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Evidence on the nature and extent of the relationship between oil prices and equity values in the UK

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Abstract

A number of recent studies have found a link between movements in crude oil prices and equity values. However, the literature concentrates almost exclusively on North American and Australian data and is primarily conducted at a stock market-wide level. The present study therefore investigates the relationship between the price of crude oil and equity values in the oil and gas sector using data relating to the United Kingdom, the largest oil producer in the European Union. The evidence indicates that the relationship is always positive, often highly significant and reflects the direct impact of volatility in the price of crude oil on share values within the sector.

JEL classification: C51; G12; L71; Q40

Keywords: Oil prices; Share returns; Volatility; Inter-sectoral comparison

1. Introduction and background to the study

A number of recent studies have examined the relationship between natural resource prices and the equity values of firms in related industries. For example, Sadorsky (2001) provides a detailed analysis of the relationship between oil prices and equity values in the Canadian oil and gas sector, using monthly data covering the period from the final quarter of 1983 to the final

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quarter of 1999. Sadorsky's paper reports a significant positive relationship between the oil and gas equity index and the price of crude oil, with a 1% change in oil prices being associated with a change of 0.305% in the value of the index. The author also reports a significant positive relationship between the return on the index and the return on the stock market as a whole, and a negative association between the index value and both the premium on 3-month vs. 1-month Government debt and the US/Canadian Dollar exchange rate. Prior to Sadorsky's study, most research relating oil prices to financial market activity examined the impact of price shocks on share prices across the entire market, rather than concentrating on equity values in the oil and gas sector. The results of the earlier studies appear to indicate that stock prices are negatively (positively) impacted by rises (falls) in oil and gas prices in both the US (Huang et al., 1996; Sadorsky, 1999) and Australia (Faff and Brailsford, 1999).[1] Jones and Kaul (1996) attempt to identify the source of any such relationships by examining the manner in which oil price shocks, changes in real cash flows and movements in share prices are linked. Their study reports that the effect of oil price volatility on equity values can be explained entirely on the basis of changes to the expected value of future cash flows, although the evidence in this regard is stronger for the US and Canada than for the UK and Japan.

Very little research has directly examined the impact of oil prices on the equity values of UK-listed oil and gas firms. This appears to represent a substantive omission from the literature; despite recent falls in net export levels, the oil and gas industry in the UK remains the largest in the European Union and accounted for 8% of Britain's exports in June 2004.[2] Moreover, the nation has been a net exporter of oil since August 1991,[3] while shares of oil and gas firms continue to represent a significant proportion of the total market value of companies listed on the London Stock Exchange; the oil and gas sector accounted for more than 11% of the entire market capitalisation of the Official List at the end of 2003.[4] In addition, the London Petroleum Exchange provides one of the world's most important global oil price benchmarks, Brent Crude.[5] Sadorsky's (2001) Canadian results appear to be at variance with those of earlier findings. For example, they imply that unexpected increases in oil prices will lead to increases in the oil index, and that there exists a significant positive relationship between the oil index and the market as a whole. Previous studies had indicated that shocks to the oil price would positively impact upon the oil index, but negatively impact upon the market index (Huang et al., 1996, Faff and Brailsford, 1999). Consequently, there is an important need to carry out further research to investigate this apparent anomaly. The UK, with its maturing North Sea oil interests which are constantly under the scrutiny of analysts and finance experts (coupled with its well-established stock exchange), appears to represent the ideal arena in which to test Sadorsky's results and determine whether they can be replicated in another country with a major oil and gas

[1] Research suggests that such relationships are not confined to the oil and gas sector, but may also occur in other natural resource industries (e.g., Faff and Chan's (1998) evidence of a link between gold prices and equity prices on the Australian stock market).

[2] At the start of the 1980s, the oil and gas industry's contribution to the total value of UK exports peaked at levels of around 20% (Morrison and Johnson, 2004).

[3] Although the UK became a net oil importer by volume in June 2004, it remained a net exporter by value, with a net surplus for the month of £22 million (Morrison and Johnson, 2004).

[4] The total market capitalisation of the oil and gas sector at the end of 2003 was £154.2 billion out of a total for the entire London market of £1355.8 billion. The only larger sector was banking, with a total equity value of £259.1 billion.

[5] In June 2002, to try and address the issue of falling production levels of Brent Crude, Platts (the industry's main price assessor) updated its definition of Brent Crude by developing BFO, or Brent–Forties–Oseberg, which incorporates two similar North Sea crude oils—North Sea Forties (UK) and Oseberg (Norway). See www.eia.doe.gov/emeu/cabs/uk.html.

industry. In addition, UK data are readily available, objective and reliable. Further, the findings of Jones and Kaul (1996) indicate that there may be essential differences existing between Canadian and UK drivers of observed relationships between stock returns and oil prices. In this context–and given the obvious importance of the oil sector to the UK's real and financial economies as well as the rapid ongoing changes occurring in the nation's export and import levels–this paper attempts to examine the extent of the relationship between oil prices and equity values in the oil and gas sector of London-listed firms.

The structure of the remainder of the paper is as follows. Section 2 outlines the regression models used in the analysis and describes the nature and sources of the data employed. Section 3 then presents the empirical results before Section 4 concludes the paper with a discussion of the main implications of the findings as well as outlining the study's limitations and making suggestions for further work.

2. Data[6] and models

To facilitate the empirical analysis, a conventional multifactor model relating share price exposure to variability in crude oil prices was developed (see Jorion, 1990; Khoo, 1994; Faff and Chan, 1998; Faff and Brailsford, 1999; Sadorsky, 2001; Sadorsky and Henriques, 2001). The two-factor version of the model used in most prior related studies is:

$$R_{it} = \alpha + \beta_o R_{ot} + \beta_m R_{mt} + \varepsilon_t \qquad (1)$$

where α is the constant term, while R_{it} is measured as the return[7] on day t on the oil and gas sector index minus the yield on 1-month UK Treasury Bills.[8] R_{ot} is the daily return on oil prices on day t; the oil prices used throughout the study are London Brent Crude Oil Index spot barrel prices in US \$. R_{mt} is the daily market portfolio excess return on day t, measured as the return on the FTSE All Share Index minus the return on 1-month UK Treasury Bills; the market return is a proxy for changes in aggregate economic wealth that affect risk premia and expected returns (Fama and French, 1989; Ferson and Harvey, 1991). The parameters β_o and β_m are the oil and gas industry beta and market beta respectively, and ε_t is a random error term. Two-factor models such as Model 1 may be underspecified because bond yields and the exchange rate between the home currency and the US \$ are not included (Sadorsky, 2001). Consequently Model 2, which adds an exchange rate factor, R_{et} and an interest rate time premium factor, R_{tpt}, to Model 1 was also estimated:[9]

$$R_{it} = \alpha + \beta_o R_{ot} + \beta_m R_{mt} + \beta_e R_{et} + \beta_t R_{tpt} + \varepsilon_t. \qquad (2)$$

Where R_{et} is the logged return on the daily exchange rate between the US \$ and the UK £. The exchange rate variable is a proxy for foreign exchange risk, which may be particularly important for multinationals (Jorion, 1990) or natural resource companies (Louden, 1993; Khoo, 1994). For example, Louden (1993) and Khoo (1994) both find that Australian gold stock movements

[6] All the raw data used in the study are available at the Appendix.

[7] Logged daily returns were used for all five variables employed in the study. There are both theoretical and empirical reasons for the use of logarithmic returns (Strong, 1992). For example, logarithmic returns are more likely to conform to assumptions of normality.

[8] This method of deriving excess equity returns is common to studies in this area (see Sadorsky, 2001).

[9] Throughout the remainder of the paper, the practice of other studies in the area is followed and the results of the fuller of the two models, i.e., Model 2, are focussed on. However, all the reported regressions were also performed on the basis of Model 1, with broadly similar findings resulting. The full results are available from the authors on request.

are related to exchange rate movements. To date, however, little work has been undertaken to examine the impact of foreign exchange risk exposure on oil and gas companies (Sadorsky, 2001). R_{tpt} is the interest rate variable, measured as the logged daily return on the premium between the annual yield on 3-month and 1-month UK Treasury Bills (Harvey, 1989) and represents the risk-free short-term discount rate. The treasury bill premium, which is an indicator of the present state of the economy, tends to be lower during economic downturns and higher during periods of strong growth (Sadorsky, 2001). Moreover, the treasury bill premium has been found to be negatively correlated with real economic output growth for up to 1 year ahead (Fama and French, 1989; Chen, 1991) and its inclusion in empirical studies that link financial and real asset prices appears necessary. Stone (1974), Martin and Keown (1977) and Faff and Chan (1998) have studied interest rate risk in the gold mining industry; the two earlier papers' findings suggest that certain assets such as gold stocks exhibit a strong sensitivity to interest rate movements. However, Faff and Chan (1998) found that the only variables with significant explanatory power are the market and gold price factors.

Daily data covering the period 1st January 1989–30th June 2001 were gathered from Datastream. This period was chosen because: (i) examination of 10–15-year periods is conventional in related studies; and (ii) it was considered sensible to stop at the end of the first half of 2001 given the potential impact of the events of the 11th of September on both oil prices and oil firms' equity values in the proceeding months and years.

As oil price fluctuation is likely to have an impact on all industrial sectors in modern developed economies (Sadorsky, 1999), the empirical analysis was replicated across four further sectors, chosen deliberately to reflect differing hypothesised links between sector performance and crude oil prices. The study thereby attempts to establish the extent to which the results for the oil and gas firms reflect the specific influence of oil price volatility on the sector's equity values, rather than the more pervasive impact of price changes on market-wide share values.

3. Results

3.1. Results for the oil and gas sector

3.1.1. Data properties

Table 1 reports summary statistics for the daily logged return data used in the study. The *t*-statistics for the means indicate that the average figure was significant at the 5% confidence level

Table 1
Descriptive statistics for the sample data

Variable	*N*	Mean	Standard deviation	*t*-statistic	Skewness	Kurtosis
R_{it}	3259	0.0007*	0.0163	2.49	0.624**	14.359**
R_{ot}	3259	0.0002	0.0197	0.45	−1.010**	15.321**
R_{mt}	3259	0.0006**	0.0131	2.67	0.918**	30.989**
R_{et}	3259	−0.0001	0.0058	−0.76	−0.181**	2.846**
R_{tpt}	3259	0.0000	0.0093	0.01	−0.495**	65.363**

The table provides information regarding the mean, standard deviation, skewness and kurtosis of the daily logged return data for the five variables used in the analysis. R_{ot} is the daily logged return on the crude oil price; R_{it} is the daily logged excess return on the London Oil and Gas sector index; R_{mt} is the daily market portfolio excess return; R_{et} is the logged daily change in the US \$/UK £ exchange rate; and R_{tpt} is the logged daily change in the difference between the 3- and 1-month UK treasury bill rate. The *t*-statistics relate to a test of the hypothesis that the mean daily logged return = 0. A * (**) indicates significance at the 5% (1%) level on a two-tailed basis.

Table 2
Pearson correlation matrix

Variables	R_{it}	R_{ot}	R_{mt}	R_{et}
R_{ot}	0.118** (0.00)			
R_{mt}	0.746** (0.00)	0.019 (0.29)		
R_{et}	−0.169** (0.00)	−0.009 (0.60)	−0.116** (0.00)	
R_{tpt}	0.314** (0.00)	0.007 (0.69)	0.363** (0.00)	−0.007 (0.68)

This table provides information regarding the extent of collinearity amongst the five variables used in the study. R_{ot} is the daily logged return on the crude oil price; R_{it} is the daily logged excess return on the London Oil and Gas sector index; R_{mt} is the daily market portfolio excess return; R_{et} is the logged daily change in the US $/UK £ exchange rate; and R_{tpt} is the logged daily change in the difference between the 3- and 1-month UK treasury bill rate. P-values are shown in parentheses. A **indicates significance at the 1% level on a two-tailed basis.

for both the oil and gas index (with a value of 0.07%) and the market index (0.06%); in contrast, the average change in oil prices of 0.02% was indistinguishable from zero. These figures differ somewhat from those provided by Sadorsky (2001) for Canadian data over the period 1983–1999; in particular, the earlier study reports (insignificant) negative average figures for the oil and gas equity index and the oil price variable, but a significant positive value for the measure of the short-term risk-free rate. These differences appear to point to the lack of inter-temporal and trans-national generalisiability in the data, and the need for an up-to-date study of the UK.[10]

Sadorsky (2001) notes that analysis of inter-temporal relationships between natural resource and financial asset prices requires careful consideration of the extent to which the data conform to the assumptions of classical linear regression analysis. The correlation matrix of daily data shown in Table 2 indicates that oil price returns, market returns and interest rate returns were each positively correlated with oil and gas share price returns, and that all of these correlations were statistically significant. Exchange rate returns, however, were negatively correlated with oil and gas share price returns. There was no evidence of pervasive significant correlation amongst the independent variables, other than for negative correlation (with a coefficient of −0.116) between exchange rate returns and market returns, and positive correlation (0.746) between interest rate returns and market returns.[11]

Augmented Dickey and Fuller (1979) unit root tests[12] were conducted to ensure that the data were stationary in nature; in each case, the absolute values of the test statistics were well above

[10] The kurtosis and, to a lesser extent, the skewness statistics shown in Table 1 indicate the presence of non-normality in the data; the extent (and impact) of non-normality in the regression residuals is therefore discussed later in this section.

[11] Given this evidence, the extent of multi-collinearity was tested further using the step-wise method. The step-wise (or 'simultaneous') method is one of a range of techniques that can be used to assess the relative contribution of each predictor variable. As each variable is entered into the model its contribution is assessed; if adding a variable does not significantly increase the predictive power of the model then the variable is dropped; see Brace et al. (2000). In the present case, each independent variable was entered and no variable was removed, suggesting that multi-collinearity is not likely to affect the regression results in any significant manner. As a further check on multi-collinearity, conventional collinearity diagnostic tests were conducted. All the independent variables had tolerance values very close to 1 and possessed small variance-inflating factor (VIF) values, ranging from 1.00 to 1.17, suggesting that multi-collinearity is unlikely to be a major problem with the data set. Full details of these results are available at the Appendix.

[12] Visual inspection of the data indicated that none of the series exhibited trends; consequently, all unit root test regressions were run with an intercept, but no trend term. Under the null hypothesis that a unit root exists, the conventionally computed t statistic is known as the τ (tau) statistic; critical values for τ have been tabulated by Dickey and Fuller (1979) via Monte Carlo simulation. In the literature, the τ test is known as the Dickey–Fuller (DF) test (Gujarati, 1995). The augmented version of the DF test differs from the basic version in that the former accommodates autocorrelation in the error term by adding lagged differences of the dependent variable. See Pesaran and Pesaran (1997). Full details of these results are available at the Appendix.

the 95% critical values for both the first (critical value −2.8639) and the second (−2.8637) sub-periods.[13] The Dickey–Fuller test results therefore indicate that the logged daily returns for each variable are stationary and the test results should not be affected by the presence of any unit roots.

3.1.2. Regression results

Previous related studies (e.g., Sadorsky, 2001; Faff and Brailsford, 1999) report substantial inter-temporal variability in the relationship between natural resource and equity prices, and so the 12.5-year sample period was divided into 25 six-monthly periods.[14] Panel A of Table 3 reports the 25 sets of results using Model 2 for the Oil and Gas sector.[15,16] Consistent with Sadorsky's (2001) findings for Canadian firms, inspection of the panel reveals that the oil price coefficient was positive in each of the 25 periods.[17] This evidence indicates that, as expected, an increase (decrease) in oil prices is reflected in positive (negative) returns being earned by shares in the sector. However, the strength and significance of the relationship varies over the sample time frame. For example, at the 5% level the oil price variable coefficient was significant on nine occasions. The relationship was significantly positive in the first period, before weakening in the second half of 1989 and not recovering until the second half of 1991. This pattern may reflect the uncertainty caused by the 1991 Gulf War (Malliaris and Urrutia, 1995), with the global supply of oil being subject to extraordinary uncertainty in the months preceding the outbreak of hostilities; a breakdown might be expected in any straightforward relationship between crude oil prices and the value of ownership stakes in oil-producing firms. From the second half of 1991 onward, the measured relationship was significant for three of the next six sub-periods, before weakening from the second half of 1994 until the first half of 1996. At the start of 2000, the relationship lessened in strength again, although it remained consistently positive through to the end of the sample period.

Daily share returns and oil price movements appear to exhibit a consistently positive association, but it is possible that the underlying relationship is of a longer term nature which may differ from that which emerges from analysis of the daily data. To examine this possibility, cumulative returns were computed for each variable for each of the 150 months in the sample period and regression model (2) re-analysed. The results of this analysis are shown in Panel B of Table 3; inspection of the panel reveals that the results obtained on the basis of the monthly data are very similar in nature to those which were obtained with the daily data. In particular, monthly oil price changes are found to have a significantly positive impact on monthly equity returns in

[13] The current study examines a period approximately twice as long as that used in the most closely related prior study by Sadorsky (2001). It was therefore decided to test for the presence of unit roots over two sub-periods, namely: the first 6 years (i.e., 12 of the 6-monthly periods employed in the regression analysis) and the last 6.5 years (or 13 periods). Gujarati (1995) and others note that sub-period stationarity is implied by full-period stationarity; therefore, if unit roots are found to be absent from each of these longer periods, similar conclusions can be drawn about any shorter sub-periods therein.

[14] All the regressions for both Model 1 and Model 2 were re-performed over the full 12.5-year period, as well as the 6- and 6.5-year periods employed in the stationarity tests. The findings were broadly comparable with those relating to the 25 six-monthly periods, and the detailed results are available from the authors on request.

[15] Durbin–Watson statistics were calculated for each regression and these ranged from 1.41 to 2.27; in the vast majority of cases (22 out of the 25 sub-periods) the statistic suggested that the regression residuals were free of any serial correlation.

[16] All regressions reported in Table 3 were performed on the basis of White's (1980) adjustment for heteroskedasticity.

[17] This was also the case for Model 1.

Table 3
Regression results for the oil and gas sector

Panel A—daily data

Sub-period	k	R_{ot}	R_{mt}	R_{et}	R_{tpt}	R^2 adjusted
1989-1	0.000	0.073**	0.941**	−0.016	0.100	0.836
1989-2	0.001	0.028	0.904**	−0.257**	0.039	0.689
1990-1	0.000	0.063	1.101**	−0.024	0.209	0.674
1990-2	0.001	0.018	0.453**	−0.064	0.005	0.234
1991-1	0.000	0.023	0.772**	−0.231*	0.279**	0.661
1991-2	0.000	0.164**	0.921**	−0.367**	0.064	0.725
1992-1	−0.001	0.196	0.825**	−0.140	−0.006	0.473
1992-2	0.000	0.099	0.887**	−0.396**	0.171**	0.875
1993-1	0.001	0.218**	0.994**	−0.330**	0.003	0.835
1993-2	0.000	0.123	0.981**	−0.266**	0.103	0.642
1994-1	0.001	0.203**	0.965**	−0.161	0.154*	0.737
1994-2	0.000	0.053	1.001**	−0.111	0.024	0.915
1995-1	0.000	0.051	0.955**	−0.201**	0.030	0.956
1995-2	0.000	0.079	1.058**	−0.161	−0.091	0.781
1996-1	0.000	0.118**	0.979**	−0.210	0.156	0.581
1996-2	0.001	0.038	1.153**	−0.172	−0.051	0.688
1997-1	0.001	0.181**	1.014**	−0.161	−0.281**	0.583
1997-2	0.000	0.058	1.259**	−0.194	−0.324	0.759
1998-1	0.000	0.064	0.895**	−0.352	1.658	0.321
1998-2	0.000	0.193**	0.856**	−0.335	0.336*	0.606
1999-1	0.000	0.221*	0.906**	−0.579	0.848**	0.394
1999-2	−0.001	0.227*	0.881**	0.149	−0.364	−0.313
2000-1	0.000	0.125	0.534**	−0.094	0.547	0.126
2000-2	0.000	0.126	0.506**	−0.433	1.033	0.129
2001-1	0.001	0.124	0.692**	0.109	0.089	0.290

Panel B—monthly cumulative data

k	R_{ot}	R_{mt}	R_{et}	R_{tpt}	R^2 adjusted
0.002	0.236**	0.985**	−0.034	0.117	0.747

This table reports the results of regression Model 2 for the oil and gas sector; all regressions were performed on the basis of White's (1980) correction for heteroskedasticity. k is the constant term. Period "yyyy-p" refers to period p in year yyyy. R_{ot} is the daily logged return on the crude oil price; R_{it} is the daily logged excess return on the London Oil and Gas sector index; R_{mt} is the daily market portfolio excess return; R_{et} is the logged daily change in the US \$/UK £ exchange rate; and R_{tpt} is the logged daily change in the difference between the 3- and 1-month UK treasury bill rate. A * (**) indicates significance at the 5% (1%) level on a two-tailed basis.

the sector, with a significant regression coefficient of 0.236 resulting. Overall, therefore, the evidence in Table 3 suggests that there is a pervasive positive relationship between crude oil prices and the value of oil equities, but the strength varies considerably, possibly reflecting more general macro-economic and political factors. This result is consistent with those reported in earlier studies by Sadorsky (2001) for Canada as well as Faff and Brailsford's (1999) evidence for Australia and Jones and Kaul's (1996) findings for Canada, the US, the UK and Japan. The evidence of this and previous studies as a whole suggests that the finding is robust across time and national boundaries.

As regards the effect of the return on the market as a whole on oil and gas equities, Table 3 shows–consistent with Sadorsky's (2001) Canadian evidence–that the estimated coefficient was positive and statistically significant throughout the period, but its magnitude varied. For example, the coefficient fell sharply in magnitude in the second half of 1990 before gradually increasing over the next 3 years. One possible explanation for the reduction in the market beta in 1990 is the fact that the sharp decline occurred in the months leading up to the Gulf War in 1991; it is conceivable that the weakening of the relationship between the market index and share values in the oil and gas sector reflected uncertainty in the market for oil itself and oil-based equities (Urrutia and Malliaris, 1997). Increases in the market as a whole would therefore be less likely to lead directly to increases in the oil and gas index if uncertainty regarding the outlook for the sector greatly exceeds that of the rest of the macro-economy. The estimated coefficients for the exchange rate and interest variables in Model 2 were mostly insignificant, generally negative in the former case and positive in the latter.

3.2. Inter-sectoral comparison of results

Faff and Brailsford (1999) detect oil price risk across several Australian industrial sectors.[18] Examining share returns across sectors with varying hypothesised degrees of dependence on oil prices should, therefore, help establish whether the results reported for the oil and gas sector principally reflect market-wide concern about the effect of oil price changes on the macro-economy, or are dominated instead by the impact of the direct relationship between oil pricing risk and the value of oil producers' shares. The same two models and data period were therefore employed in analysis of a further four sectors, namely: Mining, Transport, Banking and Software/Computer Services. The mining sector was chosen because it has similar characteristics to the oil and gas sector in terms of the nature of the underlying extractive activity, while the transport sector index was selected because the importance of fuel costs to constituent firms might cause it to exhibit a negative dependence on the price of crude oil. The other two sectors' indices were chosen because they were hypothesised as having no direct relationship with oil prices, other than reflecting the impact of crude oil prices on demand conditions in the economy as a whole. The extent to which comparison of the regression results reveals inter-sectoral differences in the impact of oil price fluctuations on equity indices should help in identifying the degree to which the results for the oil and gas sector reflect a direct sector-specific relationship.[19]

3.2.1. Regression results

Panel A of Table 4 reports the coefficient estimates for Model 2 using data for the four non-oil and gas sectors, while Fig. 1 illustrates the oil price coefficient estimates for all five sectors to allow a visual comparison of the results.[20] Inspection of these reveals a number of marked differences between the findings; for example, the former demonstrates that the oil price coefficient values for the mining sector fluctuated between −0.098 and 0.119 across the 25 sub-periods, but were insignificant in each case. These results indicate that the relationship between oil prices and share returns is not statistically significant in the mining sector. The fact that the evidence reported earlier for the oil and gas sector does not appear to be replicated in an industry

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[18] Faff and Brailsford report significant positive oil price sensitivity in the Oil and Gas and Diversified Resources industries, but a significant negative sensitivity in other sectors.

[19] Details regarding the properties of the index return data for the four sectors is available at the Appendix. In each case Dickey–Fuller tests confirmed the absence of unit roots, while examination of the Durbin–Watson statistics indicated that in the vast majority of sub-periods the regression residuals were free of significant serial correlation. These results are also available at the Appendix.

[20] Graphical illustration of the coefficient estimates for variables R_{mt}, R_{et} and R_{tpt} in all five sectors is available at the Appendix.

Table 4
Coefficient estimates for the oil price return variable in the non-oil and gas sectors

Panel A—daily data

Sub-period	Dependent variable			
	R_{min}	R_{trn}	R_{bnk}	R_{scs}
1989-1	−0.047	0.064	−0.043	−0.020
1989-2	0.030	−0.005	−0.025	−0.105
1990-1	−0.049	0.048	−0.121**	0.019
1990-2	0.001	−0.016	0.000	−0.012
1991-1	0.008	0.016	−0.024	−0.028
1991-2	0.049	0.077	−0.004	−0.001
1992-1	0.119	−0.127	−0.011	−0.018
1992-2	0.012	−0.128	−0.115	0.118
1993-1	0.042	0.161	−0.143*	−0.042
1993-2	0.014	−0.099	−0.062	−0.005
1994-1	0.002	0.092	−0.016	−0.032
1994-2	0.042	−0.011	0.050	−0.020
1995-1	−0.023	−0.020	−0.006	0.064
1995-2	0.039	0.227*	0.068	−0.014
1996-1	0.018	0.009	0.029	−0.015
1996-2	0.021	−0.005	−0.034	−0.006
1997-1	−0.016	0.003	−0.067	0.049
1997-2	−0.098	0.048	0.021	−0.040
1998-1	0.065	−0.024	0.008	0.014
1998-2	−0.047	−0.087	−0.069	0.030
1999-1	0.019	−0.016	−0.032	−0.017
1999-2	0.065	0.017	0.033	−0.056
2000-1	−0.067	−0.089	0.014	0.124
2000-2	−0.004	−0.025	0.020	−0.025
2001-1	0.117	−0.040	0.084	0.049

Panel B—monthly cumulative data

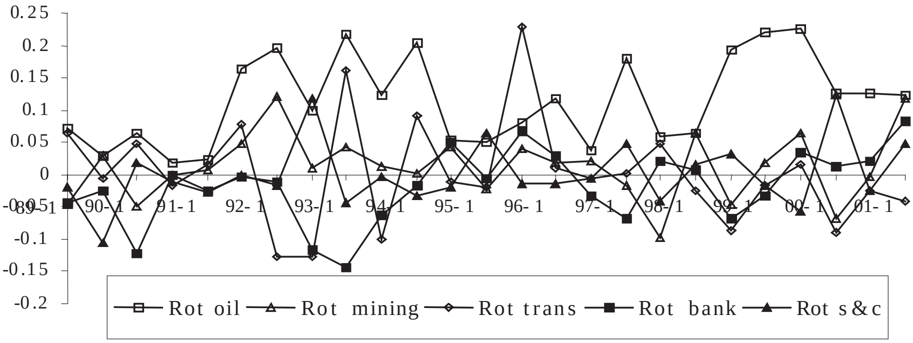
	Dependent variable			
	R_{min}	R_{trn}	R_{bnk}	R_{scs}
	0.100	−0.026	−0.051	0.103

This table reports the coefficient estimates for the daily logged oil price return variable in Model 2 for the mining (R_{min}), transport (R_{trn}), banking (R_{bnk}) and the software and computer services (R_{scs}) sectors. A * (**) indicates significance at the 5% (1%) level on a two-tailed basis.

as closely related as mining suggests that the market interprets and reacts to changes in natural resource prices on a sector-by-sector basis.

The oil price coefficient values for the transport sector fluctuated between −0.128 and 0.227 across the 25 sub-periods, taking a negative value on 14 occasions; in all but one case, however, the coefficient was insignificant. These results appear to indicate that the relationship between movements in oil prices and share returns is weak, despite the potentially negative impact of oil price rises on income streams.[21] This evidence in turn suggests that the positive relationship found between oil prices and equity values in the oil and gas sector reflects most of the impact of

[21] One explanation for this result, which differs from most previous evidence in the area, may be the fact that the earlier studies focus largely on North America and Australia, where the underlying geography means that transportation distances are typically much longer.



Note: This figure records the coefficient estimates for the daily logged return on the oil price variable (R_{ot}) for all five sectors. "Oil" is the Oil and Gas sector; "Trans" is the Transport sector; "Bank" is the Banking Sector; "S&C" is the Software and Computer Services sector.

Fig. 1. Oil price coefficient estimates for all sectors.

oil price variability on oil and gas firms and is not dampened by any offsetting effects on operating and other input costs. The oil price coefficient for the banking and software/computer services sectors was also generally insignificant, indicating again that for non-oil and gas industrial sectors the effect of oil price volatility on equity returns is minimal. As with the oil and gas sector, the longer term impact of oil price movements on equity values was investigated by examining monthly cumulated data for the 150 months in the sample period. These results, presented in Panel B of Table 4, are again consistent with the findings based on daily data; in each of the four sectors the coefficient estimates (which ranged from 0.103 for the software and computer services sector to -0.051 in the banking sector) were indistinguishable from zero.

Considering the five sectors as a whole, the results indicate that the effect of oil price variability is generally insignificant, other than in the case of the oil and gas sector itself. The evidence therefore appears to suggest that the findings for the oil and gas firms are unique to that sector in that: (i) the relationship between oil prices and equity returns was positive in all periods; and (ii) the relationship was significant in more than a third of these (and–when monthly data were analysed–across the entire sample period). The weak relationship between oil prices and share values in the non-oil and gas sectors is arguably surprising, given the commonly asserted view that oil price movements can impact on general macro-economic conditions (e.g., Jones and Kaul, 1996; Faff and Brailsford, 1999). However, the finding of any direct or indirect effect is complicated by the ability of companies to pass on their sensitivity to oil price variability to customers through altering prices or risk hedging (Faff and Brailsford, 1999). Most importantly, given the wider aims of this study, these results suggest that the relationship between crude oil prices and equity values in the oil and gas sector directly reflects the risk faced by UK firms when the market value of their main productive resource alters.

4. Discussion and conclusions

A multi-factor model was employed in this paper to investigate the relationship between oil pricing risk and the equity returns earned by UK-listed oil and gas firms. The results indicate that oil and gas stock returns are impacted by several risk factors, namely: changes in crude oil prices; the stock market as a whole; and (to a lesser extent) the exchange rate. In particular, a rise in oil prices or the equity market as a whole tends to increase the return on the UK oil and gas equity index while an increase in the US $ exchange rate typically decreases the return. Furthermore, the positive market betas indicate that oil and gas stocks were not a good hedging tool over the sample period.[22] These results are very similar to Sadorsky's (2001) findings relating to the Canadian oil and gas sector, with the one major exception being that the short-term interest rate premium was mostly positively correlated with oil share values in the UK, albeit weakly, but negatively correlated in Canada.

The results for four other sectors, chosen on the basis of their hypothesised dependence on crude oil prices, indicate that the relationship between oil prices and equity values in the non-oil and gas sectors is weak. This finding permits interpretation of the equivalent result for the oil and gas sector as reflecting the direct impact of oil price variability on the income streams of producers, independent of any indirect impact on market values such as the effect of an unanticipated rise in oil prices when OPEC supply is reduced. These results add weight to the argument that industries are not homogeneous and that different variables can impact industry returns in disparate ways (Faff and Brailsford, 1999). Moreover, the results appear to have implications for management and policy makers in these industries; in particular, the findings might be relevant when evaluating the efficiency of existing hedging policies.

The paper has a number of obvious limitations. First, the empirical work deliberately focussed on analysis of the four-factor regression model employed in related studies of other countries' equity markets, to facilitate maximum comparability with the earlier evidence. In the future, and not withstanding the strong goodness of fit results reported in this and the previous studies, researchers may develop models with a larger number of independent variables that more closely predict changes in equity values in the oil and gas sector. Second, although the choice of which other sectors to analyse was based on examining the nature of the underlying characteristics of each industry, the decision was necessarily arbitrary to some degree; the results (and their interpretation) therefore need to be conditioned in the light of this. Finally, the 6-monthly focus adopted for the analysis was intended to allow inter-temporal variability in the nature and effect of oil price volatility to emerge from the study. However, the growing level of instability in the oil industry and global equity markets in recent years means that investigation of even shorter sub-periods might have to become the norm in studies such as this in the future.

The evidence in this paper suggests that a significant level of pricing risk exists for oil and gas firms operating in developed countries with significant private equity holdings. However, much of the world's oil is produced within a very different economic environment and a pertinent question appears to be if, and how, pricing risk manifests itself when concern over exposure to the vagaries of global equity markets is limited. Future research might usefully examine this issue and thereby identify the extent of any commonalties in findings between the impact of pricing risk in large developed countries with a wide industrial base and (as reliable stock market data in developing countries become available) in nations where the oil industry dominates economic activity and international trade.

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[22] See Pring (1991) for a detailed discussion of this issue.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.eneco.2005.09.002.

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