Oil price shocks and sectoral stock markets in an emerging economy

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November 2018

1 Introduction

Oil is an essential commodity, associated directly with production and receives noticeable attention for its impact on the economy. Since the first shock to the oil prices in 1973, numerous studies have examined the macroeconomic impacts of oil price shocks on various countries. Pioneering work by [Hamilton, 1983] linked the economic contractions in the US to oil price increases in the 1970's. Since then various researchers have attempted to study the transmission of oil price shocks finding significant impacts of these shocks across economies.

From a theoretical point of view, oil prices can affect the economy through several channels. Oil price shocks have been associated with adverse impacts on production due to higher input costs [Balke et al., 2002], reducing demand via inflationary pressures [Loungani, 1986, Edelstein and Kilian, 2007], affecting the natural rate of unemployment [Davis and Haltiwanger, 2001], depressing investment due to their impact on uncertainty [Ferderer, 1996]. Oil prices can also depress aggregate demand by transferring income from oil importing countries to oil exporting countries [Brown and Yücel, 2002].

Thus, it has been well established in literature that oil prices impact macroeconomic aggregates. However, the impact of these shocks go far beyond just the macroeconomic aggregates. These macroeconomic variables shape investor sentiment about an economy, determine their consumption and investment decisions further affecting the stock market movements. The stock markets of a country are an integral part of the dynamics of economic activity. They are usually considered as an indicator of country's social mood, economic strength and development [Hamilton, 1983, Kilian, 2009, Mork et al., 1994]. Therefore the literature investigating the relationship between oil price and stock market returns have started emerging. It is important to understand this relationship for several reasons. First, increased correlations amongst the national stock markets due to increased globalization has weakened the risk reduction benefits of international market diversification. As a result of this, investors now seek industry based diversification within a country or in

international stock markets. At the same time, higher oil prices may have dissimilar effects on different industries because of the dissimilar dependencies on oil. Thus, industry-level analysis, in addition to market level analysis, is crucial in revealing the effects of oil price shocks masked by the aggregate stock market effect, and it is important for investors to fully account for the differences in sectoral oil sensitivities when implementing sector-based investment strategies. Large fluctuations in oil markets lead to increased price volatility, which affects price stabilization policies and imposes more challenges on market participants (producers, consumers, and investors)[Bouri et al., 2017]

[Jones and Kaul, 1996, Sadorsky, 1999, Papapetrou, 2001, Park and Ratti, 2008, Basher et al., 2012] confirm the existence of a significant relationship between oil price fluctuations and the stock markets.

[Kilian, 2009] argues that most of the existing studies look at oil price shocks in a linear or non-linear setting, relying on the implicit assumption that oil price changes exclusively originate from the exogenous supply side of the oil market. Following a short period of a price drop in 2001, oil prices have increased steadily and substantially since 2002 reaching a record high in the summer of 2008. Unlike the 1980s, where oil price rise was associated with economic recessions, the recent oil price surges have not brought a sharp economic downturn. While historical oil price increases were linked to supply shocks from wars and political uncertainty in oil exporting countries, the recent increase in oil price has been attributed to the strong market demand [Hamilton, 2009]. In the wake of these changes, some researchers suggested that it was important to disintegrate the oil price shocks into those that come from shocks to oil supply and those that originate from shocks to oil demand. Studies by [Kilian, 2009], [Peersman and Van Robays, 2009], [Kilian and Murphy, 2012] find that there are significant differences in the impact of these two shocks on the economies. As a result, these studies proved that the routes through which oil prices can affect the economy go beyond the simple mechanisms that were originally employed[1],[2].

The goal of the paper is to use this oil price distinction proposed by [Kilian, 2009] in order to assess the impact of oil price shocks on the sectoral stock markets in India. Understanding the relationship between oil prices and stock market prices in an emerging economy like India is an important topic to study because the emerging economies continue to grow and are expected to exert a larger influence over the global economy. Due to its strong

[1]The sharp decline of prices in the second half of 2008 coincides with the rapid decline in aggregate demand due to the worldwide recession. From 2010 to early 2012, the oil prices increased again mainly due to realized aggregate demand shocks stemming from emerging economies as well as expected future supply shocks due to uncertainty in Middle East after the Arab spring.

[2]The sharp fall in oil prices after June 2014 has been attributed to a number of factors. According to [Baffes et al., 2015], these include, several years of upward movements in the production of unconventional oil, weakening global demand, a significant shift in OPEC policy, unwinding of some geopolitical risks and an appreciation of the U.S. dollar.

growth, India has also become a popular destination for international investors. According to a report by U.S. Energy Information Administration (EIA), India was the fourth-largest consumer of crude oil and petroleum products after the United States, China, and Japan in 2015, and it was also the fourth-largest net importer of crude oil and petroleum products. The gap between India's oil demand and supply is widening, as demand in 2015 reached nearly 4.1 million barrels per day (b/d), compared to around 1 million b/d of total domestic liquids production. EIA expects demand to accelerate as India's transportation and industrial sectors continue to expand under economic development, oil price declines since mid-2014, and recent government policy initiatives to increase highway and road infrastructure and promote Indian manufacturing.[3] Indian markets share a deep nexus with international crude oil. Nearly all industries, consume oil as a natural resource in some way or the other. From the industries' perspective, it is expected that high oil prices lead to increase in the overall costs of goods, causing their profits to plunge which in turn will impact its performance in the stock market. From the investors' perspective, increasing oil prices leads to rise in inflation due to which Central Bank hikes the interest rate, leading to a shift in the investment returns from stock markets [Singhal and Ghosh, 2016].

Given the importance of oil for an importer such as India, it is imperative to study the impact of oil price fluctuations on the Indian Stock markets, more so in a sectoral setting. The existing studies for India include [Jain and Biswal, 2016] who study volatility transmissions at the market level instead of sectoral level and [Singhal and Ghosh, 2016] who look at the time varying co movements between oil prices and stock returns both at aggregate and sectoral level. They however, do not distinguish between the different sources of the oil prices shocks as proposed by [Kilian, 2009].

This study adds to the existing literature in two ways: 1) It augments the existing literature on developing countries by including sectoral stock markets 2) It uses the distinction made between supply and demand shocks to study these effects. The paper proceeds as follows, Section 2 introduces the econometric methodology used in the paper. Section 3 discusses the results and section 4 finally, concludes.

2 Data

The data used in this paper is monthly data spanning 2000:1- 2018:5.[4] The data on global crude oil production is obtained from EIA. The data on oil prices are obtained from World bank commodity price as the US dollar price of Brent crude and the data on US CPI is obtained from the FRED. The data for

[3] https://www.eia.gov/beta/international/analysis.php?iso=IND

[4] The index for real economic activity used by [Kilian, 2009] is an older version of the index. The updated version which has been used in this paper is available on Lutz Kilian's website.

the sectoral stocks returns on India is obtained from Bombay Stock Exchange sectoral historical indices. The data for the sectoral stock market contains monthly data from 2000:1- 2018:5 for BSE Sensex, Health care, Metals, Oil Gas, Auto, Consumer durables. Data for Industrials, Utilities and Finance starts from 2005:9-2018:5. The period of the study is motivated by the availability of the data for the Indian stock market prices. Oil prices are expressed in logarithmic real dollar terms. The stock returns are expressed in the form of real returns by adjusting the continuously compounded returns for inflation in India.

S&P BSE SENSEX is a free float market capitalization based index that represents the movement of stocks of the 30 most financially sound and actively traded firms. These 30 stocks belong to the different sectors of the economy therefore SENSEX, which indicates the average movement of these sectors, is the representative of Indian economy. Since Brent crude comprises significant share in the Indian crude basket, therefore, it has been taken as a proxy for the crude oil market movements.

Figure 1 exhibits the evolution of the series during the sample period.

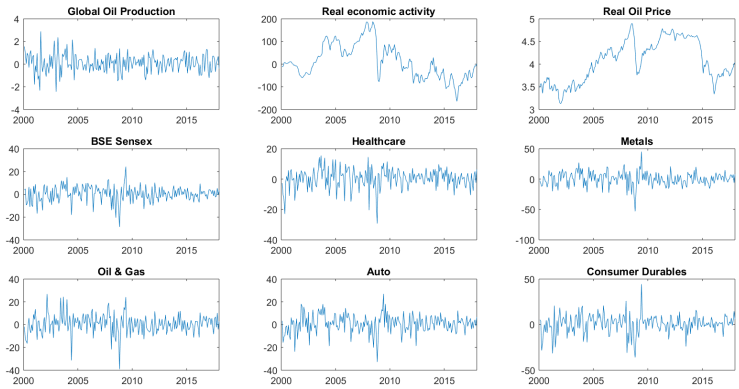

Figure 1: Time-series plots of data used in the analysis:2000:1-2018:5

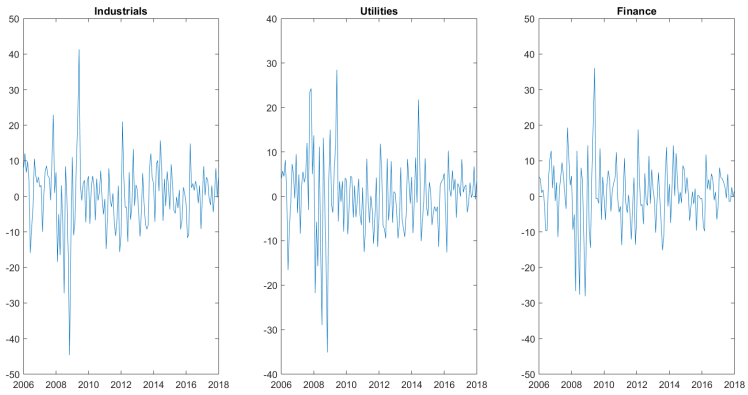

Figure 2: Time-series plots of data used in the analysis:2005:10-2018:5

The effect of the 2007/09 global financial crisis is evident in figure 1 and 2, where stock market returns (aggregate and industrial sectors) exhibited negetive returns and the aggregate stock market return fell by almost 51 percent between January 2008 and October 2008 in the midst of the crisis. In addition, the global economic activity index suffered a huge drop of about 145 percent during the same period of time, suggestive of the global economic downturn. Similar patterns are observed in the oil price movement which also dropped by 42 percent from $92 to $53 during the same period.

3 Methodology

As put forth by several authors, the impact of oil price shocks crucially depends on the source of oil price fluctuations. In a first stage of the econometric analysis, I therefore follow [Kilian, 2009] and identify three oil price shocks - driven by either oil supply, global demand, or oil specific demand - in a structural VAR. In the second stage I analyze the effect of these shocks on aggregate and sectoral stock returns in India.

3.1 Econometric Methodology

The VAR model is specified as Follows

$$A_0 y_t = \alpha + \sum_{i=1}^{24} A_i y_{t-i} + \epsilon_t \tag{1}$$

where y includes : i) The percentage change in global crude oil production ii) An index of real economic activity iii) The log real oil price in dollars, deflated using the US CPI and ϵ_t denotes the vector of serially and mutually uncorrelated

structural innovations. [Kilian, 2009] argues that A_0^{-1} has a recursive structure such that the reduced-form errors e_t, can be decomposed according to e_t, $= A_o^{-1}\epsilon_t$:

$$e_t = \begin{bmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} \epsilon_t^{oilsupplyshock} \\ \epsilon_t^{aggregatedemandshock} \\ \epsilon_t^{oilspecificdemandshock} \end{bmatrix} \tag{2}$$

As discussed in [Kilian, 2009], the restrictions on A_0 may be motivated as follows. Crude oil supply shocks are defined as unpredictable innovations to global oil production. Crude oil supply is assumed not to respond to innovations to the demand for oil contemporaneously. This is plausible as oil-producing countries will be slow to respond to demand shocks, given the costs of adjusting oil production and the uncertainty about the state of the crude oil market. The model also imposes the exclusion restriction that increases in the real price of oil driven by oil market specific shock will not lower global real economic activity immediately, but with a delay of at least a month. This restriction is consistent with the sluggish behavior of global real economic activity after each of the major oil price increases in the data. Finally, innovations to the real price of oil that cannot be explained based on oil supply shocks or aggregate demand shocks by construction will reflect changes in the demand for oil as opposed to changes in the demand for all industrial commodities. This shock in particular represents fluctuations in precautionary demand for oil driven by uncertainty about future oil supply shortfalls.

The second stage of this approach conditions the sectoral stock returns in India to the shocks estimated in the first stage. Following [Kilian, 2009], the oil shocks are treated as predetermined, so that the identified shocks to the global oil market are the same for each industry. In other words, domestic variables do not affect global oil market variables. A similar approach has been used by [Lee and Ni, 2002]. Treating the oil shocks as predetermined we can examine their effects on the India stock markets based on the following regressions:

$$\Delta x_t = \alpha_j + \sum_{i=0}^{24} \phi_{ji} \widehat{\epsilon}_{jt-i} + \mu_{jt}, j = 1, 2, 3 \tag{3}$$

where j=1,2,3 represents the index of the three different oil shocks and Δx_t is the change in the real stock returns. In this regression model the impulse response coefficients at horizon h corresponds to ϕ_{jh}. In conducting inference on the response estimates implied by model (3), the possible presence of serial correlation in the error term is dealt with by using block bootstrap methods.[5]

[5] All results in this paper are for block size 4 and 20,000 bootstrap replications.

4 Results

4.1 Indian Economy

4.1.1 Oil price shocks

The reduced-form VAR model is consistently estimated by the least-squares method. The resulting estimates are used to construct the structural VAR representation of the model. Inference is based on a recursive-design wild bootstrap with 2000 replications. Figure 3 shows the movement of real oil prices over the period 2000-2018. Between January 2007 and August 2008 the oil prices rose sharply from $54 to $133.9 experiencing a surge of almost 147 percent during this period. As explained in detail later, this increase has mainly been attributed to the strong growth in oil demand. The sharp decline following mid 2008 coincides with the financial crisis which led to a decline in economic activity and hence a fall in the demand for oil. However, as the economy gained momentum, oil prices also increased from as low as $41.6 in December 2008 to $110.6 in December 2013. These movements in oil prices have been a result of a mix of demand and supply shocks as will be explained in detail later.

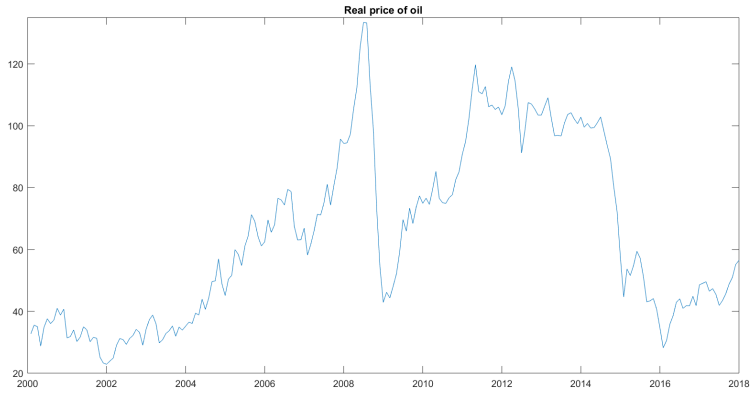

Figure 3: Real oil price movements between:2000-2018

Figure 4 represents the time path of the structural shocks implied by the model (expressed as annual averages). Figure 4 shows that, at any point in time, the real price of oil responds to a multitude of shocks, the composition of which evolves over time.

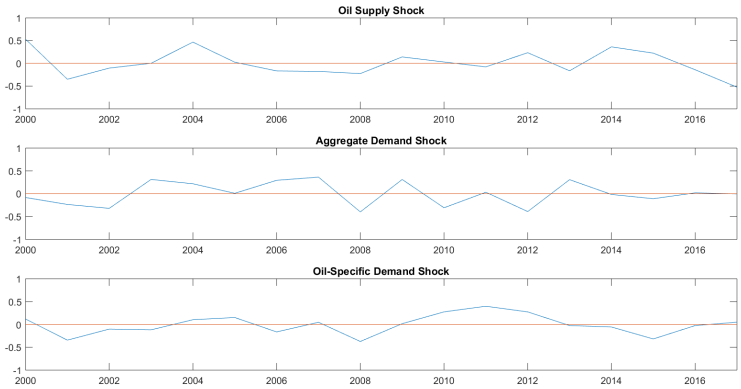

Figure 4: Evolution of the structural shocks over the period:2000-2017

Positive shocks to the global demand have been repeated since 2003 and a large negative shock occurred in 2008. [Baumeister and Kilian, 2016a] provide a brief account of the oil price movements between 2000 and 2014 and how they respond to different shocks related to demand and supply over time, as is evident in Figure 4. They claim that the most remarkable surge in the price of oil since 1979 occurred between mid-2003 and mid-2008 with the WTI price climbing from $28 to $134 per barrel. There is widespread agreement that this price surge was not caused by oil supply disruptions, but by a series of individually small increases in the demand for crude oil over the course of several years. Authors such as [Hamilton, 2009], have made the case that these demand shifts were associated with an unexpected expansion of the global economy and driven by strong additional demand for oil from emerging Asia (China and India) in particular. Because oil producers were unable to satisfy this additional demand, the price of oil had to increase.

The sharp decline in prices in mid 2008 post the financial crisis illustrates the powerful effects of a sharp drop in the demand for industrial commodities on the price of these commodities. As orders for industrial commodities worldwide were sharply curtailed in the second half of 2008 in anticipation of a major global recession, if not depression, the demand for commodities such as crude oil plummeted, causing a fall in the price of oil between June 2008 and February 2009. When it became clear in 2009 that the collapse of the global financial system was not imminent, the demand for oil recovered to 2007 levels.

There have been a number of smaller demand and supply shocks in the oil market between 2010 and early 2014. For example, events such as the Libyan uprising in 2011 were associated with an increase in the price of oil. Between June 2014 and December 2014, the monthly average price of Brent crude oil fell by $49, which amounts to 44% of its original value. The

decline in oil prices in 2014 between July and December has been analyzed by [Baumeister and Kilian, 2016b]. They trace the predictable component in the price of oil in part to the cumulative effects of adverse demand shocks prior to July 2014 that reflected an unexpected slowdown of the global economy. They also trace it in substantial part to the cumulative effects of positive oil supply shocks and to shocks to expected oil production that occurred prior to July 2014.

The recent increase in oil prices between 2017 and 2018 has been a combination of multiple factors. Crude oil prices have probably been driven higher for three reasons: falling global oil inventories, heightened market perceptions of geopolitical risks, and strong global economic growth signals. In a report the EIA stated that global oil inventories fell an average of nearly 0.6 million barrels per day (b/d) in each of the five quarters between (January 2017 through March 2018). Several geopolitical risks presented sources of uncertainty. These risks, including the re-imposition of oil sanctions against Iran and the upcoming results of May elections in Venezuela, that may have materialized into actions that remove oil supplies from the global market and, in turn, tighten global oil balances. At the same time, global liquid fuels consumption was quickly increasing. Greater GDP growth could put upward pressure on crude oil prices, and simultaneously drive systemic market movements in equities, bonds, and other commodities, which are often correlated with movements in crude oil prices.[6]

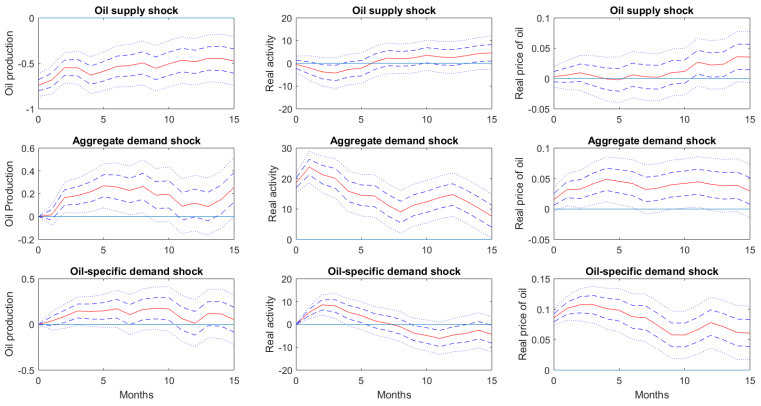

Figure 5: Responses to One-Standard-Deviation structural shocks

Figure 5, shows the responses of global oil production, real economic activity, and the real price of oil to one-standard deviation structural innovations. All shocks have been normalized such that an innovation will tend to raise the

[6] https://www.eia.gov/todayinenergy/detail.php?id=36152

price of oil.

An unexpected shock to the oil supply causes a sharp decline in oil production, followed by a subsequent reversal of the decline within the first year. As explained in [Kilian, 2009], this pattern is consistent with the view that oil supply contractions in one region tend to be followed by production increase somewhere else. At the same time, this shock leads to temporary but insignificant decline in the global real activity. The impact on price is initially insignificant and rises significantly only after a 10 month lag.

An unanticipated aggregate demand expansion leads to a significant increase in global real economic activity. Unanticipated aggregate demand expansions also lead to an increase global oil production with a delay of about a month. Finally, aggregate demand expansions also cause an immediate, large, persistent, and statistically significant increase in the real price of oil.

An unanticipated oil market-specific demand shock has an immediate, large, and persistent positive effect on the real price of oil that is highly statistically significant. There is evidence of overshooting in the response, as predicted by theoretical models of precautionary demand [Alquist and Kilian, 2010]. These shocks are also associated with a temporary increase in real economic activity. As opposed to [Kilian, 2009] where they find a very short decline in production, we find that for our sample, this shock leads to a partially significant increase in global oil production with some delay.

As noted [Kilian, 2009], our results show that shocks to oil supply have very little impact on oil prices. This result is consistent with the fact that oil supply shocks have little systematic predictive power for changes in the real price of oil. As suggested by Figure 8, most of oil price movements are caused by sharp increases in precautionary demand which stem from the uncertainty about future oil productions. As shifts in precautionary demand are ultimately driven by expectations about future oil supply shortfalls, and such expectations can change almost instantaneously in response to exogenous political events, they tend to trigger an immediate and sharp increase in the real price of oil. These results imply that the effects of the three shocks on the oil price differ in magnitude and persistence. Moreover, the effects of oil price changes on oil production and world industrial production are very different depending on what kind of underlying shock drives the oil price changes.

Figure 6 plots the respective cumulative contribution of each oil demand and oil supply shock to the real price of oil based on a historical decomposition of the data.

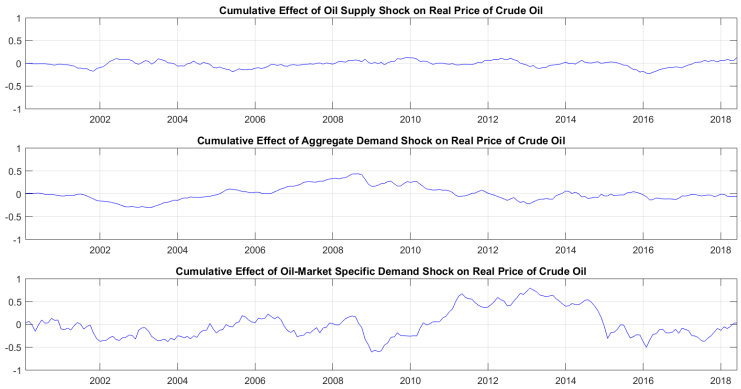

Figure 6: Historical decomposition of real price of oil

The results shows that oil supply shocks have historically made relatively small contributions to the real price of oil. On the other hand shocks to aggregate demand and oil market–specific demand have a significant contribution. Whereas, the aggregate demand shock caused long swings in the real price of oil, the oil market–specific demand shock is responsible for fairly sharply defined increases and decreases in the price of oil.

These results are as expected when one looks at the specific events. For example the aggregate demand shocks contribute to the oil price increase in the later half of 2000's which is associated with rising aggregate demand stemming from global growth particularly in Asian economies.

The sharp fall in the real price of oil following the financial crisis in the second half of 2008 appears to be due more to a decline in oil market–specific demand than the direct effect of a change in oil production (first panel) or the fall in real economic activity (second panel). Following 2010, most of the oil price movements can be attributed to changes in oil market specific demand as shown in the third panel. These results are consistent with an increase in precautionary demand in the wake of global events such as the Libyan uprising in 2011. The latest increase in prices have been a result of a combination of different factors such as the changes in global oil production and global uncertainty due to events such as the sanctions on Iran and the political changes in Venezuela both of which are important producers of oil

4.2 Indian Stock market

This study considers monthly historical index on BSE Sensex, and eight sector indices namely, Health care, Industrials Metals, Oil and Gas, Auto, Consumer

durables, Utilities and Finance. The real returns are obtained by adjusting the continuously compounded returns for inflation[7].

4.2.1 Aggregate stock Returns

Aggregate demand shocks are expected to mainly exhibit positive correlation with stock market returns as these shocks are primarily driven by the global economic activity. Thus, higher economic activity should drive stock prices up, at the same time when it increases the price of oil. The opposite effect is expected for oil-market specific demand shocks. These shocks generate uncertainty in the market, driving oil prices to higher levels, while at the same time stock prices down. Supply-side shocks are expected to show low or zero correlation with stock market returns considering that current evidence suggests these shocks do not currently exercise any important impact in the economy.

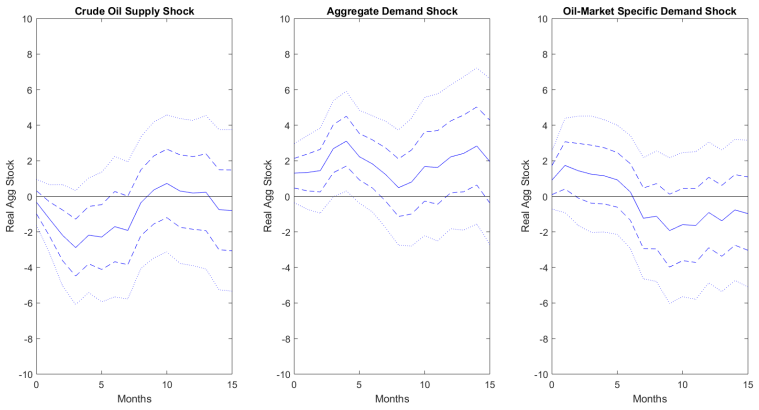

Figure 7: Cumulative responses of Aggregate Indian real stock returns point estimates with one and two standard deviation bands

Figure 7, shows the cumulative responses of aggregate stock returns in India to one standard deviation of the three structural shocks identified in the global oil market. The three structural shocks to the global oil market, which all tend to raise the oil price, have very different effects on aggregate stock returns. The results for the aggregate stock market highlight the point that the responses of aggregate real stock returns may differ substantially, depending on the underlying cause of the oil price increase. Unanticipated disruptions of crude oil production lead to a partially significant decline of the cumulative Indian

[7]The data for India CPI is obtained from FRED website. The CPI is indexed at 2010 prices

stock returns which lasts for about 8 months. These results can be expected for a small economy like India which relies heavily on oil for production mainly as an importer. In contrast, an unexpected increase in the global demand for industrial commodities driven by increased global real economic activity leads to a persistent increase in the aggregate stock returns that is partially statistically significant for the first 7 months based on one-standard error bands.

The results point to an interesting observation, where an unanticipated increase in aggregate demand, inspite of causing an increase in the real price of oil leads to an increase in the aggregate stock returns. While one might think that an increase in prices will have a negetive effect on the economy in general and therefore the stock returns, these results highlight the importance of identifying the channel of these oil price shocks. As pointed by [Hamilton, 2009] most of the oil price increase in 2000's was driven primarily by the growth in the demand for industrial activities mainly due to the growth in Asia stemming from India and China. This strong growth has resulted in positive investor sentiments about the Indian economy as a result of which the stock returns prove resilient to these oil price increases. This result is in line with the findings in [Kilian and Park, 2009] for the US stock returns and by [Apergis and Miller, 2009] for 8 different economies, who also find different effects due to oil supply and oil demand shocks.[8] These authors also found that global demand exerts a positive impact on real stock returns.

As opposed to expectations and [Kilian and Park, 2009] where they find a decline in the aggregate stock returns following a shock to the precautionary demand, a similar shock in India leads to a small short run increase in the aggregate stock returns which is partially significant for about a month. This increase experiences a reversal after about half a year but is insignificant. This suggests the idea that the oil-specific demand of India shouldn't be classified with the precautionary demand which is due to the uncertainty about the oil supply shortfalls. In contrast, it should be viewed as an indicator of economic development.

Several authors claim that the increased participation of hedge funds in oil markets has led to an increase in speculation. This inturn has created an increased correlation between oil prices and stock returns [Fattouh et al., 2013, Hamilton and Wu, 2015, Tang and Xiong, 2012]. This behaviour of the oil market could justify the positive relation between the stock market returns and the oil-market specific shocks. Overall, though, this finding implies that the India stock market is relatively more "secure" against oil market based risk.

[8] [Apergis and Miller, 2009] investigates how explicit structural shocks that characterize the endogenous character of oil price changes affect stock-market returns in a sample of eight countries — Australia, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States

Table 1 reports the variance decomposition reports results for the effects of each of the three structural oil shocks plus the stock-market returns shocks only on stock-market returns. The numbers reported indicate the percentage of the forecast error in each variable that we can attribute to each of the innovations at different horizons (from 1 month to 24 months). I report the percentages for selected forecast horizons (1, 5, 10, 15, 24 months).

Period	S.E.	OILPROD	REA	ROP	SENSEX
1	6.84	0.006	3.065	1.35	95.57
5	7.28	2.96	5.22	4.79	87.03
10	7.57	5.29	8.09	7.86	78.74
15	7.96	5.76	9.34	8.33	76.57
24	8.43	8.44	12.64	9.75	69.17

Table 1: Variance Decomposition of aggregate stock returns for India (percentage terms)

In the short term, the cumulative effect of the three oil price shocks accounts for only 4.5 per cent of the variation in the Indian real stock market returns. However, the effects of oil price shocks increases as the time horizon increases. In the long term, approximately 30 per cent of the variability in real stock market prices is accounted for by the three oil price shocks. Aggregate demand shocks accounts for approximately 12 per cent, whereas oil-specific shocks and oil supply shocks account for about 10 per cent and 8 per cent, respectively. This is consistent with the impulse response findings in the previous subsections in which the stock market prices responded mostly to aggregate demand shocks in a significantly positive manner. The explanatory power of the oil price shocks to variations in stock market prices suggest that crude oil market shocks are an important fundamental for the Indian stock market.

In sum, the impact of oil price shocks on Indian stock market differs depending on the source of the oil price shocks. The stock market responds negatively to an oil price shocks that originate from the supply-side, whereas it responds positively if the shock originates from the demand-side. The significant effect of the demand shocks justifies the growing importance of the demand component of oil price shocks over the supply shocks in the last decade.

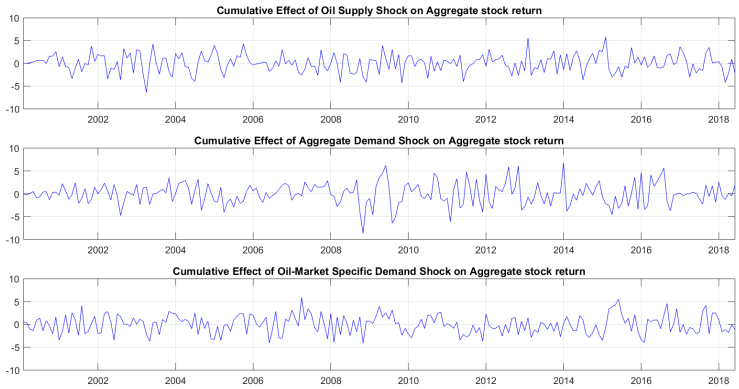

Figure 8: Historical Decomposition of aggregate stock returns for India

Figure 8 plots the historical decomposition of India's aggregate stock returns due to oil supply shock, aggregate demand shock and oil market specific demand shocks. The results show that the changes in the stock returns are a combination of all the three shocks, however these changes have been dominated mainly by the global demand shocks which is consistent with the results of regression model 3 as depicted in figure 10. The results of the historical decomposition show that contraction in mid 2008 was driven mainly by the decline in the global demand.

4.2.2 Sectoral Stock Returns

This section analyses the response of stock markets across sectors to different shocks to oil price. This exercise helps in determining portfolio choice for investors in response to the different types of shocks.

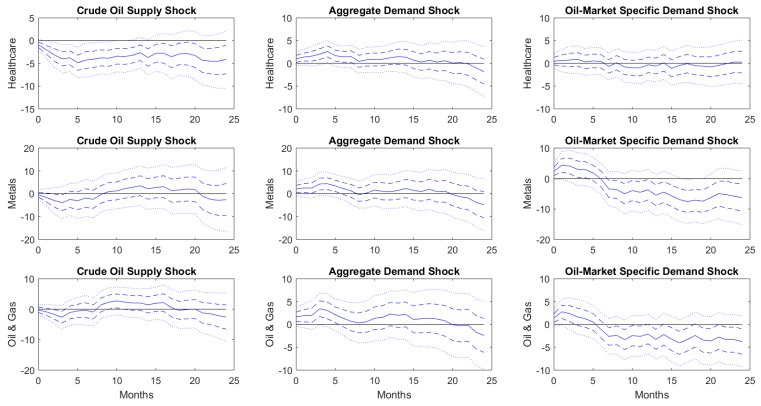

Figure 9: Cumulative responses of sectoral real stock returns: point estimates with one and two standard deviation bands

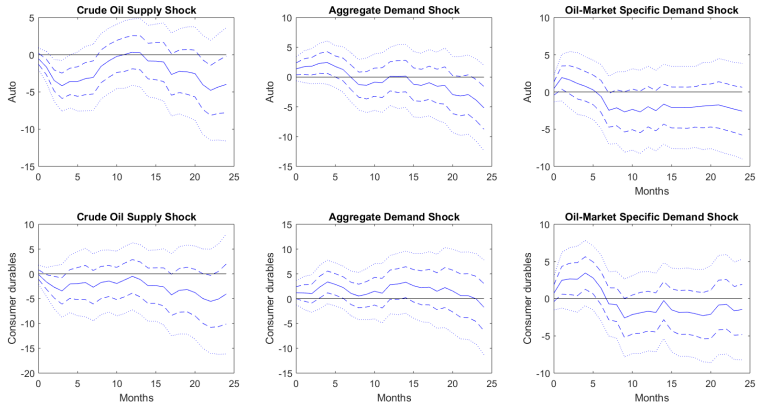

Figure 10: Cumulative responses of sectoral real stock returns: point estimates with one and two standard deviation bands

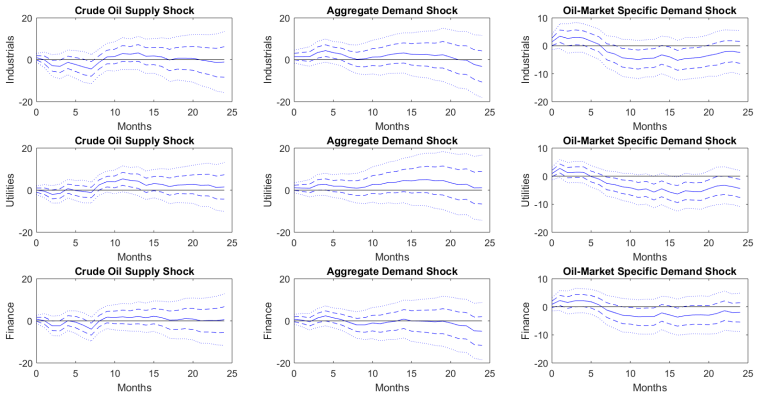

Figure 11: Cumulative responses of sectoral real stock returns: point estimates with one and two standard deviation bands: Smaller sample

The figures above, underscore the importance of studying the source of oil price shock as each one of them can lead to different portfolio adjustment. For example, a shock to global oil production has a partially significant, negetive impact on health care, auto and consumer durables. Amongst these, the impact on the first two industries is relatively more significant than the latter. The returns on other industries barely depreciate. The recent changes in the economy where oil supply shocks do not cause oil prices as much as shocks stemming from the demand side has been confirmed by these results as they have next to zero effect on most of the sectoral stock returns. These results confirm the point stated by [Kilian, 2009, Apergis and Miller, 2009] in the fact the recent changes in oil prices are dominated more by demand side shocks. With respect to an emerging economy like India, these results are also analogous to the results of [Cunado et al., 2015] who study the impact of the three different oil price shocks in four Asian economies (Japan, India, Indonesia and Korea) on their GDP, CPI , real effective exchange rate and interest rate. They find that that an oil supply shock has limited impacts on the four Asian countries during the recent period, reflecting structural changes and strong rapid growth in economic fundamentals.

[Lee and Ni, 2002] observe a large decline in output of the automobile industry due to oil price shocks. They explain that, the large effect of oil shocks on demand for automobiles is not surprising. An oil price shock in the short run may affect demand for automobiles more than it does to consumption of gasoline because the latter is largely determined by factors that are costly to adjust, such as the types of cars households own and the locations of homes and workplaces. After an oil price shock, demand for automobiles is weakened since a potential new car owner may opt for other means of transportation to save the operating cost of automobile, or postpone purchasing a new car

because uncertainty about future fuel prices makes it harder to decide which type of car to buy.

For the case of India, we find that only an oil price increase caused by a shock to global oil production leads to a decline in the automobile stock returns however, the shock to aggregate demand leads to an increase in the stock returns for the automobile industry. As stated by EIA, the rapid growth in emerging economies has led to an increase in oil consumption and hence an increase in the demand for oil. Commercial and personal transportation activities, in particular, require large amounts of oil and are directly tied to economic conditions. Although transportation oil use is usually a smaller share of total oil consumption in non-OECD countries, this use tends to increase rapidly as expanding economies increase the need to move goods and people. Vehicle ownership per capita is also highly correlated with rising incomes and has much room to grow in non-OECD countries.[9]. Given the strong growth in the India economy, one can expect the automobile industry to be positively affected by this growth and hence immune to oil price shocks particularly those stemming out of aggregate demand shocks. The impact reverses after 7 months but is mostly insignificant.

At the same time, an increase in Aggregate demand causes a partially significant increase in all the industries. This can be explained by the fact that even though positive aggregate demand shocks increase the price of oil, they also signify an increase in aggregate demand, which is regarded as positive news and thus stocks could exhibit more bullish behaviour. The strong growth overcomes the negetive effect of oil price shocks. These results are consistent with [Kilian and Park, 2009, Broadstock et al., 2012] study where they find a positive relationship between stocks and aggregate demand shocks. The observed positive impact on sectoral stock returns during periods with aggregate demand-side shocks may be due to the fact that India has a played a strong role in determining recent oil demand. The fact that it has gone through substantial economic growth over recent years and the resulting higher demand for oil make the estimated positive reaction of sectoral stock returns due to demand-side shocks plausible for this economy.

The response of the various sectors to oil specific demand shocks mirrors the response of the aggregate stock returns, where it is positive initially, following a reversal in about six months. However this effect is very short lived and mostly insignificant for all sectors, except for metals, oil & gas and consumer durables. This result points to the argument that Indian stock markets are in general immune against oil market specific demand shocks. As pointed out by [Kilian and Park, 2009], there exists a widespread perception that investors in times of political uncertainty increase their demand for precious metals such as gold or silver, causing the share prices of companies that produce gold or

[9]https://www.eia.gov/finance/markets/crudeoil/demand-nonoecd.php

silver to increase when political turmoil contributes to high oil prices. Likewise unanticipated global demand expansions may be taken as signals of inflation risks, resulting in an appreciation of precious metals shares. For example, shares in the gold and silver mining industry will appreciate in response to a positive oil-market specific demand shock. [10]. [11].Consistent with these views, we find an increase in metals stock returns after an unexpected increase in the oil market specific demand or the precautionary shock.

Given these results, several points can be offered to make investment decisions. The first one is that investment decisions can be enhanced by a better examination of the type of oil shock and its impact on the stock markets. Secondly, by studying the impact on different sectors, better decisions can be made with respect to which stocks maybe safer against others during oil price shocks thus offering insights into hedging strategies.

5 Conclusion

This study empirically investigates the relationship between the three shocks to oil prices and stock market returns in India both at the aggregate and the sectoral level. The three shocks to oil prices have been inherited by the distinction provided in [Kilian, 2009] between shocks to oil supply and shocks to oil demand. Movement of seven sectoral indices namely- Health care, Metals, Oil Gas, Automotive, Consumer durables, Industrials, Utilities and Finance; with the international crude prices has been examined from 2000 to 2018 using the structural VAR approach outlined by [Kilian, 2009].

The main results can be summarized as follows. Shocks to oil supply have little effect on the global oil prices however shocks to aggregate demand lead to a persistent increase in the oil prices. Lastly, the maximum impact on oil prices is due to the unanticipated shocks to oil market specific demand. These results are in line with most of the recent studies that suggest the declining importance of oil production in generating significant effect on oil prices. These impacts are also consistent with the recent developments in global oil markets, which include increasing demand from growing emerging economies as well as a combination of political disturbances in several oil producing nations.

The results for the aggregate stock market highlights the importance of studying the oil price shocks based on the source of this shock as each of them have a different impact on the aggregate stock market. While a shock to global

[10] [Broadstock et al., 2012] find that for China aggregate demand and oil-market specific demand shocks are highly correlated with the Metals Mining sector, whereas oil-market specific demand shocks are more strongly correlated with the Oil Gas sector

[11] [El-Sharif et al., 2005] find similar results for oil and gas equity returns and oil prices in general. They find that equity returns in oil and gas is positively related to oil price movements. This result is consistent with those reported in earlier studies by [Sadorsky, 2001] for Canada

oil production leads to a decline in the stock market return, the shock to aggregate demand causes an initial significant increase in the returns. Lastly, the shock to an oil market specific demand causes a very short lived increase in stock returns but the overall impact is mostly insignificant. The results show that Indian stock markets are mostly immune to precautionary demand shocks.

The results for the sectoral analysis indicate that global oil production shocks are mostly insignificant except for causing a decline in Health care, Auto mobiles and Consumer Durables. Aggregate demand shocks lead to a persistent increase in almost all of the industries except Automobiles where this pattern reverses in the long run. Overall, in the presence of strong growth in the Indian economy, the stock markets experience a growth in returns when faced with an aggregate demand shock. Lastly, the unanticipated oil market specific demand shocks lead to a very short run increase in Metals, Consumer Durables and Oil & Gas industry stock market returns. The effect on the other industries is mostly insignificant. These results indicate that Indian markets are more susceptible to aggregate demand shocks owing to strong growth in the economy.

Overall, the results are broadly consistent with the large class of literature that indicates the declining importance of global oil supply and the positive impacts of aggregate demand shocks on sectoral stock returns. These results also signify the importance of studying the impact on different sectors to the different shocks to oil price to better understand the benefits of diversification.The conclusions can be of great interest to different economic actors. For investors and portfolio managers, the disparity in oil price exposure across industries can be used to identify potential sector-based hedging opportunities and to make optimal portfolio allocation decisions. For corporate managers, to know whether the oil price risk constitutes a systematic risk factor in industry stock returns is critical for risk management purposes. For policy makers, understanding the transmission of oil price shocks to industries is essential to develop improved energy-investment and energy-consumption policies.

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