

Seasonal Adjustment and Forecasting of Quarterly Gross Domestic Product: Estonian Experience

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adjustment and their implications
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1. Abstract

This paper summarizes experiences with forecasting of quarterly gross domestic product (GDP) using seasonal adjustment methods, regression and ARIMA models. We use term “forecast” in our paper. In our opinion it’s better to use term “forecast” if results are obtained using formula $y_{t+1} = f(y_{n1}, y_{n2}, \dots, y_t)$. This type of forecasting is possible if all numbers $y_{n1}, y_{n2}, \dots, y_t$ are available. For GDP it means that forecasting can be done immediately after first publication. On the other hand, it seems to be better to use another term for model if results are calculated using formula $y_{t+1} = f(y_{n1}, y_{n2}, \dots, y_t, x_{m1}, x_{m2}, \dots, x_{t+1})$. It means, that for second model we need at least one additional time series $\{x_{m1}, x_{m2}, \dots, x_{t+1}\}$ more. This series are available later, than time series used in forecasting model. As a result, this second model is available later than the forecast is done.

Statistics Estonia started with seasonal adjustment of GDP and its components at the end of 1998. The main reason why we did this was to create a simple tool to do short term forecast of GDP for our internal use. Later we used the forecast as a possible concurrent approach for FLASH estimation of GDP. The GDP by institutional sectors (five institutional sectors plus net taxes on production – all together six time series) was the source data for seasonal adjustment and forecasting in this task. We made the forecasts on the basis of a trend (or seasonally adjusted time series) and a seasonal component using regression methods. We assumed that the expectation of the irregular components is equals to zero for the additive model and one for the multiplicative model.

Since the end of 2000 we used the interface DEMETRA for seasonal adjustment. At the same time we additionally started forecasting GDP using ARIMA models. Two methods of forecasting were used: the ARIMA model directly for GDP and indirect model as sum of ARIMA models for components of GDP by institutional sectors. As the outcome we got total at least three different forecasts. To choose the best forecast we made trials with using following econometric criteria: RMSE (*Root Mean Squared Error*), MAE (*Mean Absolute Error*), MAPE (*Means Absolute Percent Error*) and TIC (*Theil Inequality Coefficient*). In such a case we have multi-criterion problem and we don’t know its compromise solution. Therefore we decided to choose two criteria only: RMSE and TIC, and our forecast is partially an expert solution that takes these two criteria into consideration.

In the last year the forecasts for second and third quarter were not so good (the discrepancy from the flash estimated GDP was 1.9 and 1.1 percent points respectively). Therefore in this year we decided to develop a new, simple (one equation) model using econometric methods.

Statistics Estonia published new revised data for GDP in September 2006. In our illustrations we used data for GDP and its components before this revisions.

2. Gross domestic product

The main aggregate indicator of economy in the country is gross domestic product (GDP). GDP at market prices is the final result of the production activity of resident producer units. An institutional unit is resident in a country when it has a centre of economic interests in the economic territory of that country.

The institutional units are grouped according to their principal activity and function, which are considered to be indicative of their economic behaviour. The main sectors, divided again into sub-sectors, are:

- non-financial corporations;
- financial corporations;
- general government;
- non-profit institutions serving households;
- households.

The gross domestic product can be defined in three ways (*The European System of Accounts ESA 1995, Eurostat, 1996*):

- a) GDP is the sum of gross value added of the various institutional sectors or the various industries plus taxes and less subsidies on products (which are not allocated to sectors and industries) – production approach,
- b) GDP is the sum of final uses of goods and services by resident institutional units (actual final consumption and gross capital formation), plus exports and minus imports of goods and services – expenditure approach,
- c) GDP is the sum of uses in the total economy generation of income account (compensation of employees, taxes on production and imports less subsidies, gross operating surplus and mixed income of the total economy) – income approach.

Production approach is the basic method for compiling GDP in Estonia as it covers the most complex range of indicators. The estimates of GDP at basic prices, for compiling the scheme for total national economy, are made by economic activities from the data compiled by institutional sectors. In calculations of GDP by production approach, the value added created by economic activities is calculated first. The result is GDP at basic prices. GDP at basic prices does not include net taxes (taxes less subsidies) on products. By adding net taxes on products to GDP at basic prices, GDP at market prices is received.

According to the range of application of GDP, it is estimated at current prices or at constant prices. GDP at current prices is appropriate for estimating various structural indicators and indices in a certain period. Most important, especially in view of changing economy, is the assessment of economic development, which means guaranteeing comparability of results with those of previous periods. To give the information on the real growth of GDP, the GDP figures from different periods are converted into the prices of one particular period (year) and then compared. This year is called the base year. In Estonia the base year at the moment is 2000. The GDP at constant prices is calculated by production and expenditure approach. In the case of income approach constant price calculations are not possible because the basis for income approach are not the transactions in goods and services whose prices could be converted into the prices of the base period.

The GDP figures for the reference period are published several times. The quarterly GDP is published three months after the quarter by using the quarterly data. Together with the publication of the fourth quarter the provisional estimate for the whole year is given. 16–17 months after the period (year) the improved estimate of GDP is published based on the yearly reports of enterprises and public institutions. The publication of the new improved estimate will turn the previous provisional estimates invalid. Some results of estimated GDP are shown in graph.

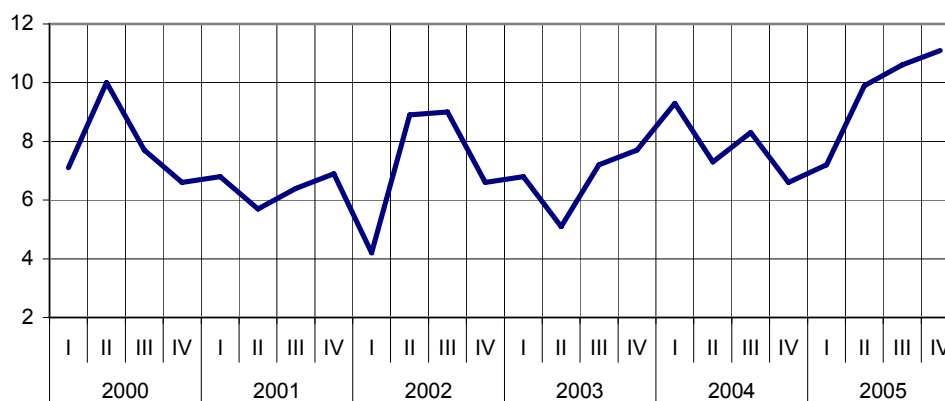


Figure 1. **GDP change at constant prices compared with the same period of previous year, 1st quarter 2000 – 4th quarter 2005.**

For the reason that the first estimates of GDP are released after considerable delay, it makes them unsuitable for a person who needs them for operative calculations and analysis, e.g. the economic analysts or persons responsible for economic and monetary policy. It therefore seems important to provide with a reliable and rapid system of preliminary estimates for the main quarterly accounts aggregates, so as to have an early and consistent view of developments in the economy. This system of preliminary estimates has been given the name “flash estimates”.

A flash estimate is defined as the earliest picture of the economy according to national accounts concepts, which is produced and published as soon as possible after the end of the quarter, using a more incomplete set of information than the set used for traditional quarterly accounts. (*Handbook of Quarterly National Accounts, European Communities, 1999*).

We started to compute GDP flash estimates in 1998. It was first published for the first quarter of 1998 in our News release as one number (GDP growth). According to the official Eurostat timetable, the flash estimate of the quarterly GDP is published 60 days after the end of reference quarter. At the end of this year (or beginning of next year) we are planning to publish flash estimate 45 day after the end of quarter.

The results of GDP flash estimates and real GDP growth are given as they were published before revision in the Table 1.

Table 1. **GDP growth and its flash estimate**, 4th quarter 2003 – 4th quarter 2005

Quarter	Flash estimate, %	Real GDP growth, %
2003Q4	5.8	5.7
2004Q1	6.8	6.8
2004Q2	6.0	5.9
2004Q3	6.2	6.1
2004Q4	5.8	5.9
2005Q1	7.0	7.2
2005Q2	10.0	9.9
2005Q3	10.8	10.6
2005Q4	10.5	11.1

Until the 3rd quarter 2005 the difference between GDP flash estimate and preliminary quarterly national accounts has varied up to 0.5 percentage points. In 4th quarter 2005 this difference was 0.6 percentage points.

3. Seasonal adjustment of time series

Time series is a set of observations of a variable measured at successive points of time. Probability theory considers a time series as a realization of a discrete random process.

Decomposition of time series means that this series is presented as a sum or product of certain (unobserved) components. The selection of components and choice of functional relation between them depend on the time series as well as on the target of analysis.

We are using two models for the decomposition of time series (Y_t) into trend, seasonal and irregular components

$$\text{Multiplicative model (M): } Y_t = T_t \times S_t \times I_t,$$

$$\text{Additive model (A): } Y_t = T_t + S_t + I_t,$$

where T_t is trend (or trend-cycle), S_t is seasonal and I_t – irregular component.

The trend (T_t) is medium- or long-term movements of time-series. The trend-cycle combines the long-term trend and the business-cycle movements in the data.

The seasonal component (S_t) may be influenced by the economical, political or environmental conditions, but also by cyclicity of production, recurring from year to year. This component includes two types of effects (*Quarterly National Accounts Manual. Concepts, Data Sources and Compilation. IMF, 2001*): the seasonal effect narrowly defined and calendar-related systematic effects that may be not stable in annual timing. The seasonal effect narrowly defined is an effect that is reasonably stable (it may be gradually change over time (moving seasonality)) in terms of annual timing, direction and magnitude. Possible causes for the effect are natural factors, administrative or legal measures, social/cultural traditions, and calendar-related effects that are stable in annual timing (e.g., public holidays such as Christmas).

Calendar-related systematic effects on the time series that may be not stable in annual timing are caused by variations in the calendar from year to year. They may include the following:

- a) the trading-day effect which is the effect of variations from year to year in the number of working, or trading days and the weekday composition for a particular month or quarter relative to the standard for that particular month or quarter. Trading day effects are less important in quarterly data than in monthly data but can still be a factor that makes a difference.
- b) the effects of events that occur at regular intervals but not at exactly the same time each year, such as moving holidays or paydays for large groups of employees, pension payments and so on.
- c) other calendar effects, such as leap-year and length-of-quarter effects.

Seasonal movements are often large enough that they mask other characteristics of the data that are of interest to analysts of current economic trends. Seasonal adjustment of time series generally means to identifying and eliminating the regular within-a-year influences (seasonal effect narrowly defined, Easter effects, local calendar effects, working and trading day effects) to highlight the underlying trends and short-run movements of economic processes. Seasonal adjustment produces data in which the values of neighboring periods are usually easier to compare. Seasonally adjusted data could be preferred to unadjusted because seasonally adjusted data allows to see those characteristics that seasonal movement tends to mask, especially changes in the direction of the series.

The irregular component (I_t), which is called also a stochastic or random component, may include the interaction effect of occasional components and “distinctive happenings” which have occurred in economy as well as mistakes in the initial data. It is not possible to forecast values of irregular component differently from the values of trend or seasonal components. We only can have assumptions about its statistical distribution. The irregular component includes the following effects:

- a) irregular effects narrowly defined,
- b) outlier effects, that is, unusually large or small observation, caused either by errors in the data or special events,
- c) other irregular effects, such as effects of unseasonable weather, natural disasters, strikes and irregular sales campaigns.

Multiplicative model can be used for the description of macroeconomic time series (for example, GDP), the components of which are expressed at current prices. Additive model, on the other hand, can be used for the description of economic time series, the components of which are expressed at constant prices. To answer the question to which model (additive or multiplicative) is better we must look at the graph of time series. If the amplitude of the seasonal component is roughly proportional to the trend level then the multiplicative model is better. If the amplitude of the seasonal component is roughly constant over time then seasonal adjusting with the additive model is better. Experience in the field of time series and statistical tests will also help to select a model.

EUROSTAT has compared carefully several methods (and computer programs) for seasonal adjustment. It was decided to focus attention on two seasonal adjustment methods and computer programs in the future:

- a) methods based of an empirical or sophistic origin, also called non-parametric methods. The choice is: X-12-ARIMA of the US Bureau of the Census,

b) methods based on econometric modelling of time series, or parametric methods. The family of usable models is provided by the theory of stochastic processes and is known under the name of ARIMA models. The choice is: TRAMO/SEATS (*TRAMO – Time Series Regression with ARIMA noise, Missing Observations and Outliers, SEATS – Signal Extraction in ARIMA Time Series*), an ARIMA model-based method, written by Agustín Maravall (*Banco de España*) and Víktor Gómez (*Ministerio de Economía y Hacienda*).

X-12-ARIMA is a seasonal adjustment program developed at the US Bureau of the Census. The program is based on the Bureau's earlier X11 program and the X-11-ARIMA/88 program developed at Statistics Canada.

TRAMO/SEATS is a model-based seasonal adjustment program. TRAMO fundamentally focuses on the modelling of the data series. SEATS decomposes the linearised series (cleaned from Easter effects, calendar effects, trading day effects and outliers) from TRAMO into components.

Both programs (X-12-ARIMA and TRAMO/SEATS) can calculate forecasts for original series and components. EUROSTAT has developed the user-friendly seasonal adjustment interface to TRAMO/SEATS and X-12-ARIMA. The current release of this interface (program DEMETRA) is version 2.04.

We started with seasonal adjustment of GDP and its components at the end of 1998. Our time series begin from 1st quarter 1993. The option “four quarters are equal to the year”, means that the sum of seasonally adjusted quarters is equal to sum of unadjusted four quarters of the same year, was used. Initially we used for seasonal adjustment package X11 (UK version). At that time, when choosing the decomposition model, we assumed that additive model can be used to describe macroeconomic time series, the components of which are expressed at constant prices and multiplicative model can be used to describe of macroeconomic time series, the components of which are expressed at current prices. We assessed the quality of seasonal adjustment visually, with the help of seasonally adjusted time series graph. To identify possible outliers the help of the graph of the irregular component was used. Since the end of 2000 we are using interface DEMETRA and applying all its opportunities, where program X12-ARIMA was used for seasonal adjustment of GDP and its components.

Our seasonally adjusted GDP and its components are published in press release, monthly bulletin and are available in the statistical database on our website (<http://www.stat.ee>). Once a year the seasonally adjusted GDP and its component at current and constant prices by kind of activity, institutional sectors and expenditure components are published in our publication “Gross Domestic Product”. Since 2005, we started to provide seasonally adjusted quarterly time series on GDP and its components to Eurostat. Time series are provided on main aggregates of national accounts, including GDP components of expenditure and income approaches.

4. Forecasting of quarterly GDP: Estonian experience

Necessity for seasonal adjustment arose in 1998 when we looked for a simple tool to do short term forecast of GDP for our internal use. Output from this forecast was later possible concurrent approach to FLASH estimates of GDP. The GDP by institutional sectors (five institutional sectors plus net taxes on production – all together six time series) calculated at constant prices was the source data for seasonal adjustment and forecasting in this task.

As a result of seasonal adjustment we get information about three components of time series: trend, seasonal and irregular component (sometimes instead the trend we used seasonally adjusted time series). We tried to interpolate trend (sometimes is better to do it with seasonally adjusted time series) with regression models. Three types of model were used:

a) linear model: $T_t = a + b * t;$

b) quadratic model: $T_t = a + b * t + c * t^2;$

c) logarithmic model: $T_t = a + b * \log(t)$,

where $t = 1, 2, 3, \dots$ denotes time. For forecasting seasonal component S_t , $t = T, T+4, T+8, \dots, T+4*YEAR$, we used the linear model $S_t = a + b * t$, only. We used package EViews for regression analysis and forecasting.

To choose one, two or three best approximation we used criteria R^2 and Akaike Information Criteria (AIC), which is based on the sum of squared residuals. The best specification is choosing with the lowest value of the AIC . This criterion is calculated as:

$$AIC = \log\left(\frac{RSS}{T}\right) + \frac{2k}{T},$$

where RSS is sum of squared residuals and k is number of estimated parameters. EViews calculates both criteria R^2 and AIC . Therefore it is easy to use this selection criterion. After that we find forecast for trend and seasonal component. On the assumption about the model we can calculate expected value of GDP. We assumed, that the expected value of the irregular component is equal to zero for the additive model and one for the multiplicative model.

In the end of 2000 when we started to use DEMETRA in seasonal adjustment of GDP it was possible to do additional forecasting using ARIMA models. Two methods for forecasting were used: direct model for GDP and indirect model for components of GDP by institutional sectors. These forecasts can be obtained directly from DEMETRA output. ARIMA(p,d,q)(P,D,Q) $_s$ model can be written as:

$$(1 - \Phi_1 B - \Phi_2 B^2 - \dots - \Phi_p B^p)(1 - \phi_s B^s - \phi_{2s} B^{2s} - \dots - \phi_{ps} B^{ps})(1 - B)^d (1 - B^s)^D Y_t = \delta + (1 - \Theta_1 B - \Theta_2 B^2 - \dots - \Theta_q B^q)(1 - \theta_s B^s - \theta_{2s} B^{2s} - \dots - \theta_{qs} B^{qs})u_t,$$

where B is the backshift operator, $s=4$ for quarterly data, p and P are orders of autoregressive and seasonal autoregressive part, q and Q are orders of moving average and seasonal moving average part, d and D are orders of difference and seasonal difference.

We got at least three different forecasts for GDP: at least one forecast is obtained from interpolation of trend and seasonal component, at least one from direct ARIMA model forecast and at least one from indirect model as sum of ARIMA models for components of GDP by institutional sectors. The main problem is now to find suitable forecast. Before 2005 we used only R^2 , AIC and expert opinion for finding suitable forecast. From 2005 the situation has changed. We decided to formalize the process of choosing the best forecast using concrete econometric criteria for testing. We divided our time series into two overlapping parts: one ($\Omega = \{y_{k+1}, y_{k+2}, \dots, y_T, y_{T+1}, \dots, y_{T+h}\}$) is for calculating of models and second ($\Psi = \{y_{T+1}, \dots, y_{T+h}\}$, what is included in Ω , or is equal with Ω ($\Psi \subseteq \Omega$)), is for testing this model. We used last nine quarters for testing models. For choosing the best forecast we made trials using four econometric criteria: RMSE (*Root Mean Squared Error*), MAE (*Mean Absolute Error*), MAPE (*Means Absolute Percent Error*) and TIC (*Theil Inequality Coefficient*). These criteria are calculated (see *EViews 5, User's Guide. Quantitative Micro Software, LLC, 2004*) by using the following formulae:

$$RMSE = \sqrt{\frac{1}{h} \sum_{t=T+1}^{T+h} (y_t - Y_t)^2},$$

$$MAE = \frac{1}{h} \sum_{t=T+1}^{T+h} |y_t - Y_t|,$$

$$MAPE = \frac{1}{h} \sum_{t=T+1}^{T+h} |(y_t - Y_t) / y_t|,$$

$$TIC = \frac{\sqrt{\frac{1}{h} \sum_{t=T+1}^{T+h} (y_t - Y_t)^2}}{\sqrt{\frac{1}{h} \sum_{t=T+1}^{T+h} y_t^2 + \frac{1}{h} \sum_{t=T+1}^{T+h} Y_t^2}}.$$

The first two forecast error statistics depend on the scale of the dependent variable. These should be used as relative measures to compare forecasts for the same series across different models: the smaller the error, the better the forecasting ability of that model according to that criterion. The other two statistics are scale invariant. The Theil inequality coefficient always lies between zero and one, where zero indicates a perfect fit.

In this situation we have many (at least three) interpolations functions and four criteria. We couldn't be sure that all four criteria behave absolutely similarly. Therefore we don't know compromise solution for such kind of problem.

To illustrate what has been said, let us show the process of the choice of the forecast of GDP at constant prices for first, second, third and fourth quarter of 2005. Some results are interesting. Namely, the difference between the forecast and the flash estimate was quite big for second and third quarters. For the fourth quarter there was the problem that forecast was close to flash estimate but real calculated GDP growth was substantially bigger.

Let us start from the first quarter. We selected four variants of possible forecasts and calculated values for our four criteria. Results for last 9 quarters are shown in Table 2. We denote the value of the GDP forecast and growth calculated from the trend as Trend1 and Trend2. If the GDP forecast was calculated using ARIMA model, we denote it with ARIMA1 (directly calculated) or ARIMA2 (calculated as sum of ARIMA models for GDP components by institutional sectors).

Table 2. Results for forecasts of GDP for 1st quarter 2005.

	RMSE	TIC	MAE	MAPE	Expected		The best forecast, %	Flash estimate, %	GDP growth, %
					GDP, million kroons	GDP growth, %			
Trend1	345.3	0.00591	296.6	0.01009	29 503.4	6.3	6.5	7.0	7.2
Trend2	322.9	0.00552	274.5	0.00938	29 560.7	6.5			
ARIMA1	442.0	0.00754	374.3	0.01282	29 605.7	6.6			
ARIMA2	449.9	0.00767	380.5	0.01309	29 377.8	5.8			

This table consists of two parts. The first part includes calculated values for four econometric criteria (*RMSE*, *TIC*, *MAE*, *MAPE*), expected values of GDP and its expected growth. The second part includes the best forecast of GDP, its flash estimate, published 60 days after end of quarter and real GDP growth, published 90 days after end of quarter. We defined the best forecast as best expected GDP growth, which satisfy optimality criteria. We can see that expected forecast values, calculated from the trend are a bit better for all criteria. Additionally we can see that all econometric criteria behave similarly. In this situation the best variant is

Trend2 (showed in bold) and the best ARIMA model is ARIMA1 (showed in bold italic). As a result of this analysis, we select the variant Trend2 as the best forecast for GDP. We can see that flash estimate of growth of GDP for first quarter of 2005 was 7.0% and real calculated and published growth of GDP was 7.2%. The difference between the best forecast and flash estimate is equal 0.5 percent points.

Let us proceed to the second quarter. Results calculated for the last 9 quarters, are shown in Table 3.

Table 3. Results for forecasts of GDP for 2nd quarter 2005.

	RMSE	TIC	MAE	MAPE	Expected		The best forecast, %	Flash estimate, %	GDP growth, %
					GDP, million kroons	GDP growth, %			
Trend1	301.2	0.00509	204.0	0.00735	33 531.6	7.3	8.1	10.0	9.9
Trend2	233.1	0.00394	176.8	0.00625	33 744.0	8.1			
ARIMA1	303.7	0.00514	232.8	0.00815	33 525.2	7.3			
ARIMA2	285.7	0.00484	237.6	0.00817	33 400.4	6.9			

In this situation we can see that expected forecast values calculated from the trend are a bit better than for ARIMA models for all criteria. Additionally, we can see that all econometric criteria calculated for Trend1 and Trend2 behave similarly. On the other hand the expected forecast values calculated on basis of ARIMA model behave in different ways. Using first two criteria (*RMSE*, *TIC*) the expected forecast values calculated using the ARIMA2 model seem to be better, but if we use last two criteria (*MAE*, *MAPE*), then the expected forecast value calculated with ARIMA1 model seems to be better. These results are shown in bold italic. As a result of this analysis, we selected the variant Trend2 for GDP best forecast. We can see that the flash estimate of growth of GDP for second quarter of 2005 was 10.0% and real calculated and published growth of GDP was 9.9%. It was the first quarter after many years when difference between GDP flash estimate and forecast was so large. As a rule this difference was not bigger than 0.5 percentage points.

Now we can analyse results for the 3rd quarter 2005. They are shown in Table 4.

Table 4. Results for forecasts of GDP for 3rd quarter 2005.

	RMSE	TIC	MAE	MAPE	Expected		The best forecast, %	Flash estimate, %	GDP growth, %
					GDP, million kroons	GDP growth, %			
Trend1	303.4	0.00498	238.3	0.00770	33 593.6	9.1	9.7	10.8	10.6
Trend2	204.3	0.00334	183.0	0.00594	33 752.6	9.7			
ARIMA1	355.9	0.00585	254.5	0.00805	33 631.5	9.3			
ARIMA2	387.4	0.00636	282.6	0.00892	33 707.4	9.5			

We can see that all econometric criteria behave similarly. Analogically, after analysis similar to that in the preceding case we selected the variant Trend2 for GDP best trend-based forecast. The best ARIMA model based forecast is ARIMA1 and it is shown in bold italic. As result of the analysis we selected the variant Trend2 for the best forecast for GDP. We can see that flash

estimate for third quarter of 2005 was 10.8% and real calculated and published GDP was 10.6%. The situation is similar to that in the previous quarter.

Finally, we can analyse results for the 4th quarter 2005. They are shown in Table 5.

Table 5. Results for forecasts of GDP for 4th quarter 2005.

	RMSE	TIC	MAE	MAPE	Expected		The best forecast, %	Flash estimate, %	GDP growth, %
					GDP, million kroons	GDP growth, %			
Trend1	263.8	0.00422	227.5	0.00741	35 307.0	10.0	10.4	10.5	11.1
Trend2	234.5	0.00378	207.7	0.00675	35 462.8	10.4			
ARIMA1	369.6	0.00596	272.1	0.00848	35 516.9	10.6			
ARIMA2	399.3	0.00644	304.1	0.00948	35 574.1	10.8			

Situation in the left side of the table is analogical to that in the preceding quarter. There is interesting situation on the right side of the table. The best forecast of GDP growth was 10.4%. We can see that flash estimate was 10.5%, but real calculated and published GDP growth was 11.1%. It was for the first time, when difference between flash estimated and really estimated GDP growth exceeds 0.5 percent points.

Finding the compromise solution between four criteria is not a simple problem. After testing we finally decided to use two criteria only: *RMSE*, as most used criteria, and *TIC*, which shows the fit quality. In case of ideal solution values for both criteria are minimal. Otherwise we could find compromise solution, where *TIC* is minimal or close to it, but *RMSE* obtains restriction

$$|RMSE - RMSE_{\min}| < \varepsilon,$$

where ε is the fixed value. In practice this means, that we choose the optimal solution using only few possible pretenders using criteria *RMSE* and *TIC*. In that case the values for both criteria may not be minimal. This process applies to all institutional sectors. It improves quality of calculated value added forecasts for all institutional sectors and GDP forecasts altogether. Process of calculation of value of criteria *RMSE* and *TIC* is simply realized with EXCEL facilities.

Our practice of calculation the forecast shows, that sometimes this forecast is underestimate and sometimes overestimate. It means, that difference between the really calculated GDP and the forecast value may be positive or negative. The difference between our forecasts and flash estimated GDP was as a rule not more than 0.5 percentage points. On the other hand, till now (excluded 4th quarter 2005), the difference between GDP flash estimates and preliminary estimate has varied up to 0.5 percentage points.

The forecasts for the second and the third quarter for 2005 were not so good (the discrepancy from the flash estimated GDP was 1.9 and 1.1 percent points respectively). In this year the best forecast of GDP for the 4th quarter 2005 was close to flash estimate, but the discrepancy from the really calculated GDP was quite big. Therefore in this year we decided to develop a new, simple (one equation) model using econometric methods.

5. Results

1. We started with flash estimation of GDP in 1998. It was first published for the first quarter of 1998 in our News Release. We continue publication of our flash estimation as GDP growth.

2. At the same year we started with seasonal adjustment of GDP and its components. Our time series begin from 1st quarter 1993. The option “four quarters are equal to the year”, means that the sum of seasonally adjusted quarters is equal to sum of unadjusted four quarters of the same year, was used. Our seasonally adjusted GDP and its components are published in press release, monthly bulletin and are available in the statistical database on our website.

3. Necessity for starting seasonal adjustment arose in 1998 when we looked for a simple tool to do short term forecast of GDP for our internal use. Output from this forecast is used later as possible concurrent approach to FLASH estimates of GDP. The GDP by institutional sectors calculated at constant prices was the source data. We tried to interpolate trend or seasonally adjusted time series and seasonal component with regression models. We found forecast for trend and seasonal component. On the assumption of additive or multiplicative model we can calculate expected value of GDP. For calculation the forecast we assumed, that the expected value of the irregular component is equal to zero for the additive model and one for the multiplicative model. Since we started to use DEMETRA in seasonal adjustment of GDP it was possible to do additional forecasting using ARIMA models.

4. The forecasting of GDP is not a simple procedure. The main purpose of this paper was to show the possibility to formalizing the process of calculation this forecasts using concrete formal criteria. We made trials using four econometric criteria. Finally we have seen, that for finding the “best forecast” is it possible, to our opinion, to use only two criteria instead of four: *RMSE* and *TIC*. In case of ideal solution, values for both criteria are minimal. Otherwise we choose the optimal solution using not more than a few possible pretenders for criteria *RMSE* and *TIC*. In that case the values for both criteria may not be minimal. This process applies to all institutional sectors too. It improves quality of calculated forecasts of value added for all institutional sectors and GDP forecasts altogether. Process of calculation of value of criteria *RMSE* and *TIC* is simply realized with EXCEL facilities.

5. The forecasts for second and third quarter for 2005 were not so good (the discrepancy from the flash estimated GDP was 1.9 and 1.1 percent points respectively). In this year the best forecast of GDP for the 4th quarter 2005 was close to the flash estimate, but the discrepancy from the really calculated GDP was quite big. Therefore in this year we decided to develop a new, simple (one equation) model using econometric methods.

6. References

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