

The logo for The Energy and Resources Institute (TERI), featuring the word "teri" in a stylized, lowercase, red font.The logo for the Norwegian Embassy, featuring a blue square with a white lion rampant, and the text "NORWEGIAN EMBASSY" below it.

Global Oil Markets and India's Vulnerability to Oil Shocks

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Abstract

This paper examines the trends and patterns in oil shocks and India's vulnerability to shocks in supply and prices at the national and international and national levels. First examining the definitions and international experiences of crude oil volatility, a qualitative approach is taken to examine the impact of volatility on major indicators. This paper takes a broad definition of volatility looking at demand, supply and speculation. In addition, a manifestation of the country's dependence on oil and its reflection through different economic and physical indicators such as share of oil in the energy basket, importance of crude oil and petroleum products in the trade balance and the patterns of trade in the recent years is also examined to understand the extent of vulnerability to shocks. It has been found that the vulnerability to these is expected to rise in the future as dependence on imported oil is projected to rise. Finally, based on international experience, measures to mitigate this vulnerability have been recommended.

Introduction

Global energy scenario

The global energy landscape is currently undergoing significant changes as alternative hydrocarbon sources are evolving as major contributors to the energy basket. Simultaneously, an impetus to increase the share of renewable energy sources (particularly in Europe) to address climate concerns is also contributing to an increase in the share of these low carbon source in the overall energy mix. Based on the data from the International Energy Agency (IEA), oil production is expected to rise to 98 million barrels per day (mbpd) by 2035. Most of this increase is projected to be in the production of natural gas liquids and unconventional oil. The production of coal is also expected to increase in this period and reach 6300 million tonnes of coal equivalent (mtce). The largest increase is, however, expected to be in the production of natural gas which will register a growth of 47% and reach 5 trillion cubic metres (tcm), largely on account of growing unconventional natural gas production in North America (USA and Canada)

Energy scenario in India

The demand for energy in India, in tandem with the economic growth and the resulting prosperity of the country has increased substantially in the recent years, particularly in the past decade. In the coming years, even as the growth rates moderate in the short to medium term, the growth of energy demand is projected to continue. In such a scenario, it is essential to meet the demand for all energy sources not only to meet the growth objectives but also to sustain the growth achieved till date. Primary energy consumed in the country has increased more than four times in the period from 1971 to 2009 (Figure 1).

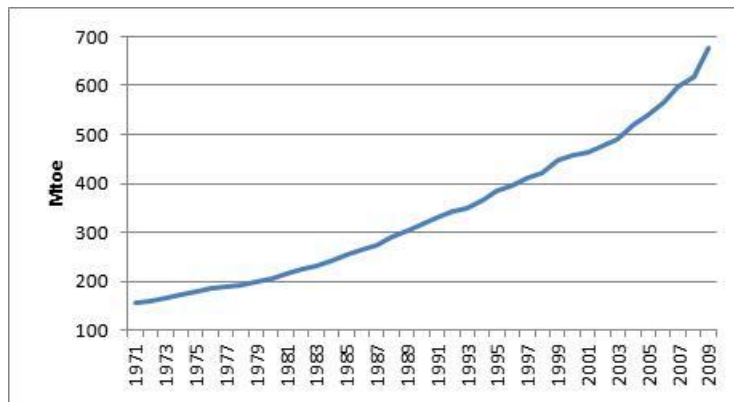


Figure 1 Total primary energy supply in India (in Million tonnes of oil equivalent)

Source: UNESCAP

India's oil consumption

Crude oil forms a significant proportion of the country's energy basket, next only to coal (Figure 2). The consumption of crude oil in India has increased from 12.6 million tonnes of oil equivalent (mtoe) in 1965 to 162.3 mtoe in 2011 reflecting an increase of more than 10 times. In terms of share in the total energy basket however, crude oil consumption has remained fairly constant, always remaining in the range of 28% to 36% (1971-2011). The growing demand for crude oil is increasingly being met through higher imports. Figure 3 presents the share of crude oil imports in the total refinery throughput for the past few years.

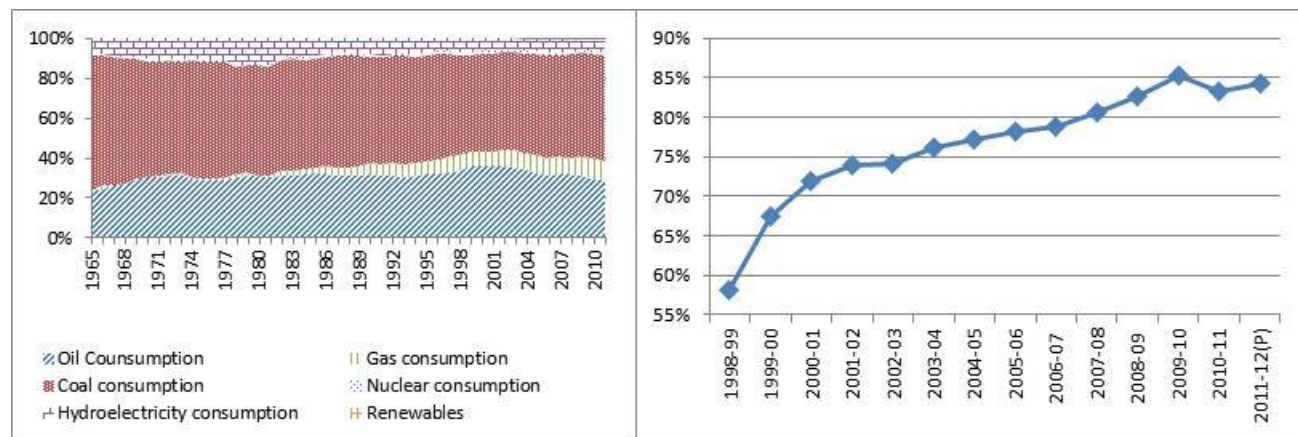


Figure 2 Share of fuel sources in primary energy consumption

Source: BP (2012)

Figure 3 Share of crude oil imports in refinery throughput

Source: PPAC, P: Provisional

This rising dependence on petroleum products and the growing share of imports in the domestic oil consumption subjects the domestic economy to the volatility in international markets thereby creating a need to examine in detail the relation between oil shocks and macroeconomic parameters. Despite the dependence on crude oil, domestic production has remained low and has, in fact, stagnated in the recent years. This has led to a rise in dependence on imports of crude oil to meet the domestic demand. This paper aims to examine the changing patterns of volatility in crude oil supply and India's resilience to respond to any fluctuations in the availability of crude oil in the domestic and international markets. The following sections describe the international experience of volatility in supply, the explanation for the persistent volatility and the options that can be used to manage the volatility in oil supplies.

International experience of volatility in crude oil supply

There have been periods of significant changes in oil supply where the quantity of oil available in international markets varied significantly due to prevailing circumstances in oil producing countries. The major oil price shocks that have occurred are summarized in Table 1 along with their start and end dates and the estimated crude oil supply loss for each period.

Table 1 Crude oil shocks

Start		End			Crude oil Supply Loss (mbpd)*
Month	Year	Month	Year		
November	1956	March	1957	Suez Crisis	2
June	1957	August	1957	Six day war	2
October	1973	March	1974	Arab Israel War and Arab Oil embargo	4.3
November	1978	April	1979	Iranian Revolution	5.6
October	1980	January	1981	Iran-Iraq War	4.1
August	1990	January	1991	Iraqi invasion of Kuwait	4.2
June	2001	July	2001	Iraqi Oil export suspension	2.1
December	2002	March	2003	Venezuelan Strike	2.6
March	2003	December	2003	Iraq War	2.3
September	2005			Hurricane Katrina	1.5
July	2011			Libya Collective Action	1.6

Source: IEA (2012)

*mbpd: million barrels per day

The Iranian revolution of 1956 and the Arab oil embargo (1974) have caused the largest supply shocks/shortages in the global crude oil markets. Figure 4 presents the trend in crude oil prices for the past six decades. A significant change in the prices of crude oil took place only after the first oil shock in the 1970s.

The oil shocks over time have been driven by different reasons and characteristics that destabilised the international oil markets in the course of the past four decades. The shock of early 1970s was due to the embargo imposed by Arab countries and the eventual formation of OPEC in 1973. The formation of this oligopoly like structure in the oil markets led to the group maintaining control over the marginal production of crude oil to eventually controlling the prices. Thereafter, in 1979, price increase was a result of the Iranian revolution and the Iran-Iraq war. In fact, the increase in prices during this period saw the largest absolute increase in real prices in the post OPEC times. The prices increase from US\$14/bbl in 1979 to over US\$31/bbl in 1980 and further to nearly US\$37/bbl in 1981, registering a real price increase of over US\$50/bbl (in 2011 prices) (BP, 2012). A decade later, the Iraqi invasion of Kuwait also led to another supply shock that lasted nearly six months from August 1990 to early 1991. After yet another ten years, in June 2001, responding to the sanctions from West, Iraq suspended its exports of crude oil and the UN initiated oil-for-food humanitarian programme. Thereafter, in 2003, in a strike by the workers of the Venezuela National Oil Company, Petroleos de Venezuela, SA (PDVSA) the exports from the country stopped and left a major gap in the imports of USA which had to be substituted by supplies from other, more distant sources (such as countries in the Middle East) leading to a disruption in the supplies over the short term.

The loss in supply due to these shocks has notably reduced over time and in nearly a decade, the more evident losses have primarily been due to physical disruptions of supply and not due to political situations and market control of oil producers. However, one could also argue that the integration of oil markets and increased fungibility of crude oil as an internationally traded commodity also implies that physical shortages get replaced by supplies from alternate sources fairly quickly but their impact is manifested in the form of price spikes.¹

As can be expected, periods of supply shocks (identified in Table 1) also correspond with spikes in international oil prices. However, there are other periods (such as 1987, 1996, 2011) where the prices of oil increased but not due to supply shocks. However, these were very small changes where prices increased by

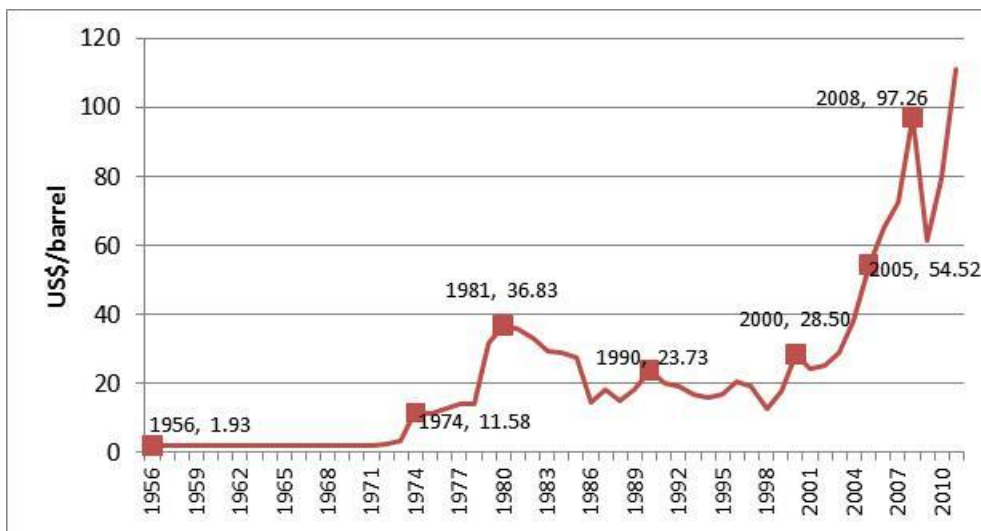


Figure 4 Trends in international crude oil prices

Source: (BP, 2012)

Volatility in petroleum prices and its impact on the macro economy has been well researched and documented. In the following sections, we analyze the reasons for, and the nature of changes in oil prices, the impact of and vulnerability to oil price shocks/changes and patterns of volatility over time.

Examining oil volatility

In examining oil volatility, attention needs to be paid to several aspects including the changing patterns of vulnerability to oil shocks, overall impacts of oil volatility and most importantly, the causes of oil volatility. Volatility itself can be defined as volatility due to supply shocks, demand shocks or price shocks due to rise in precautionary demand. Oil shocks in the past have all

¹ For instance, see (Billig, 2004)

impacted key macroeconomic parameters. In fact, these are widely believed to have led to macroeconomic downturns. In his analysis of the impact of oil price shocks on the US, Hamilton (1983)² has found that economic downturns in USA were preceded by oil shocks (Hamilton J. D., 1983) (Hamilton J. , 2000). Oil price shocks affect several macroeconomic parameters such as GDP, interest rates, investment, unemployment and exchange rates (Rafiq, Salim, & Bloch, 2009).

Changing patterns of vulnerability to oil shocks

In a survey of existing literature on developed economies, Schubert and Turnovsky (2011) have concluded that vulnerability of these economies to oil shocks in real economic terms has declined in the recent years. The authors attribute this decline to a reduction in the oil intensity of the GDP (Schubert & Turnovsky, 2011). For a small developing oil importing economy on the other hand, using a neo-classical model based on three parameters - degree of oil dependence of the economy, degree of flexibility of production (measured by the elasticity of substitution) and the degree of access to world financial markets, the authors have found that in the short term, macroeconomic variables such as capital, GDP, debt, interest etc. are impacted adversely. However, in the medium to long term some of these variables return to their pre-shock trajectory/levels. This is primarily due to the use of a tradition neo-classical model in the analysis. While noting that no two oil prices are similar, Killian (2006) states that the shocks after the mid-1970s have been on account of increased economic activity reflected in high global aggregate demand and /or demand for oil.

Bacon and Kojima (2008), conduct a decomposition analysis of the change in vulnerability of countries to oil price shocks (Bacon & Kojima, 2008b). The authors have disaggregated the total change in vulnerability into production and consumption effects. They find that vulnerability to oil prices varies widely across the sample of countries examined. They also find that supply factors had a major role to play in determining the pattern of volatility in the period around 2006. This is owing to the declining production from many of the large producing countries. In his analysis of different periods of oil price shocks using parameters of real economic activity, Killian (2008) mentions that a change in the precautionary demand or actual economic activity has a sustained impact on prices of oil while a change in production only has a transitory impact on real prices.

Explaining the volatility in oil prices

Volatility in crude oil prices is driven primarily by three factors – demand side push, supply side pull and the impact of speculation. As in any other market, demand and supply form the most important determinants of crude oil prices. Archanskaia, Creel, & Hubert (2011) have found that until the end of 1980s, oil price shocks were primarily supply driven, thereby implying that these had an impact on the global economic activity. However, oil price shocks after this period have

²Available at <http://digidownload.libero.it/rocco.mosconi/Hamilton1983.pdf>

mostly been demand driven, the most recent one among them being the spike in prices following the economic crisis of 2008. In an attempt to find an explanation for the spike, Hamilton (2008) examines the theoretical explanations for changes in oil prices. He concludes that variables including supply side factors such as the role of OPEC, time required for oilfields to commence production (lead times), depleting oil reserves; and demand side factors - price elasticity of demand and income elasticity are all responsible for changes in oil prices. We examine the key factors in detail in the following sub-sections.

Global reserves and production

Although a large number of countries are dependent on crude oil for meeting their energy demand, the reserves and production of crude oil is concentrated in some regions. Members of the Organization of Petroleum Exporting Countries (OPEC)³ together have the largest share in world petroleum production and in the total proven reserves. Possessing nearly 72% of the world oil reserves, these countries contributed 42% of the global oil production in 2011 (BP, 2012). Reserves held by the OECD member nations, on the other hand, form a little over 14% of the global reserves.

The share of oil producing companies has also undergone in the past few decades as the large multinational corporations that were major drivers of oil market have now been replaced by state owned oil companies of large oil producing countries (most of which are members of the OPEC) (Smith, 2009).

Several of the major oil producing and exporting are politically high-risk countries of West Asia, and this adds to global energy vulnerabilities. Political tensions in these regions can affect the supply of oil to global markets, a fact that has been observed in most disruptions reported in Table 1. The most recent disruption happened in 2011-12 during the Arab awakening when oil production in Libya reduced substantially subsequently leading the IEA member countries to release stocks from their strategic oil stockpiles. Even more recently in early 2012, the imposition of a trade embargo by the European Union and USA on Iran led to persisting tensions over the blocking of the Strait of Hormuz is forms a significant global chokepoint for crude oil trade. In 2011, nearly 35% of all seaborne crude oil passed through the strait (EIA, 2012).⁴

A related factor that affects the availability and prices of crude oil is the presence of spare capacity in the large producing countries. The OPEC countries hold spare capacity for production of crude oil that is generally available to meet short terms disruptions and this can contribute towards meeting short-term volatility. The level of spare production capacity of the OPEC countries has fluctuated in the past years from as high as 5.4 mbpd in 2002 to a low of 1

³ OPEC comprises of Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates in the Middle East; Algeria and Libya in North Africa; Angola and Nigeria in West Africa and Ecuador, Venezuela in South America.

⁴ Other such chokepoints are the Strait of Malacca, Suez Canal, SUMED pipeline, the Bab el_Mandab and the Turkish and Danish Straits. However, for India, the Strait of Hormuz is the most critical sea trade route.

mbpd in 2005 and then rising again to reach nearly 4 mbpd in 2010 (EIA, 2013). This available spare capacity is also used in managing and maintaining overall supply in the international markets. While the issue of supply management by the OPEC member countries has been analysed and widely debated, citing cases of cheating by the members in the cartel, (Killian, 2006) attributes changes in prices primarily to market forces.⁵

Another issue that determines the level and trend in production of crude oil is the peaking of production from conventional sources and the declining reserves of oil. Peak oil is the point in time when global petroleum production will reach a maximum, thereafter entering a phase of terminal decline. Beginning from as early as 2020, estimates of a timeline vary across different studies.⁶ The trend is evident across localized oil production centres. United States, which was the largest producer of crude oil in the 1950s reached its peak level of oil production in 1971. Simultaneously, production from the North Sea region is also declining (Kesicki, 2010).

However, this *peak oil* theory is increasingly being challenged by the rising production of unconventional oil. As per latest available projections from different sources, availability of unconventional oil (which is technologically more difficult to access and more expensive to extract) forms such as Canadian tar sands, ultra heavy oil from the Orinoco Belt of Venezuela, pre-salt formations in deep offshore fields from Brazil and also the shale oil and tight oil from North America will add to the global crude oil availability. In fact, the total crude oil production could increase to as much as 110.6 mbpd in 2020 from 93 mbpd reported in 2011 (Maugeri, 2012).

Whether or not the production and availability of crude oil will peak therefore remains to be seen. However, even with these new sources of oil being available, the costs of crude oil is expected to remain high. Oil found in these new/unconventional sources is likely to be more expensive to extract given the high cost of the associated extraction technology. This will certainly affect the global prices and may even bring an end to the era of '*cheap oil*'. In fact, the prevailing high prices may have had a role to play in making the exploration and production of unconventional oil viable. Another outcome of the increased availability of unconventional oil is also its geo-strategic implications. The new sources of oil are located in North and Latin America. As supplies from these sources gain major shares of global oil supplies, it is also likely to have implications for the traditional oil producing countries and their positions in the global political and energy map.

⁵ See Killian(2006), pg 4

⁶ The peak oil theory was proposed by MK Hubbert in 1949 who suggested that the oil production for any region follows a bell-shaped curve wherein the production from the fields first grows at an exponential rate to reach a peak and then starts declining. Hubbert, in 1956 accurately predicted that the oil production from the United States would peak around 1970.

Global demand

The rising demand for crude oil particularly from the emerging countries is one of the most significant sources of changing trade patterns in global crude oil markets. The consumption of crude oil in China has more than doubled in the past decade, growing from 228 mt in 2001 to more than 483 mt in 2012. The country now has a share of over 11% in the global crude oil consumption. Over the same period, the consumption of crude oil in India has increased from 107 mt to 171 mt currently, representing more than 4% of the global oil consumption. In the OECD countries, USA continues to be the largest consumer of crude oil (19.8% of total consumption) followed by Japan (5.3%). Sudden changes in the demand from any major global energy consumers affect the availability of oil for the rest of the world and consequently the international prices of crude oil. The shutdown of nuclear power generation capacity in Japan, for instance, was followed by an increase in the demand for both crude oil and natural gas. While the power demand is being met largely from high cost LNG imports by the country, there has also been an increase in the total crude oil consumption in the country (Figure 4).

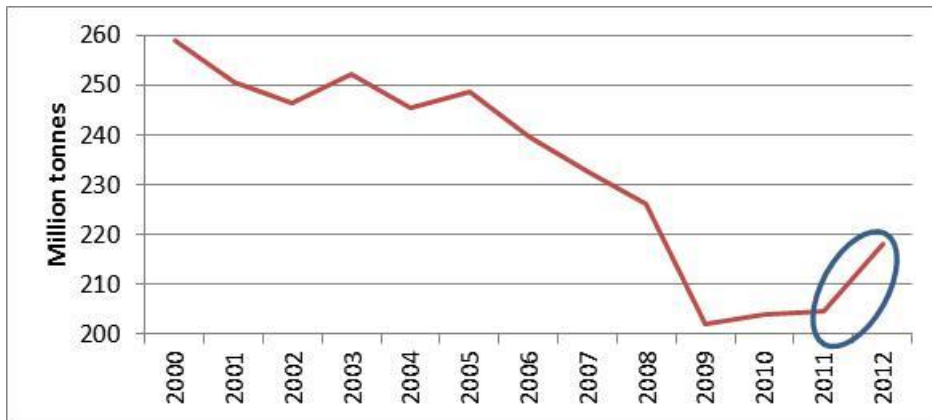


Figure 5 Crude oil consumption in Japan
Source: BP (2013)

Apart from the increase in demand from Japan, there has been another development across the Pacific. As was highlighted in the Introduction, there has been an increase in the production of gas in the US. This increased availability of energy in the country is also likely to affect the demand for other energy sources in the country. Gas is already competing with and even replacing coal in the power generation sector. Additionally, this newly available gas would also find increased usage in the industry and transport sectors. As these changes take place, the demand for crude oil from the US, the largest consumer of imported crude oil, will stabilize thereby positively affecting the availability of oil for the rest of the world.

Speculation and impact of derivative markets

A considerable body of literature also exists on examining the impact of speculation on the prices of crude oil. Crude oil is a widely traded commodity and derivative markets for crude oil are extremely large in size and value. Speculative trade markets also encapsulate the notion of

precautionary demand for oil where *futures* trading is used as a measure to reduce the impact of price volatility in the future. The rising number of financial institutions participating in the oil trade market has affected the size and movements in global oil trading. The *financialisation* of oil markets has also led some to conclude that the rising volatility in oil markets is a result of speculative trading.

In academic literature, however, there appears to be an ongoing debate on whether and to what extent does the speculation drive oil prices. In a survey of literature, Fattouh, Kilian, & Mahadeva, (2012) find evidence for an increased correlation between the various commodity markets. However, in their own analysis, the authors conclude that this is not sufficient to attribute the spike in oil prices after 2003 to speculative players alone. Vansteenkiste (2011) finds that volatility in crude oil prices since 2004 has reflected a ‘chartist’ regime, implying the role of speculative players in the oil trading market. On the other hand, Aquist & Kilian (2008) find that futures markets do not help in predicting the spot market prices, thereby questioning the impact of speculation on the real oil trade. Irwin & Sanders (2012) also do not find support for the Masters Hypothesis⁷. While examining the impacts of different determinants on volatility of oil prices, Kesicki (2010) finds that speculation has played only a limited role in affecting oil prices in the oil price surge of 2008.

All in all, the general academic discourse supports that oil shocks continue to be driven by the demand supply fundamentals and although speculative trade and financialisation do play an important role in the markets these are not major determinants of the prevailing volatility in international markets. Other factors that impact prices of crude oil include demand and supply, refining capacities, geopolitics and exchange rate and inflation. Overall macroeconomic uncertainty also determines the volatility of crude oil prices by affecting the elasticity of demand and supply (Van Robays, 2012).

The Indian Scenario

As mentioned previously, the Indian economy is highly dependent on imports to meet its domestic crude oil requirement. Any fluctuation in the global markets, therefore, has a disproportionate impact on the major macroeconomic indicators representing the economy’s performance. This is supported by findings from existing academic literature too. Bhanumurthy, Das, & Bose (2012) have summarized the literature available on the impact of oil price shocks on the Indian economy. Most papers have found that oil price shocks have a positive impact on domestic inflation, and negatively affect the industrial production and economic growth levels. Gupta (2008) computes the oil vulnerability index (OVI) of a cross section of 26 countries using various indicators. These include ratio of oil imports to GDP, oil consumption per unit of GDP, GDP per capita, share of oil in total energy, domestic reserves to consumption ratio, exposure to

⁷ Masters Hypothesis refers to the claim made by Michael Masters that investments in commodity indexed funds was the cause of commodity price spikes in 2007-08

geo-political risks and market liquidity. India is found to be one of the most vulnerable countries. In their decomposition analysis Bacon and Kojima (2008b) have also found that between 1996 and 2006, India's vulnerability to oil prices has increased from 1.8 in 1996 to 2.6 in 2001 and further to 4.4 in 2006. This is driven by a combination of factors including rising in oil prices, rise in the share of oil imports and change in exchange rates. Battacharya and Batra (2009), for example, have analysed the relation between international prices of petroleum and the impact on variables such as exchange rate, money supply, Index of Industrial Production and Wholesale Price Index under a situation when changes in international prices are allowed to pass through to domestic petroleum product prices. Bhanumurthy, Das, & Bose (2012) also use a macroeconomic model to examine the impact of oil price shocks on macroeconomic variables in the 12th Five Year Plan period (2012-17) in cases of complete and partial pass through. The authors find that deregulation of oil prices will have an impact on the growth trajectory of the economy as also on other macroeconomic indicators such as inflation, current account deficit and government revenue.

In this section of the paper, we first examine the factors that determine the vulnerability to oil shocks in India. This is followed by a discussion on the actual impacts noted in the past and finally, some options for managing the vulnerability.

Factors that determine vulnerability to shocks in India

Vulnerability to oil supply and price shocks is dependent on the oil intensity of energy consumption, oil intensity of the GDP, domestic production of crude oil and also the oil import dependence of the country.⁸ Another issue that affects the vulnerability to shocks is the availability on oil in the international oil markets. We analyse each of these factors and discuss the likely trajectory of each factor for the near to mid-term future.

Domestic oil production and proportion of dependence on imports

As discussed earlier, the country's dependence on imports to meet the domestic crude oil requirements has increased markedly. This increased dependence on foreign countries also exposes the country to geopolitical uncertainties and the volatility in the international oil markets. More than two-thirds of the total crude oil imported by India originates in the Middle East and more than 80% imports are from OPEC countries (Table 2 and Figure 6). This implies that a significant proportion of India's crude oil supplies pass through the geopolitical bottleneck – the Straits of Hormuz.

⁸ Schubert and Turnovsky (2011)

Table 2 Sources of crude oil imports

	2007-08	2008-09	2009-10	2010-11	2011-12
Middle East	92.94	94.96	103.72	104.98	118.64
Africa	21.49	21.23	32.94	35.58	31.13
Asia	4.63	4.90	3.95	3.27	3.44
South America	1.43	7.63	12.09	15.06	14.54
Eurasia	2.47	1.81	3.98	1.54	1.04
North America	0.41	-	0.22	0.2	0.02
Australia	0.17	0.09	0.36	1.69	0.65
Total	123.54	130.62	157.26	162.32	169.46

All figures are in Mt
Source: Lok Sabha (2013)

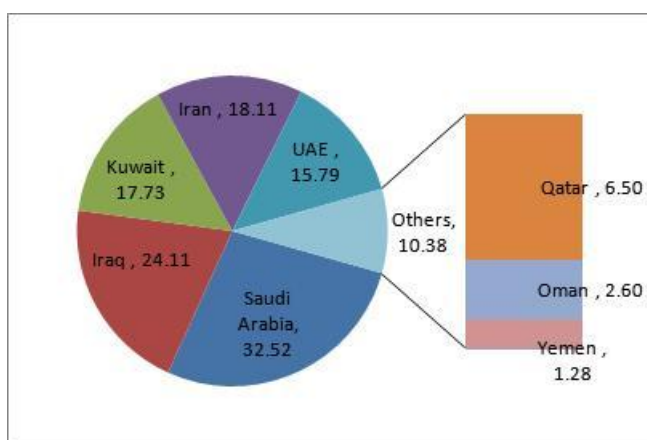


Figure 6 Country-wise imports from Middle East (in Mt), 2011-12
Source: Lok Sabha (2013)

The dependence on imports is projected to increase further and is expected to rise to exceed 90% by 2031/32. As per TERI projections, the total oil consumption will rise to 392 million tonnes of oil equivalent (mtoe) in 2021/22 and further to 836 mtoe in 2031/32 in the reference scenario. In an alternative scenario⁹, the consumption will increase to 223 mtoe in 2021/22 and further to 457 mtoe in 2031/32 (TERI, 2009a). The rising dependence will also impact the requirement of foreign exchange, and will therefore affect the current account balance of the country.

Table 3 presents the requirements of foreign exchange in the two years under different scenarios of crude oil prices. As can be noted, the growing demand for foreign exchange is projected to impose a significant burden on the trade balance. In order to put these statistics into perspective, the expenditure on importing oil in 2010-11 was in excess of USD 100 billion and in 2011-12 the

⁹ The alternative scenario referred here is the sustainable scenario where the efforts are made to increase energy efficiency and push for an increase in renewable energy (TERI, 2009a)

expenditure had already exceeded USD 139 billion. This is primarily due to the increase in international crude oil prices in the recent years.

Table 3 Foreign exchange requirement under different scenarios (in USD billion)

	2021/22		2031/32	
	Reference	Alternative	Reference	Alternative
at USD 100/bbl	131.23	106.84	304.29	278.63
at USD 125/bbl	164.04	133.55	380.36	348.29
at USD 150/bbl	196.85	160.27	456.44	417.95

Source: Author's calculations based on demand projections in (TERI, 2009a)

The high dependence on imports is due to low domestic production and relatively low estimated reserves. The total oil reserves in India have declined from 770 MT in 2007-08 to 757 MT in 2010-11. The production has, however, increased from 34 MT to 37.71 MT in the same period, thereby giving an R/P ratio of 20 years. On the other hand, the world reserves have increased, particularly on account of reserve accretion in OPEC countries.

Energy intensity and oil intensity of the economy

Energy intensity of the GDP is computed as the ratio of total energy consumed to the country's GDP. While the aggregate primary energy supply in the country has increased, the energy intensity of the economy, represented as the ratio of primary energy per 1000 dollars of GDP¹⁰ has reduced over time (Figure 7). Energy intensity of GDP is determined by the share of different sectors in the economy, level of industrialization, efficiency of energy consumption and lifestyle patterns in general. Therefore, one major factor that determines the total demand for energy is the share of industry in the total output. This share has remained constant within the range of 19 and 21% but has been declining in past half decade. Other factors that have affected the trend of energy intensity are the low level of vehicle ownership and the high costs of energy for industry (Prayas, 2009). However, this declining trend also reflects that the pace of growth in energy consumption has been slower than the country's economic growth.

¹⁰ Measured at 2005 PPP levels

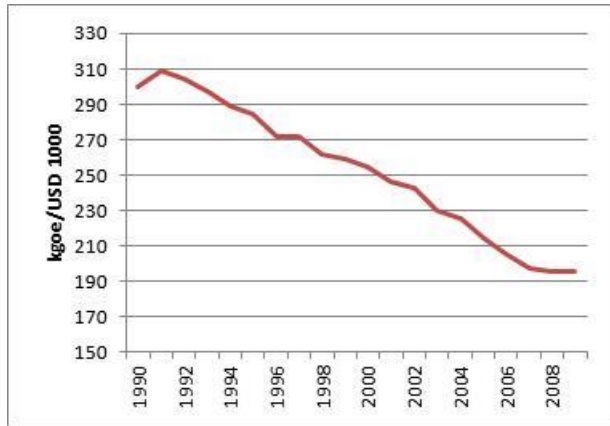


Figure 7 Energy Intensity of GDP

Source: UNESCAP

To determine the impact of oil shocks on the economy it is also essential to examine the share of oil in the total energy basket. Figure 8 presents the oil intensity of the commercial energy basket in the past two decades and the comparative numbers for China, the Asia Pacific region as also the global oil dependence.

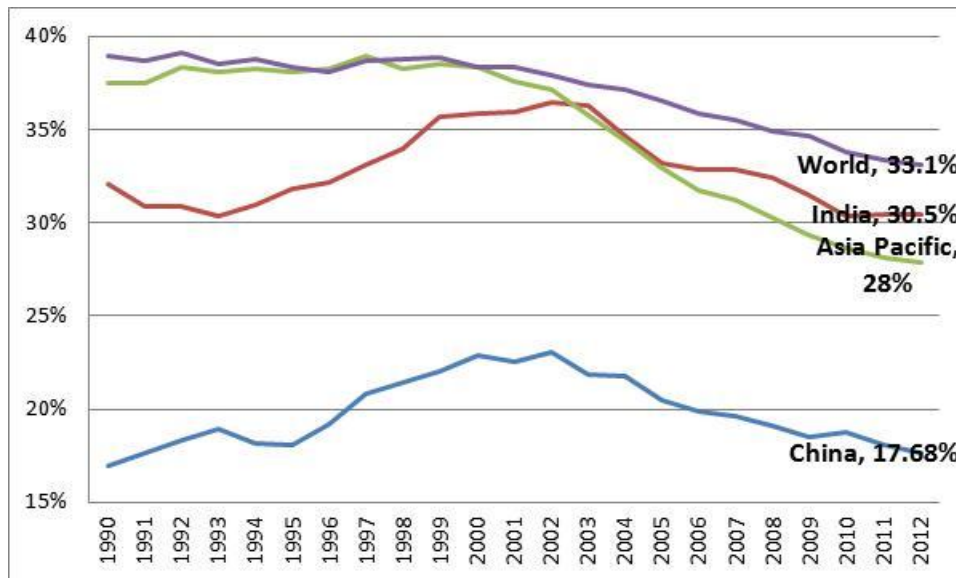


Figure 8 Share of oil in total primary energy consumed (in %)

Source: (BP, 2012)¹¹

As can be noted, the share of oil has largely remained between 25% and 35%. It has always been below the world average but is more than that in the Asia Pacific region. The smaller share of oil

¹¹ These figures could be different from those reported in the government data but due to lack of comparable historical data and the absence of conversion to a single unit, data from (BP, 2012) has been used.

in the energy basket in China is primarily due to the predominance of coal in the country's energy basket which forms nearly 70% of the total energy consumed in the country.¹² Specifically, in the periods of oil shocks in the past, the intensity was high in 1973 during the Arab oil embargo and in 2001 and 2003 during the suspension of exports from Iraq and the Iraq war, respectively. Dependence on oil in India (29% in 2011) is close to the world average (33%) (BP, 2012).

As policy moves towards introducing measures to enhance energy efficiency, the energy intensity is expected to decline further to meet the targets set for different sectors under various policies. Dependence on oil however, is projected to continue. As per TERI projections, in the reference scenario, the share of oil in the total energy basket will be nearly 39% in 2031/32 (TERI, 2009a).

Fuel diversity in the key consuming sectors

In addition to the dependence on imported crude oil, the fuel diversity of the major consuming sectors is also a determinant of vulnerability to shocks in the oil market. The transport sector is one of the major consumers of crude oil in the country and accounts for nearly 40% of the country's total oil consumption (Figure 9). Further, petroleum fuels themselves form more than 95% of the energy basket of the transport sector.

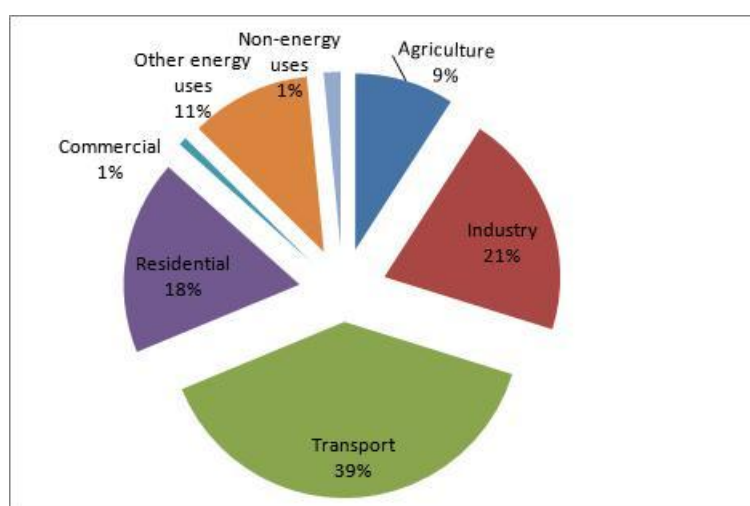


Figure 9 Sector-wise consumption of petroleum products in 2010-11
Source: (TERI, 2013)

This relative lack of diversification in the fuel basket of the sector makes it particularly vulnerable to any shocks in the market. While diversification to other energy sources such as natural gas and electricity has been witnessed in recent times, the sector depends heavily on petroleum products (primarily diesel and petrol) to meet its continually rising demand. As regards other sectors such as industry, while the sector is vulnerable to any shocks in supply,

¹² Based on the data available in (BP, 2012)

demand or prices, the overall impact gets muted due to the relatively lesser share of oil based products in the sector's energy basket as coal and power form larger shares of the total energy consumed.

Availability of foreign exchange reserves to pay for oil imports

A key determinant of vulnerability to oil shocks is the availability of foreign exchange reserves to pay for oil imports. As indicated in Table 3, increase in oil prices can lead to very high requirement of forex, given the projected rise in dependence on imported crude oil. Figure 10 provides the reserve levels of foreign exchange in India. While the reserve stock increased rapidly in the period from 2000-01 to 2007-08, the period thereafter has seen a combination of decline and stabilization of the reserve stocks. This lack of increase in the reserves position, coupled with the steadily increasing oil prices and the dependence on imports of crude put the ability to pay for the imports under duress.

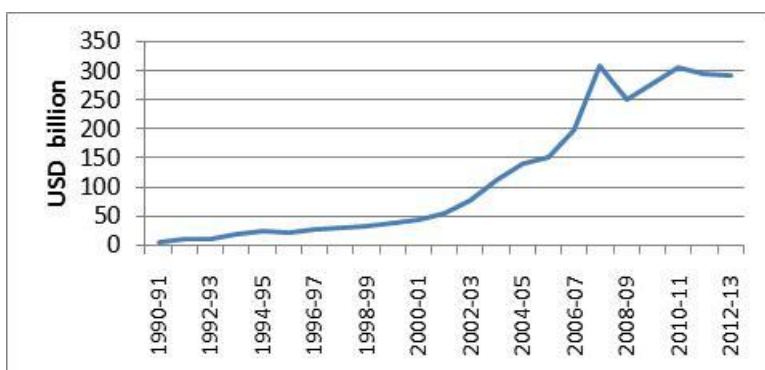


Figure 10 Foreign exchange reserves in India
Source: RBI (2012)

On the foreign reserves and current account balance front, another important factor in determining the vulnerability to shocks, and the ability to mitigate them is the export earnings of the country (Figure 11). Oil imports from a major share of the total export earnings and current stand at around 56% of the total exports (RBI, 2013). This share has increased in the past two years owing to an upward movement of crude oil prices vis-à-vis other products thus leading to a favourable terms of trade for oil and petroleum products. An interesting trend can also be noted in the nature of exports which now increasingly comprise of earning from petroleum products.¹³

¹³ The current share of oil related exports in the total earnings is around 20%.

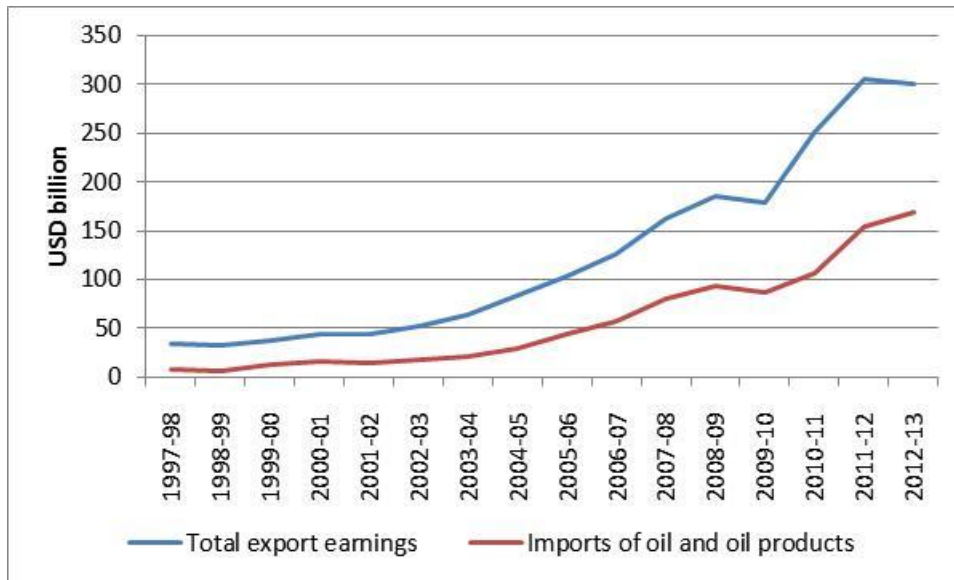


Figure 11 Trend of export earnings vs. oil import payments
Source: RBI (2013)

Impacts of oil shocks on the Indian economy

We now examine the impacts of oil shocks on the Indian economy. As mentioned in the preceding sections, oil shocks have significant impact on critical macroeconomic variables, particularly countries that are dependent on imports to meet the domestic demand for oil. This is true in case of India as well. However, an analysis of these impacts like the one carried out by Hamilton for the US economy may not be possible in India's case. This is primarily due to the absence of complete pass-through on domestic fuel prices as the Government maintains control over the prices of refined petroleum products. Such an analysis would therefore require a CGE based model which is outside the purview of this paper.

On the other hand, an understanding of the impact of international oil shocks can be made possible by identifying the key macro-economic variables that are likely to reflect the vulnerability to such shocks.

Based on the available literature that has been summarized in the preceding section, the key macro-economic parameters which reflect the impact of oil price volatility include:

- GDP Growth rate
- Total import bill and current account balance
- Fiscal balances (in case of provision of fuel subsidies by the government)

GDP growth rate

As can be noted from Figure 13, the periods of high oil prices have, in the past, largely coincided with, or were followed by, lower GDP growth rates.

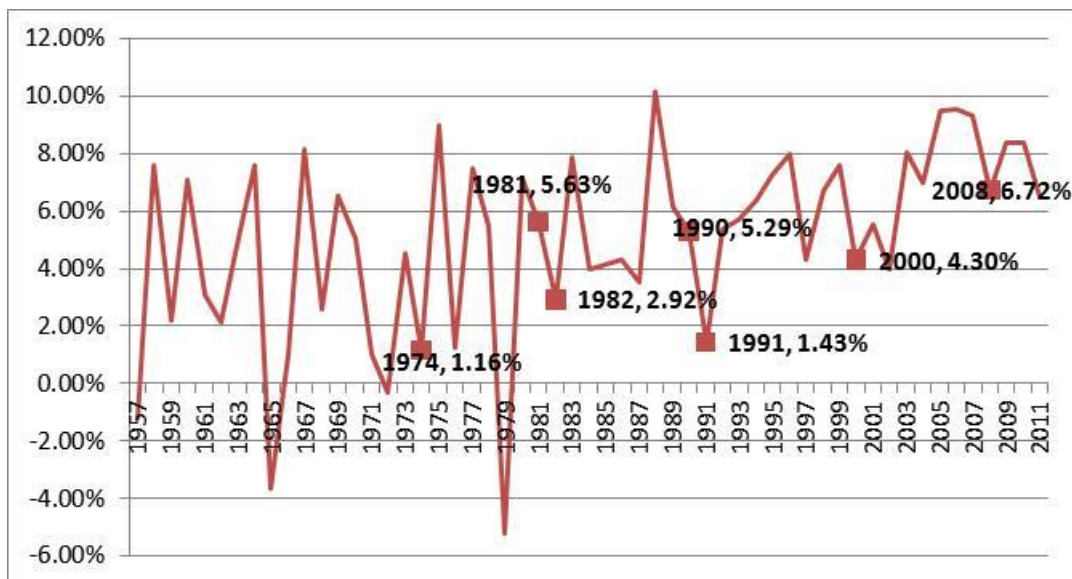


Figure 12 Trends in year-on-year GDP growth rates

Source: RBI (2012)

While there may have been other factors affecting the growth rate at these points, but the high prices of crude oil in the international markets have reflected on the domestic economy due to the impact on current account balances, the overall inflation rates and also due to their impact on the fiscal balances also which ultimately affect the national income. The high correlation and the perceived relations and channels through which oil shocks impact domestic economy are an indication of the impact that these have on the performance of the economy.

Import bill and current account balance

An increase in oil prices will also get reflected in the total current account balance for import dependent countries. As mentioned previously, India's dependence on imported crude oil has increased substantially (see Figure 3) and this has also adversely affected the total trade balance of the economy. Crude oil and petroleum products form nearly 32%¹⁴ of the country's total import bill and this share has increased in the past years on account of both – an increase in the volume of crude oil imports as well as the price at which crude oil is imported in the country.

¹⁴ Provisional figures for 2011-12 (RBI, 2012)

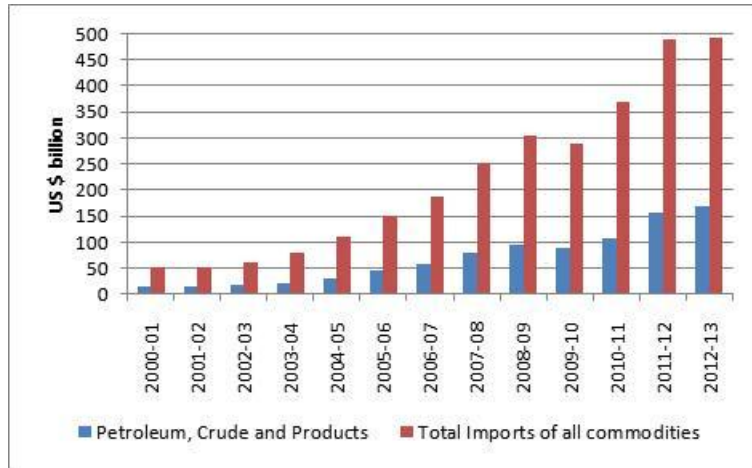


Figure 13 Share of petroleum, crude and products in the total imports
Source: RBI (2013)

Over time however, with an increase in the country’s refining capacity, the share of exports of petroleum products in the total export basket has also increased from less than 1% in 1970-71 to over 18% in 2011-12. Therefore, changes in global oil prices not only affect the debit side but also the credit side of the current account balance of the country.

Fiscal balances: the impact of subsidies

Given the prevalence of subsidies on sales of petroleum products and the existence of de-facto government regulation of prices of these products, volatility of crude oil prices is likely to get reflected in the fiscal and revenue balances of the government. The petroleum product prices in India have historically been controlled by the government. Following the first oil price shock of 1970s, an Administered Pricing Mechanism was put in place wherein the prices of refined products were regulated by the government. During the period from 1997 to 2002, a first attempt was made to dismantle the APM and deregulate petroleum product prices. However, with rising global crude oil prices, the government followed an ad-hoc pricing policy. While the fiscal subsidies were reduced, oil bonds were issued to oil companies to meet the growing under-recoveries. In 2008-09, it was decided that the oil bond based compensation mechanism would be discontinued and the subsidy burden would be met through budgetary allocation. During the past few years, the government’s share in under-recoveries has increased in the past five years. Oil subsidies now form a significant portion of the total budget expenditure and any shocks in international crude oil prices that are not allowed to pass-through to final consumer prices are likely to result in an increase in this proportion.

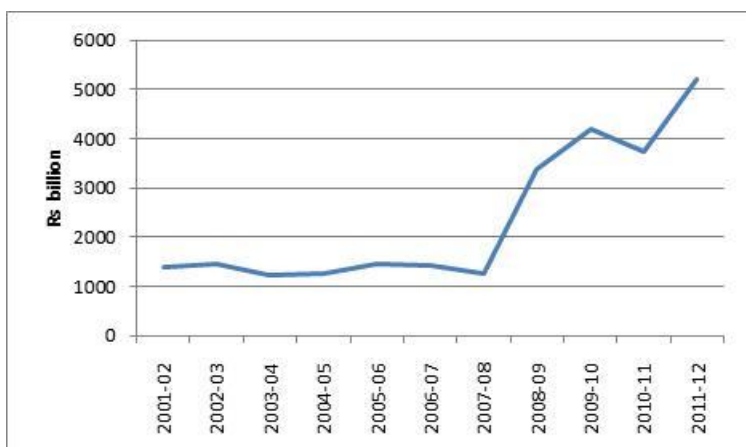


Figure 14 Gross fiscal deficit (2001-02 to 2011-12)

Source: RBI (2012)

Managing vulnerability to oil shocks

As the dependence on imports is likely to continue and so is the vulnerability to shocks, it is pertinent to look at measures that help in reducing the vulnerability and building resilience to oil shocks.

In the **short term**, building defenses against supply and price shocks by construction of Strategic Petroleum Reserves (SPRs) provides the most immediate defence against any shocks in supply or even demand. Further, SPRs also have the potential to act as a strategic signal against any intended blockage of supplies.

Based on available estimates, as of December 2009, India already possessed nearly 74 days of commercially tappable storage capacity (OIDB, 2009). Construction of SPRs is already underway and the first phase when completed will add 5.33 MT of crude oil storage space. A second phase is also being planned and will add 12.5 MT to the strategic oil stocks of the country. However, in addition to the country's own stocks, collaboration with other countries to undertake joint stockpiling and release activities need to be adopted. In this context, having agreements with both consuming and supplying countries is essential. Since any supply shortage or maritime blockage is likely to impact most Asian oil consumers, a programme among these nations to jointly create and maintain strategic oil storage capacities will help in addressing short term supply shocks.

In order to reduce the impact of oil price shocks on the domestic economy, it is critical to review the country's policy on fuel subsidies and to manage the energy access agenda in a financially sustainable manner. As mentioned in the preceding sections, petroleum product subsidies form a major proportion of the country's total fiscal outgo. In addition to this, the contribution from oil companies (especially those in the upstream sector) also affects the ability of these companies to invest in increasing their domestic production capacity and expansion of infrastructure to effectively reduce reliance on imports.

In the **medium and long term**, efforts to diversify sources of crude oil imports and substitution towards alternatives need to be made. As stated previously, countries from the Middle East constitute the largest sources of crude oil supply for India. Efforts need to be made to diversify the crude oil import portfolio of the country and to enhance diplomatic relations with oil producing countries. Cross investments wherein companies from oil producing are allowed to make investments in energy infrastructure in India can also be considered (TERI, 2009b). In this context, countries from Latin America and Africa provide vital options. In the past few years, imports of crude oil from Venezuela have increased from less than 2 Mt in 2007-08 to nearly 10 MT in 2011-12. Similarly, imports from Nigeria, have also increased from nearly 10 MT in 2007-08 to the current level of over 14 MT (2011-12). Increasing imports from these countries and furthering bilateral ties with their respective Governments will form a key component of India's oil security policy in the coming years. In addition to these emerging players, imports of unconventional oil (tar sand, natural gas liquids etc.) from North America (Canada and USA) also provide an opportunity to diversify the country's supply base. Not only do these options provide additional sources of oil, the relative geo-political certainty of supplies region adds to the long term security of oil supply for India.

In the medium term, policies to enhance domestic oil production also need to be encouraged, and foreign companies with expertise in exploration, particularly in deep offshore fields, need to be invited to participate in the upstream industry. This will also require substantial effort on the domestic front in making high quality data available for different oil basins and commissioning studies on the geology of reserves.

Further, in order to reduce the dependence on crude oil altogether, efforts to move towards alternative sources of supply need to be made. Particularly in the transport sector, policies on blending of biofuels in automotive fuels have already been introduced but the enforcement of such regulations, coupled with investments in making the entire value chain feasible need to be provided. Further, promotion of electric and hybrid vehicles, encouraging a shift towards public modes of passenger transport and towards railways in freight transport needs to be undertaken.

Also notable is the increased share of renewables in the total energy mix of the country. An emphasis has been placed on developing the solar based energy generation capacity of the country. With the Jawaharlal Nehru National Solar Mission in place (JNNSM), the total solar based power generation capacity is set to rise to 20 GW by 2022. The average tariff has reduced by more than Rs10 per kWh in just two round of bidding. Significant more gains are in store for the sector with an increase in the scale of production in the sector and the improvements being initiated in terms of technology. Introduction of measures such as feed-in tariffs, renewable purchase obligations and other forms of government support will also bolster the efforts to diversify the energy basket.

In addition to these sources, as more unconventional natural gas is becoming increasingly available in North America, and there is a likelihood of global gas prices stabilising in the long term, a policy on importing gas on a sustained basis, establishing infrastructure to ensure its absorption in some of the major petroleum product dependent sectors will be useful in diversifying the energy economy away from crude oil dependence.

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