



GLOBAL OIL MARKETS & INDIA'S VULNERABILITY TO OIL SHOCKS

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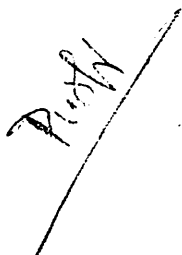
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Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA/BBA/B.Sc.

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Table of Contents

Acknowledgment	ii
Table of Contents	iv
List of Tables and Illustrations	vii
List of Figures	vii
Executive Summary / Abstract	viii
Chapter 1: Introduction	1
1.1 Overview	2
1.2 Background	3
1.3 Purpose of the Study	4
1.4 Research Hypotheses	5
Chapter 2: Literature Review	6
2.1 Review Area Broad	8
2.2 Review Area Narrow	19
2.3 Factors critical to success of study	21
2.4 Summary	25
Chapter 3: Research Design, Methodology and Plan	27
3.1 Data Sources	28
3.2 Research Design	29
3.3 Data Analysis Procedures	30
Chapter 4: Findings and Analysis	37
4.1 Descriptive Statistics	38
4.2 Correlation/ Regression Analyses	38

Chapter 5: Interpretation of Results	39
5.1 Interpretation of Results	39
5.2 Comparison of Results with Assumptions (Hypotheses)	40
Chapter 6: Conclusions and Scope for Future Work	42
Bibliography	45
References	45

List of Tables and Illustrations

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

Figure 2 Share of fuel sources in primary refinery energy consumption

Figure 3 Share of crude oil imports in throughput

Figure 4 Trends in international crude oil prices

Figure 5 Crude oil consumption in Japan

Figure 6 Country-wise imports from Middle East (in Mt), 2011-12

Figure 7 Energy Intensity of GDP

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

Figure 9 Sector-wise consumption of petroleum products in 2010-11

Figure 10 Foreign exchange reserves in India

Figure 11 Trend of export earnings vs. oil import payments

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

Figure 13 Share of petroleum, crude and products in the total imports

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

List of Figures

Table 1 Crude oil shocks

Table 2 Sources of crude oil imports

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

Executive Summary/Abstract

This paper ascertains India's vulnerability to oil shocks due to the fluctuations of prices, demand supply and economic situations that are evident within the international market. The demand for energy in India is increasing rapidly and therefore the country imports petroleum products and oil from Middle East countries, Africa and South America. A majority of the Middle East countries are undergoing political conflicts for which the prices charged for importing oil and petroleum are also higher. India can overcome the adverse situation it involves in by producing non-conventional sources of energy and natural gas in the country. This will help in reducing the dependency of the country on other countries for importing oil. Moreover, it will even help in contributing towards the economic development that is evident within the country.

Introduction

The increasing demand for energy has been rapidly accelerating in the global context that has created a growing demand in the global oil market. India is one of the largest oil consuming countries of the world and an estimation of 717 oil barrels are required every year in order to maximise the economic output. Crude oil suffices one third of the total energy demand that is evident in India along with contributing to four fifth of the overall energy imports of the country. Import of energy to India contributes to about 6.3% of the overall Gross Domestic Product (GDP) of the country. Therefore, it is evident that the rapid increase in the prices of crude oil will lead to the economic downfall along with higher fiscal deficit and increasing current account deficit.

Overview - Global energy scenario

These days' hydrocarbon sources are considered as one of the major contributors to the energy pool and all of this is happening because of some significant changes in global energy landscape. At same time, an impetus in order to increase the share of energy sources (renewable) to reference some climate concerns is also helping to an increment in the share of such low carbon source. On the basis on the data available from IEA (International Energy Agency), the production of oil is expected to increase approx 98 mbpd (million barrels per day) by the year 2035. Mostly, this increment is projected and expected to be in the production of unconventional oil and natural gas liquids.

In this period, the coal production is also expected to be incremented and reach 6300 mtce (million tonnes of coal equivalent). The huge increase is expected to be seen in the natural gas production where a growth of 47% will be registered and expected to reach 5 tcm (trillion cubic metres), mainly on the account of increase in production of unconventional natural in North America.

Background - Energy scenario in India

In the recent years, it has been seen that the demand for energy in India has increased. In the coming years, the increase in energy demand is expected to be continued even when the growth rates can be seen moderate in the short term to medium term. In this scenario, it is necessary to meet the demand for every kind of energy sources not just only to meet the increased objectives but also to maintain the growth of energy sources achieved till date. The energy consumed in India has increased more than 4 times in the period (1971 to 2009) (Figure 1).

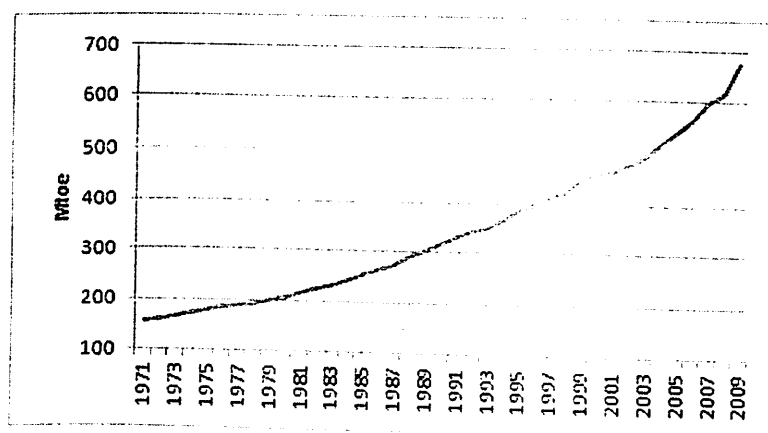


Figure 1 Total primary energy supply in India (in Million tonnes of oil equivalent)

Source: UNESCAP

Purpose of the Study

This paper examines and presents the latest trends in oil shocks and also the vulnerability of India to shocks in supply and prices at the national and international levels. Beginning with examine the definitions of crude oil volatility and international experiences. To examine the effect of volatility on some major indicators, a qualitative approach is taken. This paper covers volatility's broad definition analyzing the demand and supply.

In addition to this, a manifestation of how a country is dependent on oil and energy sources and its reflection through various indicators economically and physically such as total share of oil in the energy pool, importance of petroleum products and crude oil in the trade and also the patterns of such trade in the recent few years can also be examined in order to understand the contribution of vulnerability to shocks. It has been seen through these patterns that the vulnerability to shocks is expected to increase in the coming years as dependency on the imported oil and oil products is projected to increase. Finally, on the basis of international experience, measures to pros and cons of this vulnerability are recommended.

Research Hypothesis

With the economic development of India, the demand for petroleum products has been increasing rapidly in order to suffice the need for growing demand of energy. The country mainly imports oil from Iraq, Iran, South America and Africa. Therefore, changes in the fiscal policies, tariffs, export duties and economic conditions of the oil importing countries will directly impact on the economy of India. The high demand for crude oils and the Iraq conflict have created a great threat for the oil importing countries including India as higher prices will have to be paid for importing oil.

India is highly dependent on petroleum products in order to suffice the growing demand of energy requirement in the country. In order to reduce the vulnerability of oil shocks, it will be beneficial for the country in switching to natural gas and other non-conventional sources that are available for generating energy rather than depending on crude oil as a source of energy. The example of the United States (USA) may be considered where the country has adopted shale gas as an alternative source of energy and therefore has been successful to overcome the threat of oil shocks. Moreover, for importing petroleum, India should shift to other petroleum producing countries rather than Iraq, Iran and other countries of Middle East where the supply of crude oil can be disrupted owing to the increased political conflicts among the region.

In order to implement the idea of using natural gas and other non-conventional sources of energy such as biogas, hydropower and solar power as alternates to crude oil and petroleum, it is necessary for India to develop proper infrastructure that would support their successful implementation. Moreover, it is very essential to recruit highly skilled and technically specialised employees that will help in ensuring efficiency and better productivity. Proper technical equipments are also inherently necessary to ensure successful implementation of the plan that India can import from various foreign countries that are opting for other resources than oil.

Literature Review

India's oil consumption

Crude oil creates a significant proportion of energy basket of the country, next only to coal (Figure 2). In India, the crude oil consumption has increased from 12.6 mtoe in 1965 to 162.3 mtoe in 2011. This reflects an increment in consumption more than 10 times in this period. In the terms of share in the energy basket, it has been found that consumption of crude oil is fairly constant, always found in the range of 28 percentages to 36 percentages in the period (1971-2011).

Figure 3 presents the share of crude oil imports in the total refinery throughput for the past few years.

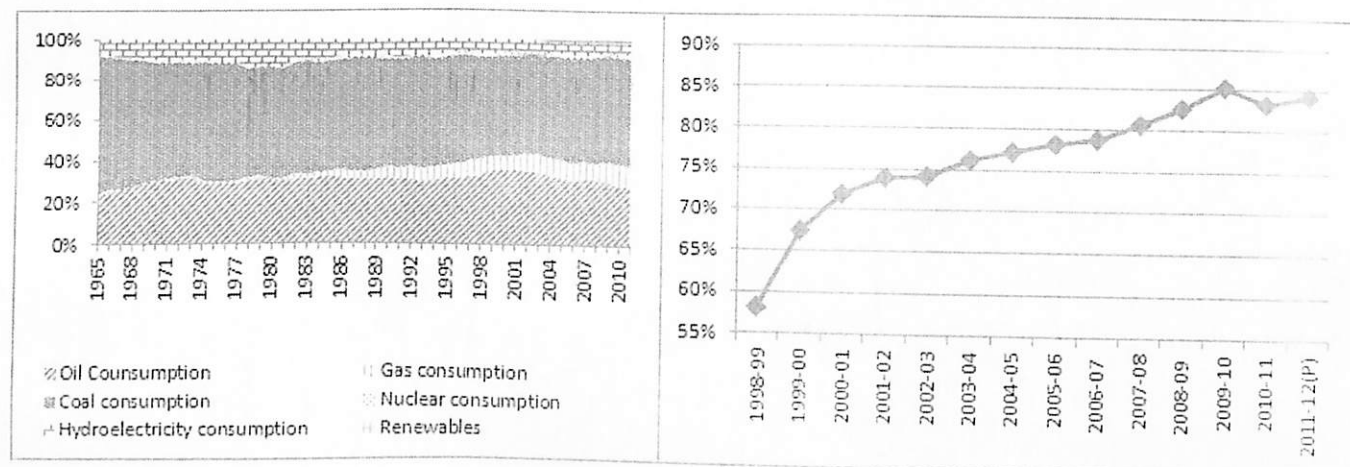


Figure 2 Share of fuel sources in primary refinery energy consumption

Source: BP (2012)

Figure 3 Share of crude oil imports in throughput

Source: PPAC, P: Provisional

This rising dependency on petroleum products and also the increasing share of imports in the consumption of domestic oil subjects the country's economy to the volatility in the international markets therefore it makes essential to examine the relation between macroeconomic parameters and oil shocks. Despite the dependency on crude oil, it has been seen in recent few years that the domestic production of energy sources has remained low and stagnated. This situation has led to a increase in dependency on imports of petroleum products and crude oil in order to meet the domestic demand of energy. The main of this paper is to examine and analysis the changes in patterns of volatility in supplying crude oil and resilience of India to respond if there is any ups and downs in the availability of petroleum products and crude oil in the markets whether they are domestic or international. The next sections describe the volatility's international experience in supply, the persistent volatility's explanation and the choices that can be made to manage or control the volatility in oil supplies.

Review Area Broad

International experience of volatility in crude oil supply

It has been many periods of significant patterns in supplying oil where the availability and quantity of oil in international markets varied due to prevailing situations in oil producing countries. Some major oil price shocks are summarized in Table 1 including their starting and ending dates and the estimated loss for each period for supplying oil.

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 (1956) and the Arab oil embargo (1974) were the main reasons that caused the biggest supply shortages/shocks in the international crude oil markets. Figure 4 represents the trend in prices of crude oil for the last 6 decades. After first oil shock (in 1970s), a significant change in the crude oil prices took place.

The oil shocks/shortages over the time have varied due to various reasons and the characteristics that responsible for destabilishing the international oil share markets in the past four decades. The embargo imposed on UAE countries and also the formation of OPEC (1973) were the main reasons behind the shock/shortage of early 1970s. This formation of oligopoly structure in the oil markets brought the group managing control on the crude oil's marginal production for controlling the oil prices. And thereafter, price of oil increased in 1979 due to the Iran-Iraq war and the Iranian revolution. In fact, prices increased during this period were considered as the huge increase in oil prices in the previous OPEC times.

The oil prices increase from US\$ 14/bbl to over US\$ 31/bbl in 1979 and 1980 respectively and in 1981 increases nearly US\$37/bbl, thereafter registering a real oil price increase of over US\$50/bbl (in 2011). After a decade, the Kuwait's Iraqi invasion also brought another oil supply shock that lasted nearly six months (from August 1990 to early 1991). After this another 10 years, in June 2001, in the respond to the sanctions from West, export of crude oil was suspended by Iraq and then UN initiated oil for food humanitarian programme. After this, due to strike by the workers in the Venezuela National Oil Company (Petroleos de Venezuela, SA) in the year 2003, the country stopped the exports and made a major gap which had to be filled by imports

from other and more distant sources such as Middle East countries.

The loss in oil supply because of these shocks/shortages has reduced notably over the time, and primarily many evident losses have been because of physical disruptions of oil supply and not because of market control of producers and political situations. However, it can be argued that the integration of both oil markets and fungibility of crude oil as an international commodity also states that physical shocks can be replaced by supplies fairly quickly from alternate sources but their effect is manifested in the terms of price spikes.¹

As can be presented and expected, time periods of oil supply shocks (identified in Table 1) are correspond with oil prices in international markets. However, there are some other periods (1987, 1996 and 2011) where the oil prices increased but not because of supply shocks. These can be considered as very small changes where oil prices increased by.

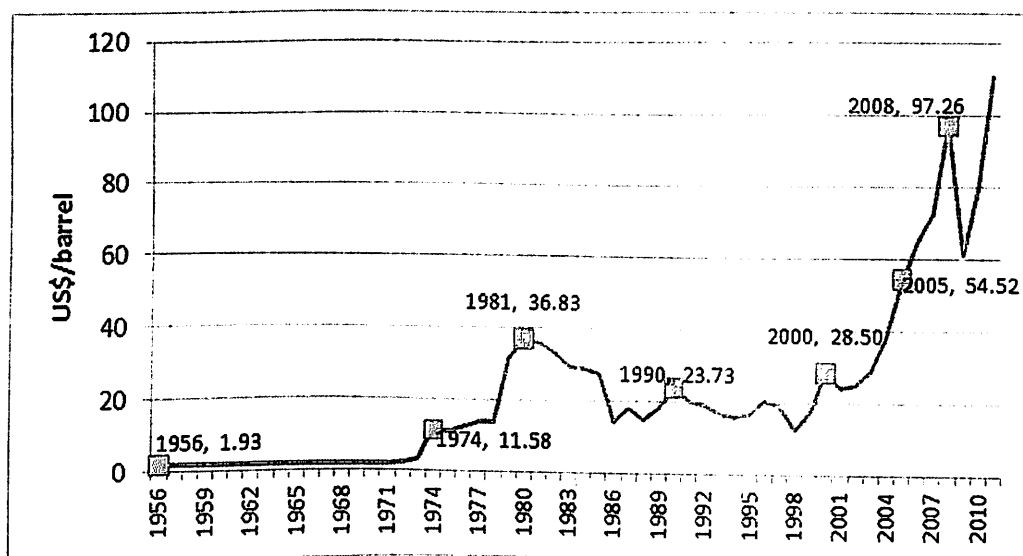


Figure 4 Trends in international crude oil prices

Source: (BP, 2012)

¹ For instance, see (Billig, 2004)

Volatility available in petroleum prices and its effect on the macro-economy has been analyzed, researched and documented well. In the next sections, we will analyze the nature of changes in prices of oil, reasons for changes in prices of oil, the vulnerability to and impact of oil price shocks and volatility's patterns over time.

Examining oil volatility

During examine oil volatility, it is necessary to pay attention to many other aspects including the changes in patterns of vulnerability to oil shortages/shocks, overall affects of oil volatility and also the causes behind oil volatility. Volatility itself can be described as the volatility because of demand shocks, supply shocks or price shocks just because increase of precautionary demand. in the past, oil shocks are having allimpacted key parameters for macroeconomic. In fact, it is widely believed that they led to macroeconomic downturns. In this analysis if we consider the impact of price shocks on the United States, Hamilton (in 1983)² has found that the economic downturns were preceded by oil shocks in USA (Hamilton J.D.,1983) (Hamilton J.,2000). There are several macroeconomic parameters that are affected by oil price shocks such as interest rates, unemployment, GDP, investment, and exchange rates.

Changing patterns of vulnerability to oil shocks

In a survey on developed economies, it has been concluded by Schubert and Turnovsky (2011) that in the recent years, vulnerability of such economies to oil shortages/shocks in real terms of economic has declined. This decline is attributed by the authors to a decrement in the oil intensity. On the other hand, a small oil importing economy uses a neo-classical model that is based on following three parameters – (i) degree of oil dependency of the economy, (ii) degree of flexibility of oil production and (iii) degree of access to the international financial markets.

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

It has been found by authors that macroeconomic parameters such as GDP, capital, interest, debt are impacted adversely in the short term. However, from medium term to long term some of these parameters are returned to their pre-shock levels/trajectory. This is mainly due to the use of a neo-classical model. While noticing that it is not possible for two oil prices to be similar, Killian (2006) found that the oil shocks after the mid 1970s with increasing economic activity was reflected in high global demand for oil.

A decomposition analysis was conducted by Bacon and Kojima, 2008. The analysis of the variation in vulnerability of various countries to oil price shortages/shocks. The overall change in vulnerability to oil has been disaggregated by the author into consumption and production affects. The authors find that the vulnerability to prices of oil varies across some countries examined. They also find that oil supply factors play a big role in determining and analyzing the pattern of volatility during period around 2006. Killian (2008) also mentions in his analysis of various periods of price of oil that a variation in precautionary demand or/and real economic activity having a sustained impact on oil prices while a variation in production only having a transitory impact on actual prices.

Explaining the volatility in oil prices

Volatility in prices of crude oil is driven mainly by following three factors: demand side push, the impact of speculation and supply side pull. Just like any other market, demand & supply are very important determinants of oil prices. Creel, Archanskaia, & Hubert (2011) found that price shocks were mainly supply driven, implying that they were having an impact on the international economic activity or market.

However, after this period, price shocks have been demand driven mostly, and the most recent one of them become the spike in oil prices following 2008s economic crisis. During the attempt in finding an explanation for this spike, Hamilton (2008) analyses and examines some theoretical explanations for variations in oil prices. According to him, variables including factors (supply

side) such as depleting oil reserves, OPEC's role, time needed for oil fields in order to commence production; and factors (demand side) - income elasticity and price elasticity are all responsible for variations in oil prices. In the following sub-sections, we examine all the factors in detail.

Global reserves and production

Although there are a number of countries that are dependence on crude oil in order to meet their energy demand, production of oil and the reserves is concentrated in some areas. Members of the (OPEC)³ all together having the largest share in petroleum production in world and in the overall proven reserves. And possessing approximately 72% oil reserves in world, such countries contributed 42% world oil production in 2011. On the other hand, OECD member countries form a little above 14% of the world reserves.

In the past few decades, the share of companies which produce oil has undergone as one of the largest MNCs (multinational corporations) that were considered as main drivers of the oil market have been replaced now by some state owned oil companies of big oil producing nations (most of these nations are the members of the OPEC) (Smith, 2009).

Many of the big oil exporting and producing are politically and economically high-risk countries in West Asia, and it is an addition to the world energy vulnerabilities. Thus, the supply of oil in world market can be affected by political tensions in such regions, and it is a fact that has been realised in disruptions mentioned in Table 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.

The recent disruption was happened in period 2011-12 at the time of Arab awakening when the production of oil in Libya decreased subsequently leading the members of IEA in order to release stocks or shares from their strategic stockpiles of oil. More recently, a trade embargo's imposition by the USA and European Union on Iran brought persisting tensions on stopping the Strait of Hormuz forms a very significant world chokepoint for the trade of crude oil in early 2012., Nearly 35% of overall seaborne crude oil in 2011, passed through (EIA, 2012)⁴.

The presence of spare capacity can be considered as related factor in the large oil producing countries that affects the prices and availability of crude oil. The OPEC nations are holding spare capacity for crude oil production that is available generally to meet some short terms disruptions. And this can be contributed towards meeting the short term volatility.

The spare oil production capacity level of the OPEC nations has fluctuated from as high level as 5.4 mbpd to a low level of 1 mbpd in 2002 to 2005 respectively and then increasing again to reach approximately 4 mbpd in year 2010 (EIA, 2013). This availability of spare capacity is used also in maintaining and managing total supply of oil in the global markets. Though, the supply management (by the OPEC) issues have been analysed and debated globally, citing cheating cases by the OPEC members nations in cartel, (Killian, 2006) attributes variations in oil prices to market forces.⁵

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.

⁵ See Killian(2006), pg 4

Another issue also exists that determines the trend and level in crude oil production is the peaking of oil production from some conventional sources and simultaneously the decreasing reserves of oil. At a point called Peak oil is the time when world petroleum production reaches a maximum, and thereafter enters a terminal decline phase. Starting from as early as year 2020, a timeline is estimated to be varied across various studies.⁶ This trend is considered as an evident across oil production centers that are localized. In the 1950s, US was the largest crude oil producer that reached its oil production peak level in 1971. Simultaneously, oil production in the region of North Sea is also decreasing (Kesicki, 2010).

However, this theory of *peak oil* is being challenged increasingly by the rising unconventional oil production. According to the latest projections that are available from various sources, the availability of unconventional oil (which is not so easy to access and also much expensive to extract) forms such as ultra heavy oil (from the Orinoco Belt in Venezuela), Canadian tar sands, pre-salt formations (in deep offshore fields in Brazil) and also the tight oil and shale oil (from North America) are going to add to the global availability of crude oil. In fact, the overall production of crude oil could enhance to 110.6 mbpd in year 2020 from 93 mbpd in year 2011 (Maugeri, 2012).

Whether or not the crude oil availability and production will peak thus remains to be seen. Even with being availability of new sources of oil, the prices of crude oil are also expected remain to be high. Finding oil in these new and unconventional sources is considered to be much expensive to extract and gives the high cost of extraction technology associated with it. This will surely affect the international prices and may bring terminal to '*cheap oil*' era. In fact, prevailing high costs may have had a big role in making the production and exploration of unconventional oil viable. Geo-strategic implications are another outcome of the rising availability of unconventional oil. These new sources of oil are found in Latin and North America. As oil supplies from such sources got major shares of international supplies of oil, it is also to have implications and positions of traditional oil producing countries in the global energy and political map.

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 increasing demand of crude oil mainly from some emerging countries is the most significant sources cause changes in trade patterns in international oil markets. The crude oil consumption in China is more than doubled as comparison to past decade, increasing from 228 mt to 483 mt in 2001 and 2012 respectively. Now, china has a share of more than 11% in the international consumption of crude oil. In the same period, crude oil consumption in India has been raised from 107 mt to 171 mt, representing above 4% of the international consumption of oil.

In the OECD nations, USA remains to be the largest oil consumer (19.8% of overall consumption) and Japan is second largest consumer (5.3%). Any sudden changes from any major international energy or oil consumers affect the oil availability for the rest of the world and also affect international crude oil prices. For instance, shutting down of capacity of nuclear power generation in Japan was followed by increasing in demand for both natural gas and crude oil. While the demand of power is being met from high price LNG imports, there is also an increase in the total consumption crude oil in the nation (Figure 4).

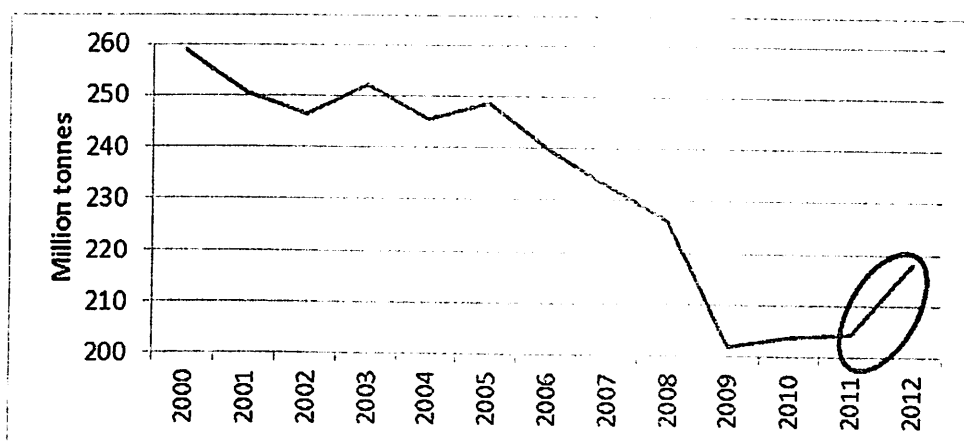


Figure 5 Crude oil consumption in Japan

Source: BP (2013)

Apart from increasing demand from Japan, some another development has been across the Pacific. As highlighted above in the Introduction, an increase can be seen in the gas production in the US. This increased energy availability in the nation is likely to affect the other energy sources demand in the nation. Gas is replacing coal in the sector of power generation and also already competing with coal. This gas would also find more usage in the transport sectors and industry. Due to these changes, the crude oil demands from the US (the largest imported crude oil consumer), will stabilize and positively affect the oil availability for the rest of the world.

Speculation and impact of derivative markets

There exists a body of literature on examining the effect of speculation on crude oil prices. Crude oil is considered as a largely traded commodity and crude oil's derivative markets are extremely large in value and size. Speculative trade market encapsulates the notion of Pre-cautionary demand for oil in which *futures* trading is treated as a measure in order to reduce the effect of

price or cost volatility in the future. Movements and Size in global oil trading are affected by increasing number of financial institutions or organizations participating in this trade market. It has been seen that *financialisation* of oil trade markets gives a conclusion that the growing volatility in oil trade markets is an outcome of speculative trading.

In academic literature, an ongoing debate is appeared on whether and/or to what extent speculation drives prices of oil. In a survey of academic literature, (Fattouh, Kilian, & Mahadeva) (2012) find an evidence for growing correlation between different commodity markets. In their own examine and analysis, according to a conclusion this is not enough to attribute the prices spike after 2003 to speculative gamer or player alone. Vansteenkiste (2011) concludes that a 'chartist' regime has been reflected by volatility in prices of crude oil since 2004, playing the speculative players role in the trading market of oil.

On the other side, Aquist & Kilian(2008) conclude that future markets are not going to help in predicting the market rates, thereby raising questions regarding the effect of speculation on the actual oil trade. It has been found that Irwin & Sanders (2012) also not find any support or assist for the Masters Hypothesis⁷. During examining the affects of various determinants on oil prices volatility, it is found by Kesicki (2010) that a limited role has been played by speculation in affecting prices of oil in the oil price surge in year 2008.

All in all, according to general academic discourse oil shocks/shortages are supposed to be driven continuously by the demand and supply fundamentals. financialisation and speculative trade do play very important role in the oil trade markets but these are not really major factors to prevail volatility in global markets. Other determinants that affect crude oil prices include geopolitics, refining capacities, demand and supply, and exchange rate. Overall uncertainty in macroeconomic also determines the volatility of prices of oil by affecting elasticity of demand & supply (according to Van Robays, 2012).

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

Review Area Narrow

The Indian Scenario

As it mentioned previously that the economy of India is highly dependent on the imports in order to meet its crude oil domestic requirement. Any kind of fluctuation or variation in the international markets, therefore, having a disproportionate effect on the many macroeconomic factors representing the performance of the economy. It has been summarized by Bhanumurthy, Das, & Bose (2012) that the available literature on the effects of oil shocks on the economy of India. As found in most of the papers, price shocks are having a positive effect on domestic inflation but negatively impact on the economic growth levels and industrial production.

According to the computation by Gupta (2008) the oil vulnerability index of a cross section of twenty-six nations using different indicators. These indicators include ratio of crude oil imports to GDP, local reserves to oil consumption ratio, GDP per capita, consumption of oil per unit of GDP, share of oil in overall energy, exposure to political risks and the market liquidity. Among the most vulnerable nations, India is found one of them. According to decomposition analysis by Bacon and Kojima (2008b), they have found that in between 1996 to 2006, oil prices vulnerability in India has increased from total 1.8 in year 1996 to total 2.6 in year 2001 and then further to total 4.4 in year 2006.

All this is absolutely driven by a combination of determinants including rising in the share of crude oil imports, rising in prices of oil, and changing in foreign exchange rates. It has been analyzed by Battacharya and Batra in 2009 that the relation between global prices of petroleum or crude oil and the effect on factors such as money supply, exchange rate, Industrial Production index and index of Wholesale Price under a condition when changes in global prices of oil are allowed to pass through to prices of domestic petroleum product.

This section of the paper includes examining the factors that are helpful in determining the oil shocks vulnerability in India. This section is followed by a relevant discussion on the real affects noted in the recent past years and then finally, some options to manage the vulnerability.

Factors Critical to Success of Study

Factors that determine vulnerability to shocks in India

Vulnerability to oil price and supply shocks is depend on oil intensity of the GDP, the overall oil intensity of consumption, crude oil domestic production and the oil import dependency of the nation.⁸ The Another issue that impacts the vulnerability is the oil availability in the global oil markets. Here we analyse each and every factors and then discuss the trajectory of each for the near future.

Domestic oil production and proportion of dependence on imports

As discussed earlier, oil import dependency of the country to meet the domestic oil needs has increased. This increased dependency on foreign countries for import also exposes the nation to uncertainties of geo-political and the volatility in the global oil markets. India imports More than two-thirds of the overall crude oil from Middle East and nearly 80% from OPEC member countries (Table 2 & Figure 6). This means that a proportion of India's oil supplies have to pass through the geo-political bottleneck.

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)

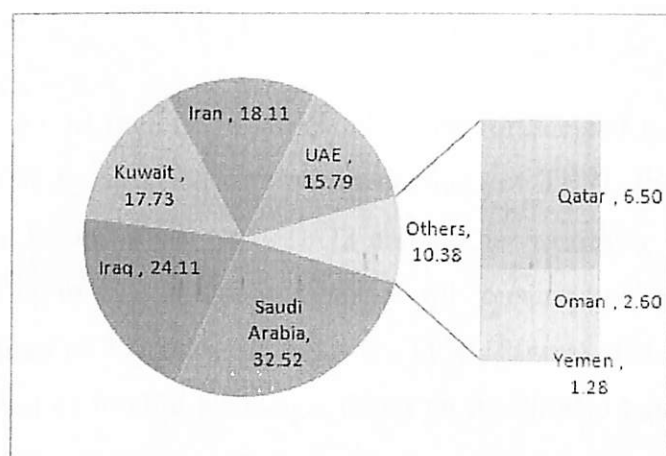


Figure 6 Country-wise imports from Middle East (in Mt), 2011-12

Source: Lok Sabha (2013)

Summary

The dependency on oil imports is projected to rise further and is also expected to increase to exceed nearly 90% by 2031-32. As per projections of TERI, the overall oil consumption is going to increase to 392 mtoe in 2021-22 and further to nearly 836 mtoe in 2031-32 in the scenario. According to an alternative scenario⁹, oil consumption will be increased to 223 mtoe in 2021-22 and then to 457 mtoe in 2031-32 (TERI, 2009a). This increasing dependency will also affect the need of foreign exchange, therefore it will also have the impact on the account balance of the nation.

Table 3 represents the needs of foreign exchange in the period of two years under various scenarios of oil prices. The rising demand for foreign exchange put a significant burden on the trade balance. To put such statistics into perspective, overall expenditure on oil importing in 2010-2011 was in more than USD 100 billion and the expenditure had exceeded in 2011-12 USD 139 billion. This is mainly due to the rising in global crude oil prices in the past years.

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)

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 dependency on imports is because of low domestic oil production and simultaneously low estimated oil reserves. The overall oil reserves available in India have decreased from 770 MT to 757 MT in 2007-08 and 2010-11 respectively. The production in the same period has increased from total 34 MT to total 37.71 MT, and giving a ratio called R/P ratio of recent 20 years. The world reserves, on the other hand, have increased on account of oil reserve accretion in OPEC members countries.

Research Design, Methodology and Plan

The notion of oil vulnerability is multidimensional and is defined as a state that makes oil-consuming countries extremely vulnerable to international developments such as higher oil prices and oil supply disruptions. The literature on oil vulnerability highlights the fact that there are three major risks that contribute to the overall oil vulnerability of an economy—market (or economic) risk, supply risk, and environmental risk. Market risk of an economy refers to the risks of macroeconomic effects due to erratic price fluctuations in oil markets. Supply risk of an economy refers to the risks of physical disruptions in oil supplies. The environmental risk of an economy refers to the risks related to climate change, global warming, accidents, and polluting emissions due to increased oil usage.

Data Sources

In this paper, we have focused on the first two types of risks— market risk and supply risk (Planning Commission, 2006; CIEP, 2004; INDES, 2004; IAEA, 2005; APERC, 2003). Exposure to market risk measures the market vulnerability of economies. In this context, the World Bank has conducted two studies—‘The impact of higher oil prices on low-income countries and the poor’ and ‘The vulnerability of African countries to oil price shocks’— highlighting the major determinants of the vulnerability of these economies to higher oil prices. A large number of studies such as UNDP/ESMAP (2005), IAEA (2005), ESMAP (2005), IEA (2004), and ORNL (2006) show that the market risk or macroeconomic effects (such as increase in inflation and unemployment and negative repercussions on balance of payments) of higher oil prices depend on the cost of oil in national income, degree of dependence on imported oil, oil consumption per unit of GDP, share of oil in energy supply, strategic petroleum oil reserves, foreign exchange reserves, and level of economic development of an economy.

High import bills relative to GDP or high oil consumption per unit of GDP result in larger macroeconomic adjustment costs (in terms of impact on inflation, unemployment, balance of payments, and so on) in the face of a given increase in the international oil price. The oil price increase (associated with supply interruption) impacts a significant part of the economy, and consequently, has a larger economic effect. Similarly, the higher the share of oil in total primary energy supply, the greater is the direct exposure of an economy to such developments.

Two other important factors are the foreign exchange reserves and GDP per capita. These factors are negatively related with oil vulnerability, as they are measures of international competitiveness and thus, determine the overall paying capacity for imported oil in foreign exchange. Further, the expansion in domestic storage capabilities increase the countries’ ability to bear shortrun oil supply disruptions. The higher the strategic petroleum reserves, the lesser are the likely macroeconomic impacts at least in the short run. However, strategic reserves do not play a significant role in achieving oil security when disruptions are for longer duration. Exposure to supply risks measures the supply vulnerability of economies.

Research Design

A large body of literature exists on the indicators for measuring oil supply risk. Factors such as level of domestic reserves relative to oil consumption and exposure to geopolitical risks determine the oil supply vulnerability of oil-importing countries. Higher is the ratio of domestic reserves relative to consumption, lower is the oil vulnerability. The ratio indicates the consumption equivalent life of the proven oil reserves (which is the number of years the reserves are expected to last if they are consumed at the current rate of consumption).

Also, dependence on domestic oil supply is preferred over imported oil, as it avoids risks from geopolitical insecurities and exchange rate uncertainties. The literature on geopolitical oil supply risks makes a distinction between short and long-term risks. Short-term risks are usually linked with supply shortfalls due to acute weather conditions, localized terrorist attacks, accidents, and other events that affect 'operational security' or 'systems security'. Long term risks to oil security are associated with the supply shortfalls due to the major changes in the political set-up, strategic actions and policies of producing countries, large scale damages to oil-producing facilities or reservoirs, decline in investment in oil production and transportation facilities, market failures or government failures (CIEP, 2004; INDES, 2004). The impact of geopolitical uncertainties (such as the oil embargo of 1970 by OPEC) on an economy can be measured by a large number of indicators, such as level of imports, diversification of supply sources, political risk in the supplying countries, and market liquidity.

Data Analysis Procedures

The higher the level of imports, the greater the possibility and cost of disruption, if it occurs. The higher the geographical diversification of the supply sources, the lower is the risk associated with the loss from any particular supply source. Currently, the overall supply capacity is not substantially higher than the world demand. Any small disruption, therefore, can affect different countries differently, depending on their sources of supply. Despite the oil market being global, diversification is important as a large quantity of oil exported by producing countries is sold on term contract basis and is not available for open oil market trade.

Thus, in case of a sudden oil disruption, it may not always be possible to arrange new oil supplies immediately (even by offering higher prices).⁸ In addition, diversification in favour of economies that are politically more stable can further shield importing countries from geostrategic risks. Another important factor that determines geopolitical risk is the size of domestic demand relative to world supply and is termed as market liquidity. This measures the ability of a given country to switch between various suppliers (see Blyth and Lefevre, 2004; Van Hove, 1993; Neff, 1997; von Hirschhausen and Neumann, 2003; ECN, 2004; Gupta, 2007).

Energy intensity and oil intensity of the economy

The GDP's Energy intensity is calculated as the ratio of total consumed energy to the GDP of the country. While the country's aggregate supply of primary energy has increased, the economy's energy intensity, represented in the ratio i.e. primary energy per USD 1000 of GDP¹⁰ has decreased over the time (Figure 7). The GDP's energy intensity can be determined by the share of various sectors involved in the economy, efficiency of (energy) consumption, level of industrialization and also the lifestyle patterns.

Therefore, the main factor that helps in determining the overall energy demand is the industry share in the total outcome. This share of industry has remained constant in the range between 19% and 21% but also has been decreasing in last half decade. Some other factors such as low

level ownership of vehicle and expensive energy for industry have affected the energy intensity trend (Prayas, 2009). This declining trend, however, also reflects that growth in consumption of energy is slower than economic growth of the country.

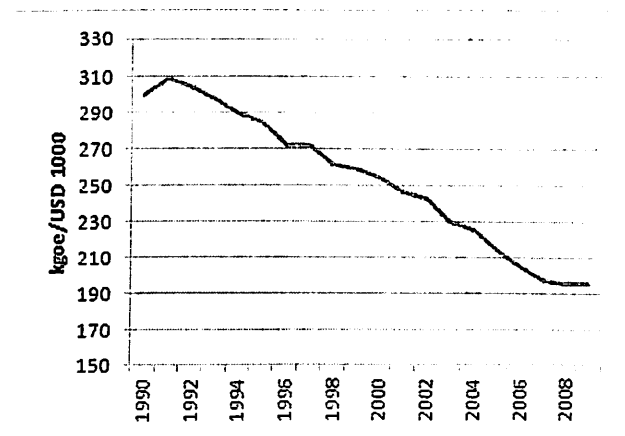


Figure 7 Energy Intensity of GDP

Source: UNESCAP

In order to determine the effect of oil shocks on the national or international economy it is also necessary to analyze the share of oil in the overall energy basket. In Figure 8 Share of oil in total primary energy consumed in the past two decades.

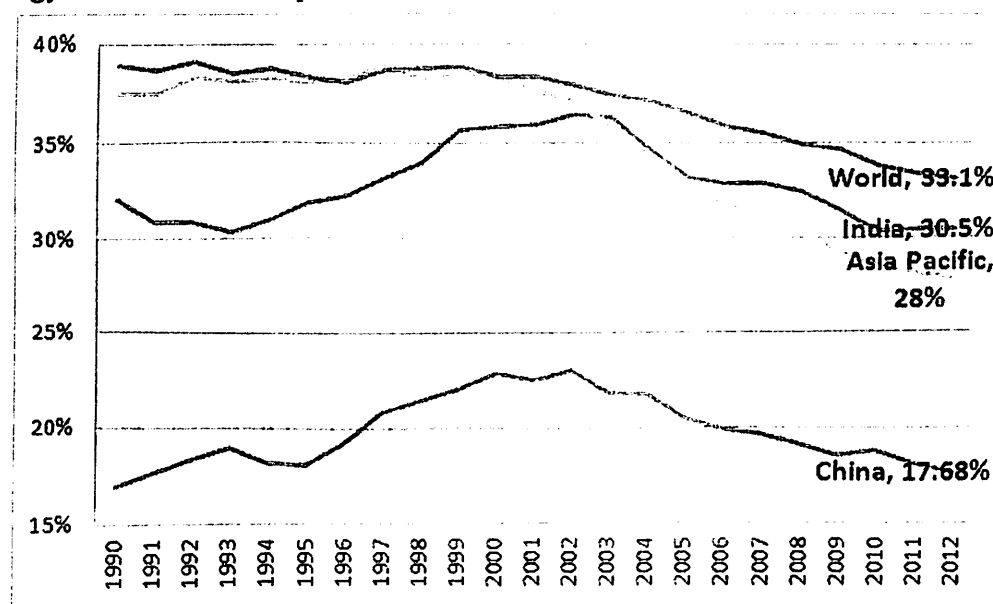


Figure 8 Share of oil in total primary energy consumed (in %)

Source: (BP, 2012)¹¹

As it is to be noted, the share of oil in the market has remained between 25% and 35% largely. This percentage has been always below the total world average but it is more than average in the Asia Pacific. In China, the reason behind the smaller oil share in the basket of energy is the coal predominance in the energy basket of the country which forms approximately 70% of the overall energy consumption in the country.¹²

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.

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

In the past, specifically during the periods of oil shocks, the intensity was recorded high in 1973 when the Arab oil embargo and during exports suspension from Iraq in 2001 and the Iraq war in 2003. In India dependency on oil (total 29% in 2011) closed to the global average 33% (BP, 2012).

According to the policy that moves towards introducing factors or measures in order to enhance the energy efficiency, the intensity of energy is expected to decrease further to meet the goals set for various sectors under different policies. Oil dependence however, is projected to be continued. In the reference scenario, as per projections by TERI, share of oil in the overall energy basket is going to be nearly 39% in period 2031-32 (TERI, 2009a).

Fuel diversity in the key consuming sectors

In addition to this dependency on crude oil imports, the fuel diversity is also a factor of vulnerability to shocks in the market. One of the major crude oil consumers is the transport sector in the country and records for approximately 40% total oil consumption in the country (Figure 9). In the transport sector, petroleum fuels form above 95% of the energy basket.

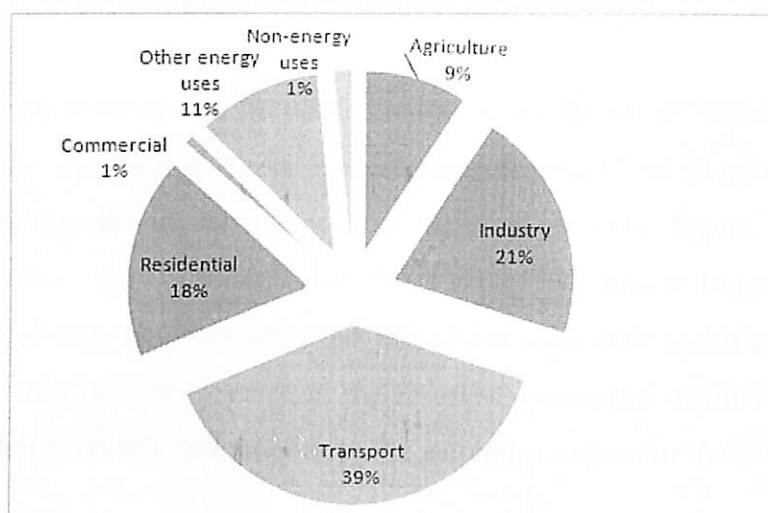


Figure 9 Sector-wise consumption of petroleum products in 2010-11

Source: (TERI, 2013)

In the energy basket of the sector, this lack of diversification makes it vulnerable to any kind of shocks in the market. On the other hand, in recent times, diversification to some other energy resources such as electricity and natural gas has been witnessed; the sector depends mainly on petroleum products such as primarily petrol and diesel in order to meet its demand that is continually rising. As regards some other sectors for example industry, while this sector is considered as vulnerable to any type shocks in demand, supply or prices, the total effect gets muted just because of the lesser share of products that are oil based in the energy basket of the sector as power and coal form the largest shares of the total consumed energy.

Availability of foreign exchange reserves to pay for oil imports

Foreign exchange reserves can be considered as a key factor of vulnerability to oil to pay for importing oil. As indicated in Table 3, increasing oil prices lead to extremely high requirement of forex, given the rise in dependency on crude oil imports. Figure 10 presents the foreign exchange's reserve levels in India. While there is rapidly increase in reserve stock in the period (2000-01 to 2007-08), and thereafter the period has seen both stabilization and decline of the reserve stocks. The lack of increase in the reserves causes the steadily increasing prices of oil and the dependency on of crude imports make a country to pay for these imports under duress.

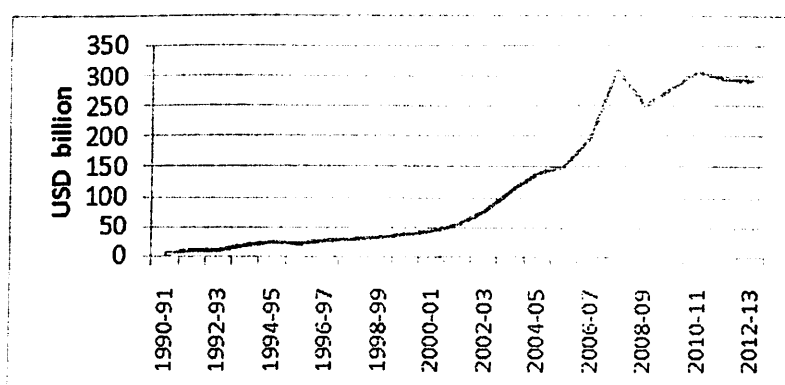


Figure 10 Foreign exchange reserves in India

Source: RBI (2012)

On the account balance and front foreign reserves current, to determine the vulnerability to shocks and to mitigate them, the country's export earnings is another important factor (Figure 11). Oil is imported from a large share of the overall earnings of export and currently stands at nearly 56% of the overall exports (acc. to RBI, 2013). In the last two years, this share has increased with crude oil prices upward movement and thus leading to a trend of trading for

petroleum products and oil. There is an interesting trend that can be noted also in the form of exports which comprise of earning from oil and petroleum products¹³.

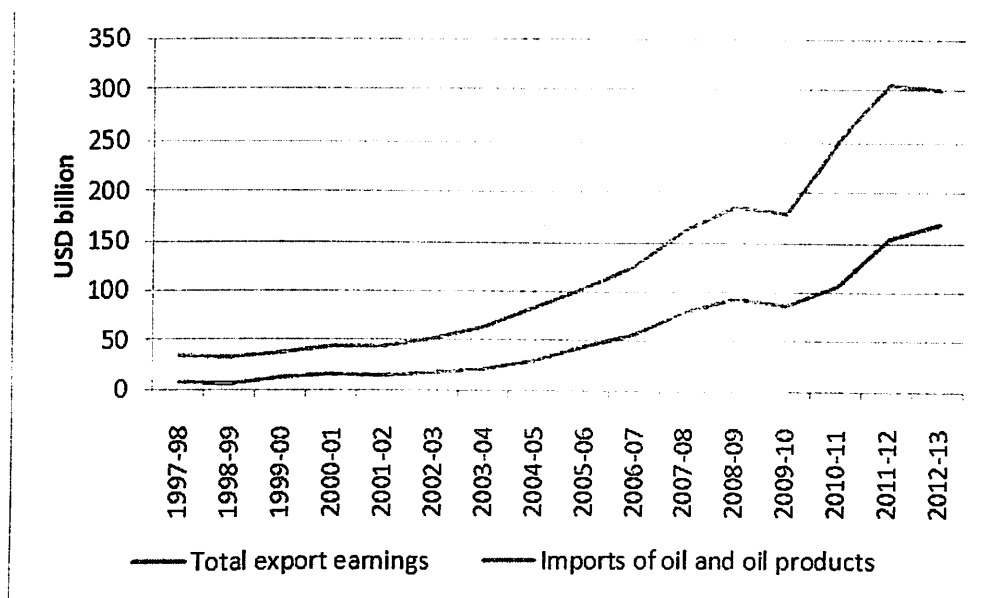


Figure 11 Trend of export earnings vs. oil import payments

Source: RBI (2013)

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

Finding & Analytics

Impacts of oil shocks on the Indian economy

Now we are going to examine the affects of oil shocks on the economy of India. As mentioned in the previous sections, these oil shocks are having significant effect on critical variables of macroeconomic, particularly nations that are imports dependent in order to meet the oil domestic demand. This is really true in case of India also. An analysis of these affects like one that is carried out for the economy of US by Hamilton may not possible in case of India. This is mainly because of the absence of overall pass-through on prices of domestic as the Government manages control over the refined petroleum products prices. An analysis like this would therefore need a CGE based model as the preview of this paper.

On the other side, an understanding of affect of global oil shocks can be made by identifying the key factors of macro-economic that reflect the vulnerability to these shocks.

On the basis on available literature, summarized in the previous section, the key factors of macro-economic which reflect the affect of oil price volatility include:

- Growth rate of GDP
- Current account balance and Overall import bill
- Fiscal balances

Descriptive Statistics

GDP growth rate

It can be noted from the Figure 13, in the past, the periods of high prices of oil having, highly coincided with lower GDP growth rates.

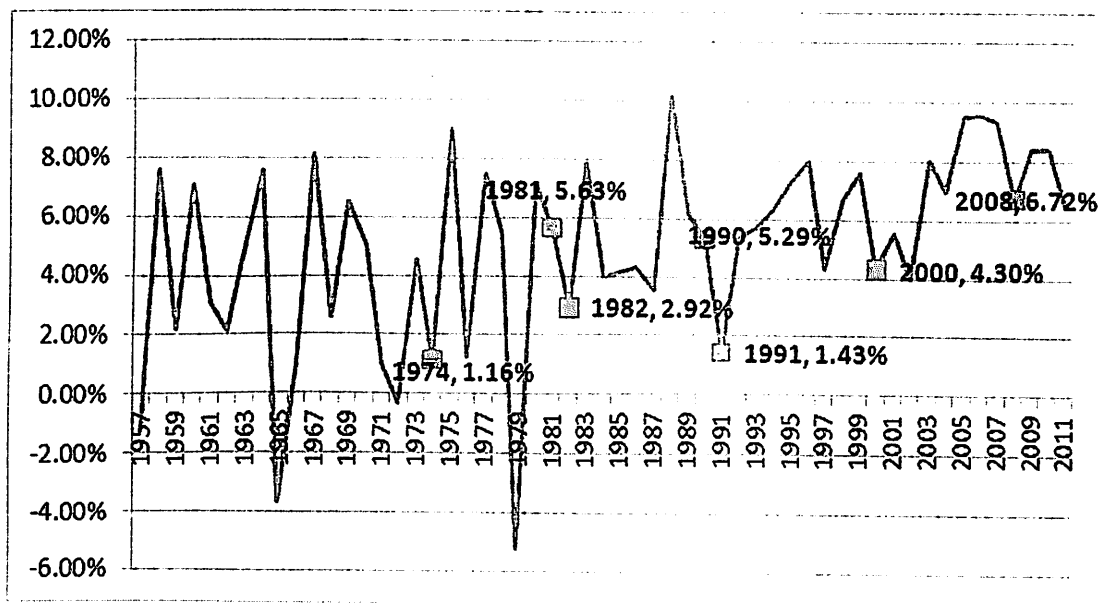


Figure 12 Trends in year-on-year GDP growth rates

Source: RBI (2012)

While there can have been some other factors at these points, affecting the growth rate, but in the global markets, the high crude oil prices have reflected on the country's domestic economy due to the affect on current a/c balances, and also because of their affect on the fiscal balances that ultimately affect the country's income. The perceived relations and high correlation and also channels through which these oil shocks affect domestic economy are one of the indications of the affect that these are having on the economy's performance.

Interpretation of Results

Import bill and current account balance

Increasing prices of oil will get reflected in the overall current account balance for the countries dependent on imports. As mentioned earlier, dependency of India on imported crude oil has increased substantially (for reference see Figure 3). This has adversely also affected the overall trade balance. Petroleum products and Crude oil forms approximately 32%¹⁴ of the overall import bill of the country and in the past years, this share in the market has increased on the account of both – the price at which country imports the crude oil and as well as an increase in the volume of imports..

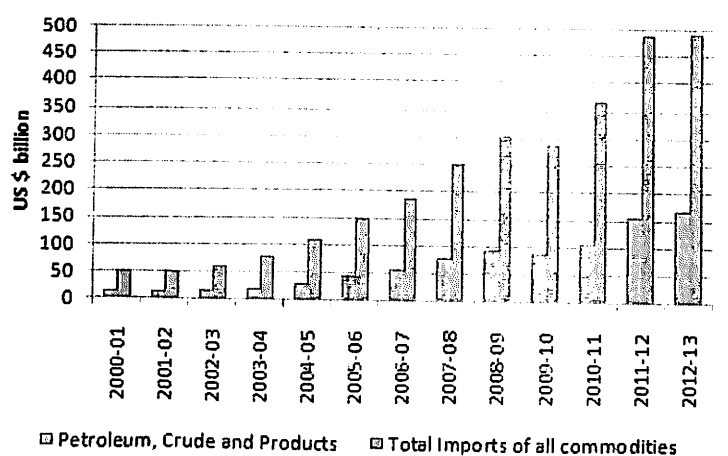


Figure 13 Share of petroleum, crude and products in the total imports

Source: RBI (2013)

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

Over time, with an increase in refining capacity of the country, the share of petroleum products exports in the overall export basket has increased also from below 1% (1970-71) to above 18% (2011-12). Therefore, not only the debit side of the country's current account balance is affected by variations in global prices of oil but the credit side is also affected.

Comparison of Results with Assumptions (Hypotheses)

Fiscal balances: the impact of subsidies

The subsidies on selling of these petroleum products and the government regulation of the prices of such products, volatility of prices of crude oil is likely to affect the revenue and fiscal balances of the government. In India, the prices of petroleum product have been controlled historically by the government. After the first oil shock in the 1970s, there were an Administered Pricing Mechanism was established wherein the government regulated the refined products prices. During the period of five years (1997 to 2002), a first attempt was made to deregulate the prices of petroleum products and dismantle the APM.

However, with increasing global prices of crude oil, an ad-hoc pricing policy was followed by the government. While a reduced could be seen in the fiscal subsidies, oil bonds were given or issued to oil companies in order to meet the increasing under-recoveries. It was decided in 2008-09 that the oil bond which is based on compensation mechanism would not be continued and through budgetary allocation, the burden of subsidy would be met. In the past five years, in under-recoveries, the share of government has increased. A significant portion is formed now by oil subsidies to the overall budget expenditure and oil shocks in global prices of crude oil will not be allowed to pass-through to the final prices and resulted in an increase in the proportion.

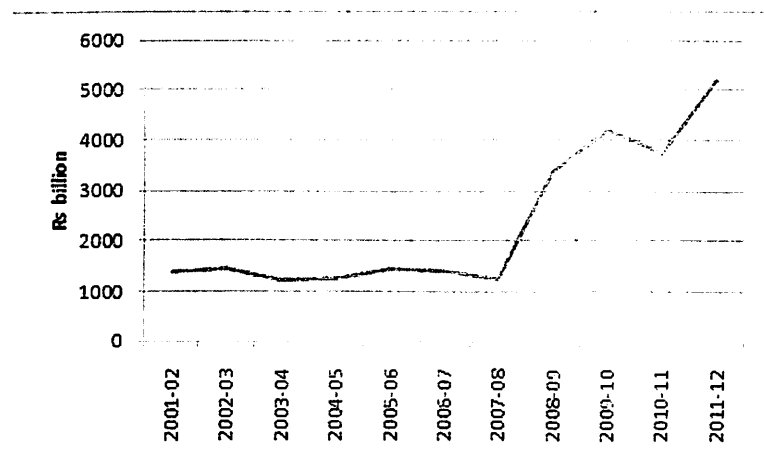


Figure 14 Gross fiscal deficit (2001-02 to 2011-12)

Source: RBI (2012)

Conclusion and Scope of Future Work

Managing vulnerability to oil shocks

As the dependency on imports of oil is likely to be continued and so this dependency is the vulnerability to oil shocks, it is necessary to look at factors that make it possible to reduce this vulnerability and to build resilience to oil shocks.

In the **short term**, to build defenses against price shocks and supply by constructing SPRs (Strategic Petroleum Reserves) provides the immediate defense against such shocks in demand or even supply. Further, Strategic Petroleum Reserves also having the potential in order to act as a strategic signal opposing any intended supplies blockage.

According to the estimates available as of December 2009, India already possessed around 74 days of tappable storage commercial capacity (OIDB, 2009). SPRs Construction is already underway, and when the first phase will be completed, it will add 5.33 MT of the oil storage. The second phase of construction is being planned also and 12.5 MT will be added to the country's strategic oil stocks by it. However, in addition to own stocks of the country, collaboration with other countries required to be adopted. In this context, to have agreements with supplying and consuming countries is necessary and essential. Since any maritime blockage or supply shortage is likely to affect most of the oil consumers from Asia, a programme to create and maintain the strategic oil storage capacities among these countries and this programme is expected to help in addressing such short term oil supply shocks.

For reducing the affect of price of oil shocks on the country's domestic economy, it is not easy but critical to review the policy of the country on subsidies on fuel and also to manage the agenda of energy access in a sustainable manner. It is already mentioned in the previous sections, subsidies on petroleum product form a large proportion to the total fiscal outgo of the country.

In the **medium to long term**, efforts need to be made to diversify the crude oil imports sources and substitution towards other alternatives. It has been stated previously that nations from the Middle East region constitute the biggest sources in supplying crude oil for India. Efforts are needed to be made in order to diversify the country's oil import portfolio and also to enhance good and diplomatic relations with the oil producing nations. Some cross investments wherein oil producing companies are allowed in making investments in India's energy infrastructure can be considered also (TERI, 2009b).

Nations from Africa and Latin America some vital options are provided. In the last few years, from Venezuela, crude oil imports have increased from below 2 Mt (2007-08) to approximately 10 MT (2011-12). Similarly, from Nigeria, oil imports have also increased in last few years, from approx. 10 MT (2007-08) to the over 14 MT (2011-12). Increasing oil imports from these nations and furthering bilateral bonds with respective Governments are going to form a key component of oil security policy of India in the coming years..

In the medium term, to enhance the production of domestic oil, policies are also needed to be encouraged, and companies which are good in exploration, need to be invited in order to participate in this upstream industry. Substantial effort would also be required on the domestic front to make data of high quality available for various oil basins.

Furthermore, to reduce the dependency on oil altogether, some efforts are needed to be made to move towards other alternative sources of oil supply. Mostly in the transport sector, some policies have been introduced already but the enforcement of these regulations, highly coupled with investments to make the overall value chain feasible required to be provided..

The increased share of renewable is also notable in the overall energy mix of the nation. An emphasis has been put to develop the country's energy generation capacity based on solar. With the JNNSM (Jawaharlal Nehru National Solar Mission), the overall power generation capacity based on solar is set to increase to 20 GW by year 2022. The average tariff has also reduced by above Rs10 per kWh in only two round of bidding. There are some more significant gains are in

the store for the sector having increase in the production scale in this sector and the improvements are being started in terms of technology. Some measures are introduced such as renewable buy obligations, feed-in tariffs, and government support will also boost the efforts made to diversify the basket of energy.

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