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Geary WP2011/07
January 2011

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US Oil Price Exposure: The Industry Effects

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Abstract

This paper investigates the exposure of industry level portfolios to oil price shocks. Our paper utilizes the Campbell (1991) decomposition of stock returns based on a log-linear approximation to the discounted present value relation while allowing for time varying expected returns. The results from our baseline regressions indicate that there is little sensitivity in industry level portfolios to unexpected movements in oil prices, with the gold, oil & gas and retail industries being the only exception. In contrast, based in the Campbell (1991) decomposition, we identify extensive exposure to oil prices in industry level returns in particular channels. The extent of the exposure is particularly significant for a number of the industries, with positive (negative) permanent implications for gold, and the oil and gas industries (retail and meals, restaurants and hotels).

Keywords: Oil, Industry Stock Returns, Vector autoregression
JEL Classification: E32, C32

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1 Introduction

There has long been interest in the extent and effects of oil price exposure on economic activity. Recent empirical evidence, such as Hamilton (2009), finds that shocks to oil prices tend to reduce output growth. However, there has been, until recently, much less research examining the exposure of asset returns to oil price shocks, with notable contributions including Chen et al (1986), Jones and Kaul (1996) Sadorsky (1999) and Kilian and Park (2009). These authors estimate the exposure of broad market indexes to oil shocks, finding that stock prices generally tend to fall in response to positive oil price shocks. More recently, the relationship between stock returns and oil prices has been investigated by Sorensen (2009), Park and Ratti (2008), Gogineni (2009), Miller and Ratti (2009) and Fan and Jahan-Parvar (2009).

In this paper, we estimate the exposure of industry level stock returns to oil price shocks, and we decompose the channel through which that exposure operates. We first estimate this exposure in the context of a linear factor model, such as the Arbitrage Pricing Theory (APT), with measured macroeconomic factors, as in Chen et al (1986). We then identify the sources of exposure in industry level stock returns by decomposing total returns into two primary components, consistent with the rational valuation formula (RVF) for stock prices. The RVF states that prices will equal the present value of future dividends, or cash flows, discounted at the appropriate time-varying, risk-adjusted discount rate. Campbell (1991) and Campbell and Ammer (1993), among others, have utilized this relationship to decompose changes in excess returns into a component representing revisions in future cash flows, and a component representing revisions in future expected returns, or discount rates.[1] The exposure of industry level stocks returns to oil prices can then be apportioned to revisions in expectations regarding these two components, where revisions to future cash flows is related to cyclical economic effects and revisions to future excess returns or discount rates is related to risk premia.

In particular we examine the role played by innovations in expected dividend growth and innovations in future excess returns in relation to US industry stock returns. Two studies that have previously examined this issue, both from the per-

[1] Examples of international studies include, Cuthbertson, Hayes and Nitzsche (1999) who have applied this approach to explain movements in UK stock returns.

spective of aggregate US returns, find conflicting results. Kilian and Park (2009) reject the role of expected dividend growth channel, while Jones and Kaul (1996) find a major role for expected dividend growth.[2] It is unclear whether stock returns fall because oil prices affect expected future cash flows, or, for example, risk premia. Our paper reinvestigates this channel.

In the context of our linear factor model, we find that the direct exposure of industry portfolio returns to oil prices is relatively weak for the majority of industries, which is consistent with prior research (see Huang et al, 1996).[3] Some industries, however, have statistically significant exposure to oil prices, including the oil and gas industry. Consistent with our priors, the exposure of this industry to oil prices is positive.

Based on Campbell's (1991) decomposition of stock returns, we then investigate the channels through which oil prices affect 18 industry portfolios for the US, using data complied by Kenneth French. We find that about half of the industries have significant (at the 5% or 10% level) exposure to oil prices through expected revisions in cash flows, while thirteen industries have exposure (at the 5% or 10%) level through expected future risk premia. The exposure through cash flows to oil prices is largest in magnitude for gold and the oil and gas industry. In contrast to previous studies, which focused on aggregate stock returns (Jones and Kaul (1996) and Kilian and Park (2009)), our industry level analysis suggests that both cash flows and excess returns play a statistically significant role, and that the role varies by industry.[4]

The cash flow channel may be interpreted as having effects that are permanent, since it represents future investment opportunities. For gold and the oil and gas industry, the (positive) permanent channel dominates the discount rate channel, indicating the long-term investment benefits to these industries as a result of an oil price shock. However, the permanent, cash flow, effects also dominate the *negative* exposure of meals, restaurants & hotels and retail industries. Our results are a

[2]Specifically, Kilian and Park (2009) conclude that we can reject that the response is driven by expected dividend growth alone.

[3]Both Jones and Kaul (1996) and Kilian and Park (2009) find evidence of oil price exposure at the aggregate level.

[4]Recent studies examining the influence of oil price changes on industry equity returns in international markets include Sadorsky (2001) and McSweeney and Worthington (2007).

potential indication why previous studies have been unable to uncover the extent of oil price exposure.

2 Literature Review

One of the first studies to investigate the exposure of stock returns to oil price movements was Chen et al. (1986), who find that oil price have no significant effect on US stock returns for the period 1958 to 1984. Huang et al (1996) find a similar result using oil price futures and both aggregate and industry level US daily data for the period 1983 to 1990.[5] Jones and Kaul (1996) highlight the potential differences depending on whether countries are net oil exporters or importers. These authors examine the case of US, Japan, UK and Canada using quarterly data from 1947 to 1991, finding a negative relationship in all cases, with the results particularly strong for Japan (a net oil importer) and considerably weaker for Canada (a net oil exporter). Drawing on the RVF, Jones and Kaul (1996) examine the role played by cash flows and excess returns on aggregate returns following oil price movements. Jones and Kaul (1996) find that oil price changes influence US and Canadian stock returns via current and expected future real cash flows.[6] [7]

Recent research by Kilian and Park (2009) accounts for economic conditions when addressing oil price movements by treating oil price movements as endogenous. Kilian and Park (2009) decompose the oil price shocks into aggregate demand shocks and supply shocks with a structural VAR. In their model, the response of the stock market to these two types of shocks is very different, with the aggregate demand shock leading to a reduction in stock returns, while the aggregate supply shock (representing better global economic conditions) leads to an increase in returns. Unlike Jones and Kaul (1996), these authors highlight the dominant role played by excess return channel in relation to the influence of oil price shocks on stock returns.

More recently, Sorensen (2009) finds that oil price changes caused by exogenous

[5] The only exception is when Huang et al. (1996) examine the relationship between oil price futures and oil company returns.

[6] The authors are unable to find any statistically significant evidence of a role played by expected returns or cash flows in the case of Japan and the UK.

[7] Sadorsky (1999) also finds evidence of the importance of the importance of oil price shocks on aggregate stock returns and highlight the evidence of asymmetric effects.

events tend to predict future stock returns. Park and Ratti (2008) highlight the significant impact of oil price shocks on US and European stock markets. This impact is extenuated by oil price uncertainty for the case of European markets, but not for US stock markets.[8] Gogineni (2010) examines industry level exposure to stock prices, finding that industries that are heavily dependent on oil prices are most sensitive to oil prices. Fan and Jahan-Parvar (2009) find that oil prices predict stock returns, but only for one-fifth of the forty nine industries in their sample.

3 Methodology and Exposure Metrics

Our empirical methodology has two components. In the first stage, we decompose asset returns into two components, representing innovations in contemporaneous and future dividends, and future excess returns. In the second stage, we estimate the exposure of each component to two state variables, the broad market and oil prices, in the context of the linear factor model with measured macroeconomic factors.

3.1 Campbell Decomposition

Campbell (1991) decomposes innovations in excess returns into innovations in three components: contemporaneous and future dividends and future excess returns. This intuitive result is derived from a log-linear approximation to the simple discounted present value relation given by the Gordon growth model, while allowing for time varying expected returns. The innovation in current excess returns is then simply the difference between the realized and expected return.

In particular, the Campbell (1991) and Campbell and Ammer (1993) show that, after a linearization, the innovation in contemporaneous returns can be represented as

$$\tilde{e}^{e}_{t+1} = \tilde{e}^{d}_{t+1} - \tilde{e}_{t+1} \tag{1}$$

where $\tilde{e}^{e}_{t+1} = r_{t+1} - E_t r_{t+1}$ represents the innovations in excess returns; $\tilde{e}^{d}_{t+1}$

[8] In particular Miller and Ratti (2009) identify the importance of periods of oil price instability regarding the long-run relationship between international stock markets and world oil prices.

represents innovations in contemporaneous and future dividends and $\tilde{e}_{t+1}$ represents innovations in future expected returns or discount rates applied to cash flows. The intuition is that positive innovations in returns $\tilde{e}^{e}_{t+1}$ must be due to either upward revisions in future cash flows $\tilde{e}^{d}_{t+1}$ or downward revisions in future discount rates $\tilde{e}_{t+1}$.

More formally, these innovations are derived as revisions in the conditional expectations of the discounted future value of dividends and returns

$$\begin{aligned} \tilde{e}^{d}_{t+1} &= (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j \Delta d_{t+j+1} \\ \tilde{e}_{t+1} &= (E_{t+1} - E_t) \sum_{j=1}^{\infty} \rho^j e_{t+j+1} \end{aligned} \tag{2}$$

The discount factor ρ, in steady state, is equal to the equity price divided by the equity price plus dividend. In practice, implementing this decomposition requires empirical proxies to estimate the revisions in the conditional expectations in equation (2). A natural method for generating these conditional expectations is to linearly project the excess stock returns on variables known contemporaneously. This is the approach taken by Campbell (1991) and Campbell and Ammer (1993).

In the context of our implementation, the excess return on each industry portfolio $r_{i,t}$ is assumed to be a linear function of l state variables x_t (here $l = 4$) which are known to market participants at time t. If the industry returns are stacked in a vector $\mathbf{r}_t$, with $r_{i,t}$ as the i^{th} row

$$r_{i,t+1} = a_i \mathbf{x}_t + \tilde{e}_{i,t+1} \tag{3}$$

and a_i is the i^{th} row of the l element coefficient vector. As state variables, we use the excess market return (CRSP value-weighted index minus 3 month Treasury bill yield), long short yield spread (10 year Treasury bond yield minus the 3 month treasury bill yield), the market smoothed price earnings ratio (measured as the log ratio of the S&P 500 price index to a 10 year moving average of S&P 500 earnings) and the small stock value spread (measured as the difference between the log book-to-market ratios of small value and small growth stocks). The included state variables are consistent with those adopted by recent studies, including Campbell and Vuolteenaho (2004) and Cohen, Polk and Vuolteenaho (2009). Finally, the change in oil price is also included.

The vector of state variables is assumed to follow a first order vector autoregression (VAR) process:[9]

$$\mathbf{x}_{t+1} = \mathbf{\Pi}\mathbf{x}_t + \tilde{\mathbf{x}}_{t+1} \tag{4}$$

where $\tilde{\mathbf{x}}_{t+1}$ is the mean zero innovation in the vector of state variables. Hence the expectation in the current period of any future values of the state variables is:

$$E_t\mathbf{x}_{t+j+1} = \mathbf{\Pi}^{j+1}\mathbf{x}_t \tag{5}$$

and the revision in long horizon expectations of x_t made between the current period and the next is:

$$(E_{t+1} - E_t)x_{t+j+1} = \mathbf{\Pi}^j\tilde{\mathbf{x}}_{t+1} \tag{6}$$

Using the definitions of the news variables in equation (2) and the revision of expectations in the vector of state variables in equation (6), Campbell (1991) derives the news components of the returns for each portfolio i as function the model parameters:

$$\begin{aligned} \tilde{e}^d_{i,t+1} &= (\mathbf{e}1' + (\mathbf{e}1'\rho\mathbf{\Pi})(I - \rho\mathbf{\Pi})^{-1}\tilde{x}_{t+1} \\ \tilde{e}^e_{t+1} &= (\mathbf{e}1'\rho\mathbf{\Pi})(I - \rho\mathbf{\Pi})^{-1}\tilde{x}_{t+1} \end{aligned} \tag{7}$$

where $\mathbf{e}1'$ is a selection vector which 'picks out' the excess market return from the VAR. The left hand side variables in equation (7) are the news about future dividends on portfolio i, (related to cyclical economic effects) and news about future excess returns, (related to risk premiums).

[9]Sequential tests of lag length based on the Akaike information (AIC) and Schwartz Bayesian (SBC) suggest that a lag length of one is appropriate, consistent with studies adopting this approach (e.g., Cuthbertson and Nitzsche, 2005).

3.2 Return decomposition

In the second stage, we estimate the exposure of each of the components of asset returns to the macroeconomic factors, which includes oil prices. The sensitivity (beta) decomposition is defined by using the unconditional variances and covariances of the innovations in returns and factors (oil price changes). The beta on the return to portfolio i with respect to the k^{th} factor (e.g. oil price changes) is defined as:

$$\beta_{i,k} = \frac{cov(\tilde{e}_i, \tilde{e}_k)}{var(\tilde{e}_k)} \tag{8}$$

which is simply the covariance between the unexpected excess return on portfolio or industry i, $\tilde{e}_i$, and the unexpected excess return on factor k, $\tilde{e}_k$, divided by the variance of the unexpected excess return on the kth factor. These factor betas $\beta_{i,k}$ can then be decomposed into betas related to dividends and betas related to future excess returns:

$$\begin{aligned} \beta_{i,k} &= \frac{cov(\tilde{e}_{di},\tilde{e}_k)}{var(\tilde{e}_k)} - \frac{cov(\tilde{e}_{ei},\tilde{e}_k)}{var(\tilde{e}_k)} \\ &= \beta_{di,k} - \beta_{ei,k} \end{aligned} \tag{9}$$

where $\beta_{di,k}$ is the beta between the innovation in the k^{th} factor (e.g. oil price changes) and news about portfolio i's future cash flows or dividends and $\beta_{ei,k}$ is the beta between the innovation in the k^{th} factor and news about future industry excess returns or discount rates. In the language of Campbell and Vuolteenaho (1994), this is a 'good beta'. Note that this latter beta will, in general, be negative, making the contribution to the total beta positive (note that Campbell and Vuolteenaho (1994) report the negative of this beta).

The factor innovations, which must be conditionally mean zero, are simply the residuals from the k individual VAR equations given by equation (4)

$$\tilde{e}_k = \tilde{x}_{k,t+1} \tag{10}$$

where $\tilde{x}_{k,t+1}$ is the k^{th} row of the innovation vector $\tilde{x}_{t+1}$. Having estimated equation (4) and calculated the decomposition given by equations (7) it is straightforward to calculate the factor betas in equation (9).

4 Data and Empirical Results

4.1 Data

The degree of oil price exposure is examined over the period December 1974 to December 2009, for 18 industry portfolios for the US, using data compiled by Kenneth French. The portfolios constructed by Kenneth French are from the CRSP database and are consistent with our aggregate stock return data. The state vector contains the market excess return (CRSP value-weighted index minus 3 month Treasury bill yield), long short yield spread (10 year Treasury bond yield minus the 3 month treasury bill yield), the market smoothed price earnings ratio (measured as the log ratio of the S&P 500 price index to a 10 year moving average of S&P 500 earnings) and the small stock value spread (measured as the difference between the log book-to-market ratios of small value and small growth stocks). Our choice of state variables is consistent with those adopted by recent studies in the asset pricing literature, including Campbell and Vuolteenaho (2004) and Cohen, Polk and Vuolteenaho (2009). Finally, the change in oil price is also included, where the price of oil is the US FOB Cost of Crude Oil (in US Dollars).

The five state variables enter the VAR as deviations from their mean and the VAR is estimated with a lag length of one.[10] Table 1-3 report the summary statistics and the correlations for aggregate stock returns, industry stock returns and all state variables. As can be seen from table 1, there is considerable variation across each of the industries, as well as consistent evidence of non-normality. Table 2 indicates all industries have a negative relation with higher oil price movements, with the exception of chemicals, coal, gold, machinery, oil & gas, steel and utilities.

4.2 Empirical Results

Before addressing the extent of the exposure to oil price movements, we investigate the general level of market exposure across the industry level portfolios for the US. In column 2 of table 4 we report the market excess return betas for each of the

[10] We tested the lag length in the VAR using the standard information criteria, Akaike information (AIC) and Schwartz Bayesian (SBC) and found a lag length of one. This is consistent with studies that have adopted this approach in the asset pricing literature, (see Cuthbertson and Nitzsche, 2005).

industrial sectors in the US. In all cases the market betas are statistically significant at the 5% level, with the smallest market beta of 0.478 for utilities and the largest being 1.363 for steel. Thus for every 1% increase in market risk, there is a wedge of close to 1% driven between the two U.S. sectors. In column 3 we report the oil betas. The magnitude of the oil beta point estimates is small and tends to vary in sign. The oil betas on the gold, oil & gas and retail industries are significant at the 5% level, while the betas on coal, consumer goods, restaurants and transport industries are significant at the 10% level. The signs on the beta coefficients indicate that, following an unexpected increase in the price of oil, required returns on firms in the gold and oil & gas industries also tend to increase.

Our findings, while consistent with those reported previously (see Huang et al., 1996), suggest that the exposure of US industry stock returns to changes in oil prices is relatively modest, although thus far our estimation model has focused on the extent of gross exposure via unexpected changes in oil prices, rather than through some component parts. These potential sources of exposure has not been empirically modeled previously, but they may be thought of as an avenue for more complicated exposures, e.g. through the potential effects on production costs, market share and the implications for firm's competitiveness.

We next move to our primary results, the decomposition of beta exposures to oil prices. We should note that this decomposition accounts for potential nonlinear relations in the level of exposure, the importance of which several studies have previously highlighted in the context of asset pricing (Giddy and Dufey, 1995; Kanas, 1996; Bartram, 2004).

The decompositions of the sensitivity terms, news about future cash flows and news about future excess returns are reported in table 5. Consider first the market betas on cash flows and excess returns. By construction, the sum of the excess return and cash flow beta equals the total beta, and we expect the excess return betas to be negative, implying that contribution to the total beta is positive (see equation 10). For all industries, the market betas related to excess returns has the expected sign (negative), indicating that exposure to market risk through excess return translates into lower future discount rates on future cash flows. For all industries except gold, the exposure to market risk through cash flows is positive

The decomposition results identify the extent of indirect exposure to oil price movements. Unexpected changes in excess market returns typically have a positive impact on revisions in expectations about both future cash flows and future excess returns. Moreover, the majority of estimated coefficients are statistically significant. Furthermore in the majority of cases the absolute value of the future excess return beta is much larger than the cash flow (dividend) betas, suggesting changes in stock returns associated with a change in the market excess return are due more to revisions in expectations about future excess returns than future dividends. This finding is consistent with the results from recent studies including Campbell and Vuolteenaho (2004).

In relation to oil price exposure, it is clear from the decomposition results that there exists considerably greater levels of exposure than that identified solely by the initial regression analysis in table 4. The level of oil price exposure increases significantly, when the channels of influence are considered. Both retail and meals, restaurants & hotels report a negative relationship between oil price movements and future cash flows. Kilian and Park (2009) have also highlighted both these industries as being particularly sensitive to oil price exposure. Unlike the previous evidence, which focused purely on aggregate stock returns (see Jones and Kaul (1996) and Kilian and Park (2009)), our industry analysis finds that both cash flows and excess returns play a statistically significant role. For those industries reporting a negative relationship to the exposure, the cash flow channel would appear to dominate. Our results imply that for retail and meals, restaurants & hotels the 'bad' permanent effects outweigh the 'good' transitory effects (see, Campbell and Vuolteenaho, 2004).[11] The implication of the cash flow channel bearing the brunt of the exposure is that any negative effect on these industries is likely to be permanent and the investment opportunities into the future are likely to be effected.

Both gold and oil & gas report a positive exposure to oil price movements, with the channel of influence being driven again by the cash flow channel. Our results imply that there is likely to be permanent benefits to these industries as a result of the exposure. Finally, automobiles, chemicals and paper report positive exposures to oil price movements, with the channel of influence being dominated by excess returns.

[11] Campbell and Vuolteenaho (2004) refer to this as the 'bad' beta outweighing the 'good' beta.

5 Conclusion

This study investigates the level of oil price exposure faced by industries in the US. Our study isolates two potentially critical issues that have been predominantly overlooked by the empirical literature to date. First, rather than taking account of the exposure to changes in oil prices, which includes both expected and unexpected changes, we focus solely on unexpected changes. The second critical element of our analysis is that we investigate the possible channels of influence in relation to oil price exposure. The Campbell (1991) decomposition approach adopted here, although novel in this literature, has proven successful in the finance asset pricing literature. Our results for the direct effects of both oil price exposure applied to the US industry portfolios are weak, but consistent with those results documented previously in the literature (see Huang et al., 1996). There is little evidence to suggest widespread oil price exposure in relation to US industries. It is only when we adopt the beta decomposition that we identify the true extent of oil price exposure.

There is considerably greater levels of oil price exposure once we take into account the channel through which the influence occurs. We find evidence of widespread oil price exposure, with signs that are generally consistent with economic theory. Not only do gold and oil & gas industries benefit from the exposure, these effects are likely to have permanent investment effects. While, industries such as meals, restaurants & hotels and retail are likely to be adversely effected on a permanent basis due to their exposure to oil price movements.

Unlike the previous evidence, which focused purely on aggregate stock returns (see Jones and Kaul (1996) and Kilian and Park (2009)), our industry analysis finds that both cash flows and excess returns play a statistically significant role. The cash flow channel would appear to dominate those industries that are particularly sensitive to oil price movements. The implication of the cash flow channel bearing the brunt of the exposure is that any positive or negative effect on wealth is likely to be permanent and the investment opportunities into the future are likely to be effected. Our results are a potential indication why previous studies have been unable to uncover the extent of oil price exposure.

References

[1] Bartram, S.M., 2004. Linear and nonlinear foreign exchange rate exposures of German nonfinancial corporations. Journal of International Money and Finance 23, 673-699.

[2] Campbell, J.Y., 1991. A variance decomposition for stock returns. Economic Journal 101, 157-179.

[3] Campbell, J.Y., Ammer, J., 1993. What moves the stock and bond market. Journal of Finance 48, 3-37.

[4] Campbell, J.Y., Vuolteenaho, T., 2004. Bad beta, good beta. American Economic Review 94, 1249-1275.

[5] Chen, N.-F., Roll, R., Ross, S.A., 1986. Economic forces and the stock market. Journal of Business 59, 383-403.

[6] Cohen, R.B., Polk, C., Vuolteenaho, T., 2009. The price is (almost) right. Journal of Finance, 64, 2739-2782.

[7] Cuthbertson, K., Hayes, S., Nitzsche, D., 1999. Explaining movements in UK stock prices. The Quarterly Review of Economics and Finance 39, 1-19.

[8] Cuthbertson, K., Nitzsche, D., 2005. Quantitative Financial Economics. Second Edition, Wiley.

[9] Fan, Q., Jahan-Parvar, M.R., 2009. US Industry-Level Returns and Oil Prices. MPRA Paper 15670, University Library of Munich, Germany.

[10] Giddy, I.H., Dufey, G., 1995. Uses and abuses of currency options. Journal of Applied Corporate Finance 8, 49-57.

[11] Gogineni, S. 2010. Oil and the stock market: An industry level analysis. The Financial Review 45, 995-1010.

[12] Hamilton, J.D., 2009. Causes and consequences of the oil shock of 2007-08, Brookings Papers on Economic Activity, 215-259.

[13] Huang, R., Masulis, R., Stoll, H., 1996. Energy shocks and financial markets. Journal of Futures Markets 16, 1-27.

[14] Jones, C., Kaul, G., 1996. Oil and the stock markets. Journal of Finance 51, 463-491.

[15] Kanas, A., 1996. Exchange rate economic exposure when market share matters and hedging using currency options. Management International Review 36, 67-84.

[16] Kilian, L., Park, C., 2009. The impact of oil price shocks on the U.S. stock market. International Economic Review 50, 1267-1287

[17] McSweeney, E., Worthington, A.C., 2008. A comparative analysis of oil as a risk factor in Australian industry stock returns, 1980-2006. Studies in Economics and Finance 25, 131-145.

[18] Miller, J.I., Ratti, R.A., 2009. Crude oil and stock markets: Stability, instability and bubbles. Energy Economics 31, 559-568.

[19] Park, J., Ratti, R.A., 2008. Oil price shocks and stock markets in the U.S. and 13 European countries. Energy Economics 30, 2587-2608.

[20] Sadorsky, P., 1999. Oil price shocks and stock market activity. Energy Economics 21, 449-469.

[21] Sadorsky, P., 2001. Risk factors in stock returns of Canadian oil and gas companies. Energy Economics 23, 17-28.

[22] Sørensen, L. Q., 2009. Oil price shocks and stock return predictability. EFA 2009 Bergen Meetings Paper. Available at SSRN: http://ssrn.com/abstract=1341013.

Table 1: Summary Statistics

	Mean	Standard Error	Skewness	Kurtosis	JB Normality test
Aircraft	1.451	6.759	-0.471*	2.314*	109.501*
Automobiles	1.028	7.201	0.275*	6.901*	840.587*
Chemicals	1.067	5.719	-0.173	2.607*	121.337*
Coal	1.496	10.333	0.221	1.850*	63.474*
Consumer Goods	1.017	4.825	-0.222	1.885*	63.803*
Electrical Equipment	1.398	6.437	-0.320*	2.259*	96.710*
Entertainment	1.451	7.755	-0.080	4.148*	302.337*
Gold	1.033	11.139	0.868*	5.481*	579.827
Machinery	1.053	6.410	-0.705	3.045*	197.523*
Meal, Restaurants & Hotels	1.255	5.869	-0.247*	1.904*	67.869*
Oil & Gas	1.249	5.536	-0.018	1.490*	38.962*
Paper	1.038	5.791	0.156	2.663*	126.054*
Retail	1.230	5.698	-0.133	2.391*	101.5412*
Rubber	1.120	6.102	-0.214	3.906*	270.787*
Ships	1.012	7.107	-0.255*	1.987*	73.795*
Steel	0.933	7.879	-0.292*	2.492*	114.867*
Transport	1.109	5.776	-0.429*	1.886*	75.302*
Utilities	1.061	4.090	-0.170	1.311*	32.171*
Excess Market Return	0.011	0.046	-0.721*	2.495*	145.296*
Spread	1.746	1.292	-0.607*	0.021	25.765*
Price-Earnings Ratio	2.855	0.494	-0.036	-1.103*	21.389*
Value Spread	0.686	0.137	1.336*	3.583*	349.573*
Oil Price Change	0.005	0.075	-0.702*	4.894*	453.626*

Note: This table reports summary statistics on industry level stock returns based on data from Ken French. The sample is December 1974 through to December 2009. * denotes significance at 5%.

Table 2: Industry Correlation Coefficients

	Aircraft	Automobiles	Chemicals	Coal	Consumer Goods	Electrical Equipment	Entertainment	Gold	Machinery	Meals, Restaurants & Hotels	Oil & Gas	Paper	Retail	Rubber	Ships	Steel	Transport	Utilities	Oil Price Changes
Aircraft	1	0.64	0.72	0.43	0.66	0.71	0.66	0.22	0.73	0.71	0.54	0.72	0.64	0.66	0.71	0.64	0.75	0.50	-0.01
Automobiles		1	0.70	0.35	0.59	0.69	0.68	0.19	0.74	0.62	0.40	0.72	0.66	0.69	0.57	0.66	0.70	0.41	-0.04
Chemicals			1	0.51	0.68	0.76	0.70	0.29	0.82	0.69	0.61	0.85	0.68	0.75	0.64	0.75	0.78	0.49	0.03
Coal				1	0.32	0.43	0.40	0.27	0.56	0.34	0.57	0.41	0.30	0.45	0.36	0.51	0.43	0.44	0.17
Consumer Goods					1	0.69	0.64	0.13	0.62	0.72	0.38	0.74	0.69	0.67	0.56	0.49	0.68	0.46	-0.09
Electrical Equipment						1	0.72	0.25	0.81	0.70	0.49	0.74	0.73	0.73	0.64	0.73	0.77	0.47	-0.05
Entertainment							1	0.15	0.75	0.73	0.41	0.66	0.69	0.74	0.60	0.65	0.70	0.41	-0.02
Gold								1	0.34	0.21	0.37	0.27	0.14	0.23	0.21	0.38	0.21	0.19	0.18
Machinery									1	0.67	0.63	0.76	0.66	0.77	0.66	0.84	0.78	0.44	0.05
Meals, Restaurants & Hotels										1	0.42	0.68	0.80	0.69	0.62	0.55	0.74	0.48	-0.13
Oil & Gas											1	0.49	0.34	0.46	0.47	0.55	0.46	0.57	0.25
Paper												1	0.68	0.74	0.61	0.69	0.78	0.45	-0.01
Retail													1	0.71	0.55	0.55	0.75	0.40	-0.15
Rubber														1	0.62	0.68	0.75	0.46	-0.08
Ships															1	0.56	0.66	0.40	-0.01
Steel																1	0.68	0.37	0.10
Transport																	1	0.45	-0.07
Utilities																		1	0.03
Oil Price Changes																			1

A * denotes significance at 5%.

Table 3: State Variables Correlation Coefficients

	Excess Market Return	**Spread**	**Price-Earnings Ratio**	**Value Spread**	**Oil Price Change**
Excess Market Return	1	0.189	0.214	0.192	-0.002
Spread		1	0.783	0.820	0.011
Price-Earnings Ratio			1	0.977	0.067
Value Spread				1	0.039

Table 4: Total Betas

	Market Beta	**Oil Beta**
Aircraft	1.091**	0.001
	(18.78)	(0.02)
Automobiles	1.119**	-0.048
	(15.46)	(0.61)
Chemicals	1.039**	-0.016
	(25.23)	(0.26)
Coal	1.163**	0.202*
	(10.70)	(1.88)
Consumer Goods	0.779**	-0.084*
	(18.86)	(1.83)
Electrical Equipment	1.210**	-0.060
	(28.95)	(0.91)
Entertainment	1.294**	-0.042
	(20.71)	(0.52)
Gold	0.683**	0.355**
	(4.62)	(3.40)
Machinery	1.224**	0.028
	(29.92)	(0.38)
Meal, Restaurants & Hotels	0.926**	-0.086*
	(18.56)	(1.74)
Oil & Gas	0.763**	0.221**
	(15.14)	(4.57)
Paper	0.979**	-0.051
	(20.70)	(0.98)
Retail	0.964**	-0.116**
	(21.71)	(2.24)
Rubber	1.034**	0.088
	(19.21)	(1.48)
Ships	1.001**	0.001
	(13.69)	(0.01)
Steel	1.363**	0.100
	(22.83)	(1.24)
Transport	1.000**	-0.085*
	(20.79)	(1.72)
Utilities	0.478**	0.007
	(10.32)	(0.18)

Results of the sensitivity of each of the industry portfolios to the market return in the US. All figures in parenthesis are t-statistics. A ** and * denote significance at 5% and 10% respectively.

Table 5: Beta Decomposition

	Excess Returns		Cash Flows	
Industry	**Market**	**Oil**	**Market**	**Oil**
Aircraft	-0.914**	0.005	0.0018	0.044
	(28.39)	(0.08)	(0.26)	(1.15)
Automobiles	-0.895**	0.119**	0.225**	0.066
	(25.41)	(2.10)	(3.04)	(1.47)
Chemicals	-0.640**	0.182**	0.399**	0.166**
	(21.07)	(4.77)	(8.52)	(4.69)
Coal	1.651**	0.042	2.813**	0.245
	(33.22)	(0.43)	(22.33)	(1.32)
Consumer Goods	-0.451**	0.051*	0.244**	0.056
	(24.62)	(1.93)	(3.03)	(1.25)
Electrical Equipment	-0.488**	0.014	0.721**	-0.046
	(20.71)	(0.42)	(16.40)	(1.12)
Entertainment	-1.050**	0.098*	0.244**	0.056
	(22.30)	(1.58)	(3.03)	(1.25)
Gold	-0.938**	0.137*	-0.255*	0.493**
	(33.85)	(2.50)	(1.71)	(5.30)
Machinery	-0.211**	0.080**	1.013**	0.107*
	(14.18)	(4.70)	(25.51)	(1.80)
Meal, Restaurants & Hotels	-0.990**	-0.098*	-0.064	-0.184**
	(24.38)	(1.71)	(1.01)	(5.55)
Oil & Gas	-0.168**	0.051**	0.595**	0.272**
	(5.65)	(3.38)	(10.56)	(6.63)
Paper	-0.698**	0.169**	0.281**	0.117**
	(27.28)	(4.13)	(5.59)	(3.82)
Retail	-0.735**	-0.080*	0.228**	-0.197**
	(23.19)	(1.93)	(3.79)	(6.45)
Rubber	-0.898**	0.095*	0.136**	0.007
	(27.54)	(1.82)	(2.22)	(0.20)
Ships	-0.322**	0.011	0.679**	0.012
	(13.71)	(0.52)	(8.43)	(0.22)
Steel	-0.033	0.035*	1.329**	0.134*
	(0.93)	(1.73)	(19.18)	(1.78)
Transport	-0.795**	0.074	0.205**	-0.011
	(28.71)	(1.58)	(3.59)	(0.33)
Utilities	-0.399**	0.039	0.078*	0.046*
	(18.32)	(1.62)	(1.74)	(1.62)

Results of the sensitivity of each of the industry portfolios to the market return in the US. All figures in parenthesis are t-statistics. A ** and * denote significance at 5% and 10% respectively.