# Fuel Pricing Policy Reform in India: Implications and Way Forward

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This paper undertakes an examination of the differential impact of international oil prices on domestic inflation and output growth in India under two alternative scenarios. One scenario is, when domestic fuel prices are allowed a formula-based automatic alignment with international oil prices and the second, when as per current policy, fuel prices have evolved as a consequence of revisions specified periodically by the government. The differential impact analysis has been undertaken in a structural Vector Autoregressive framework using the technique of innovation accounting.

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As the sixth largest crude oil consumer and the seventh largest oil importer, India today imports more than 70% of its crude oil requirements. According to an International Energy Agency (IEA) forecast in 2006 the demand for oil in India would increase by 2.9% per year, reaching 5.6 million barrels a day (mbd) in 2030. This expected level of consumption would make India the world's third largest oil consumer.

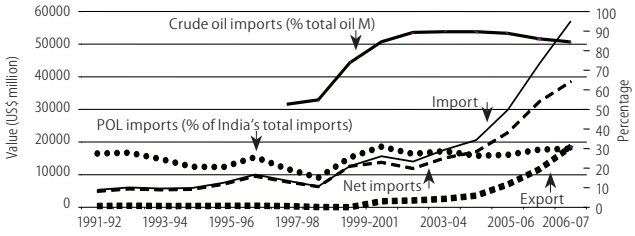
International crude oil prices increased dramatically over the past few years and attained a peak of around $137/barrel (bbl) in July 2008, some 35% above the 1979 record high in real terms.[1] The July 2008 oil prices were a historical maximum in nominal terms as well. After August 2008 though, international crude prices gradually declined.

A rise in the price of crude oil gets passed on to the price of petroleum products and as a consequence from the consumer standpoint, the energy bill of the economic agents (households, industry and government) grows, whereas from the production standpoint, companies have to contend with a rise in unit costs. In terms of demand, this slows down consumption expenditures. In terms of supply of goods and services, a rise in the energy price causes a drop in productivity, which is passed on to real wages and employment, selling prices and core inflation, profits and investment, as well as stock market capitalisation.

The negative relationship between oil prices and economic activity has been well documented in empirical economics literature. In the short term, the frictions and uncertainties over the persistence of oil price increases dominate, making the impact more pronounced. However, the long-term effects may be less severe as the possibility of substitution over a period of time on account of relative price changes may lead to a reallocation of the factors of production cushioning thus, the negative effects of the oil price increase. Further, rising oil prices entail a decline in demand, while falling oil prices do not trigger an equal and/or immediate spike in demand.[2] An increase in the oil price therefore feeds through to GDP growth to a much larger extent than a decline. This asymmetry in the oil price effect is attributable to the adjustment costs associated with sectoral reallocations and the implications of uncertainties for spending on consumer durables and investment.

Significantly, the role of monetary policy also contributes to the impact that the oil price shock can have on the economy. When confronted with an oil price shock, monetary policymakers face a fundamental trade-off. Depending on their monetary policy strategy, they can try to either counter real effects with expansive measures or to fight inflationary effects with restrictive

**Figure 1: Trends in India's Oil Exports and Imports**




Source: RBI and Petroleum Planning and Analysis Cell (PPAC).

measures. Both these strategies would have implications for the growth process, with the former partially offsetting the restrictive impact of an oil price hike on demand and growth and the latter further constraining the growth process.

Empirical estimation using econometric models has revealed that the impact of crude oil prices on economic activity is exerted in an unstable manner, both in the short term and over a long period. The estimated impact observed in the 1970s appears to weaken from the onset of the 1980s, until it becomes non-significant during the 1990s. This progressive attenuation and short-term variability of the effects of oil price movements on macro variables is explained on several counts including a fall in oil intensity and role and strength of monetary policy. Importantly, this has been observed in economies that have allowed for a full price pass-through of the oil shock. Empirical evidence reveals that in the non-OECD countries demand for oil has been much less price-responsive and has in fact grown almost as rapidly as income (see Dragay, Gately and Huntington 2007). This it is argued could possibly be a reflection of the policy design in many developing countries whereby pass-through of higher oil prices to final consumers is avoided.

India has so far followed a near administered fuel pricing policy. In the recent past, in the face of dramatic changes in fuel prices, the need for domestic fuel price revision in line with these changes has been felt in many quarters. However, given the social implications as also the political sensitivity of this issue in India, a policy shift from regulation to deregulation of fuel prices has not happened.

This paper attempts to examine the impact of international oil prices on domestic inflation and output growth in India under two alternative scenarios. These include, one, when domestic fuel prices are allowed to automatically adjust to changes in international oil prices and, two, when changes in domestic fuel prices are regulated by the government. The paper thus makes an attempt to provide inputs for policy shaping in the context of fuel price reform in India. The analysis attains significance in the light of current trends in India's oil imports and the fluctuations in international crude oil prices in 2008 and 2009. The formal impact analysis is preceded by a brief description of India's oil import dependence, fuel pricing policy and a detailed analysis of the international oil price pass-through coefficient in the Indian economy.

India is a net oil importer. In 2007-08, India consumed 129 million tonnes of petroleum products and met about one quarter of its oil needs from domestic production. The rest was imported largely in the form of crude. India's import bill has been increasing steadily since 2000. Table 1 and Figure 1 present the trends in the oil sector in India, including the steep rise in the import bill in the recent past. While exports from this sector have been increasing steadily since 2000-01, imports have simultaneously increased by even larger amounts resulting in a consistent upward movement in net oil imports.[3] The import bill[4] in 2007-08 was $56 billion having increased by over six times its 1997-98 level of $7,719 million. Overall, oil imports account for about 30% of India's total import bill with crude oil accounting for over 80% of the gross oil imports and in 2007-08 India's oil import bill was a little over 6% of its GDP, almost double the 2003-04 level.[5]

That India's high dependence on oil imports will continue is evident when we analyse the current trends of oil production and consumption in the Indian economy. Domestic oil production has remained fairly stable in India for many years despite some new discoveries in Rajasthan. At the end of 2007 India had proven reserves of 5.5 billion barrels (*BP Statistical Review* 2008). Unless significant new sources are discovered, domestic oil supply will last an estimated 19 years at 2007 production levels. On the other hand, increasing economic growth is likely to further fuel the demand for oil. In particular, demand for vehicles is expected to contribute to oil consumption, demand and hence imports. Passenger car penetration is still low in India and even a modest increase towards international levels of car ownership[6] could have a huge impact on world oil demand and prices. Other statistics and trends reveal similar potential. As of 2006, one person in the United States consumed more oil than 29 people in India. This low level of oil consumption in as large a populated country as India points to the enormous likelihood of growth in oil consumption. The Energy Information Administration estimates of gains in oil consumption for India over the last two years show a similar picture. In comparison with other high demand economies, the growth in demand for oil in India has been more than that in Japan and South Korea while being less than China[7] and the US over the last two years (Figures 2 and 3, p 79).

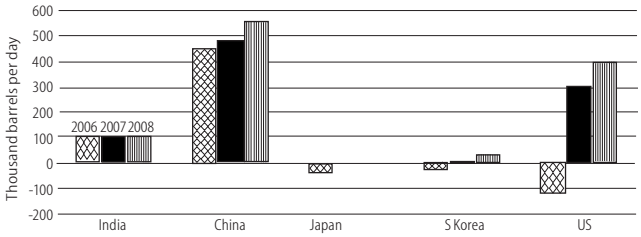
India is working to improve domestic oil exploration and production. To increase domestic supplies, the Indian government is trying to attract foreign companies to participate in exploration and production activities.[8] While the government needs to undertake specific policy action to increase domestic production, it is also to be realised that given the country's limited reserves, oil production cannot continue increasing over the long term. In the entire Asia Pacific region, it is estimated that between 2007 and 2015, oil production is projected to grow by 1% a year in comparison with 3% annual growth in oil consumption. As a result, by 2015, the projected 71% of all the oil in the region will be imported (Wu et al 2008).

**Table 1: India – Trends in Oil Imports**

| Year | Oil Import/Total Imports | Oil Import/GDP |
|---|---|---|
| 1991-92 | 27.43 | 2.21 |
| 1992-93 | 27.88 | 2.52 |
| 1993-94 | 24.69 | 2.28 |
| 1994-95 | 20.69 | 2.01 |
| 1995-96 | 20.52 | 2.32 |
| 1996-97 | 25.65 | 2.83 |
| 1997-98 | 19.68 | 2.16 |
| 1998-99 | 15.10 | 1.67 |
| 1999-00 | 25.39 | 3.06 |
| 2000-01 | 30.97 | 3.71 |
| 2001-02 | 27.23 | 3.18 |
| 2002-03 | 28.72 | 3.77 |
| 2003-04 | 26.32 | 3.71 |
| 2004-05 | 26.76 | 4.70 |
| 2005-06 | 29.47 | 5.99 |
| 2006-07 | 29.95 | 6.90 |

Source: RBI.

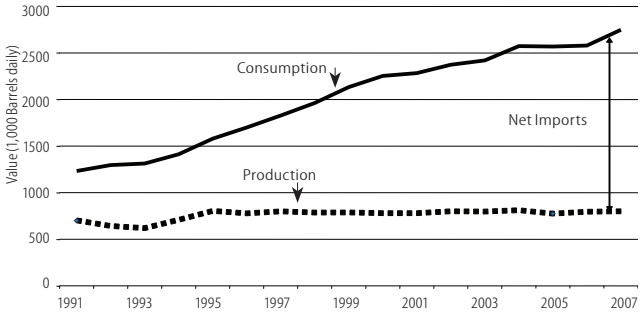
**Figure 2: Oil Demand Growth Comparison** (2006-08)*




* 2006 is estimate, 2007-08 is forecast

Source: EIA *Short-Term Energy Outlook* (January 2007).

**Figure 3: Oil Production and Consumption in India**




Source: *BP Statistical Review*, 2008.

**Table 2: Correlation – WPI and International Oil Prices** (04/1994 to 12/2008)

| | Brent | WPI |
|---|---|---|
| Brent | 1 | 0.874909 |
| WPI | 0.874909 | 1 |

Brent: International crude oil price; WPI: wholesale price index.

**Table 3: Rolling Correlation – WPI and International Oil Prices**

| | 2000q4 | 2001q4 | 2002q4 | 2003q4 | 2004q4 | 2005q4 | 2006q4 | 2007q4 |
|---|---|---|---|---|---|---|---|---|
| | Brent | Brent | Brent | Brent | Brent | Brent | Brent | Brent |
| WPI | 0.46 | 0.54 | 0.6 | 0.7 | 0.79 | 0.84 | 0.88 | 0.94 |

The current trends of oil consumption, future potential for growth in consumption and almost stagnant production levels together suggest a sustained high level of dependence of the Indian economy on imports of oil and as a consequence its increasing exposure to the international oil market price volatility. When in July 2008 international crude prices attained a historical peak, the Indian basket of crude[9] simultaneously averaged close to $132 a barrel against $65 a barrel at the start of the fiscal last April. These trends pose a major challenge for the Indian economy.

## Fuel Pricing Policy in India

Notwithstanding the rising level of oil imports, hikes in international oil prices and the consequent impact on the import bill, India has continued to follow an administered fuel pricing policy. The Administered Pricing Mechanism (APM) was initiated with the objective of ensuring stable prices and insulating the domestic market from the volatility of crude oil prices in the international market. These objectives were achieved through the operation of the Oil Pool Account that was used to adjust the variation in various elements of costs to the oil companies. However, in due course it was realised that in order to sustain/accelerate the domestic exploration and production efforts essential for future oil security of the country the public sector oil producers needed to be freed from government controlled pricing mechanism to get international prices for their products. Accordingly, starting with a phased manner the APM was fully dismantled in April 2002. The oil companies made frequent price revisions in the price of petrol and diesel over 2002 and 2003 when international prices were fairly stable. However, in subsequent years when international prices of crude oil started to witness sharp and spiralling increases, India, in the interest of the consumer, resorted to moderate policy-induced revisions in fuel prices.

The process of fuel price fixation in India while protecting consumers from the price variations entails that the price volatility shocks be absorbed either by the oil marketing companies (OMCs) or the government. The OMCs in India buy the petroleum products from their own refineries on import/trade parity basis.[10] The retail selling price at Delhi for petrol and diesel is derived by the OMCs on the basis of a formula within the framework of import substitution.[11] From this by deducting the taxes and statutory charges[12] the net sales realisation of the OMCs is derived. The difference between this and the sales price as allowed by the government is termed as "under-recovery" per unit of the good. So that, to the extent that due to government-imposed restraints on the retail selling prices of refined products, the OMCs are unable to pass on to the consumer the increase in cost on account of more expensive crude oil they incur an "under-recovery" on their trading sales. This is evident when we draw comparisons between movement in international and domestic fuel prices.

Between March 2005 (when Brent crude prices first crossed the $50/barrel mark) and March 2008, the price of Brent crude increased by 96%. Over the same period the domestic price of petrol increased by only 13%. A similar story unfolds when we analyse the differential increase in domestic and international diesel prices. Since March 2005, the international diesel prices have increased by 106% while domestic prices increased by only about 21%. The scenario for kerosene is even starker. Domestic kerosene prices are the least reflective of changes in international prices. Since March 2005, international kerosene prices experienced an increase of 93%. In contrast the domestic kerosene prices increased from 8.995/lit to Rs 9.0775/lit thus registering an increase of less than 1%. The price of public distribution system (PDS) kerosene has been frozen since May 2006. Marginal price adjustments to the tune of 10 paise/litre were made in April 2006. In July 2008 when international prices were at their peak the OMC "under-recovery" was Rs 12.90/litre of petrol and Rs 13.9/litre in the case of diesel.[13,14]

**Table 4a: Correlation – Quarterly Change in International Oil Prices and Domestic Petrol Prices**

| | CHDPD | CHQBRT |
|---|---|---|
| CHDPD | 1 | 0.256603 |
| CHQBRT | 0.256603 | 1 |

CHDPD: change in domestic petrol prices; CHQBRT: change in international oil prices.

**Table 4b: Lag Correlation – Quarterly Change in International Prices and Domestic Petrol Prices**

| | CHDPD(t+1) | CHQBRTt |
|---|---|---|
| FCHDPD(t+1) | 1 | 0.435358 |
| CHQBRTt | 0.435358 | 1 |

CHDPD: change in domestic petrol prices at time t+1; CHQBRT: change in international oil prices at time t.

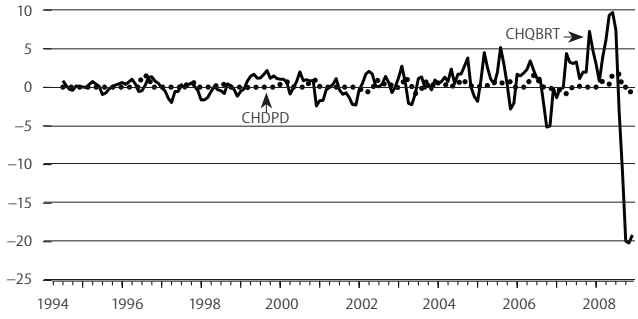
Implicit in this price mechanism followed in India is thus a huge subsidy that is given to the consumer in the form of significantly lower prices for the four sensitive items, namely, motor spirit, high speed diesel (HSD), PDS kerosene and domestic liquefied petroleum

**Table 5: Correlation: Change in International Oil Prices and Domestic Fuel Prices: Product-wise: 2003-08**

| | DD | ID | IK | MSS | DK | DP | CB |
|---|---|---|---|---|---|---|---|
| DD | 1 | | | | | | |
| ID | 0.273935 | 1 | | | | | |
| IK | | 0.914794 | 1 | | | | |
| MSS | | | | 1 | | | |
| DK | | | 0.31307 | | 1 | | |
| DP | 0.668943 | | | 0.083668 | | 1 | |
| CB | 0.056573 | 0.881459 | 0.845466 | 0.820682 | 0.119036 | 0.174654 | 1 |

CB: Crude Brent price, DD: domestic diesel, ID: international diesel price, IK: international price of kerosene, MSS: Motor Spirit Singapore, DK: domestic price of kerosene, DP: domestic price of petrol. Only the relevant correlations are reported.

**Figure 4: Quarterly Change in International Oil Prices and Domestic Petrol Price** (in %)




CHDPD: quarterly change in domestic petrol prices; CHQBRT: quarterly change in international crude oil prices, change with respect to corresponding period in previous year.

gas (LPG) and, the OMCs to compensate for their under-recoveries through the issue of oil bonds. It is now widely accepted that large fuel subsidies in India adversely impact government deficit, OMC efficiency and energy consumption patterns. Hence, the need of the hour is to do away with subsidies and deregulate fuel prices.

In the next section we examine the impact of a formula-based automatic adjustment of fuel prices on inflation and output growth in India. Given that inflation is the primary channel of passage of international and domestic fuel price hike to the demand and supply-side of the economy, we first make an attempt to understand the existing relationship between international prices, domestic fuel prices and general inflation in some detail before the formal impact analysis is undertaken.

The analysis is undertaken using monthly data for the period (April 1994 to December 2008). The representative international crude oil price used for the analysis is Brent as it has a high correlation with the other benchmark international crude oil prices as also with the price of the Indian basket. The value of the correlation is over .95 in all cases. The data for different variables has been culled from various sources including the *International Financial Statistics* of the IMF, *Handbook of Statistics on the Indian Economy* and monthly bulletins (various issues), of the Reserve Bank of India; *BP Statistical Review*; www.ppac.org.in and *Basic Statistics* of the Ministry of Petroleum and Natural Gas, Government of India.

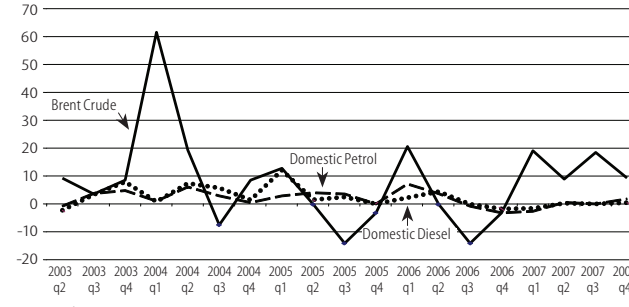
## International Oil Prices and Domestic Inflation

As a first step to understanding this relationship, we estimate the bi-variate correlations between monthly international oil prices and the domestic price index over the reference period. In addition, for a deeper insight into the oil price – inflation relationship we also calculate the four-quarterly/one-year rolling correlations. The results are presented in Tables 2 and 3 (p 79).

It is observed that the value of the correlation coefficient between WPI and international crude oil price is high over the entire reference period.[15] However, this appears to be a recent phenomenon. Table 3 shows rolling correlation coefficients for the period after 2000 when for the first time the value is close to attaining modestly high levels. The correlation values range from modest to high (>/=0.7) only after 2003. This could possibly be a reflection of the dismantling of the APM in the Indian oil market.

It may be thus stated that domestic fuel prices in India have in the recent past followed international prices. We proceed to explore if this also implies that changes in international oil prices are followed by changes in domestic fuel prices. As the general price indices would only be reflecting the impact of international oil prices through the prior hike in domestic oil product prices, we now estimate the correlations between quarterly change in domestic and international prices for individual petroleum products. Correlation coefficients are calculated at quarterly frequency so as to incorporate the lag with which policy change in domestic prices may be announced in response to the change in international prices. Also, accounting for a possible lag in price changes to be reflected in India, correlations have been estimated with domestic fuel price changes for the subsequent quarter. A detailed correlation analysis using specific petroleum products and their reference international prices is undertaken for the more recent period when dramatic increases in international oil prices have been experienced. Several variants of the bi-variate correlations are estimated. The results presented in Tables 4a, 4b (p 79) and 5 are observed to be at variance with the simple price correlation estimates and thus revealing.

**Figure 5: Quarterly Change – International and Domestic Petrol/Diesel Price** (2003-08, in %)

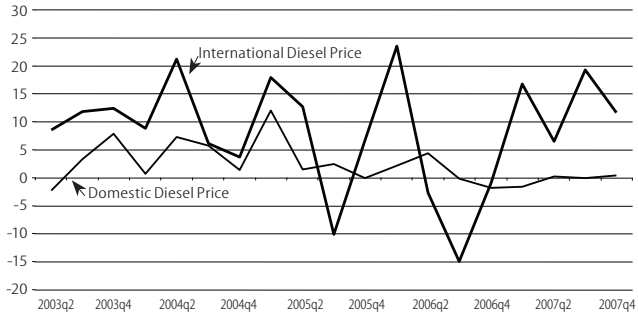



Note: % change over previous quarter.
Source: PPAC

The correlation coefficients are low in value implying thereby the absence of co-movement between the change in domestic diesel prices, petrol prices and the prevailing international prices for these products. All variants of correlation estimates lead to the same conclusion that change in international prices and domestic fuel price change in India do not move in a synchronous fashion.[16]

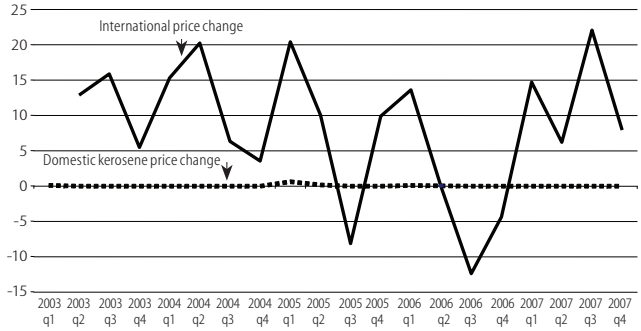
The simple correlation analysis of the level of and change in international and domestic general and fuel prices thus leads us to conclude that even though the domestic and international prices may be moving in the same direction, the quantum of

**Figure 6: Quarterly Change – International and Domestic Diesel Price** (2003-08, in %)




Note: % change over previous quarter.
Source: PPAC

**Figure 7: Quarterly Change – International and Domestic Kerosene Price** (2003-08, in %)




Note: % change over previous quarter.
Source: PPAC

change in the two series is not in any way synchronised. Figures 4, 5 (p 80), 6 and 7 showing quarterly changes in individual petroleum product prices in the domestic Indian market against their reference international prices provide further evidence in support of our conclusion. Domestic diesel prices and petrol prices do move in the same direction but the movements are not as sharp and changes not as frequent as in the case of the international diesel and crude Brent. In the case of kerosene, the domestic price changes are infrequent and only marginal in comparison with the changes in the international prices. For all the products the magnitude of change in domestic prices falls well short of that in the international prices. It is also clear that the price volatility of the international markets is not allowed to be reflected in domestic price variations. The domestic price change curves are far smoother than the international price curve that has several spikes. Significantly, some of the very recent hikes in prices have not been followed in the case of domestic product prices. In fact, in 2007-08 the persistent increase in international oil prices is observed to be coterminous with persistent stability in domestic diesel and oil prices. The story of kerosene prices is in a different category altogether. Prices are kept frozen for long periods and changes, if any, are marginal with very long time lags.

The limited reflection of change in international oil prices in changes in domestic fuel prices is further confirmed when we undertake a formal calculation of the oil shock price pass-through coefficient for the Indian economy.

## Coefficient of Oil Shock Price Pass-through in India

A more formal analysis of the international oil price shocks and domestic inflation is undertaken by calculating the pass-through coefficient of international oil price inflation to general inflation in India for a given time horizon. For our analysis an oil shock is defined as an event when the increase in oil prices is more than 50% in a year and the increase persists for at least six consecutive months. The pass-through coefficient is defined as the ratio of accumulated inflation and oil price change for a 24 month window. Given below are the pass-through coefficients for two oil shocks as identified over the reference period.

Our estimates reveal that the extent of pass-through of the oil price increase to general inflation levels in India over the recent period has been modest to begin with (around 57%) and then registered a decline to about 29% more recently. The decline in oil pass-through coefficient is significant as the impact of increase in international prices on domestic inflation maybe consequently weaker than expected. This then has repercussions through the second round effects on other variables in the economy.

Theoretically it has been proposed that the impact of oil prices on inflation levels and the extent of pass-through is a function of the reaction function of the economic authorities. The choice of the exchange rate regime, monetary target and cyclicality of fiscal policy as also the persistence of the shock and the increasingly competitive pressures on producers on account of globalisation that may limit their ability to pass the increased production costs to consumers are all critical in determining the outcome of the oil price increase on inflation. Recent empirical evidence across a large sample of countries reflects that there is almost in all countries, a fall in the impact of oil prices. Empirically it has been found that the lower impact of oil prices on domestic inflation can be explained by fall in oil intensity. We examine if this empirical explanation for a low pass-through holds true for India as well.

## Relationship between Prices and Oil Intensity

To examine if the smaller pass-through coefficients and thence the inability of the domestic fuel and general price level to reflect the international oil price hike and/or changes therein can be explained as an outcome of falling oil intensity in India, we follow a two-step procedure. First, we observe the trends in oil intensity which is calculated using GDP, both, in terms of current and purchasing power parity. The extent of responsiveness of oil intensity in India to changes in international oil prices is then examined in a Vector Autoregressive (VAR) framework. A Granger Causality test is carried out to ascertain the direction of the causal relationship, if any, between price changes internationally and oil intensity changes in India. Both, the regression analysis and the causality test help understand if the fall in oil intensity is in response to oil price changes or independent of the former. In case the latter holds and oil intensity is a consequence of other factors and developments in the Indian economy, there would be little reason to say that falling oil intensity has in anyway contributed to or is a consequence of the fall in the extent to which

**Table 6: Oil Shocks and Corresponding Pass-through Coefficients in India**

| Oil Shocks | Pass through Coefficient |
|---|---|
| 2005 Q4 ( March) | 0.57 |
| 2006 Q2 (July) | 0.29 |
| 2007 Q3* | – |

* The coefficient of pass-through has not been calculated for this oil shock as the data points after the oil shock are not sufficient for the purpose.

**Table 7: India – Trends in Oil Intensity**

| Year | $O_i$ | $O_{ig}$ |
|---|---|---|
| 1991 | 1.61 | 4.29 |
| 1992 | 1.59 | 4.49 |
| 1993 | 1.50 | 4.66 |
| 1994 | 1.49 | 4.38 |
| 1995 | 1.52 | 4.29 |
| 1996 | 1.49 | 4.37 |
| 1997 | 1.51 | 4.35 |
| 1998 | 1.51 | 4.62 |
| 1999 | 1.51 | 4.71 |
| 2000 | 1.48 | 4.82 |
| 2001 | 1.41 | 4.73 |
| 2002 | 1.38 | 4.70 |
| 2003 | 1.29 | 4.09 |
| 2004 | 1.23 | 3.70 |
| 2005 | 1.09 | 3.16 |
| 2006 | 0.97 | 2.82 |
| 2007 | 0.92 | 2.42 |

Source: IFS, *World Economic Outlook*, 2008 and *BP Statistics*; Oi: at GDPppp and Oig: at GDP current $

**Table 8: Oil Intensity in India and International Oil Prices**

| Dependent Variable: Oil Intensity | DOI |
|---|---|
| DLn (Oil Price) $_{t-1}$ | -0.081548 |
| | (0.04379) |
| | (-1.86234) |
| DLn (Oil Intensity)$_{t-1}$ | 1.043812 |
| | (0.36275) |
| | (2.87749) |
| DLn (GDP)$_{t-1}$ | 1.223992 |
| | (0.36444) |
| | (3.35852) |
| C | -0.144185 |
| | (0.02639) |
| | (-5.46407) |
| R-squared | 0.91 |
| Adjusted R -squared | 0.82 |
| No of observations | 16 |

1 A symmetric model is estimated avoiding thus the introduction of any complication in the model of asymmetric impact of a fall or rise in international oil prices.
2 Figures in parentheses represent standard errors and t ratios.

international oil prices have an impact on domestic inflation. The absence of a reflection of international oil price changes in domestic fuel/general inflation levels would then obviously be attributable to other factors.

Table 7 presents our calculations for oil intensity[17] as it has evolved in India over the 1991-2007 period. It is evident that over the last decade and a half, oil intensity has declined to little over half its initial level in 1991. Much of this fall in oil intensity is observed over 2005-07, a period that has been marked by increase in oil prices. Significantly, it may also be noted that the oil intensity when measured in terms of GDP at PPP rates is less than half the levels in current GDP terms.

We formally test for a potential causal link from oil prices to oil intensity in India using the following trivariate variable VAR model over 1991-2007.[18] Specifically, the equation estimated for the purpose is:

$$\Delta \ln (E)\, t = \alpha_1 t + \alpha_2 \Delta \ln (E)_{t-1} + \alpha \Delta \ln(y)_{t-1} + \beta \Delta \ln P_{t-1} + \varepsilon \quad \ldots(1)$$

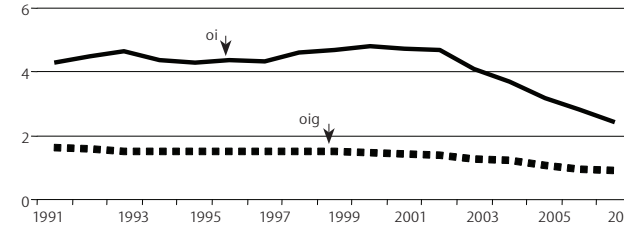
where $E$ is oil consumption as a share of GDP, $y$ is GDP and $P$ is the price of oil and $\varepsilon$ is an i.i.d. term. The coefficient of relevance is $\beta$. A zero value of $\beta$ will imply that prices do not affect changes in oil intensity while a value less than zero, i e, a negative coefficient will mean that prices affect oil intensity. Results are presented in Table 8.

Reviewing the results of the symmetric hypothesis it is apparent that the oil prices do not have an impact on oil consumption in any significant manner in India. The coefficient of oil prices is negative but very small in value and statistically insignificant.[19] Figure 9 is representative of this trend. In the figure, peaks in oil prices are indicated to see if any fall in consumption coincides with oil price peaks internationally. On the contrary the increase in consumption of oil in India continues uninfluenced by peak international prices or any changes in international oil prices. This conclusion is further reinforced by the Granger causality test. Based on the test results, we can conclude that the null hypothesis of no Granger causality from international oil price to oil intensity in India cannot be rejected.

An obvious explanation of the limited reflection of international oil prices on domestic inflation and the limited role of oil intensity therein, that also has implications for future oil consumption patterns and environment and thereby its impact on oil intensity in India, is that as oil price changes are to a large extent absorbed by OMC "under-recovery" and ultimately public subsidies, individuals and industries do not have the incentive to reduce their oil consumption or increase their efficiency levels in response to higher international oil prices. Oil intensity hence remains a passive variable in the Indian economy. Changing oil consumption patterns are therefore not to be held responsible for an incomplete reflection of changes in international oil prices in domestic fuel prices/inflation in general unlike in many countries that have a low price pass-through coefficient. In fact, as we can see, over the second oil shock, oil price change is greater than that in the previous period and oil intensity fall is less or equal to that in the previous period and the pass-through coefficient actually falls.

The obvious channels of transmission from the international oil prices to general inflation through domestic fuel and energy input prices and the consequent second round effects do not thus operate in the Indian economy. As oil prices in India are not coordinated in time or magnitude with international oil price changes,

**Figure 8: India – Trends in Oil Intensity** (barrels consumed per day/GDP)



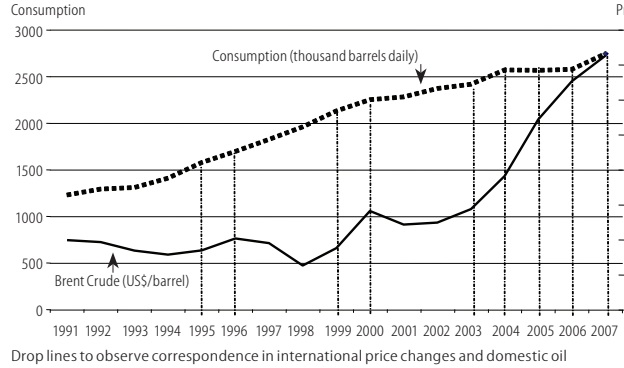

Source: *BP Statistical Review* and IFS, IMF.

**Table 9: Granger Causality Test – International Oil Prices and Oil Intensity in India** (1991-2007)

| Null Hypothesis: | Observations | F-Statistic | Probability |
|---|---|---|---|
| DOP does not Granger Cause DOI | 15 | 0.09928 | 0.75810 |
| DOI does not Granger Cause DOP | | 1.01969 | 0.33252 |

DOP: international oil prices; DOI: domestic oil intensity.

**Figure 9: International Oil Price and Domestic Oil Consumption**




Drop lines to observe correspondence in international price changes and domestic oil consumption.
Source: IFS and *BP Statistical Review*, 2008.

**Table 10: Variance Decomposition of WPI**

| Period | SE | ER | DPD | M3D | WPI |
|---|---|---|---|---|---|
| 1 | 0.959027 | 0.01563 | 32.45068 | 0.003144 | 67.53055 |
| 2 | 1.663594 | 1.152515 | 29.73169 | 0.001755 | 69.11404 |
| 3 | 2.253131 | 0.771206 | 29.3679 | 0.199419 | 69.66148 |
| 4 | 2.737496 | 0.541479 | 28.43795 | 0.320595 | 70.69997 |
| 5 | 3.035482 | 0.444345 | 28.17792 | 0.416817 | 70.96092 |
| 6 | 3.240371 | 0.658283 | 28.43592 | 1.040077 | 69.86572 |
| 7 | 3.380498 | 1.096987 | 27.48124 | 3.280768 | 68.141 |
| 8 | 3.489421 | 1.652025 | 27.14145 | 5.981072 | 65.22546 |
| 9 | 3.5731 | 2.505222 | 26.72251 | 8.257352 | 62.51492 |
| 10 | 3.633451 | 3.406441 | 26.04821 | 10.08719 | 60.45816 |
| 11 | 3.696191 | 4.307528 | 25.32877 | 11.94041 | 58.4233 |
| 12 | 3.759967 | 5.218752 | 24.6909 | 13.61496 | 56.47539 |

DPD: domestic petroleum prices; ER: exchange rate; M3D: money supply; WPI: wholesale price index.

**Table 11: Variance Decomposition of WPI**

| Period | SE | ER | BRTAVG | M3D | WPI |
|---|---|---|---|---|---|
| 1 | 0.860354 | 0.000218 | 1.800544 | 0.000299 | 98.19894 |
| 2 | 1.480959 | 1.453828 | 14.48107 | 0.009661 | 84.05544 |
| 3 | 2.034526 | 1.065608 | 23.39559 | 0.601909 | 74.9369 |
| 4 | 2.570478 | 0.680721 | 30.80384 | 1.107765 | 67.40767 |
| 5 | 3.009556 | 0.573359 | 37.06052 | 1.762066 | 60.60405 |
| 6 | 3.354921 | 1.083138 | 39.00308 | 3.350228 | 56.56355 |
| 7 | 3.623463 | 1.845785 | 38.65378 | 6.770279 | 52.73015 |
| 8 | 3.805354 | 2.548057 | 37.34762 | 10.23097 | 49.87335 |
| 9 | 3.949227 | 3.819619 | 35.54466 | 13.65054 | 46.98518 |
| 10 | 4.070983 | 5.388778 | 33.58456 | 16.74304 | 44.28361 |
| 11 | 4.185052 | 7.193505 | 31.79163 | 19.08625 | 41.92861 |
| 12 | 4.292285 | 8.802282 | 30.47667 | 20.79128 | 39.92977 |

DPD: domestic petroleum prices; ER: exchange rate; M3D: money supply; BRTAVG: three-month rolling average of Brent.

in times of increasing oil prices the domestic fixed prices lead to OMCs inability to recover the costs. The same mechanism may also imply that there is more than desirable compensation for the OMCs' in times of rapidly falling oil prices. To correct this anomaly in the system, reform of fuel pricing in India is imperative. The dramatic changes in international oil prices in the recent past have made continued government support and OMC suffering untenable. It also needs to be realised that inherent in fuel price reform is not just ensuring OMC survival but also a signalling mechanism for efficient allocation and consumption of energy resources. Careful price alignment with international price changes will help establish a more reasonable relationship between oil prices and oil intensity that is not yet evident in India. In the next section we examine the implications of fuel price reform on domestic inflation and output growth.

## Implications of Fuel Pricing Reform in India

The implications of fuel price reform for inflation and output growth in India are analysed by examining the differential impact of domestic fuel prices on the wholesale price index (WPI) and the index of industrial production (IIP) in two alternative scenarios. These are, one, when domestic fuel prices are allowed a formula-based automatic alignment with international oil prices and two, when as per current policy, the fuel prices have evolved as a consequence of revisions specified periodically by the government. For the former scenario, formula-based automatic adjustment is defined as moving average of the last three month international C&F prices.[20] In the latter case, domestic petrol price structure is taken as the representative domestic fuel prices.[21]

The differential analysis is undertaken in a structural VAR framework with exchange rate, fuel price, money supply, WPI and IIP, that is variables that are representative of the interlinkages between international oil prices and domestic economy. The variables follow an ordering such that the exogenous policy variable is the first variable and target variable the last. Following Sim's methodology all variables included in the VAR framework are in levels.[22] Using the AIC criterion and expected time period for the petrol prices to impact on inflation and IIP, the VAR has been estimated using a lag length of eight periods. The impact analysis is undertaken using innovation accounting, i e, both variance decomposition and impulse response functions (IRFs) are examined. Presented in Figures 10-14 and Tables 10-13 are the results for variance decomposition and IRFs showing the differential impact of a one unit shock to fuel prices on domestic inflation and IIP. For IIP, the simulated time paths are examined for short (12 months), medium and long term (24-36 months and 48 months) considering that the after effects of fuel price increase may occur with a lag initially and then on account of their transmission through several channels and possibilities of substitution and adjustments in the economy the impact may vary in the long run.

The magnitude of response of WPI to a one unit shock in domestic petrol prices is much higher if prices are allowed to automatically and fully adjust to changes in international oil prices. The initiation of increase in both cases, i e, when prices are government regulated and when they are freely responding to international oil price changes, is immediate but in case of the former policy controlled price structure, the impact of a shock is short-lived, up to the fourth month before it starts to revert to its original level. With reform, i e, a three-month rolling average based price adjustment, the impact lasts longer, is sharper and more magnified till it attains a peak around the fifth month after which it undergoes a sharp decline.

The variance decomposition results reveal that the change in WPI is largely on account of its own variation when the regulated domestic fuel price structure is under consideration. The contribution of domestic petrol prices although the most significant among other variables, remains constant at about a fourth of the total variation throughout the 12 month period. On the other hand, when domestic prices are allowed to reflect changes in international oil prices the contribution of the latter to domestic inflation increases to about 39% by the sixth month, after which it declines marginally to about 31% by the end of the 12 month period.

**Figure 10: Inflation (WPI) Adjustment to a Shock in Domestic Petroleum Prices (DPD)**

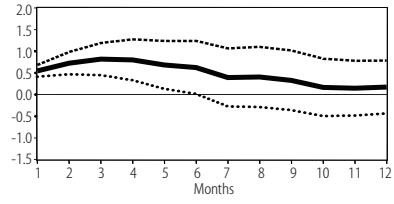



**Figure 11: Inflation (WPI) Adjustment to a Shock in International Oil Prices (BRTAVG)**

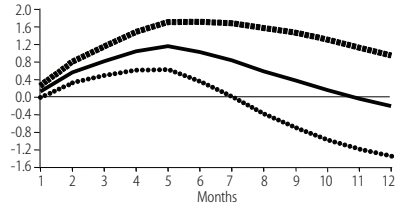


**Table 12: Variance Decomposition of IIP**

| Period | SE | ER | DPD | M3D | WPI | IIP |
|---|---|---|---|---|---|---|
| 1 | 6.769713 | 3.320973 | 1.14433 | 4.0733 | 1.384243 | 90.07716 |
| 2 | 6.925204 | 4.205895 | 1.289514 | 5.555567 | 2.010401 | 86.93862 |
| 3 | 7.779294 | 5.888493 | 2.370198 | 6.697906 | 1.627323 | 83.41608 |
| 4 | 8.544196 | 7.713393 | 2.410763 | 11.47449 | 2.215387 | 76.18596 |
| 5 | 8.75883 | 8.655224 | 2.923802 | 13.06532 | 2.747398 | 72.60826 |
| 6 | 9.053118 | 11.06083 | 3.789647 | 14.6051 | 2.576335 | 67.96809 |
| 7 | 9.535451 | 11.47053 | 6.100037 | 18.12724 | 2.743284 | 61.55891 |
| 8 | 9.607279 | 11.48828 | 6.369498 | 18.73836 | 2.761398 | 60.64246 |
| 9 | 9.730779 | 11.5102 | 7.380344 | 18.43132 | 3.440524 | 59.23761 |
| 10 | 9.906093 | 11.53916 | 8.509371 | 18.34272 | 3.573497 | 58.03525 |
| 11 | 10.11145 | 11.737 | 9.729278 | 18.05869 | 4.380306 | 56.09473 |
| 12 | 10.5254 | 11.12767 | 12.61817 | 16.67363 | 5.455676 | 54.12485 |

DPD: domestic petroleum prices; ER: exchange rate; M3D: money supply; WPI: wholesale price index.

**Table 13: Variance Decomposition of IIP**

| Period | SE | ER | BRTAVG | M3D | WPI | IIP |
|---|---|---|---|---|---|---|
| 1 | 6.998868 | 3.394024 | 2.019901 | 5.317499 | 2.102462 | 87.16611 |
| 2 | 7.271328 | 4.558826 | 2.550771 | 7.679773 | 3.173896 | 82.03673 |
| 3 | 8.278136 | 6.258217 | 2.009303 | 7.974641 | 2.543342 | 81.2145 |
| 4 | 9.273958 | 7.546682 | 2.256271 | 13.58904 | 2.947807 | 73.6602 |
| 5 | 9.53516 | 8.861115 | 2.266936 | 15.46002 | 3.183644 | 70.22828 |
| 6 | 9.769457 | 10.80815 | 2.200053 | 16.78714 | 3.098699 | 67.10596 |
| 7 | 10.13134 | 11.39764 | 2.053355 | 19.6969 | 4.437601 | 62.4145 |
| 8 | 10.17571 | 11.55562 | 2.03629 | 20.0965 | 4.435167 | 61.87642 |
| 9 | 10.27117 | 11.80195 | 2.02204 | 19.91114 | 5.510681 | 60.75418 |
| 10 | 10.35526 | 11.77227 | 2.072692 | 19.94186 | 5.887955 | 60.32522 |
| 11 | 10.45513 | 11.79052 | 2.034302 | 19.7327 | 6.74316 | 59.69931 |
| 12 | 10.67516 | 11.76075 | 1.989045 | 18.97476 | 8.309089 | 58.96635 |

ER: exchange rate; M3D: money supply; WPI: wholesale price index; BRTAVG: three-month rolling average of Brent.

Correspondingly, contribution of own variation of WPI declines consistently from about 98% to about 40% by the end of the 12 month period. Between the sixth and the 12th month, when the contribution of international prices gradually falls, interestingly, the contribution of money supply increases. The latter is apparently a reflection of the countercyclical role that monetary policy can and has been used to play in the Indian economy to counter external factors and curb rising inflation.

The response of IIP to fuel prices when allowed to adjust automatically to international price changes is evident in the form of a negative trend over the short run. The IIP reveals a tendency to enter the negative zone after eight-nine months following an initial marginal correction around the third month. The decline becomes pronounced after the fourth month. The entry into the negative zone is not very sharp possibly as fuel prices contribution to IIP variation is only about 2% as is evident from the variance decomposition results. This is in contrast with the situation when price revisions are regulated by the government. In this case the decline, even though immediate and negative, is spread only over about a month before recovery and stabilisation in the positive zone begins. In the medium and the long run the IIP tends to recover in short spurts only to soon revert back to zero growth. The contribution of international oil price variation to the IIP variance is greater in the long run.[23]

From the above analysis it is clear that fuel prices if left free to adjust automatically to international price variations will impact inflation in a more sustained fashion. The impact of prices aligned with international oil prices in contrast with that of government regulated prices on inflation and output growth not just lasts longer but is also more magnified. In fact, freely adjusting domestic fuel prices may lead the IIP into a negative zone. This is in contrast with the infrequent, delayed and small price revisions undertaken by the government in India. Undoubtedly then this makes the case for price reform in India,

not easy. Additionally, petroleum products have been subsidised for so long that all customers are highly accustomed to low prices and there is likely to be resistance from both the political and social classes. But it should be noted that as price revisions get delayed, when they do occur, they have to be large and therefore would appear steep as single one time revisions as in India's case this year. This holds true, even though, a large but one-off price change is less likely[24] to become embedded into the core rate of inflation, again, as has been evident in the Indian case. A way out has therefore to be found so as to implement price reform with minimum social costs.

**Figure 12: IIP Adjustment to a Shock in Domestic Petroleum Prices (DPD) – Short Run**

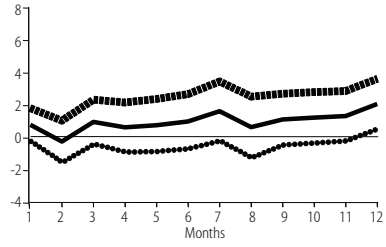
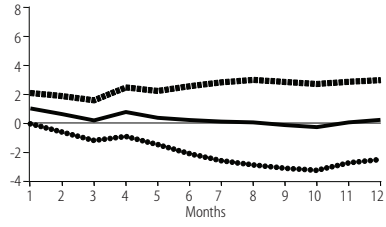
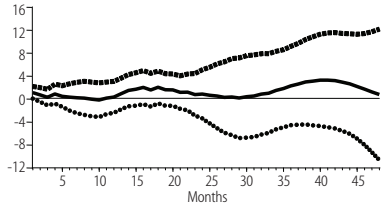



**Figure 13: IIP Adjustment to a Shock in International Oil Prices (BRTAVG) – Short Run**




BRTAVG: three-month rolling average of international crude oil price (Brent).

**Figure 14: IIP Adjustment to a Shock in International Oil Prices (BRTAVG) – Long Run**




BRTAVG: three-month moving average of international crude oil prices.

## Way Forward

A move towards petroleum product price liberalisation may require undertaking suitable initial adjustments in the existing administered fuel price structure so as to bring it in line with international prices. A review of international experience shows that a reform package that includes liberalising domestic petroleum prices and allows for a robust adjustment formula is the first step in this direction. Product sensitivity may define the sequencing of these adjustments. Over time this can evolve into a system that allows domestic prices to automatically adjust to variations in international prices. Simultaneously, social costs of fuel price reform and consequent subsidy reduction can be minimised through a combination of measures like adequate compensation packages for the affected groups and an information campaign to make people realise the benefits of price reform/subsidy reduction.

In introducing a formula-based price-adjustment mechanism as analysed in this paper the frequency of adjustment and the time period over which the reference price is averaged is an important aspect that needs to be carefully considered. In the context of volatile movements in international prices it may be wise to take a moving average of actual prices spread over a reasonably longer period of a few months. However, infrequent price adjustments based on moving averages of several months will lead to a temporary need to finance the difference between actual prices and smoothed recommended prices. Further, they will require that when the adjustments are made they will have to be large to adjust for past several months rise in prices internationally.

The process of revising fuel price structure will also involve some reform of the administrative mechanism. Careful consideration will need to be given to the administrative costs as the process will require close tracking of international prices, collection of data, calculating the averages and passing on the information to retailers. Liberalisation of prices will inevitably also require a move away from public sector control of all activities and allowing entry of private sector and liberalisation in areas like supply, distribution and import. Important in this context would be to establish a regulatory body that would prevent monopolistic activities and anti-competitive behaviour. Given the large number of economic and social considerations it may be appropriate for the government to set up an independent body for undertaking reform of the existing mechanism of fuel price fixation in India.

NOTES

1 The three benchmark prices for oil, i e, the West Texas Intermediate, Brent and Dubai reached record highs around the same time.

2 At a time when consumption of fossil fuels and greenhouse gas emissions and concentrations is being considered a major contributory factor to global warming and climate change, higher oil prices, by leading to reduced oil consumption in the economy, are seen to also have beneficial effects.

3 Data for this available only from 1997-98.

4 Refers to net import bill, as petroleum products are also the single-largest export item from India. In fact it is to be noted that the oil sector is the country's largest foreign exchange earner. Starting from virtually no exports in 1999-2000, the oil sector now accounts for almost 17% of the country's foreign exchange earnings.

5 After partial offsetting by customs collections on oil imports.

6 Dargay, Gately and Huntington (2007) project that vehicle ownership in China and other developing countries will grow much faster than income – up to twice as fast – as their per capita incomes increase through the range of $3,000 to $12,000. This is consistent with the historical experience of all countries.

7 In case of Japan one major reason for slow growth in oil consumption has been the development of fuel saving technology. In South Korea this is attributed to some extent to the economy moving away from heavy industry in contrast with China where the emphasis on heavy industry is far more.

8 As a net importer of oil, the Indian government has introduced policies aimed at increasing domestic oil production and oil exploration activities. As part of this effort, the Ministry of Petroleum and Natural Gas crafted the New Exploration License Policy (NELP) in 2000, which for the first time permits foreign companies to hold 100% equity ownership in oil and natural gas projects. However, to date, only a handful of oil fields are being operated by foreign firms.

9 The composition of Indian crude basket represents average of Oman and Dubai for sour grades and Brent (dated) for sweet grade in the ratio of 59.8:40.2.

10 The trade parity pricing model for diesel and petrol is the weighted average of the import and export parity prices in the ration of 80:20. Trade parity pricing takes into account the emergence of India as an exporter of products like petrol and diesel.

11 In India prices for kerosene are determined on the basis of import parity prices and for petrol and diesel, it is determined on the basis of trade parity pricing model. The import parity price is taken as the international competitive price that sets the ceiling for the domestic price. Notional charges are taken as $2/bbl which includes the free on board price, ocean freight, insurance and exchange rates, custom duties, losses during transit and port charges. The import parity principle, in effect enables the Indian refining companies to import at inflated prices, which bear no relation to the actual cost of production in the country. The notional method of pricing petroleum products overstates the losses of OMCs. It is thus important to distinguish between OMCs losses and under-recoveries. The latter is purely related to the notional price that

## Appendix

**Table A.1: Cointegration**

| Hypothesised No of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| Series: ER DPD M3D WPI | | | | |
| None * | 0.136534 | 48.81507 | 47.85613 | 0.0405 |
| At most 1 | 0.083575 | 23.56527 | 29.79707 | 0.2194 |
| At most 2 | 0.046167 | 8.554002 | 15.49471 | 0.4082 |
| At most 3 | 0.002463 | 0.424079 | 3.841466 | 0.5149 |
| Series: ER DPD M3D WPI IIP | | | | |
| None | 0.330585 | 134.3410 | 88.80380 | 0.0000 |
| At most 1 | 0.129530 | 64.50600 | 63.87610 | 0.0442 |
| At most 2 | 0.105065 | 40.36828 | 42.91525 | 0.0879 |
| At most 3 | 0.080910 | 21.05363 | 25.87211 | 0.1772 |
| At most 4 | 0.035964 | 6.373045 | 12.51798 | 0.4145 |
| Series: ER BRTAVG M3D WPI | | | | |
| None * | 0.260223 | 94.94401 | 54.07904 | 0.0000 |
| At most 1 * | 0.163320 | 43.10210 | 35.19275 | 0.0057 |
| At most 2 | 0.054489 | 12.43219 | 20.26184 | 0.4109 |
| At most 3 | 0.016119 | 2.795089 | 9.164546 | 0.6197 |
| Series: ER BRTAVG M3D WPI IIP | | | | |
| None * | 0.269301 | 119.4234 | 69.81889 | 0.0000 |
| At most 1 * | 0.248449 | 66.08517 | 47.85613 | 0.0004 |
| At most 2 | 0.063747 | 17.53051 | 29.79707 | 0.6008 |
| At most 3 | 0.033942 | 6.332672 | 15.49471 | 0.6562 |
| At most 4 | 0.002716 | 0.462392 | 3.841466 | 0.4965 |

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level.
** MacKinnon-Haug-Michelis (1999) p-values.

**Table A.2: Variance Decomposition of IIP**

| Period | SE | ER | BRTAVG | M3D | WPI |
|---|---|---|---|---|---|
| 1 | 6.998868 | 3.394024 | 2.019901 | 5.317499 | 2.102462 |
| 2 | 7.271328 | 4.558826 | 2.550771 | 7.679773 | 3.173896 |
| 3 | 8.278136 | 6.258217 | 2.009303 | 7.974641 | 2.543342 |
| 4 | 9.273958 | 7.546682 | 2.256271 | 13.58904 | 2.947807 |
| 5 | 9.53516 | 8.861115 | 2.266936 | 15.46002 | 3.183644 |
| 6 | 9.769457 | 10.80815 | 2.200053 | 16.78714 | 3.098699 |
| 7 | 10.13134 | 11.39764 | 2.053355 | 19.6969 | 4.437601 |
| 8 | 10.17571 | 11.55562 | 2.03629 | 20.0965 | 4.435167 |
| 9 | 10.27117 | 11.80195 | 2.02204 | 19.91114 | 5.510681 |
| 10 | 10.35526 | 11.77227 | 2.072692 | 19.94186 | 5.887955 |
| 11 | 10.45513 | 11.79052 | 2.034302 | 19.7327 | 6.74316 |
| 12 | 10.67516 | 11.76075 | 1.989045 | 18.97476 | 8.309089 |
| 13 | 11.11992 | 12.51535 | 2.363175 | 18.57554 | 7.828032 |
| 14 | 11.42158 | 12.49965 | 3.678636 | 17.68382 | 8.061403 |
| 15 | 11.98106 | 12.6225 | 5.106651 | 16.46017 | 8.691618 |
| 16 | 12.4758 | 12.57834 | 7.036647 | 16.72169 | 9.003974 |
| 17 | 13.0114 | 12.90063 | 7.714335 | 17.08433 | 9.854886 |
| 18 | 13.49369 | 12.58618 | 9.213115 | 16.79674 | 10.94289 |
| 19 | 13.96519 | 13.05969 | 9.748294 | 17.33397 | 11.28671 |
| 20 | 14.36241 | 13.40217 | 10.25219 | 17.52806 | 11.39647 |
| 21 | 14.82301 | 14.06996 | 10.12088 | 17.68881 | 11.75248 |
| 22 | 15.24458 | 14.68577 | 10.06391 | 17.87108 | 11.94603 |
| 23 | 15.73845 | 15.76059 | 9.612044 | 18.3395 | 11.85371 |
| 24 | 16.19131 | 16.29437 | 9.288523 | 18.14569 | 12.07614 |
| 25 | 16.64367 | 17.07213 | 8.890185 | 17.96157 | 12.09172 |
| 26 | 17.06473 | 17.71878 | 8.511369 | 17.79319 | 12.28994 |
| 27 | 17.51124 | 18.19183 | 8.091855 | 17.57029 | 12.6326 |
| 28 | 17.87503 | 18.31708 | 7.782652 | 17.18807 | 13.39454 |
| 29 | 18.23816 | 18.52066 | 7.476614 | 16.83039 | 14.0865 |
| 30 | 18.56636 | 18.40273 | 7.23817 | 16.39853 | 14.99335 |
| 31 | 18.88228 | 18.16042 | 7.042686 | 15.89582 | 16.06672 |
| 32 | 19.19772 | 17.78743 | 6.954443 | 15.39325 | 17.29858 |
| 33 | 19.5396 | 17.35356 | 6.917894 | 14.89244 | 18.58009 |
| 34 | 19.92715 | 16.73991 | 7.129988 | 14.32156 | 20.06708 |
| 35 | 20.34685 | 16.10643 | 7.542296 | 13.74161 | 21.46266 |
| 36 | 20.81672 | 15.41853 | 8.291239 | 13.14642 | 22.68715 |
| 37 | 21.332 | 14.71187 | 9.243842 | 12.54851 | 23.7685 |
| 38 | 21.90516 | 13.97973 | 10.46016 | 11.95135 | 24.77982 |
| 39 | 22.49654 | 13.32178 | 11.68865 | 11.49032 | 25.52075 |
| 40 | 23.1181 | 12.69359 | 12.94321 | 11.10073 | 26.13007 |
| 41 | 23.73871 | 12.16412 | 14.04994 | 10.7999 | 26.58234 |
| 42 | 24.34741 | 11.75297 | 14.96767 | 10.64776 | 26.87123 |
| 43 | 24.9271 | 11.4854 | 15.54877 | 10.6323 | 27.05507 |
| 44 | 25.47693 | 11.30806 | 15.85982 | 10.65493 | 27.26515 |
| 45 | 25.9817 | 11.27064 | 15.87844 | 10.75427 | 27.43514 |
| 46 | 26.44406 | 11.3107 | 15.6945 | 10.87007 | 27.60867 |
| 47 | 26.85885 | 11.38515 | 15.3827 | 10.91583 | 27.83841 |
| 48 | 27.22892 | 11.45627 | 15.02596 | 10.8908 | 28.14535 |

the companies would charge if they were free to do so.

12 There are three duties/taxes collected by the government on the sale of petroleum products-sales tax that goes to the state government and excise and custom duty go into the kitty of the central government.

13 Author's calculations based on the differential between an aggregate of OMC cost component and retail prices after taxes that determine the actual per litre sales revenue for the OMCs. The under recovery in this case is not based on the notional formula within the import substitution framework as used by the OMCs but on the fact that in reality the over-whelming bulk of the refined product sold by OMCs is refined imported and domestic crude (3:1).

14 After compensation through government bonds and from upstream companies the estimated net under recovery to be borne by the OMCs though, may have been a smaller amount. As of April 2008. Since May 2008 the compensation through government bonds has increased to 50%.

15 Correlations have also been estimated using the CPI, the results show no variations.

16 Interestingly, changes in all international petroleum product prices are highly correlated.

17 Measured as barrels of oil consumed per day per annual GDP.

18 Data with annual frequency and hence the longer reference period for estimation.

19 At 1% level of significance.

20 Cross country experience has shown that the most effective smoothing rules are short moving average (three month/six month) rule.

21 Given that petrol is the most important of all the petroleum products in terms of its possible impact on inflation and IIP.

22 Levels are used to retain maximum information and proximity to the actual relationship among the variables. This is justified on the basis of the presence of more than one cointegrating relationship between these variables. For cointegration results please refer to Appendix Table A.1.

23 Variance decomposition for IIP over the medium and long run is presented in Appendix Table A.2.

24 Relative to a full pass-through which when reflected in the inflation rate has greater possibility of getting embedded in the core rate of inflation and people's expectations.

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