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Oil price shocks, competition, and oil & gas stock returns — Global evidence

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ABSTRACT

Extant literature suggests that oil price shocks have a strong impact on the macroeconomy and the stock market. However, relatively less is known about the effect of country-level determinants, competition, and asymmetrical relationship in affecting the oil & gas stock return at the firm-level. Using a comprehensive firm-level monthly data from 70 countries spanning 1983 to 2014, we find: (i) macroeconomic stress negatively impact firm-level returns; (ii) oil price shocks positively impact firm-level returns; (iii) firms located in high oil producing countries are more sensitive to global uncertainty and oil price shocks; (iv) firms located in non-competitive industries are less sensitive to oil price shocks; and (v) firms located in non-competitive industries are less affected by the drop in oil price, as compared to firms that are located in highly competitive industries. Our results remain qualitatively similar using a battery of robustness checks.

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1. Introduction

To what extent are the systematic asset price risks of oil & gas firms explained by the oil price shocks that are themselves affected by the macroeconomic forces? Are monopoly firms less affected by the oil price volatility? Does the stock market react symmetrically to the oil price increase or decrease, especially when the competition level within the oil & gas industry is taken into consideration? We attempt to answer these important issues in this paper. We find that including a measure of macroeconomic stress can better explain the systematic asset price risk of the oil & gas firms. The firms that are domiciled in high oil producing countries or face strong competition from other firms in the same industry are more sensitive to oil price shocks and market stress. Finally, firms that are operating in non-competitive oil & gas industry are less affected by the drop in oil price than firms that face strong competition from other firms operating in the same industry.

The relationship between oil price and economic activity has been extensively studied in the extant literature. The general consensus is that oil price shocks can significantly affect the economic activity of the country. For example, Hamilton (1983) finds that oil price shocks are responsible for majority of the US recession, post-World War II. The findings are further tested and supported by Burbidge and Harrison (1984) and Gisser and Goodwin (1986). Recently, a number of studies have extended the relationship between oil prices and economic activity to the stock market. The evidence, however, is mixed. For instance, Jones and Kaul (1996) and Sadorsky (1999) find a negative relationship between oil price shocks and stock return, while Chen et al. (1986) and Huang et al. (1996) do not find a significant relationship between oil prices and the US stock return.

Sadorsky (2001) and Hamilton (2003) study the sources of oil price shocks and indicate that the oil prices may themselves be affected by the macroeconomic forces. This suggests that oil price shocks may not be exogenous as macroeconomic forces, such as political, economic and financial risks affect systematic asset price risk. For instance, the underlying reason for the volatility in oil price was due to political (1990 Gulf War), economic (1994 Mexico; 1997 East Asia crisis; 2001 Argentina), or financial reasons (1998 LTCM Russia; 2008 Mortgage-backed-securities US) [See Figs. 1 & 2]. Further, financial innovation in exotic securities has led to more trading in oil futures, derivatives, and other similar instruments. Therefore, market stress and disruption can adversely affect trading of these instruments, leading to distortion of oil prices (Wen et al., 2012).

A few papers addressed this issue by considering macroeconomic factors in addition to oil price shocks. Sadorsky (2001) and Boyer and Filion (2007) suggest that exchange rates and interest rates are important risk factors. For instance, Sadorsky (2001) find that an increase in exchange rate decreases stock return. Boyer and Filion (2007) document that weakening of Canadian dollar against the US dollar negatively

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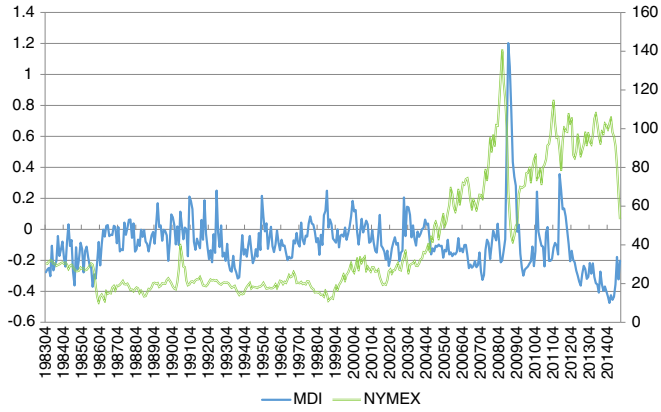


Fig. 1. Market Dislocation Index (MDI) and NYMEX Oil Price Index.

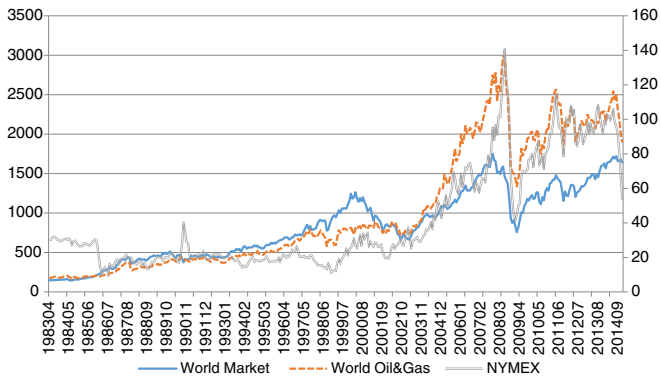


Fig. 2. NYMEX Oil Price, Global Oil & Gas Industry Index and Global Market Index.

affects the stock return. However, the exchange rate and the interest rate prevalent in the local market may not fully capture the extent of global market stress or uncertainty. To this end, we use a better measure of macroeconomic stress — Market Dislocation Index (MDI) proposed by Pasquariello (2014). The market dislocation is defined as the stressful conditions in which asset mispricing increases significantly. Pasquariello (2014, page 1870) note that, "MDI is a good candidate proxy for the commonality in the many frictions affecting the ability of global financial markets to correctly price traded assets." Pasquariello (2014) notes that market dislocation measure is reasonable proxy for a range of international, economic and financial market variables, such as NBER recession dummy, changes in Volatility Index (VIX), world market return volatility, "TED", and slope of yield curve spread, among others. Further, this measure is superior in terms of avoiding model misspecification, as the model measures violations of three well-known arbitrage parity conditions. Therefore, as MDI significantly relates to asset pricing, we argue that combining oil price shocks and MDI can better explain the systematic asset price risk of oil & gas firms. As seen in Fig. 1, this measure tracks important events of the macroeconomy, such as the European currency crisis in 1992–1993, the Asian crisis in 1997, the Russian default in 1998, the Global Financial Crisis (GFC) of 2008–2009, the European debt crisis of 2009–2010, and the Arab Spring in 2011–2012.[2]

The impact of oil price shock on firm-level stock return in the presence of product market competition requires further investigation. Increasing rates of mergers and acquisitions in the US oil companies have resulted in consolidation and higher wholesale gasoline prices (Oladunjoye, 2008). Consequently, a decrease in competition may result in sticky gasoline prices and the firms may cushion themselves from oil price shocks. For instance, Bacon (1991) observe "rockets and feathers" occurrence, where firms increase the gasoline price rapidly following an increase in the crude oil price but decrease the gasoline price slowly following a drop in crude oil prices. Similarly, Borenstein and Cameron (1992) note that the asymmetry reaction of crude oil price changes to gasoline prices may arise due to the market power of some producers or distributors. Although the extant literature (see Deltas, 2008; Oladunjoye, 2008 among others) study the effect of gasoline prices in the presence of competition, a comprehensive analysis has been limited to date. Most of the studies are restricted towards the gasoline prices at the retail and wholesale level in the local market. Not much is known on how the effect will be transmitted to the stock market under varying level of competition.

[2] In unreported results, we check the statistical relationship between NYMEX oil return and MDI. We undertake Vector autoregression (VAR) to account for a possibility of a two-way relationship between MDI and NMEX oil price change. Using 2 lag-order selection, the VAR results indicate that lag MDI negatively influences the NYMEX oil return. However, the influence of lag NYMEX oil return on MDI is statistically not significant.

The role of country-level determinants in affecting firm-level oil & gas stock return also requires attention. It can be argued that the performance of oil & gas firms depends on country-level determinants, such as production and consumption of oil. For example, Russia, Venezuela, Saudi Arabia and other oil-exporting countries generate a large share of revenue from oil exports and therefore a drop in oil prices can have a major impact on the overall economy. Lopez-Murphy and Villafuerte (2010) find that a small decrease in oil prices increases large demand for finances in the near term for oil producing countries. Further, falling oil prices were some of the primary reasons for the Russian Government to devaluate its currency and default on debt (Sadorsky, 2001). An investigation of how the stock market responds to oil price shocks, taking into account country-level determinants, may provide further insights on the importance of country-level determinants.

Previous studies frequently use oil & gas index as a benchmark to assess the impact of oil prices on the stock market. However, it is well known that the use of indices introduce a number of shortcomings that can bias the results (Banz and Breen, 1986; Brown et al., 1992). Specifically, Brown et al. (1992) assert that including only surviving stocks in a sample may lead to artificial performance persistence and therefore statistical tests may be unreliable. Further, by the measure of construction, oil & gas index composites do not capture well the performance of distressed, dead, or delisted stocks. This is due to index construction approach where large and well-known oil & gas firms are given preference. This may artificially inflate the oil & gas index returns, especially during the period of market stress when the bankruptcy filing rate rises. For instance, the average monthly firm-level oil & gas stock return is −0.56% with a standard deviation of 20.89%. In contrast, oil & gas index average return and standard deviation is 0.64% and 8.09%, respectively. In addition, firm-level determinants cannot be controlled if oil & gas index is used as a performance benchmark. This leads to exclusion of important firm-level determinants, such as leverage, expected cash flows, size, liquidity, and discount rate, from the estimation procedure (Miller and Ratti, 2009). We address these shortcomings by using firm-level data spanning over three decades.

Previous studies investigating the linkage between oil price shocks and stock market mainly study industrialized economies. For instance, Park and Ratti (2008) study the relationship between oil price shocks and stock return in the US and 13 European countries. Papapetrou (2001) studies the oil price shocks in Greece; Sadorsky (2001) and Boyer and Filion (2007) investigate the Canadian market, and El-Sharif et al. (2005) concentrate on the UK market. Recently, Ramos and Veiga (2011) extend the analysis to 34 countries, covering developing and developed countries. Although these studies contribute to the existing literature by documenting intuitive findings, not much is known on the impact of oil price shocks at the firm-level in developing and transitional economies. By extending the analysis to 70 countries, we provide evidence on the influence of oil price shocks and macroeconomic stress on firm-level oil & gas stock return at a global level.

Our study contributes to the existing literature in a number of ways. As pointed out by Huang et al. (1996), oil or oil by-products are one of the main input factors that influence profitability and expected cash flows of a firm. By using firm-level oil & gas data, we improve the robustness of the findings. Also, we study the systematic risk of macroeconomic forces that are more likely to affect weak oil & gas firms, especially in oil producing countries. Thus, the use of firm-level data, covering developed, developing, and transitional countries over a long period, addresses the bias associated with performance evaluation using oil & gas index.

Second, to the best of our knowledge we are not aware of any other paper that investigates the role of competition within the oil & gas industry in driving firm-level stock return. The results from this paper may be of particular interest to policy makers and regulators as the results suggest that oil & gas firms operating in non-competitive oil & gas industry are less sensitive to oil price shocks. Also, asymmetric stock return is observed in response to oil price increase and decrease for the firms operating in the non-competitive oil & gas industry.

Third, our study indicates that country-level determinants are important factors in explaining firm-level stock return. Particularly, we show that the oil & gas firms located in oil-rich countries are more sensitive to oil price shocks and market stress. Further empirical work can explore other country-level determinants that are important in explaining firm-level return.

The rest of this paper is organized as follows: The background literature is reviewed in Section 2. Data and methodology is presented in Section 3. In Section 4, we present empirical results and their implications. Finally, Section 5 summarizes research findings and concludes.

2. Background literature

Prior evidence on the linkage between oil price shocks and financial markets come from (Huang et al., 1996; Jones and Kaul, 1996; Sadorsky, 1999). Particularly, Sadorsky (1999) shows the importance of oil prices and their volatility in explaining real stock return. Huang et al. (1996) report contradictory findings as the authors fail to find any strong connection between oil futures and aggregate-level market return. Elyasiani et al. (2011) extend the analysis to 13 US indices and find that oil price shocks and oil return volatility constitute systematic asset price risk for nine out of 13 industries. Kilian and Park (2009) study the sources of oil price shocks and document that demand and supply imbalance impact stock return differently. However, the authors only consider the demand and supply imbalance but not other factors that can lead to oil price shocks.

Studies have been also undertaken in the markets outside the US. Using aggregate level Canadian oil & gas index, Sadorsky (2001) finds a positive relationship between oil price and oil & gas stock prices; while a negative relationship is observed between exchange rate, term premium, and oil & gas stock prices. El-Sharif et al. (2005) extend the analysis to the UK market and consistent with Sadorsky (2001), the authors find a positive relationship between oil price and oil & gas stock prices. Boyer and Filion (2007) re-examine the determinants of oil & gas stock return in the Canadian market by considering five common and five fundamental factors. Using firm-level data, the authors show how each of the common and fundamental factors affects oil & gas stock return. The authors assert that increase in oil prices have a positive effect on the oil & gas stock prices.

Nandha and Faff (2008) analyse the relationship between oil and global industries. Using 35 Datastream global industry indices that represent the performance of each industry across countries (instead of each country), the authors note that an increase in oil prices adversely affects the stock return of all industries except mining, and oil & gas industries. Park and Ratti (2008) analyse the impact of oil price shocks on real stock return in the US and 13 European countries between 1986 and 2005. The authors show that oil price shocks explain the variability of real stock return in the same month or within a month. Ramos and Veiga (2011) extend the analysis to 34 markets and document that oil prices are a globally priced factor for the oil industry. The authors also document that the stock returns of oil & gas stocks respond asymmetrically to oil price changes.

3. Data and methodology

3.1. Market Dislocation Index (MDI)

We follow Pasquariello (2014) in constructing the market dislocation index. The market dislocation measure is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). Since the approach does not depend on any model, this significantly reduces model misspecification and as a result increases the robustness of the measure. MDI is available online but not extended post-2009, therefore we reconstruct this measure as the following.[3]

3.1.1. Covered Interest Rate Parity

As per CIRP law of one price, the theoretical forward exchange rate of borrowing in any currency A at the interest cost r_A for $T - t$ days, exchanging the borrowed amount to currency B at the spot exchange rate $S_{t,A/B}$ and depositing in currency B at interest rate r_B is as the following:

$$F^*_{t,T,A/B} = S_{t,A/B}\left(\frac{1 + r_{A,t,T}}{1 + r_{B,t,T}}\right)$$

Therefore, if the law of one price holds, the difference between market forward exchange rate between currency A and B ($F_{t,T,A/B}$) and the theoretical forward exchange rate ($F^*_{t,T,A/B}$) should be close to zero.

In order to calculate daily CIRP violations, we use the same currency suggested by Pasquariello (2014). We retrieve daily spot and forward exchange rates of the five most heavily traded foreign exchange currencies from 1st May 1990 to 31st December 2014.[4] These are CHF/USD, GBP/USD, EUR/USD, JPY/USD, CHF/EUR, GBP/EUR, JPY/EUR, CHF/GBP and JPY/GBP. We also retrieve corresponding LIBOR rates of each country for seven different maturities (7, 30, 60, 90, 180, 270, and 360 days). Nine different exchange rates with seven different maturities result in 63 CIRP permutations. Both the exchange rates and LIBOR are available from Datastream. Finally, for each permutation we compute absolute log differences as, $\text{CIRP}_{i,t} = |\ln(F_{t,T,A/B}) - \ln(F^*_{t,T,A/B})| * 10{,}000$.

3.1.2. Triangular Arbitrage Parity

The second arbitrage violation deals with price discrepancy among three different currencies. This approach entails buying the vehicle currency indirectly through other cross-rates currency. For example, instead of buying USD/JPY directly, one can buy USD/GBP and then exchange with GBP/JPY, resulting in USD/JPY. In the absence of arbitrage opportunity, one will find the difference between direct and cross-currency exchange rate close to zero, i.e., $S_{t,A/B} - S^*_{t,A/B} = 0$, where $S^*_{t,A/B} = S_{t,A/V} * S_{t,V/B}$, V is the vehicle currency and, A and B are the cross-rate currencies.

We retrieve daily spot exchange rates of the most liquid, relatively free-floating currencies of AUD, CAD, CHF, FRF, GBP, ITL and JPY. We use either USD or EUR as a vehicle currency.[5] This dataset comes from the Pacific Exchange Rate Service.[6] For each of the 112 TAP permutations, we compute daily absolute log differences between direct currency and cross-rates as, $\text{TAP}_{i,t} = |\ln(S_{t,A/B}) - \ln(S^*_t, A/B)| * 10{,}000$.

[3] See Pasquariello (2014) for detailed MDI construction procedure.
[4] Forward rates prior to 1st May 1990 are unavailable.
[5] We use DEM instead of EUR as one of the vehicle currencies prior to the introduction of the Euro. Similarly, we use FRF and ITL as cross-rate currencies prior to the introduction of the Euro.
[6] http://fx.sauder.ubc.ca/.

3.1.3. ADR parity

The last set of arbitrage deviation relates to price discrepancy between the stock listed in the local market and US-listed American Depositary Receipt (ADR), taking into account bundling ratio and corresponding date exchange rate. The theoretical ADR price derived from the domestic listed stock is as the following:

$$P^{*}_{i,t} = S_{t,USD/H} * q_i * P^{H}_{i,t}$$

where $S_{t,USD/H}$ is the spot exchange rate between local currency and USD, q_i is the bundling ratio and $P^{H}_{i,t}$ is the unit stock price of the underlying foreign shares in their local currency H. In the absence of trading frictions, an arbitrage opportunity may exist if $P \neq P^{*}_{i,t}$. In order to find ADRP violations, we include 247 domestic–U.S. pairs of daily closing stock prices from 40 countries that are listed as ADR in either NYSE, NASDAQ or AMEX stock exchange. For each pair, we calculate ADRP violation as $\mathrm{ADRP}_{i,t} = |\ln(P_{i,t}) - \ln(P^{*}_{i,t})| * 10{,}000$.

The final index construction entails a number of steps as underlined by Pasquariello (2014). First, each parity is standardized relative to its own historical distribution. Next, an equal-weighted average of all three parities is computed on that day. In the last step, the monthly market dislocation index is computed from daily data by taking the average over the month. A high MDI suggests that market is under stress.

3.2. Stock price

The stock price data is from Datastream. We use International Classification Benchmark (ICB) to find stocks that operate in the oil & gas industry.[7] This results in retrieving information of 2136 active and dead/delisted stocks from 70 countries. Consistent with Nandha and Faff (2008) and Park and Ratti (2008), we use monthly frequency data. We use firm-level stock return to measure the sensitivity of stock return towards oil price shocks and market uncertainty. The monthly firm-level stock return is calculated as $R_{i,t} = \ln(P_t/P_{t-1})$, where P is the price of stock i in month t. The stock price is adjusted for theoretical growth in value of the dividend, assuming reinvestment. Thus, the stock prices reflect both capital gain and dividend yield.

3.3. Control variables

In order to control the effect of other variables that are known to affect the stock return, we use market return, illiquidity, standard deviation of stock return, leverage, log of market value, percentage of foreign sales, GDP growth rate, and price to book value ratio. We calculate illiquidity as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. This measure is calculated as the ratio of zero trading days to the total number of trading days over the last one year. As a priori, it is expected that illiquidity and stock return have a positive relationship. Riskiness of firm is computed as daily standard deviation of stock return over the last one year. It is expected that a risky stock command a higher return. We calculate leverage as long-term debt scaled by the total assets. Fama and French (1992) document a negative relationship between firm size and price to book value with stock return. Consequently, we use the log of market value and price to book value ratio to control these factors. We include Foreign sales % computed as foreign sales scaled by total sales. This variable is included to take into consideration that oil & gas firms may derive revenue from other countries in addition to domestic market sales. GDP growth rate, retrieved from World Bank, proxies the income level of the country. To improve the quality of the data, we follow Ince and Porter (2006) and Chui et al. (2010) to address the data issues noted in Datastream. The control variables and the stock return are winsorized at 1 and 99 percentile to minimize the effect of outliers.

3.4. Oil price and market return

We use New York Mercantile Exchange (NYMEX) roll-on-future one month oil price as a proxy for oil & gas prices. Our choice for NYMEX is motivated by Elyasiani et al. (2011) where the authors suggest a number of advantages of using future oil prices over spot prices, including less random temporary noise. Substituting NYMEX with West Texas Intermediate Cushing (WTI) or the UK Brent crude oil does not alter our main findings. Following Sadorsky (2001) and Elyasiani et al. (2011) we use risk-free rate adjusted stock and market return. The country-specific market return and risk-free rate are retrieved from Datastream. NYMEX prices are available from the US Energy Information Administration (USEIA) website. The USEIA provides NYMEX prices, starting 29th April 1983, and therefore our sample period is from May 1983 to December 2014.

3.5. Product market competition

We construct sales Herfindahl–Hirschman Index (HHI) as a proxy for competition within the oil & gas industry in each country. This measure is extensively used in the extant literature, particularly in the industrial organization literature (see Tirole, 1988 among others). It is calculated by squaring the market share of each firm in the industry within the country and then adding the resulting numbers. The range of HHI measure lies between zero and one, with a high HHI index suggesting monopoly in the given industry. We calculate the sales HHI of at least four firms in the industry out of a maximum number of firms of 50. This is consistent with the US Census that uses the 50 largest firms within each industry or the largest four-firm concentration ratio. We also consider alternatives where the maximum number of firms used in calculating sales HHI is not imposed or only the top four sales firms within the oil & gas industry are considered. The results remain qualitatively similar in either case. We use Worldscope database to obtain sales figure of publicly listed oil & gas firms. The competition measure is calculated for the oil & gas industry in each country and each year.

Table 1 reports for each sample country, the number of firm-month and country-month observations used in the analysis. It also reports the median oil production and consumption of each country, collected from the USEIA website. A comprehensive 274,218 firm-month observations from 70 countries are used for empirical analysis. The sample has a wide coverage of firms located in developed, developing and transitional economies, including major countries across all geographical regions. We also note that, as expected, the sample is not evenly distributed across countries. Canada and the US dominate the sample. However, robustness checks do not suggest the dominance of firms listed in Canada and the US driving the main findings of this study.

In the fourth and fifth columns, we report the median oil supply and consumption, measured in thousand barrels per day. As per USEIA,[8] production is defined as, "The lifting of oil and gas to the surface and gathering, treating, field processing (as in the case of processing gas to extract liquid hydrocarbons), and field storage. The production function shall normally be regarded as terminating at the outlet valve on the lease or field production storage tank. If unusual physical or operational circumstances exist, it may be more appropriate to regard the production function as terminating at the first point at which oil, gas, or gas liquids are delivered to a main pipeline, a common carrier, a refinery, or a marine terminal." Consumption is defined as, "consumption of

[7] In unreported results, we consider using industry classification provided by FF48 classification (Fama and French, 1997), which in turn is drawn from the Standard Industrial Classification (SIC). This does not alter our main findings.

[8] https://www.eia.gov/tools/glossary/.

Table 1
Sample description.

No	Country	Firm-months	Country-months	Production	Consumption
1	Argentina	962	322	802	542
2	Australia	22,966	380	588	989
3	Austria	323	323	27	262
4	Bangladesh	818	271	6	86
5	Belgium	160	160	11	550
6	Brazil	638	244	2284	2297
7	Bulgaria	135	135	3	99
8	Canada	119,856	380	2954	2065
9	Chile	305	305	18	249
10	China	1321	252	3809	6795
11	Colombia	299	242	690	277
12	Cote d'Ivoire	156	78	NA	NA
13	Cyprus	306	167	0	56
14	Czech Republic	426	236	10	179
15	Ecuador	196	196	398	140
16	Egypt	189	111	712	712
17	Finland	147	147	10	208
18	France	2280	380	97	1915
19	Germany	578	314	140	2533
20	Ghana	64	64	78	65
21	Greece	387	198	7	408
22	Hong Kong	248	166	0	354
23	Hungary	294	228	37	145
24	Iceland	63	63	NA	18
25	India	6986	299	818	2426
26	Indonesia	722	241	1042	1341
27	Ireland	2580	368	0	143
28	Israel	4199	263	4	242
29	Italy	630	228	155	1729
30	Japan	5974	379	104	5319
31	Jordan	178	102	0	108
32	Kazakhstan	157	68	1609	216
33	Kuwait	158	111	2692	431
34	Lithuania	112	112	10	57
35	Luxembourg	92	46	NA	59
36	Malaysia	1264	347	741	475
37	Mauritius	76	76	NA	22
38	Morocco	411	225	4	174
39	Netherlands	916	379	75	769
40	New Zealand	374	311	52	131
41	Nigeria	397	64	2459	287
42	Norway	1849	379	2385	221
43	Oman	109	109	819	114
44	Pakistan	2555	269	67	360
45	Papua New Guinea	479	380	55	15
46	Peru	191	191	121	166
47	Philippines	2081	326	14	312
48	Poland	578	180	34	527
49	Portugal	98	98	5	274
50	Qatar	10	10	NA	NA
51	Romania	631	197	117	220
52	Russia	5001	203	9732	2803
53	Saudi Arabia	193	110	11,429	2580
54	Singapore	1297	380	9	744
55	Slovak Republic	90	90	10	79
56	Slovenia	191	191	0	54
57	South Africa	722	380	201	466
58	South Korea	2509	327	17	2155
59	Spain	599	333	29	1385
60	Sri Lanka	217	217	−1	81
61	Sweden	2420	306	7	350
62	Switzerland	316	208	4	266
63	Thailand	1822	334	310	1008
64	Turkey	1158	323	58	648
65	Ukraine	278	104	94	287
66	United Arab Emirates	57	57	2947	586
67	United Kingdom	15,107	380	90	1747
68	United States	54,355	380	9445	18,771
69	Vietnam	777	96	340	432
70	Yugoslavia	185	68	21	80
	Total	274,218			

Table 1 reports for each sample country, the number of firm-month and country-month observations used in the analysis. It also reports the median oil production and consumption of each country, collected from the USEIA website.

petroleum products because it measures the disappearance of these products from primary sources, i.e., refineries, natural gas-processing plants, blending plants, pipelines, and bulk terminals. In general, product supplied of each product in any given period is computed as follows field production, plus refinery production, plus imports, plus unaccounted-for crude oil (plus net receipts when calculated on a PAD District basis) minus stock change, minus crude oil losses, minus refinery inputs, and minus exports." Saudi Arabia, Russia and the US rank high in oil supply, whereas the US, China and Japan rank high in oil consumption. Interestingly, Saudi Arabia oil consumption is similar to Germany even if the population and GDP are lower. Anecdotal evidence suggests that increasing electricity demand and lack of alternative sources of energy has led to high oil consumption in Saudi Arabia.[9]

We report summary statistics of sales HHI in Table 2. The overall sales HHI in the oil & gas industry is 0.43, suggesting that the oil & gas industry is relatively less competitive. Many countries, such as Austria, Brazil, South Africa among others, have a high sales HHI ratio, indicating that few firms dominate the oil & gas industry. On the contrary, oil & gas firms domiciled in Canada and the US face strong competition from other firms within the same industry. The standard deviation shows variation of sales HHI across years. Although the standard deviation of 0.25 is not high, this indicates that competition within each country's oil & gas industry is not sticky. In unreported results, we calculate average and median sales HHI across countries in each year from 1983 to 2013. We find that sales HHI has increased marginally from 0.35 (year 1983) to 0.45 (year 2013).

We report summary statistics of control variables in Table 3. We find that the average firm-level monthly stock return is −0.56% with a standard deviation of 20.91%. Compared to stock return, average market return is 0.60% with a reasonable standard deviation of 5.20%. We also document bias that may arise if oil & gas index returns are used instead of firm-level stock return. In untabulated results, we calculate oil & gas index return and find average and median monthly return of multi-country oil & gas index as 0.64% and 0.30% respectively. The standard deviation of sub-index return is 8.09%, suggesting that sub-index returns are positively skewed and less volatile than firm-level stock return. We also find that out of a total of 2136 firms, only 552 were operating at the end of 2014. This indicates that close to 75% of the firms are delisted due to various reasons. These observations suggest that the performance of the majority of the firms may not be captured by an aggregate level oil & gas index that mainly tracks the performance of large and well-known firms.

As seen in Table 3, the illiquidity of oil & gas firms is 39.15%, suggesting that on average the stock prices of firms did not change in four out of 10 days. Similarly, the average and median market valuation is 38 and 33 million USD respectively. It also seems that oil & gas firms have lower level of leverage as the average and median leverage ratio is 12.80% and 5.01% respectively. Finally, the exposure to international sales is relatively low as the average and median foreign sales percentage is 7.82% and 0% respectively. This suggests that a small number of oil & gas firms generate substantial share of revenue from international sales.

[9] http://www.wsj.com/articles/SB10001424052702303816504577319571732227492.

Table 2
Summary statistics of sales HHI.

No	Country	Sales HHI			No. of years in sample
		Mean	Median	St. dev	
1	Argentina	0.51	0.52	0.10	21
2	Australia	0.35	0.34	0.06	20
3	Austria	0.95	0.95	0.01	9
4	Brazil	0.98	0.98	0.01	10
5	Canada	0.11	0.10	0.03	31
6	China	0.49	0.49	0.01	15
7	Cyprus	0.32	0.25	0.19	11
8	France	0.44	0.39	0.14	31
9	Germany	0.20	0.12	0.18	17
10	Ghana	0.50	0.50	0.00	4
11	Hong Kong	0.64	0.64		1
12	India	0.20	0.17	0.05	19
13	Indonesia	0.40	0.40	0.10	10
14	Ireland	0.89	0.89	0.05	20
15	Israel	0.51	0.47	0.08	10
16	Italy	0.67	0.65	0.07	18
17	Japan	0.17	0.16	0.02	31
18	Kazakhstan	0.71	0.71	0.03	3
19	Kuwait	0.77	0.76	0.03	9
20	Malaysia	0.25	0.23	0.11	23
21	Netherlands	0.60	0.37	0.31	22
22	New Zealand	0.73	0.80	0.13	3
23	Nigeria	0.31	0.31	0.01	4
24	Norway	0.56	0.56	0.11	27
25	Pakistan	0.35	0.31	0.13	21
26	Philippines	0.92	0.93	0.14	22
27	Poland	0.48	0.49	0.04	11
28	Romania	0.47	0.45	0.06	9
29	Russia	0.21	0.19	0.04	16
30	Singapore	0.27	0.25	0.09	23
31	South Africa	0.95	0.95	0.01	2
32	South Korea	0.41	0.36	0.14	17
33	Spain	0.56	0.53	0.09	14
34	Sweden	0.47	0.45	0.15	17
35	Switzerland	0.54	0.56	0.04	3
36	Thailand	0.44	0.40	0.11	14
37	Turkey	0.38	0.40	0.04	21
38	United Kingdom	0.42	0.31	0.19	31
39	United States	0.12	0.12	0.02	31
40	Vietnam	0.31	0.31	0.01	7
	Overall	0.43	0.39	0.25	

In this table we report summary statistics of sales HHI of the oil & gas industry within a country. Number of years in the country indicates for how many years sales HHI of oil & gas industry is available for the country.

In Table 4, we report correlation matrices between dependent and independent variables. The correlation between stock and market return is 0.217 and statistically significant at the 1% level. As oil prices positively influence oil & gas stock return, we find a correlation of 0.147 between firm-level stock return and NYMEX oil return. MDI is negatively correlated with stock return, suggesting that an increase in global market stress decreases the stock return of oil & gas firms. Firm size is positively related to the stock return. We also do not find the problem of multi-collinearity as none of the correlations exceeds absolute 0.50.

4. Empirical results

Before undertaking further analysis, we verify whether the data suffers from unit root problem. In Table 5, we present a modified Dickey–Fuller *t*-test, proposed by Elliott et al. (1996) to check if the unit root problem exists. The results indicate that the MDI index is stationary as the DF-GLS *tau*-statistic is outside of the 1% critical value in all four lags and therefore the null hypothesis of unit root is rejected. However, oil price (NYMEX) *tau*-statistic is within the 1% critical value and therefore the series suffers from the unit root problem. Using the log difference (returns) of NYMEX, though, addresses the problem as the null hypothesis of unit root is rejected at the 1% level. In unreported results, we find that unit root tests suggested by Phillips and Perron (1988) and Kwiatkowski et al. (1992) indicate similar outcome. We also find (unreported) that other variables used in the analysis follow $I(0)$ processes.

In Table 6, we investigate the impact of oil price change and market dislocation on oil & gas stock return by running the following regression:

$$R_{i,j,t} = \propto_0 + \alpha_1 MDI_t + \alpha_2 NYMEXreturn_t + \sum \alpha_3 Controls + \alpha_4 + \varepsilon_{i,j,t} \quad (1)$$

where $R_{i,j,t}$ is excess return of firm i, in country j, in month t over the risk-free rate; α_1 is the market dislocation index; α_2 is the NYMEX roll-on-future one month oil return; α_3 is a set of control variables and α_4 is a set of firm-fixed effects to control for unobservable time-invariant heterogeneity. For each country we retrieve country-specific Datastream market index and use as an explanatory variable. We cluster standard error at the firm-level to control for intragroup correlation within the firm. The main coefficients of interests are α_1 and α_2 with the expectation that α_1 is negative and α_2 is positive. Columns 3 and 4 include control variables, whereas Columns 1 and 2 do not. We use panel regression with fixed effect to infer the results. We undertake Hausman (1978) test to check whether fixed effect or random effect model is more

Table 3
Summary statistics of main variables.

Variable	Distribution							
	Mean	St. dev	25th	50th	75th	Skewness	Kurtosis	N
Stock return	−0.56%	20.91%	−8.85%	0.00%	7.42%	0.09	7.95	274,218
Market return	0.60%	5.20%	−1.89%	1.04%	3.56%	−0.49	13.38	274,218
MDI	−0.09	0.19	−0.20	−0.10	−0.02	2.49	15.78	274,218
NYMEXret	0.34%	9.31%	−5.21%	0.92%	6.54%	−0.34	4.95	274,218
St. dev of return	5.47%	4.94%	2.23%	3.93%	7.11%	2.23	9.76	274,218
Illiquidity	39.15%	30.02%	12.98%	30.53%	61.83%	0.62	2.13	274,218
Log of MV	3.65	3.06	1.31	3.49	5.80	0.23	2.55	274,218
PTBV	2.75	4.43	1.04	1.69	2.74	6.27	53.59	165,695
Leverage	12.80%	16.07%	0.00%	5.01%	22.71%	1.23	3.82	164,927
Risk-free	0.46%	0.22%	0.33%	0.44%	0.58%	0.71	4.47	274,218
Foreign sales %	7.82%	23.34%	0.00%	0.00%	0.00%	3.13	11.62	274,218
GDP growth rate	2.92%	2.41%	1.92%	2.80%	4.14%	0.00	8.45	274,218

In this table we report distribution of main variables. Stock return is monthly log firm-level return, calculated as $R_{i,t} = \ln(P_t / P_{t-1})$, where P is the price of stock i in month t. Market return is monthly log return of the market in which the firm is located. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEXret is New York Mercantile Exchange roll-on-future one month oil price. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. PTBV is price to book value and leverage is long-term debt divided by total assets. Risk-free rate are country-specific monthly rates retrieved from Datastream. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency.

Table 4
Correlation coefficient.

	Stock return	Market return	MDI	NYMEX return	St. dev of stock return	Illiquidity	Log of MV	PTBV	Leverage	Risk free rate	Foreign sales %	GDP growth rate
Stock return	1											
Market return	0.217***	1										
MDI	−0.0919***	−0.238***	1									
NYMEX return	0.147***	0.207***	−0.230***	1								
St. dev of stock return	−0.00137	−0.000876	0.0902***	0.00388*	1							
Illiquidity	−0.00634***	0.00574**	0.0232***	0.0168***	0.293***	1						
Log of MV	0.0766***	0.00561**	−0.0788***	−0.00202	−0.553***	−0.665***	1					
PTBV	0.0541***	0.0146***	−0.0294***	0.0144***	0.0414***	0.0337***	−0.0290***	1				
Leverage	0.00912***	0.0108***	−0.00470	−0.0193***	−0.210***	−0.299***	0.336***	−0.0139***	1			
Risk-free	0.0105***	−0.00734***	0.0789***	0.00806***	0.0423***	0.0783***	−0.140***	−0.0273***	0.111***	1		
Foreign sales %	0.00407*	−0.0124***	−0.00587**	0.000950	−0.127***	−0.165***	0.273***	−0.0439***	0.0252***	−0.0676***	1	
GDP growth rate	0.00471*	0.0285***	−0.0380***	0.0120***	−0.117***	−0.0343***	0.0217***	0.0169***	0.0103***	0.0839***	−0.0614***	1

In this table we report correlation coefficient between main variables. Stock return is monthly log firm-level return, calculated as $R_{i,t} = \ln(P_t / P_{t-1})$, where P is the price of stock i in month t. Market return is monthly log return of the market in which the firm is located. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEX is New York Mercantile Exchange roll-on-future one month oil price. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. PTBV is price to book value and leverage is long-term debt divided by total assets. Risk-free rate are country-specific monthly rates retrieved from Datastream. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

appropriate for this study. Under the null hypothesis, it is assumed that random effect model is more appropriate. In unreported results, we reject the null hypothesis as the value of (chi^2) is 2859.35 with a probability of 0 %. Therefore, Hausman test suggest that fixed effect model is appropriate for this study.

The results in Column 1 suggest that the oil & gas firms are less risky compared to overall market as the *RM_RF* coefficient is 0.871 and statistically significant at the 1% level. This is consistent with Boyer and Filion (2007) and Sadorsky (2001) where the authors note that oil & gas firms are less risky but poor hedging alternatives. Including MDI as an additional explanatory variable in Column 2 yields a negative coefficient of −0.051, significant at the 1% level. This is expected as an increase in global uncertainty and stress leads to lower oil & gas stock return. This suggests that oil & gas firms do not provide a good hedging tool when the market uncertainty and stress is high.

In Column 3, we include NYMEX oil return and other control variables. The positive effect of oil prices on oil & gas firms can be seen as the coefficient is 0.223 and statistically significant at the 1% level. This is expected as the rise of oil price increases the cash flow and profitability of oil & gas firms. The MDI coefficient remains negative and statistically significant at the 1% level. The coefficients of firm risk (standard deviation of stock return) and illiquidity are positive, suggesting that risky and illiquidity stocks require higher return. We find a negative relationship between foreign sales percentage and excess stock return, suggesting that firms exposed to international revenue are likely to have lower stock return. GDP growth rate of the country positively affects the oil & gas stock return. The GDP growth rate coefficient is 0.0403 and statistically significant at the 5% level.

In Column 4, we consider an alternative measure of macroeconomic stress, Kilian Index.[10] Kilian Index is a measure of global real economic activity from Kilian (2009) and available from Kilian's website throughout the sample period. The Kilian Index coefficient is positive and statistically significant at the 1% level, suggesting that an increase in real economic activity positively affects the stock return of oil & gas firms. In Column 5, we replace MDI with Volatility Implied Index (VIX) to investigate whether MDI is an appropriate proxy for global market uncertainty. As VIX Index is only available post-1990, the number of observations was from 274,218 to 252,375. Nevertheless, we find that an increase in implied volatility, i.e. an increase in global uncertainty, negatively affects the stock return of oil & gas firm. In Column 6, we introduce additional control variables, PTBV and leverage. Although the number of observations drops from 274,218 to 154,732, the results are consistent with Column 3.[11]

The results are also economically significant. For instance, when global uncertainty rises from the bottom 25th percentile (MDI = −0.20) to the top 25th percentile (−0.02), the monthly excess stock return decreases by 0.28% (=0.0155 × (−0.02 + 0.20)) using Column 3 estimates. Similarly, a change in oil price from the bottom 25th percentile (NYMEXret = −5.21%) to the top 25th percentile (NYMEXret = 6.54%), increases the monthly excess stock return by 2.62% (=0.223 × (6.54 + 5.21)) using Column 3 estimates. Summing up, the result suggests that both the market uncertainty and oil price shocks are important determinants of firm-level oil & gas stock return.

In Table 7, we investigate whether the effect of MDI and NYMEX oil return are felt evenly in high oil producing and net oil output countries. It can be reasoned that the countries that rely overly on oil production as a source of revenue are sensitive to oil prices and global market stress. Therefore, a change in oil prices or international geopolitical events

Table 5
Unit root test.

Lags	MDI		NYMEX		Log dif NYMEX	
	DF-GLS tau statistic	1% critical value	DF-GLS tau statistic	1% critical value	DF-GLS tau statistic	1% critical value
4	−5.687	−3.480	−2.562	−3.480	−7.984	−3.480
3	−6.168	−3.480	−2.635	−3.480	−8.344	−3.480
2	−6.232	−3.480	−2.569	−3.480	−9.100	−3.480
1	−6.353	−3.480	−2.451	−3.480	−11.741	−3.480

In this table we present a modified Dickey–Fuller *t*-test, proposed by Elliott et al. (1996) to check if the unit root problem exists.

[10] We thank an anonymous referee for suggesting this analysis.
[11] As the sample size drops by less than half with the inclusion of PTBV and leverage factor, we do not include them in further analysis. The results, though, remain qualitatively similar with their inclusion.

Table 6
Effect of market dislocation and oil price shocks on oil & gas prices.

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
	Excess stock return	Excess stock return	Excess stock return	Excess stock return	Excess stock return	Excess stock return
Excess market return	0.871***	0.826***	0.762***	0.773***	0.738***	0.849***
	(55.75)	(52.20)	(49.53)	(51.75)	(45.03)	(61.06)
MDI		−0.0510***	−0.0155***			−0.0169***
		(−20.40)	(−6.25)			(−6.13)
Kilian Index				0.0000524***		
				(2.90)		
VIX Index					−0.000439***	
					(−6.57)	
NYMEX oil return			0.223***	0.228***	0.225***	0.259***
			(36.71)	(37.56)	(35.19)	(34.30)
St. dev of Stk return			0.519***	0.516***	0.527***	0.663***
			(30.08)	(30.23)	(29.05)	(18.44)
Illiquidity			0.135***	0.135***	0.148***	0.137***
			(28.41)	(28.43)	(29.55)	(18.40)
Log of MV (~US$)			0.0282***	0.0283***	0.0298***	0.0242***
			(32.37)	(31.97)	(34.60)	(20.82)
Foreign sales %			−0.0248***	−0.0253***	−0.0221***	−0.0154***
			(−7.17)	(−7.34)	(−6.24)	(−4.09)
GDP growth rate			0.0403**	0.0483**	0.0186	0.0258*
			(2.06)	(2.45)	(0.91)	(1.09)
PTBV						0.00318***
						(10.81)
Leverage						−0.0407***
						(−6.06)
Constant	−0.0114***	−0.0159***	−0.197***	−0.196***	−0.198***	−0.199***
	(−526.07)	(−73.43)	(−37.61)	(−37.09)	(−35.51)	(−24.48)
Firm F.E.?	Yes	Yes	Yes	Yes	Yes	Yes
Clustered S.E.?	Firm-level	Firm-level	Firm-level	Firm-level	Firm-level	Firm-level
N	274,218	274,218	274,218	274,218	252,375	154,732
Adj. R-sq	0.047	0.049	0.081	0.080	0.080	0.136

In this table we investigate the impact of NYMEX oil return and market dislocation on the oil & gas stock returns. The dependent variable is stock return less risk-free return (RI_RF), calculated as $R_{i,t} - R_f$. Risk-free adjusted market return (RM_RF) is monthly log return of the market in which the firm is located less corresponding risk-free return. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). Kilian Index is Global Real Economic Activity Index from Kilian (2009). VIX Index is Chicago Board Options Exchange (CBOE) Volatility Implied Index. NYMEXret is New York Mercantile Exchange roll-on-future one month oil price change. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency. PTBV is price to book value and leverage is long-term debt divided by total assets. The model includes firm-fixed effects. Standard error is clustered at the firm-level. *t-Stats* are given in parentheses and are based on robust standard errors.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

can significantly affect the cash flow of the economy (Lopez-Murphy and Villafuerte, 2010). In a similar vein, we argue that firm-level oil & gas stock return in low oil producing countries are less sensitive to oil price fluctuations and global uncertainty as the economy of the country is potentially diversified and not dependent on a single industry, such as oil & gas. To this end, we split the sample into high and low oil production/consumption countries. Each year we sort the countries on the basis of production and consumption statistics available from USEIA. We use the median oil production and consumption as a cut-off measure to bifurcate the sample into low and high.

In Columns 1 and 2, we concentrate on oil production; while in Columns 3 and 4, we concentrate on the net oil output, i.e. oil production less consumption within the country. We find that the MDI coefficient is −0.01 (*t-stat* − 2.74) for low oil producing countries compared to −0.0341 (*t-stat* − 9.85) for high oil producing countries. Similarly, NYMEX oil return coefficient is 0.157 (*t-stat* 16.61) for low oil producing countries, as compared to 0.227 (*t-stat* 30.65) for high oil producing countries. Taken together, the results suggest that oil & gas firms located in high oil producing countries are more sensitive to global uncertainty and oil price shocks. Similar results can be observed when we split the sample based on net oil output at the country-level. The high MDI coefficient is almost three times larger than low MDI, while the NYMEX return does not significantly differ.

Economically, the results are meaningful. For instance, when the MDI increases from the bottom 25th percentile to the top 25th percentile, the monthly excess stock return of firms domiciled in low oil producing countries decreases by 0.18%. Further, the monthly excess stock return decreases by 0.61% for the firms domiciled in the high oil producing countries. Similarly, a change of oil price from the bottom 25th percentile to the top 25th percentile results an increase of 1.84% monthly excess stock returns for the firms domiciled in low oil producing countries. This monthly excess stock returns increases to 2.67% for the firms domiciled in high oil producing countries. These estimates are calculated using the same procedure as reported previously.

In this section, we examine the role of product market competition in moderating the effect of oil price shocks and market uncertainty on stock return. We form terciles based on whether or not the firm is located in the lowest HHI industry, the medium HHI industry or the highest HHI oil & gas industry. Forming (2×1) and (4×1) vector of sales HHI dummies to capture varying degrees of competition do not alter our findings. In addition to control variables, the regression also includes sales HHI dummies to control for the direct effect of competition on firm-level stock return.

We report the results in Table 8. In Model 1, we introduce the interaction between NYMEX oil return and competition (sales HHI) tercile dummies. The NYMEXreturn coefficient in a high-competition oil & gas industry, i.e., HHI (low) is 0.310 (*t-stat* 28.18); whereas NYMEXreturn coefficient in a low-competition oil & gas industry, i.e., HHI (high) is 0.164 (*t-stat* 16.31). Further, we undertake Wald test (unreported) to check whether the coefficients are symmetric. The null hypothesis is rejected at the 1% level, suggesting that the oil & gas firms operating in a non-competitive oil & gas industry are less likely

Table 7
Country-level production and consumption of oil.

Dependent variable	(1)	(2)	(3)	(4)
	Production		Production–consumption	
	Low	High	Low	High
	Excess stock return	Excess stock return	Excess stock return	Excess stock return
Excess market return	0.814***	0.716***	0.807***	0.707***
	(37.51)	(34.89)	(43.79)	(29.71)
MDI	−0.0100***	−0.0341***	−0.0149***	−0.0348***
	(−2.74)	(−9.85)	(−4.61)	(−8.83)
NYMEX oil return	0.157***	0.227***	0.220***	0.188***
	(16.61)	(30.65)	(25.46)	(23.52)
St. dev of stock return	0.543***	0.549***	0.504***	0.568***
	(11.20)	(27.34)	(12.32)	(27.32)
Illiquidity	0.106***	0.152***	0.117***	0.158***
	(14.60)	(24.20)	(17.42)	(23.08)
Log of MV (~US$)	0.0250***	0.0312***	0.0257***	0.0324***
	(19.13)	(29.02)	(22.90)	(25.18)
Foreign sales %	−0.0170***	−0.0402***	−0.0136***	−0.0495***
	(−4.49)	(−5.04)	(−3.69)	(−6.34)
GDP growth rate	−0.0569**	0.149***	−0.0252	0.141***
	(−2.57)	(4.71)	(−1.07)	(4.25)
Constant	−0.176***	−0.213***	−0.184***	−0.216***
	(−20.61)	(−33.24)	(−23.96)	(−31.01)
Firm F.E.?	Yes	Yes	Yes	Yes
Clustered S.E.?	Firm-level	Firm-level	Firm-level	Firm-level
N	89,695	172,538	123,262	138,971*
Adj. R-sq	0.114	0.071	0.114	0.067

In this table we investigate whether the effect of MDI and NYNEX oil return are felt evenly in high oil producing and net oil output countries. We use the median oil production and consumption statistics available from USEIA as a cut-off measure. The dependent variable is stock return less risk-free return (RI_RF), calculated as $R_{i,t} - R_f$. Risk-free adjusted market return (RM_RF) is monthly log return of the market in which the firm is located less corresponding risk-free return. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEXret is New York Mercantile Exchange roll-on-future one month oil price change. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency. The model includes firm-fixed effects. Standard error is clustered at the firm-level. *t-Stats* are given in parentheses and are based on robust standard errors.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

Table 8
Effect of competition on oil & gas stock prices.

Dependent variable	(1)	(2)	(3)
	Excess stock return	Excess stock return	Excess stock return
Excess market return	0.738***	0.751***	0.739***
	(47.15)	(48.19)	(47.12)
HHI (low) × NYMEXret	0.310***		0.299***
	(28.18)		(26.85)
HHI (medium) × NYMEXret	0.178***		0.179***
	(18.05)		(18.01)
HHI (high) × NYMEXret	0.164***		0.172***
	(16.31)		(17.21)
HHI (low) × MDI		−0.0461***	−0.0324***
		(−11.14)	(−7.83)
HHI (medium) × MDI		−0.0180***	−0.0192***
		(−3.00)	(−3.18)
HHI (high) × MDI		−0.00435	−0.0107***
		(−1.14)	(−2.91)
MDI	−0.0218***		
	(−8.32)		
NYMEXret		0.209***	
		(33.70)	
St. dev of ret	0.529***	0.530***	0.530***
	(28.63)	(28.52)	(28.60)
Illiquidity	0.149***	0.149***	0.149***
	(27.05)	(27.01)	(27.00)
Log of MV	0.0317***	0.0316***	0.0317***
	(32.17)	(32.09)	(32.14)
Foreign sales %	−0.0248***	−0.0253***	−0.0250***
	(−6.28)	(−6.41)	(−6.34)
GDP growth rate	0.00555	−0.00995**	0.00282*
	(0.24)	(−0.44)	(0.12)
HHI (medium) dummy	0.0255***	0.0268***	0.0264***
	(12.97)	(13.38)	(13.11)
HHI (high) dummy	0.0235***	0.0250***	0.0250***
	(6.93)	(7.36)	(7.33)
Constant	−0.229***	−0.229***	−0.230***
	(−35.52)	(−35.59)	(−35.60)
Firm F.E.?	Yes	Yes	Yes
Clustered standard error?	Firm-level	Firm-level	Firm-level
N	246,631	246,631	246,631
Adj. R-sq	0.081	0.081	0.081

In this table we examine the role of product market competition in moderating the effect of oil price shocks and market disruptions on stock returns. The dependent variable is stock return less risk-free return (RI_RF), calculated as $R_{i,t} - R_f$. Risk-free adjusted market return (RM_RF) is monthly log return of the market in which the firm is located less corresponding risk-free return. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEXret is New York Mercantile Exchange roll-on-future one month oil price change. We form terciles on the basis of whether the firm is located in the lowest HHI industry, the medium HHI industry or the highest HHI industry. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency. The model includes firm-fixed effects. Standard error is clustered at the firm-level. *t-Stats* are given in parentheses and are based on robust standard errors.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

to be influenced by the changes in oil price. Thus, the stock return of oil & gas firms operating in non-competitive oil & gas industry are less likely to be impacted by the oil price shocks.

In Model 2, we introduce the interaction between MDI and sales HHI tercile dummies. The results are in line with Model 1, suggesting that firms located in a non-competitive oil & gas industry are less sensitive to global uncertainty and therefore the stock return are less sensitive to global uncertainty. HHI (low) × MDI coefficient is −0.0461 (*t-stat* − 11.14), whereas HHI (high) × MDI coefficient is −0.00435 (*t-stat* − 1.14). In Model 3, we include the interaction between NYMEX oil return, MDI and sales HHI tercile dummies. The results are consistent with Model 1 and Model 2. Wald tests (unreported) also suggest that NYMEX oil return and MDI coefficients are asymmetric. In summary, the results suggest that firms that face less competition from other firms in the oil & gas industry are less sensitive to oil price shocks and market uncertainty. These results are in line with Sen (2003), who study the retail gasoline prices in Canada. The author finds international crude input prices and product market competition (to a smaller extent) are important determinants in explaining retail gasoline prices.

Previous literature (Hamilton and Herrera, 2004; Hooker, 1996; Huang et al., 2005; Mork, 1989; Mory, 1993; Ramos and Veiga, 2011) suggest that the oil price shocks on economic activity are asymmetric. An exception to this is Nandha and Faff (2008) who report contradictory findings and show that symmetric relationship is observed between oil prices and global industry indices. Nevertheless, there is little evidence on the asymmetric relationship between the oil price and stock market at the firm-level. In Table 9, we present evidence of an asymmetric relationship between oil prices and firm-level oil & gas stock return with and without controlling for the competition level within the oil & gas industry. We introduce two variables, an increase and decrease in oil prices, to document the impact on stock return of oil & gas industry.

Table 9
Asymmetric effect of oil price.

Dependent variable	(1)	(2)
	Excess stock return	Excess stock return
Excess market return	0.767***	0.740***
	(50.17)	(47.21)
MDI	−0.00410	−0.01000***
	(−1.61)	(−3.69)
Positive oil	0.131***	
	(13.01)	
Negative oil	0.313***	
	(32.45)	
HHI (low) × positive oil		0.133***
		(6.62)
HHI (medium) × positive oil		0.129***
		(7.97)
HHI (high) × positive oil		0.162***
		(10.57)
HHI (low) × negative oil		0.467***
		(24.08)
HHI (medium) × negative oil		0.231***
		(15.98)
HHI (high) × negative oil		0.181***
		(11.52)
St. dev of return	0.521***	0.530***
	(30.13)	(28.58)
Illiquidity	0.135***	0.150***
	(28.36)	(27.03)
Log of MV	0.0282***	0.0318***
	(32.45)	(32.22)
Foreign sales %	−0.0245***	−0.0249***
	(−7.12)	(−6.29)
GDP growth rate	0.0477**	0.00967*
	(2.42)	(0.42)
HHI (medium) dummy		0.0177***
		(7.48)
HHI (high) dummy		0.0131***
		(3.53)
Constant	−0.190***	−0.218***
	(−36.33)	(−33.64)
Firm F.E.?	Yes	Yes
Clustered standard error?	Firm-level	Firm-level
N	274,218	246,631
Adj. R-sq	0.081	0.082

In this table we present evidence of an asymmetric relationship between oil prices and oil & gas stock prices with and without controlling for competition level. The dependent variable is stock return less risk-free return (RI_RF), calculated as $R_{i,t} - R_f$. Risk-free adjusted market return (RM_RF) is monthly log return of the market in which the firm is located less corresponding risk-free return. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEXret is New York Mercantile Exchange roll-on-future one month oil price change. We form terciles on the basis of whether the firm is located in the lowest HHI industry, the medium HHI industry or the highest HHI industry. We introduce two variables, an increase and decrease in oil prices, to document the impact on stock return. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency. The model includes firm-fixed effects. Standard error is clustered at the firm-level. *t-Stats* are given in parentheses and are based on robust standard errors.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

In Model 1, the main coefficients of interests are Positive Oil (NYMEX oil return × positive oil price dummy) and Negative Oil (NYMEX oil return × negative oil price dummy). The results indicate that the sensitivity of firm-level stock return to an increase in oil price is much lower than a decrease in oil price. The Positive Oil and Negative Oil coefficients are 0.131 (*t-stat* 13.01) and 0.313 (*t-stat* 32.45) respectively. We undertake a Wald test to check whether the coefficient, Positive Oil and Negative Oil, are the same. The *F*-test value is 138.86 and statistically significant at the 1% level, suggesting that coefficients are asymmetric. Similarly, we test the hypothesis that coefficients are jointly equal to zero (Positive Oil = Negative Oil = 0).The null hypothesis is again rejected (probability less than 1%), suggesting that the coefficients are not similar.

In Model 2, we introduce competition level within the oil & gas industry and document intuitive results. We find that an increase in oil price affect the firm-level stock return at a similar magnitude under varying levels of competition. The HHI (low) × Positive Oil coefficient is 0.133 (*t-stat* 6.62), whereas HHI (high) × Positive Oil coefficient is 0.162 (*t-stat* 10.57). However, a significant difference is observed when we compare a decrease in oil price for the oil & gas firms operating in the non-competitive industry compared to the firms that face strong competition from other firms in the oil & gas industry. The HHI (low) ∗ Negative Oil coefficient is more than double the size of HHI (high) ∗ Negative Oil and statistically significant at the 1% level, i.e. 0.467 (*t-stat* 24.08) and 0.181 (*t-stat* 11.52) respectively.

We undertake the Wald test to check whether the coefficients are the same or jointly equal to zero. We find that the Wald test is unable to reject the null hypothesis of [HHI (low) ∗ Positive Oil = HHI (high) ∗ Positive Oil] at the 1% level (*F*-value 1.26, prob. 26.23%). On the contrary, the Wald test rejects the null hypothesis of similar coefficient [HHI (low) ∗ Negative Oil = HHI (high) ∗ Negative Oil] at the 1% level (*F*-value 138.78, prob. < 1%). Taken together, the results suggest that the firms that face less competition from other firms operating in the oil & gas industry are unlikely to pass on the benefit of oil price drop. Stated alternatively, the stock return of firms operating in a low-competition industry are less affected by the decrease in oil price when compared to firms that operate in highly-competitive oil & gas industry with the country. The results are in line with Ramos and Veiga (2011), who suggests that some firms are less sensitive to oil price changes and are able to pass the effect onto consumers. The results are largely consistent with the "rockets and feathers" hypothesis of Bacon (1991), where the author shows that the firms increase the gasoline price rapidly following an increase in the crude oil price but decrease the gasoline price slowly following a drop in crude oil prices. Also Borenstein and Cameron (1992) note that the asymmetry reaction of crude oil price changes to gasoline prices may arise due to the market power of some producers or distributors.

We undertake various robustness checks to reinforce the findings of this study. In Column 1 of Table 10, we follow Sadorsky (2001) and use Newey and West (1987) adjusted standard errors to account for serial correlation and heteroscedasticity. The results are consistent with our baseline regression results that are reported in Column 3 of Table 6. MDI is negatively related to the firm-level stock return, whereas NYMEX oil prices are positively related to the firm-level stock return. In Column 2, we use a longitudinal hierarchical model that is increasingly used when the data is nested in levels.[12] This study uses firm-level data with repeated observation across years and nested within a country. Accordingly, the data can be organized at two levels, i.e. at the firm level and at the country-level. Time-series value of each firm can be nested at the firm-level and further at the country-level. For example, repeated monthly observations of British Petroleum are nested at the firm-level, which can be further nested within the UK (country-level). Thus, hierarchical modelling is supposedly superior in capturing interdependencies at various levels. In addition, hierarchical model adjusts for uneven distribution of sample within the nest and therefore uneven sample distribution is not a major concern using this model. We let the intercept vary at the country level and firm-level to capture interdependencies at various levels. We find the results qualitatively similar to previous results, as the MDI and NYMEXret coefficients are statistically significant and in the expected direction. The MDI and NYMEXret coefficients are −0.0176 (*t-stat* − 8.28) and 0.226 (*t-stat* 52.72) respectively.

[12] See Searle et al. (2009); McCulloch and Neuhaus (2001); Verbeke and Molenberghs (2009); and Raudenbush and Bryk (2002) for details.

Table 10
Robustness checks.

Dependent variable	(1)	(2)	(3)	(4)	(5)
	Newey–West S.E. adjusted	Hierarchical model	Weighted regression	Excluding Canada and the US	Excluding countries with less than 100 observations
	Excess stock return	Excess stock return	Excess stock return	Excess stock return	Excess stock return
Excess Market return	0.761***	0.762***	0.818***	0.735***	0.762***
	(87.77)	(98.98)	(52.53)	(30.44)	(49.48)
MDI	−0.0197***	−0.0176***	−0.0212***	−0.00933***	−0.0157***
	(−7.99)	(−8.28)	(−6.08)	(−2.69)	(−6.28)
NYMEX oil return	0.229***	0.226***	0.236***	0.162***	0.223***
	(49.13)	(52.72)	(31.17)	(17.41)	(36.72)
St. dev of stock return	0.295***	0.423***	0.537***	0.544***	0.518***
	(20.34)	(40.28)	(27.44)	(12.96)	(30.06)
Illiquidity	0.0577***	0.101***	0.159***	0.102***	0.135***
	(31.56)	(46.03)	(24.93)	(15.09)	(28.39)
Log of MV (~US$)	0.0118***	0.0198***	0.0311***	0.0243***	0.0282***
	(56.14)	(67.51)	(25.92)	(20.10)	(32.35)
Foreign sales %	−0.0161***	−0.0184***	−0.0407***	−0.0164***	−0.0248***
	(−10.77)	(−8.33)	(−6.23)	(−4.80)	(−7.15)
GDP growth rate	0.0287*	0.0279	0.137***	−0.00553	0.0404**
	(1.84)	(1.51)	(3.84)	(−0.26)	(2.06)
Constant	−0.0953***	−0.164***	−0.208***	−0.179***	−0.197***
	(−48.04)	(−37.58)	(−31.66)	(−22.23)	(−37.60)
N	274,218	274,218	274,218	100,007	273,668
Adj. R-sq			0.070	0.105	0.081

In this table we undertake a battery of robustness checks. In Column 1, we follow Sadorsky (2001) and use Newey and West (1987) adjusted standard errors to account for serial correlation and heteroscedasticity. In Column 2, we use a longitudinal hierarchical model that is ideal when the data is nested in levels. In Column 3, we run weighted regression that accounts for a number of observations associated with each country. In Column 4, we exclude the firms listed in Canada and the US altogether from the regression. In Column 5, we exclude countries with less than 100 firm-month observations. The dependent variable is stock return less risk-free return (RI_RF), calculated as $R_{i,t} - R_f$. Risk-free adjusted market return (RM_RF) is monthly log return of the market in which the firm is located less corresponding risk-free return. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEXret is New York Mercantile Exchange roll-on-future one month oil price change. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency. Standard error is clustered at the firm-level. *t-Stats* are given in parentheses and are based on robust standard errors.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

An important concern that needs to be addressed is unequal sample distribution. As seen in Table 1, the sample is dominated by Canadian and US firms. Of the total 274,218 firm-month observations, Canadian and the US firms dominate with 174,211 observations, i.e., 63.53% of the full sample. Therefore, it may be the case that the oil & gas firms domiciled in Canada and the US are driving the findings of this study. To negate this concern, we run weighted regression that accounts for a number of observations associated with each country. More specifically, following Costa et al. (2013), we use the square root of a number of observations in a weighted multi-factor regression model to control for uneven sample size across countries. The benefit of using square root of a number of observations is that standard error of the mean is a function of the square root of *n*. In Column 3 of Table 10, we find the magnitude and sign of the MDI and NYMEX oil return coefficients similar to our baseline regressions. We also consider excluding the firms listed in Canada and the US altogether from the regression, but our major findings do not weaken, as reported in Column 4 of Table 10. The MDI coefficient is negative, whereas NYMEX oil return coefficient is positive. Both the coefficients are statistically significant at the 1% level.

We also consider the possibility that the results are driven by countries with few firm-month observations. For instance, Table 1 indicates that there are few countries with less than 100 firm-month observations, e.g. Ghana, Iceland, and Qatar. Consequently we rerun our analysis after excluding the countries that have fewer than 100 firm-month observations. The results, reported in Column 5 of Table 10, indicate qualitatively similar results as compared to our baseline results. The results remain robust if we remove countries with fewer than 200 firm-month observations (unreported).

To further validate the findings of this study, we undertake additional robustness checks in Table 11.[13] In Column 1 of Table 11 we investigate whether the competition level within the oil & gas industry is biased due to non-inclusion of private firms. As discussed previously, the HHI Index is constructed using the sales data of publicly-listed firms. However, state enterprises and other unlisted firms may prefer to remain private and therefore sales HHI Index may not be capturing the actual level of competition with the oil & gas industry. To address this concern, we construct sales HHI Index that incorporates information from the publicly and privately listed firms. The sales data of private firms is retrieved from Bureau van Dijk's Orbis database. Orbis database collects financial information of private firms extensively across countries. Following Borell et al. (2010) we impose some filters to improve quality of the data. Specifically, to limits the impact of "phantom" firms, we restrict the sample to only those firms that have at least US$ 100,000 in sales. Next, we merge the sales data of public and privately listed firms and construct sales HHI index of oil & gas industry within each country and each year. This results in retrieving information of 57,578 firm-year sales data of 15,297 public and private oil & gas firms spanning 2004 to 2013.

The results reported in Column 1 of Table 11 suggest a similar pattern. Following an increase in oil prices, firms operating in non-competitive oil & gas industry (coefficient of 0.244, *t-stat* 9.77) experience a higher stock return compared to firms that are operating in a highly-competitive oil & gas industry (coefficient of 0.0868, *t-stat* 3.01). Similarly, the stock return of firms operating in non-competitive

[13] We thank anonymous reviewers for suggesting these additional checks.

Table 11
Additional robustness checks.

Industry	(1)	(2)	(3)	(4)	(5)	(6)
	Oil & gas	Exploration & production	Integrated oil & gas	Oil & gas	Oil & gas	Oil & gas
Dependent variable — excess stock return	(Local currency)	(Local currency)	(Local currency)	(Local currency)	(Local currency)	(US$ equivalent)
Excess market return (local market)	0.885***	0.758***	0.773***			
	(42.62)	(47.23)	(18.58)			
Excess market return (S&P 500)				0.559***		0.734***
				(48.38)		(58.65)
Excess market return (DS world market)					0.621***	
					(54.16)	
Private & public HHI (low) × positive oil	0.0868***					
	(3.01)					
Private & Public HHI (mEd.) × positive oil	0.251***					
	(9.90)					
Private & public HHI (high) × positive oil	0.244***					
	(9.77)					
Private & public HHI (low) × negative oil	0.456***					
	(16.79)					
Private & public HHI (mEd.) × negative oil	0.307***					
	(10.24)					
Private & Public HHI (high) × negative oil	0.244***					
	(10.01)					
Private & public HHI (medium) dummy	0.00810**					
	(2.53)					
Private & public HHI (high) dummy	0.0188***					
	(3.30)					
NYMEX oil return		0.239***	0.0813***	0.269***	0.234***	0.350***
		(37.28)	(5.69)	(44.55)	(39.65)	(53.88)
MDI	0.00659*	−0.0165***	0.00346	−0.0254***	−0.0169***	−0.0211***
	(1.82)	(−6.15)	(0.65)	(−10.31)	(−6.88)	(−8.19)
St. dev of stock return	0.630***	0.533***	0.232**	0.525***	0.522***	0.530***
	(18.13)	(30.06)	(2.22)	(29.92)	(29.99)	(25.90)
Illiquidity	0.228***	0.141***	0.0486***	0.135***	0.134***	0.149***
	(22.97)	(28.12)	(4.49)	(28.00)	(27.90)	(28.95)
Log of MV (~US$)	0.0451***	0.0292***	0.0156***	0.0280***	0.0281***	0.0297***
	(24.55)	(31.43)	(7.01)	(32.11)	(32.33)	(34.05)
Foreign sales %	−0.0133***	−0.0233***	−0.0287***	−0.0254***	−0.0258***	−0.0207***
	(−2.87)	(−6.28)	(−4.67)	(−7.19)	(−7.39)	(−5.99)
GDP growth rate	0.0358	0.0440**	0.0455	0.0598***	0.0555***	0.0721***
	(1.15)	(1.99)	(1.13)	(2.86)	(2.67)	(3.10)
Constant	−0.323***	−0.199***	−0.122***	−0.198***	−0.196***	−0.213***
	(−27.68)	(−37.15)	(−6.95)	(−37.53)	(−37.29)	(−39.15)
Firm F.E.?	Yes	Yes	Yes	Yes	Yes	Yes
Clustered standard error?	Firm-level	Firm-level	Firm-level	Firm-level	Firm-level	Firm-level
N	115,601	246,462	27,756	274,218	274,218	247,578
Adj. R-sq	0.124	0.077	0.179	0.060	0.064	0.087

In this table we undertake additional robustness checks. In Column 1, we include HHI index that is computed using both the sales data of publicly and privately listed firms. In Column 2, the results are reported only for the Oil & gas firms that are primarily engaged in "Exploration & production". In Column 3, the results are reported only for the Oil & gas firms that are primarily engaged in "Integrated oil & gas". In Column 4, we use S&P 500 market excess return, while in Column 5, we use DS World market excess return. In Column 6, we convert the local firm-level returns to equivalent US stock returns using corresponding date exchange rate. To maintain consistency, we use US risk-free rate and S&P 500 market index. Risk-free adjusted market return (RM_RF) is monthly log return of the market in which the firm is located less corresponding risk-free return. MDI is based on the law of one price and derived from the deviation in the Covered Interest Rate Parity (CIRP), Triangular Arbitrage Parity (TAP) and American Depositary Receipt Parity (ADRP). NYMEXret is New York Mercantile Exchange roll-on-future one month oil price change. Riskiness of firm is computed as daily standard deviation of stock returns over the last one year. Illiquidity is calculated as per the Lesmond et al. (1999) model, where a stock with no change in price over a period of time is considered illiquid. Log of MV is logarithm of market value in US$. Foreign sales % is percentage of foreign sales scaled by total sales. GDP growth rate, from World Bank, is annual percentage growth rate of GDP at market prices based on constant local currency. Standard error is clustered at the firm-level. *t-Stats* are given in parentheses and are based on robust standard errors.

* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

oil & gas industry (coefficient of 0.244, *t-stat* 10.01) experience less impact following a decrease in oil prices as compared to firms that operate in a highly-competitive oil & gas industry (coefficient of 0.456, *t-stat* 16.79). Thus, the results are qualitatively similar to Column 2 of Table 9.

In Column 2 and Column 3 of Table 11 we check whether the results hold when we further divide the oil & gas firms into "Exploration & production" and "Integrated oil & gas" respectively. Out of 2136 firms, we note that 1936 firms are associated with "Exploration & production", whereas 200 firms are associated with "Integrated oil & gas". We find the performance of firms that are primarily engaged in "Exploration & production" are qualitatively similar to overall oil & gas firms. However, it seems that "Integrated oil & gas" firms are less affected by oil price shocks and statistically not related to MDI. As seen in Column 3, NYMEX oil return coefficient is 0.0813 (*t-stat* 5.69) and MDI coefficient is 0.00346 (*t-stat* 0.65). This can be due to "Integrated oil & gas" entities diversifying the risk by integrating downstream and upstream operations.

In Column 4 and Column 5 of Table 11, we examine whether S&P 500 Index or Datastream (DS) World Market Index is a better benchmark for the overall market return instead of country-specific market return. This step takes into consideration that market portfolio should be independent of the country where the stock is traded. In Column 4, we substitute local market return with S&P 500 return. In Column 5, we substitute local market return with DS World return. To maintain consistency, we use US risk free rate instead of local market risk free rate in calculating excess return in Column 4 and Column 5. We find

that the results remain qualitatively similar results as compared to our baseline regression. As expected, the excess market return (either S&P 500 or DS World Market) coefficients are smaller and are therefore less sensitive in comparison to local market. NYMEX oil return is positive and statistically significant, whereas MDI is negative and statistically significant in Column 4 and Column 5.

The final test pertains to the effect of foreign exchange on the stock return. From the perspective of an international investor, an investment made outside of the local market should reflect currency and country risk. The investor is more interested in total returns that reflect firm-level stock return and exchange rate return. Further, Sadorsky (2001) and Boyer and Filion (2007) suggest USD/CAD exchange rates as important macroeconomic determinants. Therefore, it may be intuitive to report the results in one currency, such as US dollars, to maintain uniformity and better interpretation of the results. To this end, we convert the local stock prices into US dollar prices using equivalent day exchange rate. These exchange rates are retrieved from Pacific Exchange Rate Server. Next, we deduct US risk-free rate to compute excess stock return. To maintain consistency, we use S&P 500 index as a benchmark market. The results, reported in Column 6 of Table 11, suggest that firm-level stock return is positively affected by changes in oil prices. Consistent with prior results, the results indicate that an increase in global uncertainty negatively impact firm-level stock return.

5. Conclusion

In this study, we propose that systematic asset price risk of oil & gas firms are better modelled if both the oil price shocks and macroeconomic forces are taken into consideration. Further, the use of oil & gas index as a performance benchmark of oil & gas firms may skew the returns positively and mask volatility. This may lead to unreliable statistical inferences. To this end, we use a better measure of market stress and undertake a comprehensive analysis using firm-level data from 70 countries spanning three decades.

We find that both oil price shocks and market stress have a strong impact on firm-level stock return. The firm-level stock return is positively and negatively related to the oil price and market stress respectively and therefore does not provide a good hedging tool. The results are also economically significant. For instance, when MDI rises from the bottom 25th percentile to the top 25th percentile, the monthly excess stock return decreases by 0.28%. Similarly, a change in oil price from the bottom 25th percentile to the top 25th percentile increases the monthly excess stock return by 2.62%.

We also investigate the role of country-level determinants in explaining the sensitivity of firm-level stock return towards oil price and market stress. We find that firms located in oil-rich countries are more sensitive to oil price fluctuation and market stress than firms located in countries that produce less oil. The results are also economically significant. For instance, when the MDI increases from the bottom 25th percentile to the top 25th percentile, the monthly excess stock return of firms domiciled in low and high oil producing country decreases by 0.18% and 0.61% respectively. A change of oil price from the bottom 25th percentile to the top 25th percentile results in an increase of 1.84% and 2.67% monthly excess stock return for the firms domiciled in low and high oil producing countries respectively.

Next, we investigate the role of product market competition in moderating the effect of oil price shocks and market uncertainty on stock return. To determine the level of competition with the oil & gas industry, we compute sales HHI Index of oil & gas industry within each country and for each year. We find that firms that face less competition are less sensitive to oil price changes and market stress than those that face strong competition from other firms operating in oil & gas industry. The results suggest that the market power of the firms dampen the volatility of the firm-level stock return. Finally, we consider the asymmetric effect of oil price on firm-level return. We find that stock return of firms operating in low-competition oil & gas industry is less affected by the decrease in oil price when compared to firms that face strong competition from other firms. Our paper has strong policy implications. Regulators and policy makers should consider industry competitiveness as an important determinant while undertaking important decisions. Regulators and policy makers should undertake steps to encourage competition within the industry to discourage dominating oil & gas firms from gaining undue benefits.

Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.eneco.2016.04.019.

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