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Investment and Oil Price Volatility

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INVESTMENT AND OIL PRICE VOLATILITY

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Abstract

In this note, we consider the relationship between oil price volatility and firm returns for 560 firms listed on the New York Stock Exchange. Using daily time series data from 2000 to 2008, we find that oil price volatility increases firm returns for the majority of the firms in our sample.

1.   INTRODUCTION

Oil price and its effects on investments (returns) have occupied significant interest over the last decade. Recent studies have shown that oil price is a significant determinant of stock market returns (Driesprong et al., 2008) and firm returns (Narayan and Sharma, 2011). The work of Driesprong et al. (2008) considers 18 developed and developing country stock exchanges and find significant evidence that oil price predicts market returns; the evidence is relatively stronger for developed countries. In a recent study, Narayan and Sharma (2011) examine the relationship between oil price and firm returns. They also document significant evidence that oil price is both a determinant and a predictor of firm returns.

In light of the work already done on the relationship between oil price and firm returns, what remains unknown to-date is: How does a rise in oil price volatility affect firm returns? In this note, our goal is to answer this question. To do so, we estimate the effect of the oil price volatility on returns for 560 firms listed on the NYSE. We categorize firms into 14 different sectors so as to compare our results of the effects of oil price volatility by sector. A sector-wise comparison is needed to gain a deeper insight, in particular to know whether firms are heterogeneous and are likely to respond to oil price volatility differently. This difference in firm response to oil price volatility arises from the fact that firms in different sectors respond to public information (oil price related) with different speed. In other words, firms in different sectors depending on the relevance of oil to them take different amounts of time to assess and evaluate the effects of oil price. This type of firm behavior has been referred to as the gradual information diffusion hypothesis, proposed by Hong and

Stein (1999), and empirically shown in the context of the oil price-firm return relationship by Narayan and Sharma (2011) and Driesprong et al. (2008).

Briefly foreshadowing the main results, we unravel two new findings—previously unknown in this financial economics literature—regarding the relationship between oil price volatility and firm returns on the NYSE. First, we discover that oil price volatility has a statistically significant and positive effect on firm returns for the majority of the firms in our sample. Second, we find that the effect of oil price volatility on firm returns is sector-specific. In other words, firms in different sectors respond to oil price volatility differently, suggesting that firms on the NYSE are heterogeneous.

The rest of the note is organized as follows. In the next section, we present the empirical model and discuss the theoretical motivation for undertaking an oil price volatility and firm return relationship. We also discuss the main findings. In the final section, we provide some concluding remarks.

2. EMPIRICAL MODEL, THEORETICAL MOTIVATION, AND MAIN FINDINGS

The goal of this section is threefold. First, we outline the empirical framework for testing the relationship between oil price volatility and firm returns. Second, we explain the theoretical motivation for the existence of a relationship between oil price volatility and firm returns. Third, we discuss the results.

2.1. Empirical Model

We estimate the following GARCH (1,1) model for each of the 560 firms using daily time series data from 05 January 2000 to 31 December 2008 to examine oil price volatility-firm returns nexus:

$$R_t = \alpha_1 + \alpha_2 vgOP_t + \varepsilon_t \tag{1}$$

The variance equation of Model 1 is of the following form:

$$h_t^2 = \gamma_0 + \gamma_1 \varepsilon_{t-1}^2 + \gamma_2 h_{t-1}^2 \tag{2}$$

$$\varepsilon_t = h_t \vartheta_t$$

$$\vartheta_t \sim N(0,1)$$

In this model, R_t is the stock returns on day t; and $vgOP$ is the conditional volatility of the growth rate in crude oil prices, which is estimated using a GARCH (1,1) model where the growth rate in oil price is regressed against a constant term. In estimating the GARCH model, a log likelihood function is maximized on the assumption of conditional normality of the firm return shock, ε_t. The statistical significance of the variables in the proposed models is based on the procedure proposed by Bollerslev and Wooldridge (1992).

2.2. Theoretical motivation

The link between oil price volatility or uncertainty and firm returns can either be positive or negative. A number of theoretical studies have shown that the effect of uncertainty on investment (returns) depends on the assumptions made regarding risk aversion, the degree of irreversibility of investment, and the nature of competition (see Bell and Campa, 1997 and the references therein). On the other hand, Caballero (1991) argues that under risk neutrality, the sign of the relationship between

uncertainty and investment depends on the interaction between the extent of competition in the industry and the irreversibility of the investment. Pindyck (1988) argues that a firm would hold more capacity if future demand is uncertain because uncertainty increases the value of the firm's investment options, and hence the opportunity cost of irreversible investing. This seems to suggest that uncertainty resulting from oil price shocks should have a positive effect on firm returns.

In related work, Hartman (1972) shows that when a competitive firm faces a linearly homogenous production function, an increase in output price uncertainty, which can obviously result from an oil price shock, will lead to an increase in investment. Pindyck (1982), however, cautions that such a relationship only exists when the marginal adjustment cost function (MACF) is convex. When the MACF is concave, then an increase in uncertainty will actually reduce investment. Moreover, Zeira (1990) argues that risk aversion and incomplete markets are likely to contribute to a negative relationship between uncertainty and investment. The work of Hartman (1972), Pindyck (1982), and Zeira (1990) thus suggests that oil price uncertainty can either have a positive or negative effect on firm returns.

2.3. *Main findings*

Before we proceed to the main results, a note on the data series used is in order. We obtain all firm return data from the Centre for Research on Securities Price (CRSP). We were able to obtain consistent time series daily data for the period 05 January 2000 to 31 December 2008 for 560 firms listed on the NYSE. It should be noted that while there are thousands of firms listed on the NYSE exchange, consistent data for the time period considered here was only available for 560 firms.

The results on the effect of oil price volatility and firm returns are reported in Table 1. The results are organized as follows. In Column 1, we report each of the 14 sectors. Column 2 reports the number and percentage (in parenthesis) of firms with a statistically significant and positive effect of oil price volatility on firm returns. Columns 3, 4, and 5, report the number and percentage of firms with a statistically significant and negative, statistically insignificant and positive, and statistically insignificant and negative relationship between oil price volatility and firm returns. Essentially, our approach was as follows. Using Equations (1) and (2), we estimated the relationship between oil price volatility and firm returns for each of the 560 firms listed on the NYSE. Following this exercise, we categorized firms into 14 sectors, and worked out the number and percentage of times the relationship was positive and negative, and statistically significant and statistically insignificant.

Our results suggest that oil price volatility affects firms from different sectors differently, both in terms of sign and magnitude. The results can be summarized as follows. First, for all 14 sectors, the effect of oil price volatility on firm returns is positive and statistically significant in most of the cases. The statistically significant and positive relationship between oil price volatility and firm returns ranges from as low as 12 percent of firms in the computer sector to as high as 42.9 percent of firms in the medical sector. There is zero cases reported for negative relationship between oil price volatility and firm returns in the case of firms in the computer sector, transportation sector, real estate sector and general services sector. For the remaining 10 sectors, the negative and statistically significant effect of oil price volatility on firm returns is less than seven percent of firms.

INSERT TABLE 1

Second, firms belonging to the following sectors experienced the largest effect of oil price volatility on firm returns: medical sector (42.9 percent of firms), financial sector (35.6 percent of firms), general services sector (31.8 percent of firms), and manufacturing sector (30.7 percent of firms). For the remaining 10 sectors, the statistically significant and positive relationship ranges from as low as 12 percent in the case of firms in the computer sector to as high as 26.3 percent of firms in the chemical sector.

It follows that in this note we have discovered two new findings regarding the relationship between oil price volatility and firm returns on the NYSE. Our first main discovery is that oil price volatility has a statistically significant and positive effect on firm returns for the majority of the firms in our sample. Our second main finding is that the effect of oil price volatility on firm returns is sector-specific. In other words different sectors firm returns respond to oil price volatility differently, suggesting that firms on the NYSE are heterogeneous.

3.   CONCLUDING REMARKS

In this note, we investigate the empirical relationship between oil price volatility (a form of uncertainty) and firm returns. We consider 560 firms listed on the New York Stock Exchange (NYSE) over the time period 2000 to 2008 (daily data). We find strong evidence that the majority of the firms on the NYSE experience a rise in returns when oil price volatility increases. This finding is consistent with several theoretical proposals that make the link between uncertainty and investments, such as Hartman (1972), Pindyck (1982, 1988), Zeira (1990) and Caballero (1991).

Our second finding is equally new in this literature. When we examine the effect of oil price volatility on firm returns by disaggregating firms into 14 different sectors, we find evidence of a heterogeneous response of firm returns to oil price volatility. This finding is consistent with the firm heterogeneity observed by Narayan and Sharma (2011).

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Table 1: Effects of oil price volatility on firm returns of different sectors on the NYSE

	Sig +	Sig -	Insig +	Insig -
Energy Sector	11 (27.5%)	1 (2.5%)	21 (52.5%)	7 (17.5%)
Electricity Sector	10 (13.2%)	4 (5.3%)	41 (53.9%)	21 (27.6%)
Supply Sector	13 (20%)	3 (4.6%)	35 (53.8%)	14 (21.5%)
Manufacturing Sector	23 (30.7%)	3 (4%)	34 (45.3%)	15 (20%)
Food Sector	5 (17.9%)	1 (3.6%)	16 (57.1%)	6 (21.4%)
Chemical Sector	5 (26.3%)	1 (5.3%)	9 (47.4%)	4 (21.1%)
Medical Sector	12 (42.9%)	2 (7.1%)	11 (39.3%)	3 (10.7%)
Engineering Sector	8 (22.2%)	1 (2.7%)	18 (50%)	9 (25%)
Computer Sector	3 (12%)	0	6 (44%)	6 (40%)
Transportation Sector	6 (23.1%)	0	14 (53.8%)	6 (23.1%)
Banking Sector	5 (14.7%)	1 (2.9%)	21 (61.8%)	7 (20.6%)
Financial Sector	26 (35.6%)	1 (1.4%)	38 (52.1%)	8 (10.9%)
Real Estate Sector	3 (13%)	0	10 (43.5%)	10 (43.5%)
General Services	7 (31.8%)	0	12 (54.5%)	3 (13.6%)

Notes: Column 1 reports the number and percentage (in parenthesis) of firms with a statistically significant and positive effect of oil price volatility on firm returns. Columns 3, 4, and 5, report the number and percentage of firms with a statistically significant and negative, statistically insignificant and positive, and statistically insignificant and negative relationship between oil price volatility and firm returns. The results are reported for firms belonging to each of the 14 sectors on the NYSE. The data used is daily form 5 January 2000 to 31 December 2008. The estimated model is based on a GARCH (1,1) specification as represented by Equations (1) and (2).