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A Study on Price indices in Indian Economy

By

Anujit Mitra
&
Shubhabrata Das

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Please address all your correspondence to:

Prof. Shubhabrata Das
Associate Professor
Indian Institute of Management Bangalore
Bannerghatta Road
Bangalore – 560 076
Fax: (080) 6584050
Email: shubho@iimb.ernet.in

Or

Shri Anujit Mitra
Assistant Adviser
Department of Statistical Analysis and Computer Services,
Reserve Bank of India
Mumbai
Email: amitra@rbi.org.in

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Anujit Mitra & Shubhabrata Das*

Abstract

In this paper we investigate the progression of the wholesale price index (WPI) and various consumer price indices (CPIs) in the last four decades. Different time series models are used to analyze the past data and project their movement in the coming years. Any change in petroleum prices has direct as well as indirect effect on the WPI. We estimate the indirect impact through appropriate distributed lag models. The effective time taken for the full impact is also investigated. For the CPIs, we study the extent by which its constituents carry the impact of extraneous variable like fuel price index. The work is aimed at gauging the possible impact of further increase in the fuel price index on the aggregate WPI as well as select CPIs.

I. Introduction

Index numbers are used to measure the average changes in a set of variables over different set of situations like a period of time. The price indices like Wholesale Price Index (WPI) and Consumer Price Indices (CPI) are treated as important barometers for health of the economy. The CPI, which was earlier referred as the 'cost of living' index, tries to capture how the population is getting affected by the changing price level of the commodity basket they use. As the commodity basket varies widely in different segments of the society, we have four CPIs in India. Out of these four, three are compiled and published by Labour Bureau. These are CPI for Agricultural Workers, Rural Workers and Industrial Workers. The CPI for Urban non-manual Worker is compiled and published by Central Statistical Organisation (CSO). In this paper the CPI for Rural Workers has not been studied, as it is very much similar in nature to the CPI for Agricultural Workers. The other popular price index number is the WPI, which is a much generalized index capturing the price movements in the wholesale market. In India, WPI is always under focus as this is used to measure the rate of inflation in our country, which makes the

* Anujit Mitra is working as Assistant Adviser in Department of Statistical Analysis and Computer Services, Reserve Bank of India in Mumbai. Shubhabrata Das is an Associate Professor, Quantitative Methods & IS Area in Indian Institute of Management Bangalore. The views expressed in this paper are that of the authors and no way should be construed to be that of the organizations they are associated with.

headline in the newspaper and keenly discussed in other mass media. In this paper we have a look at the progression of WPI as well as the various CPIs.

The spurt in the WPI during the past few months has created a lot of stir among the public. The fuel prices in India are still administered though there was lot of debate on the growing bill on subsidies. It was generally felt that the domestic oil prices should be linked with the international market prices. Some section feels that it would put a huge burden on the poor and in general trigger off high inflation, which the country can ill afford at this juncture. We investigate how the changes in the oil price index (WPI) affect the aggregate WPI as well as the CPIs. However, we have not tried to come out with any policy prescriptions, as that is much beyond the scope of this paper and require much wider analysis.

II. The Price Indices in India

In this section we take a brief look at the Price Indices in India, WPI and the CPIs.

Whole Sale Price Index: This is compiled and published weekly by the Office of Economic Adviser, Ministry of Commerce & Industry, Government of India. The current series for WPI is having 1993-94 as base year with 435 commodities in the basket. Previous two WPI series were 1981-82 and 1970-71 with 447 and 360 commodities respectively. Among the three major commodity groups of (i) Primary Articles, (ii) Fuel, Power, light & Lubricants and (iii) Manufactured products, the representation of the second group in terms of number of commodities almost remained unchanged in the last two series (20 and 19). However, it is interesting to note that the weight of this group has steadily increased from 8.45 in 1970-71 to 10.66 in 1981-82 and finally to 14.23 in 1993-94. This shows the growing importance of this group in Indian economy.

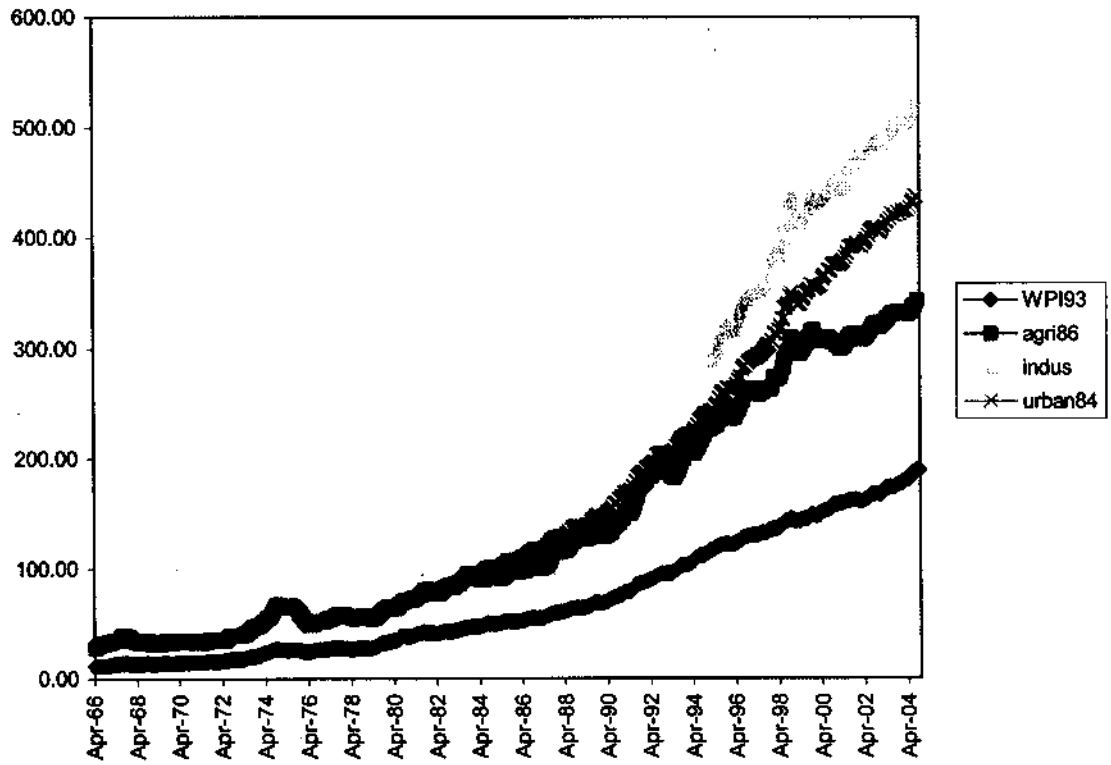
Consumer Price Indices: The data and methodologies for compilation of the CPIs are available in the websites www.mospi.nic.in. We may recall that the motivation for construction and maintenance of CPI (then referred as the Cost of Living Index Numbers) in India was the sharp price rise as an aftermath of the First World War. It was heavily used for fixing the wages and deciding the quantum of compensation to be provided to the workers for the rise in prices of commodities. As can be expected, the methodologies followed were keenly debated and had political overtones. In post independence period these indices assumed further importance with the implementation of Minimum Wages Act, 1948 whereby it was made mandatory for the State Governments to maintain cost of

living indices for certain sections of the workers specified in the act. Generally the Consumer Price Indices are treated as the "practical approximation" of the true cost of living index.

The current series of CPI for Agricultural Worker and Rural Worker are having base of 1986-87. Previous to that the base was 1960-61. The base year for the current series of CPI for Industrial Worker is 1982 and that of Urban Non-manual Worker is 1984-85.

Long time-series data with ample documentations on the WPI and CPIs are available in the link on "Database on Indian Economy" provided in the website of the Reserve Bank of India (www.rbi.org.in).

Chart 1: WPI and the CPI's



III. Time Series Forecasting using Decomposition methods and Exponential Smoothing

In this section, the progression of WPI and the three CPI series are studied extensively using the various time series techniques based on exponential smoothing and decomposition. For a description of these methods, one may refer to standard texts in Time series, e.g. Brockwell & Davis (2002). While carrying out these analyses, we have set aside the (monthly) data from January 2003 onwards (up to August/September/October 2004) for validation purpose; this period serves as the testing phase. The data prior to the testing phase is used for modeling as well as predicting values during the testing phase as well the forecast period (period following the testing phase up to the end of 2005). Since the actual data is available during the testing phase, we obtain the error in prediction for each of the adopted methods for series during the testing phase. There are several methods in consolidating errors across the different time points. We have chosen to focus on the root mean square error (root MSE in short), and this provides the benchmark and direction in accommodating the different (and often conflicting) predicted values during the forecast period, as derived by the various methods under consideration. Thus, for each of the four series, our analysis is summarized through three graphs and tables

i) Graphs showing actual versus predicted values of the series during the testing period;

ii) Table representing errors in prediction during testing period and root MSE; &

iii) Graph showing the predicted values during the forecast period.

The exponential smoothing based methods suggest a gradual/smooth updating of the series. The simple exponential smoothing, which is suitable for series without any trend or seasonality, is also tried. But since the price indices under consideration all have positive trend, this provides a poor fit (it had a root-MSE of about 2 to 6 times, as compared to the other methods, in the various cases) and forecast. Because of this, we have chosen not to include it in the graphs and tables below. We then consider two variations of Holt's Exponential Smoothing (also known as Linear exponential smoothing) with either linear or percentage trend components. The other two variations considered are known as Holt-Winter's (HW smoothing) methods, which are applicable for data with trend as well as seasonal components; the two variations corresponding to the additive model and multiplicative model respectively. The additive or multiplicative

models are the basis for the decomposition method. The additive and the multiplicative models look like:

$$Y_t = T_t + C_t + S_t + I_t, \quad \text{or} \quad Y_t = T_t \times C_t \times S_t \times I_t,$$

or a variation where the trend and the cyclical component are combined. While there are various methods of estimating these components, we use moving average method for estimating combined effect of trend and cyclicality and the ratio to moving average method to estimate the seasonal effects. The smoothing coefficient is set at 0.1.

The seasonality coefficients are marginal as evidenced through the following tables, viz. 1.a and 1.b. Because of this, the four variations of exponential smoothing are quite comparable in general.

Table 1.a. Seasonal Indices in the Additive model

	WPI	Agri CPI	Urban CPI	Indus CPI
January	-0.241	0.311	-0.138	-1.527
February	-0.141	0.428	-0.173	-4.430
March	0.243	0.316	-0.057	-5.137
April	0.528	-0.134	0.023	-3.794
May	0.651	-0.607	0.040	-3.080
June	0.541	-0.733	0.061	-0.747
July	0.458	-0.351	0.066	2.996
August	-0.012	-0.218	0.064	2.459
September	-0.409	0.173	0.038	2.274
October	-0.416	0.304	0.042	5.107
November	-0.587	0.305	0.030	5.399
December	-0.615	0.205	0.005	0.482

Table 1.b. Seasonal Indices in Multiplicative model

	WPI	Agri CPI	Urban CPI
January	99.329	97.964	101.133
February	99.712	98.058	100.858
March	100.492	98.865	100.956
April	101.233	100.459	100.649
May	101.52	101.724	99.836
June	101.156	102.223	99.696
July	100.77	102.103	99.092
August	99.839	101.567	98.823
September	99.069	100.228	99.024
October	99.214	99.361	99.234
November	98.857	98.899	99.787
December	98.81	98.548	100.911

SYSTAT, SPSS, ITSM2000 [viz. Brockwell and Davis (2002)] and MS-EXCEL are the software used in the various stages of these analyses.

Analyzing WPI Time series:

Chart 2.a. **Actual vs Predicted WPI : Using various TS techniques**

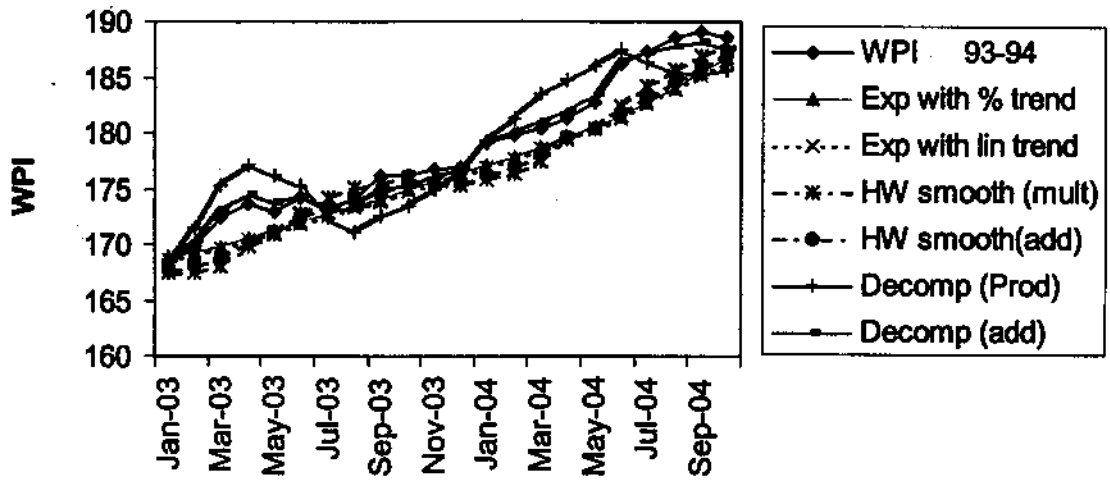
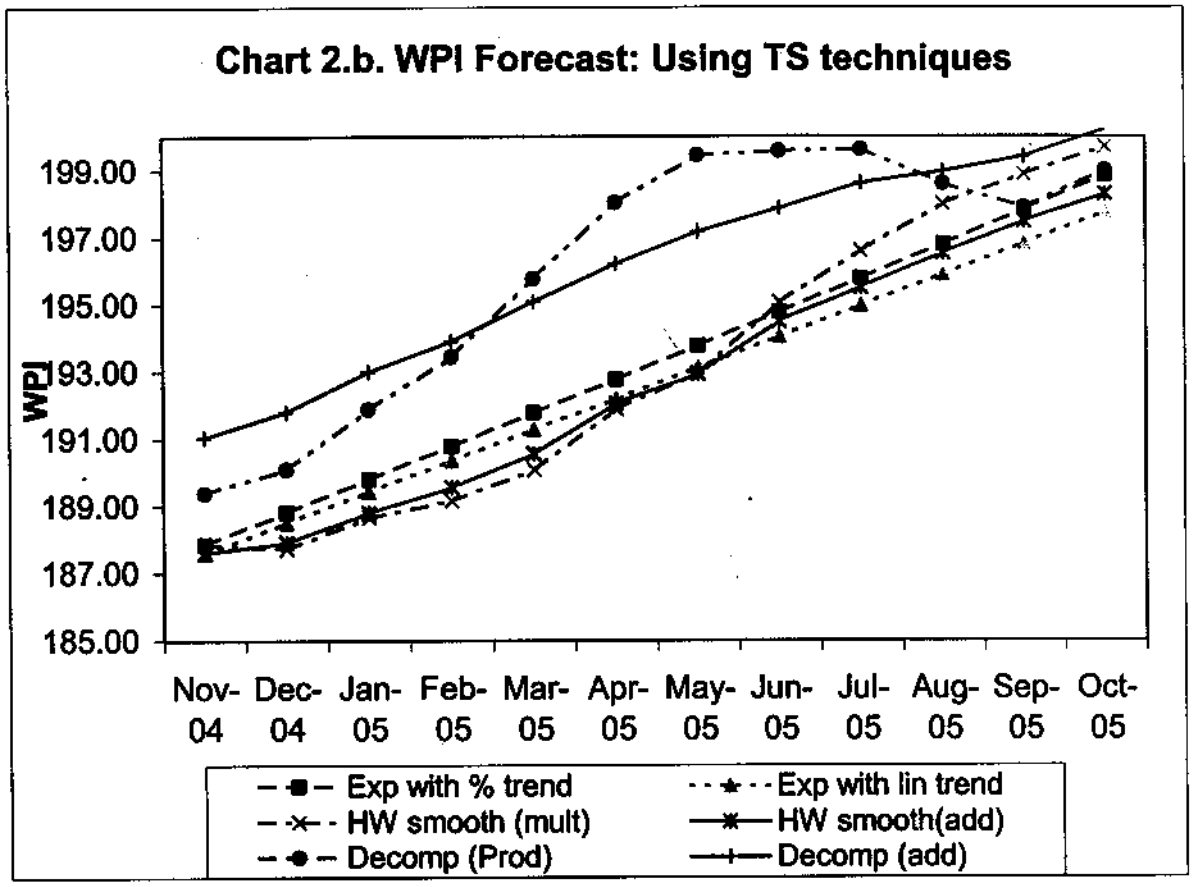


Table 2: Error in Predicting WPI

	Exp with % trend	Exp with lin trend	HW smooth (mult)	HW smooth(add)	Decomp (Prod)	Decomp (add)
Jan-03	0.53	0.33	-0.84	-0.58	0.20	0.17
Feb-03	-0.68	-0.86	-2.46	-1.96	1.47	0.45
Mar-03	-2.56	-2.73	-4.30	-3.71	2.93	0.86
Apr-03	-3.22	-3.39	-3.86	-3.58	3.33	0.77
May-03	-1.68	-1.84	-2.00	-1.95	3.14	0.79
Jun-03	-2.08	-2.23	-1.38	-1.79	1.15	0.30
Jul-03	-0.41	-0.56	1.05	0.13	-0.79	-0.07
Aug-03	-0.60	-0.76	1.12	0.01	-2.88	-0.66
Sep-03	-2.07	-2.22	-0.73	-1.55	-3.63	-0.95
Oct-03	-1.27	-1.42	-0.02	-0.69	-2.72	-0.87
Nov-03	-1.13	-1.28	-1.20	-1.29	-1.74	-0.58
Dec-03	-0.59	-0.74	-1.71	-1.38	-0.46	-0.21
Jan-04	-2.10	-2.25	-3.26	-2.97	0.21	0.17
Feb-04	-1.93	-2.09	-3.40	-2.88	1.55	0.45
Mar-04	-1.56	-1.72	-2.85	-2.27	3.07	0.86
Apr-04	-1.60	-1.77	-1.84	-1.59	3.47	0.77
May-04	-2.22	-2.40	-2.35	-2.32	3.31	0.79
Jun-04	-4.76	-4.94	-3.90	-4.36	1.23	0.30
Jul-04	-4.58	-4.78	-3.18	-4.14	-0.86	-0.07
Aug-04	-4.47	-4.69	-2.79	-3.97	-3.12	-0.66
Sep-04	-3.73	-3.95	-2.26	-3.19	-3.90	-0.95
Oct-04	-1.91	-2.16	-0.63	-1.43	-2.91	-0.87
root-MSE	2.45	2.60	2.44	2.51	2.49	0.64



Observations for WPI TS: The decomposition method based on additive model wins the race by far as all the other five methods have almost comparable performance during the testing period and have a root MSE about four times that of the winner. This forecasts a gradual increase of WPI in the next 12 months with the index touching about 200 in October 2005.

Exploring CPI for Agricultural Worker TS:

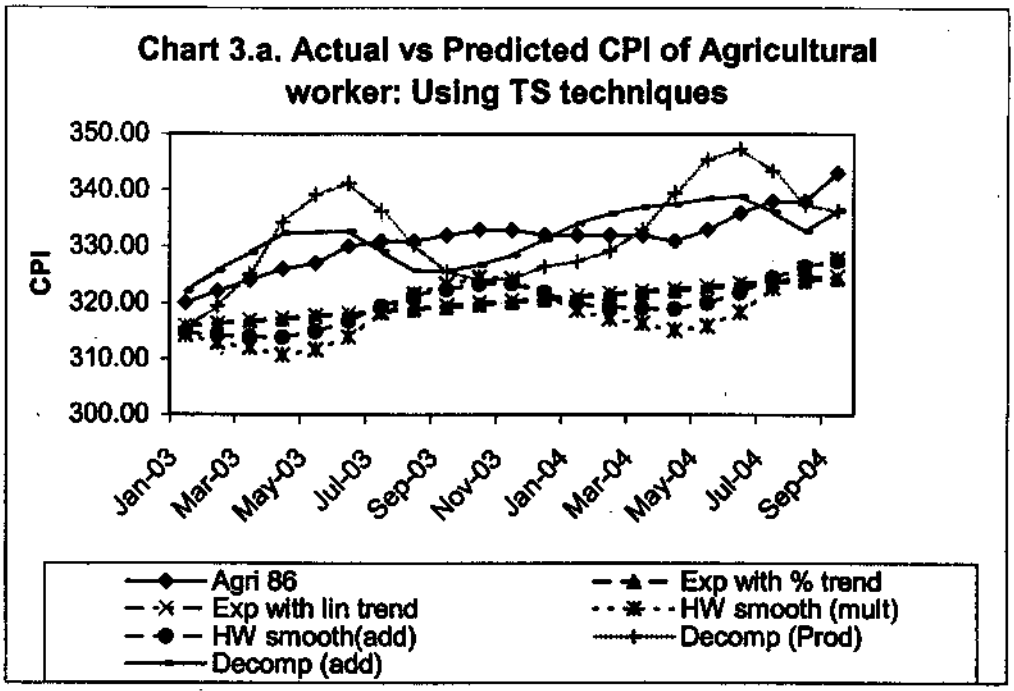
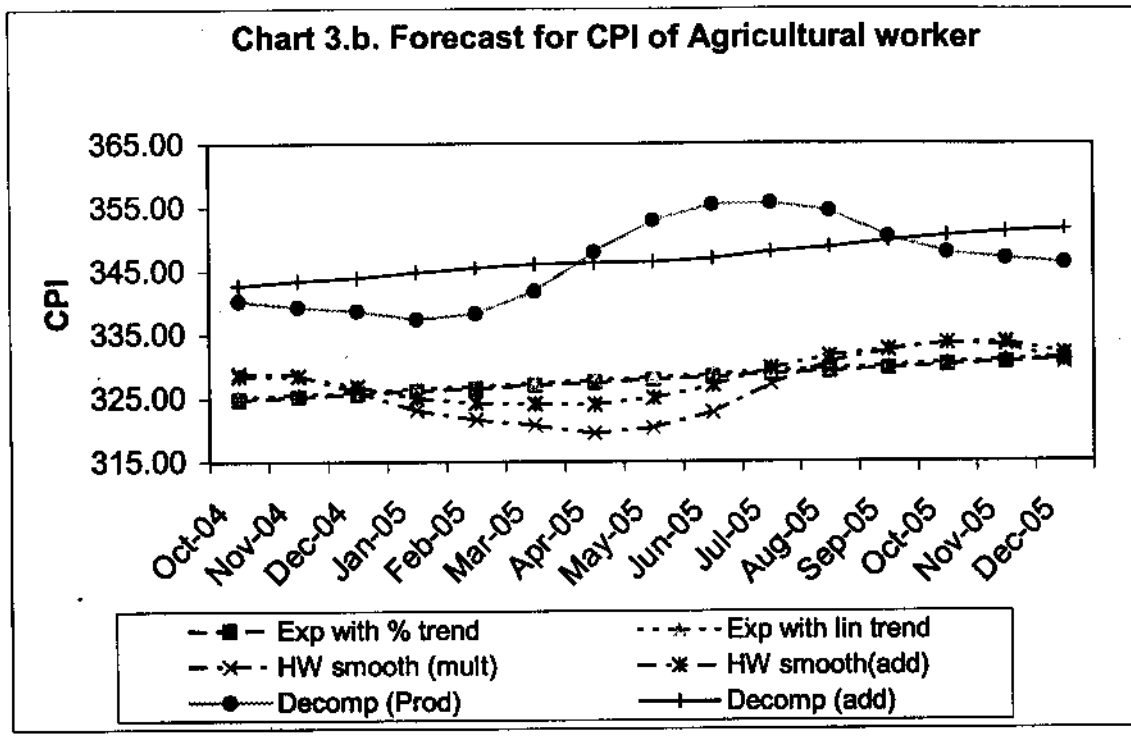


Table 3: Error in Predicting CPI of Agricultural worker

	Exp with % trend	Exp with lin trend	HW smooth (mult)	HW smooth(add)	Decomp (Prod)	Decomp (add)
Jan-03	-4.23	-4.08	-5.74	-5.22	-4.43	2.06
Feb-03	-5.81	-5.64	-9.15	-7.88	-2.68	3.71
Mar-03	-7.38	-7.20	-12.06	-10.12	1.06	4.88
Apr-03	-8.95	-8.75	-15.27	-12.23	8.28	6.33
May-03	-9.53	-9.31	-15.43	-12.16	12.17	5.44
Jun-03	-12.10	-11.87	-16.03	-13.26	11.14	2.74
Jul-03	-12.67	-12.43	-12.84	-11.65	5.36	-1.73
Aug-03	-12.24	-11.99	-9.44	-9.65	-0.55	-5.22
Sep-03	-12.81	-12.55	-8.68	-9.65	-6.50	-6.31
Oct-03	-13.38	-13.10	-8.50	-9.66	-8.94	-6.20
Nov-03	-12.95	-12.66	-8.79	-9.57	-8.71	-4.61
Dec-03	-11.52	-11.22	-10.50	-10.21	-5.51	-0.72
Jan-04	-11.09	-10.78	-13.34	-12.11	-4.59	2.14
Feb-04	-10.66	-10.34	-14.77	-12.76	-2.76	3.82
Mar-04	-10.22	-9.89	-15.70	-13.00	1.09	5.00
Apr-04	-8.79	-8.45	-15.92	-12.11	8.41	6.44
May-04	-10.36	-10.01	-17.07	-13.05	12.39	5.56
Jun-04	-12.92	-12.57	-17.64	-14.14	11.34	2.81
Jul-04	-14.49	-14.13	-15.39	-13.53	5.47	-1.76
Aug-04	-14.05	-13.69	-11.94	-11.53	-0.56	-5.34
Sep-04	-18.61	-18.24	-15.16	-15.54	-6.72	-6.55
root-MSE	11.33	11.05	12.95	11.34	7.02	4.51



Observations for CPI of agricultural worker: Again, the decomposition method for the additive model performs the best, although its error for the last two months in the testing period are on the higher side, casting only a degree of uncertainty over the predicted values. This method forecasts a (fairly) slow and steady growth over the next year with the index reaching about 350 figure by the end of 2005. By contrast to the WPI series analysis, the decomposition method for the product model takes a decisive second position ahead of all the exponential smoothing methods. The product model forecast depicts more of a fluctuating figure during 2005 as compared to the additive model but projects a roughly similar index by the end of the year. In arriving at a single forecast, we recommend taking average between the two forecasts based on the two decomposition models. Although there is some justification for using the average all the six forecasts, specially because the exponential methods show fairly comparable picture in terms of their accuracy and forecast much lower values than the earlier two methods mentioned.

Exploring CPI for Urban Non-Manual Worker TS:

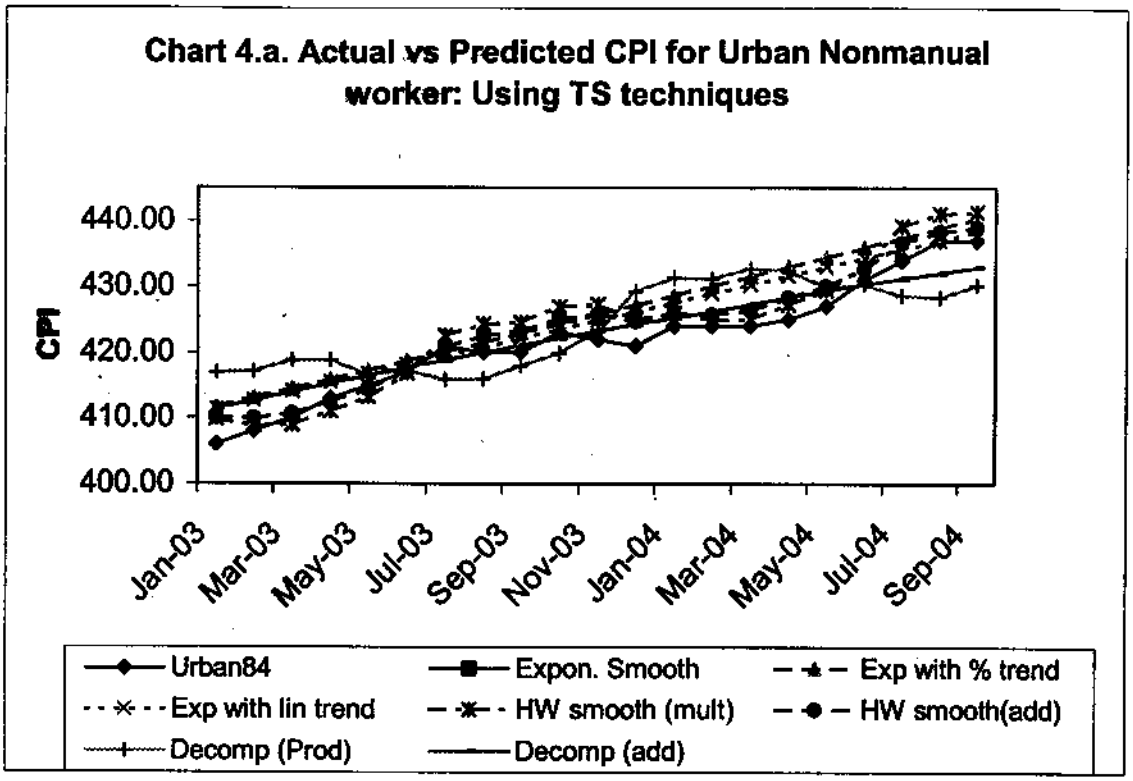
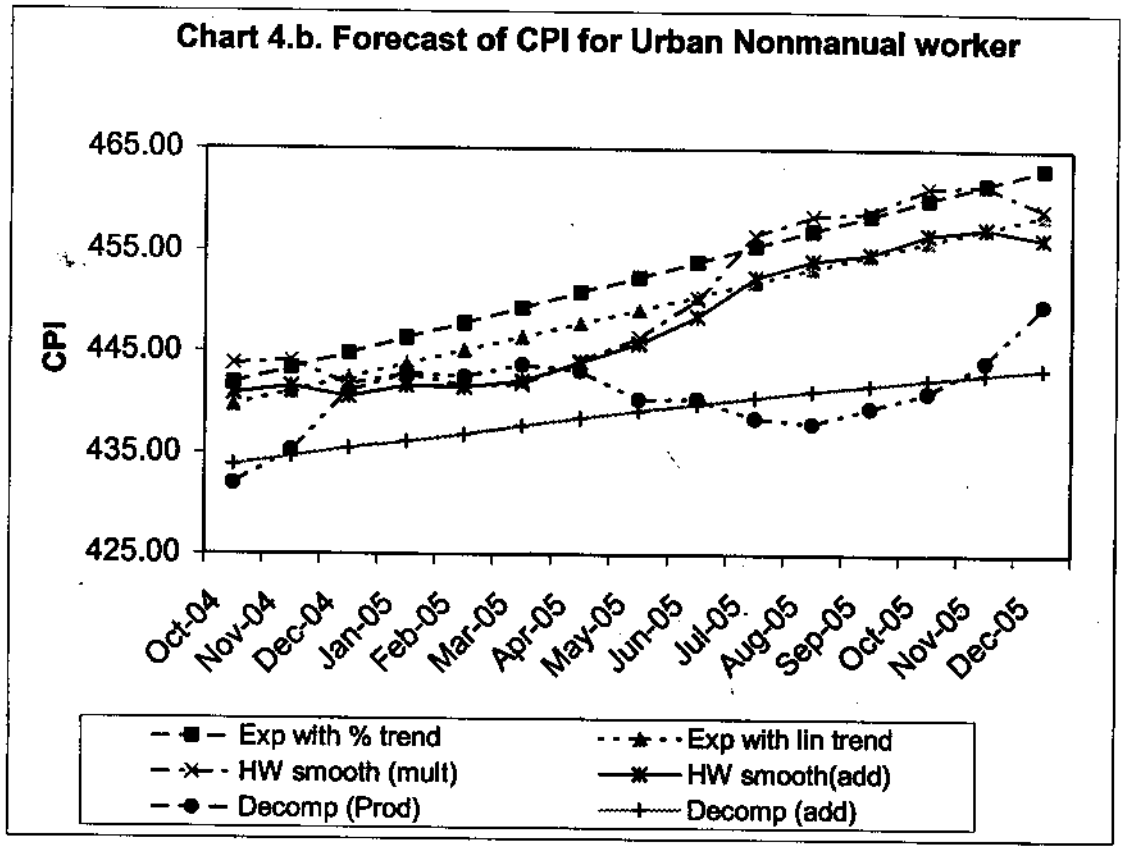


Table 4: Error in Predicting CPI of Urban Nonmanual Worker

	Exp with % trend	Exp with lin trend	HW smooth (mult)	HW smooth(add)	Decomp (Prod)	Decomp (add)
Jan-03	5.69	5.36	3.86	4.12	10.96	5.43
Feb-03	5.08	4.71	0.76	1.96	9.12	4.65
Mar-03	4.47	4.06	-1.08	0.64	8.80	3.99
Apr-03	2.87	2.41	-1.94	-0.51	5.77	2.28
May-03	2.27	1.76	-1.81	-0.67	1.62	1.49
Jun-03	1.68	1.11	-0.20	-0.01	0.24	0.69
Jul-03	-0.91	-1.54	1.53	-0.17	-5.11	-2.15
Aug-03	1.50	0.81	4.29	2.54	-4.08	-0.01
Sep-03	2.93	2.16	4.66	3.20	-2.09	1.08
Oct-03	1.35	0.51	3.94	2.11	-3.07	-0.81
Nov-03	3.78	2.86	5.24	3.78	1.39	1.26
Dec-03	6.22	5.21	3.98	3.76	8.27	3.30
Jan-04	4.66	3.56	2.01	1.87	7.31	1.20
Feb-04	6.10	4.92	0.87	1.71	7.21	2.18
Mar-04	7.55	6.27	1.04	2.39	8.68	3.30
Apr-04	8.01	6.62	2.25	3.23	7.39	3.37
May-04	7.47	5.97	2.47	3.08	2.90	2.35
Jun-04	4.93	3.32	2.22	1.74	-0.72	-0.69
Jul-04	3.40	1.67	5.18	2.58	-5.37	-2.77
Aug-04	1.88	0.02	4.01	1.29	-8.60	-4.87
Sep-04	3.36	1.37	4.39	1.94	-6.81	-4.02
root-MSE	4.51	3.64	3.08	2.32	6.17	2.83



Observations for CPI of urban Non-manual worker: The Holt-Winter's smoothing method for additive model performs the best here, closely followed by the decomposition method for the additive model. Also, the performance of the latter in the two last months during the testing period is especially poor compared to the former. However, because the former consistently predict index than the latter during the forecast period, it may be prudent to take the average of the two in coming up with single forecasted values. That would result in predicting a slow but steady growth to slightly above the 450 mark for this CPI by the end of 2005. Also noteworthy, that in general, all the exponential smoothing methods have performed creditably as compared to the decomposition methods for this data.

Exploring CPI for Industrial Worker TS:

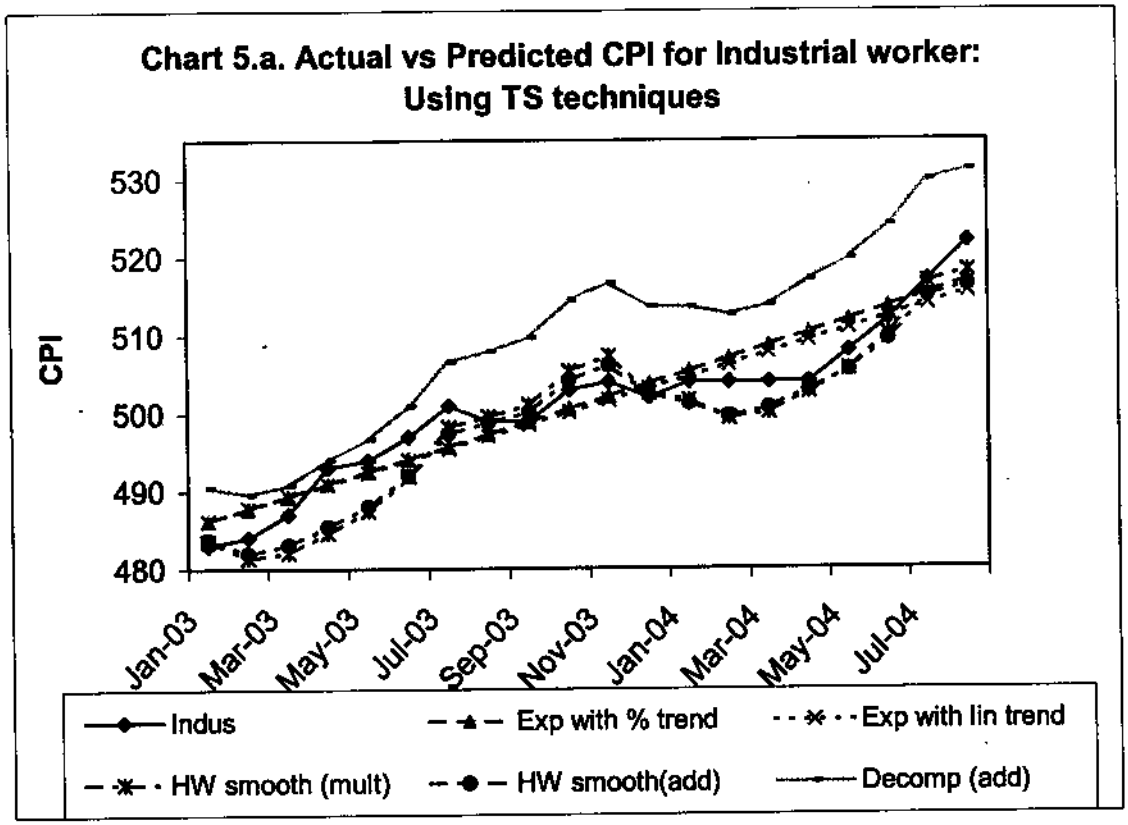
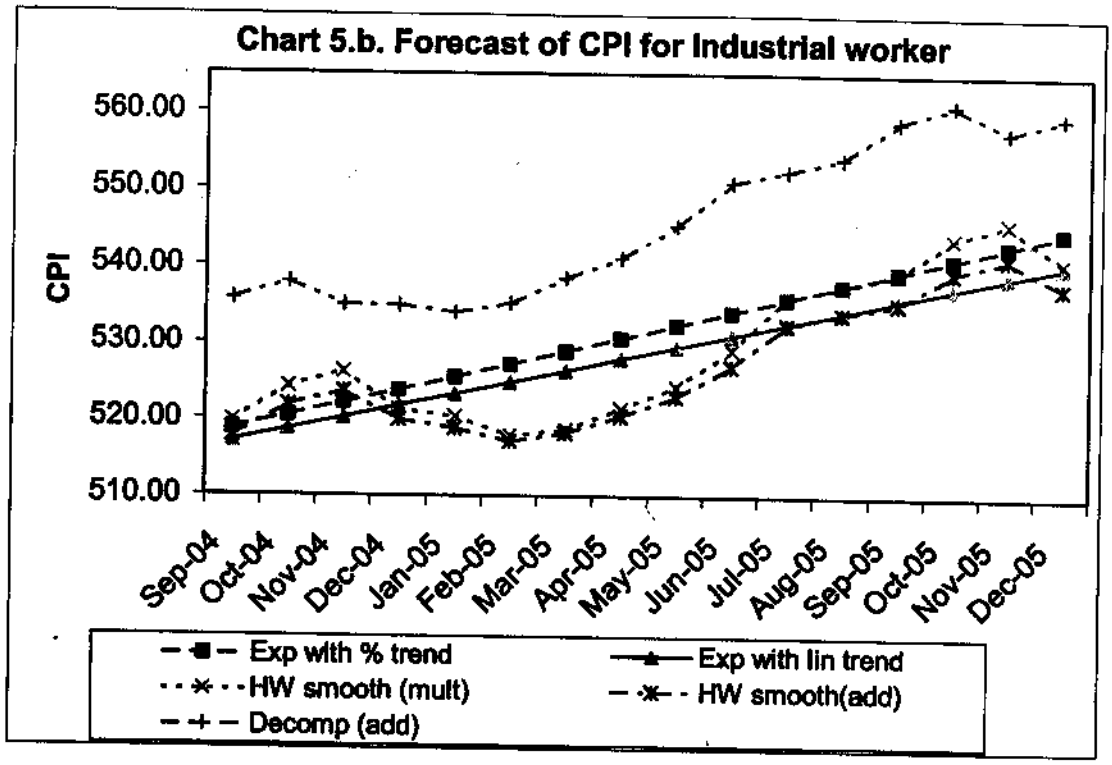


Table 5: Error in Predicting CPI of Industrial Worker

	Exp with % trend	Exp with lin trend	HW smooth (mult)	HW smooth(add)	Decomp (add)
Jan-03	3.17	3.21	0.63	0.73	7.55
Feb-03	3.75	3.75	-2.60	-1.97	5.57
Mar-03	2.33	2.29	-4.89	-3.87	3.80
Apr-03	-2.09	-2.16	-8.37	-7.61	1.07
May-03	-1.49	-1.62	-6.59	-6.00	2.71
Jun-03	-2.90	-3.07	-5.16	-5.06	3.97
Jul-03	-5.29	-5.53	-2.80	-3.60	5.64
Aug-03	-1.68	-1.98	0.57	-0.20	9.03
Sep-03	-0.07	-0.44	2.04	1.16	10.78
Oct-03	-2.45	-2.90	2.44	1.22	11.54
Nov-03	-1.83	-2.35	3.34	2.13	12.76
Dec-03	1.80	1.19	0.58	0.40	11.77
Jan-04	1.43	0.74	-2.36	-2.74	9.69
Feb-04	3.07	2.28	-4.68	-4.44	8.71
Mar-04	4.72	3.82	-3.94	-3.35	9.93
Apr-04	6.37	5.37	-1.33	-1.08	13.20
May-04	4.02	2.91	-2.45	-2.47	11.85
Jun-04	1.69	0.46	-1.85	-2.54	12.11
Jul-04	-1.65	-3.00	-0.26	-2.07	12.78
Aug-04	-4.98	-6.46	-3.83	-5.67	9.17
root-MSE	3.08	3.05	3.50	3.36	8.96



Observations for CPI of Industrial worker: The two exponential smoothing methods accounting for trend (i.e. the Holt's method) perform the best here, although the performance of all the methods, with the exception of the decomposition method for additive model, are fairly comparable during the testing phase. However, because all the remaining four methods (other than decomposition method with additive model) suggest fairly comparable values and err on the negative side (under-predict) towards the end months of the testing phase, while the decomposition method errs on the positive side during the testing phase, we recommend the average of all the methods, in projecting this CPI index for the forecast period.

For the exponential smoothing methods we have worked with the coefficients of 0.1, which is a default choice with most software. However, time permitted, we would have liked to try various other values and made selection on that front, which could have improved the performance of the exponential smoothing methods. Thus, it is a bit unfair to discount these methods in comparison to the decomposition-based methods, even for the WPI series and the CPI for agricultural workers.

The final single forecast based on time series analysis for the series under consideration is reported in the following Table 6.

Table 6: Final Forecast of WPI and CPIs

Mo-Yr	WPI	Agri CPI	Urban CPI	Indus CPI
Nov-04	191.03	341.35	438.09	525.42
Dec-04	191.81	341.36	437.98	524.32
Jan-05	193.00	341.06	438.86	524.35
Feb-05	193.91	341.93	439.14	524.42
Mar-05	195.11	343.92	439.91	526.10
Apr-05	196.21	347.09	441.24	528.27
May-05	197.16	349.69	442.52	530.90
Jun-05	197.87	351.14	444.19	534.43
Jul-05	198.61	351.75	446.44	537.82
Aug-05	198.96	351.52	447.61	539.40
Sep-05	199.39	349.99	448.22	541.60
Oct-05	200.22	349.16	449.47	544.46
Nov-05	200.88	348.95	450.08	545.22
Dec-05	201.68	348.88	449.82	544.49

This implicitly assumes no major paradigm shift. In the following section we inspect the impact of Fuel prices on these price indices series.

IV. Direct and Indirect Impact of Oil Prices on WPI and the CPIs

The oil prices in India are administered. In last few years it has been endeavored by the Government to make these prices linked with the international market prices. The idea was to reduce the bill on subsidies. As long as the international oil prices were stable, there were few criticisms for this arrangement. However, the oil prices steadily surged ahead in the market after the US intervention in Iraq. In India, many experts thought that passing on the full load of this price-rise would trigger off inflation and may harm the economy. This is more so as at this juncture the Indian economy is showing signs of recovery and it is poised to move into a higher growth path.

There are direct and indirect effects of increase in the oil price on the price indices. As Petrol, Diesel, Kerosene, LPG etc are part of the commodities basket; there is a direct and immediate effect on the indices. However, these are also used as input directly or indirectly to produce other commodities in the basket and influence their prices. Further, prices of many other commodities may be linked with the oil prices, as they may be supplementary or complementary economic goods.

Since the impact may not be instantaneous, i.e., it could take up to several months, to realize the full impact of change (typically increase) in the oil prices, a lagged model is appropriate here. The model thus looks like

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \cdots \beta_k X_{t-k} + \varepsilon_t$$

where Y_t is the relevant CPI (or WPI) and X_t is the oil-price index at time t. An important and often contagious parameter is the choice of k, which indicates the maximal lag for impact and need to be pre-determined. While it is possible to select k on the basis of estimated residuals out of various selection, in our analysis we stick to common sense choices of k=2, 3 or 4. The other important aspect is the estimation of the regression coefficients and for this work we have adopted the Almon approach as opposed to somewhat more popular Koyck approach because the latter would necessarily imply a decreasing nature of the β coefficients. The Almon approach postulates a polynomial model for the β's and keeping in mind the above required flexibility in terms of relative ordering of the coefficients, we choose a quadratic model, viz.

$$\beta_i = a_0 + a_1 i + a_2 i^2.$$

Now α, a_0, a_1, a_2 are estimated from usual multiple regression model

$$Y_t = \alpha + a_0 Z_{0t} + a_1 Z_{1t} + a_2 Z_{2t} + \varepsilon_t$$

$$\text{where } Z_{0t} = \sum_{i=0}^{k} X_{t-i},$$

$$Z_{1t} = \sum_{i=0}^{k} i \times X_{t-i}, \quad Z_{2t} = \sum_{i=0}^{k} i^2 \times X_{t-i}.$$

For more details, one can refer to any standard textbook on econometrics, e.g. Gujarati (1995).

On the other hand, one may implement a simple linear regression model with the relevant CPI or WPI as the 'dependent' variable and the Fuel price index as the 'independent' variable. Results from these analysis, reporting the estimated coefficients is reported in the Table 7:

Table 7: Impact of Fuel price index on WPI and CPIs: Comparison between SLR and lagged model

Model	Coefficient	Dependent Variable			
		WPI	Agri CPI	Indus CPI	Urban CPI
SLR	CONSTANT	79.186	179.007	202.633	144.467
	FUEL	0.377	0.604	1.176	1.098
lagged model with k=2	Alpha	80.349	184.277	202.500	149.714
	beta0	0.307	0.658	0.715	0.758
	beta1	0.033	-0.031	0.187	0.039
	beta2	0.034	-0.049	0.281	0.282
lagged model with k=3	Alpha	80.767	185.860	202.457	151.145
	beta0	0.284	0.578	0.689	0.674
	beta1	0.074	0.136	0.217	0.174
	beta2	-0.012	-0.078	0.060	0.018
	beta3	0.026	-0.065	0.220	0.207
lagged model with k=4	Alpha	81.206	187.356	202.511	152.548
	beta0	0.258	0.506	0.628	0.594
	beta1	0.098	0.213	0.286	0.241
	beta2	0.006	0.017	0.091	0.051
	beta3	-0.018	-0.084	0.042	0.024
	beta4	0.026	-0.089	0.139	0.159

The consistency between the two analyses is remarkable to say the least, and this leads us to a fairly trustworthy estimate of the aggregate impact of fuel price on the WPI and the various CPIs. In particular, we observe that, with a unit increase in Fuel price index, the WPI would increase by about 0.37, while the same for the CPIs for the Agricultural worker, Industrial worker and Urban non-manual employee to be around 0.57, 1.18 and 1.08, respectively.

Next, we attempt to divide this total effect into the direct effect and indirect effect. This is built on the information regarding weights used in constructing the price indices, and since this was readily available only for the WPI and not for the CPIs, we restrict this part of the analysis and discussion to WPI alone, to start with. Towards the end of this paper, we attempt a similar analysis for the CPI series.

The current construction of WPI suggests:

$$WPI = \frac{22.085 \times WPI_{PA} + 14.226 \times WPI_{F} + 63.749 \times WPI_{MP}}{100},$$

where the three WPIs referred to in the numerator of the right-hand-side of the above equation are the wholesale price index for (i) Primary articles (ii) Fuel, power, light & (iii) Manufactured products, respectively. Thus, with every unit increase in the WPI for the Fuel, the overall WPI should increase by about 0.14, as a direct impact. Thus, one would speculate that the remaining, that is about 0.23 (=0.37-0.14) to be the indirect impact of Fuel index on the WPI. Indeed that is found to be the case as evident from the study of the impact of the fuel index on the remaining two components of WPI.

Table 8.a. Impact of Fuel price index on other WPI components: Comparison between SLR and lagged model

Model	Coefficient	Dependent Variable: WPI for Primary article	Dependent Variable: WPI for Manufacturing product
SLR	CONSTANT	87.202	92.072
lagged model with k=2	Alpha	89.160	93.537
	beta0	0.240	0.188
	beta1	0.049	0.036
	beta2	0.075	0.018
lagged model with k=3	alpha	89.730	93.953
	beta0	0.217	0.172
	beta1	0.084	0.064
	beta2	0.024	0.006
	beta3	0.037	-0.002
lagged model with k=4	alpha	90.317	94.359
	beta0	0.195	0.163
	beta1	0.102	0.067
	beta2	0.040	0.010
	beta3	0.011	-0.010
	beta4	0.013	0.008

The justification of the above is as follows. With every unit increase in Fuel WPI, the aggregate WPI would go up by 0.14226 as direct contribution of Fuel WPI, whereas it would manifest into an increase of WPI for primary article by about 0.365 which, in turn, will result into an increase of the (aggregate) WPI by 0.365 ×0.22085 = 0.048. Similarly, every unit increase in Fuel WPI will result in a net increase of aggregate WPI by about 0.242 × 0.63749 = 0.154. Note that the aggregate total increase (0.377) in WPI conforms to the result from the direct regression analysis of WPI of Fuel index. When apportioned, the share of contribution may be summarized through Table 8.b.

Table 8.b

Route of Impact of Fuel on WPI	Percentage
Direct impact of Fuel WPI	37.7%
Impact through WPI for primary article	21.4%
Impact through WPI for manufacturing product	40.9%

How long does it take to impact?

From the lag model considered with the three choices of maximal lag, we summarize the average impact coefficients. This is listed below in Table 9:

Table 9: Impact of Fuel price index on WPI at different month lags

	WPI	Agri CPI	Indus CPI	Urban CPI
lag 0	0.283	0.580	0.677	0.675
lag 1	0.068	0.106	0.230	0.151
lag 2	0.009	-0.037	0.144	0.117
lag >=3	0.017	-0.119	0.200	0.195
Aggregate	0.372	0.570	1.185	1.074

Thus, for the WPI, the impact of change in the Fuel price index is almost instantaneous, with about 76.1% impact on the WPI index for that month itself and about 18.4% impact takes place after a month.

The situation is far from clear for the CPI of the agricultural worker, but a closer look at the results from the three cases suggests most of the impact is instantaneous. The picture for the CPI of industrial worker as well as the urban non-manual workers is drastically

different through. For these two indices, the direct impacts are only about 57.2% and 62.9% respectively, while the impacts after one month are about 19.4% and 14.1%. The impacts after 2 months are about 12.2% and 10.9% and the impacts after 3months or longer accounts for about 16.9% and 18.2% respectively for the above two groups.

Earlier we had shown the decomposition of the impact of Fuel price index on (aggregate) WPI into direct impact and impact through its other two components, viz. WPI for primary articles and WPI for manufactured products. The following table summarizes further decomposition taking into account the time taken for these impacts to enact.

Table 10.a. Route of Impact of Fuel on WPI

Lag	Direct (Fuel)	Primary article	Manufacturing product	Aggregate
0	0.142	0.048	0.111	0.301
1	0	0.017	0.036	0.053
2	0	0.010	0.007	0.018
>=3	0	0.007	0.000	0.007

Table 10.b. Percentage Impact of Fuel on WPI at different lags

Lag	Direct (Fuel)	Primary article	Manufacturing product	Aggregate
0	47.1%	16.0%	36.9%	100%
1		32.7%	67.3%	100%
2		58.8%	41.2%	100%
>=3		100.0%	0.0%	100%

Impact of Fuel wholesale price index on the CPIs:

While the information on weights at commodity group level used in constructing the CPI for Urban Non-manual labourer is not readily available in the public domain, the same for the Agricultural worker and the Industrial worker as well as the price indices for the various commodity groups (as listed in the Tables 11.a & 11.b) of these categories of workers are available from annual reports on CPIs published by the Labour Bureau. We run regression with each of the component price indices as well as aggregate CPI on the Fuel (WPI) index and combine the results with the above mentioned weights to obtain how CPIs for these groups get effected by increase in Fuel price (index). A major difference from the corresponding WPI analysis steps from the fact that there is no direct component of Fuel price index directly built into the CPIs and hence all the six (five) commodity groups enjoy similar stature in transmitting the effect of change in the Fuel price index. The results are summarized in Tables 11.a and 11.b below.

Table 11.a. CPI for Industrial Workers

Weight of its constituents and the impact they carry in terms of Fuel WPI shift

			Regression on Fuel WPI			
Sl. No.	Group	Weight	Constant	Fuel WPI	Impact	% Impact
1	FOOD GROUP	57.00	259.51	0.94	*0.53*	*45.2%*
2	PAN, SUPARI, TOBACOO & INTOXICANTS	3.15	236.80	1.68	*0.05*	*4.5%*
3	FUEL & LIGHT	6.28	32.30	2.07	*0.13*	*11.0%*
4	HOUSING	8.67	17.78	2.22	*0.19*	*16.3%*
5	CLOTHING, BEDDING & FOOTWEAR	8.54	203.46	0.54	*0.05*	*3.9%*
6	MISCELLANEOUS GROUP	16.36	156.65	1.38	*0.23*	*19.2%*
Aggregate/ GENERAL CPI		100	100	202.07	1.18	

Table 11.b. CPI for Agricultural Workers

Weight of its constituents and the impact they carry in terms of Fuel WPI shift

			Regression on Fuel WPI			
Sl. No.	Group	Weight	constant	Fuel_WPI	Impact	% Impact
1	FOOD GROUP	69.15	219.51	0.40	*0.28*	*56.0%*
2	PAN, SUPARI, TOBACOO & INTOXICANTS	3.79	194.13	0.78	*0.03*	*5.9%*
3	FUEL & LIGHT	8.35	122.65	0.83	*0.07*	*13.9%*
4	CLOTHING, BEDDING & FOOTWEAR	6.98	197.48	0.58	*0.04*	*8.1%*
5	MISCELLANEOUS GROUP	11.73	167.37	0.68	*0.08*	*16.1%*
Aggregate/ GENERAL CPI		100	100	202.84	0.50	

Columns 4 & 5 in Tables 11.a & 11.b report the intercept and slope parameter from the simple linear regression of the row series with Fuel (WPI) index. As with the WPI

analysis, the consistency of the component-wise regression with the aggregate is remarkable. This allows us to complete the impact analysis, as reported in the last two columns. The impact the groups carry is obtained by multiplying the respective regression coefficient with the commodity group weight and the percentage impact transferred by the group is obtained by dividing the group impact by the aggregate impact. Thus a unit increase in the Fuel wholesale price index would result in an increase of 1.18 (*0.50*) in the CPI of an Industrial (*Agricultural*) worker, 45% (*55.9%*) is through food basket price index, 4.5% (*5.1%*) is through intoxicants, 10.6% (*13.6%*) is through fuel and light etc. Note that for the CPI for agricultural workers, no data for the housing component is available and hence considered to have null weightage in their CPI. In passing we may also note that the constant term with the aggregate CPI as 'dependent variable' is approximately the weighted average of the constant terms for the component-wise regressions.

In this paper, the policy angle regarding the desirability of removal of subsidies for the oil prices were not taken up. It has only looked at the extent of impact of the change in oil prices on the price indices, directly and over-all. It is also found how much time it takes for the effect to be transmitted fully into the indices.

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