Finnish Quarterly National Accounts - methodological description

Contents

Chapter 1 Overview of the system of Quarterly National Accounts

1.1 Organisation

Quarterly National Accounts (hereafter referred to as QNA) are compiled at the National Accounts Unit of Statistics Finland's Economic Statistics Department. The compiling process involves one full-time person (team leader) and eight to ten other National Accounts experts (most of whom are also involved in compiling Annual National Accounts).

1.2 Publication timetable, revisions policy and dissemination

QNA are published at the lag of 65 days from the end of a quarter. A calendar showing all future release dates for the current year can be found on the web pages of Finnish National Accounts at: http://tilastokeskus.fi/til/ntp/tjulk_en.html.

QNA data are subject to revisions after their first release, so it is advisable to always search the latest version from the QNA web pages when using time series. The revisions to QNA data that are caused by revisions in the quarterly and monthly source data take place within around twelve months from the initial release. Any revisions subsequent to this are usually due to revisions in annual National Accounts. Annual accounts data will be revised until the supply and use tables are published, that is, around two years from the ending of the statistical reference year. However, seasonally adjusted and trend time series may revise with every release irrespective of whether the original time series has been revised or not.

1.3 Compilation of QNA

QNA are derived statistics, the compilation of which is based on the use of indicators formed from basic statistics or other source data. Unlike for annual accounts, exhaustive data on different transactions are generally not available quarterly. Lack of coverage means that in most cases the data cannot be compiled directly by summing from the source data. Instead, annual national accounts data are interpolated (disaggregated/divided to quarters) and extrapolated (for latest quarters) with indicators.

The compilation of data at current prices takes place in three phases. First, the quarterly indicator time series are constructed and updated for each QNA transaction. The indicator time series may be a single source data time series or a weighted combination of several source data time series. The indicator should reflect the quarterly development of the respective QNA transaction as well as possible. The indicators used in QNA are described in Chapters 4 to 8.

In the second phase the indicator time series are benchmarked to the annual national accounts using the proportional Denton method (see Chapter 3). As a result of benchmarking, quarterly time series are formed until the latest year of the annual national accounts. In the third phase the latest quarters are extrapolated with the help of the indicator using the ratio of the value of the latest annual accounts and the annual sum of the indicator (the so-called annual benchmark-to-indicator method).

QNA data is compiled according to European system of accounts ESA 2010. ESA 2010 is broadly consistent with the System of national accounts of the United Nations (SNA 2008).

1.4 Balancing

Total demand and supply are not fully balanced in QNA, but the statistical discrepancy between them is shown separately. If the statistical discrepancy becomes excessive, there is cause to suspect that one or several demand and supply components are erroneously estimated. In that case the most probable transactions causing imbalance are sought and their current price values are adjusted where needed.

1.5 Volume estimates

QNA volume data are published as chain-linked series at reference year 2010 prices. The chain-linking is performed with the annual overlap method in which volume estimates at the average prices of the previous year are used. The volumes at the average prices of the previous year are calculated by deflating the current price data with the change(s) in the price index/indices. Before chain-linking, volume time series at previous year's prices are benchmarked to the annual accounts with the pro rata method, where each quarter of the same year is raised or lowered in the same proportion.

1.6 Seasonal adjustment and working day adjustment

Seasonal adjustment and working day adjustment are performed in QNA with the TRAMO/SEATS method and the Demetra 2.2 software. In addition to the seasonally adjusted series, trend series and working day adjusted series are also published in QNA at both current and reference year 2010 prices. Seasonally adjusted aggregates at current prices are summed up from seasonally adjusted sub-series. All series at reference year 2010 prices, including aggregates, are adjusted individually. Seasonally adjusted, working day adjusted and trend time series are benchmarked to the annual accounts again after the seasonal adjustment.

Chapter 2 Publication timetable, revisions policy and dissemination of QNA

2.1 Release timetable and revisions to data

QNA are released at the (maximum) lag of 65 days from the end of a quarter. A calendar showing all future release dates for the current year can be found on the web pages of Finnish National Accounts at: http://tilastokeskus.fi/til/ntp/tjulk_en.html.

QNA are not published in between the four regular publications even if revisions in other national accounts statistics, such as the annual accounts or statistics on general government revenue and expenditure, would occur. Such revisions will be included in the next regular publication of QNA. An exception to this rule is the publication of the annual accounts in July, when QNA database tables are updated with the data benchmarked to the new annual levels.

QNA data become revised after their first release so it is advisable to search always the latest version from the QNA web pages when using time series. The revisions can be divided into those arising from changes in the source data of QNA, those caused by benchmarking to annual accounts and revisions due to other, mainly methodological reasons. The revisions of QNA data that arise from changes in their quarterly and monthly source data take place within around twelve months from the initial publication. Any revisions after this are usually caused by revisions in the new annual accounts and benchmarking of QNA to them.

On account of the characteristics of mathematical/statistical methods used in the compilation, it is also always possible that the time series become slightly revised in connection with a new release, even if no changes took place in the source data or annual accounts. The seasonal adjustment methods, in particular, are sensitive to new observations, so each new quarterly data will change seasonally adjusted and trend time series for the quarters preceding it as well. The more the new quarterly data differ from the development anticipated by the seasonal adjustment method, the more the preceding quarters become revised in the seasonally adjusted time series.

2.2 Contents published

The principal publication format of QNA is a free-of-charge release on the Internet. The online release (http://tilastokeskus.fi/til/ntp/index_en.html) comprises a brief release text, a longer review text and data tables in the Statfin -database accessible via the ”Tables” link. The database tables of the online release contain the entire data content of QNA. Statfin -database includes the new ESA 2010 time series and also older “historical” QNA time series. The ESA 2010 time series are divided into four tables in all of which time series start from the 1st quarter of 1990:

Table 1. *Value added of industries quarterly (GDP production approach)*

Table 2. *GDP expenditure approach and National income*

Table 3. *GDP income approach quarterly*

Table 4. *Employment quarterly*

Table 1 contains data on value added at the accuracy of 24 industries. QNA makes use of the Standard Industrial Classification TOL2008, which is uniform with the EU's NACE Rev. 2 and the UN's ISIC industrial classifications.

The industries in Table 1 (industry code in brackets):

- Primary production (A)
- Agriculture (01)
- Forestry (02)
- Total industries (B, C, D, E)
- Manufacturing (C)
- Forest industry (16-17)
- Chemical industry (19-22)
- Metal industry (24, 25, 28-30, 33)
- Electrical and electronics industry (26-27)
- Energy supply; Water supply and waste management (D, E)
- Construction (F)
- Trade; Transport; Accommodation and food service activities (G, H, I)
- Trade (G)
- Transport (H)
- Information and communication (J)
- Financial and insurance intermediation (K)
- Real estate activities (L)
- Professional, scientific and technical activities; Administrative and support service activities (M, N)
- Public administration and defence; Education; Health and social work (O, P, Q)
- Other service activities (R, S, T)
- Secondary production (B, C, D, E, F)
- Services (G, H, I, J, K, L, M, N, O, P, Q, R, S, T)
- General government services
- Private services

In addition, Table 1 contains data on taxes on products (D21), subsidies on products (D31) and gross domestic product.

Table 2 contains data on the national balance of supply and demand, i.e. the items of total supply and total demand. Total supply is composed of gross domestic product and imports. Exports and imports are separated in the table into goods and services. Final consumption expenditure is broken down to government and private consumption expenditure in which household consumption expenditure is further itemised by five types of goods: durable, semi-durable, non-durable goods, services, and tourism expenditure as net. Gross fixed capital formation is broken down to buildings; machinery, equipment and transport equipment and “Cultivated biological resources and intellectual property products”. Gross fixed capital formation is also broken down to public and private sector. Table 2 also contains data on consumption expenditure of non-profit institutions serving households, change in inventories, net acquisitions of valuables, statistical discrepancy, the terms of trade effect, primary income from/to the rest of the world, gross national income, net national income, current transfers from/to the rest of the world, savings, capital transfers from/to the rest of the worlds and net lending.

Table 3 contains data on wages and salaries, and employers’ social contributions with the breakdown of eleven industries (A11 aggregate division). In addition, the table shows data on operating surplus/mixed income, consumption of fixed capital, taxes on production and imports less subsidies, and gross domestic product.

Table 4 gives data on numbers of persons employed and hours worked with the breakdown of eleven industries (A11 aggregate industry division). Persons employed and hours worked are additionally broken down to employees and self-employed persons. Moreover, the table gives figures on total population and employed persons according to the national concept.

The data of Tables 1 and 2 are published at both current prices and as chain-linked volume series in which the reference year is 2010. In addition to the original series, all tables also contain seasonally adjusted, working day adjusted and trend series.

Change percentages of the original and working day adjusted series compared with the respective quarter of the year before can also be seen from the tables. Change percentages from the previous quarter can additionally be seen from the seasonally adjusted and trend series.

2.3 Special transmissions

QNA times series are updated in July when annual accounts are released. Update concerns internet database tables and the time series service ASTIKA. Updated time series do not actually contain new quarterly information, because the data are compiled by benchmarking/extrapolating the indicators used in the June QNA publication to the new Annual National Accounts levels.

The flash estimate on GDP for the national economy, which is summed up from the monthly data on the Trend Indicator of Output, is published with the release of the Trend Indicator of Output at the lag of 45 days from the end of a quarter.

2.4 Policy for metadata

A description of QNA is available on the web page of the publication at: http://tilastokeskus.fi/meta/til/ntp_en.html

The quality description (in Finnish only) is also available on the QNA pages: http://tilastokeskus.fi/til/ntp/laa.html

Chapter 3 Compilation of QNA

3.1 Overall compilation approach

3.1.1 General architecture of the QNA system

The compilation of QNA in Finland is based on the use of current price indicator series together with various mathematical/statistical methods. The compilation thus differs from the annual national accounts, which are mostly compiled by direct compilation method[1]. Indicators in QNA are quickly released intra-annual statistics or other source data that are considered to represent, or correlate with, national accounts transactions. Indicators are utilised because unlike in the annual accounts, exhaustive data on the values of national accounts transactions are generally not available quarterly or monthly. Even if exhaustive data were available quarterly at some time lag, it would be rare for them to be available in the timetable required by QNA, i.e. within 50 days from the end of a quarter.

The purpose of the indicator is to track the quarterly development of the QNA transaction as well as possible. The indicator time series may be individual time series selected directly from source statistics or weighted combinations of the time series of several source statistics. When constructing indicators one must take into account the accuracy of the used indicators, such as constant upward or downward bias. If constant bias is detected in the indicator, the indicator values are adjusted as needed before benchmarking and extrapolation. The adjustments can be deterministic or based on a statistical model. They may concern the whole time series or only one observation of the indicator time series.

In the calculation of current price data the information of the indicators and the information of annual national accounts is combined using benchmarking and extrapolation methods.

Volume data are compiled by converting current price data first into the previous year's average prices and by chain-linking these previous year's average price data into reference year 2010 prices using the annual overlap method (see 3.3).

3.2 Benchmarking, extrapolation and balancing

3.2.1 Benchmarking to annual accounts

Current price QNA time series are compiled by first benchmarking the current price indicator time series to annual accounts and then extrapolating the latest quarters with the same indicator. The purpose of benchmarking is to estimate the QNA time series using the indicator time series so that the

[1] In the direct compilation method the source data is first summed. Then coverage adjustments and other adjustments are made if required. The use of the direct compilation method requires sufficiently exhaustive source data.

annual levels of QNA time series are equal to the levels of annual national accounts. Benchmarking can be thought as a solution to the problem: how to combine the annual data of annual accounts with a quarterly indicator data, so that the quarterly path of the result time series follows the indicator as closely as possible.

It is essential to understand that the *level* of the benchmarked QNA time series is determined by the annual accounts, but its quarterly *path* by the indicator. Thus the level of the indicator values need not be anywhere near the values of their corresponding QNA transaction; the indicator can be a 2005=100 index series, for example. Benchmarking requires that all indicator series are complete, starting from 1990Q1. As a result of benchmarking the original current priced QNA time series are formed starting from 1990Q1 and ending to the latest year of annual national accounts.

Benchmarking is done with the *proportional Denton method*[2], which is a deterministic (non-stochastic) procedure for temporal disaggregation of time series. Its' objective is to retain the original quarter-to-quarter development of the indicator time series in the resulting QNA time series. If an observation in an indicator series at time t is denoted with i_t and an observation in the benchmarked QNA series at time t with x_t, the benchmarked values are those that minimize the equation

$$min \sum_{t=2}^{T} \left[\frac{x_t}{i_t} - \frac{x_{t-1}}{i_{t-1}} \right]^2$$

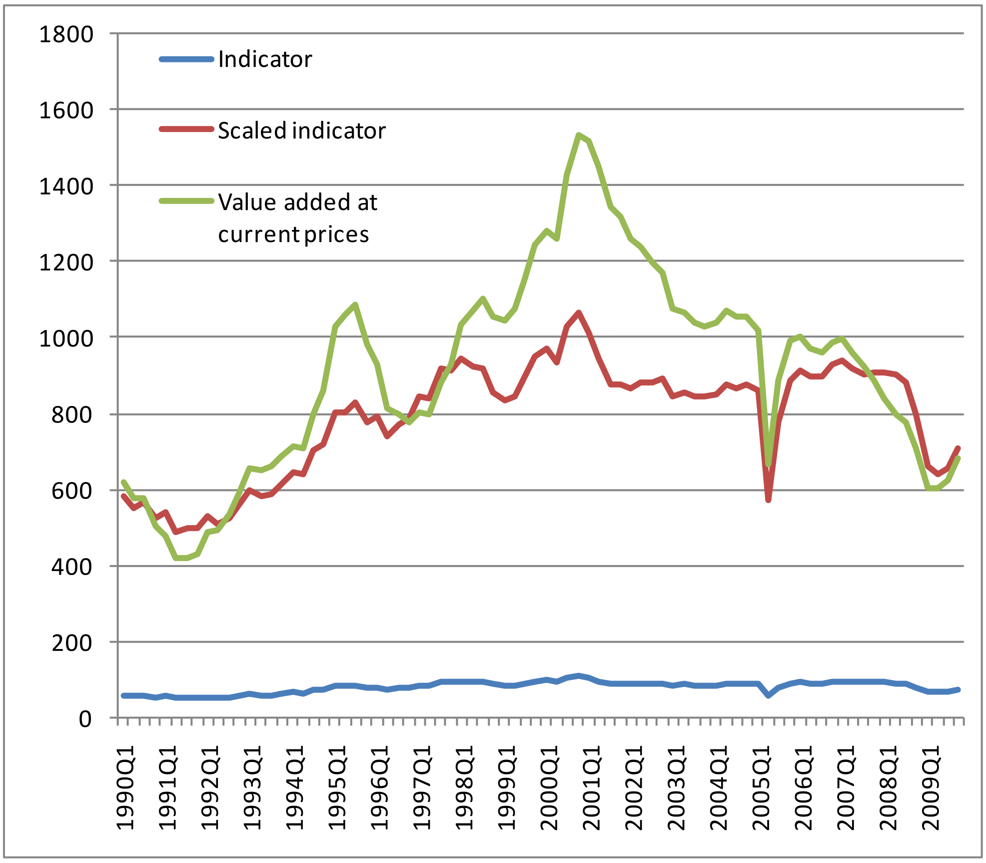
where T denotes the last quarter of the time series. The sum of squares is minimized subject to annual constraints, i.e. that the sum of all quarters of the year must be equal to the corresponding value in annual accounts. Benchmark to indicator ratio BI_t will thus be estimated for every quarter of the year,

$$BI_t = \frac{x_t}{i_t},$$

which, when the entire time series is considered, deviates as little as possible from the BI ratio of the previous point in time.

[2] Denton, F.T. (1971), "Adjustment of monthly or quarterly series to annual totals: An approach based on quadratic minimization." Journal of the American Statistical Association, 82, 99-102.

Figure 1: Indicator and a time series benchmarked with the proportional Denton method



The graph above shows the indicator for the pulp and paper industry in the non-financial corporations sector (S.11) and the QNA value added time series formed from it by benchmarking. The indicator in this case is a turnover index (2000=100). For the sake of illustration, a scaled indicator (in red) was added by multiplying the indicator values by ten. When comparing the scaled indicator and the benchmarked value added time series, we see how the proportional Denton method retains the quarterly development of the indicator in the benchmarked time series, even though the annual development of the annual national accounts at times differs considerably from the annual development of the indicator. Special attention should be given to the dip in 2005Q2, which was due to the strike/shutdown in the paper industry.

An other variant of Denton method, the *Denton difference method*, is also utilized in the benchmarking of QNA, albeit much less than the proportional Denton. The Denton difference method is almost identical to proportional Denton except in this case the (sum of squares of the) differences minimized are based on actual differences of the benchmark and the indicator instead of differences in proportional BI ratios:

$$min \sum_{t=2}^{T} \left[(x_t - i_t) - (x_{t-1} - i_{t-1}) \right]^2$$, subject to annual constraints.

The choice between these two Denton methods boils down to following consideration. If we want to retain the proportional quarterly changes (i.e. quarterly growth rates) of the indicator in the benchmarked time series, we choose the proportional Denton. On the other hand, if we want to retain the actual quarterly changes (i.e. first order differences) of the indicator in the benchmarked time series, we choose the Denton difference method. The Denton difference method is utilized in a few QNA time series where the quarterly growth rates of the indicator are, usually due to small sample size, too volatile for the proportional Denton method.

There are also various benchmarking methods that are based on time series models and in which the original time series is used as the external regressor. A simple example of this is Chow-Lin[3], and if suitably formulated, the Denton method can also be regarded as a special case of this kind of a model. With the exception of particularly problematic series, the Denton method and methods based on simple time series modelling produce in practice the same benchmarked series, and no reasons for changing the method have emerged from the examinations made. The proportional version of the Denton method is also recommended for benchmarking in the IMF's QNA manual[4]. More complex models would make it possible to study interesting connections to seasonal adjustment, for example, but then the benchmarking proper would not necessarily succeed equally reliably. Further reading about time series model-based methods is available in the master's thesis written at Statistics Finland (Hakala, 2005)[5].

3.2.2 Extrapolation

Denton benchmarking yields the original current price QNA time series up till the latest year of annual national accounts, but not beyond. In Finland, the full annual national accounts are released in July, over six months after the end of the statistical reference year. It follows that when compiling the QNA data on the first quarter of a year in May, the first quarter of the current year as well as all four quarters of the previous year are still missing from the time series after benchmarking.

These latest quarters, of which there are two to five depending on the time of release, are calculated by extrapolation. Extrapolation is done with the indicator time series, using the annual benchmark-to-indicator ratio.

As a result of benchmarking, the sum of the quarters in any year of the benchmarked current priced time series is exactly equal to that in the annual accounts. The annual benchmark-to-indicator ratio used in extrapolation can then be calculated by dividing the annual sum of the latest benchmarked QNA values with the annual sum of the respective indicator time series. The *annual BI ratio* thus is the ratio of the latest annual account data to the respective indicator values.

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[3] Chow, G.C. – Lin, A.-L. (1971), “Best Linear Unbiased Interpolation, Distribution and Extrapolation of Time Series by Related Series.” *The Review of Economics and Statistics*, 53 (4) s. 372–375.
[4] http://www.imf.org/external/pubs/ft/qna/2000/Textbook/ch6.pdf
[5] Hakala, Samu (2005), "Aikasarjojen täsmäyttäminen" (In Finnish only; Benchmarking of time series).

In extrapolation the (latest) values of the indicator time series are multiplied by the annual BI ratio:

$$x_t = \frac{x_{Y-1}}{i_{Y-1}} \times i_t$$

where x_t is the extrapolated QNA value for quarter t, x_{Y-1} is the sum of the QNA values in the latest benchmarked year, i_{Y-1} is the sum of the indicator values in the same year and i_t is the value of the indicator in quarter t.

As in benchmarking, the extrapolation method is selected with a criteria that the resulting current priced QNA time series should follow as closely as possible the development of the indicator. Extrapolated current price QNA estimates can still be adjusted, if needed. Adjustments are made when some additional information, which is not included in the indicator, is available.

Table 1: Extrapolation with the annual BI ratio

Time period	Indicator	QNA value (bench-marked), EUR mil.	QNA value (extrapolated), EUR mil.
2008Q1	90.7	847	
2008Q2	90.1	809	
2008Q3	88.4	773	
2008Q4	79.8	689	
2009Q1	65.9		((847+809+773+689)/(90.7+90.1+88.4+79.8))*65.9 = **589**
2009Q2	64.2		((847+809+773+689)/(90.7+90.1+88.4+79.8))*64.2 = **574**
2009Q3	65.5		((847+809+773+689)/(90.7+90.1+88.4+79.8))*65.5 = **585**
2009Q4	70.8		((847+809+773+689)/(90.7+90.1+88.4+79.8))*70.8 = **633**

3.2.3 Balancing of demand and supply

Total demand (consumption, investments and exports) and total supply (production and imports) are not fully balanced in QNA. The statistical discrepancy between them is shown separately. However, a large statistical discrepancy signifies that some indicator(s) of demand or supply may have problems. If the quarterly statistical discrepancy in current prices seems to grow excessively large, the transactions/indicators causing the imbalance are identified and their current price values are adjusted if necessary.

The most unreliable indicators in QNA are those used in the estimation of gross fixed capital formation, changes in inventories, consumption of services, and imports and exports of services.

Change in inventories is a particularly difficult transaction to estimate due to problems related to coverage, time of recording and valuation. Consequently, the change in inventories is normally the primary target for balancing.

The indicators for the household consumption of services as well as some items of gross fixed capital formation have relatively poor coverage. Gross fixed capital formation in machinery/equipment and in other (intangible) assets are often adjusted due to their great volatility.

The source data for exports and imports of services have large revisions, which is due to difficulties in measuring these items. Estimates of imports and exports are not, however, usually adjusted in balancing, because the national accounts should be consistent with the balance of payments.

GDP calculated using income approach always balances with GDP calculated using production (value added) approach, because operating surplus is a residual transaction in QNA (see Chapter 6).

3.2.4 Estimation in preliminary data

The availability of monthly and quarterly source statistics that can be used as indicators is good in Finland. From the very first publication approximately 90 per cent of QNA data are based on indicators derived from statistical/register sources. That said, particularly in the first publication some of the source data are incomplete, with the latest month missing for example. The most important transactions where first QNA estimate is based on incomplete data are taxes on products, gross fixed capital formation in buildings and value added in the household sector (see Chapter 4).

3.3 Volume estimates

3.3.1 General data policy

Volume refers to data adjusted for price changes. One problem with current price estimates is that price fluctuations can often dominate the changes in value. Volume estimates are needed to separate real changes in economic activity from these price changes. That is why the percentage change of GDP is normally derived from the volume estimates.

Volume in national accounts is not simply a measure of quantity, because it also comprises changes in quality. For example, the volume of mobile phone production can grow even if the quantity produced does not change. This happens if the quality (i.e. technical features) of new mobile phones is better than that of old ones.

QNA volume data are published as chain-linked series at reference year 2010 prices. Chain-linking means that the volume data of each year are first calculated at previous year's prices. From these are calculated the annual volume changes, which are then linked together to form a chain-linked volume time series. An alternative way of calculating volume series, utilised prior to 2006, is to use a fixed base year.

In the quarterly national accounts the calculation of volume data starts with deflation, in which current price time series are converted to volume series at the average prices of the previous year by dividing current price values of each quarter with a deflator. The deflator is a suitable price or price index for the transaction. In order to convert current price values to previous year volumes, we first calculate the ratio between the quarterly price and the previous year's average price. The deflator in this ratio form thus expresses the price level of each quarter relative to the average price level of the previous year:

$$D_t = \frac{P_t}{P_{Y-1}}$$

where P_t is the price of quarter t, P_{Y-1} is the average price of the previous year (arithmetic mean) and D_t the ratio value of the deflator.

Several price indices can be used for constructing a deflator for one transaction. In this case the P in the equation above is a weighted combination of multiple price indices.

In annual national accounts, output and intermediate consumption are deflated separately (double deflation). In Finland's QNA however, the value added is deflated directly with output prices. Intermediate consumption is not estimated nor deflated separately in QNA, because there are no reliable quarterly indicators for intermediate consumption.

The deflators for value added by industry are constructed from product level price data[6]. Product level prices are weighted with the product weights of current price *output* derived from the supply and use tables. Price indices and their weights in the QNA value added are therefore the same as in the output of annual accounts, except for those few products whose final price data are obtained only at annual frequency[7].

Deflation with same prices and weights as in annual accounts improves the accuracy of the volume estimates of the QNA value added/GDP. On the other hand, the lack of the intermediate consumption estimates in QNA hampers accuracy, which is why the release of annual accounts in July may cause considerable revisions to the value added/GDP volumes in QNA.

When deflators have been constructed for all transactions and their industries, deflation can be started. The volume at the average prices of the previous year for quarter t is:

$$PYP_t = \frac{CP_t}{D_t}$$

where CP_t is the current priced value and D_t the ratio value of the deflator in quarter t.

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[6] The supply and use tables have 790 products, for each of which is defined a specific price index.

[7] Because the supply and use tables are completed with a lag of around two years after the end of the statistical reference year, the weight structure of the latest supply and use table is used for several years. For example, the QNA value added data for the years 2008 to 2011 published in September 2011 were deflated using the output weights of the supply and use tables of 2008. The same weight structure was also used in the annual accounts data concerning 2008 to 2010 published in July 2011.

Table 2: Deflation with one price index (NB The average price index for 2006 is 103.8)

Time period	Value in QNA at current prices	Price index	Deflator	Volume in QNA at previous year's average prices
2006Q1	1,478	103.4		
2006Q2	1,499	103.1		
2006Q3	1,530	104.0		
2006Q4	1,590	104.5		
2007Q1	1,518	104.4	104.4 / 103.8 = 1.006	1,518 / 1.006 = 1,509
2007Q2	1,537	104.8	104.8 / 103.8 = 1.010	1,537 / 1.010 = 1,522
2007Q3	1,551	105.2	105.2 / 103.8 = 1.014	1,551 / 1.014 = 1,530
2007Q4	1,610	105.9	105.9 / 103.8 = 1.021	1,610 / 1.021 = 1,577

3.3.2 Chain-linking and benchmarking

Volume estimates at previous year's average prices are benchmarked to the annual accounts with the pro rata method, that is, each quarter of a year is raised or lowered in equal proportion:

$$x_t = \frac{x_Y}{i_Y} \times i_t$$

where x_t is the benchmarked quarterly volume at previous year's average prices, x_Y is the volume at previous year's prices in the annual accounts, i_Y the annual sum of the non-benchmarked quarterly volumes at previous year's average prices, and i_t is the non-benchmarked quarterly volume at previous year's average prices.

The pro rata method is used in this case instead of the Denton benchmarking method because the previous year's price time series have break points at each turn of the year. As the quarters of each year are deflated to the previous year's prices, changes at the turn of the year in the time series (e.g. 2007Q1/2006Q4) are not comparable with the changes within the year (e.g. 2006Q4/2006Q3). The Denton method aims to retain the changes between all quarters of the original series, which is why the data to should be continuous as in the current price time series[8].

Benchmarked volume data at previous year's prices are not normally published but they are included in Eurostat's ESA transmission program. They are available to users upon request.

After the volumes at the average prices of the previous year have been benchmarked, they are chain-linked to reference year 2010 price volume series with the annual overlap method[9]. The chain-linking starts with a calculation of the annual chain-linked volume index:

$$CL_Y = \frac{PYP_Y}{CP_{Y-1}} \times CL_{Y-1}$$

where CL_Y is the value of the annual chain-linked volume index in year Y, PYP_Y is volume at previous year's prices in year Y (summed from benchmarked quarterly volumes), CP_{Y-1} is the previous year's current price value (summed from benchmarked quarters) and CL_{Y-1} is the previous year's chain-linked volume index. The first year value of the chain-linked volume index can be set to 1 or 100.

Then, for each quarter, the ratio of the quarterly volume (at previous year's average prices) to the current price average of the previous year must be calculated. The previous year's index value from the chain-linked annual volume index is then multiplied with these quarterly ratios, to obtain a quarterly chain-linked volume index series:

$$CL_Q = \frac{PYP_Q}{\frac{CP_{Y-1}}{4}} \times CL_{Y-1}$$

where CL_Q is the quarterly chain-linked volume index in quarter Q, PYP_Q is the quarterly volume at previous year's average prices, $CP_{Y-1}/4$ is the previous year's current price quarterly average, and CL_{Y-1} is the previous year's value of the chain-linked annual volume index.

The quarterly chain-linked volume index time series can be scaled to the level of any reference year by multiplying all the quarters of the volume index with the same multiplier. The multiplier is derived from the ratio:

$$\frac{CP_{VV}}{\sum CL_Q}$$

where CP_{VV} is the current priced annual value of the desired reference year and ΣCL_Q is the sum of the index values of the quarterly chain-linked volume index in the same reference year.

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[8] The pro rata method is not recommended for the benchmarking of continuous series, because it creates break points at year turns (step problem).

[9] Information on the quarterly accounts volume calculations can be found in Chapter 9 of the IMF's QNA Manual: http://www.imf.org/external/pubs/ft/qna/2000/Textbook/ch9.pdf. Example of Annual overlap on page 159.

In a chain-linked series, the choice of the reference year is arbitrary and it only indicates that volumes are expressed relative to the current price level of the reference year. Because price weights change annually in chain-linked volume time series, price and volume changes are more accurately estimated when compared to a fixed base year volume series.

The drawback of chain-linked time series is loss of additivity, which means that the series cannot be summed with each other. Thus, for instance, a chain-linked volume of GDP is not equal to the sum of its components.

Because of the properties of the annual overlap chain-linking method, the chain-linked quarterly volumes will automatically be equal to chain-linked annual accounts if quarterly volumes at previous year's prices and quarterly current price values have first been benchmarked.

3.4 Seasonal adjustment and adjustment for working days[10]

Quarterly national accounts (QNA) time series show seasonal variation typical of short-term economic time series with observations inside the year. The reasons for this are such as variation caused by the time of the year, the difference in the sales of products by season and timings of transactions. In addition to the variation between winter and summer months, consumption over the Christmas and Easter seasons, payments of tax refunds and back taxes that in Finland fall due in December, as well as companies' payments of dividends in spring after closing of accounts are examples of causes of seasonal variation in quarterly series.

Seasonal variation in short-term economic time series makes the detection of turning points difficult. Also, the longer term development is difficult to detect from the original series. Indeed, in a time series containing observations at intervals shorter than one year, seasonal variation is often seen as a nuisance which has very little to do with development over a longer time period. The conclusion must not be drawn from this that seasonal adjustment would be constant or deterministic, and that its modelling or adjustment would be a triviality in the way of bigger things (also see Takala 1994, pp. 69-71[11]).

When quarterly national accounts time series are analysed, in addition to the calculation of the change from the quarter a year ago (Q/Q-4), the change should be preferably calculated from the previous quarter (Q/Q-1) as well. Turning points in the examined variable can only be observed by comparing development from the previous observation. However, to be able to do this,

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[10] This section is in many parts based on the article by Arto Kokkinen and Faiz Alsuhail (2005). Aika-sarjan ARIMA-mallipohjaisesta kausitasoituksesta (in Finnish only; About ARIMA-based seasonal adjustment of time series). *The Finnish Economic Journal, 4/2005*, Volume 101 (http://www.ktyhdistys.net/Aikakauskirja/sisallys/PDFtiedostot/KAK42005/KAK42005Kokkinen.pdf) and materials of Statistics Finland's courses on seasonal adjustment (2006) (Kokkinen).

[11] Takala, K. (1994): "Kahden kausipuhdistusmenetelmän vertailua; X11 ja STAMP" (in Finnish only; Comparison of two seasonal adjustment methods; X11 and STAMP), in *Suhdannekäänne ja taloudelliset aikasarjat (in Finnish only; Upturn in the economy and the role of economic time series)*, pp. 67– 103, Statistics Finland. Surveys 210, Helsinki.

a time series must be broken down to its components and seasonal variation within the year removed.

It is often suggested that short-term economic time series that contain more frequent than annual observations should be broken down to four components: trend (development in the long run), business cycle (medium-term variation caused by economic cycles), seasonal variation (variation within one year) and irregular variation. The last one of these is presumed to be random white noise with no information that would be useful to the analysis of the series. Because making an unambiguous and clear distinction between the trend and the business cycle is difficult, these components are usually estimated together, referring to trendcycle. When the concept of trend is used in this methodological description it refers to the trendcycle as is typical in analyses of short-term time series. When seasonal variation is removed, a seasonally adjusted series is obtained containing the trendcycle and irregular variation.

The ARIMA model-based[12] TRAMO/SEATS method recommended by Eurostat is used in seasonal adjustments of quarterly national accounts series. The ARIMA model-based seasonal adjustment starts by modelling of the variation in the observation series by means of an ARIMA model. The obtained ARIMA model is then utilised in breaking down the variation in the time series into its trend, seasonal and irregular components. The division into the components is done so that the obtained components can be expressed with ARIMA models. The most significant difference from the ad hoc approach (e.g. methods X11/X12, Dainties, Sabl, BV4) is that in TRAMO/SEATS own, specific filter formulas are formed for each time series for the adjustment of the data.

The method also contains an efficient procedure for making adjustments for working and trading days and for identifying outliers. TRAMO/SEATS makes it possible to forecast the components and to calculate standard errors and confidence intervals for them. The program and the method were created by Agustín Maravall and Victor Gomez[13].

Whenever a time series is seasonally adjusted, the autocorrelation structure of the original series is interfered with. If the used filter (be it a general ad hoc filter or one based on a wrong model) fails to screen out expressly and only the seasonal variation frequencies of a time series, or trend frequencies when a trend is being estimated, the autocorrelation structure of the original time series becomes skewed with the temporally repeated characteristics of the original phenomenon.

The ARIMA model-based seasonal adjustment and the TRAMO/SEATS method offer one analytical solution to this problem. In the TRAMO phase, the original series is pre-adjusted for outliers and variation in numbers of working and trading days so that the pre-adjusted series can be ARIMA modelled. This modelling of the autocorrelation structure of the entire pre-

[12] More about ARIMA models, e.g. in Brockwell and Davis (2003): Introduction to Time Series and Forecasting, Chapter 3.
[13] See, e.g. V. Gomez and A. Maravall (1996): *Programs TRAMO and SEATS. Instructions for the User*, (with some updates). Working Paper 9628, Servicio de Estudios, Banco de España.

adjusted series is utilised when the variation in the time series at different frequencies is broken down to its components in the SEATS phase.

The point of departure in the decomposition is that each component should only describe the precise part of the autocorrelation structure of the whole series and the variation that relates to it, that is, the components are mutually orthogonal. Interpretationally this means that the reasons that cause seasonal variation (such as time of year) in a time series are uncorrelated with the reasons behind a long-term trend, such as investments or R&D activity. In addition, it is presumed that a time series is made up of components that are realisations of linear stochastic processes. Then each component (with the exception of the irregular term) can be presented by an ARIMA model.

Both the pre-adjusted series and its components are ARIMA modelled while respecting the dynamic characteristics of the original series. Finally, the deterministic factors observed in the pre-adjustment, outliers and working or trading day variation, are assigned to the components as follows: level change (level shift (LS)) to trend, variation caused by numbers of working days and trading days (working day/trading day effects (WD/TD)) to seasonal variation, and individual outlier observations (additive outliers (AO)) and momentary outlier observations lasting for the duration of several observations (transitory changes (TC)) to random variation. Thus the variation in the entire original time series becomes distributed to the components of final trendcycle, final seasonal variation and final irregular variation.

The components mentioned are unobservable in the original time series and they can be formed in numerous ways. When dividing the observation series into components, the ARIMA model-based approach is also faced with the identification problem. In the TRAMO/SEATS method the so-called canonical decomposition is used from among different alternatives. In this the variance of random components is maximised and the components of the pre-adjusted time series can be defined unambiguously.

When comparing the variance of the random variation produced by means of canonical decomposition with random variation in other methods, such as the other model-based method, STAMP, and the aforementioned ad hoc methods, it is good to bear in mind that:

1. The modelling of a pre-adjusted time series is made with diverse (pdq)*(PDQ) models[14] of the seasonal ARIMA model family which produces random variation that has quite small variance and is tested to be random.

2. The identification of the seasonal ARIMA model for a pre-adjusted series is based on the Bayesian Information Criterion (BIC)[15] according to which

[14] Notes p,d,q refer to the models' basic ARIMA part and PDQ to seasonal ARIMA part, where p (or P) is the number of AR parameters, d (D) the number of differentiations, q (Q) is the number of MA parameters. The T/S model selection is based on the following maximum limits p=3,d=2,q=2; P=1,D=1,Q=1. More about SARIMA models by, e.g. Brockwell and Davis (2003): Introduction to Time Series and Forecasting, Chapter 6.5.

[15] Min BIC (p, q) = $\log\sigma^2 + \log(p+q)T^{-1}\log T$, where p and q are the numbers of AR and MA parameters in the model and T the number of time series observations. When T gets close

the selection of the model is determined by as small variance as possible in random variation, achieved with as small number of estimated parameters as possible.

Thus, before the decomposing SEATS phase the variance of random variation, i.e. the residual of the seasonal ARIMA model fitted to the pre-adjusted time series, is quite small. The assignment of most of this random variation of an entire time series to the random variation component in the SEATS decomposition phase (and minimising the random variation in other components) cannot be assumed to lead to any greater variance of the random variation component than in the mentioned other methods in which the whole time series is not first modelled with a model of the seasonal ARIMA model family. By contrast, the combination of the deterministic modelling of working and trading day variation often results in a greater variance of the seasonal component in TRAMO/SEATS. In addition, the stochastic modelling strategy of seasonal variation improves the explanatory power on seasonal variation by capturing moving seasonality in time, along with the modelling of working and trading day effects.

In order to reduce the revision of the latest adjusted observations, a forecast for a few observations forward must be produced in all seasonal adjustment methods. It is usually done basing on an ARIMA model, as in X11/X12 ARIMA, even when the seasonal adjustment filter is not at all associated with the model concerned. One logical justification of ARIMA model-based seasonal adjustment is that the filter used in the adjustment of a series is based on the same series-specific ARIMA model with which the forecast is made. In all eventualities, the latest one to three adjusted observations will become revised against new statistical observations in all methods. The revisions are due to a forecast error, that is, new observations differ from the development predicted earlier by the ARIMA model. The larger the differences, the greater is also the revision of the already published seasonally adjusted and trend series.

to infinity BIC finds the model that produced the time path based on simulations. See more, e.g. Brockwell and Davis (2003): Introduction to Time Series and Forecasting, p. 173.

With standard regression and ARIMA model symbols, the two-phase TRAMO/SEATS method can be presented as follows:

TRAMO (**I**) / SEATS (**II**):

I) $y_t = x_t'\beta + z_t$ [16]

Pre-adjustment regressions
- working/trading day effects (WD/TD)
- outliers (LS, AO, TC)

Residual from the pre-adjustment, z_t follows an ARIMA model

II) $z_t = p_t + s_t + u_t$

$$\Rightarrow z_t = \frac{\theta_p(B)}{\phi_p(B)} a_{pt} + \frac{\theta_s(B)}{\phi_s(B)} a_{st} + u_t$$

Residual of the pre-adjusted series after decomposition, random

(pre-adjusted series = (initial)trend +(initial)seasonal component + random variation)

Finally, the deterministic factors of part I and the stochastic factors of part II are combined and the original series divides into its final components:

$$y_t = p_t(+LS) + s_t(+WD/TD) + u_t(+AO,TC)$$

Final irregular

observation series = trend + seasonal component + irregular component

The above final decomposition shows that when the seasonal component is being removed, calendar effects are also eliminated in seasonal adjustment.

[16] In the Tramo phase for a pre-adjusted series, z_t, an ARIMA model $z_t = \frac{\theta(B)}{\phi(B)} \varepsilon_t$ is identified. In the SEATS phase, the lag polynomials of this model, $\phi(B)$ and $\theta(B)$, are divided into trend and seasonal components based on the frequency domain analysis. Part of ε_t is divided into trend and seasonal components, again based on the frequency domain analysis, and the remaining part forms a random residual after decomposition, u_t. In the canonical decomposition the variance of u_t is maximised.

3.4.1 Policy for seasonal adjustment

Seasonally adjusted time series are published both at current prices and as chain-linked volume series at reference year 2010 prices. Unadjusted, or original, series benchmarked to annual national accounts are also published both at current prices and as chain-linked volume series at reference year 2010 prices. The chain-linked time series at reference year's prices are adjusted with a direct adjustment method and the time series at current prices with an indirect adjustment method. In the direct method all time series, inclusive of aggregates, are adjusted separately. The indirect method means that seasonally adjusted aggregates at current prices are formed by summing up the adjusted sub-series. The randomness of the residual of the aggregate series that is formed by summing up the residuals of the ARIMA models of the sub-series is then tested. Apart from this methodological description that is publicly available, the users can also receive information about the implementation of seasonal adjustment on courses organised by Statistics Finland and simply by asking about it. The policies applied in describing the modelling of time series are openness and sharing of information.

The publication ESS Guidelines on Seasonal Adjustment[17] steering the seasonal adjustment practices of Eurostat and EU Member States is followed in seasonal adjustment and working day adjustment. The governing principle in seasonal adjustments is to make the modellings carefully once a year and keep both the deterministic pre-adjustment factors and the identified ARIMA model fixed between annual reviews of the modelling, yet so that the parameter values are re-estimated on each calculation round. An exception to this are outlier observations mid-way through the year, such as a labour dispute, for example. With regard to the main aggregate series, the model of a certain series might be revised if the modelling no longer fits the data due to new observations. The main principle is to keep the specifications of the model identified for a series (apart from the estimation of model parameters) unchanged so that adoption of models does not cause revisions to the history of a seasonally adjusted series on every round. The aim in the updating of parameter values is to produce forecasts with as full information as possible on the past on every calculation round. The objective in this is to reduce revisions to the latest observations in adjusted series when new observations become available.

3.4.2 Policy for working day adjustment

Working day adjusted (more generally calendar adjusted) time series are published both at current prices and as chain-linked volume series at reference year 2010 prices. In principle, the working or trading day adjustment (inclusive of adjustments for a leap year, Easter and national public holidays) is based on the testing of statistical significance during several modelling rounds by using monthly data from the sources used for QNA whenever possible.

[17] http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-09-006/EN/KS-RA-09-006-EN.PDF

Working or trading day adjustment factors (inclusive of omission of working day adjustment of a series) are not changed mid-way through the year between modelling rounds. In the best case, basing on experiences from modelling examinations from several years over an extended time period, efforts are made to find at least for the main series a stable, series-specific solution with meaningful contents by also using the monthly indicators for the phenomenon concerned.

For the series that are not working or trading day adjusted original series are presented in place of series adjusted for working days. The original series are naturally also published, so the congruence of the said series shows that no adjustment for working days has been done to the data describing the phenomenon concerned. In a case like this, the seasonally adjusted series is of course not calendar adjusted either.

Chapter 4 GDP and components: the production approach

4.1 Gross value added by industry

In QNA, gross value added is calculated at the accuracy of 200 industry/sector combinations. The 2-digit level of NACE rev. 2 classification is applied for the majority of industries, although for a few industries the calculation is done at the 3-digit level. The sector classification is the 2-digit level with the exception that in the general government sector central government (S.1311), local government (S.1313) and compulsory social insurance (S.1314) form sectors of their own.

An indicator of value added is constructed for each industry/sector combination. These indicators are then benchmarked and extrapolated to estimates of current priced value added. With the exception of financial services, indicators for value added in QNA are output indicators like turnover. Intermediate consumption is not estimated separately in QNA, because there are no reliable indicators for the value or volume of intermediate consumption available on the quarterly frequency.

In addition, a deflator time series is formed for each industry/sector combination by means of which the current price time series can be deflated to the volume time series at previous year's average prices. Deflators are formed from the price data on the product level (national account supply and use tables contain around 790 products) by weighting. The products produced by the industry/sector combinations and their weights are obtained from supply and use tables. Deflators are formed using output prices and weights, because there are no price indices or product structures for value added.

The price weights of the latest available supply and use table are applied to the latest quarters. Because supply and use tables are complete at a delay of around two years, the price weights of the latest deflators of value added are also at least two years old. If the weight structure is known to have changed in some industry/sector, the deflator is adjusted as needed before deflation.

Agriculture (01)

The data sources are statistics released by the Information Centre of the Ministry of Agriculture and Forestry (TIKE)[18]. These include monthly statistics on dairy, egg and slaughterhouse production. Producer prices of agricultural products are also available on monthly basis. Statistics on crop production are the source data for agricultural production of crops.

The current price indicator for agricultural production of crops is based on the crops of wheat, rye, barley and oat. Annual crops are allocated to quarters according to accrual costs of the production process. Quarterly crops are then multiplied by corresponding quarterly producer prices.

[18] http://www.maataloustilastot.fi/en/

The current price indicator for other agricultural production has five products: milk, beef, pork, poultry and eggs. The indicator is calculated by multiplying the volumes of outputs by basic prices of the corresponding quarter. Basic price comprises the producer price and subsidies on products.

The volume indicators are then calculated for each product by multiplying the output volumes by the previous year's average price. Price estimate for the deflation of agriculture is obtained implicitly from the ratio of total current price value and total volume at previous year prices.

Forestry (02)

The sources are the monthly data on market fellings and stumpage prices obtained from the Metinfo forest information service of the Finnish Forest Research Institute. The indicator for value added is a weighted combination of the indicators for forest cultivation (around 75 %) and logging (around 25 %).

The indicator for forest cultivation is calculated by multiplying the smoothed quantity of market fellings by stumpage prices. The time series of market fellings is smoothed when calculating the indicator for forest cultivation to account for forest growth. The indicator for logging is calculated by multiplying the (non-smoothed) market fellings with the index of wage and salary earnings in forestry.

Stumpage prices have the biggest weight in the deflator.

Fishing (03)

The source data are those on the value of fish production and its price development by the Finnish Game and Fisheries Research Institute.

Total industries (B, C, D, E)

The data sources for non-financial corporations sector (S.11) are Statistics Finland's (monthly) Indices of Turnover in Industry[19], (monthly) Volume Index of Industrial Output[20] and Producer Price Indices for Manufactured Goods[21].

For industries 30 (Manufacture of other transport equipment), 35 (Electricity, gas, steam and air conditioning supply) and 36 (Water collection, treatment and supply) the indicator for value added is calculated by multiplying the Volume Index of Industrial Output in each industry by the corresponding Producer Price Index. For all other industries in sector S.11 the indicator for value added is the Index of Turnover.

In the household sector (S.14), the source is turnover in the Tax Administration's periodic tax return data[22]. The turnover of the latest quarter is esti-

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[19] http://tilastokeskus.fi/til/tlv/index_en
[20] http://tilastokeskus.fi/til/ttvi/index_en
[21] http://tilastokeskus.fi/til/thi/index_en
[22] Periodic tax return data are monthly data collected by the Tax Administration containing all enterprises' and corporations' turnover subject to value added tax, and wage and salary sum data.

mated with the ARIMA model (mostly Seasonal ARIMA), because data on turnover in the periodic tax return file accumulates slowly.

The deflators for manufacturing are mainly formed from the Producer Price Indices for Manufactured Goods. The share of services, such as maintenance and product development, in the output of manufacturing industries has been growing constantly. For this reason deflators also contain producer price indices for services, Index of wage and salary earnings and other price data on services.

Construction (F)

The data sources for building construction are Statistics Finland's (monthly) Volume Index of Newbuilding[23] and (annual) Statistics on Renovation Building. The data sources for civil engineering are the value and volume indices[24] of sales in Statistics Finland’s Index of Turnover of Construction.

The indicator for value added in building construction is formed by adding to the current priced index of the Volume Index of Newbuilding an estimate of the output in renovation building. In the deflator for building construction the weights are biggest in the price indices derived from the Volume Index of Newbuilding, which are based on the price index of the Haahtela consulting company.

The indicator for value added in civil engineering is the index of civil engineering in the Index of Turnover of Construction. The deflator is calculated from the implicit price index of volume indices of turnover and sales, which is based on the Cost Index of Civil Engineering Works. The same indicator for building construction and civil engineering is used for all sectors.

Trade (G)

The data sources are the monthly turnover and price indices from Statistics Finland’s Turnover of Trade[25].

The indicators for value added are the turnover indices for wholesale trade, retail trade and motor vehicle trade of the Turnover of Trade.

The deflators are price indices used in the deflation of the “volume of turnover” indices of the Turnover of Trade. These price indices are weighed Consumer Price Indeces.

According to ESA 2010, output and value added for this industry are calculated from sales margin (turnover less bought merchandise). In QNA turnover has to be used as the indicator for value added because quarterly data are not available on the development of the margin.

Transport and storage (H)

The data sources are Statistics Finland’s Turnover of Service Industries[26] and Producer Price Indices for Services[27].

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[23] http://tilastokeskus.fi/til/ras/index_en
[24] http://tilastokeskus.fi/til/rlv/index_en
[25] http://tilastokeskus.fi/til/klv/index_en

The indicator for the value added of sector S.11 is the value index of the Index of Turnover. The indicator for the value added of sector S.14 is the turnover in the periodic tax return data.

In the deflator the Producer Price Indices have the biggest weights.

Accommodation and food service activities (I)

The data sources are Statistics Finland's Turnover of Service Industries, Producer Price Indices for Services and Consumer Price Index[28].

The indicator for the value added of sector S.11 is the value index of the Index of Turnover. The indicator for the value added of sector S.14 is the turnover in the periodic tax return data.

In the deflator the Consumer Price Index (food service industries) and Producer Price Index (accommodation services) have the biggest weights.

Information and communication (J)

The data sources are Statistics Finland's Turnover of Service Industries and Producer Price Indices for Services.

The indicator for the value added of sector S.11 is the value index of the Index of Turnover. The indicator for the value added of sector S.14 is the turnover in the periodic tax return data.

In the deflator the Producer Price Indices have the biggest weights.

Financial and insurance activities (K)

The data sources for Financial service activities (NACE 64) and Activities auxiliary to financial services and insurance activities (NACE 66) are Statistics Finland's *Financial statement statistics on Credit Institutions*[29] and *Investment service companies*[30], Consumer Price Index and Producer Price Index for Services.

The indicator for value added in financial service activities is derived as output less intermediate consumption. Output is comprised of two elements: market output and financial intermediation services indirectly measured (FISIM). The indicator for market output is the quarterly commission income of credit institutions in the Statistics on Credit Institutions.

FISIM at current prices are calculated quarterly in national accounts. The calculation is based on sector-specific credit and deposit stock data of the Statistics on Credit Institutions and the corresponding interest data.

The source data for intermediate consumption are "other administrative expenses" included in the profit and loss accounts in the Statistics on Credit Institutions.

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[26] http://tilastokeskus.fi/til/plv/index_en
[27] http://tilastokeskus.fi/til/pthi/index_en
[28] http://tilastokeskus.fi/til/khi/index_en
[29] http://tilastokeskus.fi/til/llai/index_en
[30] http://tilastokeskus.fi/til/spy/index_en

The deflator for market output is formed from the Producer Price Index and Consumer Price Index of financial services. The price of FISIM is derived implicitly from the ratio of current price and previous year's average price estimates. FISIM at previous year's average prices is calculated by applying the previous year's average loan and deposit margins to the stock of loans and deposits of the calculation quarter. The stocks of loans and deposits are deflated by the price index of domestic final demand. The price/volume method for FISIM is similar to the annual accounts.

The indicator for value added of activities auxiliary to financial services and insurance activities is also derived as output less intermediate consumption. The source data for the indicator are the “commission income” and “other administrative expenses” of investment service companies, which are found in the Investment service companies statistics. The deflator is formed from the Producer Price Index for financial services and the Consumer Price Index.

There is no sufficiently detailed and timely source data for the estimation of quarterly output/value added of insurance services (NACE 65). Long-term trend growth is used as an estimate for the latest quarters.

The deflator for life insurance is the Index of wage and salary earnings. The deflator for non-life insurance is the insurance services in the Consumer Price Index.

Real estate activities (L)

The source data for industry "68 Real estate activities" are periodic tax return data, the Turnover of Service Industries and Statistics Finland's Statistics on Rents of Dwellings[31] (quarterly).

Output for industry 68 is calculated through four sub-industries. For buying, selling and letting of other real estate (industry 681+68209) and Real estate activities on a fee or contract basis (industry 683) the indicator for value added is the Index of Turnover. The deflators for these sub-industries are formed from the Producer Price Indices for Services and the Consumer Price Index.

The indicator for the value added of Letting of dwellings (industry 68201) and Operation of dwellings and residential real estate (industry 68202) is obtained by multiplying the volume estimate based on annual trend by the quarterly index of rents in the Statistics on Rents of Dwellings. The deflator is formed from the index of the Statistics on Rents of Dwellings.

Professional, scientific and technical activities; Administrative and support service activities (M, N)

The data sources for industries 69-82 are Statistics Finland's Turnover of Service Industries and Producer Price Indices.

The indicators for the value added of industries 69-82 are obtained from the Turnover of Service Industries. The deflators for the industries are mainly

[31] http://tilastokeskus.fi/til/asvu/index_en

formed from the Producer Price Indices for Services, but in some industries use is also made of the Basic Price Index for Domestic Supply, the Index of Wage and Salary Earnings, the Building Cost Index and the Consumer Price Index.

Public administration and defence; Education; Health and social work (O, P, Q)

Industries 84, 85, 86 and 87-88 are in Finland mainly activities of the public sector. The data sources for the public sector are the Tax Administration's periodic tax return data, central government's bookkeeping, and the Index of Wage and Salary Earnings[32].

The indicator for value added in the public sector is primarily the wage and salary sum data in the periodic tax return data. For the central government sector (S.1311) the data on wages and salaries in central government's bookkeeping are used as comparison data to the periodic tax return data.

With regard of the local government sector (S.1313), the problem with the periodic tax return data is that each municipality has only one business ID code in the data so that in practice all wages and salaries paid by municipalities show under industry 84 (Public administration). In the local government sector, only joint municipal boards with their own business ID codes show in the periodic tax return data in the industries of Education and Health and social work. For this reason, a fixed percentage of the wages and salaries in industry 84 is also added to the indicators for value added in industries 85, 86 and 87-88. The deflators for value added in the public sector are primarily formed from the Index of Wage and Salary Earnings.

The indicator for value added in the non-financial corporations sector's Education and Health and social work is Statistics Finland's wage and salary index. The deflators of the non-financial corporations sector are derived from the Consumer Price Index.

The indicators for value added in the household sector are formed from the turnover data of the periodic tax return data. The indicators for value added in the non-profit institutions serving households sector (S.15) are formed from the wage and salary sum data of the periodic tax return data. The deflators are mainly from the Indices of Wage and Salary Earnings.

Other service activities (R, S, T)

The source data are the Indices of Turnover, periodic tax return data, Index of Wage and Salary Earnings and Consumer Price Index. The indicator for value added in the non-financial corporations sector is the Indices of Turnover in industries 90-94, 92, 93, 95 and 96. The wage and salary index is used as the indicator for value added in industry 94 of sector S.11.

In sectors S.13 and S.15 the indicators for value added are wage and salary sum data in the periodic tax return data. In sector S.14 the indicators for value added are turnover data in the periodic tax return data, except in industry 97-98 the indicator is wage and salary sum data in the periodic tax return data.

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[32] http://tilastokeskus.fi/til/ati/index_en

In sectors S.11 and S.14 the deflators are formed mainly from the Consumer Price Index, except for industry 94, where the deflator is the Index of Wage and Salary Earnings. In sectors S.13 and S.15 the deflators are mainly formed from the Index of Wage and Salary Earnings.

4.2 FISIM - Financial intermediation services indirectly measured

Financial intermediation services indirectly measured are calculated quarterly in the same way as in annual accounts. All the balance and profit and loss account data of domestic credit institutions that are needed in the calculations for FISIM are available quarterly from Statistics Finland's Statistics on Credit Institutions. The only item of FISIM that cannot be estimated quarterly is imports.

The results from the calculations for FISIM are utilised in QNA in calculating value added for financial corporations (see Section 4.1). Allocation of FISIM to user sectors/industries is not done quarterly.

4.3 Taxes on products and subsidies on products

Taxes on products are estimated from cash based monthly data in central government's bookkeeping. Depending on the type of tax, a timing adjustment of one to two months is made to the cash based taxation data in order to bring them closer to accrual basis. Value added tax for the latest quarter has to be estimated from the data on the first two months of a quarter, because the third month source data is not available in time for QNA compilation. Year-to-year change of these two months is used for extrapolation of the latest quarter VAT.

The deflator for taxes on products is obtained by weighing the changes in various tax tariffs (value added tax, vehicle tax, fuel taxes etc.) with previous year's tax receipts. The tariff of VAT has the biggest weight in the deflator.

No data are available quarterly on subsidies on products, so the basic estimate is the level of the previous year.

Chapter 5 GDP and components: the expenditure approach

5.1 Household final consumption

Household final consumption has a separate subsystem in QNA production application. Compiling is based on 182 COICOP[33] classes, each having an indicator time series and a deflator time series.

The most important source data for indicators is The index of turnover for retail trade (by type of commodity) of Statistics Finland's *Turnover of trade* statistics. Other source data includes Statistics Finland's *Statistics on rent of dwellings*, the Finnish Vehicle Administration's data on first registrations of passenger cars, the Finnish Oil and Gas Federation's data on petrol sales, the Finnish Energy Industries data on electricity consumption, VR-group's data on railway trips, Finavia's data on flight passengers and Finnish Transport Agency's data on cruise ship passengers. Some source data are expressed in volume terms, but they are converted to current price indicators by multiplication with a suitable Consumer price index.

The consumption of financial services is based on the quarterly source data in Statistics Finland's *Financial statement statistics on Credit Institutions*. The social insurance institution of Finland's (a.k.a KELA) data on health service costs and compensations is the source data for consumption of health services. In addition, supply indicators are used for estimating the households' consumption of services: transportation, communication, hotel and restaurant services, recreational, cultural and sports services have the index of turnover of the respective service industry as an indicator.

The deflators are obtained from the sub-items of the *Consumer Price Index*, except tourism (i.e. households' consumption abroad) for which the harmonized consumer price index of European Union member states (EU28) is used as an deflator.

The 182 indicators are benchmarked, extrapolated and deflated as shown in chapter 3. The current price and previous year price time series are then summed to five COICOP classes (see chapter 2.2.) for publication. These five time series and their sum "household final consumption", are subsequently chain-linked (volumes) and seasonally adjusted.

5.2 Government final consumption

Government final consumption at current prices is obtained from Statistics Finland's Quarterly Sector Accounts[34] (QSA). The data in QSA are mainly based on Quarterly local government finances -statistics[35] and on central government's bookkeeping data.

Government final consumption is derived as a sum of collective consumption and individual consumption of general government.

[33] http://tilastokeskus.fi/meta/luokitukset/coicop/011-2013/index_en
[34] http://tilastokeskus.fi/til/sekn/index_en
[35] http://tilastokeskus.fi/til/kkt/index_en

The deflator for government final consumption is derived from the implicit QNA deflator of the value added of public sector (see 4.1), which includes mainly indices of wage and salary earnings. Collective consumption is deflated with the implicit deflator of central government NACE 84. Individual consumption is deflated with the implicit deflator of all other industries of general government.

5.3 NPISH final consumption

The indicator for consumption expenditure of non-profit institutions serving households (NPISH) at current prices is obtained by summing the value added of industries in sector S.15 (see 4.1). The deflator is the implicit deflator of the value added of sector S.15 (S.15 value added at current prices divided by value added at previous year's average prices), which is mainly formed from indices of wage and salary earnings.

5.4 Gross capital formation

Gross fixed capital formation

The estimates for construction (N111+N112) are compiled by using the same sources and methods as in the calculation of value added in construction (4.1). Data from Statistics Finland’s quarterly *inquiry on enterprises’ fixed assets* (not published, only for internal use) are used as a comparison data.

The indicator for gross fixed capital formation in machinery and equipment including weapon systems (N113+N114) is Statistics Finland’s *inquiry on enterprises’ fixed assets*, which is conducted quarterly and covers approximately 2,000 largest enterprises in the non-financial corporations sector. The sub-index of investment goods in the *Basic price index for domestic supply, including taxes* is used in the deflation of machinery and equipment.

Gross fixed capital formation in transport equipment (N1131) is based on the Finnish Vehicle Administration’s data on first registrations of motor vehicles. The volume index weighted by vehicle type is formed from data on first registrations of motor vehicles, which is multiplied by the *Basic price index for domestic supply*, *including taxes* (NACE C29) to achieve an indicator at current prices. The deflator is the same *Basic price index for domestic supply, including taxes*.

Cultivated biological resources (N115) is insignificantly small in Finland and it is estimated by dividing the previous year’s ANA value by four.

Intellectual property products (N117) are compiled with a weighed indicator that consists of research and development activities (73 %) and computer software and databases (27%). Source data for R&D is Statistic Finland’s -Research and development -statistics[36]. This is an annual statistics with final results available only after 10 months, but preliminary annual estimates for previous and current year are collected from the respondents at the begin-

[36] http://tilastokeskus.fi/til/tkke/index_en

ning of each year. Source data for computer software and databases is Statistics Finland’s *inquiry on enterprises’ fixed assets*.

Deflator time series for N117 is compiled with corresponding weights. The index of wage and salary earnings (NACE 72) is the deflator for R&D. Producer Price Index (NACE 62) is used for software and databases.

Change in inventories

The source data for change in inventories is the *Statistics on manufacturing and trade inventories*[37]. An estimate for the inventory stock of the whole economy is formed by first summing the inventory stocks of manufacturing and trade inventories and by adding to them an estimate of the value of the grain inventory stock in agriculture. Change in inventories at current prices is obtained as the difference of the quarterly inventory stocks of the whole economy: $CPSTOCK_{Q}$ - $CPSTOCK_{Q-1}$.

The volumes of inventory stocks have to be first estimated in order to calculate the volume of change in inventories. The inventory stock of manufacturing is deflated with the Producer Price Index (C Manufacturing total). The deflator for the inventory stock of trade is the Basic Price Index for Domestic Supply (total). The deflated inventory stocks are then summed together yielding the total inventory stock at previous year's average prices.

Change in inventory at previous year's average prices is the difference of total inventory stocks at previous year's prices: $PYPSTOCK_{Q}$ - $PYPSTOCK_{Q-1}$. To calculate change in the volume of the first quarter, the inventory stocks of the last quarter of each year also have to be deflated at current year's average prices.

The volume of change in inventories is not chain-linked at reference year's prices, because a chain-linked index cannot be formed due to negative figures in the time series. Gross capital formation (P.5), which is published at reference year's prices, contains the volume of change in inventories.

Estimates for change in inventories are often adjusted with the balancing of QNA, because the coverage of the source data and their price/valuation bases do not allow application of the methods and calculation accuracy used in the annual accounts as such. For this reason, changes in inventories in QNA may become considerably revised when the annual accounts are completed and the published data may differ from those in the source data.

5.5 Imports and exports

The main source data for exports and imports is the Balance of Payments[38] compiled by Statistics Finland. Monthly data of the Board of Customs[39] are used as comparison data for the exports and imports of goods. Statistics Finland’s Statistics on International Trade in Services[40] is used as comparison data for the exports and imports of services.

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[37] http://tilastokeskus.fi/til/tva/index_en
[38] http://tilastokeskus.fi/til/mata/index_en
[39] http://www.tulli.fi/en/finnish_customs/statistics/publications/preliminary_data/index.jsp
[40] http://tilastokeskus.fi/til/pul/index_en

Imports and exports at current prices in QNA should, in theory, be identical with the Balance of Payments. Only the imports and exports of FISIM are at the moment esimated somewhat differently to the BoP.

Deflators for the exports and imports of goods are constructed by weighting import and export price indices of the Producer Price Indices. Product weights (CPA classification 2-digit) for these indices are obtained from the latest annual import/export data of the Board of Customs.

Deflators for the exports and imports of services are obtained from the Producer Price Indices for Services and from the Consumer Price Index. The aggregate CPI of OECD countries from OECD is used for deflating the imports of tourism services.

Chapter 6 GDP and components: the income approach

6.1 Compensation of employees

Compensation of employees is comprised of wages and salaries and employer's social contributions. Indicators for wages and salaries are formed from Statistics Finland's Wage and Salary Indices[41]. The Labour cost index[42] provides comparison data.

Employers' social contributions are estimated by applying social contribution percentage rates to the wage and salary estimates. The main source for these rates are the annual social contribution rates confirmed by the Ministry of Social Affairs and Health. The social contribution rates are estimated quarterly for eleven industries. Because social contribution rates vary slightly by industry, the implicit social contribution percentages from the annual accounts, i.e. employers' social contributions ratio to wages and salaries, are also used for estimating the industry specific quarterly rates. The indicator for employers' social contributions is derived by multiplying the benchmarked wage and salary values with the social contribution rate of the corresponding industry. If it is known that changes have taken place in the employers' social contribution rates during the year, the rates are adjusted accordingly.

6.2 Taxes and subsidies on production

Taxes on production principally comprise taxes on products (see 4.3). Estimation of taxes on products and other taxes on production is based on General Government Revenue and Expenditure -statistics, which has central government's bookkeeping data as its' source. Data on subsidies on production are not available quarterly.

6.3 Gross operating surplus and mixed income

Source data on gross operating surplus and mixed income are not available quarterly so they are calculated as a residual item by deducting compensation of employees, taxes on production and consumption of fixed capital from GDP calculated via output.

[41] http://tilastokeskus.fi/til/ktps/index_en
[42] http://tilastokeskus.fi/til/tvki/index_en

Chapter 7 Population and employment

7.1 Population, unemployed

The data source for population is Statistics Finland’s preliminary Population Statistics. Data is released in QNA at the accuracy of 100 persons.

The size of population is not published as a seasonally adjusted or trend time series, because there is no seasonal variation.

Unemployment data is not published in QNA. Data on unemployment are released in the Statistics Finland’s Labour Force Survey.

7.2 Employment: persons employed

The number of employed persons is released in QNA in hundreds of persons. The data source is Statistics Finland’s Labour Force Survey[43] from which indicators for the number of persons employed are obtained by industry.

Because the Labour Force Survey is a sample-based survey, the change percentages for the numbers of persons employed in the smallest industries can be highly volatile. Hence, the estimates for indicators for the numbers of employed persons obtained from the Labour Force Survey are compared with the development of wages and salaries (see 6.1), the index of wage and salary earnings and hours worked. The final estimate for the numbers of employed persons is formed based on this examination. The total number of employed persons is obtained by summing up the estimates by industry.

7.3 Employment: hours worked

The data source is Statistics Finland’s Labour Force Survey from which indicators for the number of persons employed are obtained by industry. The final estimate of the number of hours worked is formed by comparing the change percentages calculated from the Labour Force Survey to data on wage and salary sums (see 6.1), the index of wage and salary earnings and employment data. The total number of hours worked is obtained by summing up the estimates by industry. The data are published at the accuracy of 100,000 hours.

[43] http://tilastokeskus.fi/til/tyti/index_en

Chapter 8 From GDP to net lending/borrowing

8.1 Primary income from/to the rest of the world, gross national income

Primary income from/to the rest of the world is comprised of compensations employees received from/paid to the rest of the world (D.1), taxes on production and products (D.2), subsidies (D.3) and property income (D.4). The data sources for compensation of employees and property income are the factor returns (compensation of employees and returns on equity) included in the Balance of Payments. Exhaustive quarterly data are not available on taxes and subsidies on products paid to/received from the rest of the world so these items must be estimated from the latest annual accounts data.

Gross national income is obtained when primary income received from the rest of the world is added to and, respectively, primary income paid to the rest of the world deducted from GDP.

Gross national income at reference year prices is calculated by summing first the gross domestic product at previous year's prices and primary income from/to the rest of the world at previous year's prices. The deflator used for primary income is the implicit price index of domestic final demand (consumption and gross fixed capital formation). The terms of trade effect, which measures the net change in export and import prices, is added to the volume of gross national income before chain-linking.

8.2 Consumption of fixed capital, net national income, acquisition less disposal of non-financial non-produced assets

No quarterly source data indicator is available for consumption of fixed capital (P.51C). However, its volume should be very stable, because in annual accounts the consumption of fixed capital is calculated as a share of the fixed capital stock.

The estimation of quarterly consumption of fixed capital starts from volume: the starting estimate for the volume at previous year's average prices is the quarterly average of the previous year's current price value. If the volume of gross fixed capital formation has changed strongly in this quarter and/or the quarters preceding it, this is taken into consideration by raising or lowering the estimated volume slightly. These adjustments are small as the gross fixed capital formation of one quarter can not have a major impact on the fixed capital stock and consequently on the consumption of fixed capital.

Consumption of fixed capital at current prices is obtained by inflating the previous year’s price volume with a implicit deflator of total gross fixed capital formation.

Net national income is obtained by deducting consumption of fixed capital from gross national income.

No quarterly data are available on acquisitions less disposal of non-financial non-produced assets (NP). Zero is used as an estimate for the latest quarter, because NP is a net transaction whose final value can be either positive or negative.

8.3 Current transfers from/to the rest of the world, net national disposable income

Current transfers are comprised of taxes on income and wealth (D.5), social contributions (D.61), social security benefits in cash (D.62) and other current transfers (D.7). The source data are from current transfers in the Balance of Payments. The Balance of Payments item of current transfers from the rest of the world (income) contains subsidies (D.3) which are deducted by using the latest annual accounts data on the sector rest of the world. The Balance of Payments item of current transfers to the rest of the world (expenditure) contains taxes on production and imports (D.2) which are deducted by using the latest annual accounts data on the sector rest of the world.

Net national disposable income is obtained by adding current transfers from the rest of the world to net national income and deducting from it current transfers to the rest of the world.

8.4 Adjustment for the change in net equity of households in pension fund reserves, net savings

Net saving of the national economy is calculated by deducting all consumption expenditure (P.3, inclusive of general government consumption expenditure and private consumption expenditure) from net national disposable income. Adjustment for the change in net equity of households in pension fund reserves is not calculated in QNA because definitionally it nets to zero at the level of the whole economy and does not thus affect net saving.

8.5 Capital transfers, net lending/borrowing

The data source for capital transfers (D.9) is the capital account contained in the Balance of Payments compiled by Statistics Finland. Net lending/borrowing (B.9) of the national economy is obtained with the following formula: Net saving of national economy (B.8n) + Capital transfers from the rest of the world (D.9) - Capital transfers to the rest of the world (D.9) + Consumption of fixed capital (P.51C) - Gross capital formation (P.5) - Acquisition less disposal of non-financial non-produced assets (NP) - Statistical discrepancy.

Chapter 9 Flash estimates

9.1 Quarterly flash estimate of GDP

A quarterly flash estimate of gross domestic product is calculated by means of the Trend Indicator of Output[44], by summing from monthly data. The flash estimate is released with the Trend Indicator of Output with a lag of 45 days from the end of a quarter. The data are submitted simultaneously to Eurostat.

The same data sources as in QNA are utilised as exhaustively as possible in the calculation of the flash estimate. Due to the fast release timetable, some QNA data is not available in Flash. Intermediate consumption as well as taxes and subsidies on products are not estimated in the compilation of the flash estimate, but quarterly GDP is carried forward with an annual change that is based on indicators of output.

Apart from the aforementioned exceptions, the same methods are used in the calculation of the flash estimate as in the calculation of QNA. Development in the value and prices of output is mainly estimated basing on data describing turnover and corresponding indices of producer prices, or data on wage and salary sums and indices of wage and salary earnings. The calculation is performed monthly with the annual overlap method. Except for the currently calculated quarter, chain-linked time series are benchmarked to correspond to quarterly and annual accounts. Monthly series are summed up to quarterly series. Quarterly series are seasonally adjusted with the TRAMO/SEATS method.

[44] http://tilastokeskus.fi/til/ktkk/index_en.html

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