

# Technical note on seasonal adjustment for Non oil exports

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## Contents

<b>1</b>	<b>Non oil exports</b>	<b>2</b>
1.1	Additive versus multiplicative seasonality . . . . .	2
<b>2</b>	<b>Steps in the seasonal adjustment procedure</b>	<b>3</b>
2.1	Tests for identifying the nature of seasonality . . . . .	3
2.2	Seasonal adjustment with X-12-ARIMA . . . . .	4
2.3	Diagnostic checks . . . . .	5
2.3.1	Validation of the automodel choice by X-12-ARIMA . . . . .	5
2.3.2	Presence of identifiable seasonality . . . . .	6
<b>3</b>	<b>Year on year growth versus seasonally adjusted point on point growth</b>	<b>6</b>
<b>4</b>	<b>Spectral representation</b>	<b>7</b>
<b>5</b>	<b>Sliding span diagnostics</b>	<b>7</b>
<b>6</b>	<b>Accounting for India-specific moving holiday effects</b>	<b>8</b>

## List of Figures

1	Non oil exports (Non seasonal adjusted) . . . . .	2
2	Monthly growth rates across the years . . . . .	3
3	Non oil exports (NSA and SA) . . . . .	5
4	ACF of residuals . . . . .	6
5	Non oil exports Spectral (NSA and SA) . . . . .	7

## List of Tables

1	HEGY test statistics . . . . .	4
2	Year on year and point on point growth rates . . . . .	9

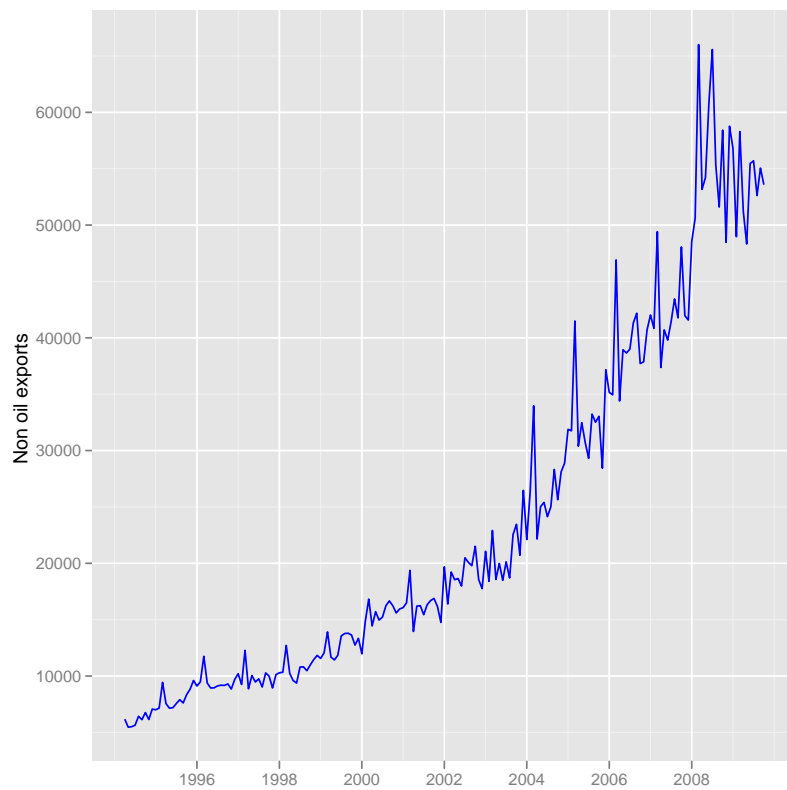
# 1 Non oil exports

We analyse the monthly data for Non oil exports in Rs.crore from April, 1994 onwards. Figure 1 shows the original plot of the series. The plot shows seasonal variations. In 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.

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**Figure 1** Non oil exports (Non seasonal adjusted)

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## 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 the given series, multiplicative seasonal adjustment is considered appropriate on the basis of the model selection criteria. The plot of the series also shows multiplicative seasonal adjustment.

## 2 Steps in the seasonal adjustment procedure

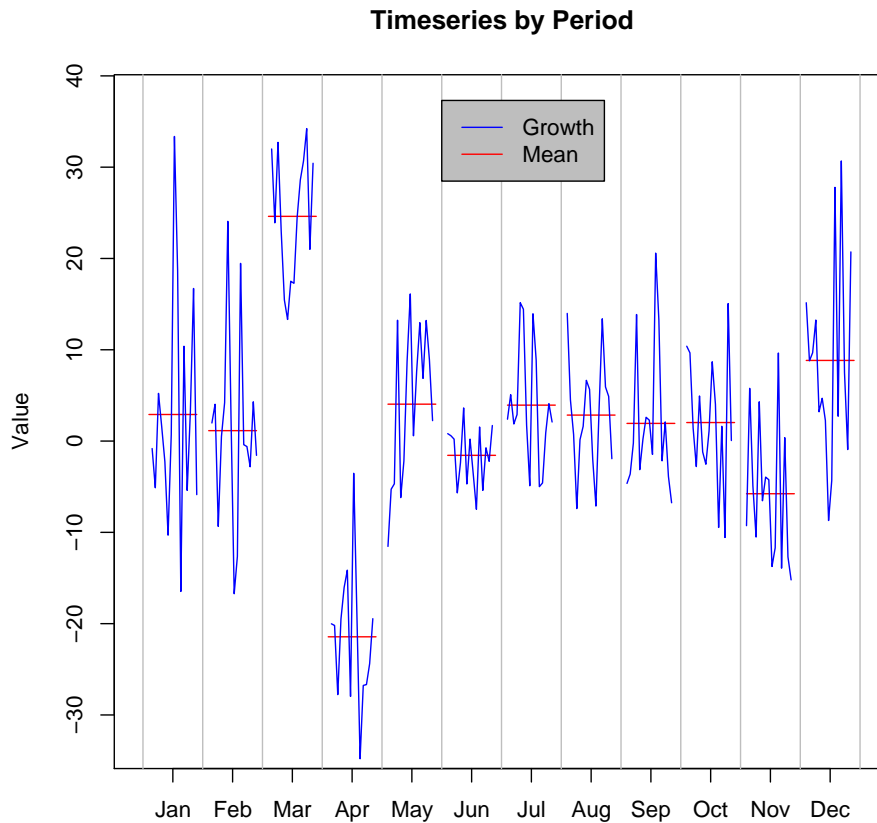
Given that seasonality exists, it is important to model seasonality before the application of seasonal adjustment procedure. Seasonality in time series can be deterministic or stochastic. Stochastic seasonality can be stationary or non-stationary.

A visually appealing way of looking at the raw data is to plot the growth rates in each of the months across the years i.e the growth of April over March in each of the years from 1994 onwards. This gives us some idea of the presence of seasonal peaks, if any in the series.

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**Figure 2** Monthly growth rates across the years

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Figure 2 shows seasonal peaks in the month of March and to a lesser extent in December.

### 2.1 Tests for identifying the nature of seasonality

We test for the nature of seasonality using HEGY and Canova Hansen test.

Under the null hypothesis of the HEGY test, nonstationary unit root behavior exists not only at the long run (or zero) frequency, but also at some or all of the seasonal frequencies.

The Canova Hansen test takes the opposite approach. The null hypothesis is stationarity with deterministic seasonality.

**Table 1** HEGY test statistics

	Stat.	p-value
tpi_1	1.80	0.10
tpi_2	-3.12	0.02
Fpi_3:4	11.93	0.10
Fpi_5:6	3.67	0.01
Fpi_7:8	8.02	0.09
Fpi_9:10	5.35	0.01
Fpi_11:12	6.03	0.02
Fpi_2:12	10.75	
Fpi_1:12	12.75	

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Canova & Hansen test  
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Null hypothesis: Stationarity.

Alternative hypothesis: Unit root.

Frequency of the tested cycles:  $\pi/6$  ,  $\pi/3$  ,  $\pi/2$  ,  $2\pi/3$  ,  $5\pi/6$  ,  $\pi$  ,

L-statistic: 1.646

Lag truncation parameter: 14

Critical values:

0.10 0.05 0.025 0.01

2.49 2.75 2.99 3.27

The test statistic of the Canova Hansen test is less than the critical values signifying that the null of stationarity with deterministic seasonality cannot be rejected. The HEGY test statistics also point towards a deterministic seasonal pattern.

*These tests suggest that the seasonal pattern in Non oil exports is deterministic.*

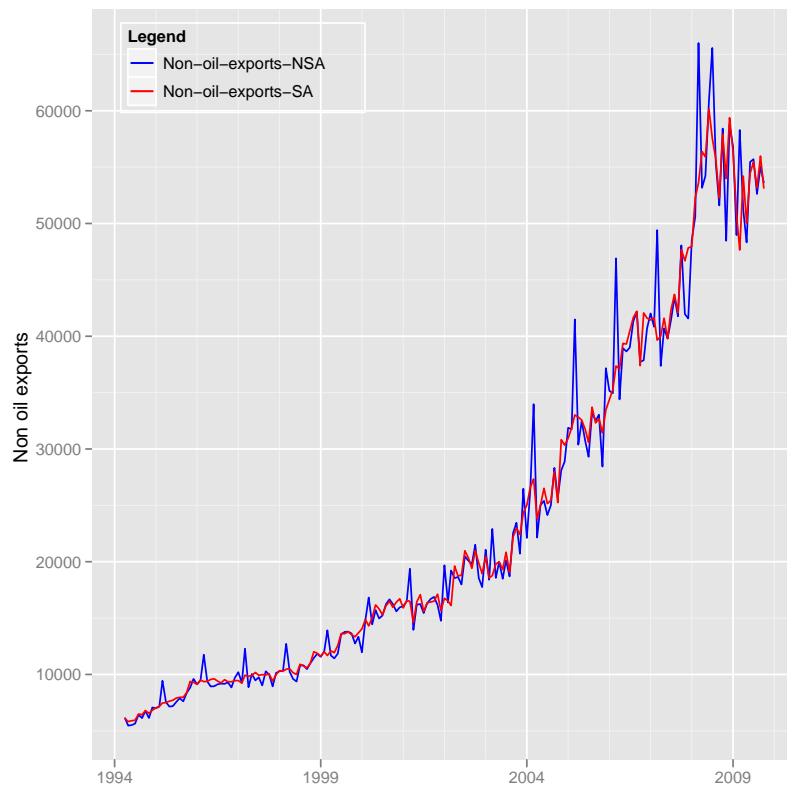
## 2.2 Seasonal adjustment with X-12-ARIMA

Seasonal adjustment is done with X-12-ARIMA method. Since the test results point towards deterministic seasonality, seasonal dummy is added in the regARIMA specification.

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**Figure 3** Non oil exports (NSA and SA)

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Figure 3 shows the non-seasonally and seasonally adjusted Non oil exports. The blue line shows the non-seasonally adjusted series and the red line shows the seasonally adjusted one.

## 2.3 Diagnostic checks

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

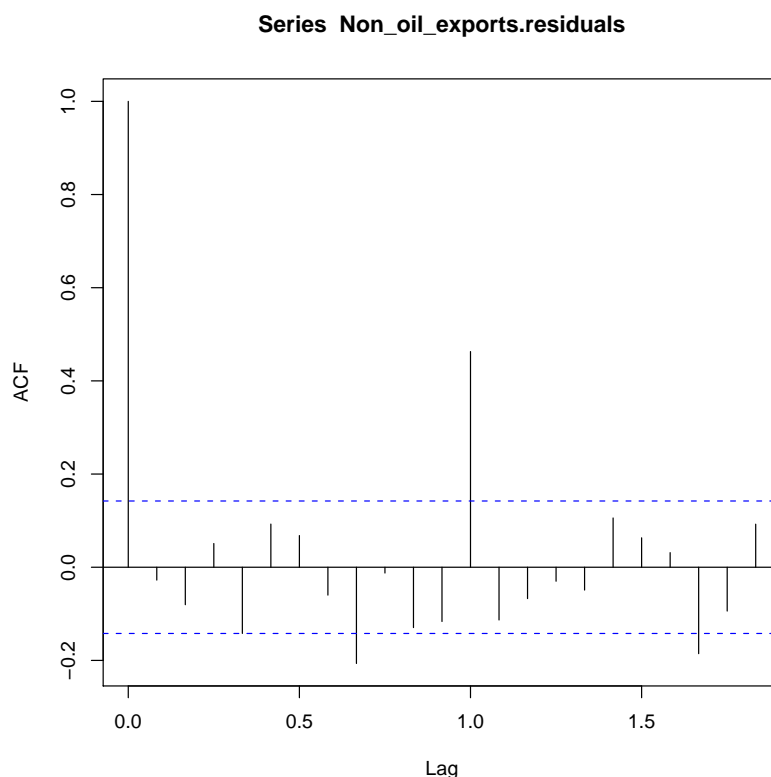
### 2.3.1 Validation of the automodel choice by X-12-ARIMA

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.

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**Figure 4** ACF of residuals

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### 2.3.2 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 for Non oil exports is 0.388.

*Non oil exports show identifiable seasonality on the basis of 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.

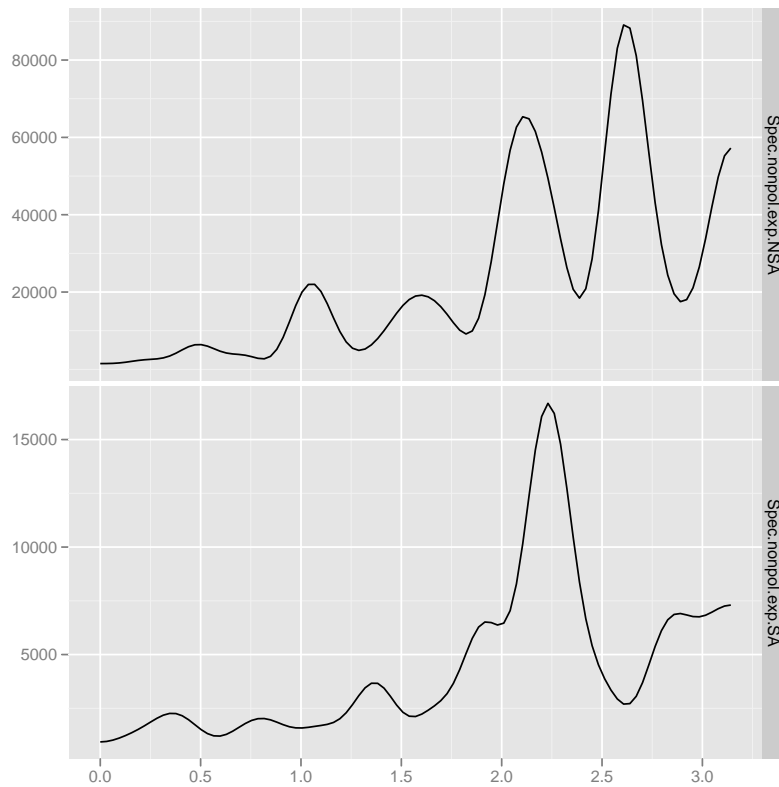
The x-axis represent frequency from 0 to  $\pi$  (3.14). The seasonal frequencies are  $\pi/6$  (0.52 on the x-axis),  $\pi/3$  (1.04 on the x-axis),  $\pi/2$  (1.57 on the x-axis),  $2\pi/3$  (2.09 on the x-axis) and  $5\pi/6$  (2.6 on the x-axis). In terms of periods (months); they are 12 months, 6 months, 4 months, 3 months and 2.4 months.

The figure at the lower panel shows that peaks at seasonal frequencies are eliminated after seasonal adjustment. Other peaks seen in the lower panel of the figure are not at seasonal frequencies.

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**Figure 5** Non oil exports Spectral (NSA and SA)

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## 5 Sliding span diagnostics

Sliding span diagnostics are descriptive statistics of how the seasonal adjustments and their month-to-month 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 month 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 month common to more than one span, the difference between the month on month change from the different spans should not exceed the threshold value (the threshold value being 0.03).

Sliding span gives the percentage of months (A%) for which the seasonal adjustment is unstable (the difference in the seasonally adjusted values for a particular month from more than one span should not exceed 0.03). It also gives the percentage of months (MM%) for which the month on month 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  $MM\% > 40.0$ .

For non oil exports A% is 13.1 and MM% is 26.5. **The sliding span diagnostics is not reliable when the range of the seasonal factors in a particular span is low (less than 5).**

## 6 Accounting for India-specific moving holiday effects

Accounting for moving holiday effect is a crucial component of pre-treatment of the series before the application of seasonal adjustment method. X-12-ARIMA is capable of handling the moving holiday effects through the inclusion of regressors for Easter Sunday, Labor Day, and Thanksgiving Day. These are important moving holidays for U.S time series.

We use the GENHOL program of X-12-ARIMA to analyse India-specific moving holiday effect. The program generates regressor matrices from holiday date file to enable X-12-ARIMA, estimation of complex moving holiday effects. It has the capability to generate regressors for before the holiday interval, surrounding the holiday interval and past the holiday interval.

The key assumption is that the fundamental structure of a time series changes for a fixed number of days before, after or for a fixed interval surrounding the holidays. We estimate the effect of Diwali which is an important moving holiday in Indian scenario. We estimate the effect with different specifications about the number of days around the festival. However we did not find significant results for diwali effect on non oil exports.

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**Table 2** Year on year and point on point growth rates

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	Y.o.Y.growth	Point.on.point.growth
2006 Jan	10.29	32.59
2006 Feb	10.06	30.68
2006 Mar	13.06	69.05
2006 Apr	13.20	-8.50
2006 May	19.92	71.18
2006 Jun	25.84	-1.61
2006 Jul	33.07	34.72
2006 Aug	24.31	34.64
2006 Sep	29.73	16.23
2006 Oct	14.18	-145.61
2006 Nov	33.13	141.50
2006 Dec	9.51	-13.34
2007 Jan	19.52	-4.81
2007 Feb	16.86	5.74
2007 Mar	5.34	-58.62
2007 Apr	8.64	10.55
2007 May	4.52	46.78
2007 Jun	2.96	-53.37
2007 Jul	6.22	74.55
2007 Aug	5.18	38.52
2007 Sep	-0.97	-45.24
2007 Oct	27.40	149.58
2007 Nov	10.83	-25.32
2007 Dec	2.14	29.23
2008 Jan	15.47	2.83
2008 Feb	23.92	103.36
2008 Mar	33.58	30.65
2008 Apr	42.28	60.10
2008 May	33.22	-10.10
2008 Jun	52.87	88.02
2008 Jul	58.28	-52.82
2008 Aug	27.37	-38.95
2008 Sep	23.55	-76.65
2008 Oct	21.56	123.18
2008 Nov	15.50	-84.59
2008 Dec	41.36	114.18
2009 Jan	17.09	-62.68
2009 Feb	-3.23	-125.23
2009 Mar	-11.69	-76.10
2009 Apr	-3.64	154.70
2009 May	-10.88	-95.97
2009 Jun	-8.85	101.09
2009 Jul	-15.05	22.41
2009 Aug	-4.92	-50.97
2009 Sep	6.69	62.01
2009 Oct	-8.28	-63.41
2009 Nov	9	
2009 Dec		
2010 Jan		

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