Modeling Crude Oil and Natural Gas Price Impact on Global Petroleum Upstream Industry Dynamics, 1980-2006

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Overview

Since the early 1980s, crude oil price volatility and stock market driven operating environment have made decision-making and strategic planning extremely difficult for the global oil and gas industry. There is evidence to show that significant crude oil and natural price changes do impact the global E&P industry with measurable implications on future petroleum resource development and supply decisions. Traditionally E&P firms have responded to low oil prices by reducing research and development budgets, capital spending, and employment. The firms also, in the past, have tended to increase capital spending and human capital expansion when crude oil prices rose, with the exception of the cautious response to positive price changes in the late 1990s and the early 2000.

In this paper, we review global E&P activity and petroleum resource development dynamics and develop an empirical model of the relationship between changes in petroleum prices and the global E&P industry activity and output. Using current tools in time series and econometric methods, we attempt to show that there is a long-term relationship between E&P activity and output and crude oil and natural gas prices. Our empirical results show that changes in petroleum prices have significant impact on changes in E&P activity and output. Specifically, in the long-run, we have attempted to show a positive relationship between changes in petroleum prices and E&P activity and output. Conversely, decreases in oil and/or gas prices in the long-run hurt E&P activity and/or petroleum upstream industry output, significantly. The nature of the relationship between these variables with respect to crude oil or natural gas prices, however, is relatively price inelastic, globally.

Methods

Understandably, the long-run responses or relationship between petroleum prices and upstream petroleum industry or output are not of the same order of magnitude across petroleum producing regions worldwide. Thus, for comparative purposes, we have estimated a dimensionless parameter to quantify the responsiveness of upstream petroleum industry activity or output to changes in petroleum prices for each of the petroleum producing regions worldwide. Two generalized hypotheses have been stipulated and tested using our empirical model results. The first is a null hypothesis of whether there is no significant difference in the impact on E&P activity or output when changes in real petroleum prices increase or decrease. The second null hypothesis is whether there is a significant difference in the responsiveness of E&P activity or output across geographic regions when prices are going up or when prices are going down.

Results

The study shows there is enough empirical evidence to suggest that the impact on E&P activity or production to changes in real oil prices vary significantly and differentially across space and time. The study also shows that for every one real dollar drop in real oil and gas prices from 1980-1989, E&P activity decreased globally and more so in North America than in the other regions worldwide. Further, for every one dollar rise in real oil price from 1999 to 2006, E&P activity rose in North America and worldwide significantly. The study also shows that global exploration activity responded asymmetrically to rising and declining real oil prices from 1980-2006; and the impact of oil and gas prices on E&P activity and/or output has significant spatial and temporal differences as well.

Quantity Equivalence of Price Impact							
Average Rig Count (#)	North America	S. & Cent. America	Europe & Eurasia	Middle East	Africa	Asia Pacific	WORLD
1980-1989	(162)	(30)	(11)	(12)	(9)	(13)	(222)
1989-1999	(40)	(8)	(4)	(6)	(3)	(7)	(66)
1999-2006	238	41	14	34	9	31	378
Average Production (mmbbl)							
1980-1989	(382,918)	(102,278)	(360,953)	(336,415)	(130,787)	(99,692)	(1,405,377)
1989-1999	(198,718)	(69,496)	(174,541)	(282,684)	(105,841)	(87,911)	(907,349)
1999-2006	829,346	393,673	1,047,630	1,483,935	547,902	492,518	4,820,859
Average Reserves Addition (Billion bbl)							
1980-1989	(4.276)	(4.510)	(2.629)	(24.866)	(1.708)	(1.060)	(37.953)
1989-1999	(1.262)	(1.707)	(3.156)	(3.968)	(2.183)	(1.051)	(13.300)
1999-2006	4.765	4.728	13.879	26.029	11.062	3.903	64.327

Conclusions

According to our empirical results, a dollar drop in real oil prices led to the disengagement of 64 drilling rigs globally from 1980-1999; and 50 of these 64 rigs were disengaged in North America during this period. On the other hand, for every one dollar rise in real price of oil from 1999-2006, we estimated that 24 and 29 new drilling rigs were employed in North America and worldwide, respectively. The study suggests that global exploration activity nd outcomes responded asymmetrically to rising and declining real oil prices from 1980-2006. The study also shows that the impact of oil prices on exploration activity in terms of rigs engaged has significant and temporal differences.

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