Study on Seasonal Adjustment of IIP Using X-12 ARIMA

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Abstract

Index of Industrial Production (IIP) is a very important economic indicator of the Indian Economy, which depicts the growth picture in key sectors of Indian Economy – manufacturing, mining and electricity. Published monthly, IIP covers as many as 399 items (item groups). Some of these items are seasonal in nature. This study attempts to identify the seasonal items first and then adjust the corresponding item indices seasonally. Finally, the seasonally adjusted item indices are combined with the (unchanged) non-seasonal item indices to arrive at the general IIP and other higher order indices. X-12 ARIMA, robust software developed by US Census Bureau has been used extensively in this paper to compile seasonally adjusted IIP. It may be noted that United Nations (UN) also recommends X-12 ARIMA for seasonal adjustment of indices and many countries worldwide are using this tool for seasonal adjustment. Comparison of the growth rates obtained from the present series of IIP (unadjusted) and seasonally adjusted IIP reveals that growth rates are more stable in case of the latter. Except for intermediate goods, which have the least percentage of seasonal items within a use-based category, volatility in growth rate for all other categories reduces significantly in case of a seasonally adjusted series.

1. Introduction

1.1 Index of Industrial Production (IIP), compiled and published monthly by Central Statistical Office (CSO), is an important indicator of short-term economic development and is used to measure the industrial growth in the economy and hence assumes great importance to all – analysts, economists, statisticians, planners and policy makers. The present series of IIP with base 2004-05 covers 399 item (item groups) across three broad sectors of the economy viz. Mining, Manufacturing and Electricity with weights 141.6, 755.3 and 103.2 respectively, in a scale of 1000. The index is calculated in stages using a fixed base Laspeyre's formula, initially for items, then major groups (NIC-3digit), divisions (NIC-2digit), sectors (mining, manufacturing, electricity) and finally for all sectors combined (general index). At each stage, the index is a weighted average of the indices calculated at immediately lower stage. Apart from the general and sectoral indices, CSO also publishes indices at 2-digit divisions of NIC-2004 and for five use- based categories viz. Basic goods, Capital goods, Intermediate goods, Consumer durable and Consumer non-durable goods. Among all these use-based categories, capital goods sector is often considered as the barometer of the economy and high fluctuation in growth rate of capital goods in IIP has remained a major concern to all the stakeholders.

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1.2 High frequency time series data on economic statistics in general and industrial production in particular, including the IIP, are often characterized by seasonal fluctuations that mask the relevant short and long term movements of these series and impede a clear understanding of the underlying economic phenomena. A proper and well-known solution is to identify and remove these effects, thus relying on the seasonally adjusted data. In this paper an attempt has been made to seasonally adjusted IIP using X-12 ARIMA, a seasonal adjustment software package developed by the US Census Bureau and used extensively by many countries world-wide for this purpose. This is also one of the software packages recommended by the United Nations Statistics Division for seasonal adjustment of IIP[2]. The seasonally adjusted indices are then compared with the unadjusted original series. Finally, the seasonally adjusted series is tested for presence of residual seasonality.

1.3 The organization of the study is as follows: Section 2 discusses about the seasonal adjustment and its advantage. The theory of ARIMA modeling is outlined in Section 3. Section 4 gives a detail framework of X-12 ARIMA for seasonal adjustment. Features and diagnostics checks given in X-12 ARIMA seasonal adjustment process is described in Section 5 and Section 6 respectively. Data analysis and the findings of the study are given in Section 7 while Section 8 offers some concluding remarks.

2. Seasonal Adjustment

2.1 ***Objective***: The main aim of seasonal adjustment is to filter out seasonal fluctuations of the time series in order to uncover the important features of the series in relation to its evolution, i.e. direction and magnitude of changes that have taken place. Usual seasonal fluctuations mean those movements, which recur with similar intensity in the same season each year and which, based on the past movements of the time series, can under normal circumstances be expected to occur.

2.2 ***Advantage:*** Seasonal adjustment supplies users and analysts with the necessary inputs for business cycle analysis, trend-cycle decomposition and turning points detection. It provides a more smooth and understandable series hence revealing the "news" contained in the time series of interest. Seasonal adjustment facilitates the comparison of long-term and short-term movements among industries, sectors and countries. However, the seasonally adjusted data and the estimated trend/trend-cycle complement the original data, but, they cannot replace the original data for the following reasons: i) unadjusted data are useful in their own right. While the non-seasonally adjusted data show the actual economic events that have occurred, the seasonally adjusted data and the trend-cycle estimate represent an analytical elaboration of the data designed to show the underlying movements that may be hidden by the seasonal variations. Thus, compilation of seasonally adjusted data, exclusively, represents a loss of information; ii) no unique solution exists on how to conduct seasonal adjustment and; iii) seasonally adjusted data are subject to revisions as future data become available, even when the original data are not revised.

[2] *International Recommendations for the Index of Industrial Production (IRIIP), 2010, UNSD*

2.3 *Need for Seasonal Adjustment:*

2.3.1 Seasonal upswing or downswing can often be confused with upward or downward trend. This fact can be a matter of concern for short-term (monthly) time series like IIP. Hence, one should focus on the smoothed indices.

2.3.2 Seasonality of a time series can add to the overall volatility of the series. In recent times, volatility in the growth rate of IIP has been a point of discussion. Seasonal adjustment to IIP can reduce the volatility, specially, in the MoM growth rates.

2.3.3 However, one must not ignore the plausibility of distortion of the quality of the seasonal estimates. For this, some interventions is necessary to detect the outliers and effects like Additive Outlier (AO), Trend Breaks or Level Shift (LS), Temporary Change (TC) etc. In other words, the seasonal adjustments should not be made on a series which has these effects. Instead, these effects should be adjusted from the time series before seasonal factors are derived finally.

2.4 ***Quality of seasonal adjustment:*** The most fundamental requirement of seasonal adjustment quality is that there is no estimable seasonal effect still present in the seasonally adjusted series. The presence of estimable seasonal effects in either the seasonally adjusted series or the de-trended seasonally adjusted series (i.e. the irregular component) is, generally, what is referred to as residual seasonality. To detect whether the seasonally adjusted time series contains residual seasonality, a special "spectral diagnostic" should be carried out for monthly data.

2.5 ***Direct and Indirect seasonal adjustment:*** A seasonally adjusted value of an aggregate series can be derived either as seasonally adjusting the series itself (direct adjustment), or as summing (or combining) the seasonally adjusted values of its component series (indirect adjustment). Under most circumstances, the direct and indirect adjustments for an aggregate series are not identical. There are some very limited situations in which the two types of adjustment coincide, particularly if the adjustments are additive. Whether direct or indirect adjustment is more appropriate for a given set of series will largely depend on the set of series under consideration. As a practical rule generally indirect seasonal adjustment should be preferred when the component series that make up the aggregate series have quite distinctively different seasonal patterns and have adjustments of good quality. The indirect seasonal adjustment in this case is of better quality than the direct adjustment. Direct seasonal adjustment should be preferred when the component series have similar seasonal patterns and summing the series may result in noise cancellation.

2.6 *Principles of seasonal adjustment*

2.6.1 Let , Y be a time series and C, S and I are respectively the trend-cycle, seasonal and irregular components of the time series. Following are two types of time-series models:

Additive model : $Y = C + S + I$

Multiplicative model: $Y = C \times S \times I$

The seasonally adjusted series is formed by estimating and removing the seasonal component.

For the additive model: Seasonally adjusted series $= Y - S\hat{} = C + I$

For the multiplicative model: Seasonally adjusted series $= Y / S\hat{} = C \times I$.

S^ is the estimate of seasonal factor.

2.6.2 In a multiplicative decomposition, the seasonal effects change proportionately with the trend. If the trend rises, so do the seasonal effects, while if the trend moves downward the seasonal effects diminish too. In an additive decomposition, the seasonal effects remain broadly constant, no matter which direction the trend is moving in.

3. Theory of ARIMA Modeling

3.1 Auto Regressive Integrated Moving Average (ARIMA), developed by Box-Jenkins, is a very familiar econometric modeling technique that deals with non-stationary time series. This non-stationarity is observed with respect to mean of the series. The package X-12 ARIMA uses ARIMA extensively. Following is a brief account of ARIMA modeling.

3.2 Auto Regressive Moving Average (ARMA) models are frequently used to model stationary time series. Thus ARMA(p,q) on a time series y_t may be defined as

$$\Phi(B)\, y_t = \theta(B)\, a_t \qquad \longrightarrow \qquad (1)$$

where, B = Backshift Operator i.e. $By_t = y_{t-1}$

$\Phi(B) = (1 - \Phi_1 B - \Phi_2 B - \ldots\ldots\ldots\ldots\ldots\ldots \Phi_p B)$ is the non-seasonal AR operator.

$\theta(B) = (1 - \theta_1 B - \theta_2 B - \ldots\ldots\ldots\ldots\ldots\ldots \theta_q B)$ is the non-seasonal MA operator

a_t is the white noise process i.e. $\{ a_t \}$ is a sequence of independently and identically random variables with zero mean and variance σ^2.

3.3 But, most time series in real life are non-stationary in nature. That is the general level or the mean level of the series changes with respect to time. In such case, one may apply ARMA on the differenced series (i.e. on the series ($\Delta y_t = y_t - y_{t-1}$)). This is ARIntegrated(I)MA model. So a ARIMA(p,d,q) model looks like:

$$\Phi(B)\, \Delta^d y_t = \theta(B) a_t \qquad \longrightarrow \qquad (2)$$

3.4 ARIMA takes into account the trend component of the time series. But, often time series possess a seasonal component that repeats every s observations. For monthly observations s = 12 (12 in 1 year), for quarterly observations s = 4 (4 in 1 year). In order to deal with seasonality, ARIMA processes have been generalized to Seasonal ARIMA or SARIMA which has then been formulated as

$$\Phi(B)\Delta^{D}y_{t} = \theta(B)\alpha_{t}$$

where α_t is such that

$$\Phi(B^{s})\Delta_{s}^{D}\alpha_{t} = \theta(B^{s})\, a_{t}$$

Where, s is the seasonal frequency; 12(for monthly data), 4(for quarterly data) etc.

D = Order of seasonal differencing

$\Phi(B^s) = (1 - \Phi_1 B^s - \ldots\ldots\ldots\ldots\ldots \Phi_P B^{Ps})$ is the seasonal AR operator.

$\theta(B^s) = (1 - \theta_1 B^s - \ldots\ldots\ldots\ldots\ldots \theta_Q B^{Qs})$ is the seasonal MA operator.

Hence, $\Phi(B)\Phi(B^s)\Delta_s^{D}\Delta^{d}y_t = \theta(B)\theta(B^s)a_t$ ⟶ (3)

This is the SARIMA or ARIMA(p,d,q) x $(P,D,Q)_s$ model.

4. Framework of X-12 ARIMA for Seasonal Adjustment

4.1 The great strength of X-12 ARIMA is that it first models the seasonality using suitable econometric series and then the obtains the seasonal factors for the seasonal period. Two broad functionalities are performed in two major steps. First, the package uses Regression-ARIMA technique to model the underlying time series. The main essence of using Regression-ARIMA is that of prior adjustment and modeling to the data. This fitted model can be used for the purpose of forecasting and backcasting, so that the forecasted and the backcasted values can be utilized for the seasonal adjustment process. Second, after this prior adjustment the actual seasonal adjustment process is executed.

4.2 Prior Adjustment Process

4.2.1 In the regression part, the package uses linear function of suitable regressors that impacts the dependent time series variable. Then the errors of the time series are modeled as SARIMA. In other words, we can think of the following model:

$$y_t = \Sigma \beta_i x_{it} + z_t \quad \longrightarrow \quad (4)$$

Here, z_t is modeled by SARIMA as discussed in earlier section. x_i 's are the regressors and the β_i 's are the regression coefficients. Here the regressors are concurrent in nature. That is x_{it} goes with y_t with respect to same time point t only.

4.2.2 In standard regression technique z_t is modeled as white noise i.e. $\{Z_t\}$ is a sequence of independently and identically distributed random variables with zero mean and variance a^2. This assumption can be grossly invalid for a time series, where the residuals are supposed to be auto correlated. But modeling z_t as SARIMA helps to capture the covariance structure of the residuals.

4.2.3 The specialty of the regression part is that it contains such variables which should not be part of the series when the seasonal adjustment process is executed. Hence, the Regression-ARIMA model first estimates the regression effects and then the regression effects are subtracted from y_t to get the zero mean series z_t, which is assumed to follow the SARIMA model.

4.2.4 There are many regressors like, Trend Constant, fixed Seasonal effect, Trading day, Leap Year etc. that can be incorporated to the model. But, most importantly there are built in regression variables to deal with abrupt changes in the level of a series: additive outliers (AOs), level shifts (LSs), temporary changes (TCs), and ramps. AOs affect only one observation in the time series, LSs increase or decrease all observations from a certain time point onward by some constant amount, TCs allow for an abrupt increase or decrease in the level of the series that returns to its previous level exponentially rapidly, and ramps allow for a linear increase or decrease in the level of the series over a specified time interval. These four regressors are interventions to tackle seasonal outliers. This is, indeed, a crucial step to adjust seasonal outliers before the seasonal adjustment process starts.

4.3 Seasonal Adjustment Process

4.3.1 Once the prior adjustment is completed the seasonal adjustment process starts. It is evident that by now, the system has identified a suitable model for the time series, the necessary forecasted and backcasted values (using that fitted model) have been generated and the necessary interventions, if necessary, have been detected and applied.

4.3.2 X-12 ARIMA performs the following algorithm in 3 iterations to derive the seasonal factors. Let us consider a multiplicative model.

(i) Moving average (MA) over Y to get the preliminary estimate of trend component (C) of the time series, say C^

⬇

(ii) Estimate of the S*I = Y/ C^

⬇

(iii) Identify the outliers based on estimate of S*I's .

⬇

(iv) S*I values are modified (weighted average of S*I values are considered to get the adjustment) for outliers. The weight is assigned in accordance with to the extremity of the outliers in the S*I series.

⬇

(v) MA over the modified S* I values = Preliminary Estimate of Seasonal factor(S), say S^

⬇

(vi) Divide Y by S^ to get preliminary seasonally adjusted series , say, $Y^{/}$

⬇

(vii) Improve S^ by repeating (i) – (vi). But all the operations are carried out on $Y^{/}$. This is followed for 2 more iterations.

⬇

(viii) The final seasonally adjusted series is obtained by dividing the **original series Y** by the latest S^.

5. Features of X-12 ARIMA Seasonal Adjustment Process

5.1 X-12 ARIMA provides flexibility over to the transformation (example log transformation) to be used to the data series and the mode (additive/multiplicative) during the prior adjustment process. X-12 ARIMA zeroes down on a particular additive or multiplicative model if it has the lower Akaike's Information Criteria (AIC).

5.2 ***Advantage of forecasting and backcasting:*** Suppose we have data on a time series from April, 2000 to January, 2012. If the series is seasonal, then, the April, 2004 and April, 2006 will have more impact on April, 2005 value. But we do not have the value on April, 2004. Here, X-12 ARIMA backcasts (extends the time series backwards) to get value of April, 2004 and makes the estimate of April, 2005 more sensible based on April, 2004. Similarly, X-12 ARIMA will forecast (extends the time series in forward) for Jan, 2012 to get data for Jan, 2013 and generate reliable estimate of Jan, 2012.The model fitted by the prior adjustment process is used extensively for the purpose of forecasting and backcasting.

5.3 Because of the capability of backcasting and forecasting, X-12 ARIMA is capable of using symmetric moving average. This also makes sure less revision of the earlier seasonal estimates when the actual future series data is available.

5.4 X-12 ARIMA produces a set of diagnostics that can be easily used to identify whether a series is seasonal or not and also the stability of the seasonal estimates.

6. Diagnostics of X-12 ARIMA

6.1 *Tests for adequacy of the fitted model:*

6.1.1 As already has been pointed out, that as part of prior adjustment X-12 ARIMA fits different ARIMA model to the series so that it can be used for forecasting and backcasting. But it is necessary to find if the fitted model is adequate or not. In other words, the fitted model must not have autocorrelation in the residuals of the fitted series.

6.1.2 Autocorrelations for the sample residuals have been used for this. A fitted model has been considered adequate for forecasting and backcasting if all the p-values for the sample autocorrelations up to lag 24 (because of monthly data) are greater than 0.05 (for 5% level of significance).

6.2 ***Tests for checking seasonality:*** It has been already pointed out that IIP is a derived index. It covers 399 different items. So, the study has a major focus on the identification of seasonal items (5 digit NIC). To check whether a series is seasonal or not the following diagnostics measures (as generated by X-12 ARIMA has been used).

6.2.1 Let,

σ_T^2 = Total variance of S*I ratios (differences)

σ_M^2 = Between Months variance to measure the extent of stable seasonality

= Sum of Squares of the difference between the average for each month of SI and the total average, adjusted by correction factor.

σ_Y^2 = Between Years variance to measure the extent of moving seasonality

= Sum of Squares of the difference between the annual average of SI and the total average, adjusted by correction factor.

σ_R^2 = Residual Variance due to irregulars

$= \sigma_T^2 - \sigma_M^2 - \sigma_Y^2$

Now, to test the presence of stable seasonality a F-statistic F_s is constructed using σ_M^2 and σ_R^2 and tested as F-test. To test the presence of moving seasonality another F statistic F_m is constructed using σ_Y^2 and σ_R^2 tested as F-test.

Since, several assumptions regarding F-test may be violated; a non-parametric Kruskal-Wallis test is also conducted to test the presence of stable seasonality.

A series is identified as seasonal only if all the three tests indicate presence of seasonality.

6.2.2 Another diagnostics M7 is constructed as a function of the Fs and F_m. It measures the presence of moving seasonality relative to stable seasonality. If the moving seasonality is too much than compared to stable seasonality, the seasonal adjustment could be effective. Hence those item indices have been seasonally adjusted for which M7 is very small, preferably between 0 and 1. Smaller the M7 better is the seasonal adjustment.

6.2.3 The spectrum of the original series also serves good purpose to detect seasonality. Spectrum graphs of a monthly series tend to have peaks around seasonal frequencies i.e. at 1/12,2/12,3/12 etc. This condition has also been imposed on the item indices for the sake of testing seasonality.

6.3 *Checking of Suitability of Seasonal Adjustment*

6.3.1 Even if a time series is seasonal, the seasonal adjustment may not be appropriate if the residual of the seasonally adjusted series displays presence of seasonality. So, the residuals of all the seasonally adjusted item indices are checked for seasonality using the Spectrum plot (as mentioned in 6.2.3).

6.3.2 Same checking is applied on the higher order derived indices also to detect if there is still residual seasonality after the indirect adjustment.

7. Data Analysis and Major Findings

7.1 ***Data set:*** The 399 item level (5 digit NIC code) production indices for the present IIP series (with base 2004-05) has been used for the paper. All the item level (5 digit NIC code) monthly production indices from April, 2005 to Jan, 2012 have been used.

7.2 ***Why indirect seasonal adjustment:*** As discussed in Section 2.5, generally indirect seasonal adjustment is preferred over the direct adjustment when the component series that make up the aggregate series have distinctively different seasonal pattern. As the item indices exhibit quite different pattern of seasonality, in this paper indirect seasonal adjustment has been attempted. Also, as at each higher (2/3/4 digit NIC or sectoral or general) the index is a weighted average of indices at immediately lower stage and hence may contain seasonal as well as non-seasonal components, direct adjustment at an aggregate level may interfere with the originality of the non-seasonal items, which is undesirable.

7.2.1 *Seasonal items:* For this study, a particular item has been diagnosed as a seasonal item only if all the three tests mentioned in Sections 6.2.1, 6.2.2 and 6.2.3 indicate seasonality. Following this criterion, 148 out of 399 item indices were diagnosed as seasonal. Use-based category-wise and NIC-2 digit-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights are shown in Table 1 and Table 2 respectively.

7.2.2 It can be seen from Table 1 that highest number of seasonal items are from consumer non-durable sector followed by capital goods sector. In percentage term, highest percentage (46.6%) of seasonal items within a use-based category comes from capital goods, closely followed by consumer durable (46.5%) and consumer non-durable items (about 45%). Only 28.4% of the basic goods and 27.4% of intermediate goods are seasonal. Total weight of seasonal items is, however, highest for basic goods (with weight 302.34 i.e. more than 66% of the total weight of this sector) followed by consumer non-durable goods (98.14, i.e. 46% of the total weight of this sector) and capital goods (54.52, i.e. 62% of the total weight of capital goods). Figure 1 shows the seasonal items belonging to different use-based categories.

7.2.3 It is observed from Table 2 that highest number (31) of seasonal items belong to the NIC division 15 i.e. food products and beverages (67% of all items in that division), followed by NIC division 24 i.e. chemical and chemical products (24) and NIC division 29 i.e. machinery and equipment n.e.c. In percentage term, highest percentage of seasonal items within a NIC division (2-digit) is observed in wearing apparel (NIC div. 18), where both the items are seasonal. This is followed by motor vehicles, trailers and semi-trailers (NIC div.34) with 80% (4 out of 5) items from this group being seasonal. No item from the NIC division 16 i.e. tobacco products showed seasonality which is quite obvious. Weight-wise the seasonal items capture more than 78% weight in food products and beverages, 100% of the weight of wearing apparel, 99.8% of the weight of the motor vehicles, trailers and semi-trailers and 80% of the weight of other transport equipment. In total, 146 out of 397 item indices (about 37%) of manufacturing sector with total weight of more than 38% of the weight of manufacturing sector were identified as seasonal.

7.2.4 Apart from this, both the mining and electricity indices were found to be seasonal. Collectively, 37% of the item indices in general IIP exhibited seasonality having combined weight of 533 (out of 1000). the presence of such huge number of seasonal items having more than 50% weight fully justifies compilation of a seasonally adjusted IIP for a better understanding of the trend.

7.2.5 After identifying the item indices having seasonality, the same are seasonally adjusted by using software package X-12 ARIMA, as discussed in earlier sections.

7.3 Index Comparisons

7.3.1 The original (unadjusted) and the seasonally adjusted general IIP are plotted against months for the period April 2005 to January 2012 in Figure 2. Clearly, the the seasonally adjusted IIP is smoothed well. It may be noted that in the original series some regular peaks could be found around March in some years. Those peaks could be attributed to the branching that occur in March due to the closure of financial year. This point also adds to seasonality of the series and after the adjustment it is taken care of.

7.3.2 Comparison of the original (unadjusted) and seasonally adjusted series for manufacturing, mining and electricity sectors are given in Annexure-I. In all these cases, the seasonally adjusted series is a more smoothed one than the corresponding original series, which justifies the seasonal adjustment.

7.4 Growth Rate Comparisons – Year-on-Year (YoY) growth vs. Month on Month (MoM) growth

7.4.1 Growth rates can be computed either year-on-year or month-on-month basis. The YoY growth rate is computed as the percent change with respect to the corresponding month in the previous year (e.g. April 2009 over April 2008), while the MoM growth rate is computed as the percentage change with respect to the preceding month (e.g. April 2009 over March 2009). Hence in a YoY comparison, the seasonality factor gets somewhat nullified as one can expect that under normal circumstances, same seasonal factors would govern the seasonality of say April 2008 and April 2009. The two figures (Figure 3 and Figure 4) show the monthly growth rates observed in the original series and the seasonally adjusted series of general IIP on YoY and MoM basis respectively.

7.4.2 The monthly growth rate on YoY, show more or less the same pattern for the adjusted and unadjusted series, both with respect to direction and magnitude of growth. However, the real improvement in the volatility of the growth rate due to seasonal adjustment can be noticed if we compare the monthly growth rate on Month to Month basis (fig.4). In MoM comparison, the divergence of growth rates from the mean growth rate seems to be much lesser in case of a seasonally adjusted IIP. Hence, in the subsequent part of the paper all the growth rates have been computed on MoM basis so as to highlight the wide divergence in the growth rate in the original and the seasonally adjusted series.

7.4.3 Although the YoY growth rate very crudely adjust some seasonality, it is interesting to compare the YoY growth rate of the original (unadjusted) series with the seasonally adjusted series for the same months, as one adjusts for seasonality in a very crude way and the other adjusts for seasonality in a robust scientific way. The results are given in Annexure-II. It can be seen from this Annexure, that these two growth rates differ significantly for many months not only in magnitude, but also in direction (some such cases are highlighted in the table). This further emphasizes the need to do a proper seasonal adjustment of the IIP series.

7.4.4 The MoM growth rates of the original and adjusted series have been compiled for all the NIC 2-digit divisions, for all the three sectors (mining, manufacturing, electricity) as also for all the use-based categories. Such comparison of growth rates for the use-based categories are given in Annexure-III, while that for the sectoral indices are given in Annexure-IV and for selected 2-digit industries (where either the weight of seasonal items is more or the percentage of seasonal item is more or both) is given in Annexure-V. In all these Annexures, there are a number of cases where there exists a significant difference in the growth rates of the two series, some of which cases have been highlighted.

7.4.5 It may be observed from Annexure-III, that among the use-based categories most significant change in the MoM growth rate is observed in capital goods, which has often been criticized for its erratic behavior. The seasonally adjusted series of capital goods show a much less volatile growth as against its unadjusted counterpart. One important observation is made in case of capital goods – Almost for all the years the MoM growth for the month of March in the original series shoots up and then declines sharply in the month of April, which indicates presence of a marked seasonality in the March index. The seasonally adjusted series of capital goods, on the other hand, shows a much less growth (decline) figure for the same months of the corresponding year. Table 3 highlights this observation.

7.4.6 For all other use-based categories except for intermediate goods, the seasonal adjustment results in a much stable growth in comparison to the unadjusted series. Only in case of intermediate goods, the seasonally adjusted and unadjusted series reveal a similar kind of growth in magnitude and direction in most of the cases, which is probably because of lesser number of seasonal items in this category (only 27% of the intermediate goods were found to be seasonal). The seasonal adjustment seems to improve the consumer non-durable index to a large extent. This is consistent with the fact that we have already pointed, that most of seasonal items come from this category only.

7.4.7 In case of sectoral indices again (see Annexure-IV), the seasonally adjusted series significantly reduces the volatility in growth rate in comparison to the original series. Among the sectoral indices, the mining index exhibits a typical 'March syndrome' as manifested by the capital goods, but in a relatively smaller magnitude.

7.4.8 In case of NIC 2-digit divisions, a distinct pattern of seasonality is observed for NIC-2 digit divisions 15 (Food Products and beverages) and 18 (Wearing apparel). In case of NIC division 15, there is a peak in the months of November and December every year in the original (unadjusted) series which may be due to increased sugar production around that time in the year. Total weight of sugar is more than 21% of the total weight of the entire NIC division 15 and hence seasonality in sugar production significantly contributes to the seasonal fluctuation of the entire food industry, which is also clear from the M-O-M growth rates of these months for seasonally adjusted and unadjusted series. In case of NIC division 18, a peak is observed in the month of December. The main reason for this is probably the seasonality in production of leather garments and also woolen garments, which are produced in huge volume in the winter as the two items under this NIC division (18) are 'Apparel' and 'Leather garments' with the later having about 27% of the weight of the entire NIC-2 digit division 18. Both these items show marked seasonality.

7.4.9 In general it may be seen that the seasonally adjusted series is well smoothed for divisions 15, 18, 19, 20, 24, 25, 26, 28, 29, 30, 33, 34 and 35.Volatility in MoM growth rate also gets reduced for all these divisions. The reduction in fluctuation in growth is most profound in NIC division 15 i.e. food products and beverages, which, quite expectedly, has maximum number of seasonal items (seasonal items in this division account for more than 78% weight of the total weight for the entire division). The indices and the growth rate in NIC 15 are given in Figure 5.1 and Figure 5.2.

7.4.10 As already mentioned, the NIC division 16 contains the tobacco products viz. biri, cigarette, panmasala, gutka, zarda etc, which are non-seasonal in nature and hence no seasonal adjustment has been done on this group.

7.4.11 However, it seems that for certain NIC divisions like NIC-17, 21, 22, 23, 27, 31, 32 and 36 the seasonal adjustment does not produce a very significant improvement in reducing the fluctuation in growth rate. However, for most of these divisions also, the growth rate observed in the adjusted series is more stable than the original series. The reason is, however, understandable. NIC divisions 17, 21, 22 and 36 respectively contain only 2, 1, 1 and 1 seasonal items. For NIC divisions 23 and 32, total weight of the seasonal items are 7.6 and 5.5 respectively (with respect to total weight of 1000). For NIC-27 out of 30 items, 21 are non-seasonal basic items.

7.5 Appropriateness of Seasonal Adjustment

7.5.1 It has been already pointed that a seasonal adjustment process will be incomplete and unstable if it does not remove residual seasonality from the adjusted series. Hence, every seasonally adjusted series must be tested for presence of residual seasonality. As mentioned earlier, the spectrum function of the adjusted series has been observed to detect if there are any peaks at the major seasonal frequencies at (1/12), (2/12), (3/12) etc.

7.5.2 The seasonally adjusted index for IIP does not show any indication of seasonality. The seasonally adjusted indices for Basic Goods, Capital Goods, Consumer–Durable Goods and Consumer Non-durable Goods also do not show any indication of seasonality. This means the indirect adjustment works fine for these categories. However, very interesting result is obtained in case of intermediate goods. The seasonally adjusted series for intermediate goods, quite surprisingly, exhibits presence of seasonality. The indirect method of seasonal adjustment does not seem to work fine in case of intermediate goods.

7.5.3 It has been pointed out earlier that, while testing for individual item indices of intermediate categories for seasonality, smaller number of items tested to be seasonal. It may be noted that this test for seasonality is a bit stringent one in the sense that the test has to pass 3 tests [2 (1 parametric and 1 non-parametric) for presence of stable seasonality and 1(parametric) test for presence of moving seasonality]. May be, for intermediate goods the test could be little relaxed such that one could take an intermediate item as seasonal if the particular test accepts at least one form of seasonality- moving or stable. Alternatively, one can think of applying direct seasonal adjustment to intermediate goods.

8. Concluding Remarks

8.1 Seasonality is an important aspect in any high frequency economic data and IIP is no exception. Presence of seasonality often masks the short and long term movements of the series, which, in turn, hampers the proper analysis of the series. Seasonal adjustment of IIP is thus a necessity for proper study of the series. In the IIP in India, 148 out of 399 item indices exhibit seasonality. NIC-2 digit-wise, Sector-wise and Use-based category-wise series of seasonally adjusted IIP in most cases present a more stable series with much less volatility in growth rate in comparison to the original series. This is more profiund in case of capital goods and consumer durable goods among the use-based category and food and beverages and automobile industries among others in the NIC division level. The results strongly recommend for seasonal adjustment of IIP in India which would help a host of stake holders to have a better understanding of the series and would also help in reducing the increasing doubt about its quality.

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Table 1: Use-based category-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights

Use-based category	Total No. of items	Weight of all items	No. of seasonal items	Weight of seasonal items	% of seasonal items	% of weight belonging to the seasonal items
Basic Goods	88	456.82	25	302.34	28.41	66.18
Capital Gods	73	88.25	34	54.52	46.58	61.78
Intermediate Goods	106	156.86	29	31.39	27.36	20.01
Consumer Durable Goods	43	84.60	20	46.56	46.51	55.04
Consumer Non-durable Goods	89	213.47	40	98.14	44.94	45.97
All	399	1000.00	148	532.95	37.09	53.30

Table 2: NIC-2-digit-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights

NIC-04	Industry Description	Total No. of items	Weight of all items	No. of seasonal items	Weight of seasonal items	% of seasonal items	% of weight belonging to the seasonal items
15	Food products and beverages	46	72.76	31	56.95	67.39	78.27
16	Tobacco products	5	15.70	0	0.00	0.00	0.00
17	Textiles	23	61.64	2	2.73	8.70	4.42
18	Wearing apparel; dressing and dyeing of fur	2	27.82	2	27.82	100.00	100.00
19	Tanning and dressing of leather luggages, handbags etc.	6	5.82	2	2.79	33.33	48.00
20	Wood and products of wood & cork except furniture;	4	10.51	1	5.11	25.00	48.58
21	Paper and paper products	8	9.99	1	0.90	12.50	9.01
22	Publishing, printing & reproduction of recorded media	2	10.78	1	0.70	50.00	6.47
23	Coke, refined petroleum products & nuclear fuel	16	67.15	5	7.61	31.25	11.34
24	Chemicals & chemical products	89	100.59	24	26.61	26.97	26.45
25	Rubber and plastics products	25	20.25	9	7.54	36.00	37.23
26	Other non-metallic mineral products	14	43.14	2	24.96	14.29	57.86
27	Basic metals	30	113.35	7	16.66	23.33	14.70

Table 2: NIC-2-digit-wise total number of items, number and percentage of items exhibiting seasonality along with their corresponding weights (Contd.)

NIC-04	Industry Description	Total No. of items	Weight of all items	No. of seasonal items	Weight of seasonal items	% of seasonal items	% of weight belonging to the seasonal items
28	Fabricated metal products, except machinery and equipment	13	30.85	8	13.59	61.54	44.06
29	Machinery and equipment n.e.c.	42	37.63	23	21.41	54.76	56.91
30	Office, accounting and computing machinery	4	3.05	1	2.33	25.00	76.37
31	Electrical machinery and apparatus n.e.c.	27	19.80	10	6.77	37.04	34.19
32	Radio, TV and communication equipment & apparatus	8	9.89	3	5.48	37.50	55.35
33	Medical, precision and optical instruments, watches & clocks	10	5.67	2	0.77	20.00	13.63
34	Motor vehicles, trailers and semi-trailers	5	40.64	4	40.56	80.00	99.80
35	Other transport equipment	12	18.25	7	14.64	58.33	80.21
36	Furniture; manufacturing n.e.c.	6	29.97	1	2.35	16.67	7.85
Total	**Manufacturing**	**397**	**755.27**	**146**	**288.28**	**36.78**	**38.17**

Table 3: Table highlighting the wide difference in growth rates for capital goods in the original and seasonally adjusted series in the months of March and April.

Year	Growth rate in original series of capital goods in the months of (March, April)	Growth rate in seasonally adjusted series of capital goods in the months of (March, April)
2006	(32.3, -33.2)	(10.0, -6.5)
2007	(28.2, -32.7)	(7.1, -7.0)
2008	(25.2, -25.5)	(9.7, -5.3)
2009	(27.8, -20.5)	(6.5, 6.4)
2010	(36.3, -27.5)	(9.0, -2.1)
2011	(65.5, -32.5)	(30.2, -7.7)

Figure 1:Pie Chart of Seasonal Items belonging to differdnt Use Based Categories.

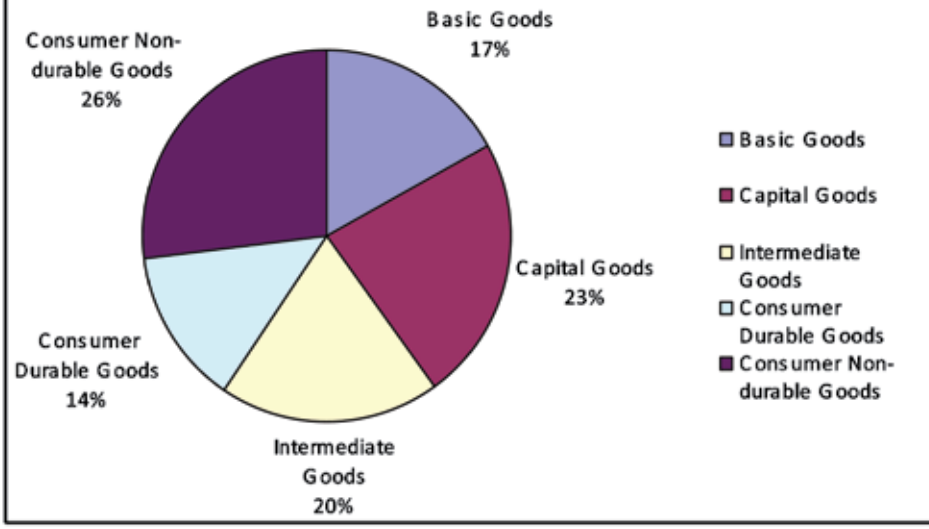
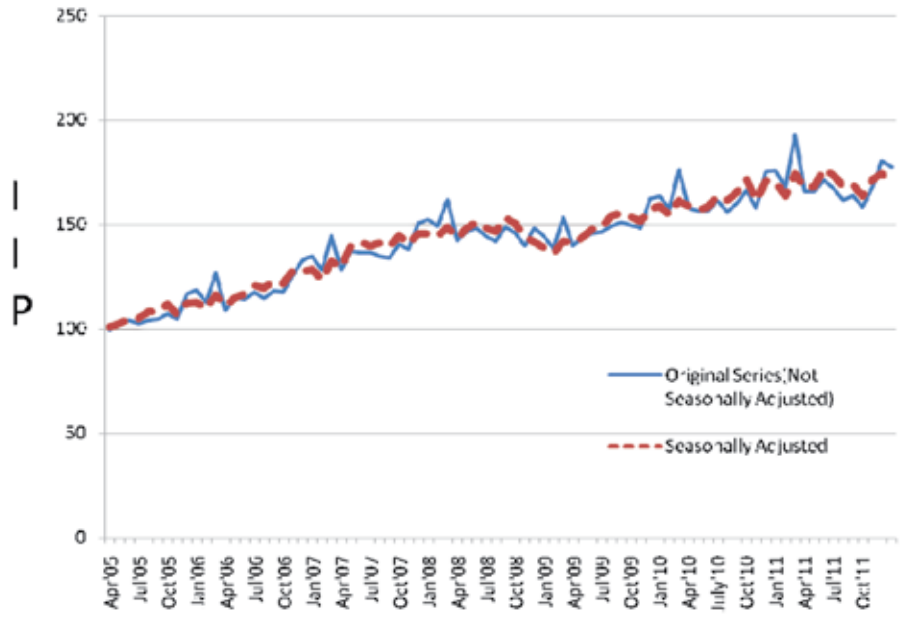


Fig 2: Comparison of General Index



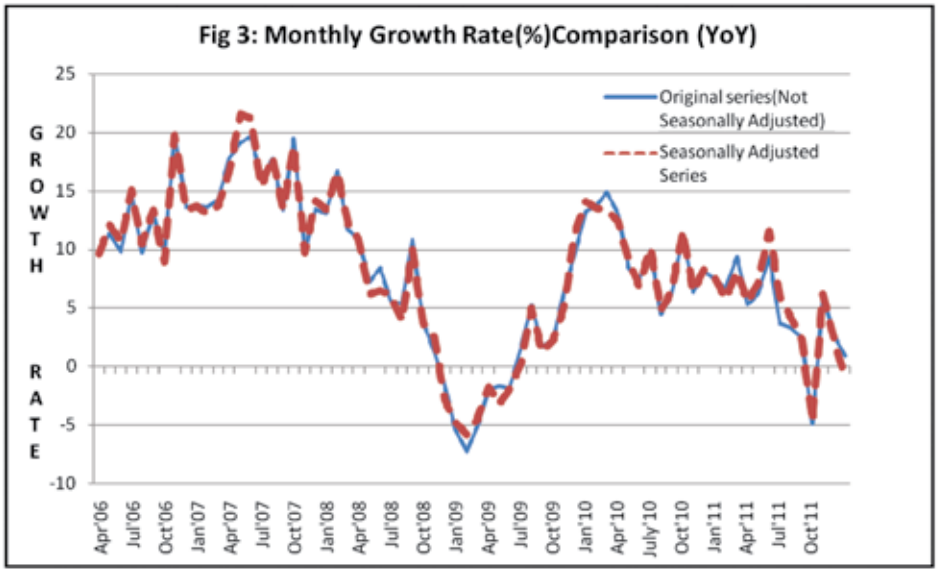


Fig 3: Monthly Growth Rate(%)Comparison (YoY)
GROWTH RATE
25
20
15
10
5
0
-5
-10
Original series(Not Seasonally Adjusted)
Seasonally Adjusted Series
Apr'06
Jul'06
Oct'06
Jan'07
Apr'07
Jul'07
Oct'07
Jan'08
Apr'08
Jul'08
Oct'08
Jan'09
Apr'09
Jul'09
Oct'09
Jan'10
Apr'10
July'10
Oct'10
Jan'11
Apr'11
Jul'11
Oct'11

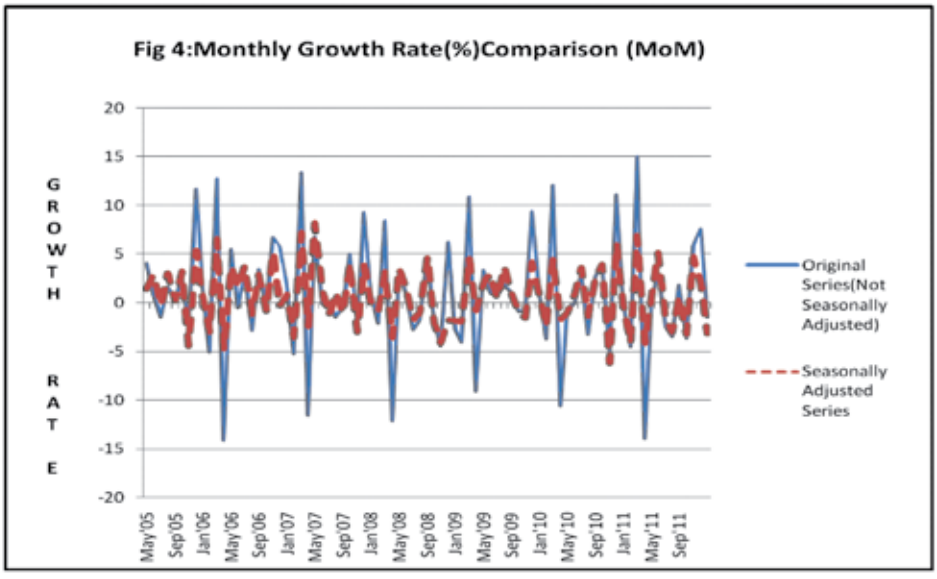


Fig 4:Monthly Growth Rate(%)Comparison (MoM)
GROWTH RATE
20
15
10
5
0
-5
-10
-15
-20
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series
May'05
Sep'05
Jan'06
May'06
Sep'06
Jan'07
May'07
Sep'07
Jan'08
May'08
Sep'08
Jan'09
May'09
Sep'09
Jan'10
May'10
Sep'10
Jan'11
May'11
Sep'11

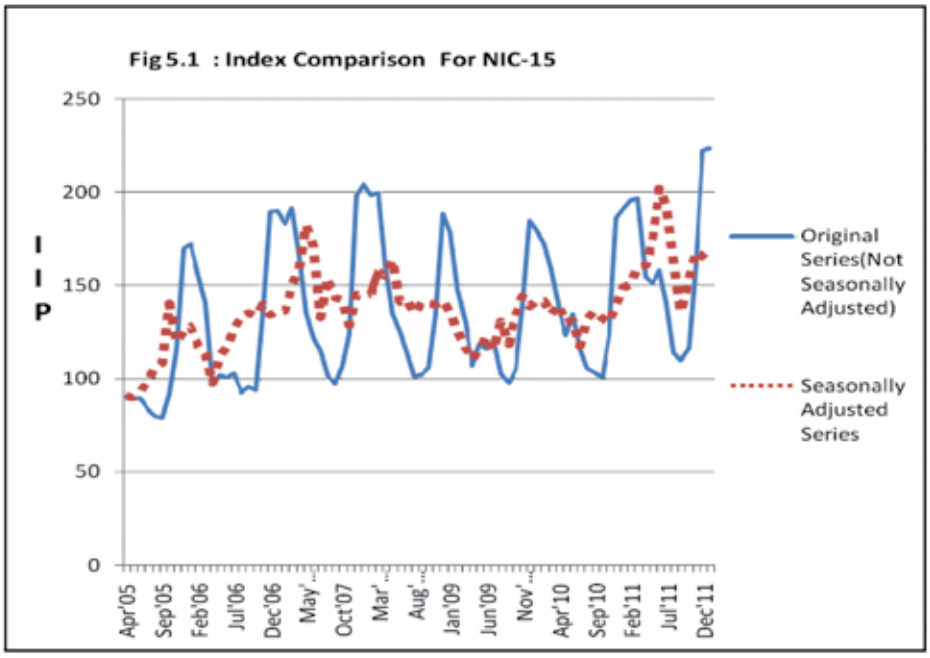


Fig 5.1 : Index Comparison For NIC-15
IIP
250
200
150
100
50
0
Apr'05
Sep'05
Feb'06
Jul'06
Dec'06
May'...
Oct'07
Mar'...
Aug'...
Jan'09
Jun'09
Nov'...
Apr'10
Sep'10
Feb'11
Jul'11
Dec'11
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series

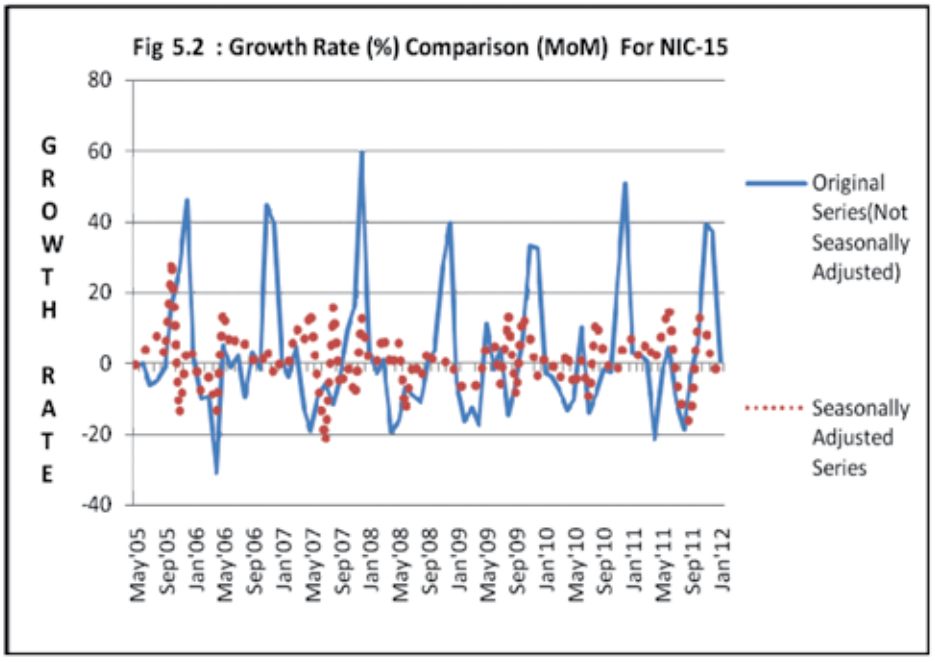
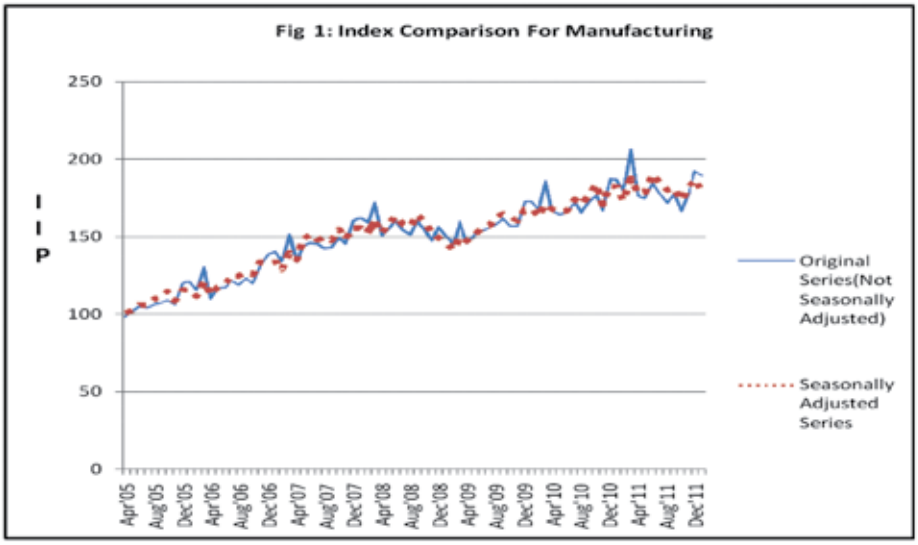
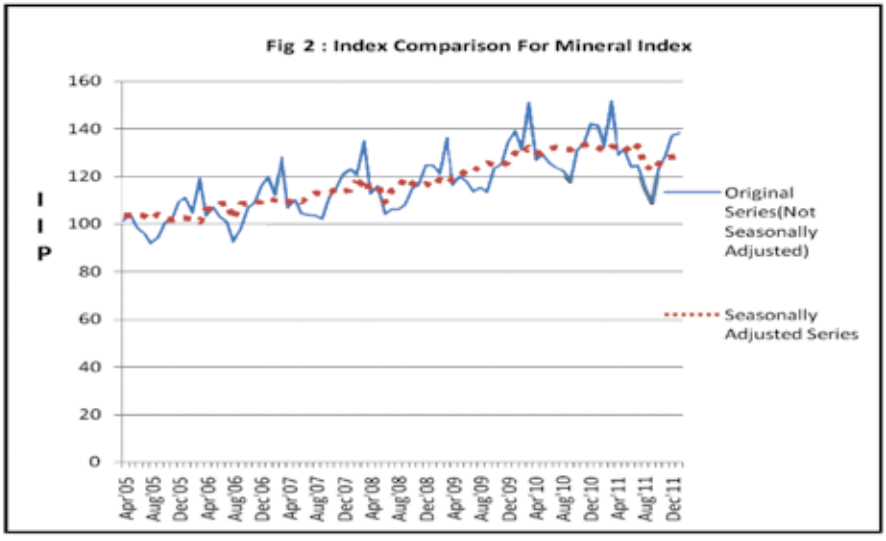


Fig 5.2 : Growth Rate (%) Comparison (MoM) For NIC-15
GROWTH RATE
80
60
40
20
0
-20
-40
May'05
Sep'05
Jan'06
May'06
Sep'06
Jan'07
May'07
Sep'07
Jan'08
May'08
Sep'08
Jan'09
May'09
Sep'09
Jan'10
May'10
Sep'10
Jan'11
May'11
Sep'11
Jan'12
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series

Annexure – I

Comparison of Indices between original (unadjusted) and seasonally adjusted series of IIP





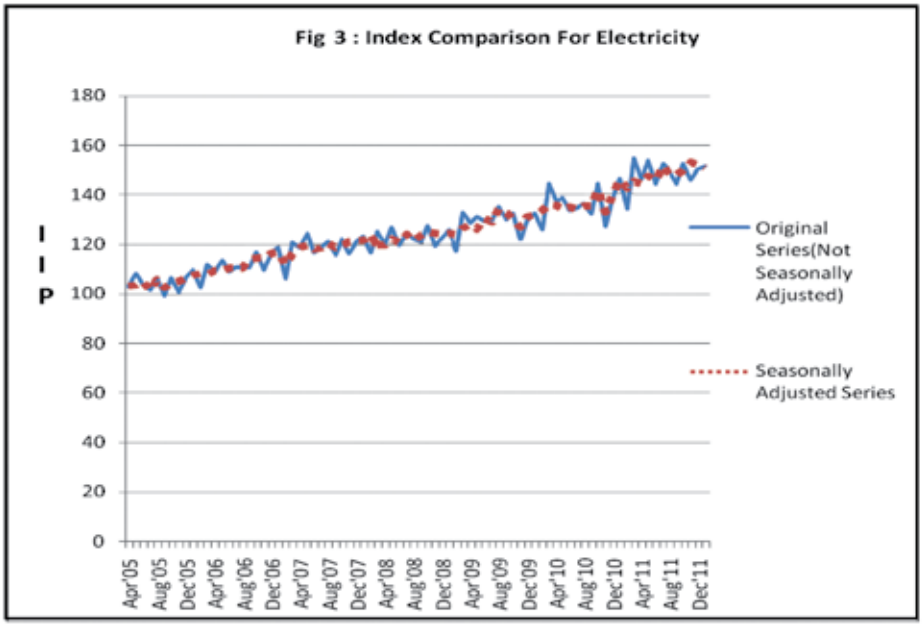


Fig 3 : Index Comparison For Electricity
IIP
180
160
140
120
100
80
60
40
20
0
Apr'05
Aug'05
Dec'05
Apr'06
Aug'06
Dec'06
Apr'07
Aug'07
Dec'07
Apr'08
Aug'08
Dec'08
Apr'09
Aug'09
Dec'09
Apr'10
Aug'10
Dec'10
Apr'11
Aug'11
Dec'11
Original Series(Not Seasonally Adjusted)
Seasonally Adjusted Series

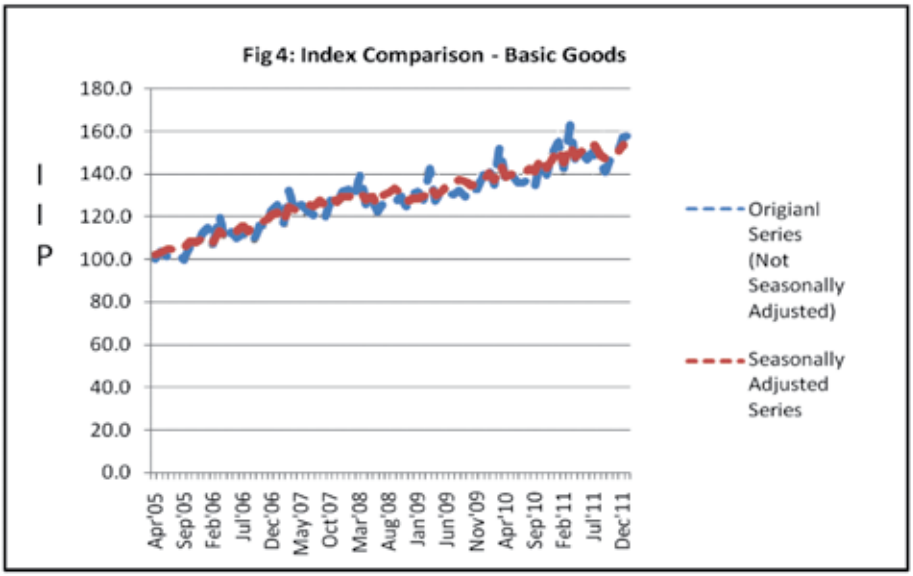


Fig 4: Index Comparison - Basic Goods
IIP
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Apr'05
Sep'05
Feb'06
Jul'06
Dec'06
May'07
Oct'07
Mar'08
Aug'08
Jan'09
Jun'09
Nov'09
Apr'10
Sep'10
Feb'11
Jul'11
Dec'11
Origianl Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

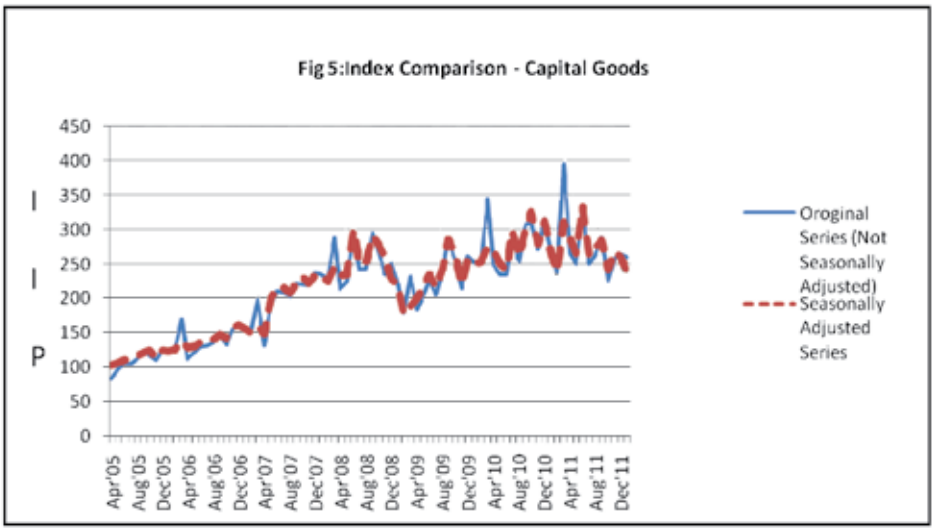


Fig 5:Index Comparison - Capital Goods
IIP
450
400
350
300
250
200
150
100
50
0
Apr'05
Aug'05
Dec'05
Apr'06
Aug'06
Dec'06
Apr'07
Aug'07
Dec'07
Apr'08
Aug'08
Dec'08
Apr'09
Aug'09
Dec'09
Apr'10
Aug'10
Dec'10
Apr'11
Aug'11
Dec'11
Oroginal Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

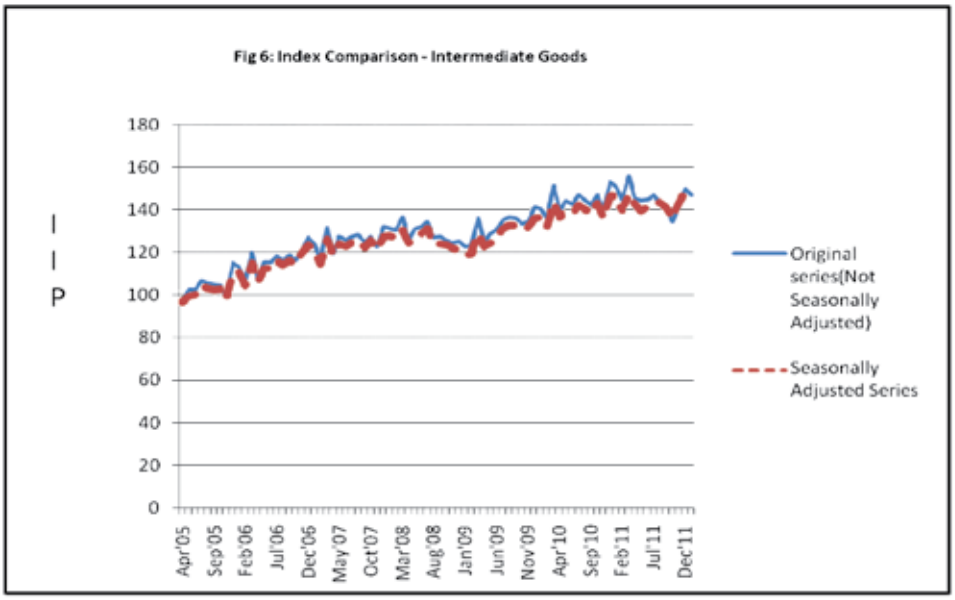


Fig 6: Index Comparison - Intermediate Goods
IIP
180
160
140
120
100
80
60
40
20
0
Apr'05
Sep'05
Feb'06
Jul'06
Dec'06
May'07
Oct'07
Mar'08
Aug'08
Jan'09
Jun'09
Nov'09
Apr'10
Sep'10
Feb'11
Jul'11
Dec'11
Original series(Not Seasonally Adjusted)
Seasonally Adjusted Series

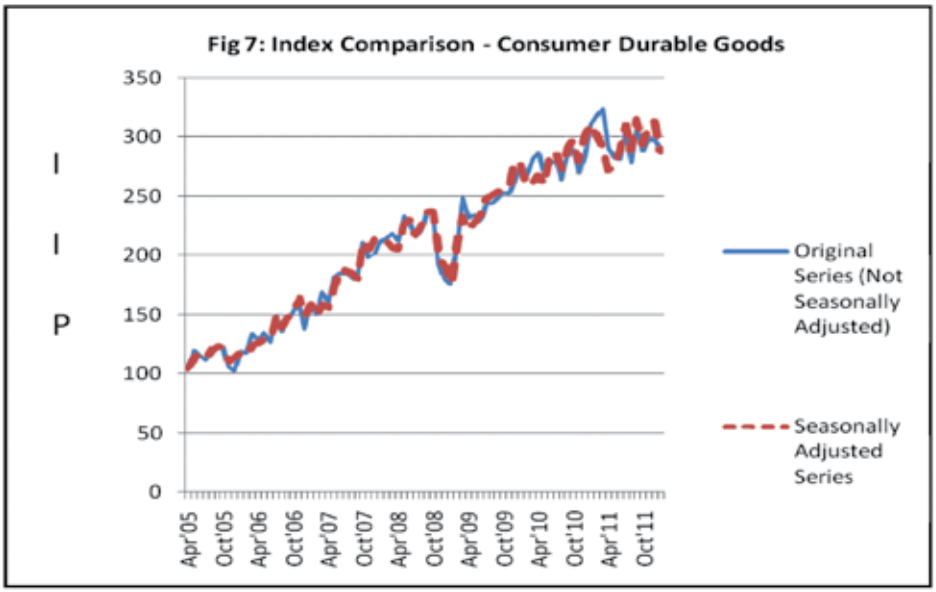


Fig 7: Index Comparison - Consumer Durable Goods
IIP
350
300
250
200
150
100
50
0
Apr'05
Oct'05
Apr'06
Oct'06
Apr'07
Oct'07
Apr'08
Oct'08
Apr'09
Oct'09
Apr'10
Oct'10
Apr'11
Oct'11
Original Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

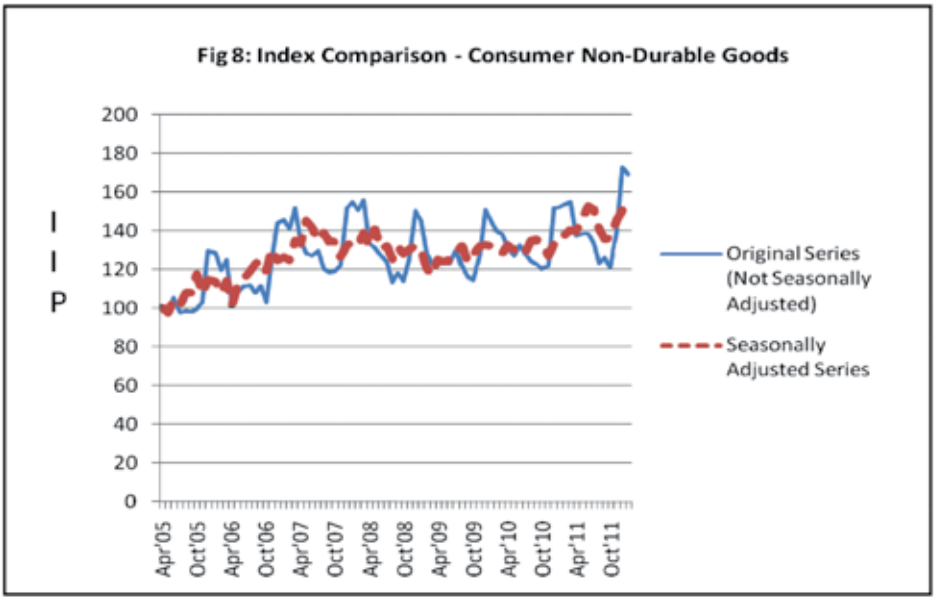


Fig 8: Index Comparison - Consumer Non-Durable Goods
IIP
200
180
160
140
120
100
80
60
40
20
0
Apr'05
Oct'05
Apr'06
Oct'06
Apr'07
Oct'07
Apr'08
Oct'08
Apr'09
Oct'09
Apr'10
Oct'10
Apr'11
Oct'11
Original Series (Not Seasonally Adjusted)
Seasonally Adjusted Series

Annexure – II

Month	YoY Growth rate observed in the Original series of IIP	MoM Growth rate observed in the Seasonally Adjusted series of IIP
Apr'06	9.85	-4.77
May'06	11.39	3.61
Jun'06	9.86	1.55
Jul'06	14.80	3.69
Aug'06	9.76	-1.16
Sep'06	13.18	2.78
Oct'06	9.65	-0.90
Nov'06	19.97	5.08
Dec'06	13.65	-0.37
Jan'07	13.84	0.71
Feb'07	13.69	-3.60
Mar'07	14.33	7.06
Apr'07	17.79	-2.44
May'07	19.19	8.09
Jun'07	19.72	1.29
Jul'07	16.19	-1.33
Aug'07	17.80	0.99
Sep'07	13.37	-1.12
Oct'07	19.58	3.90
Nov'07	9.87	-3.02
Dec'07	13.53	3.66
Jan'08	13.10	0.02
Feb'08	16.83	-0.91
Mar'08	11.74	3.07
Apr'08	11.02	-3.58
May'08	7.22	3.45
Jun'08	8.51	1.59
Jul'08	5.60	-1.74
Aug'08	5.40	-1.03
Sep'08	10.90	4.63
Oct'08	3.87	-2.02
Nov'08	1.25	-4.13
Dec'08	-1.62	-1.82
Jan'09	-5.34	-1.88
Feb'09	-7.24	-2.02

Month	YoY Growth rate observed in the Original series of IIP	MoM Growth rate observed in the Seasonally Adjusted series of IIP
Mar'09	-5.16	4.53
Apr'09	-1.92	-0.85
May'09	-1.69	1.95
Jun'09	-1.78	2.90
Jul'09	1.68	0.45
Aug'09	5.33	3.60
Sep'09	1.63	0.95
Oct'09	2.38	-0.99
Nov'09	6.33	-1.61
Dec'09	9.50	4.03
Jan'10	13.33	0.63
Feb'10	13.73	-2.49
Mar'10	14.94	4.40
Apr'10	13.08	-1.72
May'10	8.51	-1.07
June'10	7.42	0.84
July'10	9.94	3.50
Aug'10	4.47	-1.45
Sep'10	6.15	2.51
Oct'10	11.33	3.88
Nov'10	6.40	-6.21
Dec'10	8.14	5.90
Jan'11	7.51	-0.08
Feb'11	6.65	-4.11
Mar'11	9.42	6.76
Apr'11	5.29	-4.13
May'11	6.17	0.50
Jun'11	9.48	5.01
Jul'11	3.66	-1.75
Aug'11	3.40	-3.01
Sep'11	2.50	0.53
Oct'11	-4.92	-3.25
Nov'11	6.08	4.55
Dec'11	2.68	1.93
Jan'12	0.97	-3.14

Annexure – III

Month	Basic Goods		Capital Goods		Intermediate		Consumer Durable		Consumer Non-Durable	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
May'05	3.2	1.1	16.8	2.6	4.6	2.6	11.4	9.1	-2.1	-2.6
Jun'05	-2.0	1.1	6.2	3.6	0.1	1.0	-3.7	3.0	7.7	7.3
Jul'05	-0.8	0.0	0.8	1.5	4.1	3.9	-2.9	-3.2	-7.1	-3.1
Aug'05	1.2	2.1	6.1	4.6	-0.9	-1.2	5.4	5.9	0.9	6.3
Sep'05	-1.9	-0.9	10.5	4.5	-0.8	-0.6	3.7	2.5	-0.5	-0.2
Oct'05	6.9	2.3	-5.4	2.1	-0.2	0.3	0.7	-1.3	1.5	9.3
Nov'05	-1.2	-0.3	-6.0	-8.9	-4.9	-4.4	-14.0	-9.1	3.6	-8.8
Dec'05	6.2	1.8	14.7	9.1	15.1	12.5	-2.8	2.9	25.6	6.8
Jan'06	1.9	0.9	-1.4	-0.5	-1.2	-0.3	15.2	3.7	-0.9	-0.9
Feb'06	-6.3	-2.5	1.8	1.8	-5.6	-5.4	-0.7	-1.4	-6.9	-5.1
Mar'06	12.4	4.6	32.3	10.0	12.0	9.9	13.9	6.7	4.5	5.8
Apr'06	-9.5	-2.0	-33.2	-6.5	-10.7	-7.3	-4.1	1.5	-19.4	-10.6
May'06	3.2	1.3	9.1	0.6	7.8	5.4	4.9	2.1	7.6	10.0
Jun'06	-2.3	0.7	6.3	5.3	0.0	0.6	-5.7	0.5	2.3	2.8
Jul'06	1.7	2.4	0.6	1.3	2.7	2.8	16.5	15.4	1.0	3.1
Aug'06	-3.2	-2.3	3.6	1.2	-1.8	-1.8	-7.8	-7.1	-3.5	3.4
Sep'06	1.5	2.4	9.7	4.4	1.9	2.0	7.8	6.2	3.3	1.7
Oct'06	5.4	1.0	-11.1	-2.8	-1.9	-1.4	3.0	2.0	-7.4	-4.8
Nov'06	-0.1	1.0	16.0	10.2	3.6	4.3	5.3	9.4	21.2	9.6
Dec'06	6.3	2.1	5.6	2.1	5.4	3.2	-13.6	-9.2	14.9	-4.4
Jan'07	1.8	0.8	-3.5	-2.6	-2.4	-1.6	14.9	6.0	1.1	1.5
Feb'07	-6.8	-3.3	-2.3	-4.2	-5.8	-5.6	-5.0	-5.8	-3.3	-1.4
Mar'07	13.2	5.8	28.2	7.1	12.7	10.2	12.3	6.4	7.7	7.8
Apr'07	-8.0	-1.0	-32.7	-7.0	-9.0	-5.7	-5.0	-1.8	-11.1	-1.1
May'07	3.3	1.9	44.4	34.6	6.2	4.2	13.0	12.0	-4.6	8.8
Jun'07	-2.5	0.3	9.7	7.0	-1.3	-0.9	2.0	7.6	-1.3	-1.8
Jul'07	-1.5	-1.1	-0.5	0.7	1.5	1.4	0.1	-0.3	2.0	-5.3
Aug'07	1.5	2.1	-3.8	-4.0	0.8	1.0	-1.9	-1.2	-7.2	3.3
Sep'07	-2.4	-1.2	10.2	5.8	-2.8	-2.9	-1.3	-2.5	-1.3	-3.4
Oct'07	6.5	2.3	-0.8	5.0	2.2	2.7	17.9	17.3	0.7	0.0
Nov'07	-2.3	-1.3	-0.5	-3.8	-3.7	-3.4	-6.2	-3.0	1.9	-5.8
Dec'07	5.7	1.8	7.9	5.5	7.5	5.0	1.5	4.5	24.5	4.8
Jan'08	0.9	-0.1	-0.9	-0.3	-0.7	0.4	5.6	-0.9	2.0	0.8
Feb'08	-3.1	0.4	-2.3	-4.2	-0.7	-1.1	1.0	-0.8	-2.6	-1.1
Mar'08	8.5	1.5	25.2	9.7	4.7	3.0	2.1	-2.4	3.6	5.1
Apr'08	-9.5	-2.9	-25.5	-5.3	-7.9	-4.6	-2.9	-0.3	-14.5	-4.9
May'08	2.6	1.4	5.0	0.8	4.2	2.1	9.5	9.9	-1.8	6.6
Jun'08	-5.6	-2.9	31.2	27.3	0.8	1.5	-2.7	1.8	-3.2	-7.2
Jul'08	3.1	3.4	-17.9	-15.7	1.8	1.9	-4.5	-5.7	-2.5	0.9
Aug'08	0.4	0.8	0.5	-1.0	-5.4	-5.1	2.8	3.4	-8.1	-4.8
Sep'08	0.2	1.6	21.0	16.4	0.2	-0.4	5.8	5.2	4.0	4.9

Contd.

Month	Basic Goods		Capital Goods		Intermediate		Consumer Durable		Consumer Non-Durable	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
Oct'08	2.0	-1.8	-9.9	-4.7	-1.3	-0.5	0.5	0.2	-3.3	-2.7
Nov'08	-3.6	-2.8	-11.7	-6.2	-1.2	-0.8	-18.3	-16.3	9.3	1.4
Dec'08	5.0	1.0	6.5	-12.3	0.9	-1.5	-6.8	-4.0	20.3	2.1
Jan'09	1.0	0.2	-12.0	-3.9	-2.1	-1.3	-2.3	-7.3	-3.4	-2.0
Feb'09	-3.0	0.8	-17.7	-19.1	0.3	0.2	18.6	15.7	-11.2	-7.1
Mar'09	10.9	3.4	27.8	6.5	10.5	7.9	19.6	14.3	-4.4	-3.1
Apr'09	-10.1	-3.2	-20.5	6.4	-8.4	-4.8	-6.8	-4.8	0.0	6.6
May'09	3.1	1.5	10.3	7.0	3.4	1.6	1.1	2.4	1.3	-0.6
Jun'09	-0.4	2.3	11.8	9.2	1.8	1.9	-2.5	2.6	-1.0	0.8
Jul'09	-0.5	0.0	-9.5	-7.7	3.1	3.4	6.4	6.3	4.9	1.2
Aug'09	1.5	2.0	17.5	12.8	1.0	1.0	0.1	1.3	-5.7	4.5
Sep'09	-2.3	-0.8	19.0	17.0	-0.5	-0.1	1.7	0.9	-5.0	-6.4
Oct'09	3.0	-1.1	-11.5	-6.7	-1.8	-1.2	2.1	1.6	-1.1	2.9
Nov'09	-0.7	0.2	-15.2	-16.9	0.6	0.6	-0.6	0.8	11.1	3.9
Dec'09	4.7	0.9	21.5	16.5	5.0	3.1	4.6	7.4	18.2	0.4
Jan'10	3.8	3.0	-4.0	-3.0	-0.6	0.4	5.0	-0.3	-3.6	-0.7
Feb'10	-5.8	-2.2	0.4	1.3	-3.1	-3.4	-2.9	-6.6	-3.5	-1.9
Mar'10	12.7	5.2	36.3	9.0	11.1	8.6	4.8	0.5	-1.2	-1.0
Apr'10	-10.7	-4.2	-27.5	-2.1	-7.6	-4.7	1.7	2.6	-5.0	3.5
May'10	2.6	1.3	-5.7	-7.3	3.2	1.8	-6.0	-2.7	-3.3	-1.9
June'10	-2.6	-0.2	0.1	-3.6	-1.1	-0.4	3.1	9.4	4.5	0.8
July'10	0.2	0.4	22.8	23.6	3.1	2.8	0.7	0.8	-3.3	-1.9
Aug'10	0.9	1.5	-12.6	-12.2	-1.5	-1.4	-5.7	-4.6	-3.1	4.7
Sep'10	-2.6	-0.8	21.9	14.9	-1.7	-1.4	7.4	5.9	-1.2	0.3
Oct'10	9.2	4.9	-0.1	8.0	3.0	3.6	2.2	2.5	-1.9	-0.6
Nov'10	-4.5	-3.7	-12.0	-14.6	-4.4	-5.0	-6.7	-5.8	1.1	-5.2
Dec'10	6.8	3.2	16.2	12.2	8.9	7.5	5.1	6.9	24.4	4.5
Jan'11	3.6	2.9	-15.9	-14.7	-1.2	0.0	9.6	3.7	0.6	3.4
Feb'11	-7.7	-4.3	-10.2	-10.4	-4.1	-4.2	2.1	-2.7	0.8	0.1
Mar'11	13.7	6.0	65.5	30.2	7.7	5.0	1.9	-3.1	0.8	1.8
Apr'11	-10.1	-3.7	-32.5	-7.7	-6.9	-3.0	-10.1	-7.0	-11.2	-0.3
May'11	2.9	1.8	-6.1	-7.1	-0.5	-2.3	-2.7	2.0	0.8	5.0
Jun'11	-2.3	0.1	30.8	25.0	0.3	1.3	-0.3	4.1	0.0	4.0
Jul'11	2.2	2.2	-23.6	-21.4	1.5	1.3	8.1	7.2	-3.5	-1.2
Aug'11	-3.0	-3.3	5.3	4.1	-2.5	0.4	-8.7	-6.7	-7.6	-6.8
Sep'11	-3.1	-1.3	9.6	4.0	-2.0	-1.7	10.9	8.9	2.2	-3.3
Oct'11	5.1	0.9	-21.4	-14.5	-4.2	-3.6	-6.6	-6.8	-4.0	0.3
Nov'11	0.5	1.4	14.2	10.6	5.7	5.2	3.4	4.9	15.6	6.7
Dec'11	5.6	2.2	2.0	-2.8	5.4	4.1	-0.1	1.7	23.4	3.6
Jan'12	0.3	-0.6	-1.2	-8.3	-2.0	-1.5	-3.0	-7.9	-2.0	-2.2

Annexure – IV

Month	Manufacturing		Mining		Electricity		General IIP	
	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted
May'05	4.2	1.8	2.4	-0.3	5.0	0.6	4.0	1.4
Jun'05	2.6	3.5	-5.0	0.1	-3.8	1.4	0.9	2.8
Jul'05	-1.1	0.2	-2.7	-0.1	-2.3	-3.5	-1.5	-0.3
Aug'05	2.2	3.7	-4.3	-1.6	4.7	4.4	1.6	3.0
Sep'05	0.9	0.2	2.5	2.4	-6.6	-3.2	0.3	0.1
Oct'05	1.5	4.1	7.1	-1.5	7.2	1.7	2.8	3.1
Nov'05	-2.7	-5.7	0.8	-0.8	-5.4	0.8	-2.5	-4.4
Dec'05	13.2	6.5	7.4	0.5	5.8	1.2	11.6	5.2
Jan'06	1.1	0.4	2.0	0.2	2.9	1.1	1.4	0.4
Feb'06	-4.8	-3.9	-5.9	-0.3	-6.6	0.4	-5.1	-3.0
Mar'06	13.0	8.6	14.0	-1.4	8.9	-0.1	12.7	6.4
Apr'06	-15.6	-7.0	-13.3	5.2	-2.4	1.1	-14.1	-4.8
May'06	6.0	4.6	3.4	0.6	4.2	0.0	5.5	3.6
Jun'06	0.4	1.6	-3.6	1.4	-3.9	1.1	-0.5	1.5
Jul'06	4.0	4.7	-2.3	0.4	1.4	0.2	3.0	3.7
Aug'06	-2.4	-0.5	-8.3	-5.7	0.1	-0.2	-2.8	-1.2
Sep'06	3.5	2.3	6.1	5.8	-0.2	3.2	3.4	2.8
Oct'06	-2.6	-1.2	8.9	0.2	5.7	0.5	-0.4	-0.9
Nov'06	9.2	6.5	1.8	0.3	-6.1	-0.1	6.7	5.1
Dec'06	5.6	-0.7	6.7	0.2	6.1	1.7	5.8	-0.4
Jan'07	1.3	0.6	3.0	1.5	2.1	0.3	1.6	0.7
Feb'07	-4.4	-4.0	-6.1	-0.9	-10.8	-4.1	-5.2	-3.6
Mar'07	13.2	8.6	14.2	-0.2	13.8	3.8	13.3	7.1
Apr'07	-11.7	-3.3	-16.7	-0.1	-1.8	1.9	-11.5	-2.4
May'07	7.5	10.1	3.2	0.6	4.8	0.9	6.8	8.1
Jun'07	1.4	1.9	-5.2	-0.7	-6.1	-1.5	-0.1	1.3
Jul'07	-0.2	-2.0	-0.7	2.1	2.1	0.8	-0.1	-1.3
Aug'07	-2.0	0.9	-0.3	1.3	1.7	1.4	-1.5	1.0
Sep'07	0.1	-1.2	-1.3	-0.2	-4.4	-1.4	-0.5	-1.1
Oct'07	4.4	4.8	9.2	0.3	5.4	0.6	5.0	3.9
Nov'07	-2.4	-4.1	2.9	1.4	-4.8	1.5	-2.0	-3.0
Dec'07	10.4	4.7	5.5	-0.8	4.2	0.1	9.3	3.7
Jan'08	1.0	-0.1	1.8	0.5	1.9	0.1	1.2	0.0
Feb'08	-1.8	-1.7	-2.0	3.4	-5.6	1.3	-2.1	-0.9
Mar'08	8.0	4.4	11.7	-1.8	7.5	-2.7	8.4	3.1

Contd.

Month	Manufacturing		Mining		Electricity		General IIP	
	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted
Apr'08	-12.3	-4.4	-16.4	-0.4	-3.9	-0.1	-12.1	-3.6
May'08	2.9	4.0	2.9	0.6	5.5	2.0	3.1	3.5
Jun'08	3.5	2.9	-10.4	-6.1	-5.6	-1.0	1.1	1.6
Jul'08	-4.0	-3.0	1.8	4.5	4.0	2.6	-2.7	-1.7
Aug'08	-1.9	-1.2	0.0	1.1	-1.9	-2.2	-1.7	-1.0
Sep'08	5.7	5.1	1.9	3.5	-1.0	1.9	4.7	4.6
Oct'08	-3.4	-2.4	6.8	-1.9	5.4	1.0	-1.6	-2.0
Nov'08	-5.0	-5.0	1.0	-0.8	-6.4	-0.4	-4.5	-4.1
Dec'08	6.4	-2.4	7.3	0.9	3.1	-0.5	6.2	-1.8
Jan'09	-3.5	-2.2	0.0	-1.3	2.2	0.4	-2.6	-1.9
Feb'09	-3.9	-2.9	-2.9	2.7	-6.7	-0.2	-4.1	-2.0
Mar'09	10.3	5.8	12.5	-1.5	13.5	1.9	10.9	4.5
Apr'09	-8.9	-1.5	-14.7	1.9	-3.2	1.0	-9.1	-0.8
May'09	3.6	2.5	3.0	0.8	1.7	-1.4	3.4	1.9
Jun'09	1.7	2.9	-1.8	2.2	-1.4	3.5	1.0	2.9
Jul'09	1.2	0.8	-3.2	-0.6	0.5	-1.1	0.7	0.5
Aug'09	1.7	3.8	1.3	2.0	4.1	3.9	1.8	3.6
Sep'09	2.0	1.2	-1.8	0.7	-3.8	-0.9	1.1	1.0
Oct'09	-2.5	-1.0	8.9	-0.3	2.0	-2.2	-0.9	-1.0
Nov'09	-0.3	-1.7	1.7	-0.3	-8.3	-2.4	-0.8	-1.6
Dec'09	10.0	4.6	6.9	0.9	6.7	3.2	9.3	4.0
Jan'10	0.2	0.3	3.8	3.1	2.3	0.4	0.8	0.6
Feb'10	-3.3	-3.2	-5.9	-0.8	-5.1	1.4	-3.7	-2.5
Mar'10	11.3	5.0	15.5	2.4	14.5	1.9	12.0	4.4
Apr'10	-10.3	-1.9	-16.1	-1.5	-4.8	-0.2	-10.6	-1.7
May'10	-1.4	-1.2	1.7	-0.1	1.3	-1.5	-0.8	-1.1
June'10	0.8	0.8	-2.6	1.2	-3.8	0.9	0.0	0.8
July'10	4.0	4.4	-1.6	0.6	0.6	-0.9	3.0	3.5
Aug'10	-4.0	-1.9	-1.2	-0.6	1.4	1.2	-3.2	-1.5
Sep'10	4.2	3.2	-3.3	-0.3	-3.1	0.1	2.7	2.5
Oct'10	2.5	4.2	10.7	1.4	9.0	4.6	3.9	3.9
Nov'10	-5.4	-7.1	2.5	0.1	-11.9	-6.1	-5.2	-6.2
Dec'10	12.3	6.9	6.0	0.3	8.1	4.6	11.1	5.9
Jan'11	-0.4	-0.5	-0.4	-1.1	6.6	4.8	0.2	-0.1
Feb'11	-3.8	-4.7	-6.4	-1.0	-8.3	-2.2	-4.5	-4.1

Contd.

Month	Manufacturing		Mining		Electricity		General IIP	
	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted	Un-adjusted	Adjusted
Mar'11	14.9	8.1	14.6	1.2	15.0	1.8	14.9	6.8
Apr'11	-14.6	-5.0	-15.1	-0.2	-5.4	-0.6	-13.9	-4.1
May'11	-0.9	0.3	1.9	0.2	5.0	2.2	0.0	0.5
Jun'11	5.4	6.7	-5.6	-2.0	-5.9	-1.3	3.1	5.0
Jul'11	-3.6	-2.9	0.5	2.4	5.4	4.0	-2.5	-1.7
Aug'11	-3.2	-2.7	-7.3	-6.2	-1.8	-2.1	-3.5	-3.0
Sep'11	3.3	0.9	-5.4	-1.7	-3.5	-0.2	1.8	0.5
Oct'11	-6.5	-4.4	12.7	2.1	5.6	1.1	-3.6	-3.3
Nov'11	7.2	5.2	5.1	2.2	-4.3	2.1	5.8	4.6
Dec'11	8.1	2.4	6.1	0.2	2.9	-0.5	7.6	1.9
Jan'12	-1.6	-3.8	0.7	0.3	0.9	-0.9	-1.5	-3.1

Annexure – V

Month	NIC-15		NIC-18		NIC-24		NIC-26		NIC-34	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
May'05	-1.0	-0.6	-10.5	-8.7	2.8	0.1	3.5	3.3	16.1	5.7
Jun'05	-0.2	2.6	26.1	21.5	4.1	3.2	-6.3	-4.4	-7.4	3.8
Jul'05	-6.3	6.6	-16.1	-16.8	-2.0	-1.8	-1.8	0.4	10.0	-1.0
Aug'05	-4.9	7.7	-3.2	8.8	4.2	4.4	0.5	2.9	-2.0	-0.9
Sep'05	-1.3	2.3	2.5	-2.0	-2.3	-2.3	-2.1	-1.4	5.4	5.9
Oct'05	16.8	29.6	-15.4	-4.0	2.0	1.8	8.7	4.1	5.4	9.3
Nov'05	26.3	-14.8	-14.9	-13.2	-3.2	-2.6	-3.6	-0.6	-5.4	-10.5
Dec'05	46.3	4.8	43.3	7.8	7.6	7.3	11.3	5.8	-14.9	-0.1
Jan'06	1.6	2.2	-6.5	-7.6	-0.4	0.6	1.9	-0.1	34.0	5.2
Feb'06	-10.1	-8.1	8.1	13.1	-8.8	-7.1	-5.9	-3.0	-3.5	-3.1
Mar'06	-9.5	-3.7	28.4	16.4	7.5	5.5	14.5	5.8	17.8	4.4
Apr'06	-31.2	-13.8	-22.1	-8.9	-10.8	-8.2	-7.4	-1.7	-19.1	5.1
May'06	5.2	14.9	7.8	10.8	10.7	7.2	-0.7	-0.7	13.5	6.5
Jun'06	-1.3	4.2	1.9	-1.6	3.9	2.9	-0.3	1.7	-5.2	3.3
Jul'06	2.2	8.2	2.2	2.0	1.4	1.6	-1.1	0.9	11.1	2.0
Aug'06	-9.7	5.5	-5.5	8.5	-2.9	-2.8	-6.5	-4.2	-3.6	-2.7
Sep'06	2.9	1.2	6.2	-0.2	8.4	8.6	6.4	7.5	1.7	2.1
Oct'06	-1.8	-1.2	-15.9	-5.8	-2.7	-2.9	2.9	-1.7	-5.3	-2.0
Nov'06	45.0	4.5	13.5	13.1	5.1	5.9	1.2	4.4	14.3	8.6
Dec'06	39.7	-3.7	18.1	-10.9	-0.3	-0.8	7.9	2.6	-12.0	-0.4
Jan'07	0.5	1.5	7.9	7.0	-0.2	0.7	0.7	-1.3	25.7	4.8
Feb'07	-3.8	-0.2	-2.0	0.5	-5.2	-3.5	-6.7	-3.9	-6.5	-7.0
Mar'07	4.8	10.1	10.7	-0.7	9.1	7.5	15.9	7.5	10.7	-0.5
Apr'07	-13.0	5.8	-20.4	-3.4	-7.9	-5.8	-8.1	-2.8	-17.1	2.7
May'07	-19.1	15.1	7.7	11.8	3.3	0.5	3.2	3.3	2.4	-1.0
Jun'07	-9.7	-6.1	1.7	-0.0	7.0	6.1	-3.0	-1.0	-11.8	-4.2
Jul'07	-5.9	-22.6	3.1	1.7	6.4	6.5	-0.9	0.9	10.7	0.7
Aug'07	-11.7	15.9	-14.4	-3.7	-5.8	-5.8	-0.9	1.6	6.9	8.3
Sep'07	-4.1	-6.9	-1.1	-4.9	-0.5	-0.2	-1.9	-0.9	-0.6	-0.2
Oct'07	9.5	-0.6	-1.5	9.0	-1.4	-1.7	6.8	2.0	7.7	11.2
Nov'07	16.6	-9.8	-8.1	-9.7	-3.1	-2.6	-5.2	-2.2	-3.9	-8.2
Dec'07	60.0	13.2	27.1	-4.1	-0.3	-0.7	6.6	1.4	-5.1	6.1
Jan'08	3.1	-0.4	12.5	13.1	-1.8	-0.8	1.1	-1.2	12.9	-4.2
Feb'08	-2.9	0.4	0.9	2.4	-4.0	-2.5	-2.0	1.0	5.1	4.1
Mar'08	0.7	8.5	1.1	-7.4	7.3	6.2	11.8	3.5	7.7	-2.7
Apr'08	-19.5	-1.8	-26.2	-11.0	-4.5	-3.5	-11.0	-5.7	-19.8	-3.4
May'08	-16.4	5.8	-4.9	-1.6	6.9	4.9	3.1	3.5	4.4	4.3
Jun'08	-6.8	-13.7	-1.7	-4.0	0.3	-0.7	-2.6	-0.6	-6.8	-0.1
Jul'08	-9.2	0.7	12.5	10.1	0.7	0.8	2.4	4.1	10.0	0.4
Aug'08	-11.1	-4.9	-20.4	-11.0	-3.9	-3.8	-5.3	-2.7	-1.7	-0.3
Sep'08	0.8	4.0	17.2	16.3	-1.3	-0.9	1.8	2.9	-5.2	-4.9

Contd.

Month	NIC-15		NIC-18		NIC-24		NIC-26		NIC-34	
	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed	Un-adjusted	Ad-justed
Oct'08	3.7	-0.4	-9.6	*-1.6*	-1.0	-1.3	3.5	-1.3	-1.5	2.8
Nov'08	27.1	-0.5	10.4	*8.0*	-2.3	-2.0	-5.1	-1.7	-21.1	-25.7
Dec'08	40.1	1.5	39.4	*3.7*	1.5	1.0	8.0	2.1	-35.7	-20.9
Jan'09	-5.4	-4.2	-6.9	*-4.1*	-1.3	-0.1	-1.0	-3.4	44.2	9.0
Feb'09	-16.6	-7.7	-10.5	*-9.5*	-5.6	-3.8	0.4	3.7	29.5	27.7
Mar'09	-12.9	-7.1	-11.3	*-16.3*	8.5	6.7	13.2	4.6	20.4	7.6
Apr'09	-17.7	-5.3	18.6	*37.2*	4.0	6.1	-6.9	-1.1	-17.4	1.7
May'09	11.1	4.7	-19.8	*-15.7*	2.6	0.1	-1.7	-1.3	5.5	9.1
Jun'09	-2.0	6.1	6.8	*6.0*	0.9	-0.1	-0.6	1.5	0.2	6.4
Jul'09	4.1	-5.9	6.1	*2.6*	2.1	2.2	2.2	3.9	13.8	2.7
Aug'09	-14.7	13.6	-13.7	*-2.8*	5.4	5.6	-5.0	-1.9	2.2	4.3
Sep'09	-5.2	-9.5	-1.8	*-2.4*	-6.3	-5.9	-3.3	-2.4	6.2	6.0
Oct'09	7.2	13.6	-12.1	*-4.6*	-5.4	-5.7	4.7	-0.4	-1.6	2.7
Nov'09	33.5	7.2	11.9	*8.9*	-1.4	-1.2	0.6	4.1	4.9	-1.3
Dec'09	32.8	-3.8	41.7	*2.7*	3.5	2.9	10.4	4.4	0.5	9.8
Jan'10	-3.0	2.2	-12.2	*-8.0*	-1.7	-0.5	1.1	-1.3	9.2	-3.5
Feb'10	-4.1	0.0	6.7	*6.4*	-6.9	-5.1	-4.2	-1.1	6.2	3.7
Mar'10	-7.8	-4.9	-2.5	*-7.9*	7.2	5.5	12.1	3.6	11.6	2.6
Apr'10	-13.6	3.5	-6.2	*8.9*	-3.2	-2.3	-6.8	-1.2	-12.5	0.7
May'10	-10.6	-6.9	-0.3	*6.5*	5.7	3.3	-1.0	-0.5	-7.3	-2.8
June'10	9.9	0.8	1.4	*1.5*	3.3	2.3	-4.9	-2.8	3.5	7.6
July'10	-14.1	-10.2	-0.6	*-3.5*	2.4	2.6	-1.8	-0.6	13.1	4.3
Aug'10	-9.1	12.4	-3.9	*6.5*	-2.5	-2.6	-1.3	2.1	-1.6	0.3
Sep'10	-1.9	3.2	-11.9	*-11.6*	0.4	1.3	0.3	1.2	5.5	4.9
Oct'10	-2.6	-3.0	-0.1	*7.7*	-2.6	-3.1	8.4	3.4	-5.4	-1.4
Nov'10	22.8	-1.6	-5.8	*-8.5*	-0.3	-0.3	-11.8	-8.8	-2.5	-8.1
Dec'10	50.9	7.1	44.6	*2.3*	2.9	2.2	13.2	7.2	12.2	20.1
Jan'11	2.7	6.7	-12.2	*-4.6*	0.8	1.8	1.8	-0.7	2.5	-6.9
Feb'11	2.4	1.2	7.0	*5.2*	-4.1	-1.3	-1.9	1.0	4.6	2.5
Mar'11	0.5	6.4	7.9	*2.6*	4.7	3.3	12.9	4.4	11.9	4.3
Apr'11	-21.5	0.3	-14.3	*-2.4*	-2.2	-0.7	-11.7	-6.2	-12.2	-1.5
May'11	-2.1	8.7	-0.8	*6.7*	2.0	-0.2	-0.4	0.3	-7.2	-2.4
Jun'11	4.4	15.9	-14.0	*-13.8*	-2.5	-3.5	-3.7	-1.7	-3.7	-0.4
Jul'11	-11.1	-4.9	2.0	*-0.7*	-1.0	-0.8	7.6	8.7	8.9	1.1
Aug'11	-18.8	-15.4	-8.2	*-0.0*	0.7	0.6	-4.2	-0.8	-3.5	-1.2
Sep'11	-3.6	-16.7	9.5	*12.1*	2.2	2.9	-4.7	-3.8	3.0	2.0
Oct'11	5.9	13.4	-10.8	*-5.7*	-5.7	-5.8	10.4	5.1	-16.8	-12.5
Nov'11	39.3	9.6	3.8	*2.0*	0.3	0.1	-2.4	1.0	31.8	22.8
Dec'11	37.4	-1.6	48.8	*6.1*	9.1	8.9	7.3	1.3	-5.7	0.3
Jan'12	0.5	-1.7	-6.9	*0.9*	-8.0	-7.3	1.6	-2.3	13.2	3.7