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# REVISION POLICY OF SEASONALLY ADJUSTED SERIES – CASE STUDY ON ROMANIAN QUARTERLY GDP

***Abstract.*** *Seasonally adjusted data may change due to a revision of the unadjusted (raw) data or the addition of new data. These changes are called revisions and one of the key challenges for the National Statistical Offices is to balance the trade-off between the need for the best possible seasonally adjusted data, especially at the end of the series – the accuracy of seasonally adjusted data – and the need to avoid insignificant revisions that may later be reversed – series stability over time (Eurostat, 2015a, van Velsen et.al 2011).*

*Thus, designing an accurate and transparent revision policy is mandatory for any Official Statistical Office. This policy should contain: method and software choice for seasonal adjustment, dissemination and storage, methods and timing of reanalysis and revisions, means of aggregation of series, treatment of outliers, requirements for documentation both internal and for users, guidelines for releasing seasonally adjusted data (UNECE, 2012a). This study focuses of the revision policy of seasonal adjustment procedure of the Romanian Quarterly GDP (constant prices 2000). The calculations were performed using JDemetra+ v. 2.0, the official software (Eurostat, 2015b).*

***Key words*****:** *Seasonal adjustment, GDP, revision policy, JDemetra+.*
**JEL Classification: C5**

## 1. Analysing stability over time of Romanian Quarterly GDP

Table 1 shows the increase in seasonally adjusted series of the Romanian Quarterly GDP (constant prices 2000, second revision of the raw series). Revisions in the increase of the seasonally adjusted series were up to 0.9 pp for the first quarter, 0.5

pp for the second quarter, and 0.3pp for the third quarter. This may be due to economic factors or due to inadequate seasonal adjustment policy. This was previously pointed out by Nalban (2014) who, analysing press releases from the second quarter 2007-second quarter 2013 period, concluded that increases in the seasonally adjusted GDP present many errors and are not reliable for producing forecasts. As the economic factors such as the beginning of the crisis in 2008 may determine outliers in the 1995-2013 GDP series, it also creates major difficulties in the seasonal adjustment process.

**Table 1: Increase in seasonally adjusted series of the Romanian Quarterly GDP - constant prices 2000, data released second revision of the raw series (%), data source: Press Releases Archive of the National Institute of Statistics, Romania**

| | Press release no. 161 from 2 July 2014 | Press release no. 224 from 8 October 2014 | Press release no. 15 from 14 January 2015 | Press release no. 81 from 7 April 2015 |
|---|---|---|---|---|
| 2014q1 | 0.2 | -0.1 | 0.8 | 0.3 |
| 2014q2 | | -0.9 | -0.4 | -0.6 |
| 2014q3 | | | 1.8 | 2.1 |
| 2014q4 | | | | 0.7 |
| | Press release no. 166 from 7 July 2015 | Press release no. 166 from 7 October 2015 | Press release no. 21 from January 2016 | Press release no. 8 from April 2016 |
| 2015q1 | 1.5 | 1.4 | 1.4 | 1.3 |
| 2015q2 | | 0.1 | 0 | -0.1 |
| 2015q3 | | | 1.4 | 1.5 |
| 2015q4 | | | | 1.1 |

Revision of the seasonally adjusted data is a major concern for all statistical offices at European level. In order to ensure transparency towards its users, Eurostat publishes revised series for the growth rates of the seasonally adjusted GDP four quarters behind the current quarter of the press release. Next, we analysed the revisions in the GDP seasonally adjusted growth rates at European level for each quarter of 2014. Revised growth rates were taken from consecutive press releases of Eurostat for all member states except Ireland, Greece, Cyprus and Malta.

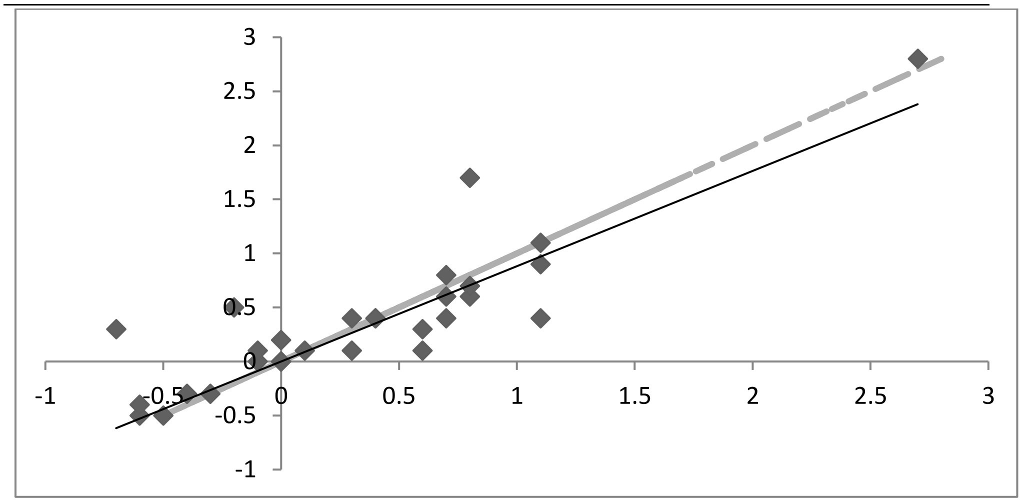


**Figure 1: Revised growth rates of the first quarter 2014 plotted against initial growth rates in of the first quarter 2014 with slope and ideal slope**

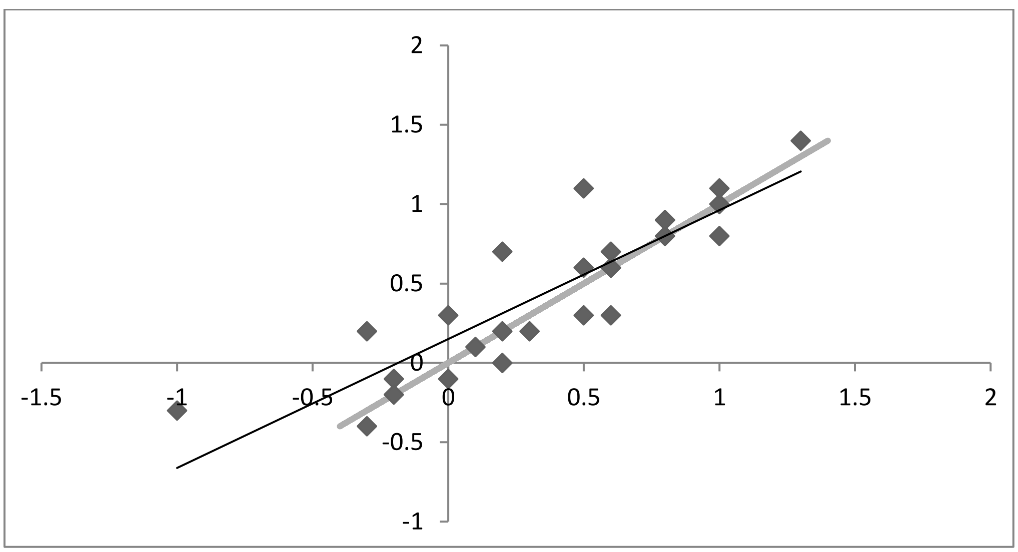


**Figure 2: Revised growth rates of the second quarter 2014 plotted against initial growth rates in of the second quarter 2014 with slope and ideal slope**

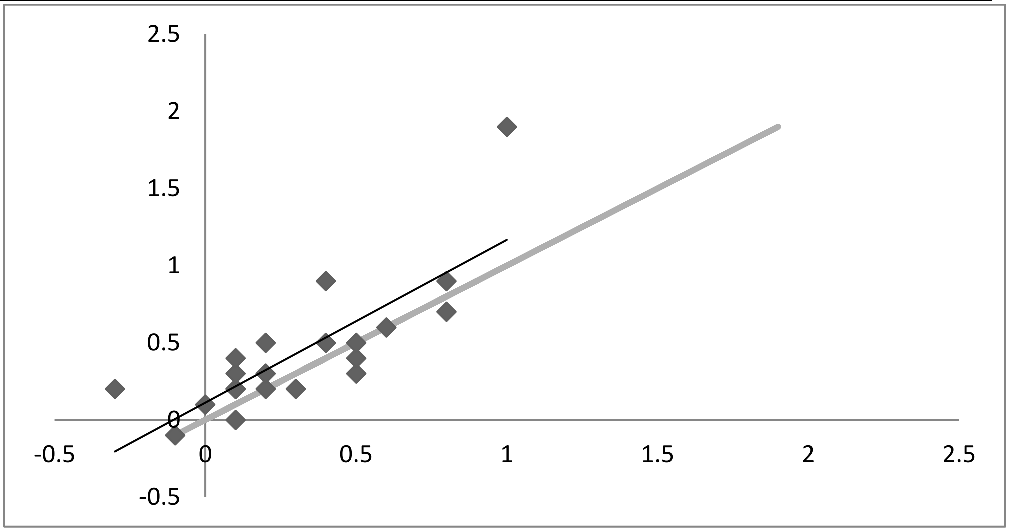


**Figure 3: Revised growth rates of the third quarter 2014 plotted against initial growth rates in of the third quarter 2014 with slope and ideal slope**

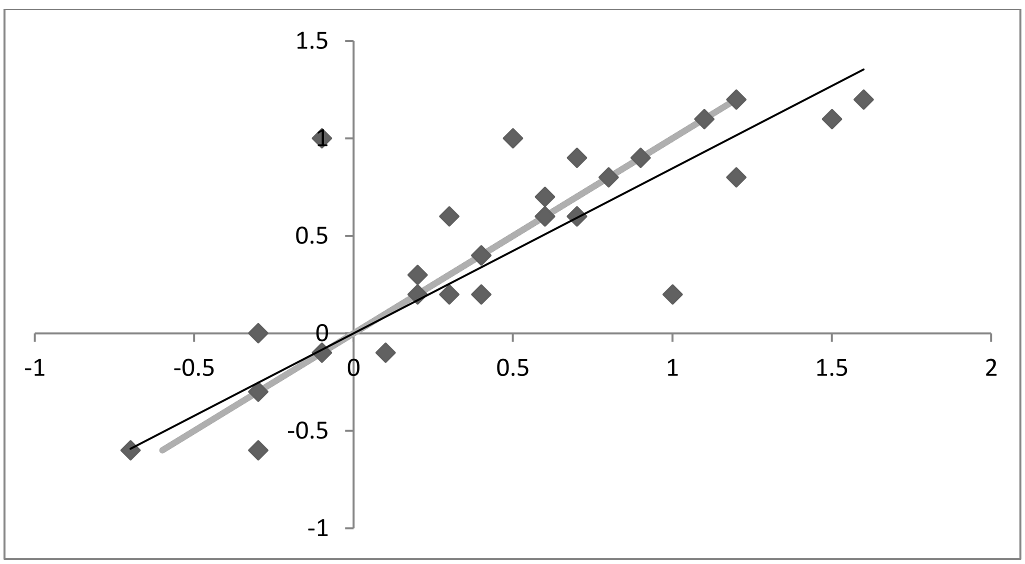


**Figure 4: Revised growth rates of the fourth quarter 2014 plotted against initial growth rates in of the fourth quarter 2014 with slope and ideal slope**

**Table 2: Regression models Between the revised growth rates and the initial growth rates for seasonally adjusted series of the GDP , first quarter 2014 to fourth quarter 2014 – European level**

| Dependent variable: Revised growth rate | | | | |
|---|---|---|---|---|
| | Model for the first quarter 2014 | Model for the second quarter 2014 | Model for the third quarter 2014 | Model for the fourth quarter 2014 |
| Intercept | 0.0996 (0.0693) | 0.1501 (0.0573) | 0.1113 (0.0807) | 0.1166 (0.0748) |
| Coefficient Initial growth rate | 0.8271** (0.0898) | 0.8121** (0.0911) | 1.0555** (0.1834) | 0.7406 (0.1017) |
| R square | 0.75 | 0.76 | 0.63 | 0.66 |

Figures 1 to 4 as well as the estimated regression models (table 2) show that there are significant changes between the revised growth rates compared to the initial growth rates at 2014 level. The highest changes could be observed for the third quarter and the lowest for the fourth quarter.

In this article, the authors examine the possibility of selecting a more appropriate revision policy for seasonally adjusted data, so that the increase in the seasonally adjusted series becomes more stable from quarter to quarter. The paper will focus on the time span of the series, decomposition method, package and ARIMA model.

## 2. Choosing the time span, decomposition method, package and ARIMA Model

One should note that the concept of seasonal variation is not theoretically defined and it is not possible to express the objective theoretical demands of the optimal seasonal adjustment method. All suggestions of seasonal adjustment methods must be tested empirically, and the final model has to be chosen based on subjective considerations, such as whether the results from the seasonal adjustment procedure are reasonable (Harhoff, 2005).

Dealing with outliers is very important in order to obtain best estimations for the seasonal adjusted time series. Eurostat (2015a) describes as an acceptable practice using the completely automatic procedure for detecting and correcting outliers already implemented in JDemetra+. Yet, one should note that historical events (that produce historical outliers) such as the 2008-2009 crisis may definitively change the seasonal pattern (Elezović, 2012). An automatic procedure for detecting outliers has been used on the Romanian GDP series from 1995 to 2015 in order to check for Additive, Level shift, Transitory change and Seasonal outliers. One Level shift outliers has been found in the first quarter of 2009. As, according to the World Bank, the economic crisis hit

Romania in 2008-2009 period[1], and this outlier has been associated with this event.One should also note that, in order to perform seasonal adjustment, time series has to be at least 3 years long for monthly data and 4 years long for quarterly data but a very long time series may not be appropriate as it may not be consistent over time (UNCE, 2012b). A quarterly series of 5 years long may be ideally (UNSD, 2010).

As a consequence, all seasonal adjustment procedures on the Romanian GDP series will consider the series starting form the first quarter 2010. Yet, a model of 5 years long (20 quarters) has also been considered as comparison when the choice of the ARIMA model is performed.

Considering the decomposition model that should be used, UNSD (2010) states that most of the time series should be seasonally adjusted using the multiplicative models (pure multiplicative or log-additive); generally, time series are may be decomposed using the following decomposition models:

**Table 3: Time series decomposition methods. Source: UNSD. (2010). Seasonal Adjustment and Time Series Issues. Workshop on Manufacturing Statistics for ECLAC member states. Santiago**

| Decomposition method | Original series | Seasonally adjusted series | When should be applied |
|---|---|---|---|
| Additive | $Y_t = T_t + S_t + I_t$ | $Y_t = T_t + I_t$ | The series contains negative numbers or zero; seasonal component is not affected by the series level |
| Multiplicative | $Y_t = T_t * S_t * I_t$ | $Y_t = T_t * I_t$ | The seasonal component varies proportionally to the level of the series. |
| Log-additive | $\ln(Y_t) = \ln(T_t + S_t + I_t)$ | $Y_t = \exp\ (T_t + I_t)$ | |

Therefore, the choice between multiplicative or additive model can be done using a graphical inspection of the series. As one can observe from figure 5 the seasonal amplitude increases over time, thus the appropriate model may be multiplicative or log additive.

[1]http://www.worldbank.org/en/country/romania/overview accessed January 6, 2016

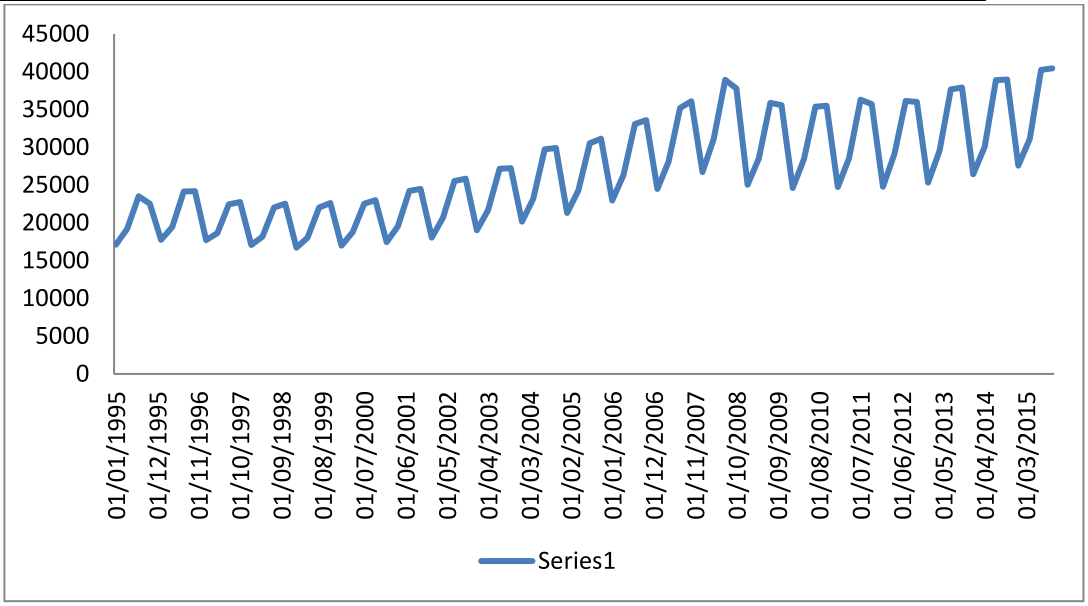


**Figure 5: Quarterly GDP of Romania – constant prices 2000, source: National Institute of Statistics**

Next, the manual choice of the model has been tested using the maximum likelihood estimation of the parameter λ in the Box-Cox transformation: first two Airline models (i.e. ARIMA (0,1,1)(0,1,1)) to the time series: one in logarithms (λ = 0), the other without logarithms (λ = 1); the test compares the sum of squares of the model without logarithmic transformation with the sum of squares multiplied by the square of the geometric mean in the case of the model in logarithms; logarithm is taken in case this last function is the maximum (Grudkowska, 2015):

$$y_i^\alpha = \begin{cases} \dfrac{y_i^\alpha - 1}{\lambda}, & \lambda \neq 0 \\ \log y_i^\alpha, & \lambda = 0 \end{cases}$$

**Table 4: Log likelihood for Romanian GDP time series from 2010-2015, source: designed by the authors**

| | 2010 Model | | 5 years Model | |
|---|---|---|---|---|
| | No transformation | Log transformed | No transformation | Log transformed |
| Log likelihood_2015 | -142.35 | 57.67 | -110.4 | 48.69 |
| Log likelihood_2014 | -113.55 | 45.47 | - | - |

As one can observe, table 4 confirms that the logarithmic form of the series should be considered for seasonal adjustment of the Romanian quarterly GDP.

Besides the decomposition method, one must choose between two seasonal adjustment packages. The two most used and recommended are X-13 originally developed at the U.S. Census Bureau and TRAMO/SEATS developed by Victor Gómez and AgustínMaravallfrom the Bank of Spain in 1996. Many studies were performed on different time series comparing the two methods and several conclusions can be stated:

- SEATS can induce seasonality into the seasonal adjustment of a non-seasonal series and it is essential for obtaining high quality seasonally adjusted data to check there is no residual seasonality in the seasonally adjusted series or the irregular component; inducing seasonality into the residual component usually occurs when the identified model does not capture seasonality; additionally, series that are modeled well by the airline model or other balanced models are good candidates for a SEATS adjustment (Hood, 2002; Upadhyaya and Yeganeh, 2015).
- SEATS does a better job with series that have a large irregular component (Hood et. al. 2000).
- Tiller and Di Natale (2005) comparing the two methods stated that the model-based approach provides increased flexibility in controlling for the effects of sampling error but it may be difficult to develop good models for some series as the model may fail occasionally when new data become available; the moving-average approach is not tailored to the specific properties of the series being adjusted while, the model-based approach develops a model on the basis of goodness-of-fit diagnostics, thus, the resulting seasonal adjustment is based on the properties of the series as represented by the model; in theory, under the assumptions of the model, the seasonal adjustment is “optimal” for the specific series.
- Seasonally adjusted data produced by X-12 based on short time series should be considered with certain caution as for a 5 years analysis, the adjustments obtained using short time series are seriously distorted for the first two years of the sample (Matas and Rondonotti, 2002).

The X13 and TRAMO/SEATS packages were compared in order to determine which package should be used for the seasonally adjusted series of the Romanian Quarterly GDP. In order to compare seasonally adjusted increases for Romanian quarterly GDP in 2015, raw series starting 2010 first quarter were used. As one can observe form table 5, both X13 and TRAMO/SEATS packages show similar results, namely stable increases from quarter to quarter, quite the same AIC and same annual increase in the seasonally adjusted series.

In order to choose the length of the Henderson moving average, one must that if the irregular component is small or the seasonal pattern is changing, the length of the chosen Henderson filter is lower (U. S. Census Bureau, 2011). As the Romanian Quarterly GDP increase in raw series changed its pattern significantly during the 2012-2015 period (according to figure 6), the 3x1 Henderson filter was chosen.

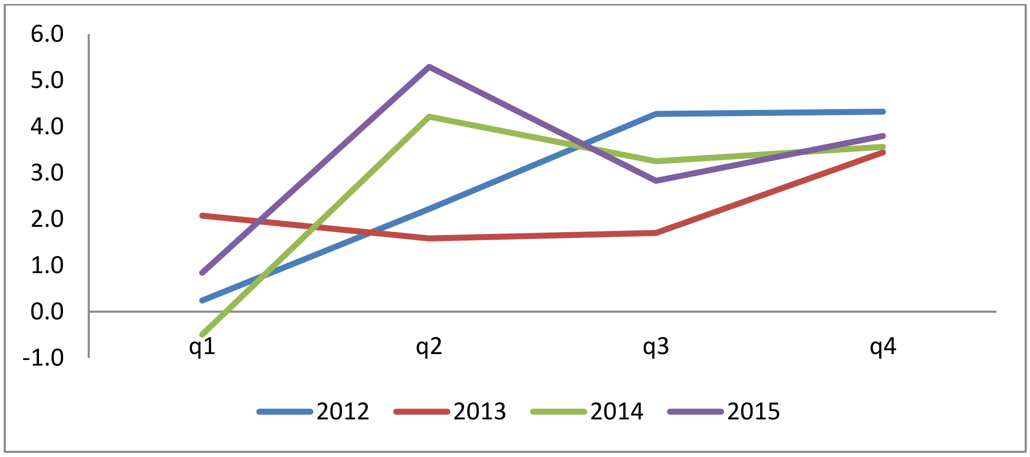


**Figure 6: Increase in quarterly raw series Romanian GDP, data source: National Institute of Statistics Romania**

**Table 5: Seasonally adjusted increase for 2015 Romanian quarterly GDP**

| | TRAMO/SEATS ARIMA 110 110 SEATS Legacy | | | | X 13 ARIMA 110 110 SEASONAL FILTER 3*1 | | | |
|---|---|---|---|---|---|---|---|---|
| Increase in q1 | 1.6 | 1.2 | 1.2 | 1.2 | 1.5 | 1.3 | 1.2 | 1.3 |
| Increase in q2 | | 0.6 | 0.6 | 0.6 | | 0.5 | 0.5 | 0.5 |
| Increase in q3 | | | 0.9 | 0.9 | | | 1.0 | 1.0 |
| Increase in q4 | | | | 1.0 | | | | 1.0 |
| AIC end of the year | 292.98 | | | | 291.9 | | | |
| Annual increase in seasonally adjusted series | 3.75 | | | | 3.75 | | | |
| Quality | all quality reports show good results | | | | all quality reports show good results | | | |

Next, simulations were computed using the same model for the 2011 first quarter to the 2016 third quarter. The increase in the raw series was chosen in order to cover the increases in raw series in the second and thee third quarters 2014 and 2015 (1.7% increase in the second quarter 2014, 3.4%increase in the second quarter 2015; 3.2% increase in the third quarter 2014; 3.6% increase in the third quarter 2015). This period was chosen in order to keep the same number of quarters as the above. The results are presented in Annex 1. One can observe from Annex 1, as for the increases in the raw series between 1.5% and 1.9% the increase in the seasonally adjusted series is very stable for the TRAMO SEATS package, while for the X13 package the revisions are high. For increases higher than 2% both packages show small revisions of the increase in the second quarter. Therefore, it is better to use the TRAMO/SEATS Package for the seasonal adjustment of the Romanian Quarterly GDP, especially because the increase in the raw series is unpredictable.

Next, the procedure for choosing the ARIMA model will be presented. In order to determine the non-seasonal and seasonal differencing orders, the ADF and HEGY tests were computed respectively (as presented by Franses et al. 2014). As one can observe from table 6, both ADF and HEGY tests show that tested series are not stationary, both overall as well as with regard only to the seasonal component.

**Table 6: ADF test T-statistics and HEGY test and Simulated P- values, for Romanian GDP – constant prices 2000 time series, source: designed by the authors**

| | ADF test T-statistics | | | HEGY test Simulated P- values | |
|---|---|---|---|---|---|
| | Trend and intercept | Intercept | None | Non-seasonal unit-root test | Seasonal unit root (4quarters per cycle) |
| 2010q1 to 2014q1 | 0.550652 | 2.450979 | 2.450979 | 0.380085 | 0.187794 |
| 2010q1 to 2014q2 | -0.171263 | -0.17126 | 1.921739 | 0.224877 | 0.202111 |
| 2010q1 to 2014q3 | -0.309273 | 2.047809 | 3.911109 | 0.932545 | 0.885246 |
| 2010q1 to 2014q4 | -0.532759 | 2.037295 | 2.037295 | 0.937952 | 0.863737 |
| 2010q1 to 2015q1 | -0.549342 | 2.391484 | 2.391484 | 0.957503 | 0.76055 |
| 2010q1 to 2015q2 | -0.561287 | 2.756489 | 1.831901 | 0.876399 | 0.789744 |
| 2010q1 to 2015q3 | -0.673895 | 2.937377 | 1.892913 | 0.949564 | 0.913585 |
| 2010q1 to 2015q4 | -0.683558 | 3.245157 | 1.944152 | 0.964473 | 0.906999 |
| 2010q2 to 2015q1 | -0.595968 | 2.049994 | 1.720389 | 0.938851 | 0.72224 |
| 2010q3 to 2015q2 | -0.753564 | 2.163253 | 1.507429 | 0.786402 | 0.76679 |
| 2010q4 to 2015q3 | -1.636721 | 0.845062 | 1.852847 | 0.714979 | 0.957497 |
| 2011q1 to 2015q4 | -1.777633 | 2.321986 | 1.995364 | 0.802667 | 0.944852 |
| * significant at 5% | | | | | |

Seasonally adjusted indices have been computed for several ARIMA specifications in TRAMO SEATS with log-transformed series and non-seasonal and seasonal differencing orders equal to 1. Moreover, only specifications that meet all quality reports should be considered. After that, the specification that best preserves the changes in quarter to quarter series and in the same time gives an annual increase in the seasonally adjusted series close to the annual increase in the raw series, has been chosen. The practice of preserving as much as possible the changes in quarter to quarter or monthly to monthly series has been emphasized as necessary by several researchers such as Hood (2006) or Gubman and Burck (2005).

Table 7 shows the results for several ARIMA specifications computed for 2014. As one can observe, ARIMA:P=1 D=1 Q=0 BP=0 BD=1 BQ=0 is the only one that passes all quality tests. Also, this specification offers great stability in the increase in the seasonally adjusted series, with the exception of the first quarter that is significantly revised in the second quarter. However one does not observe a change in sign. Also these results show an annual increase in the seasonally adjusted series very close to the increase in the raw series (of 3%).

**Table 7: Seasonally adjusted increase for the quarterly Romanian GDP 2014, 2000 constant prices time series for several ARIMA models**

| | | | | |
|---|---|---|---|---|
| ARIMA: P=1 D=1 Q=1 BP=0 BD=1 BQ=1 | | | | |
| Increase in q1 | 0.5 | 0.3 | 0.4 | 0.4 |
| Increase in q2 | | -1.3 | -1.2 | -1.2 |
| Increase in q3 | | | 2.7 | 2.7 |
| Increase in q4 | | | | 1.0 |
| AIC | 183.1 | 202.3 | 216.7 | 230.5 |
| Annual increase in seasonally adjusted series | 3.0 | | | |
| Quality | some quality reports show bad results | | | |
| ARIMA: P=1 D=1 Q=1 BP=1 BD=1 BQ=0 | | | | |
| Increase in q1 | 0.4 | 0.3 | 0.4 | 0.4 |
| Increase in q2 | | -0.3 | -0.2 | -0.2 |
| Increase in q3 | | | 1.6 | 1.6 |
| Increase in q4 | | | | 0.8 |
| AIC | 182.1 | 203.1 | 217.6 | 231.6 |
| Annual increase in seasonally adjusted series | 3.1 | | | |
| Quality | some quality reports show bad results | | | |
| ARIMA: P=1 D=1 Q=1 BP=0 BD=1 BQ=0 | | | | |
| Increase in q1 | 0.9 | 0.7 | 0.7 | 0.6 |
| Increase in q2 | | 0.5 | 0.5 | 0.4 |
| Increase in q3 | | | 1.1 | 1.1 |
| Increase in q4 | | | | 0.8 |
| AIC | 187.5 | 204.2 | 218.5 | 233.2 |
| Annual increase in seasonally adjusted series | 3.2 | | | |
| Quality | some quality reports show bad results | | | |
| ARIMA: P=0 D=1 Q=1 BP=0 BD=1 BQ=0 | | | | |
| Increase in q1 | 1.1 | 0.8 | 0.7 | 0.6 |
| Increase in q2 | | 0.6 | 0.6 | 0.5 |
| Increase in q3 | | | 1.1 | 1.0 |

| | | | | |
|---|---|---|---|---|
| Increase in q4 | | | | 0.9 |
| AIC | 186.0 | 202.6 | 217.1 | 231.9 |
| Annual increase in seasonally adjusted series | 3.3 | | | |
| Quality | some quality reports show uncertain results | | | |
| ARIMA:P=1 D=1 Q=0 BP=0 BD=1 BQ=0 | | | | |
| Increase in q1 | 1.1 | 0.5 | 0.6 | 0.6 |
| Increase in q2 | | 0.3 | 0.4 | 0.4 |
| Increase in q3 | | | 1.0 | 0.9 |
| Increase in q4 | | | | 0.8 |
| AIC | 187.0 | 205.4 | 220.3 | 234.9 |
| Annual increase in seasonally adjusted series | 3.1 | | | |
| Quality | all quality reports show good results | | | |
| ARIMA: P=1 D=1 Q=0 BP=1 BD=1 BQ=0 | | | | |
| Increase in q1 | 0.5 | 0.2 | 0.3 | 0.4 |
| Increase in q2 | | -0.6 | -0.2 | -0.1 |
| Increase in q3 | | | 1.4 | 1.5 |
| Increase in q4 | | | | 0.9 |
| AIC | 181.00 | 204.8 | 219.0 | 234.4 |
| Annual increase in seasonally adjusted series | 3.06 | | | |
| Quality | some quality reports show uncertain results | | | |

Table 8 shows the results for several ARIMA specifications computed for 2015. Only specifications that previously showed uncertain and good results were computed. As one can observe, great stability in the increase of the seasonally adjusted series was obtained for ARIMA: P=1 D=1 Q=0 BP=1 BD=1 BQ=0, 2010-present model as well as for the ARIMA: P=0 D=1 Q=1 BP=0 BD=1 BQ=0 2010-present model. The only exception is for the first quarter. Yet, a slower AIC is obtained for the same specifications but keeping 5 years length. Also, the annual increase in seasonally adjusted series is closer to the annual increase in raw series for both 2010-present models.

**Table 8: Seasonally adjusted increase for the quarterly Romanian GDP 2015, 2000 constant prices time series for several ARIMA models**

| | | 2010-present | | | | 5 years | | | |
|---|---|---|---|---|---|---|---|---|---|
| ARIMA: P=1 D=1 Q=0 BP=1 BD=1 BQ=0 | Increase in q1 | 1.6 | 1.2 | 1.2 | 1.2 | 1.6 | 0.9 | 0.9 | 1.1 |
| | Increase in q2 | | 0.6 | 0.6 | 0.6 | | 0.8 | 0.5 | 0.6 |
| | Increase in q3 | | | 0.9 | 0.9 | | | 0.6 | 0.8 |
| | Increase in q4 | | | | 1.0 | | | | 1.2 |
| | AIC | 248.27 | 264.02 | 278.57 | 292.98 | 234.37 | 233.86 | 233.85 | 234.99 |
| | Annual increase in seasonally adjusted series | 3.76 | | | | 3.6 | | | |
| | Quality | all quality reports show good results | | | | all quality reports show good results | | | |
| ARIMA: P=1 D=1 Q=0 BP=0 BD=1 BQ=0 | Increase in q1 | 0.8 | 1.2 | 1.1 | 1.0 | 1.2 | 1.0 | 0.9 | 0.9 |
| | Increase in q2 | | 1.1 | 0.9 | 0.8 | | 0.7 | 0.6 | 0.7 |
| | Increase in q3 | | | 1.1 | 0.9 | | | 0.6 | 0.8 |
| | Increase in q4 | | | | 1.0 | | | | 1.3 |
| | AIC | 234.00 | 249.0 | 263.0 | 292.7 | 235.3 | 232.0 | 231.86 | 232.15 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Annual increase in seasonally adjusted series | 3.71 | | | | 3.55 | | | |
| | Quality | all quality reports show good results | | | | some quality reports show uncertain results | | | |
| ARIMA: P=0 D=1 Q=1 BP=0 BD=1 BQ=0 | Increase in q1 | 1.2 | 1.1 | 1.1 | 1.0 | 1.2 | 1.0 | 0.9 | 0.9 |
| | Increase in q2 | | 1.0 | 0.9 | 0.9 | | 0.7 | 0.6 | 0.8 |
| | Increase in q3 | | | 1.0 | 1.0 | | | 0.5 | 0.9 |
| | Increase in q4 | | | | 1.1 | | | | 1.2 |
| | AIC | 245.54 | 259.64 | 274.14 | 288.51 | 231.89 | 231.99 | 231.85 | 227.14 |
| | Annual increase in seasonally adjusted series | 3.72 | | | | 3.6 | | | |
| | Quality | all quality reports show good results | | | | some quality reports show uncertain results | | | |

## 3. Conclusions and discussions

Considering the timing of the revision policy, each statistical program must have its own revision strategy, and schedules which should be available to data users in advance of these revisions[2]. For example, at the Statistics Norway, the model, filters, outliers and regression parameters are re-identified and re-estimated continuously as new or revised data become available, yet, users are informed in advance with regard to witch time series will be revised and the approximately revision amount[3].

As one can observe from the above examples, all models performed for the GDP series, models performed show great stability in the increase of the seasonally adjusted series. The biggest revision was observed for the first quarter when the new value for the second quarter is introduced. So, if the goal of the revision policy is to preserve the increase in seasonally adjusted series, revision should be set before adding the value for the second quarter.

Also, the models considered for seasonal adjustment performed better with a 5 years length than with 2010-present period, yet the last one show greater stability. Thus, a seasonal adjustment policy should establish whether to preserve the increase in indices or perform the best seasonal adjustment as possible.

With regard to the time span, series from 2010 should be used as the events from 2009 resulted in a level shift in the quarterly Romanian GDP time series so the period after this year is not comparable anymore to the period before this year. A consistent revision policy should contain specific measures regarding the ways to treat outliers for each particular time series as each series has its own particularities.

[2] http://www.statcan.gc.ca/eng/dai/btd/sad-faq/sec1 accessed 5 January 2016

[3] https://www.ssb.no/a/english/kortnavn/knr_en/sesongjustering_en.html#P242_15727 accessed 5 January 2016

Considering the seasonal adjustment package, TRAMO/SEATS should be used, as even for unpredicted increases in the raw series for the second quarter occur, the increase in the seasonally adjusted series is more likely to be preserved.

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**Annex 1. Increase in seasonally adjusted series using TRAMO SEATS compared to X13 based on simulated increases in raw series, for Romanian GDP – constant prices 2000 time series, source: designed by the authors:**

| Increase in raw series (%) | | Increase in seasonally adjusted series TRAMO SEATS ARIMA 110 110 SEATS Legacy (%) | | | Increase in seasonally adjusted series X13 ARIMA 110 110 3*1 Filter (%) | | |
|---|---|---|---|---|---|---|---|
| second quarter 2016 | third quarter 2016 | second quarter 2016 | revision in third quarter 2016 for second quarter 2016 | third quarter 2016 | second quarter 2016 | revision in third quarter 2016 for second quarter 2016 | third quarter 2016 |
| 1.5 | 3.0 | 0.1 | 0.2 | 0.9 | -0.7 | -0.2 | 1.4 |
| | 3.1 | | 0.2 | 1.0 | | -0.2 | 1.5 |
| | 3.2 | | 0.2 | 1.0 | | -0.2 | 1.6 |
| | 3.3 | | 0.2 | 1.0 | | -0.3 | 1.7 |
| | 3.4 | | 0.2 | 1.1 | | -0.3 | 1.7 |
| | 3.5 | | 0.3 | 1.1 | | -0.1 | 1.6 |
| | 3.6 | | 0.3 | 1.1 | | -0.1 | 1.7 |
| 1.6 | 3.0 | 0.2 | 0.2 | 0.9 | -0.6 | -0.2 | 1.4 |
| | 3.1 | | 0.2 | 1.0 | | -0.2 | 1.4 |
| | 3.2 | | 0.2 | 1.0 | | -0.2 | 1.5 |
| | 3.3 | | 0.2 | 1.0 | | -0.2 | 1.5 |
| | 3.4 | | 0.3 | 1.1 | | -0.2 | 1.6 |
| | 3.5 | | 0.3 | 1.1 | | -0.1 | 1.6 |
| | 3.6 | | 0.3 | 1.1 | | -0.2 | 1.8 |
| 1.7 | 3.0 | 0.2 | 0.2 | 0.9 | -0.5 | -0.1 | 1.3 |
| | 3.1 | | 0.2 | 0.9 | | -0.2 | 1.4 |
| | 3.2 | | 0.3 | 1.0 | | -0.1 | 1.4 |
| | 3.3 | | 0.3 | 1.0 | | -0.1 | 1.5 |
| | 3.4 | | 0.3 | 1.0 | | -0.1 | 1.5 |
| | 3.5 | | 0.3 | 1.1 | | -0.1 | 1.6 |
| | 3.6 | | 0.3 | 1.1 | | -0.2 | 1.8 |
| 1.8 | 3.0 | 0.2 | 0.2 | 0.9 | -0.4 | -0.1 | 1.2 |
| | 3.1 | | 0.3 | 0.9 | | 0.0 | 1.3 |
| | 3.2 | | 0.3 | 1.0 | | 0.0 | 1.3 |
| | 3.3 | | 0.3 | 1.0 | | 0.0 | 1.4 |
| | 3.4 | | 0.3 | 1.0 | | 0.0 | 1.5 |
| | 3.5 | | 0.3 | 1.1 | | 0.0 | 1.5 |
| | 3.6 | | 0.3 | 1.1 | | 0.0 | 1.6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.9 | 3.0 | 0.3 | 0.3 | 0.9 | -0.2 | -0.2 | 1.4 |
| | 3.1 | | 0.3 | 0.9 | | 0.0 | 1.3 |
| | 3.2 | | 0.3 | 1.0 | | 0.0 | 1.3 |
| | 3.3 | | 0.3 | 1.0 | | 0.0 | 1.4 |
| | 3.4 | | 0.3 | 1.0 | | 0.0 | 1.4 |
| | 3.5 | | 0.3 | 1.1 | | 0.1 | 1.5 |
| | 3.6 | | 0.4 | 1.1 | | 0.0 | 1.5 |
| 2.0 | 3.0 | 0.3 | 0.3 | 0.9 | -0.1 | 0.0 | 1.2 |
| | 3.1 | | 0.3 | 0.9 | | -0.1 | 1.4 |
| | 3.2 | | 0.3 | 1.0 | | -0.1 | 1.4 |
| | 3.3 | | 0.3 | 1.0 | | 0.1 | 1.3 |
| | 3.4 | | 0.4 | 1.0 | | 0.1 | 1.4 |
| | 3.5 | | 0.4 | 1.1 | | 0.1 | 1.4 |
| | 3.6 | | 0.4 | 1.1 | | 0.1 | 1.5 |
| 2.1 | 3.0 | 0.3 | 0.3 | 0.9 | 0.0 | 0.0 | 1.2 |
| | 3.1 | | 0.3 | 0.9 | | 0.0 | 1.2 |
| | 3.2 | | 0.3 | 1.0 | | 0.0 | 1.4 |
| | 3.3 | | 0.4 | 1.0 | | 0.0 | 1.4 |
| | 3.4 | | 0.4 | 1.0 | | -0.1 | 1.5 |
| | 3.5 | | 0.4 | 1.1 | | 0.1 | 1.4 |
| | 3.6 | | 0.4 | 1.1 | | 0.1 | 1.4 |
| 2.2 | 3.0 | 0.4 | 0.3 | 0.9 | 0.0 | 0.1 | 1.1 |
| | 3.1 | | 0.4 | 0.9 | | 0.1 | 1.2 |
| | 3.2 | | 0.4 | 0.9 | | 0.1 | 1.2 |
| | 3.3 | | 0.4 | 1.0 | | 0.0 | 1.4 |
| | 3.4 | | 0.4 | 1.0 | | 0.0 | 1.4 |
| | 3.5 | | 0.4 | 1.0 | | 0.0 | 1.5 |
| | 3.6 | | 0.4 | 1.1 | | 0.0 | 1.6 |
| 2.3 | 3.0 | 0.4 | 0.4 | 0.9 | 0.1 | 0.1 | 1.1 |
| | 3.1 | | 0.4 | 0.9 | | 0.1 | 1.1 |
| | 3.2 | | 0.4 | 0.9 | | 0.2 | 1.2 |
| | 3.3 | | 0.4 | 1.0 | | 0.2 | 1.2 |
| | 3.4 | | 0.4 | 1.0 | | 0.2 | 1.3 |
| | 3.5 | | 0.4 | 1.0 | | 0.1 | 1.4 |
| | 3.6 | | 0.5 | 1.1 | | 0.1 | 1.5 |
| 2.4 | 3.0 | 0.4 | 0.4 | 0.9 | 0.1 | 0.2 | 1.0 |
| | 3.1 | | 0.4 | 0.9 | | 0.2 | 1.1 |
| | 3.2 | | 0.4 | 0.9 | | 0.2 | 1.1 |
| | 3.3 | | 0.4 | 1.0 | | 0.2 | 1.2 |
| | 3.4 | | 0.4 | 1.0 | | 0.2 | 1.2 |
| | 3.5 | | 0.5 | 1.0 | | 0.2 | 1.3 |
| | 3.6 | | 0.5 | 1.1 | | 0.2 | 1.4 |
| 2.5 | 3.0 | 0.5 | 0.4 | 0.8 | 0.2 | 0.2 | 1.0 |
| | 3.1 | | 0.4 | 0.9 | | 0.2 | 1.1 |
| | 3.2 | | 0.4 | 0.9 | | 0.2 | 1.1 |
| | 3.3 | | 0.5 | 1.0 | | 0.2 | 1.1 |
| | 3.4 | | 0.5 | 1.0 | | 0.3 | 1.2 |
| | 3.5 | | 0.5 | 1.0 | | 0.3 | 1.2 |
| | 3.6 | | 0.5 | 1.1 | | 0.3 | 1.3 |
| 2.6 | 3.0 | 0.5 | 0.4 | 0.8 | 0.2 | 0.2 | 1.0 |
| | 3.1 | | 0.4 | 0.9 | | 0.2 | 1.0 |
| | 3.2 | | 0.5 | 0.9 | | 0.3 | 1.1 |
| | 3.3 | | 0.5 | 0.9 | | 0.3 | 1.1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3.4 | | 0.5 | 1.0 | | 0.3 | 1.2 |
| | 3.5 | | 0.5 | 1.0 | | 0.3 | 1.2 |
| | 3.6 | | 0.5 | 1.0 | | 0.3 | 1.3 |
| 2.7 | 3.0 | 0.5 | 0.5 | 0.8 | 0.3 | 0.3 | 0.9 |
| | 3.1 | | 0.5 | 0.9 | | 0.3 | 1.0 |
| | 3.2 | | 0.5 | 0.9 | | 0.3 | 1.0 |
| | 3.3 | | 0.5 | 0.9 | | 0.3 | 1.1 |
| | 3.4 | | 0.5 | 1.0 | | 0.3 | 1.1 |
| | 3.5 | | 0.5 | 1.0 | | 0.4 | 1.2 |
| | 3.6 | | 0.5 | 1.0 | | 0.4 | 1.2 |
| 2.8 | 3.0 | 0.6 | 0.5 | 0.8 | 0.3 | 0.3 | 0.9 |
| | 3.1 | | 0.5 | 0.9 | | 0.3 | 0.9 |
| | 3.2 | | 0.5 | 0.9 | | 0.3 | 1.0 |
| | 3.3 | | 0.5 | 0.9 | | 0.4 | 1.0 |
| | 3.4 | | 0.5 | 1.0 | | 0.4 | 1.1 |
| | 3.5 | | 0.6 | 1.0 | | 0.4 | 1.1 |
| | 3.6 | | 0.6 | 1.0 | | 0.4 | 1.2 |
| 2.9 | 3.0 | 0.6 | 0.5 | 0.8 | 0.4 | 0.3 | 0.9 |
| | 3.1 | | 0.5 | 0.8 | | 0.4 | 0.9 |
| | 3.2 | | 0.5 | 0.9 | | 0.4 | 1.0 |
| | 3.3 | | 0.6 | 0.9 | | 0.4 | 1.0 |
| | 3.4 | | 0.6 | 0.9 | | 0.4 | 1.1 |
| | 3.5 | | 0.6 | 1.0 | | 0.4 | 1.1 |
| | 3.6 | | 0.6 | 1.0 | | 0.4 | 1.2 |
| 3.0 | 3.0 | 0.6 | 0.5 | 0.8 | 0.4 | 0.4 | 0.8 |
| | 3.1 | | 0.5 | 0.8 | | 0.4 | 0.9 |
| | 3.2 | | 0.6 | 0.9 | | 0.4 | 0.9 |
| | 3.3 | | 0.6 | 0.9 | | 0.4 | 1.0 |
| | 3.4 | | 0.6 | 0.9 | | 0.4 | 1.0 |
| | 3.5 | | 0.6 | 1.0 | | 0.5 | 1.1 |
| | 3.6 | | 0.6 | 1.0 | | 0.5 | 1.1 |
| 3.1 | 3.0 | 0.7 | 0.6 | 0.8 | 0.5 | 0.4 | 0.8 |
| | 3.1 | | 0.6 | 0.8 | | 0.4 | 0.8 |
| | 3.2 | | 0.6 | 0.9 | | 0.4 | 0.9 |
| | 3.3 | | 0.6 | 0.9 | | 0.5 | 0.9 |
| | 3.4 | | 0.6 | 0.9 | | 0.5 | 1.0 |
| | 3.5 | | 0.6 | 1.0 | | 0.5 | 1.0 |
| | 3.6 | | 0.6 | 1.0 | | 0.5 | 1.1 |
| 3.2 | 3.0 | 0.7 | 0.6 | 0.8 | 0.5 | 0.5 | 0.8 |
| | 3.1 | | 0.6 | 0.8 | | 0.5 | 0.8 |
| | 3.2 | | 0.6 | 0.8 | | 0.5 | 0.9 |
| | 3.3 | | 0.6 | 0.9 | | 0.5 | 0.9 |
| | 3.4 | | 0.6 | 0.9 | | 0.5 | 0.9 |
| | 3.5 | | 0.7 | 0.9 | | 0.5 | 1.0 |
| | 3.6 | | 0.7 | 1.0 | | 0.6 | 1.0 |
| 3.3 | 3.0 | 0.7 | 0.6 | 0.8 | 0.6 | 0.5 | 0.7 |
| | 3.1 | | 0.6 | 0.8 | | 0.5 | 0.8 |
| | 3.2 | | 0.6 | 0.8 | | 0.5 | 0.8 |
| | 3.3 | | 0.7 | 0.9 | | 0.5 | 0.9 |
| | 3.4 | | 0.7 | 0.9 | | 0.6 | 0.9 |
| | 3.5 | | 0.7 | 0.9 | | 0.6 | 1.0 |
| | 3.6 | | 0.7 | 1.0 | | 0.6 | 1.0 |
| 3.4 | 3.0 | 0.8 | 0.6 | 0.7 | 0.6 | 0.5 | 0.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3.1 | | 0.6 | 0.8 | | 0.5 | 0.7 |
| | 3.2 | | 0.7 | 0.8 | | 0.6 | 0.8 |
| | 3.3 | | 0.7 | 0.9 | | 0.6 | 0.8 |
| | 3.4 | | 0.7 | 0.9 | | 0.6 | 0.9 |
| | 3.5 | | 0.7 | 0.9 | | 0.6 | 0.9 |
| | 3.6 | | 0.7 | 1.0 | | 0.6 | 1.0 |
| 3.5 | 3.0 | 0.8 | 0.7 | 0.7 | 0.7 | 0.6 | 0.6 |
| | 3.1 | | 0.7 | 0.8 | | 0.6 | 0.7 |
| | 3.2 | | 0.7 | 0.8 | | 0.6 | 0.7 |
| | 3.3 | | 0.7 | 0.8 | | 0.6 | 0.8 |
| | 3.4 | | 0.7 | 0.9 | | 0.6 | 0.8 |
| | 3.5 | | 0.7 | 0.9 | | 0.6 | 0.9 |
| | 3.6 | | 0.7 | 0.9 | | 0.7 | 0.9 |