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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

An Evaluation of Revisions and Quality Aspects of Austrian Quarterly GDP Publications

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Abstract

This study presents results of a revision analysis of Austrian Quarterly National Accounts using data between 1999 and 2008. In order to analyse different aspects of the revision pattern, a broad set of indicators is calculated and evaluated on the basis of a real time data set. Considering QNA data, adjusted and non-adjusted for working day and seasonal effects, in nominal and real terms, we find that mean revisions of GDP growth rates are unbiased over all observed revision windows. Revisions to aggregate GDP series are generally found to be smaller than those of its components. Some GDP aggregates (especially foreign trade and investment components) show relatively large and biased revisions. We also observe that changes in the release calendar and the introduction of flash estimates did not affect the reliability of first GDP estimates. In contrast, revisions were observed to decrease continuously over the sample period.

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1 Introduction

The system of Quarterly National Accounts (QNA) constitutes the most comprehensive and consistent high-frequency economic data source. For this reason it provides important information for guiding timely economic policy decisions, preparing forecasts and judging the stance in the business cycle. In order to comply with these demands, quarterly figures should – like other economic statistics – fulfill three quality aspects of economic statistics: timeliness, accuracy and reliability[1]. The analysis of revisions investigates the reliability dimension of quality, whereas measuring accuracy turns out to be difficult, as the "true" value is in fact unobservable. The extent to which statistics are subject to revisions is one of the more easily quantifiable aspects of quality (*Di Fonzo,* 2005).

On the one hand, revisions are necessary and important, as they should include new information from the ongoing flow of data. On the other hand, revisions can be the consequence of erroneous source data and compilation methods. A revision analysis explores the relative importance of those features in the revision process. This is beneficial for two main reasons:

- The communication of revisions provides users of economic statistics with information necessary to interpret the reliability of statistics and should therefore improve the awareness and confidence on the available information (*IMF*, 2001 and *Eurostat,* 2008).
- Producers of these statistics are provided with information which can be used for improving their compilation methods.

Recent publications of revision analysis for OECD countries comprise *McKenzie* (2006), *DESTATIS* (2007), Meader (2007), *OECD* (2007), *ECB* (2008), *ECB* (2009). *ECB* (2008) includes Austrian data as well, and conducted an analysis of GDP data (including flash estimates) based on seasonally- and working day adjusted data in real terms for the time period 2002Q2 – 2007Q1. While results concerning the absolute size and the volatility of revisions are similar to our study, investigations concerning a possible bias in the revisions do not come to the same conclusions. But both, sample size and underlying series differ between the two studies. While *ECB* (2008) focuses on one time series only, our analysis investigates this topic in a broader context using more and longer time series. As the release policy for Austrian QNA changed during our sample period, we create three real time datasets, in order to account for these shifts. All datasets cover total GDP, its main components of the expenditure side of the

[1] In the context of quality analysis accuracy is usually used to denote the closeness between the estimated value and the true value. Accuracy is assessed by evaluating the error associated with an estimate. Reliability usually refers to the closeness of the initial estimated values to the subsequent estimated values, i.e. revisions (*Di Fonzo*, 2005).

national accounts, as well as time series of value added in manufacturing and employees. The data are available adjusted and non-adjusted for working day and seasonal effects, as well as in nominal and real terms. For our analysis, we inspect both year-on-year growth rates (in the case of unadjusted series) and quarter-on-quarter growth rates (in the case of adjusted series). We explore the reliability of initial estimates by elaborating different quantitative indicators as proposed by the Eurostat/ECB taskforce and OECD workshops[2]. While we use basic indicators, e.g. the mean and the variance of revisions in order to assess the size, volatility and bias of revisions, we also use more advanced methods, e.g. the "*News versus Noise*" analysis to give a comprehensive picture of the revision pattern of the Austrian QNA. Another indicator showing whether the economic activity is changing its pace during the revision process is calculated as well.

The main findings are that revisions to GDP growth rates are unbiased. As revisions tend to cancel out at the aggregate level (*ECB*, 2009), revisions to most GDP components are observed to be bigger and/or biased compared to aggregate GDP series. Notably high and biased revisions are observed in components of foreign trade and investment. Additionally, we found that changes in the release policy (advancement from t+90 to t+70) and the introduction of flash estimates (t+45) did not negatively affect the reliability of first GDP estimates. In contrast, we observe that revisions tend to get continuously smaller over time.

In the future we intend to repeat the analysis on a regular basis, in order to ensure the actuality of the results. The most important quality indicators will be published in the course of the QNA publication press notice. Good examples providing this service are the Office for National Statistics (ONS) in the UK and the Bureau of Economic Analysis (BEA) in the US. They regularly publish main indicators of revision analysis in their press releases of GDP announcement and offer users the opportunity to get an impression of the precision of the data. More detailed analyses are published on a regular basis, too.

This report is structured as follows: Section 2 describes the revision policy of the Austrian QNA; it further defines the revisions subject to our analysis and presents the used datasets. The applied methodology is explained in section 3. Thereafter, results for the revisions to the regular QNA estimates relying on not adjusted (for seasonal and working day effects) data are presented in section 4. In Section 5 we evaluate revisions of seasonally- and working days adjusted regular QNA estimates. The main findings regarding the introduction of flash estimates are provided in section 6. Section 7 summarizes the main results.

[2] See *ECB and Eurostat* (2004). For information and material regarding the workshop "Assessing and Improving Statistical Quality - Revisions Analysis for the National Accounts: OECD-ONS Workshop 7 - 8 October 2004, Paris". See: http://www.oecd.org/document/23/0,2340,en_2825_497146_33729303_1_1_1_1,00.html

2 Description of the revisions and the used dataset

2.1 Calculating revisions

In Austria, QNA revisions of the original unadjusted data are undertaken with every new publication of the quarterly figures[3]. Revisions are made for the actual year and - as long as no Annual National Accounts (ANA) data have been released by Statistics Austria - also the year before. Until the third quarter 2004, the first regular QNA release was disseminated 90 days after the reference period (t+90). In order to judge the stance of the business cycle on time, the demand for more timely information was increasing. As from the fourth quarter 2004, the first regular release QNA was published already at t+70. With the second quarter 2005 onwards, the Austrian Institute of Economic Research additionally started to calculate flash estimates, which were published at t+45. This is coordinated between the National Statistics Institutes and Eurostat to guarantee the simultaneous publication of the results with the other member states. The flash estimates use uni- and multivariate time series methods in order to extend times series which are not available at that early stage of time (*Scheiblecker and Steindl*, 2006). From this time, the release of the regular QNA (t+70) constitutes the second release of the quarterly figures in Austria. It revises the results of the flash estimates, and is in turn again revised by the next vintage of the flash estimates around two months later. Table 1 gives an overview of the release calendar. It becomes apparent that the time span between the end of a quarter and its first publication had been reduced step by step over time.

Table 1: Release calendar

Reference Quarter	First release regular QNA	First release flash estimate	First release
1999Q3 – 2004Q3	t+90		t+90
2004Q4 – 2005Q1	t+70		t+70
2005Q2 – 2008Q4	t+70	t+45	t+45

Once a year the ANA are released by Statistics Austria. Since 2005 they have been published in July, while in the years before the release took place in October. Using the latest ANA data, new econometric relationships are estimated for their quarterly disaggregation, and the quarterly figures for the respective year and the preceding years are being revised. Today this process is done in August during the calculations for the flash estimate dissemination of the second quarter.

[3] For more information regarding the publication timetable, revision policy and dissemination of QNA, see Scheiblecker, Steindl and Wüger (2007).

The original quarterly data are seasonally adjusted using TRAMO-SEATS, the working day correction is done within the framework of seasonal adjustment and relies on a regression approach. The model identification procedure is carried out once a year at the time when the latest ANA data have been incorporated in the quarterly QNA. Thus, the form of the model used for seasonal and working day adjustment is re-specified only on a yearly basis, while its parameters are estimated concurrently.

The underlying analysis covers the following three revision windows:

- Revisions between the first* and the second release:

  rs_t……. second release (s_t) – first release (f_t)

- Revisions between the first release* and the estimate aligned with new information stemming from the newest publication of ANA by Statistics Austria (hereafter called "annual release"):

  ry_t……. annual release (y_t) – first release (f_t)

- Revisions between the first* and the latest available (actual) release. In this study, the latest release comprises the publication from March 2009:

  rl_t……. latest release (l_t) – first release (f_t)

* Depending on the used dataset, the first release either refers to a flash estimate, or to a regular QNA release (see section 2.2 below for a description of the used datasets).

With the publication of the ANA of 2007, Statistics Austria implemented some major methodological changes covering the time span between 1976 and 2007, which mainly affected foreign trade time series[4]. As the revision between the first and the latest release includes these changes and may distort the interpretation, we calculated the revisions between the first and the latest release before this general revision came up, too. The results for the summary statistics were similar to those of the revision between the latest release and the first release[5].

In some cases it is useful to look at incremental revisions, i.e., revisions between the second release and the annual release (rsy_t) and revisions between the annual release and the latest release (ryl_t). On the one hand, conclusions about the relative contributions of intermediate revisions to total revisions can be drawn. On the other hand, testing for the efficiency of

[4] A new survey-based balance of payment system produced a significant different data base for cross-county transactions. Moreover, some conceptional changes were implemented (e.g. inclusion of illegal production), see *Havel* (2008).

[5] Results are available from the authors.

estimates implies looking at the relationship between the incremental revision and its prior and subsequent release.

2.2 Creating real time datasets

Real time datasets were created covering the releases from the third quarter 1999 (this marks the start of compiling QNA in Austria by modern statistical benchmark methods) until the fourth quarter 2008. In order to consider the different release policies over time (the introduction of the flash estimates), three datasets were created:

- Dataset 1 covers the releases of the regular QNA only, which will be regarded always as the first estimates (even after 2005Q2 when the flash estimates already exist).
- Dataset 2 treats the data points like a whole consistent series. It includes the first available estimate at a given quarter, irrespective whether it is a flash estimate or a regular QNA release. The second available estimates always refer to the regular QNA[6]:

Reference Quarter	First release	Second release
1999Q3 – 2005Q1	Regular QNA	Regular QNA
2005Q2 – 2008Q4	Flash estimate	Regular QNA

- Dataset 3 includes the flash estimates as the first available estimate and the regular QNA release as the second estimate. At the moment the sample period is very small (consisting of 14 observations) in order to obtain stable results for certain indicators. For example according to Statistics Canada, a minimum of 30 accounting periods should be used when calculating the mean revision (*OECD*, 2004). Therefore only a small set of indicators is calculated with this dataset.

Besides the total GDP, the three real time datasets cover the main components of the expenditure side of the national accounts, the time series of value added in manufacturing[7], as well as employees. The components under consideration can be found in table 2. They are available adjusted and non-adjusted for working day and seasonal effects, as well as in nominal and real terms (apart from the employment data). In order to account for conceptional changes between the releases (like the introduction of new techniques for the

[6] Using this data set one has to bear in mind that the time span of the revision window *rs* is shorter after the introduction of the flash estimates. It comprises only a time span of around 25 days, where it is of the length of approximately 90 days when both, the first and the second estimate stem from the regular QNA.

[7] Value added in manufacturing has a weight of about one third of GDP in the production side approach. It is cyclically sensitive and does therefore provide important information of the cyclical stance of the economy.

construction of price adjusted time series – chain-linking – in 2005) the analyses are conducted with year-on-year (in the case of unadjusted series) and quarter-on-quarter (in the case of adjusted series) growth rates, with the latter ones being more important for observing business cycle dynamics.

Table 2: Components under investigation

		Unadjusted		Adjusted	
		real yoy	nominal yoy	real qoq	nominal qoq
GDP	y	x	x	x	x
Private consumption (incl. NPISH)	pc	x	x	x	x
Government consumption	gc	x	x	x	x
Gross fixed capital formation	it	x	x	x	x
Investment in machinery and equipment	i	x	x	x	x
Machinery	im	x	x	x	x
Equipment	ie	x	x	x	x
Investment in construction	ic	x	x	x	x
Residential	ir	x	x	x	x
Non-residential	in	x	x	x	x
Exports	x	x	x	x	x
Exports of goods	xg	x	x	x	x
Exports of services	xs	x	x	x	x
Imports	m	x	x	x	x
Imports of goods	mg	x	x	x	x
Imports of services	ms	x	x	x	x
Manufacturing	mf	x	x	x	x
Employees	em	x		x	

3 Methodology

In order to analyze different aspects of quality and the revision pattern of the Austrian QNA we calculate and evaluate a broad set of indicators which are commonly used and recommended by the Eurostat/ECB taskforce and OECD workshops.[8] This section describes the used summary indicators characterizing bias, size and volatility of revisions. Additionally, two other indicators, describing the forecast efficiency of first estimates as well as their success in indicating the pace of growth rates, are explained.

[8] See *ECB and Eurostat* (2004), *OECD* (2007) and *McKenzie at al.* (2008).

3.1 The bias of the revisions

We determine the possibility of systematic distortions in the estimating process by using the concept of mean revision (*MR*). This measure addresses the question of the average level of revisions being close to zero.

$$MR = \overline{R} = \frac{1}{n}\sum_{t=1}^{n} r_t, \tag{1}$$

where r_t denotes the revision as defined in section 2.1, and n is the number of observations. A positive estimate of the mean revision indicates that the first releases have a tendency to be revised upwards compared with the target release, or in other words, the first estimate is negatively biased (with the reverse being true for a negative sign of the measure). Revisions are noted as biased if the *MR* is statistically significant different from zero. The significance of the bias is evaluated by the inferential procedure of a t-test. Since it is possible that revisions are autocorrelated, a standard t-statistics, which is based on the assumption that revisions are independent of each other, is not the appropriate measure in every case. In order to account for potential serial correlation a modified t-statistics should be calculated when necessary (*Di Fonzo,* 2005).

When checking for autocorrelation in the time series of the revisions, we identified three different cases. 76 percent of the revision series are not autocorrelated, 7 percent are autocorrelated of order 1 and 16 percent are autocorrelated of order 1 and order 2.[9] Depending on the attained results we computed three different values of the t-statistics:

- The standard t-statistics, which is given by the ratio between the *MR* and the variability of the revisions, is used when no significant autocorrelation could be found:

$$t = \frac{\overline{R}}{\sigma_r}\sqrt{n}, \tag{2}$$

  where σ_r denotes the standard deviation of the revisions.

- Two variants of a modified t-statistics based on the Heteroskedasticity Autocorrelation Consistent (HAC) estimator for the variance by *Newey and West* (1987) are computed, when revisions are autocorrelated.[10] For revisions autocorrelated of order 1, the first two parts in the brackets of equation (3) are relevant for calculating the t-statistics. If

[9] Table A1 to A8 in the Appendix reports the detailed results of the autocorrelation analysis as well as the appropriate value of the t-statistics.

[10] A detailed description of the deviation of the Newey-West HAC estimator of the variance is given in the Appendix B in *Di Fonzo* (2005).

autocorrelation of order 1 and 2 persists, the whole expression for the HAC adjusted estimator for the variance of MR is taken into account.

$$\sigma_r^2 = \frac{1}{n(n-1)}\{\sum_{t=1}^{n}(r_t-\overline{R})^2 + \frac{4}{3}\sum_{t=2}^{n}(r_t-\overline{R})(r_{t-1}-\overline{R}) + \frac{2}{3}\sum_{t=3}^{n}(r_t-\overline{R})(r_{t-2}-\overline{R})\} \quad (3)$$

If revisions are found to be subject to significant systematic deviations from zero, first releases are considered as biased. However, the existence of a bias is not the only indication of unreliable initial estimates. For instance, the *MR* does not take into account that revisions could be significantly dispersed. Thus, looking at the mean absolute revision and the standard volatility gives more insight into the quality of QNA estimates.

3.2 The size and volatility of the revisions

- The standard measure for determining the size of revisions is the mean absolute revision (*MAR*).

$$MAR = \frac{1}{n}\sum_{t=1}^{n}|r_t| \quad (4)$$

- Additionally, we use the concept of the relative mean absolute revision (*RMAR*) in order to compare the revisions across aggregates and time. Therein the *MAR* is scaled using the absolute size of the first release of the investigated series.

$$RMAR = \frac{\sum_{t=1}^{n}|r_t|}{\sum_{t=1}^{n}|x_t^f|} \quad (5)$$

where x_t^f denotes the first estimate.

- The mean squared revision (*MSR*) is a further popular indicator, as it gives greater emphasis to extreme revisions, whereas the *MAR* and the *RMAR* give the same weight to all revisions.

$$MSR = \frac{1}{n}\sum_{t=1}^{n}r_t^2 \quad (6)$$

The *MSR* is commonly used for investigating the reasons of revisions more in depth (see section 3.3).

- Calculating the standard deviation of the revisions we will determine how volatile the revisions are.

$$\sigma_r = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(r_t - \overline{R})^2} \tag{7}$$

3.3 The quality of preliminary estimates using the properties of the MSR

Equations (6) and (7) indicate that for unbiased first estimates $(MR = \overline{R} = 0)$ the *MSR* is equal to the variance of the revision σ_r^2. This motivates the possibility to decompose the *MSR* into a bias, a "slope" and an error part. Following *Theil* (1961) and *Granger and Newbold* (1973), we write:

$$MSR = \overline{R}^2 + \left(\sigma_f - \rho\sigma_l\right)^2 + \left(1-\rho^2\right)\sigma_l^2 \tag{8}$$

where σ_f denotes the standard deviation of the first estimate, σ_l the standard deviation of the latest estimate and ρ denotes the correlation coefficient between them. Dividing equation (8) by the *MSR* gives:

$$1 = UM + UR + UD, \tag{9}$$

where $UM = \frac{\overline{R}^2}{MSR}$, $UR = \frac{\left(\sigma_f - \rho\sigma_l\right)^2}{MSR}$ and $UD = \frac{\left(1-\rho^2\right)\sigma_l^2}{MSR}$.

The interpretation of *UM*, *UR* and *UD* is motivated by *Di Fonzo* (2005) using the following regression model:

$$x_t^l = \alpha + \beta\, x_t^f + u_t, \tag{10}$$

where x_t^l denotes the later estimate and the least square estimate of the slope coefficient is given by $\hat{\beta} = \frac{\mathrm{cov}(x_t^f, x_t^l)}{\sigma_f^2}$. Equation (10) can be interpreted intuitively as the revised estimate x_t^l, explained by a bias α, plus some multiple β of the first estimate and some other error u_t. Ideally there should be no bias (i.e., $\overline{R} = 0$ or $\alpha = 0$, respectively) and the target estimate should not be a multiple of the first estimate (i.e., $\beta = 1$).

- Therefore, *UM*, which is defined as the proportion of the *MSR* due to the mean revision not being equal to zero, is considered as the bias part of the *MSR*.

$$UM = \frac{\overline{R}^2}{MSR} \tag{11}$$

- *UR* is the proportion of the MSR, which is due to the slope coefficient in equation (10) being systematically different from 1 ($\beta \neq 1$)[11].

$$UR = \frac{\left(\sigma_f - \rho\sigma_l\right)^2}{MSR} \tag{12}$$

- Finally, the term *UD* constitutes the proportion of *MSR* that is not caused by systematic difference between preliminary and later estimates ($u_t \neq 0$). Hence *UD* can be interpreted as the disturbance or error proportion of *MSR*. As *UD* would be 0 if equation (10) would give a perfect fit, a high *UD* shows a high stochastic proportion in revisions.

$$UD = \frac{\left(1-\rho^2\right)\sigma_l^2}{MSR} \tag{13}$$

Since we would like our revisions to fluctuate randomly around zero, a good first estimate yields low values for *UM* and *UR* and a high value for *UD*.[12]

3.4 Investigation of changes in signs of second order derivative

The main application of QNA is economic policy. In this regard, it is important that QNA provides timely information of the stance of the business cycle and especially the detection of turning points of growth rates is crucial. Hence it is interesting to know how often the earlier published growth rate points into the same direction as the later published rate. We therefore investigate the signs of the second order derivative, which indicate whether an acceleration of growth published in the first estimate still shows acceleration in the subsequent estimate.

- Acceleration percentage positive (latest release) = positive (first release)
- Deceleration percentage negative (latest release) = negative (first release)

3.5 Forecast efficiency ("News versus Noise")

There exists a trade-off between timely and accurate publication of QNA figures in the sense that more timeliness is often at cost of accuracy. Accordingly, revisions are undertaken to

[11] $\sigma_f - \rho\sigma_l = \sigma_l(1-\hat{\beta})$, see *Di Fonzo* (2005).

[12] It has to be mentioned that this can only be regarded as a necessary condition of good estimates as there exists still the possibility of a more complex, non-linear relation between first estimates and revised values.

close the gap between preliminary estimates and the "true value" of the respective economic variables. Revisions should therefore "... *ideally represent the 'news' of incorporating more accurate and detailed information which becomes available for the compilation of the later estimates.*" (*Mc Kenzie et al.*, 2008, p. 1). If revisions feature this quality, the first published estimate is said to be an efficient forecast of the final figure.[13]

For the purpose of determining whether successive revisions to initial estimates are due to the inclusion of additional information, we use the concept of "News versus Noise" which was primary introduced by *Mankiw and Shapiro* (1986). On the one hand, a preliminary estimate of an economic variable is said to contain "noise" if the following revision is necessary to correct for some measurement error or systematic bias. On the other hand, if the following revision is conducted so as to take into account new information from the ongoing flow of data, it is said to contain "news".[14] As proposed by *Mankiw and Shapiro* (1986), we conduct the analysis of "News versus Noise" by using two approaches: a simple correlation method and a regression method.[15]

Following the correlation method, a preliminary estimate contains "noise" if the revision is significantly correlated with its prior release. This implies that not all information available when compiling the first release was efficiently used, so that revisions are necessary to eliminate measurement errors and distortions. If otherwise, a revision incorporates new information available, it will be a good predictor for its following estimator, i.e., the revision and its subsequent release will be significantly correlated.

The regression method is based on the same principles but utilizes somewhat more advanced tools. The model can also be extended with external variables like seasonal dummies, stock prices, short-term interest rates or business cycles confidence indicators (see for example Mankiw and Shapiro, 1986; Richardson and Mai, 2004; Faust et. al., 2005). The two approaches, the correlation and the regression method, can be expected in most cases to reach the same conclusions. In order to determine the existence of "noise", the preliminary estimate is regressed on its subsequent revision.[16] If the coefficients are jointly significant different from zero (i.e., if we reject the hypothesis $\alpha = \beta = 0$), revisions depend on the earlier estimate, they therefore contain "noise":

$$r_t = \alpha + \beta x_t^f + \varepsilon_t \tag{14}$$

[13] The concept of forecast efficiency was originally given by *Mincer and Zarnowitz* (1969).

[14] Recent studies on forecast efficiency comprise work by *Richardson and Mai* (2004); *Faust et al.* (2005) and *McKenzie et al.* (2008).

[15] Since we are interested in the relationship between a revision and its prior and subsequent release we are looking at incremental revisions when testing for the efficiency of estimates (see section 2.1).

[16] We use heteroskedasticity and autocorrelation robust standard errors in all regressions.

Revisions are said to contain "news" if they are dependent on the later estimate. Thus, the hypothesis is tested the other way around after estimating the following equation:

$$r_t = \alpha + \beta x_t^l + \varepsilon_t \tag{15}$$

It should be noted that both equations must be estimated in order to obtain an unambigous picture about the informational content of revisions. While accepting the null hypothesis that $\alpha = \beta = 0$ in (14) implies that revisions do not contain noise, not until it is rejected in (15), a certain designation of "news" can be made. As two mutually excluding hypotheses have to be tested, both methods may not always provide definitive findings. It is therefore also possible that our results show evidence of both "news" and "noise" to be present, or none of them.

4 Analysis of revisions to the regular QNA estimates (dataset 1), unadjusted series

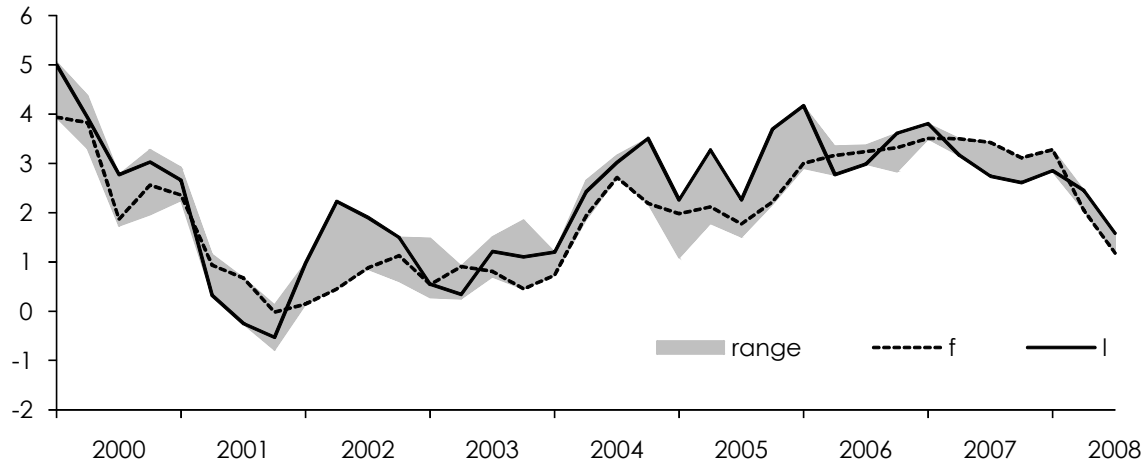
In this section we present results of the revision indicators explained in section 3, above. We evaluate dataset 1, which considers only the releases of the regular QNA and does not account for the flash estimates. We first observe revisions of estimates of year-on-year GDP growth in real terms, as well as of publications of year-on-year growth rates of components of GDP in real terms. Following, results of revision analysis of year-on-year growth rates of GDP and its components in nominal terms are presented. All series are unadjusted for seasonal and working day effects.

4.1. GDP in real terms

4.1.1 The bias of the revisions

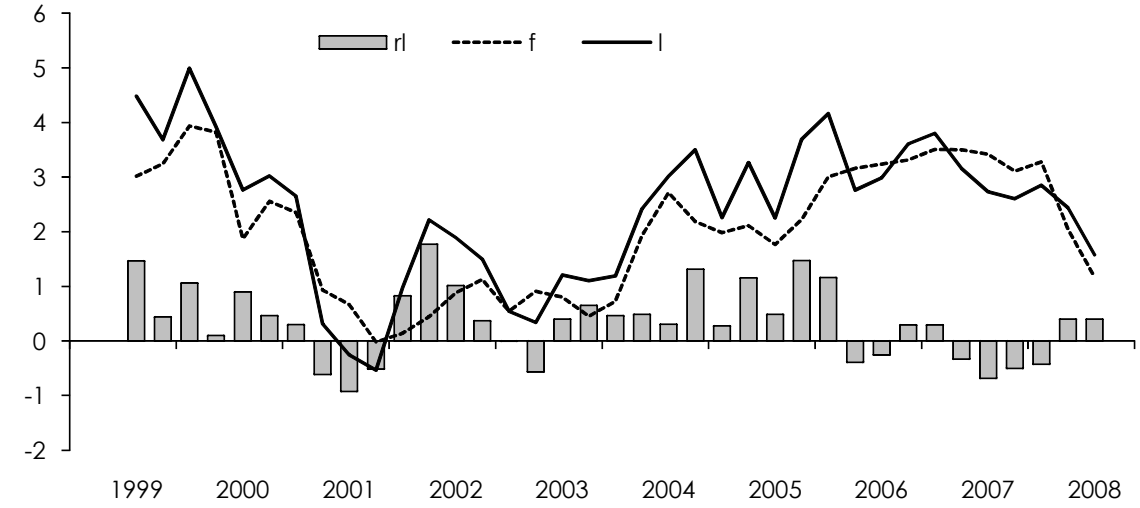
Graph 1 shows the range of publications of the Austrian quarterly GDP year-on-year growth rates in real terms. It gives the first release, the latest release, as well as the range of all the releases over time. The average growth rate taking real time data of the first publication is 2.06 percent. It increases to 2.41 percent considering the latest release (see also table 4 below). It can be seen quite clearly from the picture, that the latest publication does coincide very frequently with the upper border of the range, or in other words, the latest publication marks very often the highest release over the time period. From total 37 observations (from the third quarter 1999 until the third quarter 2008), only in 10 times the latest release is below the first published one, where for 27 observations (73 percent) the latest release is reported to be higher compared to the first published growth rate of real GDP. Graph 2 additionally shows the revisions between the first and the latest release, rl_t; for 27 observations they are positive in a sense that a revision took place upwards over time.

Graph 1: Estimates of real GDP growth



range ... range of all releases, f ... first release, l ... latest release

Graph 2: Total revisions of real GDP growth

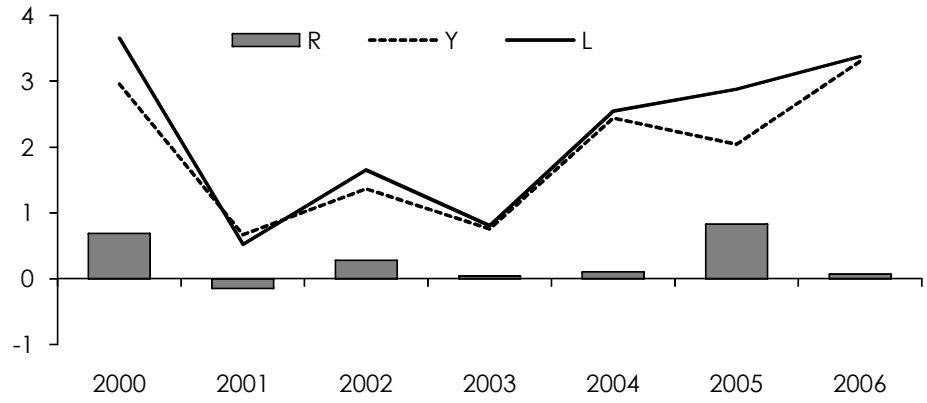


rl ... range between first release and latest release, f ... first release, l ... latest release

As soon as Statistics Austria releases the ANA (nowadays around 7 months after the end of the year), the QNA releases are bounded to these constraints. Moreover, all revisions which took place over time in ANA statistics have to be incorporated also in the QNA. Graph 3 shows the revision pattern of the annual GDP growth rates published by Statistics Austria.

Consistent with the results shown in Graph 1 and Graph 2, also in the ANA revisions were much more likely to occur upwards then downwards, which explains in part the upward revisions in QNA. For example, the positive revisions between the first and the latest release observed in all quarters in the years 2000, 2002 and 2005 (Graph 2) are reflected in the yearly pattern of revisions, too (Graph 3).

Graph 3: Revisions of real GDP growth in the ANA by Statistics Austria



R ... range between first release and latest release, Y ... first release, L ... latest release

Because of these facts, more information concerning the quality of the first GDP estimates in the QNA can be found in analyzing the revisions between the first and the second release of QNA figures, rs_t, as well as the revisions between the first release and the estimate aligned with new information stemming from the publication of ANA by Statistics Austria (ry_t), too. Following section 3.1, table 3 summarizes statistics evaluating a possible bias in the revisions, considering the three revision windows rs_t (second estimate – first estimate), ry_t (annual – first estimate) and rl_t (latest – first estimate). According to the t-tests, the *MR* is not significantly different from zero, a bias cannot be confirmed[17]. This is observed for all three revision windows. When checking for autocorrelation in the time series of the revisions, we found no autocorrelations in the windows rs_t and ry_t, but autocorrelation of order 1 and 2 in revisions between the first and the latest estimate rl_t. This means that a revision made for one period may be associated with revisions in the two previous periods. Giving the revision policy described above (the incorporation of the revisions of the ANA by Statistics Austria into the QNA once a year) this result is not surprising as considerable revisions of ANA lead to a shift of all quarters of the respective year. To adjust for the autocorrelation, we computed the adjusted t-statistics for the revision window rl_t (see equation 2 and 3).

[17] Or in other words, the hypothesis that the mean revision is zero was not rejected on a 5 percent level of significance.

Table 3: Bias in the revisions of real GDP growth rates

	MR	t-statistics	Auto-correlation
rs	0.06	1.62	no
ry	0.14	1.49	no
rl	0.35	0.42	order 1, 2

4.1.2 The size and volatility of the revisions

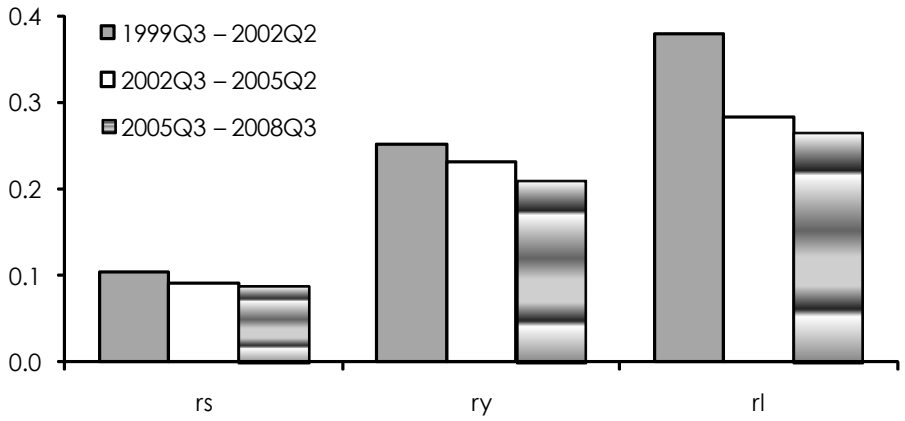
Table 4 gives an overview of further basic summary statistics giving information about the size and the volatility of revisions of quarterly year-on-year GDP growth rates (see section 3.2), as well as summary statistics of the first *(f)* and the latest publication *(l)* of GDP growth rates. A first result is that the larger the revision windows the bigger the summary statistics, too. This is quite reasonable as by time passing more and more information is coming up. The *MAR* measuring the size of the revisions regardless of its sign increases from 0.19 percentage points in the window rs_t to 0.64 percentage points in the window rl_t. This pattern was reported in a cross-country study by the *ECB* (2008), too and does also reflect some methodological changes referred to in section 2. The same applies to the standard deviation (*SD)* of the revisions, which increases from 0.24 percentage points in rs_t to 0.67 percentage points in the window rl_t. Revisions between the first and the second estimate, rs_t, range from – 0.49 to +0.57 percentage points. In the window between the first and the last estimate, rl_t, the highest downside revision was 0.93 percentage points, while the highest upside revision amounts to 1.77 percentage points.

Table 4: Summary statistics for revisions of year-on-year GDP growth rates

	MAR	SD	MIN	MAX	MEAN
rs	0.19	0.24	– 0.49	0.57	
ry	0.48	0.57	– 0.89	1.50	
rl	0.64	0.67	– 0.93	1.77	
f		1.16	– 0.02	3.93	2.06
l		1.31	– 0.53	4.99	2.41

We evaluated the revisions over time, too. Graph 2 showed above that the revisions between the first and the latest estimate, rl_t, tend to become smaller over time. A similar result was found for the Euro area, too. This general observation may also be explained by the fact that more recent observations have been subject to fewer (instances of) revisions (*ECB*, 2008). Looking at the development of the *RMAR* over time, this observation is approved for Austrian data. For the purpose of this analysis, we split up the dataset into three periods (1999Q3 – 2002Q2; 2002Q3 – 2005Q2; 2005Q3 – 2008Q3). Then the RMAR for rs_t, ry_t, and rl_t was computed for each of these time horizons. As we can see in Graph 4, especially the *RMAR* of revisions between the first and the latest estimate, rlt, is smaller in period 2 (2002Q3 –– 2005Q2) and period 3 (2005Q3 – 2008Q3) compared to period 1 (1999Q3 – 2002Q2).[18]

Graph 4: Changes in revision pattern of real GDP growth, RMAR



4.1.3 The quality of preliminary estimates using the properties of the MSR

We calculated the *MSR* and considered its three components *UM*, *UD*, and *UR* to get further insight into the quality of the revisions (see section 3.3). Table 5 gives on overview of the results. For all revision windows we find small values of *UM* and *UR*, and high values of *UD*. This indicates that the revisions are unbiased and fluctuate unsystematically around zero.

[18] In section 5 we tested for structural breaks in the revisions, which were not found to be significant. This indicates a smooth decline over time.

Table 5: Properties of the MSR of year-on-year GDP growth rates

	UM	UD	UR
rs	0.07	0.88	0.05
ry	0.06	0.94	0.01
rl	0.22	0.78	0.00

4.1.4 Investigation of changes in signs of second order derivative

The most important task of the QNA is to provide timely information of the stance of the business cycle and especially to detect its turning points (see section 3.4). Therefore we are looking if an acceleration or deceleration of real GDP growth, which is today taken from the data of the latest publication, was already detected in the first estimation. We found that in 80.6 percent of the observations an acceleration (38.9 percent) or a deceleration (41.7 percent) was detected both, in the first, and in the last publication of GDP growth. Only in 19.4 percent of the observations the sign of change in the growth rate differs between the two time points of publication. Table 6 gives an overview of the second order derivate of GDP (acceleration or deceleration of year-on-year growth rates) observed in the first and in the last publication, respectively.

We find that for those few observations, where the second order derivate in real GDP was not assessed correctly in the first estimate, the difference lasted in the most cases only for the period of one quarter. In other words, the business cycle dynamics were observed correctly in real time or with only one quarter delay. Only at the end of the year 2002 a different picture was drawn from the first and the last observation. After the burst phase in 2001, the first published figures saw the upswing starting earlier then the latest publication.

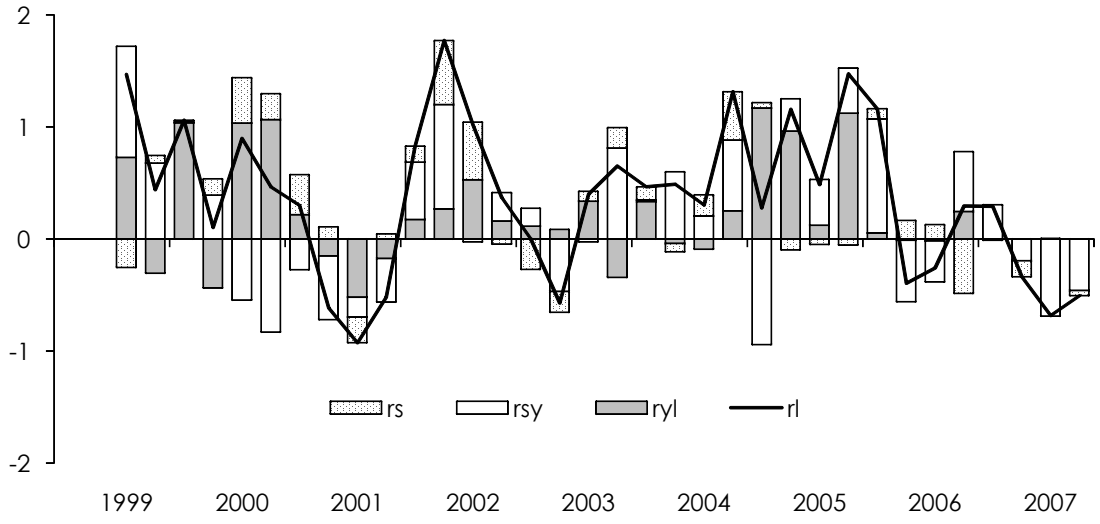
Table 6: Acceleration or deceleration of year-on-year GDP growth rates

	First release	Latest release		First release	Latest release
1999Q4	+	–	2004Q2	+	+
2000Q1	+	+	2004Q3	+	+
2000Q2	–	–	2004Q4	–	+
2000Q3	–	–	2005Q1	–	–
2000Q4	+	+	2005Q2	+	+
2001Q1	–	–	2005Q3	–	–
2001Q2	–	–	2005Q4	+	+
2001Q3	–	–	2006Q1	+	+
2001Q4	–	–	2006Q2	+	–
2002Q1	+	+	2006Q3	+	+
2002Q2	+	+	2006Q4	+	+
2002Q3	+	–	2007Q1	+	+
2002Q4	+	–	2007Q2	–	–
2003Q1	–	–	2007Q3	–	–
2003Q2	+	–	2007Q4	–	–
2003Q3	–	+	2008Q1	+	+
2003Q4	–	–	2008Q2	–	–
2004Q1	+	+	2008Q3	–	–

4.1.5 Forecast efficiency ("News versus Noise")

Graph 5 shows the revisions between the first and the latest observation, rl_t, broken down into three incremental revisions, which cover the additional revision at each stage of time: the revision between the first and second estimate (rs_t), the revision between the second and the annual (rsy_t) and the revision between annual and the latest release (ryl_t). It can be seen that all incremental revisions fluctuate around zero in both directions, but they are more likely to be positive (measured using the *MR*). Regarding their absolute size (measured using the *MAR*), higher values are observed for the revisions windows rsy_t and ryl_t compared to rs_t.

Graph 5: Incremental revisions of real GDP growth



The incremental revisions are used in order to analyze the forecast efficiency ("*News versus Noise*") in the estimates of year-on-year growth rates of the Austrian quarterly GDP. We apply the two approaches (correlation and regression method) as described in section 3.5. The results of the correlation method are given in table 7, which is divided into two triangles. The lower triangle represents the correlation between the respective revision and its prior estimate ("noise"), whereas the upper triangle displays the correlation between the revision and its subsequent estimate ("news"). Values around the main diagonal are of main interest. It can be seen that while none of the correlation coefficients in the lower triangle is significant, the correlations between rsy_t (second – annual) and y_t as well between ryl_t (annual – latest) and l_t are significant at the 5 percent level of significance. Hence, there is evidence that those revisions contain "news".[19]

[19] Anyhow, it can be seen in table 7, that in the upper triangle only in 2 cases a significant correlation was found, giving evidence that the revisions contain "news". In the 4 other cases, the existence of "news" was not found to be significant. But in these 4 cases the existence of "noise" was not significantly found, too. This is possible because the two hypotheses are mutually excluding (see section 3.5 above).

Table 7: 'News' versus 'Noise' in estimates of real GDP growth
Correlation method

	Estimates			
	f	s	y	l
Revisions				
rs	– 0.24	– 0.03	– 0.01	– 0.02
rsy	– 0.02	– 0.03	0.40 **	0.31
ryl	0.08	0.11	0.02	0.36 **

** ... significant at the 5 percent level

These findings are more or less approved by the regression method. Table 8 shows the results for the "noise" and "news" regressions respectively. On the one hand, when regressing the subsequent revision on its preliminary estimates (testing for "noise"), in the cases of rs_t and rsy_t, no evidence was found that the coefficients are jointly significant different from zero.[20] Anyhow, evidence of "noise" is present for the revision window *ryl*. On the other hand, significant relationships in the regressions of y_t on rsy_t and of l_t on ryl_t have been observed. As for that it can be concluded that the second and the annual estimate (s_t and y_t) are efficient forecasts for the following releases (y_t and l_t). These results are particularly interesting because they indicate that the revision made directly after the release of ANA by Statistics Austria are due to the incorporation of new information embodied in these statistics. The latest revision incorporates signals of "news" as well, suggesting that the available infomation was used in an efficient way in order to compile an estimate of the Austrian GDP growth rate. No clear signals were found for the first revision window, too. Following both methods, the correlation and the regression method, the revision window between the first and the second release does neither contain "news", nor "noise".

[20] The p-values of the F-statistics are above 0.05, which indicates that we cannot reject the null hypotheses at the 5 percent level of significance.

Table 8: 'News' versus 'Noise' in estimates of real GDP growth
Regression method

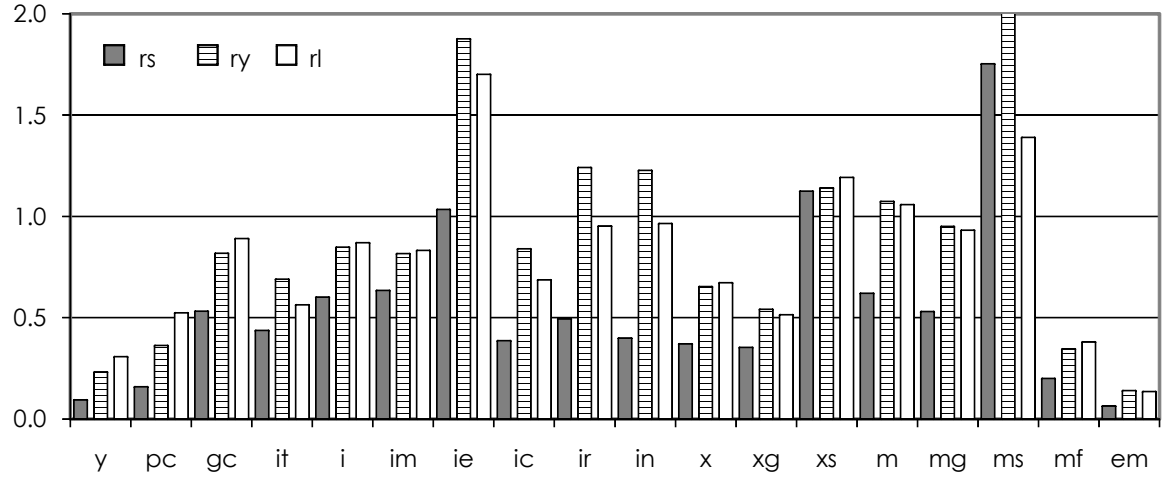
	Revisions					
	Noise			News		
	rs	rsy	ryl	rs	rsy	ryl
Estimates						
f	– 0.05					
s		– 0.01		– 0.01		
y			0.01		0.17 ***	
l						0.12 **
const.	0.17 *	0.10	0.22	0.08	– 0.29 **	– 0.06
N	37	34	34	37	34	34
adj. R^2	0.03	– 0.03	– 0.03	– 0.03	0.13	0.10
F-statistics	2.14	0.38	4.17	1.24	5.40	5.37
p-value	0.13	0.69	0.02	0.30	0.01	0.01

* ... significant at the 10 percent level, ** ... significant at the 5 percent level,
*** ... significant at the 1 percent level

4.2 Components of GDP in real terms

We run the calculations for the aggregates of GDP listed in table 2. In order to compare the size of the revisions among the components, the *RMAR* gives a good indicator, as it accounts for the size of the growth rates of the components. On the one hand, we find that the *RMAR* are low for GDP, private consumption, manufacturing and employees. On the other hand, we observe very high values for the *RMAR* in the components investment in equipment as well as imports of services. Additionally, it is striking, that among these two components the highest *RMAR* in the revision window ry_t (annual – first estimate) was found. Regarding the imports of services, this fact may be due to heavy revisions of tourism imports provided by Statistics Austria. The pattern of a higher *RMAR* in the window ry_t compared to the total revision window rl_t is observed for the components total investment, investment in construction, investment in residential construction, investment in non-residential construction, exports of goods and imports of goods, and employees, too.

Graph 6: RMAR of selected components of QNA



We were further looking for a bias in revisions of selected components of GDP. A summary is given in Table 9. Considering the first revision window rs_t, only the aggregate private consumption shows a significant bias. Investigating the revisions between the first and the annual estimate, ry_t, and the first and the latest estimate, rl_t, we detect a significant, positive bias in exports and imports. This observation is also valid for each of the components goods and services. A detailed table may be found in the Appendix, table A1. We suspect that the source data (Trade Statistics released by Statistics Austria) do cause these results too, as they are frequently revised upwards over time.

Especial high values for the *MSR* (compared to the squared *MAR*) are observed for the components investment in equipment, exports in services and import in services. This implies that there exist a considerable proportion of large revisions among these components. Breaking down the *MSR* into its three components, additionally shows a weak performance of the calculations of exports and imports in total as well as their components. Especially for the revision windows between the first and the annual estimate, ry_t, and the first and the latest estimate, rl_t, we find a small value of *UD* indicating that there is a low stochastic proportion in the revisions. This indication of the weak performance of certain expenditure side components of GDP justifies the supply side approach of GDP calculation in the compilation of QNA.

Table 9: Bias in the revisions of growth rates of selected GDP aggregates

	MR_{pc}	MR_{it}	MR_i	MR_{ic}	MR_x	MR_m	MR_{mf}
rs	0.11 **	– 0.01	– 0.55	0.36	0.24	0.37	0.09
ry	– 0.05	0.59	– 0.16	0.75	2.65 **	3.54 **	0.01
rl	0.28	0.27	0.15	– 0.27	2.61 **	3.20 **	0.33

** ... significant at the 5 percent level

4.3 GDP and its components in nominal terms

Results for the revision analysis of GDP and its components in nominal terms can be found in the Appendix, table A5. Because of the higher average growth rates, quality statistics not accounting for the size of the underlying variable (unlike the *RMAR*), are found to be higher compared to those of the real variables. Generally, conclusions drawn from results observed from data in real terms are true for their nominal counterparts as well. For the revision windows ry_t and rl_t, again a bias is observed in the revisions to total exports, exports of goods, total imports, imports of goods, and imports of services. Considering only the shortest revision window rs_t, in the aggregate export of goods a bias is observed, too. Significant *MR*s are positive, indicating that the underlying growth rates were revised over time more heavily upwards than downwards.

Like in the case of data in real terms, for most aggregates we observe size and volatility of revisions to increase with the length of the revision window. Looking at their relative size (*RMAR*) again the highest revisions are found in the GDP aggregates investment in equipment, exports of services as well as imports of services. Looking at the *MSR* which penalises greater revisions, the very high values observed for the components investment in equipment and exports of services indicate substantial revisions in these components. Breaking down the *MSR* into its three components confirms that revisions in the estimates of exports and imports in total as well as of services do not fluctuate randomly around zero (indicated by a relative low value of *UD*, especially in the revision windows ry_t and rl_t).

Looking at the changes in signs of second order derivative, in the case of the GDP, a consensus between the first and the last publication is found less frequent then in the case of the real growth rates. This reflects that the GDP deflator is subject to revisions as well.

5 Analysis of revisions to the regular QNA estimates (dataset 1), series adjusted for working day and seasonal effects

In this section we show results using real time data of the regular QNA publications too (using again dataset 1 as described in section 2.2), but adjusted for working day and seasonal effects. Furthermore the effect of Easter which shifts between the first and the second quarter has been filtered out. We first evaluate revisions of estimates of quarter-on-quarter GDP growth rates in real terms, as well as of publications of its components' quarter-on-quarter growth rates in real terms. Following, results of revision analysis of quarter-on-quarter growth rates of GDP and its components in nominal terms are presented.

Revisions to seasonally adjusted data have two separate but inter-related sources; they depend on the revisions to the original uncorrected data, as well as on the method used for seasonal adjustment (*Mehrhoff*, 2008). As stated in chapter 2, the form of the model is re-specified only once a year, but its parameters are re-estimated with every revision.[21] Thus, within one year, revisions in the adjusted series arise from new observations which have been added to the unadjusted series, leading to new ARIMA parameters and a new ARIMA forecast. This can change both, the pattern of the past, as well as the adjustment at the recent time margin. Regarding a longer time span of the revision window, a model change may have affected the revision of the adjusted data as well. A quantification of these effects is highly interesting, but out of the scope of the present study.

5.1. GDP in real terms

5.1.1 The bias of the revisions

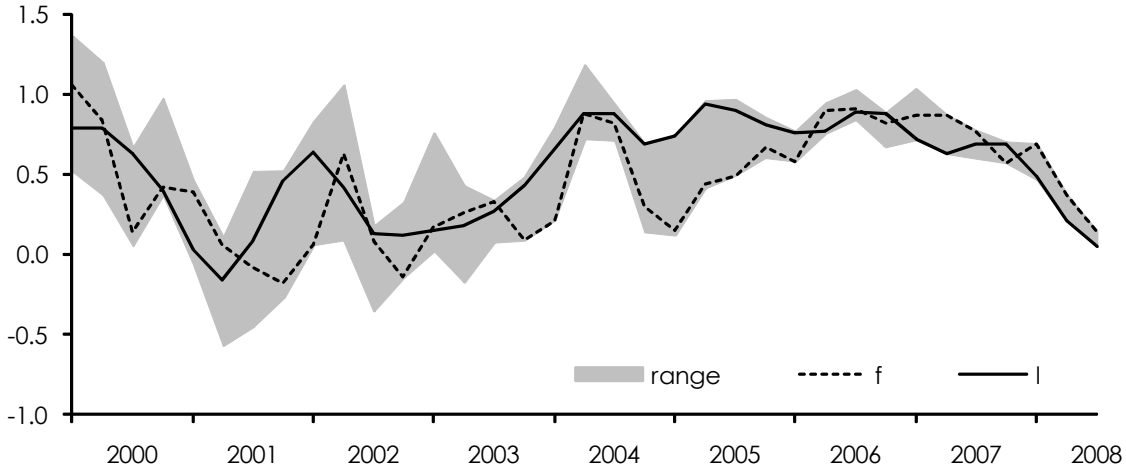
Like in the case of the unadjusted series, we first observe if GDP growth rates are biased in one or the other direction. Plotting all real time releases (graph 7), we find that the first and the latest release in mostly lie in the middle of the range of all releases (apart from the years 2004 to 2005), which gives a first indication that revisions are unbiased. Especially in the years 2000 until 2003, real time publications show a great volatility, which decreases over the sample period. Compared to the unadjusted data, downwards revisions seem to be more frequent.[22] From total 37 observations, 20 times (54 percent) the latest release of adjusted quarter-on-quarter growth rates is below the first published ones, while in the case of the unadjusted series only 27 percent of the first releases were revised downwards over time. In 17 observations (46 percent) the first published adjusted GDP estimates were revised upwards

[21] Between August 2008 and March 2009 this practice was changed. Because data are short as they are available backwards only until 1996, not only the model, but also its parameters were kept fixed over the year.

[22] Even if year-on-year GDP growth rates seemed to have a greater tendency for revisions to be positive, this finding was not found to be statistically significant (see section 4.1.1 above).

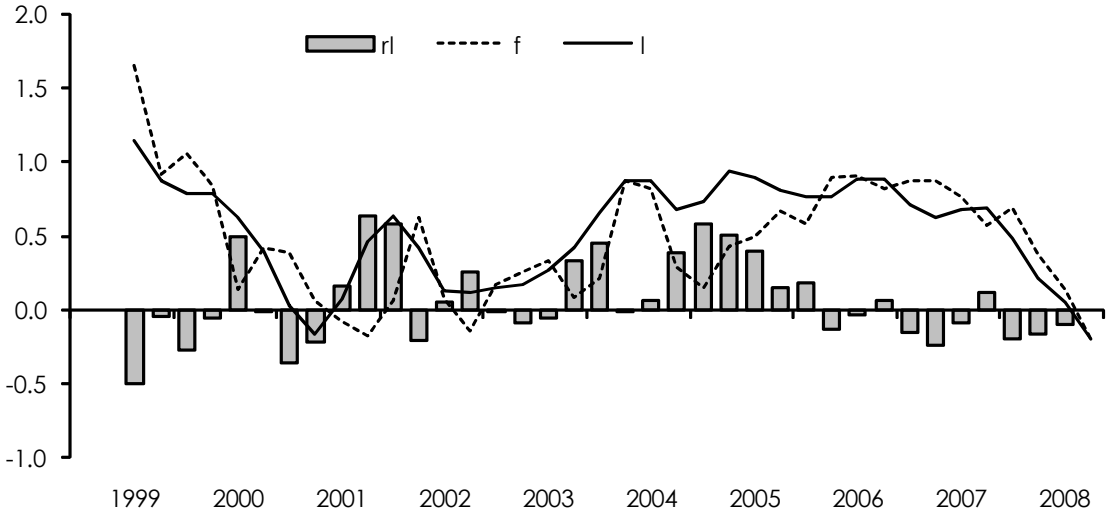
(while it was 73 percent in the case of the unadjusted series). Graph 8 shows the revisions between the first and the latest release of adjusted quarter-on-quarter growth rates.

Graph 7: Estimates of real GDP growth



range ... range of all releases, f ... first release, l ... latest release

Graph 8: Total revisions of real GDP growth



rl ... range between first release and latest release, f ... first release, l ... latest release

On average, revisions over all revision windows are found to be close to zero, amounting to a mean of – 0.03, 0.06 and 0.07, respectively. Moreover, table 10 suggests that the *MR* is not significantly different from zero, indicating that the observed pattern of revisions may have occurred by chance and not because of a bias in the first estimates. This is observed for all three revision windows. When checking for autocorrelation in the time series of the revisions, like in the case of unadjusted series, we found no autocorrelations in the revision window rs_t and ry_t, but autocorrelation of order 1 and 2 in revisions between the first and the latest estimate rl_t. Again this can be attributed to the general revisions of ANA which shift the growth path of the QNA results consequently.

Table 10: Bias in the revisions of real GDP growth rates

	MR	t-statistics	Auto-correlation
rs	– 0.03	– 0.83	no
ry	0.06	1.38	no
rl	0.07	0.20	order 1, 2

5.1.2 The size and volatility of the revisions

Analog to section 4.1.2, table 11 gives an overview of further basic summary statistics revealing information about the size and the volatility of revisions to quarter-on-quarter GDP growth rates. Summary statistics for the first (*f*) and the latest (*l*) observation of quarter-on-quarter GDP growth can be seen as well. First published quarter-on-quarter growth rates range from – 0.18 to 1.65 percent, with a mean of 0.49 percent. Looking at the latest published figures, real GDP growth rates range from – 0.16 to 1.15 percent, with a mean value of 0.56 percent. Regarding the revisions *rs*, *ry* and *rl*, it is again visible that the larger the revision windows, the bigger the summary statistics. But this fact is not as pronounced as in the case of the unadjusted data. The *MAR* measuring the size of the revisions regardless of its sign increases from 0.14 percentage points in the window rs_t to 0.20 and 0.23 percentage points in the window ry_t and rl_t, respectively. They are slightly less than half of the average growth rate of GDP.[23] The *SD* of the revisions increases from 0.18 percentage points in rs_t to 0.28 percentage points in the window rl_t. The highest downside revision between the first and the second estimate (rs_t) was 0.47 percentage points, while the highest upside revision amounts to 0.52 percentage points, which are approximately the size of the average GDP

[23] According to a recent study by the *ECB* (2008), for the smaller economies (including Austria) among the observed countries, revisions are found to have a size of more than half of the average GDP growth rate. But both, the sample size and the revision window differ from our study.

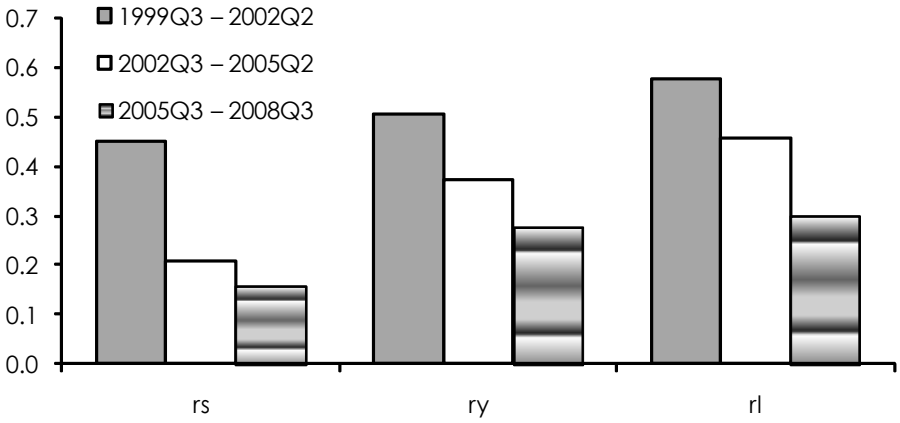
growth rates. In all three revision windows, these high revisions are located at the cyclical volatile quarters 2000Q1 to 2002Q1 and therefore, as table 11 suggests, the minimum and maximum values of revisions are roughly the same within revision windows.

Table 11: Summary statistics for revisions of quarter-on-quarter GDP growth rates

	MAR	SD	MIN	MAX	MEAN
rs	0.14	0.18	– 0.47	0.52	
ry	0.20	0.24	– 0.47	0.61	
rl	0.23	0.28	– 0.50	0.64	
f		0.39	– 0.18	1.65	0.49
l		0.32	– 0.16	1.15	0.56

Revisions of adjusted quarter-on-quarter GDP growth rates tend to become smaller over time, (like in the case of unadjusted series, see graph 4), which seems to be unrelated to the cyclical stance of the economy. While at the cyclical turning points around the boom year 1999 and the recession in 2001 revisions were substantial, at the 2007 boom and the following downswing in 2008, revisions to GDP tended to be smaller. Graph 9 shows the *RMAR* for rs_t, ry_t, and rl_t computed for the time horizons 1999Q3 – 2002Q2; 2002Q3 – 2005Q2; 2005Q3 – 2008Q3. This observation is highest pronounced in the case of revisions between the first and the second estimate rs_t. While their *RMAR* was 0.45 in the period 1999Q3 – 2002Q2, it decreased to 0.16 in the period 2005Q3 – 2008Q3. In the other two revision windows the *RMAR* decreased from around 0.5 to 0.3 percentage points over time. Besides better practice and less instances of revisions in the later sample periods, there is also an effect to be attributed to the seasonal adjustment process. The large revisions between the first and the latest release in the first and second sample period also result from technical reasons, as the length and characteristics of the time series used for identifying seasonal (and working day) factors differ considerably over the revision window.

Graph 9: Changes in revision pattern of real GDP growth, RMAR



5.1.3 The quality of preliminary estimates using the properties of the MSR

Table 12 summarizes the *MSR* and its components. The small values of *UM* again indicate the unbiasedness of revisions over all three revision windows. For the revision windows rs_t and ry_t *UD* is close to 1, while it is only 0.61 for the window rl_t, with a slope error UR of 0.34. The latter indicates that plotting the last published figures against its first estimates (see equation 10) does not yield the "line of perfect forecast" with the slope of 1.

Table 12: Properties of the MSR of quarter-on-quarter GDP growth rates

	UM	UD	UR
rs	0.02	0.90	0.08
ry	0.05	0.92	0.04
rl	0.05	0.61	0.34

5.1.4 Investigation of changes in signs of second order derivative

Adjusted quarter-on-quarter growth rates depict cyclical changes quicker than changes against the previous year. Thus, the success in indicating an acceleration or deceleration of GDP growth already in the first estimate is of particular interest in assessing the quality of QNA publications. Comparing the first and the latest released GDP growth rates, the direction was indicated correctly only in 61.1 percent. This result is worse compared to the unadjusted figures (80.6 percent), as the seasonal adjustment process includes some volatility in the

figures, too. Table 13 shows the acceleration or deceleration of quarter-on-quarter GDP growth according to its first and last publication. Like in the case of the unadjusted year-on-year growth rates, only in the recession year 2001 the cyclical stance was not assessed correctly within one quarter. The performance of indicating the pace of GDP growth was assessed to be good in the other quarters (found with no or with one quarter lag only). This is consistent with the substantial size of the revisions around the year 2001, reported above.

Table 13: Acceleration or deceleration of quarter-on-quarter GDP growth rates

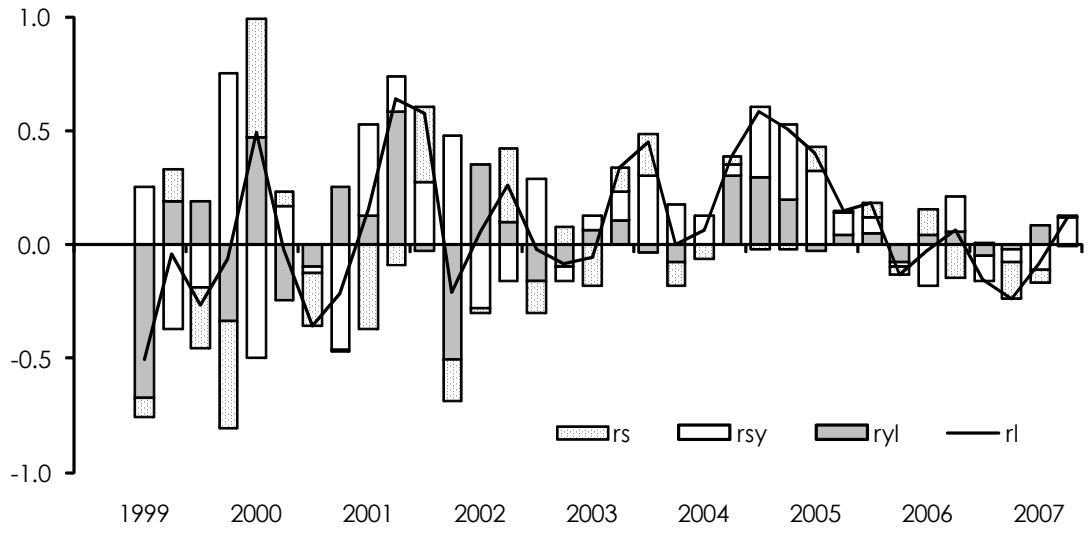
	First release	Latest release		First release	Latest release
1999Q4	–	–	2004Q2	+	+
2000Q1	+	–	2004Q3	–	+
2000Q2	–	–	2004Q4	–	–
2000Q3	–	–	2005Q1	–	+
2000Q4	+	–	2005Q2	+	+
2001Q1	–	–	2005Q3	+	–
2001Q2	–	–	2005Q4	+	–
2001Q3	–	+	2006Q1	–	–
2001Q4	–	+	2006Q2	+	+
2002Q1	+	+	2006Q3	+	+
2002Q2	+	–	2006Q4	–	–
2002Q3	–	–	2007Q1	+	–
2002Q4	–	–	2007Q2	–	–
2003Q1	+	+	2007Q3	–	+
2003Q2	+	+	2007Q4	–	+
2003Q3	+	+	2008Q1	+	–
2003Q4	–	+	2008Q2	–	–
2004Q1	+	+	2008Q3	–	–

5.1.5 Forecast efficiency ("News versus Noise")

Graph 10 below shows the revisions between the first and the latest observation, rl_t, broken down into three incremental revisions, covering the additional revision at each stage of time: the revision between the first and second estimate (rs_t), the revision between the second and the annual (rsy_t), and the revision between the annual and the latest release (ryl_t). Measuring the absolute size of the incremental revisions, like in the case of the unadjusted series, we observe the highest values for revisions between the second and the annual release (rsy_t), as well for revisions between the annual and the latest release (ryl_t). Again, revisions occurred in both directions at each stage of production, but while revisions between the first and second

estimate (rs_t) are more likely to be negative, revisions between the second and the annual (rsy_t) and revisions between the annual and the latest release (ryl_t) are more likely to be positive (measured using the *MR*).

Graph 10: Incremental revisions of real GDP growth



Investigating the forecast efficiency of the quarter-on-quarter GDP growth rates, we are again using the correlation and the regression method explained in section 3.5. Results of both methods indicate that revisions between the second and the annual estimate (rsy_t) contain news, while revisions between the annual to the latest release (ryl_t) contain only noise. Again, like in the case of the unadjusted series, for the first revision window rs_t, neither signals of news nor noise were found to be significant.

Table 14: 'News' versus 'Noise' in estimates of real GDP growth
Correlation method

	Estimates			
	f	s	y	l
Revisions				
rs	– 0.29	0.19	– 0.12	0.10
rsy	0.04	– 0.19	0.44 **	0.22
ryl	– 0.55 **	– 0.42 **	– 0.70 **	– 0.18

** ... significant at the 5 percent level

Table 15: 'News' versus 'Noise' in estimates of real GDP growth
Regression method

	Revisions					
	Noise			**News**		
	rs	rsy	ryl	rs	rsy	ryl
Estimates						
f	– 0.13					
s		– 0.13		0.09		
y			– 0.39 ***		0.27 **	
l						– 0.14
const.	0.04	0.13 *	0.25 ***	– 0.07	– 0.08	0.11
N	37	34	34	37	34	34
adj. R^2	0.06	0.00	0.47	0.01	0.17	0.00
F-statistics	2.55	1.71	13.22	1.10	5.20	0.90
p-value	0.09	0.20	0.00	0.34	0.01	0.42

* ... significant at the 10 percent level, ** ... significant at the 5 percent level,
*** ... significant at the 1 percent level

5.2 Components of GDP in real terms

We first compare the size of revisions to the adjusted quarter-on-quarter growth rates of QNA components. Therefore, again their *RMAR*, which adjusts for the different size of growth rates of the QNA aggregates, was calculated. Like in the case of the unadjusted year-on-year growth rates we observed relative small values for total GDP, employees, private consumption and manufacturing, while exports of services, imports of services and investment in equipment show relative high revisions. In the case of imports and exports of services even in the first revision window (rs_t) particularly high revisions are to be found.

We further observe that most revisions are unbiased, as the *MR* is not found to be significant at the 5 percent level (again certain revisions of investment in machinery, total exports, total imports and imports of services are biased). Table 16 summarizes the *MR* of the main expenditure side components, while the detailed results for all components can found in the Appendix, table A3. Looking at the components of the *MSR*, the unbiasedness of most first estimates is confirmed. Table A3 indicates for all QNA components low values of *UM*, but values of *UR* are very high (especially in the last revision window rl_t). This indicates that the "line of perfect forecast" with the slope of 1 is not obtained when plotting the latest published figures against its first estimates. Notably high values of *UR* are found in the components exports and imports of goods and services as well in their subcomponents and investment in machinery, as well as residential and non-residential investment and government consumption. The high proportion of *UR* (which was not observed in the unadjusted data) may also be attributed to the seasonal adjustment process and the fact that length and characteristics of the time series used for identifying seasonal factors may differ over the revision window. Different models were selected using real time data and latest published data.

Except from private consumption, total investment, investment in machinery and manufacturing, the success rate of indicating acceleration or deceleration is worse in the GDP components compared to overall GDP (61.1 percent). The numbers can be found in the Appendix, table A3

Graph 11: RMAR of selected components of QNA

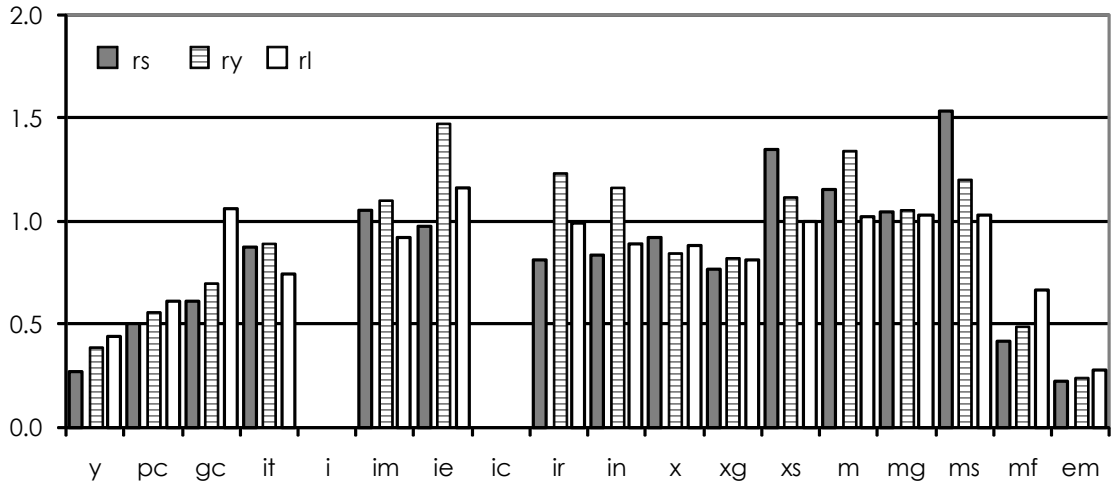


Table 16: Bias in the revisions of growth rates of selected GDP aggregates

	MR_{pc}	MR_{it}	MR_{x}	MR_{m}	MR_{mf}
rs	0.01	– 0.44	– 0.85 **	– 0.94 **	0.02
ry	0.02	– 0.29	0.03	0.09	0.13
rl	0.08	– 0.19	0.28	0.22	0.10

5.3 GDP and its components in nominal terms

While seasonal adjustment for data in real terms and deflators is calculated directly, adjusted data in nominal terms are derived from the two other series. Detailed results for the revision analysis of GDP and its components in nominal terms can be found in the Appendix, table A7. Considering the *RMAR*, again exports of services, imports of services and investment in equipment show relative high revisions, with exports and imports of services holding high revisions in the first revision window rs_t. Private consumption is found to be positively biased in the revision window rl_t, and total imports and exports are negatively biased in the revision window rs_t. Decomposing the *MSR* does not indicate that revisions fluctuate randomly around zero, too.

6 Introduction of flash estimates (datasets 2 and 3)

In recent years, Austrian National Accounts have been subject to many changes concerning the release calendar as well as the kind of price adjustment. Since the last quarter of 2004 the first releases of the regular QNA have been published 70 days after the reference period. In 2005, the concept of chain-linking was introduced. Moreover, with the second quarter of 2005 the Austrian Institute of Economic Research started to publish flash estimates in addition to regular first releases (see section 2.2).

In order to determine whether these changes induced changes in the revision pattern, we tested for a structural break in the respective revision series. The *Chow* (1960) test was carried out by establishing two break points, for which we assume that revisions could have been subject to a level shift (2004Q4 and 2005Q2 for the introduction of t+70 and the flash estimates, respectively). Revision series were regressed on constant and a dummy variable equal to 1 after the break point and zero before. The test was conducted for all revision windows. By using dataset 1 (covering only releases of the regular QNA for both, unadjusted and adjusted for seasonal and working day effects), we found that the advancement of the first release (t+70 instead of t+90) did not have any significant negative effect on the quality of QNA estimates. Moreover, by using dataset 2, which differs from dataset 1 as it includes the flash estimate and the first regular release instead of the first and the second regular release (see section 2.2), we did not find any evidence that revisions changed significantly after the introduction of the flash estimates, too. Again, the results are valid both for adjusted and unadjusted series. These results are particularly interesting as they indicate that the earlier release of quarterly figures did not affect their reliability[24]. It has to be noted that over time also the source data for the QNA (e.g., "Konjunkturstatistik im produzierenden Bereich") were published earlier, contributing to a higher reliability of the flash estimates, too. Table 17 and 18 summarize the regression results using unadjusted and adjusted GDP series, respectively. The non-significant constant (as the single explanatory variable besides the dummy) and the low R-squared indicate the 0 mean value in the underlying revisions.

[24] However, as the time series after the break points are quite short, test results should be interpreted with caution.

Table 17: Structural break, unadjusted series in real terms

	Dataset 1			Dataset 2		
	rs	ry	rl	rs	ry	rl
dummy t+70	– 0.84	– 0.18	– 0.11			
dummy flash				– 0.10	– 0.12	– 0.21
const	0.10	0.21	0.40	0.11	0.20	0.43
N	37	34	37	37	34	37
R^2	0.03	0.02	0.01	0.05	0.01	0.02

Table 18: Structural break, adjusted series in real terms

	Dataset 1			Dataset 2		
	rs	ry	rl	rs	ry	rl
dummy t+70	– 0.01	0.02	0.02			
dummy flash				0.01	– 0.03	– 0.09
const	– 0.02	0.05	0.06	– 0.02	0.06	0.09
N	37	34	37	37	34	37
R^2	0.00	0.00	0.00	0.00	0.00	0.02

The summary statistics introduced in section 3 were calculated for dataset 2 (including the flash estimates as first published estimates), too. Quality statistics do not differ considerably from the results using dataset 1 (which refers only to QNA data). Results are shown in the Appendix, tables A2, A4, A6 and A8.

Dataset 3, which covers the flash estimates as the first available estimate, and the regular QNA release as the second estimate, is not evaluated in this detailed way. With only 14 observations, the time series are too short for a meaningful interpretation of certain quality statistics. For example according to Statistics Canada, a minimum of 30 accounting periods should be used when calculating the mean revision (*OECD*, 2004). However, looking at a few stylized facts, we can regard the flash estimates as reliable advance information for the regular GDP estimates. When looking at the range of revisions between the flash estimates and the first regular releases of adjusted quarter-on-quarter GDP growth rates, we found

them to vary between – 0.15 and 0.11 percentage points. Table 19 shows the basic summary statistics for revisions between the flash estimate (as the first available estimate) and the regular QNA release (as the second estimate) to quarter-on-quarter GDP growth rates in real terms. Focusing on changes in the signs of the second order derivation of the series, we found that the flash estimates have been quite successful in indicating the acceleration or deceleration of GDP growth. In 11 out of 13 (or 84.6 percent) cases an acceleration or deceleration of growth in the flash estimates was confirmed in the regular QNA results. Using longer time series (as flash estimates were introduced earlier in other Euro area countries) with up to 20 observations, a recent study by the *ECB* (2009) found success rates varying between 95 and 100 percent in the biggest Euro area countries.

Table 19: Summary statistics for revisions to quarter-on-quarter real GDP growth rates

	MR	MAR	SD	MIN	MAX
rs	– 0.01	0.07	0.08	– 0.15	0.11

7 Summary

We present results of the revision analysis of Austrian QNA using real time data from regular QNA publications of the third quarter 1999 (as this marks the beginning of compiling Austrian QNA data by modern statistical benchmarking techniques) until the third quarter 2008. We find that the first estimates of year-on-year GDP growth in real terms are on average 0.06 percentage points below the second estimates, 0.14 percentage points below the estimates after the first publication of annual GDP by Statistics Austria (so called annual estimate) and 0.35 percentage points below the latest publication. Anyhow, using the t-test statistics, *mean revisions* are not found to be significantly different from zero. This means no significant bias in the revisions has been detected. Likewise, decomposing the *mean squared revision* does indicate that the revisions are unbiased and fluctuate unsystematically around zero.

Besides revisions to the original uncorrected data, practices in the seasonal adjustment process affect the revision pattern of the adjusted data, too. Although, *mean revisions* to adjusted quarter-on-quarter GDP growth rates are found to be close to zero (– 0.03, 0.06 and 0.07 percentage points for the three observed revision windows, respectively) and unbiased, splitting up the *mean squared revision* indicates that revisions do not fluctuate unsystematically around zero. This is notably observed for the longer revision window between the first and the latest published estimate. This can partly be attributed to the seasonal adjustment process and the fact that the length and characteristics of the time series used

for identifying seasonal (and working day) factors differs considerably over a longer revision window.

We further investigated how often the first published growth rate points in the same direction as the latest released one. Looking at second-order derivates in GDP series, we find that in 80.6 percent of the observations an acceleration or a deceleration was detected both, in the first, and in the latest publication of GDP growth, while only in 19.4 percent of the observations the sign of change in the growth rate differs between the two time points of publication. Thus, apart from minor exceptions, the stance of the business cycle was detected correctly in real time which is an important feature for guiding economic policy. Observing adjusted quarter-on-quarter growth rates, only in 61.1 percent the direction was indicated correctly at the given quarter.

When analyzing three revision windows, we find the "natural pattern" that the larger the window, the bigger the calculated summary statistics (*mean revision, mean absolute revision, standard deviation*), too. This is the case for both, unadjusted and adjusted series. The largest revision window (between the first and the latest estimate) was additionally broken down into its three incremental revisions. Thereby we find that on average revisions between the second and the annual release, as well as revisions between the annual and the latest estimate, are the highest ones. Moreover, it was shown from the "*News versus Noise analysis*" that revisions tend to contain "news". Revisions between the second and the annual release show clear signals of "news" using both, adjusted and unadjusted series. However, considering the seasonally adjusted values, signals of "noise" were found in the revision window between the annual and the latest release.

Revisions to GDP data are smaller than those of its components. This fact was recently reported in an analysis for the Euro area, too (*ECB*, 2009), as revisions at a disaggregated level tend to cancel out at the aggregate level. Evaluating the revisions of GDP components gives a diversified picture. While the observations of some components (e.g., private consumption and manufacturing) tend to be revised only moderately and/or are unbiased, the statistics indicate that time series of investment in equipment and imports of services are exposed to relative large revisions. Furthermore, they are found to be biased. This may also be the result of the differences in availability, reliability and timeliness of the underlying source data. While the retail turnover figures provide a good and timely index for private consumption values, foreign trade statistics are frequently revised. Investment components are generally difficult to measure; estimates on investment in machinery and equipment are based on the foreign trade statistics as well (*commodity flow* approach).

The article further shows that the advancement of the release of first regular QNA estimates (from t+90 to t+70 in the year 2004) as well as the introduction of flash estimates in the year 2005 did not affect the reliability of first GDP estimates. On contrary, over time revisions of GDP got continuously smaller. This was observed both for revisions to year-on-year and to adjusted quarter-on-quarter growth rates. Comparing the time horizons 1999Q3 – 2002Q2,

2002Q3 – 2005Q2 and 2005Q3 – 2008Q3, we found the *relative mean absolute revision* to decline over time, where especially around the turning points after and before the recession in 2001 substantial revisions were detected. Besides less instances of revisions in the later sample periods, better practice in the data compilation process accounts for this fact.

Revisions to flash estimates were analyzed using a second dataset, which incorporates the flash estimates as being the first publications. No evidence has been found that revisions changed significantly with the introduction of the flash estimates. Additionally, it has been shown that flash estimates contain only small revisions compared to the first regular release of QNA. Moreover, they have been quite successful in indicating an acceleration or deceleration of GDP growth rates in real terms. In the future, when time series of revisions to flash estimates are covering a longer time span, a revision analysis of flash estimates will be deducted using a wider set of indicators.

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Appendix: Summary statistics of QNA aggregates

Table A1: Series unadjusted in real terms (dataset 1)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
y	rs	0.19	0.09	0.06	0.24	0.06	no	1.62	0.07	0.88	0.05		
	ry	0.48	0.23	0.34	0.57	0.14	no	1.49	0.06	0.94	0.01		
	rl	0.64	0.31	0.57	0.67	0.35	order 1, 2	0.42	0.22	0.78	0.00	38.89	41.67
pc	rs	0.23	0.16	0.09	0.29	0.11	no	2.34	0.13	0.86	0.01		
	ry	0.53	0.36	0.47	0.69	– 0.05	no	– 0.45	0.01	0.95	0.04		
	rl	0.77	0.52	0.92	0.92	0.28	order 1, 2	0.24	0.09	0.91	0.01	33.33	38.89
gc	rs	0.59	0.53	0.73	0.85	0.03	no	0.22	0.00	0.86	0.14		
	ry	0.90	0.82	1.41	1.16	0.23	order 1, 2	0.10	0.04	0.79	0.17		
	rl	0.98	0.89	1.69	1.29	0.18	order 1	0.12	0.02	0.72	0.26	19.44	19.44
it	rs	1.59	0.44	4.07	2.02	– 0.01	no	– 0.03	0.00	1.00	0.00		
	ry	2.52	0.69	9.60	3.04	0.59	no	1.18	0.04	0.85	0.11		
	rl	2.06	0.56	7.56	2.74	0.27	no	0.61	0.01	0.81	0.18	30.56	36.11
i	rs	3.09	0.60	16.92	4.08	– 0.55	no	– 0.82	0.02	0.98	0.00		
	ry	4.36	0.85	29.76	5.45	– 0.16	order 1	– 0.03	0.00	0.90	0.09		
	rl	4.47	0.87	29.29	5.41	0.15	order 1, 2	0.02	0.00	0.83	0.17	30.56	44.44
im	rs	3.36	0.64	18.71	4.19	– 1.09	no	– 1.58	0.06	0.90	0.04		
	ry	4.31	0.82	37.81	6.15	0.15	order 1	0.02	0.00	0.88	0.12		
	rl	4.39	0.83	30.53	5.45	– 0.93	no	– 1.04	0.03	0.74	0.23	27.78	41.67
ie	rs	7.77	1.03	127.46	11.20	1.44	order 1, 2	0.10	0.02	0.97	0.02		
	ry	14.10	1.88	300.44	17.32	– 0.71	no	– 0.25	0.00	0.78	0.22		
	rl	12.78	1.70	237.27	15.07	3.18	order 1	0.18	0.04	0.64	0.32	30.56	27.78
ic	rs	1.19	0.39	2.71	1.61	0.36	no	1.37	0.05	0.83	0.13		
	ry	2.59	0.84	11.22	3.26	0.75	no	1.40	0.05	0.84	0.11		
	rl	2.12	0.69	7.66	2.75	– 0.27	no	– 0.60	0.01	0.95	0.04	33.33	41.67
ir	rs	1.42	0.49	3.48	1.85	0.25	no	0.83	0.02	0.89	0.09		
	ry	3.56	1.24	20.20	4.29	– 1.34	order 1, 2	0.03	0.09	0.91	0.00		
	rl	2.74	0.95	11.39	3.26	– 0.88	order 1, 2	– 0.19	0.07	0.93	0.01	33.33	30.56
in	rs	1.72	0.40	6.44	2.49	0.48	no	1.16	0.04	0.87	0.10		
	ry	5.27	1.23	50.21	6.67	2.39	order 1, 2	0.02	0.11	0.73	0.16		
	rl	4.15	0.97	28.85	5.37	0.24	no	0.27	0.00	0.81	0.19	33.33	36.11
x	rs	1.79	0.37	6.29	2.50	0.24	no	0.58	0.01	0.93	0.06		
	ry	3.15	0.65	13.45	2.54	2.65	no	6.35	0.52	0.46	0.02		
	rl	3.25	0.67	14.60	2.79	2.61	no	5.70	0.47	0.51	0.02	30.56	41.67
xg	rs	2.00	0.35	6.36	2.33	0.96	no	2.51	0.15	0.75	0.10		
	ry	3.06	0.54	13.20	2.94	2.13	no	4.40	0.34	0.61	0.05		
	rl	2.91	0.52	12.72	2.94	2.02	no	4.19	0.32	0.65	0.03	30.56	41.67
xs	rs	5.64	1.13	65.47	7.99	– 1.31	no	– 1.00	0.03	0.71	0.26		
	ry	5.72	1.14	57.31	6.39	4.06	no	3.87	0.29	0.38	0.33		
	rl	5.98	1.19	68.01	7.17	4.07	no	3.45	0.24	0.31	0.44	25.00	30.56
m	rs	2.29	0.62	8.15	2.83	0.37	no	0.80	0.02	0.93	0.05		
	ry	3.96	1.07	23.24	3.27	3.54	no	6.59	0.54	0.38	0.08		
	rl	3.90	1.06	22.96	3.57	3.20	no	5.44	0.44	0.49	0.07	36.11	36.11
mg	rs	2.32	0.53	9.62	3.04	0.61	no	1.23	0.04	0.93	0.03		
	ry	4.16	0.95	24.91	3.96	3.03	no	4.66	0.37	0.45	0.18		
	rl	4.07	0.93	26.33	4.14	3.04	no	4.47	0.35	0.53	0.12	33.33	36.11
ms	rs	6.16	1.75	74.77	8.65	– 0.01	no	– 0.01	0.00	0.86	0.14		
	ry	7.06	2.01	84.79	8.04	4.49	no	3.39	0.24	0.56	0.20		
	rl	4.88	1.39	38.22	5.32	3.14	no	3.59	0.26	0.34	0.40	30.56	27.78
mf	rs	0.79	0.20	0.97	0.98	0.09	order 1	0.07	0.01	0.98	0.01		
	ry	1.36	0.35	3.80	1.95	0.01	no	0.03	0.00	1.00	0.00		
	rl	1.49	0.38	4.31	2.05	0.33	no	0.99	0.03	0.97	0.00	27.78	30.56
em	rs	0.08	0.06	0.01	0.12	0.00	no	0.10	0.00	0.92	0.08		
	ry	0.17	0.14	0.05	0.22	0.01	order 1, 2	0.47	0.00	0.88	0.11		
	rl	0.16	0.14	0.04	0.20	– 0.01	order 1, 2	– 0.03	0.00	0.80	0.20	52.78	41.67

Table A2: Series unadjusted in real terms (dataset 2)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
	rs	0.20	0.10	0.06	0.23	0.07	no	1.91	0.09	0.89	0.02		
y	ry	0.51	0.25	0.39	0.60	0.16	no	1.60	0.06	0.93	0.01		
	rl	0.67	0.32	0.65	0.72	0.36	order 1, 2	0.39	0.19	0.80	0.01	30.56	36.11
	rs	0.21	0.14	0.08	0.28	0.08	no	1.77	0.08	0.91	0.02		
pc	ry	0.54	0.37	0.50	0.70	– 0.05	no	– 0.47	0.01	0.95	0.05		
	rl	0.76	0.52	0.93	0.93	0.26	order 1, 2	0.22	0.08	0.92	0.01	30.56	36.11
	rs	0.52	0.47	0.70	0.83	0.03	no	0.20	0.00	0.89	0.11		
gc	ry	0.90	0.81	1.40	1.16	0.22	order 1, 2	0.11	0.03	0.79	0.17		
	rl	0.95	0.86	1.64	1.27	0.17	order 1	0.11	0.02	0.73	0.25	19.44	19.44
	rs	1.38	0.38	3.46	1.86	– 0.08	no	– 0.25	0.00	1.00	0.00		
it	ry	2.52	0.70	9.51	3.02	0.65	no	1.30	0.04	0.86	0.09		
	rl	2.04	0.57	7.01	2.63	0.32	no	0.73	0.01	0.83	0.15	33.33	33.33
	rs	2.73	0.52	14.85	3.81	– 0.55	no	– 0.87	0.02	0.98	0.00		
i	ry	4.43	0.85	30.60	5.52	– 0.33	order 1	– 0.05	0.00	0.90	0.10		
	rl	4.54	0.87	29.24	5.41	0.14	order 1, 2	0.02	0.00	0.83	0.17	30.56	44.44
	rs	2.83	0.55	16.13	3.99	– 0.46	no	– 0.71	0.01	0.95	0.04		
im	ry	4.42	0.85	38.29	6.18	0.26	order 1	0.04	0.00	0.87	0.13		
	rl	4.69	0.90	32.77	5.67	– 0.76	no	– 0.81	0.02	0.73	0.25	25.00	44.44
	rs	6.60	0.93	94.13	9.68	– 0.62	no	– 0.39	0.00	0.91	0.08		
ie	ry	13.22	1.87	283.44	16.75	– 1.72	no	– 0.63	0.01	0.82	0.17		
	rl	11.86	1.67	202.25	13.99	2.57	no	1.12	0.03	0.73	0.23	30.56	27.78
	rs	1.14	0.38	2.60	1.59	0.28	no	1.06	0.03	0.77	0.20		
ic	ry	2.60	0.86	11.25	3.21	0.95	no	1.81	0.08	0.84	0.08		
	rl	2.14	0.71	7.63	2.75	– 0.21	no	– 0.47	0.01	0.96	0.03	36.11	38.89
	rs	1.47	0.55	3.76	1.89	0.43	no	1.39	0.05	0.94	0.01		
ir	ry	3.73	1.39	21.47	4.48	– 1.19	order 1, 2	0.03	0.07	0.93	0.00		
	rl	3.01	1.12	12.24	3.39	– 0.85	order 1, 2	– 0.17	0.06	0.93	0.01	33.33	27.78
	rs	1.54	0.36	4.66	2.15	0.14	no	0.39	0.00	0.64	0.35		
in	ry	5.28	1.25	50.02	6.57	2.61	no	2.42	0.14	0.72	0.14		
	rl	4.17	0.98	28.48	5.33	0.30	no	0.34	0.00	0.81	0.19	36.11	36.11
	rs	1.84	0.37	6.71	2.58	– 0.18	no	– 0.43	0.00	0.90	0.09		
x	ry	3.23	0.65	14.06	2.69	2.61	no	5.92	0.49	0.48	0.03		
	rl	3.27	0.66	14.98	2.96	2.49	order 1, 2	0.67	0.41	0.54	0.04	27.78	38.89
	rs	2.28	0.40	7.69	2.72	0.53	no	1.17	0.04	0.85	0.12		
xg	ry	3.13	0.55	14.15	3.07	2.17	no	4.29	0.33	0.62	0.05		
	rl	2.95	0.52	13.25	3.08	1.94	no	3.84	0.29	0.68	0.04	25.00	36.11
	rs	4.79	1.05	53.13	7.06	– 1.80	no	– 1.55	0.06	0.79	0.15		
xs	ry	5.46	1.19	45.55	5.58	3.80	no	4.15	0.32	0.44	0.24		
	rl	5.79	1.27	56.98	6.51	3.82	order 2	0.47	0.26	0.37	0.38	27.78	30.56
	rs	2.30	0.59	7.98	2.82	– 0.20	no	– 0.44	0.01	0.93	0.07		
m	ry	4.05	1.03	24.20	3.62	3.33	no	5.60	0.46	0.41	0.13		
	rl	3.92	1.00	23.46	3.83	2.96	order 1, 2	0.60	0.37	0.51	0.11	27.78	27.78
	rs	2.54	0.56	10.05	3.16	0.20	no	0.38	0.00	0.94	0.06		
mg	ry	4.32	0.95	26.12	4.19	2.93	no	4.25	0.33	0.46	0.21		
	rl	4.08	0.89	26.68	4.27	2.90	order 1, 2	0.55	0.32	0.54	0.15	33.33	30.56
	rs	5.33	1.48	63.88	7.91	– 1.13	no	– 0.87	0.02	0.87	0.11		
ms	ry	6.69	1.85	77.87	7.92	3.89	no	2.98	0.19	0.61	0.20		
	rl	4.53	1.25	33.40	5.18	2.55	no	3.00	0.20	0.40	0.41	27.78	27.78
	rs	0.69	0.18	0.85	0.92	0.11	order 1	0.10	0.02	0.97	0.01		
mf	ry	1.47	0.37	4.81	2.19	– 0.01	no	– 0.02	0.00	0.98	0.02		
	rl	1.62	0.41	5.43	2.31	0.31	no	0.82	0.02	0.97	0.02	27.78	27.78
	rs	0.07	0.06	0.01	0.12	– 0.00	no	– 0.00	0.00	0.96	0.07		
em	ry	0.17	0.14	0.05	0.22	0.01	order 1, 2	0.53	0.00	0.90	0.34		
	rl	0.16	0.14	0.04	0.20	– 0.02	order 1, 2	– 0.06	0.01	0.81	0.21	10.81	78.38

Table A3: Series adjusted in real terms (dataset 1)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
	rs	0.14	0.27	0.03	0.18	– 0.03	no	– 0.83	0.02	0.90	0.08		
y	ry	0.20	0.39	0.06	0.24	0.06	no	1.38	0.05	0.92	0.04		
	rl	0.23	0.44	0.08	0.28	0.07	order 1, 2	0.20	0.05	0.61	0.34	25.00	36.10
	rs	0.19	0.50	0.06	0.25	0.01	order 1	0.06	0.00	1.00	0.00		
pc	ry	0.21	0.56	0.07	0.26	0.02	no	0.36	0.00	0.88	0.12		
	rl	0.23	0.61	0.09	0.29	0.08	no	1.62	0.07	0.56	0.38	27.78	41.67
	rs	0.27	0.61	0.22	0.47	– 0.08	no	– 1.02	0.03	0.66	0.32		
gc	ry	0.31	0.70	0.15	0.38	0.06	no	0.94	0.02	0.77	0.20		
	rl	0.46	1.06	0.48	0.69	– 0.04	no	– 0.39	0.00	0.18	0.82	19.44	33.33
	rs	0.96	0.88	2.03	1.36	– 0.44	no	– 1.97	0.10	0.77	0.14		
it	ry	0.98	0.89	1.60	1.23	– 0.29	no	– 1.45	0.05	0.80	0.15		
	rl	0.81	0.74	1.12	1.04	– 0.19	no	– 1.11	0.03	0.28	0.69	19.44	41.67
	rs												
i	ry												
	rl												
	rs	2.30	1.06	17.16	3.91	– 1.37	no	– 2.13	0.11	0.45	0.44		
im	ry	2.40	1.10	12.65	3.48	– 0.73	no	– 1.28	0.04	0.56	0.40		
	rl	2.00	0.92	10.39	3.11	– 0.85	no	– 1.66	0.07	0.07	0.86	22.22	38.89
	rs	2.65	0.98	15.98	3.98	– 0.38	order 1, 2	– 0.08	0.01	0.95	0.04		
ie	ry	4.00	1.47	32.00	5.39	– 1.71	no	– 1.93	0.09	0.66	0.25		
	rl	3.14	1.16	16.53	4.06	0.16	no	0.23	0.00	0.31	0.69	25.00	33.33
	rs												
ic	ry												
	rl												
	rs	1.02	0.82	2.71	1.65	– 0.05	no	– 0.18	0.00	0.77	0.23		
ir	ry	1.54	1.23	5.47	2.33	– 0.24	no	– 0.64	0.01	0.49	0.50		
	rl	1.24	0.99	3.14	1.75	– 0.25	no	– 0.88	0.02	0.35	0.63	30.56	33.33
	rs	1.16	0.84	2.79	1.67	– 0.01	no	– 0.04	0.00	0.55	0.45		
in	ry	1.62	1.17	4.48	2.07	0.45	no	1.33	0.05	0.81	0.14		
	rl	1.24	0.89	3.24	1.80	0.11	no	0.36	0.00	0.30	0.69	33.33	19.44
	rs	1.45	0.92	5.50	2.18	– 0.85	no	– 2.37	0.13	0.41	0.46		
x	ry	1.33	0.85	3.58	1.89	0.03	no	0.10	0.00	0.30	0.70		
	rl	1.38	0.88	3.34	1.81	0.28	no	0.93	0.02	0.26	0.72	25.00	30.56
	rs	1.68	0.77	7.03	2.65	– 0.16	no	– 0.36	0.00	0.46	0.53		
xg	ry	1.81	0.83	7.17	2.67	0.24	no	0.54	0.01	0.26	0.73		
	rl	1.79	0.81	6.76	2.59	0.24	no	0.56	0.01	0.17	0.82	30.56	36.11
	rs	3.72	1.34	47.42	6.42	– 2.48	order 1, 2	– 0.29	0.13	0.48	0.39		
xs	ry	3.10	1.12	24.11	4.88	– 0.55	order 1, 2	0.01	0.01	0.17	0.81		
	rl	2.76	1.00	20.08	4.48	– 0.04	order 1, 2	– 0.01	0.00	0.02	0.98	19.44	22.22
	rs	1.56	1.16	5.77	2.21	– 0.94	no	– 2.59	0.15	0.38	0.45		
m	ry	1.81	1.35	7.01	2.65	0.09	no	0.21	0.00	0.50	0.49		
	rl	1.38	1.02	3.91	1.97	0.22	no	0.69	0.01	0.27	0.72	22.22	27.78
	rs	1.58	1.05	4.58	2.11	– 0.37	no	– 1.08	0.03	0.56	0.41		
mg	ry	1.60	1.06	4.48	2.09	0.33	no	0.95	0.02	0.41	0.57		
	rl	1.55	1.03	4.04	1.95	0.47	no	1.47	0.06	0.33	0.62	25.00	27.78
	rs	5.35	1.54	82.74	8.58	– 3.05	no	– 2.16	0.11	0.18	0.69		
ms	ry	4.19	1.20	47.41	6.83	– 0.93	no	– 0.82	0.02	0.36	0.62		
	rl	3.60	1.03	41.23	6.36	– 0.89	no	– 0.85	0.02	0.01	0.97	16.67	30.56
	rs	0.58	0.42	0.54	0.73	0.02	no	0.19	0.00	0.77	0.23		
mf	ry	0.68	0.49	0.77	0.87	0.13	no	0.90	0.02	0.74	0.24		
	rl	0.93	0.67	1.37	1.16	0.10	no	0.54	0.01	0.45	0.54	27.78	33.33
	rs	0.07	0.22	0.01	0.09	– 0.00	no	– 0.16	0.00	0.77	0.22		
em	ry	0.08	0.24	0.01	0.09	0.00	no	0.22	0.00	0.83	0.17		
	rl	0.09	0.28	0.01	0.12	– 0.01	order 1	– 0.08	0.01	0.61	0.38	30.56	27.78

Table A4: Series adjusted in real terms (dataset 2)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
	rs	0.13	0.26	0.03	0.18	– 0.02	order 1, 2	– 0.15	0.01	0.89	0.11		
y	ry	0.20	0.39	0.07	0.25	0.05	no	1.26	0.04	0.91	0.05		
	rl	0.23	0.45	0.09	0.29	0.06	order 1, 2	0.17	0.04	0.59	0.37	22.22	33.33
	rs	0.18	0.46	0.06	0.25	0.00	order 1	0.00	0.00	1.00	0.00		
pc	ry	0.22	0.56	0.07	0.26	0.01	no	0.15	0.00	0.87	0.13		
	rl	0.24	0.61	0.09	0.29	0.07	no	1.48	0.06	0.56	0.39	25.00	38.89
	rs	0.22	0.50	0.14	0.37	0.03	no	0.51	0.01	0.88	0.11		
gc	ry	0.31	0.69	0.15	0.38	0.06	no	0.98	0.03	0.77	0.20		
	rl	0.49	1.10	0.53	0.73	– 0.00	no	– 0.02	0.00	0.16	0.84	19.44	30.56
	rs	0.94	0.94	2.05	1.38	– 0.39	no	– 1.71	0.07	0.81	0.12		
it	ry	0.91	0.90	1.53	1.21	– 0.25	no	– 1.24	0.04	0.83	0.13		
	rl	0.77	0.76	1.03	1.00	– 0.14	no	– 0.86	0.02	0.31	0.67	22.22	38.89
	rs												
i	ry												
	rl												
	rs	2.21	1.00	17.04	3.92	– 1.30	no	– 2.02	0.10	0.45	0.45		
im	ry	2.52	1.14	12.86	3.51	– 0.75	no	– 1.30	0.04	0.55	0.41		
	rl	2.08	0.94	10.57	3.14	– 0.83	no	– 1.60	0.06	0.07	0.87	19.44	36.11
	rs	2.56	0.97	15.68	3.95	– 0.30	order 1, 2	– 0.06	0.01	0.96	0.03		
ie	ry	3.82	1.45	30.91	5.32	– 1.62	no	– 1.85	0.08	0.67	0.24		
	rl	2.86	1.09	15.29	3.90	0.24	no	0.38	0.00	0.33	0.67	25.00	30.56
	rs												
ic	ry												
	rl												
	rs	1.01	0.83	2.73	1.65	0.08	no	0.28	0.00	0.77	0.22		
ir	ry	1.63	1.34	5.73	2.39	– 0.13	no	– 0.33	0.00	0.48	0.52		
	rl	1.30	1.07	3.36	1.83	– 0.17	no	– 0.57	0.01	0.34	0.65	27.78	30.56
	rs	1.14	0.82	2.78	1.67	0.04	no	0.16	0.00	0.51	0.49		
in	ry	1.68	1.21	4.61	2.07	0.57	no	1.67	0.07	0.79	0.15		
	rl	1.31	0.94	3.32	1.81	0.20	no	0.68	0.01	0.30	0.69	36.11	19.44
	rs	1.37	0.84	5.09	2.13	– 0.75	no	– 2.16	0.11	0.40	0.49		
x	ry	1.28	0.79	3.52	1.88	0.02	no	0.06	0.00	0.31	0.69		
	rl	1.37	0.85	3.34	1.81	0.24	no	0.80	0.02	0.26	0.72	25.00	25.00
	rs	1.73	0.78	7.08	2.66	– 0.01	no	– 0.02	0.00	0.45	0.55		
xg	ry	1.73	0.79	6.98	2.63	0.26	no	0.60	0.01	0.26	0.73		
	rl	1.73	0.79	6.68	2.57	0.27	no	0.64	0.01	0.17	0.82	27.78	30.56
	rs	3.17	1.15	39.14	5.92	– 2.04	order 1, 2	– 0.24	0.11	0.41	0.48		
xs	ry	3.13	1.13	24.15	4.89	– 0.52	order 1, 2	0.01	0.01	0.17	0.82		
	rl	2.81	1.02	20.14	4.49	– 0.04	order 1, 2	– 0.01	0.00	0.02	0.98	19.44	25.00
	rs	1.39	0.99	5.11	2.09	– 0.87	no	– 2.54	0.15	0.38	0.47		
m	ry	1.74	1.24	6.91	2.63	0.04	no	0.09	0.00	0.50	0.48		
	rl	1.30	0.93	3.78	1.94	0.16	no	0.51	0.01	0.28	0.72	22.22	25.00
	rs	1.52	0.96	4.45	2.06	– 0.43	no	– 1.28	0.04	0.57	0.39		
mg	ry	1.49	0.93	4.32	2.07	0.23	no	0.67	0.01	0.42	0.56		
	rl	1.42	0.89	3.81	1.92	0.38	no	1.19	0.04	0.34	0.62	27.78	27.78
	rs	4.82	1.38	74.07	8.26	– 2.45	no	– 1.81	0.08	0.11	0.80		
ms	ry	4.21	1.21	47.51	6.85	– 0.82	no	– 0.72	0.01	0.36	0.62		
	rl	3.57	1.02	41.28	6.37	– 0.83	no	– 0.79	0.02	0.01	0.97	11.11	25.00
	rs	0.48	0.33	0.44	0.66	– 0.04	no	– 0.38	0.00	0.70	0.29		
mf	ry	0.69	0.48	0.78	0.88	0.07	no	0.45	0.01	0.69	0.30		
	rl	0.95	0.66	1.45	1.20	0.06	no	0.30	0.00	0.44	0.56	27.78	33.33
	rs	0.04	0.13	0.00	0.07	0.00	no	0.20	0.00	0.84	0.16		
em	ry	0.08	0.24	0.01	0.09	0.00	no	0.15	0.00	0.82	0.18		
	rl	0.09	0.27	0.01	0.12	– 0.01	order 1	– 0.09	0.01	0.61	0.38	25.00	25.00

Table A5: Series unadjusted in nominal terms (dataset 1)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
y	rs	0.35	0.09	0.20	0.45	0.03	no	0.41	0.00	0.91	0.09		
	ry	0.68	0.18	0.69	0.82	0.10	no	0.71	0.01	0.91	0.08		
	rl	0.76	0.20	0.92	0.91	0.29	order 1, 2	0.23	0.09	0.85	0.06	30.56	19.44
pc	rs	0.27	0.08	0.15	0.35	0.15	order 1	0.59	0.16	0.81	0.03		
	ry	0.52	0.15	0.45	0.64	– 0.20	no	– 1.89	0.09	0.90	0.01		
	rl	0.95	0.28	1.48	1.18	0.30	order 1, 2	0.18	0.06	0.94	0.00	33.33	30.56
gc	rs	0.58	0.20	0.72	0.85	0.01	no	0.05	0.00	0.92	0.08		
	ry	0.89	0.31	1.44	1.14	0.38	order 1	0.29	0.10	0.84	0.06		
	rl	1.15	0.40	2.75	1.63	0.31	order 1, 2	0.15	0.04	0.92	0.05	25.00	19.44
it	rs	1.57	0.34	3.88	1.97	0.05	no	0.16	0.00	0.99	0.00		
	ry	2.41	0.52	8.58	2.83	0.75	no	1.61	0.07	0.83	0.10		
	rl	2.20	0.47	8.37	2.86	0.44	no	0.93	0.02	0.87	0.11	33.33	38.89
i	rs	3.23	0.63	17.14	4.12	– 0.43	no	– 0.63	0.01	0.99	0.00		
	ry	4.54	0.88	33.18	5.70	0.84	order 1	0.13	0.02	0.90	0.08		
	rl	4.90	0.95	33.86	5.70	1.16	order 1, 2	0.16	0.04	0.80	0.16	27.78	44.44
im	rs	3.23	0.62	16.95	4.01	– 0.94	no	– 1.42	0.05	0.94	0.01		
	ry	4.48	0.86	38.39	6.01	1.49	order 1	0.22	0.06	0.85	0.09		
	rl	4.48	0.86	29.93	5.45	0.50	no	0.56	0.01	0.76	0.23	22.22	41.67
ie	rs	7.68	0.96	127.16	11.18	1.45	order 1, 2	0.10	0.02	0.96	0.02		
	ry	14.16	1.76	303.63	17.40	– 0.97	no	– 0.34	0.00	0.78	0.22		
	rl	12.94	1.61	238.95	15.19	2.87	order 1	0.16	0.03	0.63	0.33	30.56	27.78
ic	rs	1.21	0.24	2.81	1.63	0.40	no	1.50	0.06	0.88	0.06		
	ry	2.55	0.52	9.94	3.13	0.40	no	0.77	0.02	0.86	0.12		
	rl	2.26	0.46	8.77	2.92	– 0.51	no	– 1.07	0.03	0.96	0.01	38.89	36.11
ir	rs	1.44	0.37	3.50	1.85	0.30	no	0.98	0.03	0.89	0.08		
	ry	3.63	0.93	20.44	4.34	– 1.26	order 1, 2	0.02	0.08	0.91	0.02		
	rl	2.83	0.72	11.94	3.36	– 0.82	order 1, 2	– 0.17	0.06	0.89	0.05	36.11	30.56
in	rs	1.64	0.27	6.72	2.54	0.52	no	1.24	0.04	0.91	0.05		
	ry	4.75	0.77	38.38	5.96	1.67	no	1.71	0.07	0.72	0.21		
	rl	4.16	0.68	29.50	5.43	– 0.21	no	– 0.23	0.00	0.84	0.16	36.11	38.89
x	rs	1.87	0.29	6.92	2.62	0.19	no	0.45	0.01	0.95	0.04		
	ry	3.08	0.48	13.30	2.82	2.31	no	4.97	0.40	0.58	0.02		
	rl	3.10	0.48	12.98	2.74	2.34	no	5.21	0.42	0.56	0.01	33.33	38.89
xg	rs	2.05	0.28	6.95	2.48	0.90	no	2.21	0.12	0.76	0.13		
	ry	2.97	0.41	13.17	3.21	1.70	no	3.23	0.22	0.72	0.06		
	rl	2.81	0.39	12.78	3.19	1.62	no	3.09	0.21	0.77	0.03	38.89	41.67
xs	rs	5.44	0.67	64.32	7.95	– 1.05	no	– 0.80	0.02	0.95	0.03		
	ry	8.78	1.09	239.28	13.85	6.89	order 1	0.44	0.20	0.11	0.69		
	rl	8.33	1.03	208.55	12.67	6.92	order 1	0.46	0.23	0.09	0.68	25.00	30.56
m	rs	2.35	0.41	8.91	2.97	0.31	no	0.63	0.01	0.97	0.02		
	ry	3.49	0.60	18.31	3.31	2.71	no	4.98	0.40	0.56	0.03		
	rl	3.58	0.62	20.03	3.68	2.55	no	4.22	0.32	0.64	0.03	33.33	27.78
mg	rs	2.50	0.38	11.38	3.33	0.54	no	0.99	0.03	0.91	0.07		
	ry	3.82	0.58	23.39	4.39	2.03	no	2.81	0.18	0.73	0.10		
	rl	3.79	0.57	23.03	4.30	2.14	no	3.02	0.20	0.72	0.09	30.56	36.11
ms	rs	6.28	1.33	76.67	8.76	– 0.10	no	– 0.07	0.00	0.86	0.13		
	ry	6.78	1.44	78.08	7.86	4.03	no	3.12	0.21	0.59	0.20		
	rl	5.06	1.08	42.25	5.45	3.54	no	3.96	0.30	0.40	0.30	27.78	27.78
mf	rs	0.99	0.19	1.52	1.23	0.06	no	0.28	0.00	1.00	0.00		
	ry	1.68	0.32	4.98	2.18	– 0.49	no	– 1.37	0.05	0.94	0.01		
	rl	1.98	0.37	6.18	2.42	– 0.57	order 1	– 0.20	0.05	0.94	0.01	27.78	33.33

Table A6: Series unadjusted in nominal terms (dataset 2)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
y	rs	0.29	0.07	0.16	0.39	0.03	no	0.50	0.01	0.92	0.07		
	ry	0.70	0.18	0.70	0.84	0.08	no	0.59	0.01	0.91	0.09		
	rl	0.76	0.20	0.94	0.93	0.26	order 1, 2	0.21	0.07	0.86	0.07	30.56	22.22
pc	rs	0.23	0.07	0.12	0.32	0.11	order 1	0.46	0.11	0.81	0.09		
	ry	0.54	0.16	0.48	0.67	– 0.18	no	– 1.68	0.07	0.92	0.01		
	rl	0.96	0.28	1.54	1.21	0.29	order 1, 2	0.18	0.06	0.94	0.00	30.56	27.78
gc	rs	0.55	0.19	0.70	0.84	0.02	no	0.15	0.00	0.94	0.06		
	ry	0.89	0.31	1.47	1.15	0.39	order 1	0.29	0.10	0.83	0.07		
	rl	1.15	0.40	2.72	1.62	0.32	order 1, 2	0.15	0.04	0.92	0.04	27.78	22.22
it	rs	1.33	0.29	3.11	1.76	– 0.04	no	– 0.14	0.00	1.00	0.00		
	ry	2.37	0.51	8.60	2.82	0.81	no	1.75	0.08	0.84	0.09		
	rl	2.22	0.48	7.82	2.75	0.49	no	1.09	0.03	0.88	0.09	36.11	36.11
i	rs	2.72	0.52	14.43	3.76	– 0.54	no	– 0.87	0.02	0.97	0.01		
	ry	4.65	0.89	33.21	5.73	0.64	order 1	0.10	0.01	0.90	0.09		
	rl	4.98	0.96	33.17	5.65	1.12	order 1, 2	0.16	0.04	0.81	0.15	25.00	44.44
im	rs	2.70	0.53	14.39	3.76	– 0.48	no	– 0.77	0.02	0.98	0.01		
	ry	4.60	0.90	38.90	6.04	1.54	no	1.55	0.06	0.84	0.10		
	rl	4.71	0.92	32.16	5.64	0.63	no	0.68	0.01	0.75	0.24	19.44	44.44
ie	rs	6.52	0.86	93.62	9.66	– 0.56	no	– 0.35	0.00	0.91	0.08		
	ry	13.27	1.74	283.34	16.72	– 1.94	no	– 0.71	0.01	0.82	0.16		
	rl	12.00	1.58	201.85	14.02	2.30	no	1.00	0.03	0.73	0.24	30.56	27.78
ic	rs	1.12	0.23	2.49	1.55	0.31	no	1.23	0.04	0.78	0.18		
	ry	2.59	0.54	10.48	3.17	0.63	no	1.22	0.04	0.87	0.10		
	rl	2.32	0.48	8.97	2.97	– 0.40	no	– 0.83	0.02	0.97	0.01	38.89	33.33
ir	rs	1.49	0.39	4.05	1.96	0.48	no	1.49	0.06	0.93	0.02		
	ry	3.81	0.99	22.26	4.59	– 1.08	order 1, 2	0.01	0.05	0.93	0.02		
	rl	3.07	0.80	12.95	3.52	– 0.75	order 1, 2	– 0.15	0.04	0.89	0.07	33.33	25.00
in	rs	1.46	0.24	4.36	2.08	0.17	order 1, 2	0.09	0.01	0.67	0.32		
	ry	4.77	0.79	38.68	5.91	1.94	no	1.99	0.10	0.71	0.19		
	rl	4.23	0.70	29.36	5.42	– 0.10	no	– 0.11	0.00	0.83	0.17	38.89	38.89
x	rs	1.92	0.30	7.26	2.68	– 0.23	no	– 0.52	0.01	0.92	0.07		
	ry	3.17	0.49	13.94	2.94	2.30	no	4.75	0.38	0.60	0.02		
	rl	3.16	0.49	13.27	2.86	2.26	no	4.81	0.38	0.59	0.02	30.56	36.11
xg	rs	2.31	0.32	8.10	2.80	0.49	no	1.07	0.03	0.84	0.13		
	ry	3.08	0.43	14.12	3.30	1.80	no	3.31	0.23	0.72	0.05		
	rl	2.92	0.40	13.15	3.25	1.61	no	3.02	0.20	0.78	0.03	30.56	38.89
xs	rs	4.68	0.60	53.32	7.11	– 1.65	no	– 1.41	0.05	0.93	0.01		
	ry	8.45	1.09	223.74	13.44	6.57	order 1	0.42	0.19	0.12	0.69		
	rl	8.08	1.04	194.91	12.30	6.61	order 1, 2	0.43	0.22	0.10	0.68	25.00	27.78
m	rs	2.35	0.40	8.85	2.97	– 0.19	no	– 0.40	0.00	0.97	0.03		
	ry	3.57	0.60	19.20	3.54	2.58	no	4.44	0.35	0.60	0.05		
	rl	3.64	0.61	20.45	3.84	2.39	no	3.78	0.28	0.67	0.05	27.78	22.22
mg	rs	2.74	0.41	11.98	3.45	0.22	no	0.39	0.00	0.92	0.08		
	ry	4.06	0.61	24.90	4.56	2.03	no	2.72	0.17	0.73	0.11		
	rl	3.86	0.58	23.46	4.36	2.10	no	2.93	0.19	0.72	0.09	25.00	27.78
ms	rs	5.40	1.13	65.33	7.99	– 1.21	no	– 0.92	0.02	0.89	0.09		
	ry	6.36	1.33	70.33	7.67	3.38	no	2.68	0.16	0.66	0.18		
	rl	4.63	0.97	35.78	5.23	2.91	no	3.39	0.24	0.48	0.28	27.78	27.78
mf	rs	0.87	0.16	1.32	1.15	0.07	order 1	0.06	0.00	0.99	0.00		
	ry	1.80	0.33	6.15	2.42	– 0.53	no	– 1.33	0.05	0.91	0.04		
	rl	2.07	0.39	7.30	2.63	– 0.62	order 1	– 0.19	0.05	0.95	0.00	30.56	33.33

Table A7: Series adjusted in nominal terms (dataset 1)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
y	rs	0.19	0.20	0.06	0.24	– 0.01	no	– 0.20	0.00	0.95	0.05		
	ry	0.24	0.26	0.11	0.32	0.08	no	1.62	0.07	0.85	0.09		
	rl	0.27	0.29	0.11	0.33	0.07	no	1.21	0.04	0.71	0.25	33.33	27.78
pc	rs	0.25	0.33	0.13	0.34	0.08	order 1	0.32	0.05	0.86	0.08		
	ry	0.28	0.37	0.14	0.36	0.08	order 1, 2	0.39	0.04	0.73	0.23		
	rl	0.35	0.46	0.18	0.40	0.16	no	2.37	0.13	0.52	0.34	38.89	25.00
gc	rs	0.30	0.38	0.25	0.49	– 0.06	no	– 0.76	0.02	0.67	0.32		
	ry	0.30	0.38	0.15	0.37	0.10	no	1.73	0.08	0.82	0.11		
	rl	0.48	0.61	0.49	0.70	– 0.00	no	– 0.03	0.00	0.30	0.70	30.56	33.33
it	rs	0.83	0.69	1.58	1.22	– 0.30	no	– 1.50	0.06	0.89	0.05		
	ry	0.94	0.78	1.38	1.17	– 0.13	no	– 0.69	0.01	0.90	0.09		
	rl	0.73	0.60	0.91	0.95	– 0.10	no	– 0.62	0.01	0.48	0.51	19.44	41.67
i	rs												
	ry												
	rl												
im	rs	2.01	0.99	11.76	3.28	– 1.01	order 1, 2	– 0.25	0.09	0.51	0.40		
	ry	2.21	1.09	10.95	3.30	– 0.17	no	– 0.32	0.00	0.54	0.45		
	rl	1.73	0.85	8.18	2.85	– 0.27	no	– 0.58	0.01	0.10	0.89	25.00	36.11
ie	rs	2.53	0.85	21.55	4.59	– 0.67	no	– 0.88	0.02	0.91	0.07		
	ry	5.06	1.69	58.00	7.59	– 0.61	no	– 0.49	0.01	0.84	0.16		
	rl	3.61	1.21	22.74	4.77	0.12	no	0.16	0.00	0.23	0.77	27.78	25.00
ic	rs												
	ry												
	rl												
ir	rs	0.97	0.64	2.45	1.56	0.05	no	0.21	0.00	0.83	0.17		
	ry	1.42	0.94	4.68	2.16	– 0.09	no	– 0.24	0.00	0.59	0.41		
	rl	1.23	0.81	2.95	1.71	– 0.09	no	– 0.31	0.00	0.48	0.52	33.33	30.56
in	rs	0.91	0.60	1.95	1.39	– 0.18	no	– 0.78	0.02	0.86	0.13		
	ry	1.33	0.88	3.13	1.75	0.28	no	0.99	0.03	0.78	0.19		
	rl	1.11	0.74	2.58	1.61	– 0.05	no	– 0.19	0.00	0.51	0.49	27.78	22.22
x	rs	1.52	0.75	6.18	2.27	– 1.01	no	– 2.70	0.16	0.42	0.42		
	ry	1.55	0.76	5.43	2.33	– 0.09	no	– 0.23	0.00	0.33	0.67		
	rl	1.46	0.72	4.05	2.01	0.11	no	0.34	0.00	0.26	0.74	25.00	27.78
xg	rs	1.73	0.71	7.88	2.81	– 0.04	no	– 0.08	0.00	0.43	0.57		
	ry	2.02	0.83	9.74	3.09	0.43	no	0.84	0.02	0.35	0.63		
	rl	1.89	0.78	8.06	2.82	0.31	no	0.67	0.01	0.20	0.79	30.56	30.56
xs	rs	3.71	1.19	45.51	6.11	– 2.87	order 1, 2	– 0.36	0.18	0.54	0.28		
	ry	3.20	1.03	26.24	5.05	– 0.84	order 1, 2	0.01	0.03	0.16	0.81		
	rl	2.79	0.90	17.80	4.21	– 0.28	no	– 0.41	0.00	0.02	0.97	30.56	25.00
m	rs	1.57	0.84	5.68	2.16	– 1.01	no	– 2.84	0.18	0.42	0.38		
	ry	1.55	0.83	5.16	2.27	0.04	no	0.10	0.00	0.70	0.28		
	rl	1.49	0.80	4.69	2.16	0.10	no	0.28	0.00	0.36	0.63	19.44	27.78
mg	rs	2.42	0.93	15.31	3.91	0.03	order 1, 2	0.01	0.00	0.37	0.63		
	ry	2.53	0.97	15.66	3.93	0.46	order 1, 2	0.03	0.01	0.30	0.68		
	rl	2.43	0.93	13.03	3.58	0.47	no	0.79	0.02	0.18	0.80	25.00	25.00
ms	rs	5.02	1.35	69.07	7.70	– 3.15	order 1, 2	– 0.43	0.14	0.24	0.60		
	ry	3.54	0.95	37.29	6.04	– 0.92	no	– 0.93	0.02	0.30	0.67		
	rl	3.47	0.94	33.59	5.75	– 0.72	order 1, 2	– 0.13	0.02	0.02	0.96	22.22	33.33
mf	rs	0.59	0.37	0.48	0.69	– 0.05	no	– 0.46	0.01	0.87	0.13		
	ry	0.74	0.47	0.89	0.95	0.01	no	0.04	0.00	0.74	0.26		
	rl	0.86	0.55	1.14	1.06	– 0.14	no	– 0.83	0.02	0.59	0.39	27.78	36.11

Table A8: Series adjusted in nominal terms (dataset 2)

		MAR	RMAR	MSR	SD	MR	Auto corr.	t-statistics	UM	UD	UR	Acc.	Dec.
y	rs	0.16	0.17	0.05	0.22	– 0.01	order 1	– 0.08	0.00	0.91	0.09		
	ry	0.25	0.26	0.11	0.32	0.07	no	1.25	0.04	0.84	0.12		
	rl	0.27	0.28	0.12	0.34	0.05	no	0.86	0.02	0.69	0.29	36.11	30.56
pc	rs	0.20	0.26	0.08	0.28	0.05	order 1, 2	0.25	0.03	0.86	0.12		
	ry	0.29	0.39	0.14	0.37	0.08	order 1, 2	0.29	0.05	0.70	0.25		
	rl	0.36	0.49	0.20	0.42	0.16	no	2.37	0.13	0.50	0.37	36.11	27.78
gc	rs	0.23	0.30	0.14	0.38	0.04	no	0.59	0.01	0.92	0.08		
	ry	0.28	0.36	0.14	0.36	0.10	no	1.62	0.07	0.84	0.10		
	rl	0.50	0.65	0.53	0.73	0.03	no	0.25	0.00	0.28	0.72	33.33	36.11
it	rs	0.81	0.72	1.61	1.25	– 0.24	order 1, 2	– 0.16	0.04	0.93	0.04		
	ry	0.94	0.84	1.38	1.17	– 0.06	no	– 0.33	0.00	0.92	0.08		
	rl	0.70	0.62	0.85	0.92	– 0.02	no	– 0.16	0.00	0.52	0.48	25.00	41.67
i	rs												
	ry												
	rl												
im	rs	1.93	0.94	11.65	3.27	– 0.97	order 1, 2	– 0.24	0.08	0.52	0.40		
	ry	2.29	1.12	11.05	3.32	– 0.21	no	– 0.39	0.00	0.54	0.46		
	rl	1.81	0.88	8.32	2.87	– 0.27	no	– 0.58	0.01	0.10	0.89	25.00	33.33
ie	rs	2.49	0.84	21.44	4.59	– 0.63	no	– 0.83	0.02	0.92	0.06		
	ry	4.91	1.65	57.13	7.53	– 0.60	no	– 0.49	0.01	0.84	0.15		
	rl	3.36	1.13	21.68	4.65	0.14	no	0.18	0.00	0.24	0.76	30.56	27.78
ic	rs												
	ry												
	rl												
ir	rs	0.93	0.62	2.43	1.56	0.08	no	0.32	0.00	0.82	0.18		
	ry	1.47	0.99	4.97	2.23	0.01	no	0.03	0.00	0.57	0.43		
	rl	1.27	0.85	3.20	1.79	– 0.02	no	– 0.07	0.00	0.47	0.53	33.33	27.78
in	rs	0.86	0.59	1.92	1.37	– 0.19	no	– 0.86	0.02	0.82	0.16		
	ry	1.41	0.97	3.33	1.79	0.35	no	1.18	0.04	0.74	0.22		
	rl	1.20	0.83	2.74	1.65	0.00	no	0.02	0.00	0.49	0.51	27.78	22.22
x	rs	1.41	0.68	5.73	2.21	– 0.92	no	– 2.54	0.15	0.43	0.42		
	ry	1.49	0.72	5.32	2.30	– 0.12	no	– 0.31	0.00	0.34	0.66		
	rl	1.43	0.69	3.98	1.99	0.07	no	0.21	0.00	0.26	0.74	25.00	30.56
xg	rs	1.81	0.77	8.05	2.83	0.12	no	0.25	0.00	0.41	0.58		
	ry	1.97	0.84	9.73	3.08	0.51	no	1.00	0.03	0.35	0.63		
	rl	1.90	0.81	8.17	2.83	0.41	no	0.87	0.02	0.20	0.78	30.56	30.56
xs	rs	3.13	1.01	37.11	5.59	– 2.42	order 1, 2	– 0.31	0.16	0.47	0.37		
	ry	3.22	1.03	26.28	5.06	– 0.81	order 1, 2	0.01	0.03	0.16	0.81		
	rl	2.84	0.91	17.90	4.22	– 0.29	no	– 0.42	0.00	0.02	0.97	30.56	27.78
m	rs	1.42	0.74	5.04	2.04	– 0.94	no	– 2.81	0.18	0.43	0.38		
	ry	1.50	0.79	5.06	2.25	0.01	no	0.02	0.00	0.71	0.27		
	rl	1.39	0.73	4.50	2.12	0.07	no	0.19	0.00	0.38	0.62	19.44	27.78
mg	rs	2.36	0.89	15.21	3.90	– 0.07	order 1, 2	– 0.02	0.00	0.38	0.62		
	ry	2.45	0.92	15.48	3.92	0.38	order 1, 2	0.02	0.01	0.31	0.68		
	rl	2.26	0.85	12.66	3.54	0.40	no	0.68	0.01	0.19	0.80	19.44	22.22
ms	rs	4.46	1.21	60.07	7.31	– 2.58	order 1, 2	– 0.35	0.11	0.16	0.72		
	ry	3.54	0.96	37.27	6.04	– 0.87	no	– 0.88	0.02	0.30	0.68		
	rl	3.43	0.93	33.55	5.75	– 0.70	order 1, 2	– 0.12	0.01	0.02	0.96	19.44	33.33
mf	rs	0.49	0.30	0.40	0.61	– 0.13	no	– 1.32	0.04	0.76	0.20		
	ry	0.76	0.46	0.92	0.95	– 0.08	no	– 0.52	0.01	0.68	0.32		
	rl	0.87	0.53	1.19	1.07	– 0.21	no	– 1.20	0.04	0.55	0.41	27.78	41.67