Technical note on seasonal adjustment for Gross domestic product (Expenditure)

July 1, 2013

Contents

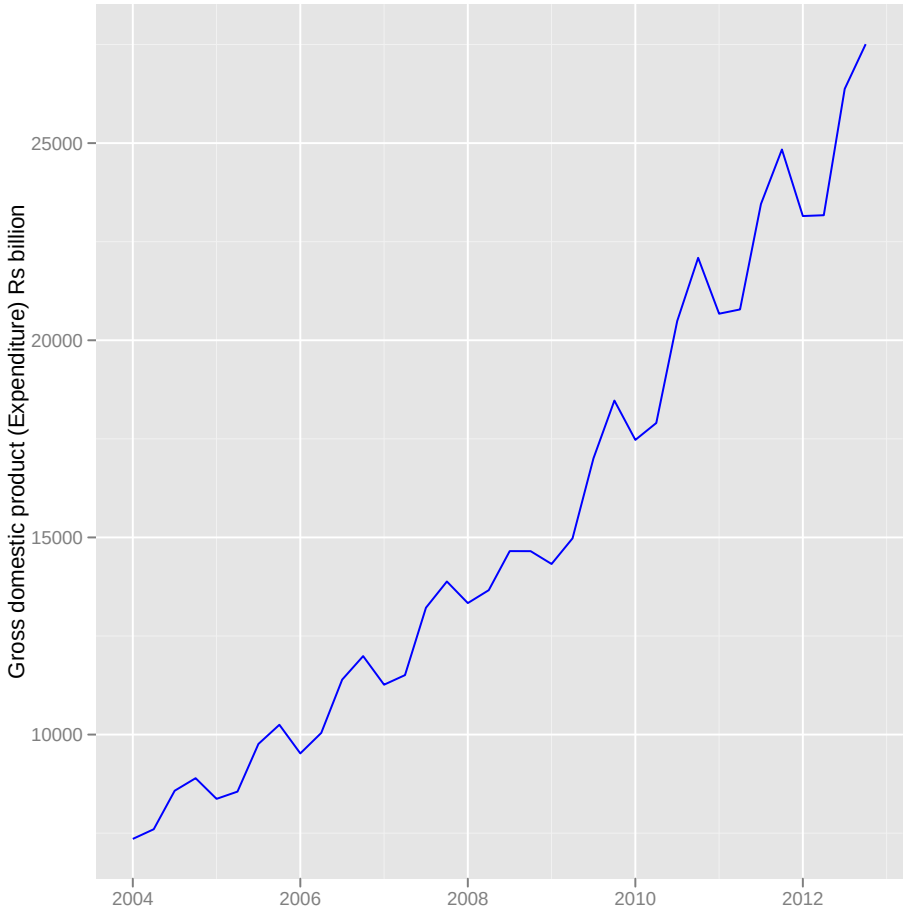
List of Figures

List of Tables

1 Gross domestic product (Expenditure)

We analyse the quarterly data for Gross domestic product (Expenditure) from the 1st quarter of the fiscal year 1999-2000. Figure 1 shows the original plot of the series. In such a non-seasonally adjusted series, it is difficult to discern a trend as the seasonal variations may mask the important characteristics of a time series.

Figure 1 GDP expenditure (Non seasonally adjusted)



1.1 Additive versus multiplicative seasonality

X-12-ARIMA has the capability to determine the mode of the seasonal adjustment decomposition to be performed i.e whether multiplicative or additive seasonal adjustment decomposition is appropriate for the series. For Gross domestic product (Expenditure), multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria.

2 Steps in the seasonal adjustment procedure

Given that seasonality exists, it is important to model seasonality before the application of seasonal adjustment procedure. Seasonality in time series can be deterministic or stochastic. Stochastic seasonality can be stationary or non-stationary.

A visually appealing way of looking at the raw data is to plot the growth rates in each of the quarter across the years i.e the growth of 2nd quarter over 1st quarter in each of the years from 1999 onwards. This gives us some idea of the presence of seasonal peaks, if any in the series.
The nature of seasonality can also be inferred intutively from the plot before the application of the testing procedures.

Figure 2 Quarterly growth rates across the years

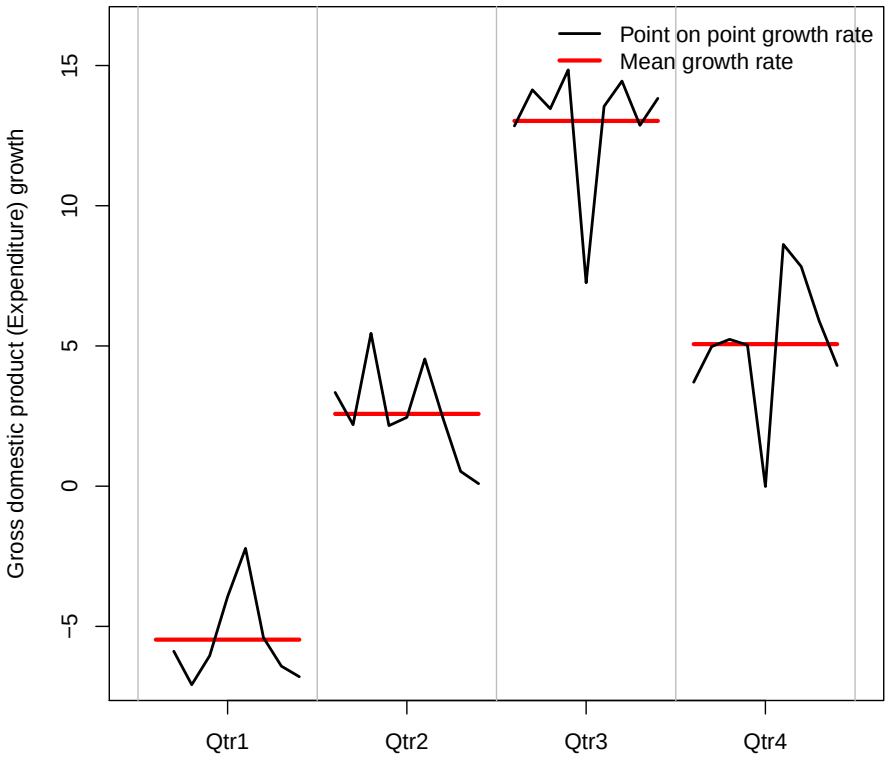


Figure 2 shows that mean growth rate in quarter 3 (October-December) is higher than the growth rate in other quarters.

2.1 Seasonal adjustment with X-12-ARIMA

Seasonal adjustment is done with X-12-ARIMA method. Since GDP expenditure shows stochastic seasonality we do not add seasonal dummy in the regARIMA specification.

Figure 3 GDP expenditure (NSA and SA)

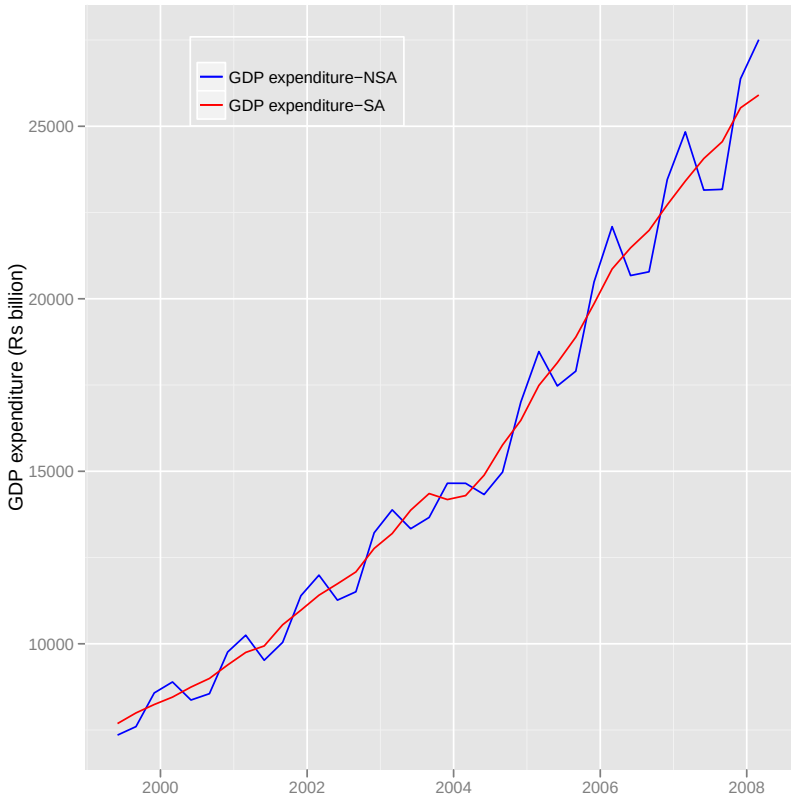


Figure 3 shows the non-seasonally and seasonally adjusted GDP expenditure. The seasonal peaks are dampened after seasonal adjustment.

2.2 Diagnostic checks

After seasonal adjustment, a series of diagnostic checks are performed through relevant tests and quality assessment statistics.

2.2.1 Validation of the automodel choice by X-12-ARIMA

A test of validation of the auto model choice by X-12-ARIMA is the randomness of the residuals of the ARIMA model. The Ljung-Box test is conducted on the residuals of the fitted ARIMA model to check whether or not the residuals are white noise. The ACFs of the residuals are plotted to check for randomness.

Figure 4 ACF of residuals

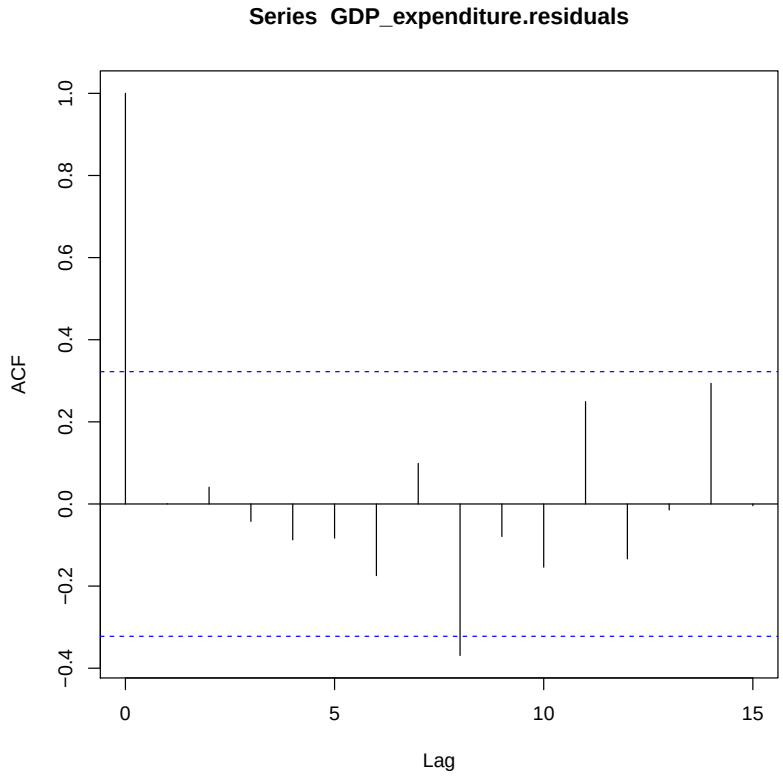


Figure 4 does not reveal significant autocorrelation amongst the residuals.

2.2.2 Presence of identifiable seasonality

The statistic M7 shows the amount of moving seasonality present relative to stable seasonality. It shows the combined result for the test of stable and moving seasonality in the series. A value lesser than 0.7 is desirable to show identifiable seasonality in the series. The value of M7 statistic for GDP(expenditure) is 0.094.

GDP expenditure shows identifiable seasonality on the basis of the M7 statistic.

3 Year on year growth versus seasonally adjusted point on point growth

Growth rates can be computed either year on year or point on point. The year on year growth rate is computed as the percentage change with respect to the corresponding month (or quarter) in the preceding year, while the point on point growth rate is computed as the percentage change with respect to the preceding period.

Table 2 shows the year on year growth and seasonally adjusted annualized rate in percent, point on point.

4 Spectral representation

Figure 5 shows the spectral plot of the growth rate of the unadjusted and seasonally adjusted series. Spectral plot, an important tool of the frequency domain analysis shows the portion of variance of the series contributed by cycles of different frequencies.
In case of quarterly series, the seasonal frequencies are pi/2 and pi which correspond to periods of 4 quarters and 2 quarters. Figure shows that seasonal adjustment removes the peaks at seasonal frequencies.

Figure 5 GDP (Expenditure) Spectral plot (NSA and SA)

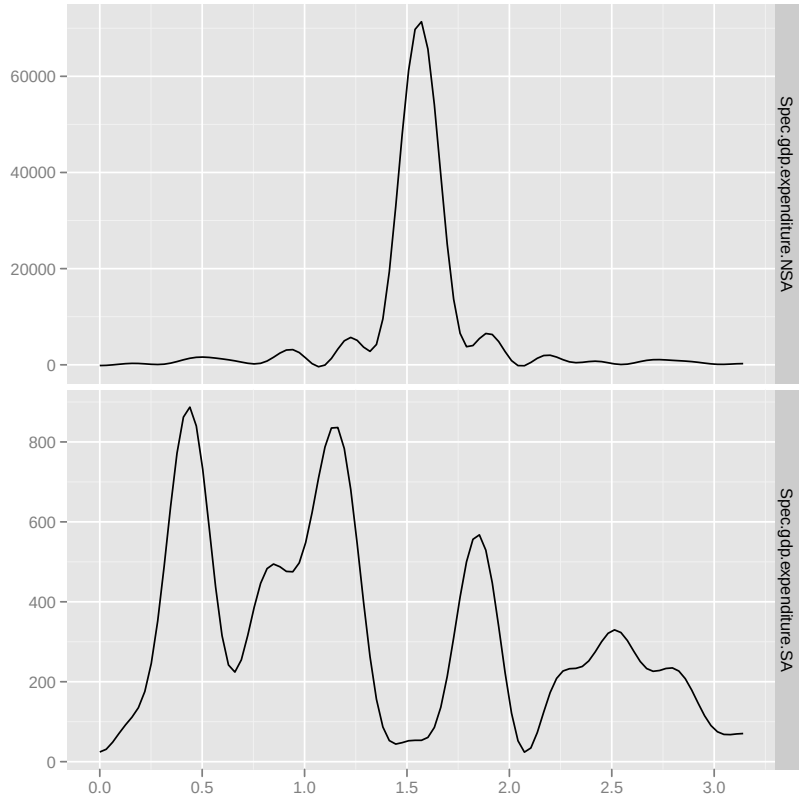


Figure 5 shows the spectral plot of the growth rate of the unadjusted and seasonally adjusted series. Spectral plot, an important tool of the frequency domain analysis shows the portion of variance of the series contributed by cycles of different frequencies.
In case of quarterly series, the seasonal frequencies are pi/2 and pi which correspond to periods of 4 quarters and 2 quarters. Figure shows that seasonal adjustment removes the peaks at seasonal frequencies.

5 Sliding spans diagnostics

Sliding span diagnostics are descriptive statistics of how the seasonal adjustments and their quarter-to-quarter changes vary when the span of data used to calculate them is altered in a systematic way.

It is based on the idea that for a quarter common to more than one overlapping spans, the percent change of its adjusted value from the different spans should not exceed the threshold value and for a quarter common to more than one span, the difference between the quarter on quarter change from the different spans should not exceed the threshold value (the threshold value being 0.03).
Sliding span gives the percentage of quarters (A%) for which the seasonal adjustment is unstable (the difference in the seasonally adjusted values for a particular quarter from more than one span should not exceed 0.03). It also gives the percentage of quarters (MM%) for which the quarter on quarter changes of the seasonally adjusted values is unstable i.e exceeding the threshold value. The seasonal adjustment produced by the procedure chosen should not be used if A% > 25.0 (> 15.0 is considered problematic) or if M M % > 40.0.
For Gross domestic product (Expenditure) both A% and MM% is 0.
The sliding span diagnostics is not reliable when the range of the seasonal factors in a particular span is low (less than 5).

Table 1 Year on year and point on point growth rates

	Y.o.Y.growth	Point.on.point.growth
2004 Q2		15.72
2004 Q3		12.02
2004 Q4		10.27
2005 Q1	13.82	13.54
2005 Q2	12.55	11.25
2005 Q3	13.84	17.05
2005 Q4	15.23	15.19
2006 Q1	13.77	7.59
2006 Q2	17.40	24.02
2006 Q3	16.71	15.69
2006 Q4	16.99	15.53
2007 Q1	18.30	11.42
2007 Q2	14.60	11.56
2007 Q3	16.00	21.91
2007 Q4	15.78	13.35
2008 Q1	18.37	19.97
2008 Q2	18.72	13.68
2008 Q3	10.87	-4.88
2008 Q4	5.55	3.23
2009 Q1	7.44	16.19
2009 Q2	9.62	22.91
2009 Q3	16.05	17.68
2009 Q4	26.07	23.85
2010 Q1	21.96	14.78
2010 Q2	19.53	16.05
2010 Q3	20.48	19.99
2010 Q4	19.60	19.75
2011 Q1	18.31	11.60
2011 Q2	16.09	9.31
2011 Q3	14.49	13.30
2011 Q4	12.44	11.91
2012 Q1	11.98	11.00
2012 Q2	11.50	8.05
2012 Q3	12.44	15.65
2012 Q4	10.76	5.80