, only data adjusted for the seasonal together with the working day effect are available. For GDP and total value added only, just working day adjusted data are published in the regular dissemination as well. The working day correction is done within the framework of seasonal adjustment and relies on a regression approach with constant parameters. Depending on theoretical as well as on statistical properties, either only the number of working days as a whole or separated by all different weekdays are considered. They are derived from a specific calendar for Austria. Furthermore, the significance of potentially included leap year and Easter effects is tested.

Seasonal adjustment is done with the TRAMO-SEATS (*Gómez – Maravall*, 1996) procedure, which enables a smooth change in the seasonal pattern over time. The individual components are adjusted seperatly; aggregates are formed by the indirect approach deriving adjusted aggregates by summing up over their adjusted component. Given the fact that chain-linked volume series are not additive by definition, the aggregates get 'de-chained' beforehand, summed up and finally chained again.

1.7 Additional information

The publication time table for regular estimates can be downloaded under:

- http://www.statistik.at/web_de/ueber_uns/veroeffentlichungskalender/index.html

The publication time table for regular as well as flash estimates can be downloaded under:

- http://www.wifo.ac.at/jart/prj3/wifo/data/uploads/downloads/formulare/WIFO-Konjunkturberichterstattung-Zeitplan.pdf

Results are available under:

- http://www.statistik.at/web_de/statistiken/wirtschaft/volkswirtschaftliche_gesamtrechnungen/bruttoinlandsprodukt_und_hauptaggregate/quartalsdaten/index.html
- http://konjunktur.wifo.ac.at/index.php?id=70
- https://www.oenb.at/Statistik/SDDS-Wirtschaftsindikatoren.html

Related press releases are to be downloaded under:

- http://www.wifo.ac.at/publikationen/pressenotizen
- http://konjunktur.wifo.ac.at/index.php?id=70

Chapter 2 Publication timetable, revisions policy and dissemination of QNA

2.1 Release policy

The flash estimates (first estimates) are released at the latest at the end of the first month following the reference quarter (approximately t+30). Exact dates are coordinated between the national statistic institutes of the EU member states and *Eurostat* to guarantee the simultaneous publication of the results. These release dates fulfill by the same time the requirements of the *Special Data Dissemination Standard* of the *IMF*. Regular disseminations (second estimates) are released at about 60 days (t+60) after the end of the reference period at the latest. The dates for the releases are published approximately one year in advance at the *WIFO* homepage

- http://www.wifo.ac.at/jart/prj3/wifo/data/uploads/downloads/formulare/WIFO-Konjunkturberichterstattung-Zeitplan.pdf

as well as on the *IMF's Dissemination Standard Bulletin Board (DSBB)* at

- http://dsbb.imf.org/Pages/SDDS/CtyCtgList.aspx?ctycode=AUT

Using new information available, revisions take place with every new publication of quarterly figures. The results of the flash estimates are replaced by the regular release, and the actual flash estimates are revising the results of the regular one of the previous quarters. But revisions go back at most to the first quarter following the latest annual release by *Statistics Austria*, usually published every July. When new annual data are available, new econometric relationships between annual data and the indicators used for the quarterly dissaggregation are estimated on an annual basis. Then the quarters of the reference year and those of the preceding years are revised. This procedure is usually done at the same time as calculations for the dataset of flash estimates of the second quarter (by the end of July) are conducted. To complete the dataset, these revisions for the remaining data are done within the regular dissemination of the second quarter (by the end of August).

For consistency, the calculation of quarterly institutional sector accounts uses the QNA as the benchmark, in order to be fully consistent with QNA.

2.2 Publishing of contents

2.2.1 Regular disseminations

Austria's QNA data are transmitted to *Eurostat* one day prior the official release date. The data transmission of the national accounts data follows the European System of Accounts (ESA 2010) rules and is set up according to the transmission programme. In particular with respect to the required tables, aggregates and variables, frequency of transmission, date of the first delivery as well as on the required data transformation (unadjusted / seasonally adjusted form).[4]

[4] Details of the ESA 2010 transmission programme can be found at: http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-01-13-429-3A-C

The press release of the regular calculation (t+60) focuses mainly on the GDP expenditure components. Regarding the production approach only the position 'Manufacturing' (NACE C), 'Construction' (NACE F) and market services in total (NACE G_N) and therein 'Wholesale and Retail Trade' (NACE G) as well as 'Accommodation and Food Service Activities' (NACE I) are indicated separately. The numbers shown are the trend-cyle series (i.e. seasonally and working day adjusted, without irregular component) on a quarter-on-quarter growth basis covering a period of minimum six quarters. In addition, total GDP growth is shown in seasonally and working day adjusted (quarter-on-quarter) as well as in unadjusted (year-on-year) terms.

Actual press releases can be found at:

- http://konjunktur.wifo.ac.at/index.php?id=70

The following components of the GDP expenditure approach are published in the press release:

- Final consumption expenditure of households (incl. NPISHs[5])
- Final consumption expenditure of general government
- Gross capital formation
- Gross fixed capital formation
- Exports, goods and services
- Imports, goods and services

A more detailed disaggregation is published in the *WIFO-Monatsberichte* as well as on the *WIFO* homepage:

- http://konjunktur.wifo.ac.at/index.php?id=70&no_cache=1
- http://www.wifo.ac.at/daten/wifo-wirtschaftsdaten

These figures cover GDP production, GDP expenditure, and GDP income. The series are published in percentage changes from previous year (unadjusted series) or from previous quarter (trend-cycle series), at current prices and in volume (chain-linked; base 2010):

The following components of the GDP expenditure approach are published:

- Final consumption expenditure of households (incl. NPISHs)
- Final consumption expenditure of general government
- Gross capital formation
    - Gross fixed capital formation
        - Machinery and equipment and weapon systems
        - Construction
- Exports, goods and services
    - Exports of goods
    - Exports of services
- Imports, goods and services

[5] Non-Profit Institutions Serving Households.

  - Imports of goods
  - Imports of services
- Gross Domestic Product

The following components (i.e. activities according to NACE Rev.2) of the GDP production approach are published:

- Agriculture, forestry and fishing *(NACE A)*
- Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities *(NACE B_E)*
- Manufacturing *(NACE C)*
- Construction *(NACE F)*
- Wholesale and retail trade, repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities *(NACE G_I)*
- Information and communication *(NACE J)*
- Financial and insurance activities *(NACE K)*
- Real estate activities *(NACE L)*
- Professional, scientific and technical activities; administrative and support service activities *(NACE M-N)*
- Public administration and defence, compulsory social security; education; human health and social work activities *(NACE O_Q)*
- Arts, entertainment and recreation; other service activities; activities of households as employers, undifferentiated goods- and services-producing activities of households for own use *(NACE R_U)*
- Gross value added (*B.1g*)
- Taxes on products (*D.21*)
- Subsidies on products (*D.31*)

The following components of the GDP income approach are published:

- Compensation of employees (*D.1*)
- Gross operating surplus and gross mixed income (*B.2g and B.3g*)
- Taxes on production and imports less subsidies (*D.2 less D.3*)

In addition, also employment data for the components of the GDP production approach are published.

2.2.2 Flash estimates

The press release for the flash estimates (t+30) contains the same structure as the press release for the regular dissemination. The regular *Business Cycle Report*, appearing in the *WIFO-Monatsberichte,* covers and discusses the results of the actual flash estimates, similar to the regular release.

2.3 Special transmissions

Some institutions have access to the results one day before the official release. In case of the regular release the complete data set is sent to:

- *Statistics Austria, Austrian Ministry of Finance and to the Austrian National Bank*

The results of the flash estimates are additionally sent to the *European Commission* one day before the official release and to the *IMF* on the release day.

The data sent are similar to the publications mentioned above, completing the *ESA 2010 Questionnaire*. No special data are generated for these institutions.

2.4 Policy for metadata

Austria's QNA subscribe to the *IMF's Special Data Dissemination Standard Plus (SDDS Plus)*. For details see:

- http://dsbb.imf.org/Default.aspx

As a subscriber to the *SDDS Plus* we submit information about the data, its production process and dissemination practices to the *IMF*, we certify the accuracy of all metadata posted on the *Dissemination Standards Bulletin Board* (*DSBB*) and we provide transparency in the compilation and dissemination of our QNA statistics. In the new converted format, the *Data Quality Assessment Framework (DQAF),* the benchmark of the *IMF* ensures an even more comprehensive view on these facts.

Chapter 3 Overall QNA compilation approach

3.1 General architecture of the QNA system

In principal the Austrian QNA follows a top-down approach, where annual figures are broken down by appropriate indicator series of higher frequencies. This is also known as the benchmarking approach. Balancing is not based on supply-use tables (SUT). Some aggregates of the expenditure side of GDP (e.g. certain components of gross fixed capital formation) are estimated by the commodity flow method, ensuring implicitly some supply-use consistency.

3.2 Balancing, benchmarking and other reconciliation procedures

3.2.1 Quarterly GDP balancing procedure

In Austria, more precise and reliable data sources are available on production than concerning expenditures. As for that, the production side can be regarded as more reliable. This is true for ANA as well as for QNA. Therefore, GDP is mainly determined by the production side of national accounts. A mismatch between the production and expenditure side is recorded as statistical discrepancy in ANA and QNA. The size of this discrepancy is used as an indicator for balancing both sides. The balancing procedure does not cover the income side of GDP with 'Gross operating surplus and gross mixed income' (B.2g + B.3g) calculated as the residual, so no statistical discrepancy is shown on the income side.

As some components of the expenditure side are estimated by a simplified version of a commodity-flow approach, some consistency between supply and use is considered implicitly. In Austrian QNA the balancing process is done for values at current prices and for price changes determined by expenditure side components, as no series for chained inventories exists.

3.2.2 Benchmarking of QNA and ANA

Benchmarking can be seen as the general principal approach for distributing annual figures over quarters and for extrapolating beyond the time horizon of most recent annual data (*IMF*, 2001, *Eurostat*, 2013). The decision for choosing the benchmarking approach in QNA is based on the fact, that ANA make use of a host of single series, which are either not available on a quarterly or monthly basis or their publication lags too far behind to be considered in the compilation of the QNA. As a principal, in Austrian QNA benchmarking is done by using indicators for distributing annual data to quarters accordingly. There are basically two methodical approaches. One is using an indicator series for a purely mathematical distribution of annual data to quarters and the other relies on establishing a statistical relation between annual data and the indicator series on which the distribution is made. Whereas the former is only applicable for distributing annual data to quarters of past years, the latter has the advantage of allowing extrapolations beyond the latest annual figures, implicitly.

The most prominent example for the first approach is the proportional (first difference) Denton method, which is strongly recommended by the *IMF* (2001).[6] For the second approach, the most appropriate method is based on the optimal regression method as proposed by *Chow – Lin* (1971), which is favoured by *Eurostat* (2013).

Apart from being recommended by *Eurostat*, the regression approach has several appealing features, making it most appropriate for compiling Austrian QNA:

- More than one indicator can be used, which corresponds to the fact, that annual aggregates to be distributed over quarters very often consist of many single series. So benchmarking can be made using at least a sub-sample of them.
- The appropriateness of the indicators cannot only be done on theoretical reasonings but also on the information given by the test statistics of the estimation procedure. Furthermore, some impression of the reliability of the output can be gained.
- The relation estimated can be used for extrapolating quarterly series beyond the time horizon covered by the annual benchmarks.
- Special attention is given to the residuals which cannot be explained by the indicator series. An explicit assumption for its evolvement can and has to be made. In the literature, several approaches for modelling the behaviour of this residual over time have been proposed.

For this kind of regression approach, the residuals unexplained by the indicator regression have to be modelled under the restriction that the quarterly totals sum up to annual benchmarks. In the original approach developed by *Chow – Lin* (1971) an AR(1) time series process had been assumed. Since then several further models have been proposed. *Fernandez* (1981) suggested a random walk behaviour and *Litterman* (1983) a development according to an ARIMA(1,1,0) process.[7] For both models the implicit assumption that residuals develop as a process of order one, I(1), is problematic, because this would imply that the benchmark series and the indicator series are not cointegrated. Furthermore – according to a study of *Proietti* (2006) – the model proposed by *Litterman* (1983) is difficult to estimate in practice. As for that, in the Austrian QNA the *Chow – Lin* (1971) approach is favoured.

When looking at the model's test statistics the following parameters are considered:

- The F-test for the overall fit of the model
- The t-test for the significance of the linear relation for each indicator
- The Durbin-Watson test statistic
- The Akaike Information Criterion
- The Jarque-Bera normality statistic
- The Box-Pierce and Ljung Box Q-statistics on normal as well as squared residuals
- The log-likelyhood test statistic

[6] An update of the QNA manual can be found here: http://www.imf.org/external/pubs/ft/qna/.

[7] Further amendments have been made by *Santos Silva – Cardoso* (2001) and *Di Fonzo* (2002) for a dynamic extension of the models.

Furthermore, the parameters of the regression are checked for their plausibility concerning their transfer of subannual variations like the seasonal pattern. So a regression parameter close to one – with the constant term close to zero – would mean a proportional transfer of the seasonal pattern from the indicator series to the quarterly output; values above one would indicate an amplification and below one a moderation.

All information like a variation in the number of working days, seasonal variation, special events, weather conditions, etc. are implicitly transferred to the output series, as long as they are reflected by the indicator series. The size of this transfer depends on the regression parameter which is itself determined by the fit between the annual benchmark series and the indicator series aggregated to annual sums or averages.

For those series for which no appropriate indicator series is available, a distribution according a mathematical procedure is used. As a division by four would lead to steps in the series at the beginning of each year, the BFL method proposed by *Boot – Feibes – Lisman* (1967) is applied, as recommended in the *IMF* (2001) manual in such a situation. This method disaggregates annual totals by minimising their sum of squared differences between successive quarters under the restriction that they sum (or average) up to the annual data. The great advantage of this method is that the produced time series evolve rather smooth over the whole time span, which implies rather low growth rates between successive quarters. In doing so the output only minimally distorts the behaviour of higher aggregates to which such series are summed up together with others containing more information.

3.2.3 Other reconciliations of QNA different from balancing and benchmarking

No such reconciliations are applied.

3.2.4 Amount of estimation in various releases

As regards estimations due to benchmarking, nearly all series are concerned. In the first regular release at t+60 the second and last month of the reference quarter of the indicator series is missing, for example, for industries NACE B to NACE F. For wholesale and retail trade (NACE G) two or one month of the indicator series are missing in order to complete the full quarter, respectively. For some of the other market orientated service sectors (NACE H to NACE N) quarterly indicator series are used and no information for the reference quarter is available at the time of the first regular release. Missing values of the indicator series, either on the monthly or quarterly frequency, are also prevailing for some taxes and expenditure side positions like private consumption, foreign trade and investment. The lack of missing data in the indicator series is solved by estimating these values based on econometric models. Approximately half of the quarterly indicator series in the first regular release contain forecasted values. The first revision (t+120), which is published with the following flash estimate, covers about 80% of the whole indicator set. The full data set for the respective quarter is available with the first regular release of the successive quarter (t+150).

For other series, indicators with a similar data generation process like the target series are available in full at the time of the first regular release and at subsequent releases, apart from occasional balancing requirements.

3.3 Volume estimates

3.3.1 General volume policy

As the Austrian QNA system is based on benchmarking in principal, this goes also for prices used in the QNA framework. So, indicator series have to be found which are able to explain price developments of ANA in the past. For this, official price index series are statistically checked for their appropriateness to do so. These series cover a wide area like retail and wholesale series, investment prices, deflators of wage series, export prices from other countries, etc. These Laspeyres type indices are taken to explain implicit price development of ANA.

Quarterly values at current prices and at average prices of the previous year are derived by this approach; both sum up to the respective annual figures. Using these two series, the annual-overlap technique is applied in order to calculate growth rates at average prices of the previous year. These growth rates compare the respective quarter with the average of the previous year's values at current prices and are chained accordingly in order to construct an index at constant prices. This index is rebased using the year 2010 as a reference in order to calculate absolute values.

Using the annual-overlap technique the series are vertically (i.e. along the time-dimension) fully additive. But the chaining implies a loss of additivity in the horizontal domain (i.e. across sub-aggregates of the GDP). Therefore, no procedures to force chain-linked sub-aggregates to sum up to their higher aggregates are applied. Additivity for price adjusted data can be established only at previous year's prices.

3.3.2 Chaining, chain-linking and benchmarking

Benchmarking concerning volume estimates is done by regressing annual chained series from the ANA on quarterly indicators in order to get time series of absolute benchmarked values. For several industries of the supply-side, a net quota in absolute values (giving the input-output-relation between chained annual data) is used to derive quarterly value added volumes from quarterly output. This quarterly net quota is derived by benchmarking it to give annual totals of chained net quota. This intermediate chaining process should not be confused with the chain-linking process according to the annual-overlap procedure, which constructs a time series of volume estimates from quarters at average prices of the previous year.

3.3.3 Chain-linking and seasonal adjustment

In Austria, seasonally adjustment is done after chain-linking volume series. This chain-linked series are not corrected to achieve additivity in the cross-section dimension (over sub-aggregates). This strategy has been chosen in order not to obstruct the time-series behaviour by adding some kind of difference. The indirect approach for seasonally adjusted economic time series has been chosen in Austria's QNA. Consequently, all series are adjusted separately and aggregates are formed by summing up the seasonally adjusted component series, with an intermediate step of dechaining, summing up and rechaining of the respective series.

There are no figures published covering seasonally adjusted values at previous year's prices as they do not constitute time series in the narrower sense.

3.4 Seasonal adjustment and working day correction

Generally, in Austrian QNA TRAMO-SEATS (*Gómez – Maravall*, 1996) is used for adjusting special effects like seasonal variation, calendar effects and detecting outliers. As for that, series to be corrected for that have to show time series properties in order to enable a modelling strategy for adjustment. So no values at previous year prices but only chain-linked series according the annual-overlap method are used for processing, with no preceding correction for cross-section non-additivity.

Publication covers original (unadjusted) series, adjusted for seasonal and working day effects as well as trend-cycle (i.e. those adjusted for seasonal, working day effects and excluding irregular components) series. In addition, for gross value added (GVA) and gross domestic product (GDP) series only adjusted for working day effects are available as well.

Once a year with the upcoming of new ANA information, not only the models for benchmarking are revised but also those used for seasonal adjustment. During the rest of the year, only the parameters of these models are re-estimated with the publication of a new release. Revisions following the adjustment process are covering the total length of the series.

In Austria, the estimation and correction of calendar and seasonal effects is only done on a quarterly basis, as there is no calculation of value added on a monthly basis.

Before seasonal adjustment is done a correction of possibly included outliers in the series is made. The following outliers are tried to be located:

- Additive outliers affecting the time series only at one point in time.
- Level shifts which shift permanently the mean of the series.
- Transitory components which influence the development of the series only for a limited time period. They can appear either as ramp effects, growing slowly over time and ending suddenly or appearing suddenly and dying out slowly.

First of all, these outlier effects are estimated by an automatic procedure as implemented in the TRAMO-SEATS procedure of the JDemetra+[8] software package. This is a kind of stepwise detection of outliers according to a t-value criterion. The value of the t-value acting as the significance threshold can be either determined automatically or manually. In Austria, the latter option is used if there exists some additional external information about some outliers or the test statistics concerning the reliability of the model can be significantly improved by clearing for more outliers.

If there is a close contact between business cycle analysis, the production of QNA and seasonal adjustment considerably improves the detection of outliers. As for that, *WIFO* sometimes model separately outliers with a complex structure in order to improve the output.

[8] The current version used is JDemetra+ 2.0.0.

3.4.1 Policy for seasonal adjustment

Before running the seasonal pattern detection process (embedded in the TRAMO-SEATS procedure), time series are corrected for calendar effects, outliers and other possible deterministic elements. Seasonal factors or components (depending on whether the model is additive or multiplicative) are modelled as ARIMA processes, allowing a smooth change of the seasonal pattern over time.

3.4.2 Policy for working-day correction

Working-day correction is done before the seasonal adjustment process. The effects are estimated in a regression analysis framework as it is the case for other deterministic effects like calendar effects (Easter and leap year), outliers like strikes or unexplained variations.

All calendar effects are tested for their significance before they are considered in the final estimation process for extraction. The calendar used in the JDemetra+ software package is Austrian specific. Only those calendar effects are submitted to statistical tests, which are theoretically founded. For example, for the sector 'Agriculture, Forestry and Fishing' (NACE A) no trading day is tested as production should not vary on the different number of working- or holidays but only a leap year variable is checked. For correcting the output of NACE G 'Wholesale and Retail Trade' all days of a weak are tested separately as the effects of the number of Fridays is possibly different from that of other days of the week. In addition, the calendar used for the trading sector does not include December, 8th as a public holiday in Austria, given that most of the retail shops are opened on that day.

Only working days of the Austrian calendar are used. This is important to mention because working days of other countries can potentially influence Austrian economic variables. So the tourism sector is not only subjected to working days of Austria but also of those of other countries.[9] In special cases artificial working days are additionally imputed. This can be the case if there is only a minor number of working days in-between two vacations (bridge days), which makes it likely that employees will bridge them with days off work. The same goes for the Easter effect, where in Austria usually an adequate number of days are located to the first and second quarter of the year.

All this calendar effects are modelled in that way that they cancel out over their respective time span. So the sum of the effects of the seven weekdays is by construction zero and also the sum of the leap year effects over a four year time span.

Contrary to the seasonal effect, calendar effects are supposed to be fixed over time. This assumption is sometimes challenged by innovations in the production process, changing working patterns or reactions to the business cycle. So the estimated working day effect can be regarded only as an average with the actual effect being higher in times of a booming economy and lower during recessions leading to asymetric reactions.

[9] Based on theoretical reasonings this working day effect should be negative.

Chapter 4 GDP components: the production approach

In Austria, results obtained from the production approach of national accounts are usually statistically more reliable compared to the expenditure approach. While for QNA publication the detail of break down is given by the European System of Accounts (ESA) regulation, it is in most cases more detailed for the calculation process.

All input data used are tested for plausibility by benchmark quotas (like productivity) as well as by statistical techniques related to time series analysis. The QNA compilation of *WIFO* enables the additional use of expert knowledge of the individual research fields situated in the institute. So, occurring data problems (like outliers and breaks in the time series) can be interpreted neatly which improves considerably the structure of the models considering such specific features.

4.1 Gross value added, including industry breakdowns

Following the guidelines of the *IMF* (2001), quarterly value added should preferably be derived indirectly as the difference between output and intermediate consumption. Austrian QNA aim at this principle, as input-output relations are calculated in order to derive value added. In this case, the procedure is the following:

Production output is benchmarked by an indicator sub-annually available, which can be regarded as suitable on theoretical and statistical grounds. Implicit annual deflators (for output as well as for value added) are chained and benchmarked by appropriate subannual price series to adjust for price changes. The relation between output and value added is estimated by benchmarking this implicit relation by a mathematical benchmarking method using an explicit forecast for extrapolating the series. Chained series and price series are combined in order to derive values at average previous year's prices.

4.1.1 Agriculture, forestry and fishing (NACE A)

The calculation of indicators for agriculture, forestry and fishing follows the recommendations 'GDP: the production approach' as described in *Eurostat* (2013, page 31). The output in agriculture can be measured in a relatively detailed manner. Output of livestock products is based on sales on the market. Quarterly data on gross production are used for the following products: milk *(Agrarmarkt Austria*, 2016*)*, beef, veal and pork *(Bundesanstalt für Agrarwirtschaft*, 2016*)*. For the output of poultry meat, statistics from slaughtering are taken (*Statistik Austria*, 2016a).

During the growing period, the output of crop production is based not on sales but on growth during the growing season. Crop specific growth rates per quarter are based on agronomic observations. Expected harvest volume is updated based on survey data (*Statistik Austria,* 2016b).

Because climate and weather have an important influence on plant growth, meteorological data which are timely available are used to take into account stochastic influence on plant growth during the growing season (*ZAMG,* 2016).

The output of forestry is measured as the wood accumulated by the growth of trees. Another factor considered is the expansion of forest land. The parameters of the output estimates are derived from the most recent Austrian forest inventory. This source provides data that are based on observations up to 2009 (*BFW,* 2016). More recent data have not yet been published to date. The growth increment of wood of standing trees per quarter is based on the work of *Hasenauer* (2005) who differentiates between deciduous trees and conifers.

For compiling the volume measures, wholesale price data covering the described agricultural products serve as indicator for temporal disaggregation of the annual deflator. A univariate optimal estimation technique is applied.

4.1.2 Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities (NACE B to E)

Value added of these industries is derived indirectly according the principles layed down in part 4.1. Therefore output and value added – both at current prices and in volume terms – are identified separately. For calculating production output for the reference quarter, we have to use benchmark and forecasting techniques to estimate the missing indicator values. For temporal disaggregation the regression approach proposed by *Chow – Lin* (1971) as presented in section 3.2.2 is applied. Regarding the structure of the error term in the regression model, as a rule, preference is given to model it as an AR(1) process and to estimate it by the Maximum Likelihood method as this approach possesses the best theoretical properties.[10] We use time series from the monthly short term business cycle statistics in industry and construction by *Statistics Austria* covering the production of the relevant industry. Given that not all input time series are available for the full reference quarter at the time of regular QNA compilation, we additionally implement time series models with exogenous variables. For Austria, the most important external database to be considered for extending the indicators used in regular QNA estimation stems from the business survey conducted by *WIFO* on behalf of the *European Commission*. These data can be assumed to carry not only information about changing production activities in several sectors but also about turning points of the business cycle. Additionally, other exogenous variables like order statistics and the amount of working days are included in the model.

For compiling quarterly output deflators, the implicit annual deflators are benchmarked by applying the same econometric technique as described above. Therefore we use information from producer and wholesale price indices.

Annual input-output-relations, used for deriving value added from production output, are disaggregated by the mathematical BFL technique. So a smooth evolving relation of which annual averages co-incide with the annual totals is derived. Clearly, this series does not show any seasonal variation.

Compiled quarterly value added volumes are cross-checked with employment figures in order to find productivity abnormalities.

[10] See e.g. section 3.2.2 or *Santos Silva – Cardoso* (2001) or *Proietti* (2006).

4.1.3 Construction (NACE F)

Value added of the construction industry is derived indirectly according the principles layed down in section 4.1. Therefore output and value added – both at current prices and in volume terms – are identified separately.

For benchmarking annual production output, we combine time series models with benchmarking methods. For the temporal disaggregation the regression approach as presented in section 3.2.2 is applied. We use time series for the construction industry out of the monthly short term business cycle statistics in industry and construction as published by *Statistics Austria*. Due to the time lag of the publication of the respective series for the reference quarter, we additionally implement time series models with exogenous variables. Therefore we use external information based on the monthly business survey, conducted by *WIFO* on behalf of the *European Commission* as well as other exogenous variables like order statistics and weather information.

To find a quarterly output deflator, we use benchmarking methods together with time series models. As indicator series, price indices concerning building construction and civil engineering as published by *Statistics Austria* give important information. Using time series models the price indices are extrapolated until the current edge of the publication period of the QNA. Annual input-output-relations, used for deriving value added from production output, are disaggregated by the mathematical BFL technique. So a smooth evolving net-quota of which annual averages co-incide with the annual totals is derived.

Compiled quarterly value added volumes are cross-checked with employment figures in order to discover productivity abnormalities.

4.1.4 Wholesale and retail trade, repair of motor vehicles and motorcycles (NACE G)

Value added of NACE G is estimated indirectly with output and value added – both at current prices and in volume terms – being identified separately. For benchmarking annual production output at current prices, monthly turnover series from the revenue statistics of the Austrian trade by *Statistics Austria* are used. So the assumption is implicitly made, that the trade margin (representing the output of NACE G) is linearly related to the turnover.

At the time of the compilation of the QNA preliminary values for NACE G 47 (retail trade, except of motor vehicles and motorcycles) are available. For NACE G 45 (wholesale and retail trade and repair of motor vehicles and motorcycles) and NACE G 46 (wholesale trade, except of motor vehicles and motorcycles) values for one month of the reference quarter are missing. Therefore the values at current prices and constant prices are estimated by forecasting the respective indicator series for the missing time periods. For the temporal disaggregation the regression approach proposed by *Chow – Lin* (1971) is applied.

The price index is estimated on the basis of the implicit price index of the Austrian trade revenue statistics, eventhough the turnover prices are far being from perfect proxies for the trade deflators due to the trading margin (*IMF*, 2001). It is assumed that there exists at least some (minor) relationship between gross value added and turnover prices and as such the *Chow – Lin* (1971) approach for temporal disaggregation is used as well.

The calculation at current prices and for the price index is made for each group (NACE G 45, G 46 and G 47).

Annual input-output-relations, used for deriving value added from production output, are disaggregated by the mathematical BFL technique. So a smooth evolving relationship with annual averages co-inciding with the annual totals is derived.

4.1.5 Transportation and storage (NACE H), accommodation and food service activities (NACE I), information and communication (NACE J)

Value added of these GDP production components are derived indirectly according the principles layed down in section 4.1. We use monthly turnover series from the short term business statistic published by *Statistics Austria* concerning the relevant service sector. Due to the publication lag the development in the QNA reference quarter is estimated by time series models. In the industry 'Accommodation and Food Service Activities' (NACE I) also monthly turnover series about foreign and domestic guests from the Balance of Payment (BOP) statistic as well as information of number of nights spent in hotels are used for plausibility checks and forecasting purposes.

To find quarterly output deflators, implicit value added deflators are benchmarked by applying the same econometric technique as described above. Therefore, information from the relevant consumer price index (e.g. for NACE I the CPI covering tourism services) as well as relevant wholesale or producer prices is used. Annual input-output-realtions, used for deriving value added from production output, are disaggregated by the mathematical BFL technique.

4.1.6 Financial and insurance activities (NACE K)

Value added is derived indirectly (output and value added – both at current prices and in volume terms) for the banking and the insurance sector, and for activities related to this. Afterwards, all activities are aggregated to the position of NACE K. For financial intermediation the main data source are the Austrian banking statistics compiled by the *Austrian National Bank* and quarterly FISIM[11] estimates obtained by *Statistics Austria*. The FISIM estimates are the sum of returns from various banking activities and different interest rates combined with volumes of savings deposits and credits to households and firms. According to ESA 2010 paragraph 14.1, FISIM only have to be calculated between non financial institutions, interbank FISIM have to be excluded.

Regarding insurance and pension fund activities, data published by the *Financial Market Authority* are used. In particular, on actual premium and claims payments in non-life insurance as well as investment income and investment charges, the claims ratios in the non-life and accident insurance industry, and total exports and imports of insurance services from the Balance of Payments statistics are considered.

To calculate quarterly output deflators of insurance activities, the following data sources are used: claims ratios and CPI items for insurance products and the standard wage index in the

[11] Financial intermediation services indirectly measured (FISIM).

insurance industry. For banking services the deflator is based on the implicit deflator derived from quarterly FISIM data.

As most of the used data are not available within the time limit of the regular QNA release, the computation is based on forecasting techniques.

4.1.7 Real estate activities (NACE L)

As data of activities belonging to this industry are rather scarce, the value added is directly derived here, without calculating gross production value as an intermediate step. As no short-term base statistics are available we use the BFL mathematical procedure to calculate the value added. As indicator for the value added deflator, renting services out of the CPI is used.

4.1.8 Professional, scientific and technical activities (NACE M), administrative and support service activities (NACE N)

Value added of these GDP production components are derived indirectly according the principles layed down in section 4.1. We use monthly turnover series from the short term business statistic by *Statistics Austria* concerning these service sectors. Missing indicator values will be forecasted using time series models with exogenous variables, such as external information based on the monthly business survey in these sectors, conducted by *WIFO*.

To find quarterly output deflators, the implicit value added deflators are benchmarked by applying the same econometric technique as described above. As indicator we use information from the output price index for business services of the relevant sectors. These series are extrapolated up to the reference quarter using time series models. Annual input-output-relations, used for deriving value added from production output, are disaggregated by the mathematical BFL technique.

4.1.9 Public administration and defence, compulsory social security (NACE O), education (NACE P), human health and social work activities (NACE Q)

For these three activities value added is estimated directly. For obtaining volume estimates we incorporate the number of employees in the relevant sector in the benchmark model. In addition, we use quarterly estimates from the short-term public finance statistics (Sector S.13 "General Government") giving information on intermediate consumption (P.2), compensation of employees (D.1), and social transfers in kind related to expenses on products supplied to households (D.632) for some consistency check.

The estimation of the quarterly deflator incorporates the public sector wage index as regressor in the benchmarking procedure. From chained quarterly estimates and the inflator series, value added at average previous year's prices and values at current prices are calculated.

4.1.10 Arts, entertainment and recreation (NACE R), other service activities (NACE S)

As data of activities belonging to this industry are rather scarce, the value added is directly disaggregated here, without calculating gross production value as an intermediate step. The

value added in the non-market sector of NACE R and NACE S is obtained by the number of employees in the respective sector. Additionally, data on relevant revenues are tested to cover the value added in the market sector.

CPI indicators (e.g. for theatre or hairdressing) are used for the respective services for the value added deflators.

4.1.11 Private households (NACE T)

For this GDP component no indicators are available for disaggregation annual output and annual value added. Therefore, an approach where annual value added is directly broken down to quarters without estimating gross production value before is employed. This is done with the purely mathematical BFL distribution procedure, as described in section 3.2.2. Like in the ANA, the ratio of output and value added is assumed to be 100%. This assumes that no intermediate consumption takes place and value added prices are fully determined by wage rises. As for that, it is assumed that prices change only at the beginning of each year and are held constant thereafter on a quarterly basis.

4.2 FISIM

According to the *Council Regulation 448/98* and the *Commission Regulation 1889/2002*, FISIM is regarded as intermediate consumption for the industries and for private households as final consumption expenses and/or as exports or imports on the expenditure side. According to ESA 2010 paragraph 14.1, FISIM only have to be calculated between non financial institutions, interbank FISIM have to be excluded. Quarterly FISIM estimates are obtained by *Statistics Austria*. Regarding the allocation on the production side of GDP, intermediate consumption at industry level is not explicitly broken down into FISIM and other intermediate consumption. So FISIM consumed by production units is treated like any other intermediate product e.g. like energy.

4.3 Taxes less subsidies on products (D.21 less D.31)

In order to obtain consistency between the QNA and the sector accounts "General Government" (S.13) published by *Statistics Austria*, the QNA figures for taxes and subsidies are based on sector account estimates from *Statistics Austria* up to the quarter prior the reference quarter. For the reference quarter estimates based on time adjusted cash tax revenues are used.

4.3.1 Taxes on production and imports (D.2)

Cash figures of taxes are adjusted in order to relate better to the consumption activity of the reference period. Plausibility checks of the overall tax/spending ratio are made regularly.

4.3.1.1 Value Added Type taxes (D.211)

As the seasonal pattern on consumption is well pronounced, regarding the Value Added Type taxes (D.211), heavy distorting effects can arise using sub-annually cash receipts. Therefore receipts are lagged by two month before aggregating to quarters, as it is done in

ANA. At the time of compilation, cash tax revenues of the federal government cover all three month of the reference quarter as well as one month of the following. The principle of accrual requires at least information of one additional month. To estimate this month, a univariate seasonal ARIMA model is used. Furthermore, an adjustment in order to improve the relation to underlying consumption is made. The results of this process are used to obtain the Value Added Type taxes for the reference quarter, for the quarters beforehand, quarterly sector account figures for D.211 are used in the compilation procedure.

In order to derive quarters in volume terms, CPI is used for benchmarking the annual deflator, offering a rather good empirical explanatory power. Benchmarking is done according the *Chow – Lin* (1971) technique.

4.3.1.2 Taxes and duties on imports excluding VAT (D.212)

Taxes on imports for the reference quarter are not modelled separately in the compilation of the QNA. On the one hand due to missing indicator values, on the other hand due to its minor weight (less than two per-cent) of the total sum of taxes on products. The D.212 aggregate is calculated jointly with "Taxes on products except VAT and import taxes" (D.214).

4.3.1.3 Taxes on products except VAT and import taxes (D.214)

Other taxes on production (D.214) include recurrent taxes levied on products, property and fixed assets. For disaggregating annual data, sector account information is used for the periods prior the reference quarter. The value for the reference quarter, at current prices, is obtained using an indicator which is constructed by summing up all cash revenues on a monthly basis that contribute to this aggregate. Again, to deal with the accrual problem, a specific lag structure is used in the temporal disaggregation process and missing data for the reference quarter are estimated with a univariate ARIMA model. Benchmarking of the indicator to the ANA is done according the *Chow – Lin* (1971) technique.

4.3.2 Subsidies on products (D.31)

Subsidies are taken from the quarterly sector accounts S.13. The missing value for the reference quarter is filled with an estimate based on a univariate ARIMA model. In special cases, additional background information concerning the seasonal structure is incorporated.

Chapter 5 GDP components: the expenditure approach

5.1 Household final consumption (P.31, S.14)

As household final consumption is the largest component of GDP by expenditure, a very detailed estimation procedure is used. The aggregate is classified into twelve groups according to the COICOP-system. For the estimation of the components at current prices the revenue statistics of the Austrian retail trade published by *Statistics Austria* is an important source. For the calculation of the respective price indices the Harmonised Index of Consumer Prices (HICP) published by *Eurostat* is used.

As at the time when the estimates are compiled the quartely data of the retail sales indicators are not yet available for the whole reference quarter, missing months have to be forecasted. This is done by means of time series models where calender effects (like holidays and Easter effects), outlier in the data and seasonal factors are considered.

To ensure consistency between quarterly and annual figures of current values and prices at average prices of the previous year, the benchmarking method proposed by *Chow – Lin* (1971) is primarily used. In this 'optimal' solution framework, quarters are derived by estimating a systemetic component and an adjustment term, obeying some time series specification.

The quarterly estimation of private consumption expenditure of households at current prices is based on the development of the most contributing items of each COICOP-group. The respective HICP indicator is used for the estimation of the consumer prices of each COICOP-group. Changes in the HICP series over time are also considered in the estimation procedure.

Retail trade turnover indices are the only source for the groups 'Food and non-alcoholic beverages', 'Clothing and footwear', and 'Furnishings, household equipment and routine maintenance of the house'.

Consumption expenditures for 'Health', 'Recreation and culture', and 'Miscellaneous goods and services' are based on turnover indices and on appropriate data of value added as derived in the production approach for the specific industry. One of the indicators of 'Miscellaneous goods and services' for calculating figures at current prices and consumer prices is the personal consumption expenditure for financial and insurance services based on the change of output of these branches (NACE K). As such, FISIM is implicitly taken into account as final consumption expenses of private households.

For the COICOP-group 'Alcoholic beverages, tobacco' information on production of beer (in hectolitre) in Austria provided by the *Verband der Brauereien* and estimates based on the retail sales of tobacco products are used.

'Housing, water, electricity, gas, and other fuels' are based on the development of the prices for this group. In particular, the HICP component of renting is mainly used to calculate personal consumption expenditures for housing services (including owner-occupied housing via imputed rental values).

Information for consumption expenditures on 'Transport' comes from the turnover of car purchases, and consumption of fuels and lubricants for personal transport.

The private consumption for the COICOP-group 'Communications' is derived from the revenue statistics of the *Telekom Austria Group*.

'Education' and 'Restaurants and hotels' are based on value added data derived in the production approach for the specific industry.

The development of international tourism expenditures is the basis to estimate the expenditures abroad by Austrian residents and non-residents in Austria.

In general, quarterly volume measures at previous year's prices are derived from values at current prices and prices at average prices of the previous year. These values are the basis for calculating the chain-linked indicators and furthermore the chain-linked volumes (base 2010).

5.2 Government final consumption (P.3, S.13), split-up in individual (P.31, S.13) and collective consumption (P.32, S.13)

In order to obtain consistency between the QNA and the sector accounts "General Government" (S.13) published by *Statistics Austria*, the QNA figures for both categories of government consumption are based on quarterly sector account estimates from *Statistics Austria* up to the quarter prior the reference quarter. For the reference quarter own estimates are obtained as follows:

Government final consumption consists primarily of non-market goods and services produced by the government. Therefore government final consumption expenditures are closely linked to output estimations. As for that, quarterly figures can be derived using values from the production side as indicators. One time factors causing differences between government output and government consumption are accounted by the introduction of special variables helping to improve the model. Individual and collective consumption are derived independently from each other.

Individual consumption of the government (P.31, S.13) absorbs large parts of the output produced by the industries 'Education' (NACE 85) and 'Human health and social work activities' (NACE 86-88). Therefore a strong relation for annual data to this supply side aggregates is found. The *Chow – Lin* (1971) procedure is used to break down annual totals at current prices to quarters. As public sector output is mainly determined by costs, wage increases play a significant role to determine public consumption deflators. Therefore wage indices of the public sector are used to disaggregate annual chain-linked deflators. By means of this, values at current and previous year's average prices are calculated. The result of the benchmarking procedure is used as an estimate for the reference quarter.

Regarding the collective consumption (P.32, S.13) – theoretically as well as empirically – there exists a strong relationship to the output produced by the industry 'Public administration and defence; compulsory social security' (NACE 84). The procedure to obtain an estimate for the reference quarter is the same as presented for the calculation of individual consumption of the government (P.31, S.13). Again information about wages and salaries are used as indicators in order to benchmark annual deflators.

5.3 Final consumption expenditure of NPISHs (P.31, S.15)

The quarterly output activity of the industries 'Human health and social work activities' (NACE 86-88) as well as 'Other service activities' (NACE 94-96) is used for explaining variations of the non-profit institutions serving households' (NPISHs') annual final consumption. Benchmarking of the indicators to the annual accounts is done according the *Chow – Lin* (1971) technique.

As output of this activity is mainly determined by costs, wage deflators play a significant role to determine NPISHs' consumption deflators. Therefore, wage indices of this activity are used to disaggregate annual chain-linked deflators, which is done again with the *Chow – Lin* (1971) approach. By means of this, values at current and previous year's average prices are calculated.

5.4 Gross capital formation (P.5)

5.4.1 Gross fixed capital formation (P.51g)

5.4.1.1 Dwellings and other buildings and structures (P.51g, AN.111, AN.112)

In the estimation procedure, capital formation in construction is split into 'Dwellings' (P.51g, AN.111) and 'Other buildings and structures' (P.51g, AN.112). For the component 'Dwellings' there exists better subannual information than for the subgroup 'Other buildings and structures'. Sources used in the estimation process of quarterly figures for dwellings comprise production values of construction of residential building and restoration work on building, as collected and compiled by the short term business survey. Time series models are used in order to extrapolate the series until the current edge of the publication period of the QNA. The series are related to capital formation at current prices and to ensure consistency between quarterly and annual figures. Volume estimates are calculated by benchmarking annual chain-linked deflators by the official residential construction price index in combination with forecasting methods. The indicator to estimate non-dwelling (i.e. 'Other buildings and structures') construction capital formation is obtained as residual from estimating total construction investment (related to total construction output) and dwelling capital formation. Information for the division into housing and non-housing capital formation is additionally drawn from the results of the *WIFO* monthly business survey conducted on behalf of the *European Commission*. It relates to the indicator of order stocks in both residential construction and other construction industries. For deriving the quarterly deflator the model uses data from price indices concerning the residential construction and non-housing construction together with forecasting methods.

5.4.1.2 Machinery and equipment and weapon systems (P.51g, AN.113 + AN.114)

The component 'Machinery and equipment and weapon systems' (P.51g, AN.113 + AN.114) can be broken down into the assests transport equipment, ICT equipment and other machinery and equipment and weapon systems. These assests are estimated separately

using a separate commodity flow approach for each of them.[12] Several indicators measuring domestic production, import and export data by product as well as final consumption are used in the benchmarking process. As most of them are not available up to the reference quarter, forecasting techniques fill the data gap. For breaking down annual chain-linked deflators, appropriate price indices (e.g. wholesale prices or prices on producer durables) are used for setting up the benchmark model.

5.4.1.3 Cultivated biological resources (P.51g, AN.115)

In order to break down annual chain-linked volumes of 'Cultivated biological resources' (P.51g, AN.115), a fixed quarterly pattern showing the weighted saisonal production of certain livestock products is used. Additionally, in order to guarantee the consistence to the annual series, the mathematical Denton procedure is applied. As a capable indicator to explain variations of the annual chain-linked deflator, a collection of producer prices of agricultural products are used in a *Chow – Lin* (1971) benchmarking framework in order to derive quarterly deflators.

5.4.1.4 Intellectual property products (P.51g, AN.117)

This sector mainly relates to intangible capital assets. In order to break down annual investment the usual benchmark framwork together with a univariate ARIMA forecast is used. Monthly turnover series from the short term business statistic concerning IT services as well as the relating labour costs are used.

5.4.2 Changes in inventories and acquisitions less disposals of valuables (P.52, P.53)

5.4.2.1 Changes in inventories (P.52)

In Austrian ANA there is a statistical discrepancy representing the difference between production and expenditure side of GDP. As there is no indicator available to calculate quarterly 'Changes in inventories' (P.52), the difference between production and expenditure side is derived together with the statistical discrepancy. In order to separate this quarterly series of changes in inventories at current prices from the statistical discrepancy, the seasonal component is extracted from the aggregate and assigned to the changes in inventory part. The idea behind this is that only changes in inventories should show a seasonal variation but not the remaining statistical discrepancy.

The difference from summing up this seasonal pattern to annual totals of inventories is distributed according the mathematical Denton benchmarking method. Quarterly final statistical discrepancy is again calculated as the residual between both sides of GDP.

As no price information concerning the quarterly development of changes in inventories is available, annually chained deflators are broken down by the mathematical BFL method. From this quarterly series, inventories at current and previous year's average prices are calculated. Changes in inventories are only published in levels at current prices.

[12] Weapon systems are not estimated individually within the QNA.

5.4.2.2 Acquisitions less disposals of valuables (P.53)

Annual series of 'Acquisitions less disposals of valuables' (P.53) at current prices are disaggregated with the *Chow – Lin* (1971) regression model, using sales statistics of *Münze Österreich* as an indicator.

The same type of model is used for benchmarking the annually chained deflator taking quarterly averages of the gold price as indicator.

5.5 Exports and imports of goods (fob) and services (P.6, P.7)

5.5.1 Exports and imports of goods (fob) (P.61, P.71)

Information on 'Exports and imports of goods' (P.61, P.71) are available on a monthly basis from the foreign trade statistic of *Statistics Austria*. They are used as a benchmarking indicator even if their definition does not exactly match with the one used in National Accounts (cif/fob corrections; duties collected by countries located at the EU border but which are implicitly paid by Austrian importing units; including maintenance services in the NA framework but not according to the trade statistics definition). Additionally, we use data for Austrian goods exports and imports from *Eurostat*, where one additional month of data is available at time of the QNA compilation. Benchmarking is done according the *Chow – Lin* (1971) approach.

A problem is that foreign trade statistics are revised every month. As revisions are often substantial, information obtained from univariate time series models must be additionally taken into account for a robust estimation for the reference quarter in the QNA.

In order to derive estimates in current and previous year's average prices, annually chained deflators are benchmarked using the *Chow – Lin* (1971) regression approach. With regards to goods exports no foreign trade price statistic is available in Austria, as a consequence German international trade price indices adjusted for an Austrian country specific import/export basket of goods are used instead. Regarding import prices, additional information from the import price index from *Statistics Austria* is taken into account.

5.5.2 Exports and imports of services (P.62, P.72)

Due to its specific nature and their importance for the Austrian economy, services and tourism services are estimated separately. Information for quarterly figures of exports and imports of services and tourism are taken from the Balance of Payment statistic. The series have to be extrapolated for the reference quarter, taking into account other relevant time series (e.g. number of stays in hotels from tourists coming from abroad). To derive the quarterly pattern in order to fulfill the constraint of the annual figures, the *Chow – Lin* (1971) method is used.

Current values for tourism exports are deflated by a special index consisting of several HICP components covering tourism related services. For tourism imports an index partly determined by the consumer prices of the COICOP group 'Hotels and restaurants' and by CPI positions covering the cost of living abroad is used.

For imports of services other than tourism, the CPI sub-category covering services are used as indicator. For exports of services other than tourism, information from the output price index for business services is taken into account. In both cases indicator series are used within a *Chow – Lin* (1971) benchmarking framework in order to derive quarterly series from annually chained deflators, which can be used for calculating current and previous year's average prices.

5.5.3 Geographical break down

Imports and exports are broken down into imports from – and exports to – EU member states which are part of the euro area, EU member states outside the euro area, and Non-EU member countries. For benchmarking the annual series, the indictors are taken from the Balance of Payment statistics. Forecasting models using additional information from the foreign trade statistic of *Statistics Austria* and *Eurostat* are used to extrapolate the series until the current edge of the QNA.

Annually chained deflators are benchmarked using the *Chow – Lin* (1971) regression approach. German international trade price indices (which are available concerning the area of origin or destination) are adjusted for the Austrian country specific import/export basket of goods.

Chapter 6 GDP components: the income approach

6.1 Compensation of employees (D.1)

In order to derive indicators suitable for benchmarking annual totals of compensations, the quarterly number of employees broken down by the lowest possible level (see section 7.2.1) is multiplied by the appropriate wage index. Regarding the industrial and construction industries, we use the index of gross wages and salaries published by *Statistics Austria*. For the other components we use the respective wage indices agreed on in the collective bargaining process. These wage indices do not reflect the effective wage, but they should be closely related as long as the relative wage drift shows no long term trend. These indicators are used in the *Chow – Lin* (1971) regression approach.

The resulted quarterly compensations are aggregated to the A10 break down:

A	Agriculture, forestry and fishing
B_E	Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply, sewerage, waste management and remediation activities
C	of which: Manufacturing
F	Construction
G_I	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M-N	Professional, scientific and technical activities; administrative and support service activities
O_Q	Public administration and defence; compulsory social security; education; human health and social work activities
R_U	Arts, entertainment and recreation, repair of household goods and other services

'Wages and salaries' (D.11) are calculated from these compensation figures by holding constant the annual relation between compensations and wages (employer's contribution rate) over the year. For extrapolation it is assumed, that the relation of the previous year is maintained, as long as no changes of this relation are to be expected.

As a control, the sum over all industries is compared to social security pension contributions per quarter.

6.2 Taxes on production and imports less subsidies (D.2 less D.3)

6.2.1 Taxes on production and imports (D.2)

'Taxes on production and imports' (D.2) are defined as the sum of taxes on products (D.21), which have been described in section 4.3, and other taxes on production (D.29). The latter are estimated by benchmarking annual totals by an indicator which is derived from the official tax revenue statistic. This indicator covers about 70% of other total taxes on production

(D.29). Again, the *Chow – Lin* (1971) approach is used as the regression framework for benchmarking. The result from the benchmarking procedure is used as estimate for the reference quarter, for all preceeding periods estimates from the quarterly sectoral accounts S.13 (see section 4.3) are included.

6.2.2 Subsidies (D.3)

'Subsidies' (D.3) are defined as the sum of subsidies on products (D.31), which have been described in section 4.3, and other subsidies on production (D.39). Identical to the compilation of the D.31 aggregate, the aggregate for D.39 contains quarterly sectoral account estimates out of S.13 ("General Government") prior the reference quarter and an estimate for the current quarter derived from an ARIMA timeseries forecast model, augmented in special cases with additional background information concerning the seasonal structure. It is to note that distributing subsidies on quarterly figures is rather difficult. First of all they are very often granted at an annual basis and secondly, even if they would be granted on a quarterly basis, cash payments have to be adjusted in order to get accrued data. As such the estimates for the most recent quarters contain a rather high confidence interval.

6.3 Gross operating surplus and gross mixed income (B.2g + B.3g)

Like in ANA the sum of 'Gross operating surplus' and 'Gross mixed income' is derived as a residual. In fact, this position is formed by the difference between GDP as determined by the production approach and the sum of compensation of employees (D.1) and taxes on productions and imports less subsidies (D.2 less D.3).

Chapter 7 Population and employment

7.1 Population (POP)

As there are no statistics or indicators which would give information about the subannual development of the population, the mathematical procedure as proposed by *Boot – Feibes – Lisman (1967)* is used for distributing annual data to quarters. For extrapolation the official annual population forecast for Austria as published by *Statistics Austria* is used.

7.2 Employment (EMP)

The regular quarterly employment dissemination covers both employees and self-employed persons broken down by industry A10, measured in jobs as well as hours worked. In some cases where it is necessary and possible, estimation takes place at a more detailed breakdown, with a final aggregation to the A10 level. Corresponding to the ANA both figures on employees and self-employees contain resident employed by resident and non-resident producer units. All indicator series used are tested for plausibility by benchmark quotas (for example productivity).

7.2.1 Employees (EEM)

In order to estimate employees measured in jobs, for most industries an optimal solution benchmarking model on the basis of a linear regression involving quarterly explanatory variables is used. The industry break down for the estimation process is the same as for the GDP production approach. As indicators, quarterly employment data by the *Federation of Austrian Social Security Institutions* (measured in jobs) are used. In some industries there exists a certain mismatch regarding both, the classification and the terms of measurement of employees between the definition in the national accounts framework and the *Federation of Austrian Social Security Institutions*.

This mismatch is considered in the compilation of the QNA. Further, if structural breaks (for example shifts in the indicator series) are identified, they are modelled explicitly. For industries where the recorded employees of the indicator series differ too much from the national accounts concept (incorporating decisively more or less employees), adjustments are applied in the estimating process. This can either be done by calibrating or by using the regression pattern of the indicator series only for a part of the series, while allocating the rest proportionally.

At the end, summing up the QNA estimates of employees for the different industries enables to explore a cross check with the aggregate employees published by the *Federation of Austrian Social Security Institutions*, adjusted for persons in the military service, maternity leave and marginally employed persons.

In QNA total hours worked of employees are derived on the lowest possible level and aggregated at the end. The series are benchmarked using various sources. For certain industries the relevant short term business survey gives appropriate monthly information of hours worked. Concerning the definition of hours worked the statistic matches closely to the

definition to be used in the national accounts framework. For the other industries, information about employees as well as about the output of relevant sectors is incorporated. Total hours worked from the *Austrian Micro census* by *Statistics Austria* serves as cross check.

7.2.2 Self-employed (ESE)

The quarterly distribution of self-employed is applied at the industry level A10. The main datasources are the Flash estimates for employment published by *Statistics Austria*. It focuses on persons whereas QNA figures are related to the number of jobs. Regarding the volatility of the series, adjustments have to be made concerning multiple job holders.

Concerning hours worked by self-employed, data from the *Austrian Micro census as* published by *Statistics Austria* (and its univariate forecast for the reference quarter) serve as background. Again external information is taken into account as well, like the monthly business survey conducted by *WIFO* on behalf of the *European Commission*.

Chapter 8 Flash estimates

The calculation of flash estimates is embedded in the framework of the regular QNA and follows the data generation process of the regular estimates. In some cases, as described above, also in the regular QNA forecasting techniques are used to extend the indicator series. As the flash estimates are published one month ahead of the regular QNA, even less indicators are available and the calculations rely on a higher degree on estimations and forecasting techniques. The advantage of compiling flash estimates within the same frame work as regular releases, explained also in *Savio* (2002), is that it is possible to revise the results of the previous quarter during the process of the flash estimates. Such an update of past observation is of great benefit for compiling flash estimates, as the lack of data at the recent time margin is usually bridged by time series methods, relying heavily on the quality of observations of the most recent past.

The following data are published in accordance with the release calendar proposed by *Eurostat* not later than at the end of the first month following the reference period:

	value		volume[1]	
	unadjusted	adjusted[2]	unadjusted	adjusted[2]
GDP-production side	✓	✓	✓	✓
Gross value added NACE A	✓	✓	✓	✓
Gross value added NACE B_E (and C)	✓	✓	✓	✓
Gross value added NACE F	✓	✓	✓	✓
Gross value added NACE G_I	✓	✓	✓	✓
Gross value added NACE J	✓	✓	✓	✓
Gross value added NACE K	✓	✓	✓	✓
Gross value added NACE L	✓	✓	✓	✓
Gross value added NACE M-N	✓	✓	✓	✓
Gross value added NACE O_Q	✓	✓	✓	✓
Gross value added NACE R_U	✓	✓	✓	✓
Taxes on products	✓	✓	✓	✓
Subsidies on products	✓	✓	✓	✓
Taxes less subsidies on products	✓	✓	✓	✓
GDP-expenditure side	✓	✓	✓	✓
Consumption of private households (incl. NPISHs)	✓	✓	✓	✓
Consumption of public households	✓	✓	✓	✓
Gross capital formation	✓	✓	✓	✓
Gross fixed capital formation	✓	✓	✓	✓
Exports of goods and services	✓	✓	✓	✓
Imports of goods and services	✓	✓	✓	✓

	value		volume[1]	
	unadjusted	adjusted[2]	unadjusted	adjusted[2]
GDP-income side	✓	✓		
Compensation of employees	✓	✓		
Gross operating surplus and gross mixed income	✓	✓		
Taxes on production and imports less subsidies	✓	✓		

[1] For the GDP aggregates absolute values are in chained-2010 Euros. – [2] Adjusted for seasonal and working day effects as well as adjusted for seasonal/ working day effects without the irregular component.

	jobs	
	unadjusted	adjusted[1]
Labour market		
Number of employees in NACE A	✓	✓
Number of employees in NACE B_E (and C)	✓	✓
Number of employees in NACE F	✓	✓
Number of employees in NACE G_I	✓	✓
Number of employees in NACE J	✓	✓
Number of employees in NACE K	✓	✓
Number of employees in NACE L	✓	✓
Number of employees in NACE M-N	✓	✓
Number of employees in NACE O_Q	✓	✓
Number of employees in NACE R_T	✓	✓

[1] Adjusted for seasonal and working day effects as well as adjusted for seasonal/ working day effects without the irregular component.

8.1 Flash GDP estimate

The estimates are based on uni- and multivariate time series models for extending those series that are used in the regular calculation of QNA. Multivariate time series models allow new external information to be considered in estimates for the missing months. This improves the possibility of detecting cyclical turning points at an early stage which is an advantage over univariate time series models.[13]

Concerning the industry and construction sector (NACE B_F) forecasting models are also necessary in the regular QNA (see section 4.1.2 and section 4.1.3). In the flash estimates these routines are extended in order to forecast one additional missing month. Likewise in the service sectors uni- or mutivariate time series techniques are applied in the regular QNA. They

[13] Certainly this advantage has not to be overstressed, as turning points based on monthly observations can only be recognised as such after some further observations are available. So there is a time lag between the registration and the recognition of them.

are extended for an additional month and/or widend regarding the amount of series when conducting the flash estimates. Concerning financial and insurance activities (NACE K), additionally pre-estimations of the quarterly FISIM is conducted using quarterly information on variations in the relevant interest rates and on the volume of savings deposits and credits of households and firms.

For only a minor part of components to be compiled, no special forecast of indicators is necessary as they are already available in the required length at the time of setting up flash estimates. This goes for example for employment data published by the *Federation of Austrian Social Security Institutions*, which are available only few days after the end of a quarter. These data build the backbone of calculating QNA employment figures and is of the same quality in flash estimates as well as in the regular QNA. A similar example are wage deflation indices by sectors underlying QNA gross salaries and certain price statistics, necessary for deflating certain components.

In the regular QNA, the quarterly indicator variable for taxes on products comprises tax revenues of the government. This monthly data covers already the end of the reference quarter, which is sufficient for most types of taxes on products. However, the principle of time adjusted cash for VAT requires instead of assigning only the last month of a specific quarter to the quarter of subject plus the first two months of the following. For estimating the missing months, a univariate seasonal ARIMA model is used.

Generally, results coming from the production approach of national accounts are statistically more reliable compared to the expenditure approach. This feature refers to the ANA and QNA and to flash estimates as well.

In the flash estimation of household final consumption most indicator values have to be forecasted by one additional month (e.g. indicators related to retail turnover), the basic method described under section 5.1 applies as well.

As for government final consumption and NPISH final consumption the required database covers the same periods as available for regular estimates, the method explained in chapter 5.2 and chapter 5.3 applies for the flash estimate as well.

The flash estimation of the components of gross fixed capital formation is based on the regular QNA estimation technique described above, whereas in most cases the forecast horizon is extended.

For the exports and imports of goods the trade statistics published by *Statistics Austria* are extended with a mulitvariate time series model using road toll data following *Fenz – Schneider* (2009). Further, qualitative information coming from the goods producing sector and the wholesale and retail trade sector are additionally considered in the model framework.

The flash estimates for tourism exports is based on the regular QNA approach, using external variables like the number of over-night stays of foreign guests in the model. The remaining exports of services are forecasted with univariate time series models. The estimates of other services imported and exported are done analogically.

8.2 Flash employment estimate

Employment data released by the *Federation of Austrian Social Security Institutions* are available already a few days after the end of the reference quarter. As explained in section 7.2 above, these data constitute the backbone of the calculation of QNA employees. No forecast is necessary and flash employment estimates are the same as disseminated in the regular QNA. This refers only to the employees, self-employed are not calculated for flash estimates. Equally, employment in total hours worked is not computed on a flash basis.

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