Response Of The Indian Stock Market To Oil Price Shocks With Respect To A Financial Crisis

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Abstract.

The purpose of this study is to investigate how Indian equity stock returns respond to changes in oil prices before, during and after a financial crisis. We refer to firm level data from 2019 to 2021. The financial crisis we are considering is the 2020 economic crisis caused due to the Covid-19 pandemic. This study will be using 245 stocks represented in the NIFTY index of the National Stock Exchange (NSE), India. We use daily prices of Indian Crude Basket for the aforementioned period to determine the oil price shocks. We also determine whether the size of the firm, measured by its market capitalization, plays a role in terms of its stock returns in response to the oil price shocks. Furthermore, we examine whether the effects of an oil price shock are homogenous across industries or whether the nature of the industry, in terms of its oil dependence and intensity, influences the response to the oil price shock. Lastly, we also try to understand of whether the direction of the shock plays a role in how the stock prices react to it.

Keywords: oil price shocks, NIFTY, Covid-19 pandemic, firm size

1. Introduction

Oil prices play a significant role in the dynamics of an economy, even more so in the case of oil-based economies and countries relying on industrial, energy and manufacturing intensive sectors. The analysis on the correlation between United States' stock market performance and oil prices derives a significant correlation between the two (Narayan et. al, 2014). Another key observation is that the response to oil price shocks is asymmetric across countries (Mork, 1989; Park and Ratti, 2008; Ono, 2011) and across different industries (Arouri, 2011; Tsai, 2015) and firm size (Tsai 2015).

India's exponential growth over the past decade has raised its dependence on oil and has made the sector one of the six core industries for India. India is one of the largest importers of the commodity, only behind the United States and China. India imports approximately 70% of its oil needs and has no exports with respect to crude oil. A fall in crude oil prices, therefore, should help the country reduce its import costs. This in effect should be reflected in the Indian stock markets, which are reflective of the economy. Hence, it is important to study the relation between the oil prices and stock market returns for India as it continues to increase its significance in the global economy. Chittedi (2012) and Ono (2011) find statistically significant relation between the Indian stock markets and crude oil prices whereas Sharma et. al. (2018) have found no such correlation in the long run.

The analysis becomes more important in case of black swan events like the global financial crisis and tests the theories to the extreme. During financial crises, the demand for oil falls significantly as production falls, capital markets restrict the movement of cash and interest

rates plummet, which results in a significant downfall of the stock markets. In his analysis about the effect of oil price shocks to the American stock market with respect to the 2008 financial crisis, Tsai (2015) draws the conclusion that stock returns respond positively to oil price change during both pre-crisis and post crisis. He also concludes that the response of the stock market is dependent on the direction of the shock during both pre-crisis and post crisis.

The recent oil price shock in April of 2020 due to a sharp decline in consumption and production across the globe, coupled with the Covid-19 pandemic raises a significant question of whether the correlation derived holds for India as well. Prabheesh et. al. (2020) examines the relation between oil price and stock market returns during the Covid-19 pandemic for Asian economies (covering India) and concludes that there is a positive co-movement between the two during the period. However, this analysis has been made by taking the stocks of all companies without any consideration of the industries to which these companies belong. Hence, it might be prudent to look at the effect of oil price shocks on each industry specifically to determine if the nature of the industry plays a distinguishing role in this analysis. We expand on the analysis for Indian markets by taking help of models developed by Tsai (2015) as a reference and conduct a statistical analysis for 250 firms based on daily stock and oil price data.

The paper ahead is structured as follows: In section 2.1, we lay out the hypothesis which will govern our analysis. Hypothesis 1 aims to analyse the response of the overall market to the oil price shocks. Hypothesis 2, described in section 2.2, elaborates on the asymmetric nature of the shocks by testing hypothesis 1 across firms of different sizes. Hypothesis 3, described in section 2.3, attempts to study the difference in the impact of these shocks across industries. Hypothesis 4, described in section 2.4, modifies the equation developed under hypothesis 1 to account for directional oil price shocks and tries to analyse the relation between positive and negative oil price shocks and stock market returns. Section 3 provides data and empirical results for the models developed in sections 2.1, 2.2, and 2.3. Section 4 provides the conclusion and gives further insights on how the results can be used for future research and the shortcomings present in the current literature.

2. Research and Hypotheses

The aim of this paper is to estimate the impact of oil price shocks on the Indian stock market before, during and after the financial crisis caused by the Covid-19 pandemic. The sections given below describe each hypothesis and its corresponding models in detail

2.1 Stock Returns and Oil Price Shocks

Hypothesis 1: In this hypothesis we state the impact of oil price shocks on stock return varies before, during and after a financial crisis. During a financial crisis, the effect of the systemic decline of the economy and the market will play a role in subduing the effects of oil price shocks. It is also expected that after a crisis, the effect of the expansionary policies will overshadow the effects of an oil price shock.

In this hypothesis we try to determine if the timing of an oil price shock has a significantly different impact on stock returns. Tsai (2015) says that with respect to American stock markets, usually a rise in crude oil prices leads to a subsequent increase in the cost of production of goods for companies, leading to a negative effect on the stock returns of these companies. However, stock markets of emerging economies such as India's often react differently to several factors as compared to stock markets of developed economies like the

United States. This is corroborated by Ono (2011) who conducts a study on the effect of oil price shocks on the stock markets of the emerging economies of Brazil, Russia, India and China. According to this study, oil price shock has a statistically significant positive effect on the Indian real stock returns at the 5% significance level. Hence, we hypothesize that there is a positive relationship between oil price shocks and daily returns of the Indian stock market before and during the onset of a financial crisis.

Previous studies show that in an expansionary or recovery period, the relationship between oil price shocks and a developed economy reverses. Kilian and Park (2009) state that, in the recovery period post the 2008 financial crisis, despite unexpectedly high oil prices, the American stock market was thriving. It is further implied that during such a recovery period, the stimulating effect of expansionary economic policies overshadows any effect that an oil price shock might produce. Therefore, it is important to note the change in response to oil price shocks that an emerging economy like India might display.

We explore the impact of oil price shocks on stock returns as follows:

$$R_{i,t} = \beta_0 + \beta_1 \Delta op_t Crisis_t + \beta_3 \Delta op_t AfterCrisis_t + \beta_5 AfterCrisis_t + \varepsilon_{i,t} \qquad (1)$$

In equation (1), $R_{i,t}$ represents the stock returns of a company i on day t. Δop_t is the oil price shock due to the change in the daily Indian Mixed Basket crude oil price. $Crisis_t$ is a dummy variable for the financial crisis at time t while $AfterCrisis_t$ is a dummy variable for the post-crisis period at time t. Hence, in equation (1), β_1 measures the effect of an oil price shock on a stock's return before a financial crisis, $\beta_1+\beta_2$ measures the effect of an oil price shock on a stock's returns during a crisis while $\beta_1+\beta_3$ does the same for the post-crisis period.

2.2 Oil Price Shocks and Stock Returns across Firm Sizes

Hypothesis 2: In this hypothesis, we state that the effect of an oil price shock across a financial crisis on stock returns depends on the size of the company.

The findings of Kleijweg (1990) show that small companies are more flexible when it comes to managing their energy resources. Hansen (1992) adds that small companies are more likely to be innovative and hence are more efficient. These studies indirectly suggest that small companies should be less impacted by oil price shocks. Narayan and Sharma (2011) document that for small companies, the relationship between oil prices and company returns is significant and positive. As the size of the company increases, the relationship between oil prices and company returns becomes more and more negative.

It is important to note, that during a financial crisis however, it is small companies that struggle more than big ones. In the midst of a financial crisis, when financial resources are constrained, it is difficult for smaller companies to acquire financing compared to large companies. This implies that the impact of oil price shocks on stock returns of small companies might see a substantial change after a crisis.

To investigate this hypothesis, we run equation (2) on three subsets of data - small-cap companies, mid-cap companies and large-cap companies - by using market capitalization as a proxy for firm size.

2.3 Oil Price Shocks and Stock Returns across industries

Hypothesis 3: In this hypothesis, we state that the effect of an oil price shock across a financial crisis on stock returns depends on the industry to which the company belongs.

The dependence on oil varies across industries depending on the nature of the product or service in question. It makes sense that industries where oil or oil products are used in their value chain and industries which are energy-intensive will be more strongly affected by oil price shocks as compared to other industries. Moya-Martínez et. al. (2014) shows that stock returns for most Spanish industries are not affected by oil price shocks. Elyasiani et. al. (2011) displays that for oil-substitute and oil-related industries, oil price shocks have a positive effect while financial industries and industries which use oil have a negative impact. In their analysis of 560 firms, Narayan and Sharma (2011) find that firms belonging to the energy and transportation industries see an increase in their stock returns when oil prices increase while the bulk of firms belonging to other industries experience a fall in returns in response to a rise in oil prices. This kind of heterogeneity is also noted by Nandha and Faff (2008) who found that apart from mining and oil and gas companies, companies belonging to other industries experience a negative impact on their stock returns due to oil price shocks. These studies show that the oil-intensity of an industry does play a role in determining the impact of an oil price shock on a company's stock returns.

Hypothesis 3 is meant to examine not only how different industries respond to oil price shocks but also the differences in their response before, during and after a financial crisis. To investigate this hypothesis, we run equation (2) on subsets of data, each subset corresponding to an industry.

2.4 Stock Returns and the Sign of Oil Price Shocks

Hypothesis 4: Stock returns respond differently to positive and negative oil price shocks, before, during and after a financial crisis.

Hamilton (1983) showed a strong correlation between oil price increases and gross national domestic growth, but he failed to investigate whether this correlation persists when oil price decreases. Mork (1989) takes this research further and finds that increases and decreases in oil prices have asymmetric effects on output. Ono (2011), in his analysis of emerging economies, further shows that statistically significant asymmetric effects do take place for India. In this hypothesis, we build upon this prior research while at the same time, investigating any changes in this asymmetric nature before, during and after a financial crisis.

We investigate this hypothesis using the following equation:

$$\begin{aligned} R_{i,t} = \beta_0 &+ \beta_1 \Delta op_t^+ Crisis_t + \beta_3 \Delta op_t^+ AfterCrisis_t + \beta_4 \Delta op_t^- + \beta_5 \Delta op_t^- Crisis_t \\ &+ \beta_6 \Delta op_t^- AfterCrisis_t + \beta_7 Crisis_t + \beta_8 AfterCrisis_t \\ &+ \beta_9 Crisis_t D_t(\Delta op_t > 0) + \beta_{10} Crisis_t D_t(\Delta op_t < 0) \\ &+ \beta_{11} AfterCrisis_t D_t(\Delta op_t > 0) + \beta_{12} AfterCrisis_t D_t(\Delta op_t < 0) \\ &+ \varepsilon_{i,t} \end{aligned} \tag{2}$$

In equation (2), Δopt+ refers to the percentage change in the price of Indian Mixed Basket Crude Oil price if the change is positive, and zero otherwise. Similarly Δopt- is defined if the change is negative. D(Δopt>0) is a dummy variable that is equal to 1 if the change of oil price is positive and zero otherwise. D(Δopt<0) is a dummy variable that is equal to 1 if the change

of oil price is negative and zero otherwise. In equation (2), β_1 measures the effect of a positive oil price shock in the pre-crisis period; $\beta_1 + \beta_2$ measures the effect of a positive oil price shock during the crisis period; $\beta_1 + \beta_3$ measures the effect of a positive oil price shock after the crisis period. Similarly, β_4 measures the effect of a negative oil price shock in the pre-crisis period; $\beta_4 + \beta_5$ measures the effect of a negative oil price shock during the crisis and $\beta_4 + \beta_6$ measures the effect of a negative price shock after the crisis period.

3. Data

The sample for our paper covers data for the period of 1 October 2019 to 18 March 2021.

3.1 Measure of stock returns[1]

In this paper, we use daily firm-level data from the National Stock Exchange of India Ltd. We look at the daily data of 245 firms listed on the National Stock Exchange of India. Daily returns on a day t are calculated as the change in the closing price on day t compared to the closing price on day t-1 as a fraction of the latter.

3.2 Measure of oil price shock[2]

We refer to the daily prices of the Indian Mixed Basket (IMB) in terms of USD/bbl and then using the daily USD/INR rate convert it to INR/bbl. The oil price shock on a day t, Δop_t , is calculated as follows:

$$\Delta op_t = [log(IMB_t) - log(IMB_{t-1})] \quad (3)$$

where IMB_t and IMB_{t-1} are the prices of IMB on day t and day t-1 respectively.

3.3 Subsample Dates for Pre-Crisis, during the Financial Crisis and post-Crisis

We divide our data into three sub-periods by taking into consideration the financial crisis caused by the Covid-19 pandemic: (1) pre-crisis, (2) during crisis and (3) post-crisis. To this division, we refer to the Nomura India Business Resumption Index (NIBRI)[3] which started falling from a value of 82.9 in March 2020 to a low of 44.7 in April and then came back to the eighties in September 2020. The fall in NIBRI corresponds to the crisis period while the period succeeding its return to March levels marks the start of the post-crisis period. In accordance with this, the periods are as follows: (1) Pre-crisis from October 1, 2019 to March 31, 2020, (2) during crisis from April 1, 2020 to September 30, 2020 and (3) post-crisis from October 1, 2020 to March 18, 2021.

3.4 Subsample Data on the basis of size

As mentioned earlier in hypothesis 2, we divide our firm data into three groups - small-cap, mid-cap and large-cap - on the basis of their market capitalization and with reference to NIFTY Smallcap 100, NIFTY Midcap 100 and NIFTY 50 (an index composed of the 50 biggest firms listed on the National Stock Exchange in terms of market capitalization). Corresponding to this, the 245 firms that this paper is using for daily stock data are divided into 97 small-cap, 98 mid-cap and 50 large-cap firms.

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1 National Stock Exchange (India) (https://www.nseindia.com/)
2 Bloomberg
3 Economic Times (https://economictimes.indiatimes.com/news/economy/indicators/nomura-india-business-resumption-index-plateaus-in-september/articleshow/86392731.cms)

3.5 Subsample Data on the basis of industry

As mentioned earlier in hypothesis 3, we divide our firm data across industries to determine if the nature of the industry influences the impact that an oil price shock has on a company's stock returns. We divide the 247 firms that are there across 20 industries as shown in Table 1.

Table 1: List of industries in sample data

Industry	**Number of firms**
Pharma	23
Chemicals	12
Financial Services	46
Consumer Services	8
Oil & Gas	10
Services	8
IT	19
Textiles	5
Automobile	15
Consumer Goods	29
Metals	11
Industrial Manufacturing	14
Telecom	3
Cement & Cement Products	9
Paper And Jute	1
Power	8
Fertilisers & Pesticides	5
Construction	12
Healthcare Services	4
Media Entertainment & Publication	3
Total	**245**

4. Empirical Results and Interpretation

4.1 Descriptive Statistics

The descriptive statistics for this data are given in Table 2. This paper includes the data of 245 firms listed on the National Stock Exchange (NSE), India. We use daily data from 1 October, 2019 to 18 March, 2021, a period of 366 days with a total of 88,217 observations. Table 2 shows that the average daily stock returns for the entire period of 366 days is 0.149%; for the pre-crisis period the average is -0.205% and for the post-crisis period the average is 0.286%. The average oil price shock is 0.057%.

Table 2. Descriptive Statistics

Statistic	Value
Number of Firms	245
Number of Observation Days	366
Total Observations	88217
Average Daily Stock returns	0.149%
Average Daily Stock returns pre-crisis	-0.205%
Average Daily Stock returns within crisis period	0.370%
Average Daily Stock returns post-crisis	0.286%
Average IMB Price Shock	0.057%

4.2 Impact of Oil Price Shocks on Stock Returns

Table 3 shows the results obtained by running equation (1) on the entire data of 245 firms. The coefficient β1 denotes the impact of the oil-price shock in the pre-crisis period, $\beta_1+\beta_2$ in the crisis period and $\beta_1+\beta_3$ in the period after the crisis. As we can see from Table 3, a 1% increase in the price of IMB leads to a 0.349% increase in stock returns before the crisis, a 0.047% increase in stock returns during the crisis and a 0.012% increase in stock returns after the crisis. From this we infer that there is an initial positive relationship between stock returns and oil price shocks which deteriorates at the onset of the financial crisis and further decreases after the crisis, that is, the expansionary phase of the economy. The pre-crisis analysis is in line with the evidence presented by Ono (2011) which states that oil price shock has a statistically significant positive effect on the Indian real stock returns. Furthermore, our analysis confirms hypothesis 1 that while there is an initial positive relationship between oil price shocks and the stock returns, this relationship is overshadowed during the crisis period and the post-crisis period by the systemic effects of the crisis and the overarching effects of post crisis expansionary policies respectively.

Table 3. Impact of Oil Price Shocks on Stock Returns in the Pre-crisis, Crisis, and Post-crisis Periods

	Coefficients	*S.E.*	*P-value*
Intercept	0.000	0.000	0.047
β_1	0.349	0.006	0.000
β_2	-0.301	0.007	0.000
β_3	-0.336	0.008	0.000
β_4	0.004	0.000	0.000
β_5	0.003	0.000	0.000
Impact of oil price shock for precrisis period (β_1)	0.349		
Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.047		
Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.012		
F-Statistic	797.873		
Prob(F)	0.000		

4.3 Size of a firm and the Impact of Oil Price Shocks on Stock Returns

Table 4 shows the results obtained by running equation (1) separately on small-cap, mid-cap and large-cap firms as explained in 3.4. A subset of our hypothesis is contradicted through the coefficients presented in Table 4, as, in the pre-crisis period, the large-cap firms are impacted the most by an oil-price shock, followed by the mid-cap firms and then the small-cap firms. We had hypothesized that in the post-crisis period, small firms are more paralyzed in terms of funding and other aspects, which leads to a change in how oil price shocks impact their stock returns as compared to the pre-crisis period. This is corroborated by the evidence produced in Table 4, which shows that small firms have a statistically significant negative relationship with oil price shocks in the post-crisis period compared to a statistically significant positive relationship in the pre-crisis period.

Table 4. Size of a firm and the Impact of Oil Price Shocks on Stock Returns

		Coefficients	*S.E.*	*P-value*
Large Cap	Intercept	-0.000	0.000339	0.732
	β_1	0.400	0.011354	0.000
	β_2	-0.341	0.013841	0.000
	β_3	-0.370	0.014764	0.000
	β_4	0.002	0.000477	0.000
	β_5	0.003	0.000485	0.000
	Impact of oil price shock for precrisis period (β_1)	0.400		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.059		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.02996		
		Coefficients	*S.E.*	*P-value*
Mid Cap	Intercept	0.000	0.000283	0.566
	β_1	0.362	0.009493	0.000
	β_2	-0.316	0.011572	0.000
	β_3	-0.345	0.012344	0.000
	β_4	0.003	0.000399	0.000
	β_5	0.003	0.000406	0.000
	Impact of oil price shock for precrisis period(β_1)	0.362		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.0462		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.017		
		Coefficients	*S.E.*	*P-value*
Small Cap	Intercept	-0.001	0.000318	0.001
	β_1	0.306	0.010621	0.000
	β_2	-0.264	0.012936	0.000
	β_3	-0.306	0.01363	0.000
	β_4	0.005	0.000445	0.000
	β_5	0.004	0.000447	0.000

	Impact of oil price shock for precrisis period (β_1)	0.306
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.042
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.001

4.4 Impact of Oil Price Shocks on Stock Returns across Industries

Table 5 shows the results obtained by running equation (1) separately on 20 different industries as explained in 3.5. Our hypothesis is contradicted through the evidence presented in Table 5, as we find that there is no asymmetric relationship with oil price shocks, across all three periods of study. This is in stark contrast to previous studies, particularly studies concerning developed markets like the U.S. markets, which show that there is a difference in the impact of oil shocks on stock market returns, possibly due to the extent of the oil intensive nature of the industries.

Table 5. Impact of Oil Price Shocks on Stock Returns across Industries

		Coefficients	*S.E.*	*P-value*
Media	Intercept	-0.002	0.00194	0.338935
	β_1	0.283	0.065033	0.000
	β_2	-0.222	0.079279	0.005
	β_3	-0.302	0.084569	0.000
	β_4	0.007	0.002734	0.016
	β_5	0.002	0.002778	0.383
	Impact of oil price shock for precrisis period (β_1)	0.283		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.061		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.020		
Healthcare		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.001	0.001115	0.291651
	β_1	0.297	0.037379	0.000
	β_2	-0.232	0.045567	0.000
	β_3	-0.326	0.048608	0.000
	β_4	0.002	0.001572	0.196
	β_5	0.001	0.001597	0.744
	Impact of oil price shock for precrisis period (β_1)	0.297		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.066		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.029		
Construction		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.003	0.000892	0.003256
	β_1	0.333	0.029907	0.000
	β_2	-0.322	0.036458	0.000
	β_3	-0.337	0.03889	0.000

	β_4	0.005	0.001257	0.000
	β_5	0.006	0.001278	0.000
	Impact of oil price shock for precrisis period (β_1)	0.333		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.010		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.004		
Fertilizers		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.001	0.001037	0.423609
	β_1	0.323	0.034752	0.000
	β_2	-0.258	0.042365	0.000
	β_3	-0.374	0.045192	0.000
	β_4	0.003	0.001461	0.068
	β_5	0.000	0.001485	0.858
	Impact of oil price shock for precrisis period (β_1)	0.323		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.064		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.052		
Power		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.001	0.000781	0.060307
	β_1	0.344	0.026177	0.000
	β_2	-0.251	0.031912	0.000
	β_3	-0.327	0.034041	0.000
	β_4	0.004	0.001101	0.001
	β_5	0.004	0.001118	0.000
	Impact of oil price shock for precrisis period (β_1)	0.344		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.093		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.016		
Paper		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.004	0.004123	0.284578
	β_1	0.296	0.138229	0.033
	β_2	-0.291	0.168508	0.085
	β_3	-0.319	0.179753	0.077
	β_4	0.006	0.005812	0.318
	β_5	0.008	0.005905	0.180
	Impact of oil price shock for precrisis period (β_1)	0.296		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.006		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.022		
Cement		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.000	0.000776	0.984033

	β_1	0.334	0.026026	0.000
	β_2	-0.297	0.031727	0.000
	β_3	-0.328	0.033844	0.000
	β_4	0.003	0.001094	0.016
	β_5	0.003	0.001112	0.002
	Impact of oil price shock for precrisis period (β_1)	0.334		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.037		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.006		
Telecom		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.000	0.002664	0.941655
	β_1	0.401	0.089322	0.000
	β_2	-0.319	0.108889	0.003
	β_3	-0.432	0.116155	0.000
	β_4	0.006	0.003756	0.104
	β_5	0.002	0.003816	0.535
	Impact of oil price shock for precrisis period (β_1)	0.401		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.082		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.031		
Industrial Manufacturing		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.001	0.000763	0.061848
	β_1	0.277	0.025572	0.000
	β_2	-0.219	0.031174	0.000
	β_3	-0.253	0.033254	0.000
	β_4	0.004	0.001075	0.000
	β_5	0.006	0.001092	0.000
	Impact of oil price shock for precrisis period (β_1)	0.277		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.058		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.024		
Metals		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.000	0.000933	0.622323
	β_1	0.433	0.031297	0.000
	β_2	-0.296	0.038153	0.000
	β_3	-0.346	0.040699	0.000
	β_4	0.003	0.001316	0.054
	β_5	0.004	0.001337	0.004
	Impact of oil price shock for precrisis period (β_1)	0.433		

	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.137		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.087		
Consumer Goods		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.000	0.000444	0.538053
	β_1	0.320	0.014892	0.000
	β_2	-0.294	0.018154	0.000
	β_3	-0.307	0.019365	0.000
	β_4	0.003	0.000626	0.000
	β_5	0.002	0.000636	0.006
	Impact of oil price shock for precrisis period (β_1)	0.320		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.026		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.013		
Automobiles		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.001	0.000693	0.280401
	β_1	0.372	0.02323	0.000
	β_2	-0.284	0.028319	0.000
	β_3	-0.322	0.030208	0.000
	β_4	0.004	0.000977	0.000
	β_5	0.003	0.000992	0.002
	Impact of oil price shock for precrisis period (β_1)	0.372		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.088		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.050		
Textiles		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.005	0.001743	0.004817
	β_1	0.258	0.055151	0.000
	β_2	-0.217	0.066406	0.001
	β_3	-0.289	0.070616	0.000
	β_4	0.012	0.002347	0.000
	β_5	0.008	0.002381	0.001
	Impact of oil price shock for precrisis period (β_1)	0.258		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.041		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.031		
IT		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.000	0.000668	0.531482
	β_1	0.394	0.022723	0.000
	β_2	-0.364	0.027739	0.000
	β_3	-0.389	0.028701	0.000

	β_4	0.005	0.000941	0.000
	β_5	0.004	0.000929	0.000
	Impact of oil price shock for precrisis period (β_1)	0.394		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.030		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.006		
Services		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.001	0.000943	0.226495
	β_1	0.304	0.031536	0.000
	β_2	-0.263	0.038426	0.000
	β_3	-0.318	0.040985	0.000
	β_4	0.004	0.001327	0.003
	β_5	0.005	0.001348	0.000
	Impact of oil price shock for precrisis period (β_1)	0.304		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.041		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.014		
Oil Gas		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.000	0.000776	0.6527
	β_1	0.332	0.02601	0.000
	β_2	-0.254	0.031708	0.000
	β_3	-0.304	0.033824	0.000
	β_4	0.002	0.001094	0.064
	β_5	0.004	0.001111	0.001
	Impact of oil price shock for precrisis period (β_1)	0.332		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.078		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.028		
Consumer Services		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.002	0.001077	0.128584
	β_1	0.389	0.036094	0.000
	β_2	-0.342	0.044001	0.000
	β_3	-0.377	0.046937	0.000
	β_4	0.005	0.001518	0.003
	β_5	0.005	0.001542	0.002
	Impact of oil price shock for precrisis period (β_1)	0.389		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.047		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.012		
Financial Services		*Coefficients*	*S.E.*	*P-value*
	Intercept	-0.001	0.000453	0.005538

	β_1	0.403	0.015094	0.000
	β_2	-0.349	0.018386	0.000
	β_3	-0.374	0.019436	0.000
	β_4	0.004	0.000636	0.000
	β_5	0.005	0.000639	0.000
	Impact of oil price shock for precrisis period (β_1)	0.403		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.054		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	0.029		
Chemicals		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.002	0.000821	0.011083
	β_1	0.380	0.027529	0.000
	β_2	-0.348	0.033522	0.000
	β_3	-0.383	0.035184	0.000
	β_4	0.002	0.001147	0.056
	β_5	0.001	0.001151	0.211
	Impact of oil price shock for precrisis period (β_1)	0.380		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	0.033		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.003		
Pharma		*Coefficients*	*S.E.*	*P-value*
	Intercept	0.002	0.00059	0.000515
	β_1	0.280	0.019769	0.000
	β_2	-0.289	0.0241	0.000
	β_3	-0.302	0.025708	0.000
	β_4	0.004	0.000831	0.000
	β_5	-0.002	0.000845	0.010
	Impact of oil price shock for precrisis period (β_1)	0.280		
	Impact of oil price shock during crisis ($\beta_1 + \beta_2$)	-0.009		
	Impact of oil price shock post-crisis ($\beta_1 + \beta_3$)	-0.021		

4.5 Impact of Positive and Negative Oil Price Shocks on Stock Returns

The results from Table 6 by running equation (2) show that the stocks don't respond to positive oil shocks during the pre-crisis period. However, there is a significant relationship between the negative oil price shocks and the stock returns. We observe that every 1% decrease in the price of IMB leads to a 0.5% decrease in the stock returns. Albeit, with the onset of the crisis, the relation of the stock returns with the positive oil price shocks increases to a significant level with a negative relation between the two, where we observe that a 1% increase in the IMB price leads to a 0.07% decrease in the stock returns. We also see that the stock returns have a positive relationship with negative oil shocks in this period, where we

observe a 1% decrease in the IMB price leads to a 0.12% decrease in the stock returns, demonstrating that any "shock" in the oil price will have a negative effect on the stock returns. As we transition from the crisis period to the expansionary phase, the relation of the stock returns and the positive oil shocks return to not having a significant impact on the stock returns and as the business recovers, a 1% decrease in IMB price results in 0.03% increase in the stock returns, showing that business tend to take advantage of the fall in prices as their operations recover. For the negative shocks, we also observe that the impact decreases for the during crisis and the expansionary phase which is in accordance with hypothesis 1. This analysis is in agreement with our hypothesis.

Table 6. Impact of Positive and Negative Oil Price Shocks on Stock Returns

	Coefficients	*S.E.*	*P-value*
Intercept	0.004	0.000	0.000
β_1	-0.002	0.013	0.905
β_2	-0.074	0.015	0.000
β_3	0.009	0.017	0.613
β_4	0.505	0.008	0.000
β_5	-0.381	0.011	0.000
β_6	-0.541	0.010	0.000
β_7	0.000	0.000	0.822
β_8	-0.004	0.000	0.000
β_9	0.005	0.000	0.000
β_{10}	0.005	0.000	0.000
β_{11}	0.000	0.000	NA
β_{12}	0.000	0.000	NA
Impact of positive oil price shock for precrisis period (β_1)	0.000		
Impact of positive oil price shock during crisis ($\beta_1 + \beta_2$)	-0.074		
Impact of positive oil price shock post-crisis ($\beta_1 + \beta_3$)	0		
Impact of negative oil price shock for precrisis period (β_4)	0.505		
Impact of negative oil price shock during crisis ($\beta_4 + \beta_5$)	0.124		
Impact of negative oil price shock post-crisis ($\beta_4 + \beta_6$)	-0.036		
F-Statistic	563.699		
Prob(F)	0.000		

5. Conclusion

In this paper, we investigate how Indian stock returns respond to oil price shocks before, during and after a financial crisis. We use the daily data from 1 October, 2019 to 18 March, 2021 of 245 firms listed on the National Stock Exchange (NSE), India. To measure the oil price shocks we refer to daily price data of IMB. We furthermore divide our stock market data across 20 industries and also into 3 parts on the basis of their market capitalization. We further strive to study if there exists any asymmetry in terms of how stock market returns are impacted by oil-price shocks.

Our analysis for hypothesis 1 is proven to have statistical significance implying that a positive correlation does exist between the oil price shock and the stock returns in the pre crisis phase and in the periods of financial crisis and its recovery, the effect of the oil price shocks are subdued. In the analysis of hypothesis 2, we see that there is a difference in statistically significant relation between the oil price returns and stock price returns as the firm size changes. We find an interesting result while testing our hypothesis 3 that there is no asymmetric relation across different industries, irrespective of its dependence on oil for India. This is in stark contrast for countries like the U.S. where the significance and the direction of the relation varies across sectors.

Our final hypothesis tests the relationship between the direction of the oil price shock and the stock return and finds that the stock returns respond differently to positive and negative oil price shocks. We find that the stock returns are not impacted by positive oil price shocks in the pre-crisis and the recovery phase. However, we find a significant positive correlation between negative oil price shocks and stock returns in the pre-crisis and the recovery phase. An important conclusion that we draw is that any kind of shock will have a negative impact on the stock price returns during a crisis.

The observations made in this paper can act as an impetus to further research on similar macroeconomic subjects and to understand, explain and theorize the findings of this paper. Further research is also required in explaining the difference in the impact of oil price shocks on mature versus emerging markets.

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