Statistics Austria
Methodological report of the action

Quality improvement of the Monthly Unemployment Rate

Eurostat Grant Agreement Number: 07131.2016.002-2016.247

GUMPRECHT Daniela, MERANER Angelika
14.09.2017

Contents

0. Introduction

The monthly unemployment rate (MUR) is an important economic indicator for short term economic analysis. Its importance for economic and social-political decisions becomes apparent considering the principle European economic indicators (PEEI) which include the monthly unemployment rate next to indicators like the GDP or the external trade balance.

The Austrian monthly unemployment rate, published by Eurostat on a monthly basis, has been produced by Statistics Austria (STAT) since 2011. Prior to that date, the estimation process was performed by Eurostat itself using a so-called hybrid estimation procedure based on quarterly LFS figures and monthly figures on unemployment from administrative data sources. Currently STAT releases unemployment figures for all months from January 2004 onwards. Austrian MURs are computed via single month estimates from the Austrian Labour Force Survey (LFS). There was a slight modification to the estimation method in 2015, when information on the administrative labour status was included in the calibration procedure. Consequently, all monthly unemployment figures were revised back to January 2004.

The overall objective of this project was an improvement of the quality of Austrian monthly unemployment rates. For this purpose, three promising estimation procedures were chosen for testing. The results were compared with the help of quality indicators as proposed by the Eurostat task force “Quality Framework for Monthly Unemployment”.

To begin with, some general words about the situation in Austria. The Austrian LFS is part of the Austrian Microcensus (MC). It is organised and operated by Statistics Austria. The sample is a regionally (NUTS-2) stratified random sample of private households. Every member of the household is legally bound to participate. The MC is a rotating sample (a household stays in the sample for five consecutive quarters, and every quarter one fifth of the sample rotates in and out). Each household is assigned a reference week and most of the questions refer to that week. The households are evenly distributed across all weeks of a quarter. The net sample of each quarter contains about 20 000 households and roughly 44 000 persons. Each month within a quarter constitutes of approximately 6 200 to 7 500 households or 13 500 to 17 000 persons, depending on whether four or five weeks belong to a month.

To get an unbiased picture of the total Austrian population (and the population of the NUTS-2 regions) within a quarter, i.e. the main results of the LFS-survey, sample values are weighted. Sample data of the Microcensus are weighted to fit the stock figures according to some demographic, economical, regional and household characteristics. More detail on the weighting procedure can be found in Meraner, Gumprecht & Kowarik (2016). Calibration is performed by iterative proportional fitting. For monthly results, sample values for each month are weighted in a similar way. The monthly unemployment rates are published for the total population, for men, women and two age groups (young persons from 15 to 24 and persons from 25 to 74).

1. Quality monitoring of MUR estimates

Within Europe a wide spectrum of various estimation procedures for the MUR was established. Nearly every country uses an individual estimation procedure – best fitting to the individual labour market situation, the circumstances of data availability etc. This "individualisation" of the estimation of MURs has some big advantages, e.g. for the quality of the indicators themselves. At the same time there are drawbacks, e.g. regarding comparability between countries and the evaluation of the quality of these estimates.

Against this background, the wish for general quality criteria for MURs based on all different estimation processes was raised. The question to be answered: How to evaluate the quality of all these different monthly unemployment rates based on different estimation processes? Therefore the Eurostat task force "Quality Framework for Monthly Unemployment" was established. The outcome was a set of indicators. These are distinguishable into the categories "volatility" and "revisions". Within each category there are main and context indicators, although some of them are not appropriate for all estimation methods used (e.g. hybrid estimation models).

Within this grant all quality indicators developed by this task force were implemented in R and computed for Austrian monthly unemployment rates based on four different estimation procedures: the one actually used at the moment, the one based on an adaption of the current method, the regression composite estimation method, and the rolling quarters approach.

All of these quality indicators are briefly listed below, focussing on the Austrian situation. Typically the indicators are calculated on seasonally adjusted data. Currently, however, Austria does not deliver standard seasonally adjusted series but rather trend series. Not all Austrian unemployment and employment series indicate a stable seasonal pattern over time. As long as the seasonal structure of (at least most of) the series is unstable, trend series are used as (seasonally) adjusted series for publication. Therefore all indicators - except for two which are explicitly for unadjusted series - are calculated on trend series. Both sets of indicators should be computed for a test period of three years[1]. Quality Indicators follow the draft of the new implementing act for the monthly unemployment rate (see Doc.: Eurostat/F3/LAMAS/10/17 annex 1, LAMAS meeting 19-21 June 2017). Article 7 point 1 says that "The quality of the overall monthly unemployment rate is monitored every three years, through the following set of indicators and thresholds: (…)". Quality indicators listed in this draft legal act are

- The correlation of month-on-month changes (V1), threshold [-0.3; 0.75].
- The frequency of double large inversions (V2), threshold < 5%.
- The frequency of very large revisions in levels (R2), threshold < 10%.
- The frequency of large revisions in month-on-month changes (R3), threshold < 10%.

They are a subset of the MUR quality indicators suggested by the Task Force and agreed on by LAMAS (see Doc.: Eurostat/F3/LAMAS/66/16, LAMAS meeting 7-8 December 2016).

1.1. Volatility

Volatility indicators are always calculated on "final" series, final meaning after the integration of the LFS quarterly results. It needs to be said that trend series are never really final, every month the whole trend series back to 2004 are recalculated, although values in the past do not really change anymore. Volatility indicators were computed for a test period of three years, from January 2014 to December 2016. For convenience, all core and context indicators are listed here.

[1] Eurostat computed volatility AND revision indicators for Austria for a test period of three years, ignoring a methodological break in the computation of Austrian monthly unemployment figures at the beginning of 2015. Due to this break, the test period for revision indicators of published MUR-series can start in March 2015 at the earliest.

Main indicators:

V1: Correlation of month-on-month changes.
V2: Frequency of double large inversions.

Context indicators:

v1: Theoretical coefficient of variation of the not seasonally adjusted data.
v2: Standard deviation of the irregular component.
v3: Frequency of implausible monthly patterns.
v4: Frequency of variations in month-to-month changes.

1.2. Revisions

Revision indicators compare the monthly estimate at first transmission and the revised value after six months. STAT changed the weighting of the whole MC, i.e. the computation of quarterly, monthly and yearly weights, in March 2015 when quarterly results for the 4th quarter of 2014 were first published. At this time, the whole MC-series back until 2004 was reweighted and revised. Final monthly weights are available from January 2004 onwards, but flash estimates used in real life for the first transmission of MURs are available from March 2015 onwards only. No back-series of flash estimates were simulated. The test period for revision indicators starts with March 2015 and lasts only 1.5 years, i.e. the last month for which first transmission data and 6th transmission data are available is September 2016. For the three different types of MUR computation procedures, flash estimates are produced from January 2014 onwards, final monthly estimates from January 2005 onwards. That means, for all three test cases revision indicators are based on 2.75 years.
All core and context revision indicators suggested by the Task Force are the following:

Main indicator:

R1: Frequency of large revisions in levels
R2: Frequency of very large revisions in levels
R3: Frequency of large revision in month-on-month changes
R4: Frequency of very large revisions in month-on-month changes

Context indicators:

r1: Mean absolute revision on raw series in levels
r2: Max absolute revision in levels
r3: Mean revision in levels
r4: Mean absolute revision in levels
r5: Mean absolute revision in month-on-month changes
For revision indicators r4 and r5 in each case two thresholds, 0.1 and 0.2 percentage points, are suggested.

1.3. Comparison with Task Force Results

A direct comparison and the replicability of these quality indicators for Austria computed by the task force and presented to LAMAS in December 2016 is not possible due to several reasons. First, the change of the weighting procedure lead to a lack of essential data for revision indicators before March 2015 which makes a test period of three years (from June 2013 until May 2016) meaningless for all revision indicators. Second, for volatility indicators all necessary values from June 2013 until May 2016 are available, nevertheless due to slight differences in the trend estimates, these indicators depend on the concrete transmission file used for computation. As an example: V1 computed by the task force equals 0.18, whereas V1 computed by STAT equals 0.24, V2 is the same (both times = 0.0).

2. New MUR estimation procedures

According to the quality indicators, the estimation method currently used for computing Austrian monthly unemployment rates is not bad per se. Both volatility and revisions are in the middle range, just as for most other countries of which only a few perform better, some perform worse. Nevertheless, an improvement is always desirable. And particularly one aspect of the Austrian MUR series, the use of trend data as seasonally adjusted data, is not completely conforming to certain guidelines or recommendations and is therefore sometimes criticised.

STAT decided to use trend data instead of not seasonally adjusted data for two main reasons: First, some series switch on several occasions from an identifiable seasonal structure to no identifiable seasonal structure as time passes, and second, trend series are less volatile.

Different estimation methods might give series with stable and identifiable seasonal structures. In that case conventional seasonal adjustment could be done.

2.1. Current weighting procedure

The process of iterative proportional fitting for quarterly LFS data is described in detail in Meraner, Gumprecht & Kowarik (2016). For monthly data the procedure is nearly the same, just some slight modifications concerning the calibration specifications are done. These specifications for monthly data are the following:

- N_{rga} … Total number of persons in private households in NUTS-2 region r (= 1,…,9), of gender g (=1, 2) and in age class a (1=0-2 years, 2=3-5 years, 3=6-9, … year classes …, 18=80-84, 19=85+).
- N_n … Total number of persons in private households with nationality n (=1,…,6) comprising the groups “Austria”, “EU-15 (without Austria)”, “EU 2004+ (joined the EU between 2004 and 2014)”, “European non-EU countries”, “Turkey”, “Others”.
- N_{rge} … Total number of persons in private households in NUTS-2 region r (=1,…,9), of gender g (=1, 2) and with administrative employment status e (=1,…,5) which consists of the groups “Employee standard”, “Employee non-standard”, “Self-Employed”, “Unemployed” and “Inactive”.
- M_{rh} … Total number of private households in NUTS-2 region r (=1,…,9) of household size h (=1,…,5) with values 1 to 5+.

Sampling errors are estimated with the help of a bootstrap procedure.

Monthly unemployment values for the latest month(s) of the series, or in other words for all months belonging to the latest unpublished quarter[2], are preliminary or flash estimates. Once quarterly LFS data are finished, final monthly estimates belonging to this quarter can be computed, i.e. monthly unemployment and employment values for young [15; 24] and older [25; 74] men and women, essentially all the values needed to compute MURs for Eurostat’s press release. These values are additionally adjusted to quarterly results to fulfil Eurostat’s demand for consistency, meaning that the mean of monthly values has to be equal to the quarterly values, see Gumprecht, Haslinger & Kowarik, 2011.

Monthly Unemployment Rates

The currently published monthly unemployment figures from January 2014 until April 2017 are given in Table 1. All values included in this table were computed in May 2017, i.e. when the monthly data for April 2017 were produced for the first time. To be more specific, it is the first transmission of data for April 2017, the second transmission of data for March 2017, etc. For September 2016 it is the revised value six months after the first estimate. The time series from January 2014 until December 2016 are also shown in Figure 1. This time span was chosen because it is the test period of the volatility indicators. Not adjusted series (black) as well as trend series (green) are given. Series for young persons are very volatile and unemployment is on a rather high level. Series for men and

[2] Depending on the point in time, one to three months of the MUR series belong to quarters still in process.

women (and the whole population) are rather stable and no seasonal pattern is evident (at least it is not visible with the unaided eye).

Month		Unemployment rates				Unemployed persons total in 1000	Unemployment rates			
		Trend series					Not adjusted series			
		Total	Males	Females	15-24 years		Total	Males	Females	15-24 years
		in %					in %			
2014	I.	5.6	5.6	5.5	11.4	256.9	6.0	6.1	5.8	12.8
	II.	5.7	5.7	5.6	11.0	248.5	5.8	6.1	5.5	10.2
	III.	5.6	5.7	5.5	10.4	263.8	6.1	6.1	6.1	11.1
	IV.	5.5	5.6	5.4	9.9	228.8	5.3	5.9	4.6	8.6
	V.	5.4	5.6	5.3	9.5	223.3	5.2	5.0	5.3	8.7
	VI.	5.7	5.8	5.4	10.4	255.4	5.8	6.4	5.2	9.9
	VII.	5.7	5.8	5.5	10.2	250.5	5.7	6.0	5.4	12.3
	VIII.	5.6	5.7	5.5	9.8	231.0	5.3	5.1	5.4	8.7
	IX.	5.7	6.0	5.3	9.9	253.6	5.8	6.1	5.4	10.7
	X.	5.7	6.2	5.2	10.2	235.0	5.4	5.9	4.9	10.0
	XI.	5.7	6.0	5.3	10.4	246.3	5.6	5.5	5.8	9.6
	XII.	5.6	6.0	5.3	9.7	245.5	5.7	6.1	5.2	10.8
2015	I.	5.5	5.8	5.3	8.6	242.8	5.6	6.0	5.2	8.2
	II.	5.4	5.7	5.2	8.8	254.0	5.9	6.2	5.6	9.6
	III.	5.7	6.0	5.3	10.5	256.2	5.9	6.6	5.2	10.9
	IV.	5.9	6.2	5.6	11.1	260.8	6.0	6.6	5.4	10.4
	V.	5.9	6.2	5.6	10.9	254.4	5.8	6.1	5.6	9.6
	VI.	5.7	6.0	5.3	10.2	247.1	5.6	6.0	5.2	10.6
	VII.	5.6	5.9	5.3	10.2	248.8	5.6	5.8	5.4	11.4
	VIII.	5.6	6.1	5.1	10.7	242.5	5.5	5.8	5.1	10.5
	IX.	5.7	6.3	5.0	11.0	257.3	5.8	6.4	5.1	11.6
	X.	5.8	6.3	5.1	11.3	230.9	5.2	5.5	4.9	10.8
	XI.	5.9	6.3	5.4	11.6	274.4	6.2	6.4	6.0	11.9
	XII.	6.0	6.4	5.6	11.6	252.3	5.7	6.1	5.4	11.1
2016	I.	6.1	6.6	5.5	12.2	277.1	6.3	6.9	5.6	12.7
	II.	6.1	6.6	5.5	12.1	287.0	6.5	7.4	5.5	13.0
	III.	5.9	6.3	5.5	10.9	262.1	5.9	6.1	5.7	9.3
	IV.	6.0	6.4	5.5	10.6	265.2	6.0	6.9	5.0	10.6
	V.	6.2	6.6	5.7	11.3	282.3	6.3	6.6	5.9	10.6
	VI.	6.2	6.7	5.7	11.6	272.7	6.1	6.4	5.6	11.3
	VII.	6.2	6.7	5.6	11.5	277.1	6.1	6.8	5.3	13.4
	VIII.	6.2	6.6	5.7	11.4	288.8	6.3	6.3	6.3	10.4
	IX.	6.0	6.3	5.7	11.4	271.9	6.0	6.1	5.9	12.9
	X.	5.9	6.2	5.5	10.9	251.9	5.6	5.8	5.4	10.5
	XI.	5.7	6.2	5.2	10.2	255.5	5.7	5.9	5.5	9.7
	XII.	5.7	6.2	5.1	10.3	248.8	5.6	6.2	4.9	10.2
2017	I.	5.7	6.2	5.1	10.5	256.1	5.8	6.2	5.3	11.1
	II.	5.8	6.3	5.1	10.5	273.6	6.2	7.3	4.9	10.6
	III.	5.7	6.3	5.0	10.3	263.0	5.9	6.3	5.4	9.4
	IV.	5.5	6.1	4.9	10.5	240.9	5.4	6.3	4.3	9.7

S: STATISTICS AUSTRIA, Labour Force Survey (Microcensus), from 2004 onwards: continuous survey (average of all weeks of a month). Compiled on 29 May 2017. Population in private households, without conscripts and people in community service. Trend series: medium and longterm development without any shortterm variations like seasonality. Estimates of current months are preliminary.

Table 1: Monthly unemployment data, current estimation procedure.

Figure 1: Monthly unemployment rates, not seasonally adjusted and trend series, for all persons aged 15 to 74, young persons aged 15 to 24, men, and women, current estimation procedure.

Quality Indicators - Evaluation

The core quality indicators for the overall monthly unemployment rate series (men and women aged 15 to 74) show a quite satisfying situation for Austria, only one revision indicator[3] (R3, frequency of large revisions in month-on-month changes) is above the threshold, see Table 2. A table with context indicators for the population aged 15 to 74 is given in the appendix, see Table A4. The most interesting context indicator is v1, the theoretical coefficient of variation of not seasonally adjusted data. This indicator is based on 500 bootstrap weights. The coefficient of variation (cv) of the monthly unemployment rate is about 0.05 in the first quarter 2014 (January 2014 cv=0.05, February 2014 cv=0.05, March 2014 cv=0.06).

Regarding the monthly unemployment rates of the subgroups published by Eurostat, the picture is partly worse. For women, three revision indicators (R1, R2 and R3) are above the thresholds (see Table A2 in the appendix) while all four revision indicators are above the thresholds for young people

[3] Computed on a test period of one and a half year only.

aged 15 to 24 (see Table A3 in the appendix). The indicators for men (Table A1 in the appendix) are as good as those for the whole population aged 15-74. Core volatility indicators are okay for all subgroups.

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.3426	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.0526	<	0.1	good
R2	freq. of very large revisions in levels	0	<	0.1	good
R3	freq. of large revisions in m-on-m changes	0.1667	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0	<	0.1	good

Table 2: Core quality indicators for currently produced MUR, Volatility indicators test period: January 2014 – December 2016, Revision indicators: March 2015 – September 2016.

Nevertheless, the computation of the trend series instead of the seasonally adjusted series is some kind of spot of bother that is not illustrated by this set of indicators.

Time Series Decomposition and Seasonal Adjustment

Since January 2011 STAT computes and publishes MUR rates based on monthly LFS data (Gumprecht, Haslinger & Kowarik, 2011). Before STAT decided to publish these values, a comprehensive analysis of the whole production process and the results was carried out. Time series analysis showed that many of the series (unemployed persons, employed persons, and unemployment rates for various sub- and super-groups) showed no seasonal pattern and a rather high volatility. As some kind of compromise between demand for seasonal adjustment from Eurostat and the need for smoothing of the series, STAT computes trend series and publishes them as (seasonally) adjusted values.
As part of this grant project, we also carefully examined the currently used as well as the three resulting alternative time series with regard to seasonal adjustment, using X-13ARIMA-SEATS (seasonal adjustment program from the US Census Bureau[4]). Apart from new series possibly showing inherent seasonal patterns there was also hope that the length of the time series might have an effect now that the time series are much longer – meanwhile more than 13 years (January 2004 until April 2017) instead of 6.5 (January 2004 until June 2010).

Summarizing the results, some series, like monthly unemployed persons aged 15 to 74, show seasonality (overall index of quality of seasonal adjustment[5]: Q=1.01, even so this might change from month to month), also unemployed men (Q=0.95) and older persons aged 25 to 74 (Q=0.86). For these series seasonal adjustment would be meaningful. But there are still series showing no (identifiable) seasonal pattern, e.g. unemployed women (Q=1.77) or young persons aged 15 to 24 (Q=1.65). Be that as it may, regarding the four subgroups (sex by age group) that have to be transmitted to Eurostat, none of them has a Q-value less or equal to 1 (young men Q=1.81, older men Q=1.11, young women Q=1.68, older women Q=1.09). Series of employment on the other hand tend to show seasonality.

In general, performing seasonal adjustment for those series with identifiable seasonality and using the not adjusted series as seasonally adjusted ones if there is no significant seasonal pattern would lead to some quite smooth series and some very erratic series. Such inconsistent series are not wanted. As a consequence, using trend series as (seasonally) adjusted series is still the means of choice.

[4] https://www.census.gov/srd/www/x13as/
[5] Q-values ≤ 1 indicate seasonality.

2.2. Adaption of the weighting procedure (Alternative A)

In the framework of this project the current weighting procedure was adapted to better fit MUR-groups. Various possibilities were considered, the most promising one was the following:

- N_{ga} … Total number of persons in private households of gender g (=1, 2) and in age class a (1=0-14 and 75+, 2=15-24, 3=25-74).
- N_n … Total number of persons in private households with nationality n (=1,…,6) comprising the groups "Austria", "EU-15 (without Austria)", "EU 2004+ (joined the EU between 2004 and 2014)", "European non-EU countries", "Turkey", "Others".
- N_{ge} … Total number of persons in private households, of gender g (=1, 2) and with administrative employment status e (=1,…,5) which consists of the groups "Employee standard", "Employee non-standard", "Self-Employed", "Unemployed" and "Inactive".

In contrast to the currently used specifications, no household sizes and no regions (NUTS2) are directly used in the weighting procedure. Still, regions are implicitly included, as the base weights (i.e. the starting values for the iterative process), which are basically the inverse of the selection probabilities, are region-specific. During the weighting process, monthly as well as quarterly weights[6] are produced. To reach convergence of the quarterly weights, some minor adjustments of the iterative proportional fitting process were required, namely the threshold for convergence had to be increased for certain specifications (e.g. increase of the threshold from 0.5% to 20% for the number of households for household size 4 and 5+, in very few instances the threshold had to be increased for other household size groups in certain regions as well).

The expectation on this approach was, to produce less volatile monthly unemployment series, especially of the sub-groups. One drawback of this approach is the risk of higher revisions when final quarterly results are available and monthly estimates have to be adapted to quarterly results[7]. Further limitations of the weighting specifications would lead to bigger differences between monthly and quarterly estimates and in the following to bigger revisions.

Monthly Unemployment Rates

Results of the MUR-estimation process itself, i.e. monthly unemployment figures (not adjusted as well as trend series) are – unsurprisingly – very similar to published results, see Table 3 and Figure 2. The main reason for the similarity of original and alternative results is entailed in the consistency-adjustment. Even if alternatively weighted flash- and final monthly results vary, the real ultimate monthly figures are very similar as they are adjusted to fit the same quarterly figures.

Quality Indicators - Evaluation

Nevertheless, quality indicators are slightly worse. As anticipated, revisions are even more problematic. In this case, two main revision indicators are above the threshold, see Table 4. To get an idea of the impact of the length of the test period on the revision indicators, all revision indicators were computed for the short period March 2015 – September 2016 too. Indicators are slightly different (e.g. R1=0.2105 instead of 0.1818), but there is no difference in the evaluation regarding the thresholds.

One of the hopes for the adaption of the weighting procedure, i.e. the downsizing of the number of calibration specifications, was to reduce the variance of the estimates. Indeed, context volatility indicator v1, the coefficient of variation, decreased: January 2014 cv=0.04, February 2014 cv=0.05, March 2014 cv=0.05.

[6] Both preliminary flash and final weights are always based on all persons of a reference month or quarter who are already processed in the data preparation process at the hypothetical date of the weighting.

[7] When fitting final monthly figures to quarterly results, slightly different quarterly figures were used than the numbers published by STAT. This means that quarterly figures were recalculated for all quarters since Q1 2005 using somewhat different combinations of the population constraints in certain cases when convergence was not reached with the original constraints. This became necessary because here we used a different function for the iterative proportional updating procedure (IPU).

Month		Unemployment rates				Unemployed persons total in 1000	Unemployment rates			
		Trend series					Not adjusted series			
		Total	Males	Females	15-24 years		Total	Males	Females	15-24 years
		in %					in %			
2014	I.	5.6	5.6	5.6	11.4	256.7	6.0	6.1	5.9	12.9
	II.	5.6	5.8	5.5	10.8	255.0	6.0	6.3	5.6	10.4
	III.	5.6	5.7	5.4	10.1	258.6	6.0	6.0	6.0	11.2
	IV.	5.5	5.5	5.4	9.9	232.1	5.4	5.9	4.8	8.5
	V.	5.5	5.5	5.4	10.0	225.2	5.2	5.2	5.3	8.9
	VI.	5.6	5.8	5.4	10.6	252.0	5.8	6.3	5.1	10.0
	VII.	5.6	5.8	5.4	10.2	253.4	5.8	6.0	5.5	12.7
	VIII.	5.6	5.7	5.4	9.8	227.5	5.2	5.1	5.3	8.1
	IX.	5.7	6.1	5.2	10.0	250.9	5.7	6.1	5.3	10.9
	X.	5.7	6.2	5.1	10.4	233.2	5.3	5.8	4.8	10.1
	XI.	5.7	6.0	5.3	10.4	245.2	5.6	5.5	5.8	9.6
	XII.	5.6	5.9	5.3	9.7	247.5	5.7	6.1	5.3	10.8
2015	I.	5.5	5.7	5.2	8.7	241.6	5.6	5.9	5.2	8.3
	II.	5.5	5.7	5.2	9.1	254.7	6.0	6.2	5.6	10.1
	III.	5.7	6.0	5.4	10.9	258.5	6.0	6.6	5.2	10.7
	IV.	6.0	6.2	5.6	11.3	260.6	6.0	6.5	5.5	10.9
	V.	6.0	6.3	5.6	10.8	254.5	5.8	6.1	5.5	9.1
	VI.	5.8	6.1	5.4	10.3	248.4	5.7	6.1	5.2	10.8
	VII.	5.6	5.9	5.3	10.5	251.4	5.7	5.9	5.4	11.8
	VIII.	5.6	6.1	5.1	10.7	244.2	5.5	5.9	5.1	10.7
	IX.	5.6	6.2	5.0	10.8	253.5	5.7	6.3	5.1	11.3
	X.	5.7	6.2	5.2	11.1	230.0	5.2	5.4	5.0	10.4
	XI.	5.9	6.3	5.4	11.5	270.2	6.1	6.2	5.9	11.8
	XII.	6.1	6.5	5.6	11.7	256.9	5.8	6.3	5.3	11.4
2016	I.	6.1	6.5	5.6	11.9	280.7	6.4	6.9	5.8	12.3
	II.	6.0	6.4	5.5	11.9	280.4	6.4	7.3	5.4	12.8
	III.	5.9	6.3	5.4	10.9	263.5	6.0	6.3	5.6	9.4
	IV.	6.0	6.6	5.5	10.8	268.1	6.1	7.0	4.9	10.3
	V.	6.2	6.6	5.7	11.4	279.5	6.2	6.6	5.8	10.9
	VI.	6.2	6.6	5.8	11.6	271.2	6.0	6.2	5.8	11.1
	VII.	6.2	6.7	5.8	11.3	279.0	6.1	6.9	5.2	13.3
	VIII.	6.2	6.5	5.8	11.5	286.0	6.3	6.2	6.3	10.5
	IX.	6.1	6.4	5.7	11.5	273.6	6.0	6.2	5.9	13.0
	X.	5.9	6.3	5.5	11.1	252.1	5.6	5.8	5.3	10.5
	XI.	5.7	6.2	5.2	10.3	251.6	5.6	5.7	5.6	9.9
	XII.	5.7	6.1	5.1	10.4	252.2	5.7	6.3	4.9	10.4
2017	I.	5.8	6.3	5.2	10.7	258.1	5.8	6.3	5.3	11.2
	II.	5.8	6.3	5.2	10.6	277.1	6.3	7.4	5.1	10.8
	III.	5.6	6.2	5.1	10.3	256.3	5.8	6.2	5.3	9.3
	IV.	5.4	5.9	4.9	10.5	236.1	5.3	6.0	4.4	9.6

S: STATISTICS AUSTRIA, Labour Force Survey (Microcensus), from 2004 onwards: continuous survey (average of all weeks of a month). Compiled on 17 July 2017. Population in private households, without conscripts and people in community service. Trend series: medium and longterm development without any shortterm variations like seasonality. Estimates of current months are preliminary.

Table 3: Monthly unemployment data, alternative A.

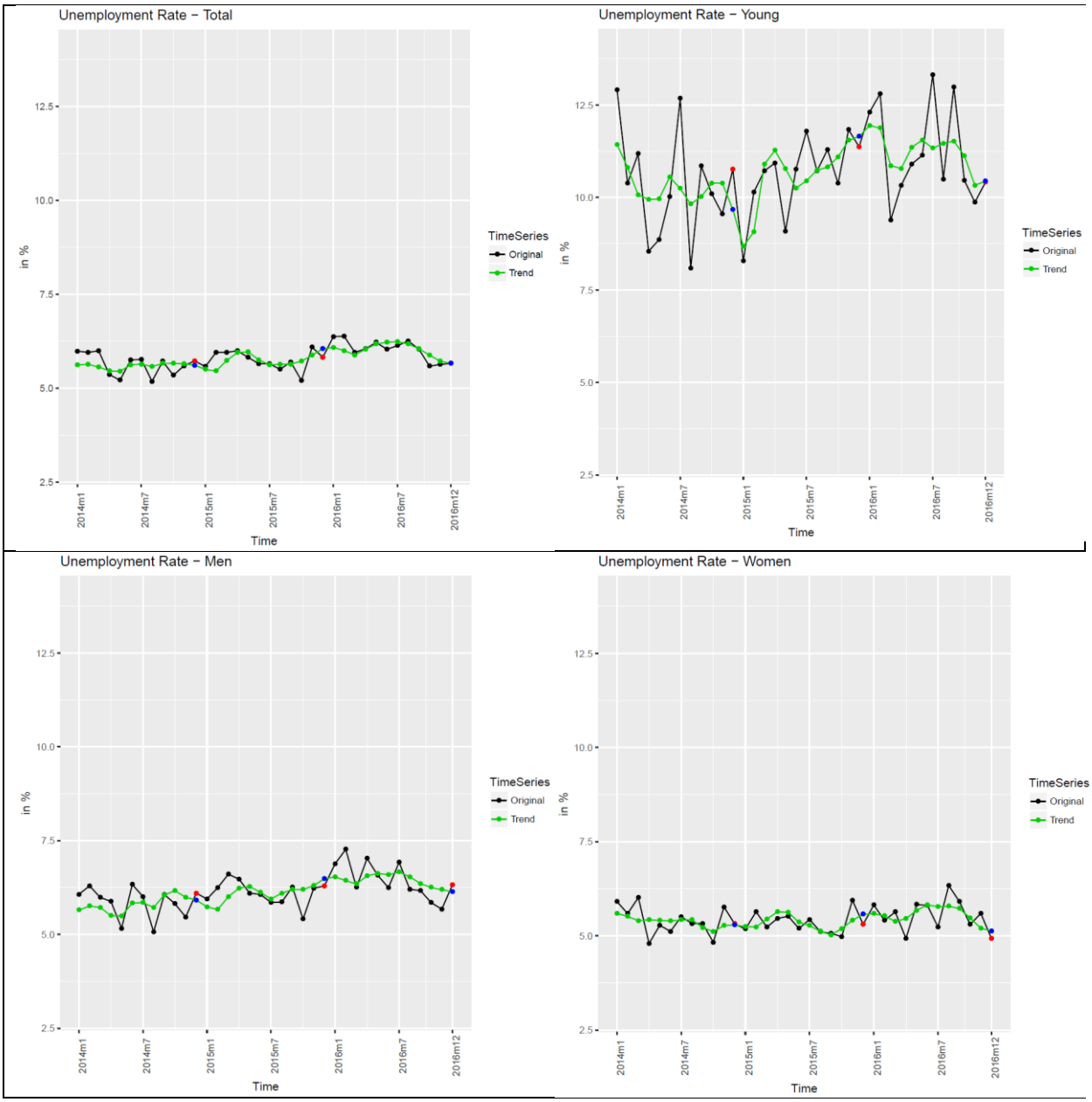

Figure 2: Monthly unemployment rates, not seasonally adjusted and trend series, alternative A.

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.4639	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.1818	<	0.1	bad
R2	freq. of very large revisions in levels	0	<	0.1	good
R3	freq. of large revisions in m-on-m changes	0.1250	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0	<	0.1	good

Table 4: Core quality indicators for MUR based on estimation alternative A, Volatility indicators test period: January 2014 – December 2016, Revision indicators: January 2014 – September 2016.

Time Series Decomposition and Seasonal Adjustment

Time series analysis shows more or less the same results for alternative A (series start in January 2005 and end in April 2017) as for series based on the current weighting procedure, no stable seasonal pattern is identifiable, i.e. seasonal adjustment in the narrower sense is not feasible. Total

monthly unemployed persons show some seasonal pattern (Q=0.98), as do monthly unemployed men (Q=0.84) and persons aged 25 to 74 (Q=0.83), but no seasonal pattern can be identified in the monthly unemployed women (Q=1.32) and young persons (Q=1.62). Considering the four sub-groups, only unemployed men aged 25 to 24 have a Q-value less to 1 (Q=0.97). Consequently, trend series would still be used as seasonally adjusted series.

Summarizing, regarding core quality indicators and seasonal adjustment, alternative A has no advantage over the current procedure. Therefore this approach is not followed up.

2.3. Regression composite estimation method (Alternative B)

This estimation was developed at Statistics Canada and is used for the Canadian Labour Force Survey, see e.g. Fuller & Rao (2001), Singh, Kennedy & Wu (2001) and Gambino, Kennedy & Singh (2001). It uses a version suggested by Fuller (1999) of the composite estimators introduced by Singh (1994, 1996).

The general idea is to use past information for the estimation of the present. According to Singh, Kennedy & Wu (2001), the regression composite (RC) estimator has the same positive properties plus some advantages over its previous version, the generalized regression (GREG) estimator:

- Less volatility due to an increase of efficiency of the estimates.
- Meeting of usual specifications from the reference period plus some additional specifications from the past.
- Consistency of sub- and super-groups.
- Possibility to compute as calibration estimator.

Even though the volatility of the currently published MUR series for Austria is below the threshold and therefore an increase of smoothness is not an obvious aim, there is the hope that smoothing the (not adjusted) series could reveal a comparatively small but inherent seasonal pattern.

We based our implementation of the RC estimation procedure on an example suggested in Gambino, Kennedy & Singh (2001). To be more specific, we decided that our primary interest lies in the estimates of level and not of change, i.e. the unemployment rate and not the change of the unemployment rate. We were also interested in using past information of the economic activity, variable "industry", as a new auxiliary variable. The decision to use the economic activity from the past is based on the fact that some sectors in Austria have rather high seasonal effects (e.g. construction and tourism) some sectors show no seasonality at all. Therefore it seemed to make sense also to include the economic activity sector from the past to estimate the labour status.

However, in contrast to the Canadian case where past information means t-1, i.e. the previous month, past information for the Austrian MUR means t-3 since the Austrian LFS is a quarterly panel (see Section 0.). The theoretical overlap is four fifth in the Austrian case. We are in the fortunate situation of having recently created overlap data sets for the computation of quarter-to-quarter labour market flow estimates which already contain imputed values for t-3. A detailed description of the structure and the generation of these quarter-to-quarter datasets are given in a (at the time of the creation of this report) still unpublished technical report, see Baierl, Gumprecht & Meraner (2017). We used these overlap data sets to construct monthly data necessary for estimating the MUR with the RC estimator. The procedure of how these monthly data sets were created is explained in more detail in the following paragraph:

As in Gambino, Kennedy & Singh (2001), let our monthly data set X consist of $i = 1, \cdots, n$ observations, let M denote the matched (common) sample and U denote the unmatched (birth) sample. We merge the auxiliary variable from time point t-3, i.e. the variable "industry" with a certain number $j = 1, \cdots, J$ of characteristic values, to our data X in the form of $j = 1, \cdots, J$ dummy binary variables x^j, i.e. numeric stand-ins for qualitative variables. This will lead to missing values in the x^j variables for the unmatched sample U. As explained in Gambino, Kennedy & Singh (2001), the missings in x^j are substituted with $\hat{y}_{t-3}^j$ for every $j = 1, \cdots, J$ respectively, which is the estimate of the proportion of people with "industry" j at time point t-3, e.g. the proportion of people employed in construction. Hence, x^j will equal 0 or 1 for observations x_i^j belonging to the matched sample M and $\hat{y}_{t-3}^j$ for observations x_i^j belonging to the unmatched (birth) sample U:

$$x_i^j = \begin{cases} x_{i,t-3}^j, & if\ i \in M \\ \hat{y}_{t-3}^j, & if\ i \in U \end{cases}$$

where $x_{i,t-3}^{j}$ is the value of observation i for variable x^j at time point t-3.

The control totals corresponding to the new auxiliary variables x^j, $j = 1, \cdots, J$, are the respective estimates of the number of people with "industry" j at time point t-3, e.g. the number of people employed in construction three months ago. The "industry" variable used in our computations consists of 8 aggregated NACE groups and a filter group. The specifications are the following:

- nace_8_1_lag … Total number of persons in private households at time point t-3 with industry 'Other sectors'[8]
- nace_8_2_lag … Total number of persons in private households at time point t-3 with industry 'Manufacturing'[9]
- nace_8_3_lag … Total number of persons in private households at time point t-3 with industry 'Construction'[10]
- nace_8_4_lag … Total number of persons in private households at time point t-3 with industry 'Trade'[11]
- nace_8_5_lag … Total number of persons in private households at time point t-3 with industry 'Transport'[12]
- nace_8_6_lag … Total number of persons in private households at time point t-3 with industry 'Accommodation and food service'[13]
- nace_8_7_lag … Total number of persons in private households at time point t-3 with industry 'Services'[14]
- nace_8_8_lag … Total number of persons in private households at time point t-3 with industry 'Public sector'[15]
- nace_8_99_lag … Total number of persons in private households at time point t-3 with no industry per definition (filter), e.g. unemployed persons, children, etc.

The remaining control totals such as gender, age, nationality, region and administrative employment status all refer to time point t for which the MUR is to be computed.

In the course of testing the use of the RC estimator, we tried four different approaches, one leading to another:

1) Model assisted estimation with R package ReGenesees – extensive model

The model assisted estimation is performed using the current constraints as defined in Section 2.1 (current weighting procedure) without the household constraints M_{rh} but together with the new "industry" control totals as introduced above. The control totals utilized in this approach are the following (see the definitions above and Section 2.1 for more detail):

- Economic activity in the past t-3 (nace_8_1_lag, …, nace_8_99_lag)
- N_{rga} (region x gender x 19 age groups)
- N_n (nationality groups)
- N_{rge} (region x gender x administrative labour status)

[8] A: Agriculture, forestry and fishing. B: Mining and quarrying. L: Real estate activities. R: Arts, entertainment and recreation. T: Activities of households as employers. U: activities of extraterritorial organisations and bodies.

[9] C: Manufacturing. D: Electricity, gas, steam and air conditioning supply. E: Water supply; sewerage, waste management and remediation activities.

[10] F: Construction.

[11] G: Wholesale and retail trade; repair of motor vehicles and motorcycles.

[12] H: Transportation and storage.

[13] I: Accommodation and food service activities.

[14] J: Information and communication. K: Financial and insurance activities. M: Professional, Scientific and technical activities. N: Administrative and support service activities. S: Other service activities.

[15] O: Public administration and defence; compulsory social security. P: Education. Q: Human health and social work activities.

To be more specific, the following calibration model was specified in function `e.calibrate()`:

```
calmodel = ~ nace_8_1_lag + nace_8_2_lag + nace_8_3_lag +
nace_8_4_lag + nace_8_5_lag + nace_8_6_lag + nace_8_7_lag +
nace_8_8_lag + nace_8_99_lag + region:gender:age + nationality +
region:gender:administrative_employment_status -1
```

Unfortunately, `e.calibrate()` did not converge with this model. We tried to reduce the number of age groups – but still no convergence in sight. Which lead us to approach number 2.

2) Model assisted estimation with R package ReGenesees - reduced model

The model assisted estimation is now performed using the modified constraints (alternative A) as in Section 2.2 together with the new "industry" control totals as introduced above. The control totals used in this approach were the following (see the definitions above and Section 2.2 for more detail):

- Economic activity in the past t-3 (nace_8_1_lag, …, nace_8_99_lag)
- N_{ga} (gender x 3 age groups)
- N_n (nationality groups)
- N_{ge} (gender x administrative labour status)

The calibration model was changed to:

```
calmodel = ~ nace_8_1_lag + nace_8_2_lag + nace_8_3_lag +
nace_8_4_lag + nace_8_5_lag + nace_8_6_lag + nace_8_7_lag +
nace_8_8_lag + nace_8_99_lag + gender:age + nationality +
gender:administrative_employment_status -1
```

Again, `e.calibrate()` did not converge. Since our goal was to use more or less consistent constraints and tolerance limits for the whole time series which did not seem possible with this procedure under satisfactory conditions we decided to go yet another way, i.e. use calibration estimation instead of a GREG based estimator since the calibration estimator converges to the GREG estimator when n is large.

3) Calibration estimation with R package simPop

Calibration estimation is carried out using the modified constraints (alternative A) as in Section 2.2 together with the new "industry" control totals as introduced above. In this approach, the same calibration specifications where used as in approach number 2). Convergence was reached using function `ipu2()` but curtailments had to be made in this case as well, i.e. the tolerance of 1e-06 had to be raised to 0.005 or even to 0.01 for `nace_8_99_lag`, the filter value of the variable "industry". In the course of this project work, some deficits of the used characteristics of the variable "industry" became apparent. The group of people exhibiting the filter value, i.e. persons without any economic activity sector, such as children, unemployed people, persons in military or community service and retired persons is very diverse. This turned out to be a shortcoming of this variable.
Therefore a breakdown of the filter-group into persons aged 15 to 64 and the rest was done. As a result, unemployed persons and working age persons out of labour force (15 to 64) are separated from children and old and most probably already retired persons.

4) Calibration estimation with R package simPop – modified "industry" control total

Calibration estimation is carried out using modified constraints (alternative A) as in Section 2.2 together with modified "industry" control totals. The variable "industry" was adapted. Filter value nace_8_99_lag from the previous approach 3 was replaced by the following two characteristics:

- nace_8_100_lag … Total number of persons in private households at time point t-3 aged 15 to 64 (i.e. unemployed and persons out of labour force).
- nace_8_99_lag … Total number of persons in private households at time point t-3 with no industry per definition and age < 15 or > 64 (filter).

Another promising option for further research is using other auxiliary variables instead of “industry”, preferably variables like the (administrative) labour status in t-3. This might lead to better results for the MUR.

Monthly Unemployment Rates

Results of approach 4, the final calibration estimation procedure of this chapter, are given in Table 5 and Figure 3 in the form of not adjusted MUR series[16] and trend series. Compared to currently published series and series of alternative A, differences are relatively small, see also Section 2.5.

Quality Indicators - Evaluation

Quality indicators (see Table 6) are more or less the same as for the current option and therefore better than for alternative A. As with the currently published MUR estimates, all core volatility indicators are within the range of the thresholds, and three out of four core revision indicators are okay, only the frequency of large revisions in month-on-month changes (R3) is too high.

Time Series Decomposition and Seasonal Adjustment

Analysing unemployment series with regards to seasonal adjustment gave more or less the same results as the current series and alternative A. The time series of the total unemployed population aged 15 to 74 slightly exceeds the marginal threshold of the overall index of quality of seasonal adjustment (Q=1.03), the series of all unemployed men and of all persons aged 25 to 74 are within the acceptance region, i.e. Q<1. Series of unemployed women and unemployed young persons have a Q-value greater 1. Regarding sub-groups, the series of unemployed older men is the only one where seasonal adjustment would be suggestable (Q=0.83), for all other unemployment series no seasonal adjustment would be recommended.

[16] Ultimate monthly values, i.e. final monthly figures adjusted to fit quarterly figures from alternative A.

Month		Unemployment rates				Unemployed persons total in 1000	Unemployment rates			
		Trend series					Not adjusted series			
		Total	Males	Females	15-24 years		Total	Males	Females	15-24 years
		in %					in %			
2014	I.	5.7	5.7	5.6	11.5	257.7	6.0	6.1	6.0	13.0
	II.	5.7	5.7	5.6	11.1	255.7	6.0	6.3	5.6	10.3
	III.	5.6	5.7	5.4	10.3	256.8	6.0	6.0	5.9	11.2
	IV.	5.5	5.6	5.4	9.8	233.3	5.4	5.9	4.8	8.5
	V.	5.5	5.6	5.3	9.6	224.2	5.2	5.1	5.3	8.8
	VI.	5.7	5.9	5.4	10.5	251.8	5.8	6.3	5.1	10.1
	VII.	5.7	5.9	5.4	10.2	253.5	5.8	6.0	5.5	12.6
	VIII.	5.6	5.7	5.4	9.7	229.1	5.2	5.1	5.4	8.3
	IX.	5.7	6.0	5.2	9.9	249.2	5.7	6.0	5.3	10.7
	X.	5.7	6.2	5.1	10.3	234.4	5.4	5.8	4.9	10.0
	XI.	5.7	6.0	5.3	10.4	245.1	5.6	5.5	5.8	9.5
	XII.	5.6	5.9	5.3	9.7	246.4	5.7	6.1	5.3	10.9
2015	I.	5.5	5.7	5.3	8.8	241.2	5.6	5.9	5.2	8.3
	II.	5.5	5.7	5.2	9.2	254.0	5.9	6.2	5.7	10.1
	III.	5.8	6.1	5.4	10.9	259.6	6.0	6.7	5.2	10.7
	IV.	6.0	6.2	5.7	11.3	258.9	6.0	6.4	5.4	10.8
	V.	6.0	6.2	5.7	10.9	254.5	5.8	6.1	5.6	9.3
	VI.	5.8	6.1	5.4	10.3	250.2	5.7	6.1	5.2	10.7
	VII.	5.7	6.0	5.3	10.6	252.8	5.7	5.9	5.5	11.9
	VIII.	5.7	6.1	5.1	10.9	243.9	5.5	5.9	5.1	10.8
	IX.	5.7	6.2	5.0	10.9	252.3	5.7	6.2	5.0	11.1
	X.	5.7	6.2	5.2	11.1	232.7	5.3	5.4	5.1	10.7
	XI.	5.9	6.3	5.4	11.5	269.1	6.1	6.2	5.9	11.7
	XII.	6.0	6.5	5.5	11.5	255.3	5.8	6.3	5.3	11.1
2016	I.	6.1	6.5	5.5	11.8	279.6	6.3	6.9	5.8	12.3
	II.	6.0	6.5	5.5	11.8	282.8	6.4	7.3	5.5	12.6
	III.	5.9	6.4	5.4	10.9	262.2	5.9	6.2	5.6	9.6
	IV.	6.0	6.5	5.5	10.9	268.7	6.1	7.0	4.9	10.4
	V.	6.2	6.6	5.7	11.4	279.7	6.2	6.6	5.8	10.9
	VI.	6.2	6.6	5.7	11.5	270.4	6.0	6.2	5.8	11.1
	VII.	6.2	6.7	5.7	11.4	279.5	6.2	7.0	5.2	13.4
	VIII.	6.2	6.6	5.9	11.5	285.6	6.3	6.2	6.4	10.3
	IX.	6.1	6.3	5.8	11.5	273.4	6.0	6.2	5.9	13.1
	X.	5.9	6.2	5.5	11.0	251.3	5.6	5.8	5.3	10.6
	XI.	5.7	6.2	5.2	10.2	252.6	5.7	5.7	5.6	9.9
	XII.	5.7	6.2	5.1	10.4	252.0	5.7	6.4	4.9	10.3
2017	I.	5.7	6.3	5.1	10.6	258.4	5.8	6.3	5.3	11.4
	II.	5.8	6.4	5.1	10.5	275.2	6.2	7.3	5.1	10.6
	III.	5.6	6.1	5.1	10.3	257.9	5.8	6.3	5.3	9.4
	IV.	5.4	5.8	5.0	10.3	233.4	5.2	5.9	4.5	9.7

S: STATISTICS AUSTRIA, Labour Force Survey (Microcensus), from 2004 onwards: continuous survey (average of all weeks of a month). Compiled on 22 August 2017. Population in private households, without conscripts and people in community service. Trend series: medium and longterm development without any shortterm variations like seasonality. Estimates of current months are preliminary.

Table 5: Monthly unemployment data, alternative B.

Figure 3: Monthly unemployment rates, not seasonally adjusted and trend series, alternative B.

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.4093	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.0909	<	0.1	good
R2	freq. of very large revisions in levels	0.0303	<	0.1	good
R3	freq. of large revisions in m-on-m changes	0.1250	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0	<	0.1	good

Table 6: Core quality indicators for MUR based on estimation alternative B, Volatility indicators test period: January 2014 – December 2016, Revision indicators: January 2014 – September 2016.

2.4. Rolling quarters approach (Alternative C)

For each consecutive period of three months, estimates are produced with the same procedure as for the current quarterly LFS. The rolling quarter estimate is used as the monthly estimate of the middle month. Due to timeliness requirements, the last weeks[17] of the last month of the rolling quarter are missing for flash estimates. This lack of information on the situation at the end of the rolling quarter is regarded and treated like "normal" non-response, i.e. it is assumed that a potential bias is corrected by the weighting procedure, particularly by the adaption to the labour status. For this test it was assumed that specifications for weighting, including the administrative labour status (which is also needed for each individual person in the LFS dataset) of the last month of a rolling quarter, are known at the point in time when (flash) rolling quarter estimates for a reference month are computed for the 1st time. In real life, these specifications and administrative data are not available in time and forecasts would be used instead. Running the rolling quarter approach in live operation would lead to worse results due to the use of forecasts instead of real data. The basic idea behind this approach is: only if the results of this (unrealistic) best case rolling quarter scenario is promising, this way will be continued. Forecasts of weighting specifications and treatment of missing information on individual data will be considered if and only if at least the optimal MUR series outperform the ones currently used. The rolling quarters were built from 2005 onwards. In course of this, an unforeseen problem occurred: some rolling quarters contain the same person twice, i.e. one and the same person is included with different reference weeks, e.g. a person has a reference week at the beginning of December 2004 and the next reference week is at the beginning of March 2005 but due to the principles of how a reference quarter and a reference month are determined, this person has reference month December 2004 and February 2005. Regarding calendar months – each person appears only once a calendar quarter, but regarding the rolling quarter Dec-Jan-Feb this person appears twice. Computing the rolling-quarter-weights one has to watch out for such cases. They occur in the following six rolling quarters: Dec(2005)-Jan-Feb, May-Jun-Jul(2008), Mar-Apr-May(2012), Nov-Dec(2012)-Jan, Aug-Sept-Oct(2013), and May-Jun-Jul(2014). In practice, this means that the base weights (start of the iteration process) of such cases have to be divided by 2 and every affected household is split up into 2 households, each corresponding to its respective reference month.

Monthly Unemployment Rates

The rolling-quarter based MUR series are given in Table 7. Like always, ultimate monthly figures are adjusted to quarterly figures[18]. Not seasonally adjusted series and the trend can be seen in Figure 4. It is obvious that rolling-quarter based MUR series are less volatile than series based on single month estimates. This raises the question whether rolling quarter based not seasonally adjusted monthly unemployment series are too smooth, in the sense that too many of the monthly features are smoothed out.

Quality Indicators - Evaluation

Quality indicators of monthly unemployment rates based on rolling quarters are worse than the ones for the current procedure. As for the results from alternative A, volatility indicators are good, but two main revision indicators are above the threshold, see Table 8. High(er) revisions are somehow expectable, as final monthly unemployment rates (based on rolling quarters) are adjusted to calendar quarters to guarantee consistence between monthly and quarterly results. Unsurprisingly V1 (correlation of month-on-month changes) has the highest value of all alternatives, but it's still below the upper threshold of 0.75.

[17] The last two or three reference weeks - depending on the definite day of the production of the LFS-dataset.
[18] Recalculated quarterly figures based on the new function for IPU.

Time Series Decomposition and Seasonal Adjustment

Concerning time series analysis and seasonal adjustment the rolling quarters approach has a big advantage over the current procedure and alternatives A and B. Due to the generally high degree of smoothness of the not adjusted series, nearly all series of monthly unemployed persons (from January 2005 until April 2017) show seasonal patterns and allow for seasonal adjustment[19], only unemployed older women (and women in general) have Q-values greater than 1. From the point of view of standardisation and coherence with respect to the degree of smoothing, even the best case scenario of alternative C would not be optimal since only three out of four of the unemployed series are seasonally adjustable.

Aside from that and in view of the fact that these results from a rolling quarter approach are based on the complete monthly data of all three months of the rolling quarter, which – in real life – would not be available in time and would have to be forecasted[20], the rolling quarter approach is not followed up.

[19] Population Q=0.66, men Q=0.55, women Q=1.07, older persons Q=0.58, and younger persons Q=0.72, young men Q=0.77, older men Q=0.62, young women Q=0.76, older women Q=1.23.

[20] One could also say that the results of alternative B are based on the assumption of perfect forecasts.

Month		Unemployment rates				Unemployed persons total in 1000	Unemployment rates			
		Trend series					Not adjusted series			
		Total	Males	Females	15-24 years		Total	Males	Females	15-24 years
		in %					in %			
2014	I.	5.7	5.7	5.7	11.4	253.4	5.9	6.0	5.8	12.1
	II.	5.7	5.7	5.7	11.3	262.3	6.1	6.2	6.0	11.9
	III.	5.6	5.7	5.5	10.6	254.5	5.9	6.2	5.6	10.4
	IV.	5.5	5.7	5.3	9.8	237.7	5.5	5.8	5.2	9.0
	V.	5.5	5.8	5.3	9.7	234.0	5.4	5.8	4.9	8.7
	VI.	5.6	5.9	5.3	9.9	237.6	5.5	5.8	5.1	9.8
	VII.	5.6	5.8	5.4	10.2	245.6	5.6	5.8	5.4	10.6
	VIII.	5.6	5.8	5.4	10.1	246.6	5.6	5.7	5.5	10.9
	IX.	5.6	5.9	5.3	10.2	239.5	5.5	5.6	5.3	10.1
	X.	5.7	6.1	5.2	10.5	241.4	5.5	5.8	5.2	10.3
	XI.	5.7	6.1	5.3	10.5	240.7	5.5	5.8	5.3	10.3
	XII.	5.6	5.9	5.3	9.8	243.8	5.6	5.8	5.4	9.8
2015	I.	5.5	5.8	5.2	9.1	246.8	5.7	6.1	5.3	9.4
	II.	5.5	5.8	5.1	9.4	251.3	5.8	6.3	5.3	9.6
	III.	5.7	6.0	5.3	10.3	256.7	5.9	6.4	5.4	10.3
	IV.	5.9	6.2	5.5	10.9	258.9	6.0	6.4	5.4	10.3
	V.	5.9	6.2	5.6	10.9	254.5	5.8	6.2	5.4	10.1
	VI.	5.8	6.1	5.5	10.7	250.1	5.7	6.0	5.4	10.5
	VII.	5.7	6.0	5.3	10.6	249.6	5.6	6.0	5.2	11.3
	VIII.	5.6	6.1	5.1	10.6	252.6	5.7	6.1	5.2	11.4
	IX.	5.7	6.2	5.1	10.8	246.9	5.6	5.9	5.1	11.1
	X.	5.8	6.2	5.2	11.1	247.4	5.6	5.8	5.3	11.0
	XI.	5.9	6.2	5.4	11.3	247.8	5.6	5.8	5.4	11.1
	XII.	6.0	6.3	5.5	11.6	261.9	5.9	6.3	5.6	11.5
2016	I.	6.0	6.4	5.6	11.6	273.3	6.2	6.8	5.6	12.1
	II.	6.0	6.4	5.6	11.5	278.6	6.3	6.8	5.8	11.5
	III.	6.0	6.4	5.6	11.2	272.8	6.2	6.8	5.5	10.9
	IV.	6.0	6.4	5.6	11.1	268.7	6.1	6.6	5.5	10.2
	V.	6.2	6.6	5.7	11.3	272.8	6.1	6.6	5.5	10.6
	VI.	6.3	6.7	5.7	11.5	277.4	6.2	6.7	5.6	11.5
	VII.	6.2	6.7	5.7	11.6	283.7	6.2	6.6	5.8	12.1
	VIII.	6.2	6.6	5.7	11.7	281.5	6.2	6.5	5.8	12.8
	IX.	6.1	6.4	5.7	11.5	273.4	6.0	6.1	5.9	11.9
	X.	5.9	6.3	5.5	10.9	256.5	5.7	5.8	5.5	10.8
	XI.	5.8	6.2	5.3	10.3	248.6	5.6	5.9	5.2	9.8
	XII.	5.7	6.3	5.1	10.3	250.8	5.6	6.1	5.1	10.2
2017	I.	5.7	6.3	5.1	10.6	263.9	6.0	6.7	5.2	11.0
	II.	5.7	6.2	5.2	10.5	265.0	6.0	6.6	5.3	10.5
	III.	5.6	6.1	5.1	10.3	262.7	5.9	6.5	5.2	9.8
	IV.	5.5	5.8	5.1	10.2	246.7	5.5	6.0	5.0	9.2

S: STATISTICS AUSTRIA, Labour Force Survey (Microcensus), from 2004 onwards: continuous survey (average of all weeks of a month). Compiled on 17 July 2017. Population in private households, without conscripts and people in community service. Trend series: medium and longterm development without any shortterm variations like seasonality. Estimates of current months are preliminary.

Table 7: Monthly unemployment data, alternative C.

Figure 4: Monthly unemployment rates, not seasonally adjusted and trend series, alternative C.

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.5846	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.0909	<	0.1	good
R2	freq. of very large revisions in levels	0	<	0	good
R3	freq. of large revisions in m-on-m changes	0.1250	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0.0313	<	0.1	good

Table 8: Core quality indicators for MUR based on estimation alternative C, Volatility indicators test period: January 2014 – December 2016, Revision indicators: January 2014 – September 2016.

2.5. Conclusions on different estimation procedures

The plots in Figure 5 allow a direct comparison of all four currently produced MUR series of all persons aged 15 to 74 ("Orig.") and all three tested alternatives A, B, and C:

- **Flash series**: first estimates of monthly unemployment rates, based on early-respondents, i.e. persons from the LFS that are already available at the point in time when flash estimation takes place, approximately t+25 days. 1st transmissions of not adjusted monthly figures.
- **Final series**: final estimates of monthly unemployment rates, based on all respondents, i.e. all LFS persons corresponding to the reference month. Estimation takes place when the LFS quarter is completed. These monthly figures are not yet adjusted to quarterly figures and they are not transmitted to Eurostat at all.
- **Not seasonally adjusted (nsa) series**: final estimates of monthly unemployment rates adjusted to quarterly figures, computed approximately q+55 days. Once these values are generated, they do not change anymore.
- **Trend series**: the trends of the complete time series[21] are reestimated every month. Trend estimation is based on all available monthly data, i.e. nsa-series plus one to three flash months. Trend series are never really final, values can always change (marginally). 6th transmissions of trend series are used for revision indicators.

As expected, all series of alternative C (rolling quarter) are smoother than all other series, differences between current MUR series and alternatives A and B are rather marginal. Levels and differences between original series and test series A and B alternate. No homogeneous tendency can be seen.

[21] For original MUR series from January 2004 onwards, for alternative series from January 2005 onwards.

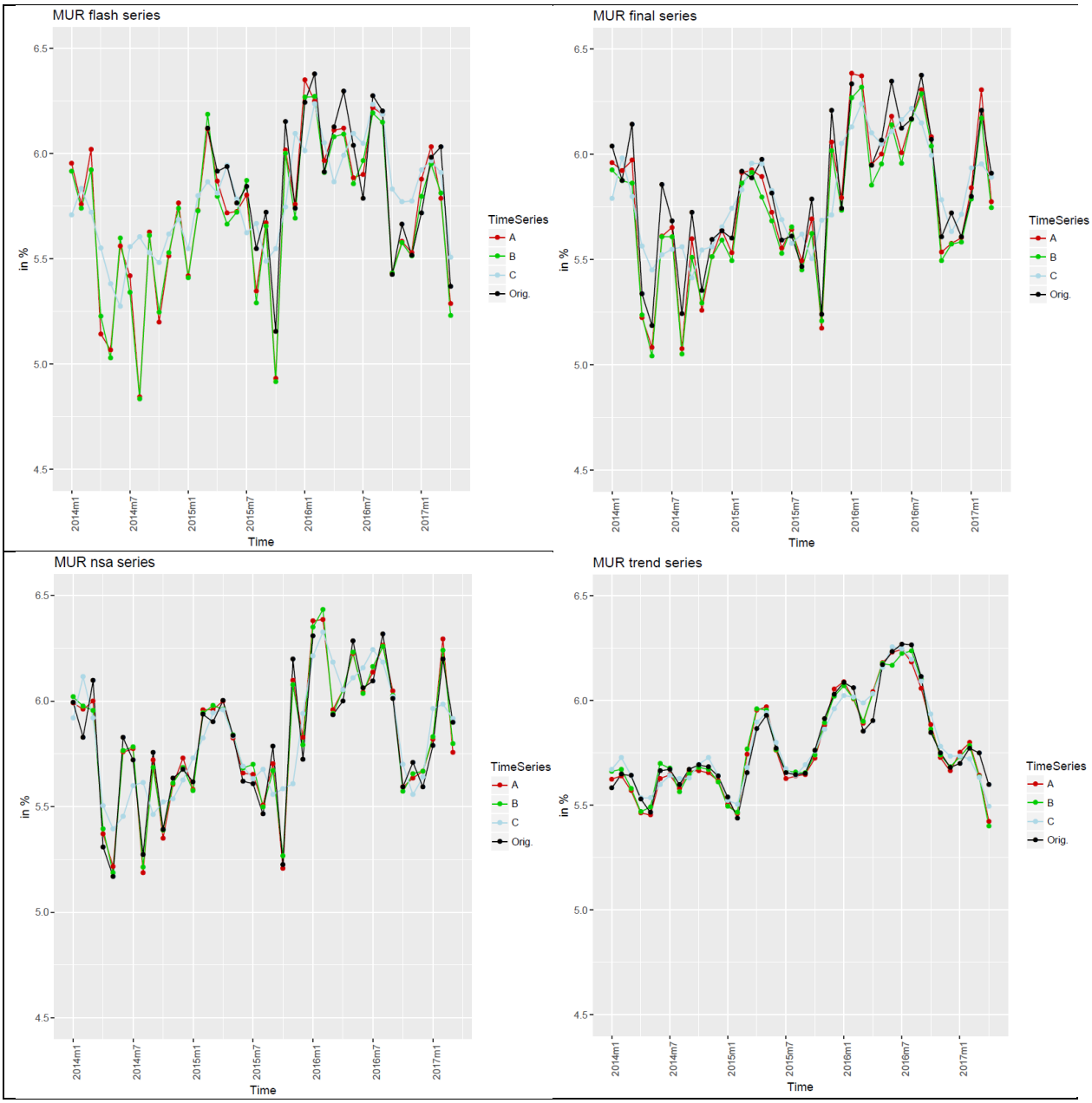

Figure 5: Flash, final, not seasonally adjusted (ultimate) and trend series of all original MUR series, alternative A, B, and C.

3. Summary

For the evaluation and ranking of all four different estimation procedures, the currently used one and alternatives A, B and C, we consider four aspects: (1) volatility, (2) revisions, (3) seasonal adjustment, and (4) timetable. An overview is given in Table 9. Estimation procedures that meet the requirements (at best) are marked by x.

Regarding quality indicators, the currently used production process outperforms tested alternatives A and C, while alternative B is just as good. Volatility indicators are in the required region for all four procedures but revision indicators of the current MUR series and of alternative B are better (three out of four are fine) than the ones of A and C (only two out of four are ok).

Regarding the possibility of producing seasonal adjusted series, the use of rolling quarters (alternative C) would be the means of choice.

Within the tight timetable for the MUR production and publication, alternative C is not manageable (at least not this best case scenario). All other options are appropriate.

Based on these criteria (and using the cost of changing the production process as an additional downstream criterion) the following ranking can be made:

1. Currently used production process
2. Alternative B (Regression composite estimation)
3. Alternative A (adaption of the weighting procedure)
4. Alternative C (Rolling quarters)

	Current process	A	B	C
Volatility	x	x	x	x
Revisions	x		x	
Seasonal Adj.				x
Timetable	x	x	x	

Table 9: Overview of performance of current production process and alternative A, B, and C.

Beside this evaluation and ranking of the different methods, another quite interesting fact came to light. It turned out that the last step of the production process of the MUR, the consistency adjustment, is the crucial one. Crucial in the sense, that it overcasts most of the differences based on the weighting procedure itself. All possible improvements of alternative weighting procedures are finally covered and (widely) erased by the last step of the MUR production process, the consistency adjustment. The revisions of published MUR series, i.e. unemployment rates of all persons aged [15; 74], men [15; 74], women [15; 74], and young persons aged [15; 24], will always be high as long as the final monthly unemployment results of a quarter have to be (made) consistent with quarterly results.

To conclude, further research on the regression composite estimation method, using other auxiliary variables like the past (administrative) labour status, will be done. However, the production process of the monthly unemployment rates will not change in the near future. The quality indicators will be computed regularly, most probably once a year, when 6th data transmission of the monthly figures for December are available.

Reference

Baierl, A., Gumprecht, D., Meraner, A., (2017) “Nutzung der Längsschnittdimension der Mikrozensus-Arbeitskräfteerhebung für die Analyse der Dynamik des österreichischen Arbeitsmarktes. Methodenbericht“. *Unpublished technical report.* [in German].

Fuller, W.A. (1999). “The Canadian Regression Composite Estimation”. *Unpublished manuscript.*

Fuller, W.A., Rao, J.N.K. (2001). “A Regression Composite Estimator with Application to the Canadian Labour Force Survey”. *Survey Methodology*, 27, 45-51.

Gambino, J., Kennedy, B., Singh, M.P. (2001). “Regression Composite Estimation for the Canadian Labour Force Survey: Evaluation and Implementation”. *Survey Methodology*, 27, 65-74.

Gumprecht, D., Haslinger, A., Kowarik, A. (2011). “Austrian LFS Monthly Unemployment Rates”. *Austrian Jounal of Statistics*. 40(4), 297-313.

Meraner, A., Gumprecht, D., Kowarik, A. (2016). ”Weighting Procedure of the Austrian Microcensus using Administrative Data“. *Austrian Journal of Statistics*. 45(3), 3-14.

Singh, A.C. (1994). “Sampling-design-based estimating functions for finite population totals”. *Invited paper, Abstracts of the Annual Meeting of the Statistical Society of Canada, Banff, Alberta, May 8-11*. p.48.

Singh, A.C. (1996). “Combining information in survey sampling by modified regression”. *Proceedings of the Survey Research Methods, American Statistical Association.* 1, 120-129.

Singh, A.C., Kennedy, B., Wu, S. (2001). “Regression Composite Estimation for the Canadian Labour Force Survey with a Rotating Panel Design”. *Survey Methodology*. 27(1), 33-44.

Appendix

Current weighting procedure

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.1120	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.0526	<	0.1	good
R2	freq. of very large revisions in levels	0	<	0.1	good
R3	freq. of large revisions in m-on-m changes	0.3333	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0.0556	<	0.1	good

Table A1: Core quality indicators for MUR of men, Volatility indicators test period: January 2014 – December 2016, Revision indicators: March 2015 – September 2016.

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.3051	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.2632	<	0.1	bad
R2	freq. of very large revisions in levels	0.1053	<	0.1	bad
R3	freq. of large revisions in m-on-m changes	0.3889	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0.0556	<	0.1	good

Table A2: Core quality indicators for MUR of women, Volatility indicators test period: January 2014 – December 2016, Revision indicators: March 2015 – September 2016.

Core	Short Description	Indicator	?	Threshold	Evaluation
V1	corr. of m-o-m changes	0.2470	>	-0.3	good
V2	freq. of double large inversions	0	<	0.05	good
R1	freq. of large revisions in levels	0.6842	<	0.1	bad
R2	freq. of very large revisions in levels	0.5263	<	0.1	bad
R3	freq. of large revisions in m-on-m changes	0.7222	<	0.1	bad
R4	freq. of very large revisions in m-on-m changes	0.6111	<	0.1	bad

Table A3: Core quality indicators for MUR of young persons aged 15 to 24, Volatility indicators test period: January 2014 – December 2016, Revision indicators: March 2015 – September 2016.

Context	Short Description	Indicator	?	Threshold	Evaluation
v1	theoretical coeff. of variation of nsa data	0.0524	.	.	.
v2	standard deviation of irregular comp.	0.2403	<	0.15	bad
v3	freq. of implausible monthly patterns	0.3	<	0.1	bad
v1	freq. of variations in m-o-m changes	0.4	<	0	good
r1	mean absolute revisions on nsa series in levels	0.0137	<	0.1	good
r2	max absolute revisions in levels	0.2611	<	0.4	good
r3	mean revisions in levels	-0.0120	<	0.1	good
r4	mean revisions in levels	0.0930	<	0.1	good
r5	mean absolute revisions on m-o-m changes	0.1029	<	0.1	bad

Table A4: Context quality indicators for MUR, Volatility indicators test period: January 2014 – December 2016, Revision indicators: March 2015 – September 2016, coefficient of variation of nsa data (v1) of December 2016.