# Accounting for Oil and Gas Exploration Activities:

# A Triumph of Economics over Politics

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**Abstract:** For more than 40 years oil and gas companies have been able to choose between two competing methods for accounting for exploration activities. The literature suggests that accounting method discretion can potentially signal managements' private information with the benefit of improving the relevance of accruals for forecasting future cash flows. However, if accounting method flexibility is used for financial window-dressing, accruals can lose their value-relevance and investors will resort to cash flows measures instead. In this study we compare the value-relevance of earnings versus cash flow for oil and gas companies from 1992 to 2013. Our results suggest that earnings are not significant, independent of accounting method choice, consistent with the view that accruals have limited value in the oil and gas industry. Rather, it seems that cash flow measures of both current and future profitability are significantly associated with oil company returns. These findings suggest that the financial markets lack confidence in oil company earnings, irrespective of accounting method choice.

*Keywords: full cost versus successful efforts, oil and gas company valuation, petroleum accounting, value-relevance.*

*JEL codes: M40, Q33, G12*

## 1. INTRODUCTION

For over forty years, accounting standard setters, regulators, oil and gas companies and academics have discussed intensively the topic of how to capitalize exploration (pre-discovery[1]) expenses for oil and gas producers. Since the 1960s oil and gas companies have been using two competing methods, the full cost (FC) and successful efforts (SE) methods (Zeff, 1978). Under the FC method, oil and gas explorers are allowed to capitalize all expenses, while under the alternative method, SE, only expenses from successful discoveries are allowed to become assets on their balance sheets. While the use of either method has no direct cash flow effect that is relevant for security pricing, the literature suggests that the accounting method choice might have indirect cash flow effects through the interaction with company-specific variables such as leverage, political costs, and management compensation (Spear and Leis, 1997). These variables are related to the financial window-dressing effects inherent in the FC method, such as earnings smoothing and lower earnings volatility (Bryant, 2003; Boone and Raman, 2007).

The topic of the impact of accounting method choice on the value relevance of oil company accounting information has been addressed in numerous academic studies, particularly in years surrounding the release of new accounting standards (e.g. the U.S. accounting standard in the late 1970s and early 1980s, and the international standards

[1] Pre-discovery costs include property acquisition and carrying costs, geological and geophysical exploration costs and exploratory drilling costs.

in the mid-2000s). Despite the attention in the academic literature, the empirical results are not conclusive. While many studies find support for the hypothesis that financial disclosures under the SE method (Harris and Ohlson, 1987; Bandyopadhyay, 1994) are more value-relevant than according to the FC approach, several studies arrive at the opposite conclusion (e.g. Collins et al., 1981; Bryant, 2003). A possible reason for varying value relevance of accruals found in the literature may be related to investor confidence in oil and gas firm accounting information.

The literature suggests that investors, faced with the difficulties of assessing the relevance of accounting numbers for predicting future cash flows due to accounting method heterogeneity may instead turn to cash flows. In fact, a survey reports that earnings are considered unreliable by oil and gas analysts comparing firm performance (Oil and gas investor, 1993)[2] Moreover, DeFond and Hung (2003) find that analysts tend to forecast cash flows for firms with more heterogenous accounting method choices. There are two views on the impact of managements' accounting method discretion on the interpretability of earnings. According to the first view, accounting discretion allows managers to communicate their private information about firm performance (Holthausen and Leftwich, 1983; Watts and Zimmerman, 1986; Healey and Palepu, 1993). Managerial discretion over recognition of accruals can be used to signal private information which is expected to improve the ability to of earnings to

[2] as cited in DeFond and Hung (2003).

measure firm performance and thereby also the firm's cash flow generating ability. In turn this signal can reduce information asymmetry and increase contracting efficiency. On the other hand, DeFond and Hung (2003) argue that accounting heterogeneity can impair comparability of company probability. Moreover, as Dechow (1994) notes, "*to the extent that management use their discretion to opportunistically manipulate accruals, earnings will become a less reliable measure of firm performance and cash flow could be preferable."* Hence, if the choice between full cost and successful efforts methods are governed by financial window dressing motives, rather than signalling private information, then the accruals of oil and gas companies will likely lose their ability to predictive future cash flows. Consequently, investors are expected to turn to alternative measures. In our study, we address this second view. We hypothesis that investors will turn to two relevant measures for oil and gas companies, namely cash flow from operations, which can convey information on current profitability, and oil and gas reserves fair values, which can provide information on future profitability. Our empirical methodology explicitly examines the relative value relevance of accrual measures of probability versus that of cash flow measures.

In order to examine the impact of accounting method heterogeneity on investors' flight to cash flows, we test four hypotheses. The first two compares the significance of the parameters on earnings variables relative to those on cash flow, and the latter two address the relative value relevance of the overall empirical model. First, we test if accounting method choice impacts the value relevance of accruals. This provides

evidence on the relevance of signals information about future profitability. Second, we test if accounting method heterogeneity confuses investors about the usefulness of accruals and will instead turn to cash flow from operations as measures of future profitability. Using the Vuong test (Vuong, 1989), the third test assesses whether a cash flow-based empirical model is better than an accruals-based model for FC firms, while the last hypothesis tests this also applies for SE firms.

The results support the view that accounting method discretion reduces value-relevance of accruals. We find evidence that short-term cash flow from operations) or long-term (change in net present value of reserves), or both, are more value-relevant than accounting earnings for both SE and FC firms. In fact, we fail to find evidence that neither earnings nor the change in earnings are significantly associated with oil company returns. A possible explanation is the adverse effect on investor confidence in earnings figures disclosed by oil and gas producers that multiple accounting methods have. Ironically, it seems that the fears of both the proponents and opponents of the successful efforts method have materialized. In fact, it seems that more objective economic variables such cash flows and net present value of reserves are more important than historical costs, indeed a triumph of economics over politics. The results are line with the concept that accounting method heterogeneity has a detrimental effect on the accrual value relevance.

We contribute to the literature in several ways. First and foremost, our main contribution is to show that in the face of accounting method heterogeneity, investors tend to resort to cash flows as measures of both short and long term performance. This is in line with the accrual relevance destruction view of DeFond and Hung (2003) and Dechow (1994). Second, we provide evidence that the market model is not sufficient for controlling for risk in value-relevance studies. We find that both commodity risk factors as well as conventional equity market risk factors are significant explanatory variables. Third, using a substantially larger dataset than in similar studies, both in terms of number of firms and time, can lead to more robust inference. According to Fields, Lys and Vincent (2001), small sample studies "exacerbate the problem of determining whether the results are due to unusual or pathological cases rather than to the general use of accounting in 'normal' day-to-day circumstances."

The remainder of the paper is organized as follows. The next section describes the background behind the current status quo situation of accounting method heterogeneity and reviews the literature on the relative value relevance of accounting method choice in the oil and gas sector. Section three describes the methodology and develops the hypotheses. Section four describes the data, followed by a presentation and discussion of the results in section five. Finally, section six concludes.

## 2. BACKGROUND

The full cost versus successful efforts debate goes back more than five decades. The processes leading up to, and including, the final decisions by the standard setters are considered to be very controversial, both the U.S. process during the late 1970s and the international process more than 20 years later (Sutton, 1984; Cortese, 2011; Cortese, Irvine and Kaidonis, 2009).

According to Van Riper (1994) the full cost method had been gaining popularity among small and medium sized oil and gas producers since the 1960s due to the method's favourable impact on earnings. As a consequence of the oil embargo of 1973 the U.S. Securities and Exchange Commission was tasked with standardizing accounting practices in the extractive industry, a commission it promptly delegated to the FASB. In 1977, the FASB published an Exposure Draft called *Financial Accounting and Reporting by Oil and Gas Producing Companies*. Under the new rules it was proposed that only the successful efforts method should be allowed, effectively discontinuing the full cost approach. According to (Cortese, 2011), the release of the Exposure Draft prompted an intensive lobby activity by the oil and gas industry, and especially by small and independent oil and gas producers who are the primary users of the full cost method. The subsequent debate involved many stakeholders including accounting standard setters, academics, and regulators such as the U.S. Securities and Exchange Commission (SEC), the U.S. Department of Energy and the U.S. Department of Justice, accounting firms, the oil and gas industry and lobby organisations sponsored

by the oil and gas industry. Van Riper (1994, p. 56) refers to the full cost versus successful efforts controversy in the U.S. of the late 1970s as "*probably the most intensely politicised accounting argument ever*". An important argument used by the full cost proponents was that the full cost method allowed companies to engage in risky exploration activities without having to expense the cost of dry holes. Implementation of the SE method as the single accounting method for oil and gas exploration activities as proposed by the Exposure Draft would therefore be a limiting factor for the U.S. oil and gas industry. It was further argued that this would have adverse effects on returns on full cost firms. Collins and Dent (1979) examining the negative difference in security returns between full cost and successful efforts firms surrounding the date of the announcement of the Exposure Draft attribute the "*difference to the anticipated consequences which this mandated accounting change is likely to have on managerial behaviour and to increased costs that will have to be borne by the affected companies*". Although a switch in method from full cost to successful efforts would not affect the underlying fundamental situation for the companies it was feared that the switch would likely have an adverse effect on capital market behaviour which "*would significantly disadvantage the competitive viability of any segment of the oil and gas producing industry*".[3]

[3] Extracted from Department of Justice response to the SEC dated February 27, 1978. Published in the Federal Register (43 F.R. 878), January 4, 1978 (as cited in Collins et al., 1981).

Consequently, the SEC opposed the proposed new accounting standard, the SFAS No. 19 Financial Accounting and Reporting by Oil and Gas Producing Companies, forcing the FASB to make an amendment to the standard, effectively suspending its implementation for an indefinite period. According to Cortese et al. (2009), three reasons explain the apparent unwillingness of legislators and accounting standard setters to regulate oil and gas accounting disclosure rules. The first two refer to the economic importance and associated political influence that the industry exerts. The last explanation refers to the distinctive nature of oil and gas exploration activities. Wright and Gallun (2005) argue that certain distinguishing features of upstream oil and gas exploration and production activities separates oil companies from other operations involving asset acquisition and use; 1) typically high risks and low probability of discovering commercial reserves, 2) a long time lag between acquiring permits and licenses and the subsequent production of reserves, 3) potentially low correlation between expenditures and results, 4) challenges with reliably valuing the underlying value of the reserves so that they merit capitalization on the balance sheet, 5) the discovery of new reserves cannot be recorded as income immediately but represent a major future income-earning event, and 6) high costs and risks often result in joint operations.

Hence, the lack of confidence in historical costs and accrual accounting for the oil and gas sector could be a result of a 'politicised' process resulting in accounting method

heterogeneity, combined with the distinctive nature of business. As the FASB expressed it:

"An important quality of information that is useful in making rational investment, credit, and similar decisions is its predictive value, specifically its usefulness in assessing the amounts, timing, and uncertainty of prospective net cash inflows to the enterprise. Historical cost based financial statements for oil and gas producing enterprises have limited predictive value. Their usefulness is further reduced because a uniform accounting method is not required to be used for costs incurred in oil and gas producing activities." FASB (1982).

At the same time, both the SEC and FASB were working on alternative measures to historical costs which could alleviate some of the concerns among investors. Recognizing that historical cost measures provided limited information value for decision making, the SEC sought an alternative measure of the value of reserves. They proposed Reserve Recognition Accounting (RRA) (SEC, 1979). This measure was later replaced by the standardized measure of Statement of Financial Accounting Standard no. 69 (SFAS No. 69) proposed by the FASB (FASB, 1982) and which had support from the SEC (SEC, 1982). While the RRA was calculated as the pre-tax net present value of future cash flows from production of oil and gas reserves, the standardized measure was its after-tax equivalent. In addition to the standardized measure (and its change), the SFAS No. 69 required oil and gas companies to disclose

a substantial amount of supplementary information relating to oil and gas activities. Moreover, SFAS no. 69 allowed oil and gas producers to choose between full cost and successful efforts methods. The SFAS No. 69 was updated in 2010 (FASB 2009; 2010), but this update did not address the choice of accounting methods.[4]

In the 2000s, IASB was working on an international standard for the extractive industries. Similar to the U.S. process in the late 1970s, this process also ended up with a standard for the extractive industries that allowed for accounting method heterogeneity, the IFRS 6. This process, like the U.S. process, was also controversial, with substantial pressure from lobbyists representing the oil and gas sector (Cortese et al., 2009; Cortese, Irvine and Kaidonis, 2010; Cortese and Irvine, 2010; Cortese, 2011).

## 3. LITERATURE

A vast body of research has addressed the impact of the Exposure Draft in the period following its release (Collins and Dent, 1978; Deakin, 1979; Dyckman and Smith, 1979; Lev, 1979; Dhaliwal, 1980; Collins et al 1981; Lilien and Pastena, 1982; Larcker and Revsine, 1983; Malmquist, 1990; Spear and Leis, 1997). These studies addressed several aspects surrounding the arguments of the FC proponents, especially under the topic of 'economic consequences'.[5] The overall impression from this body of literature

[4] The SEC also released an update of the reporting rules for oil and gas companies around the same time (SEC, 2008). The FASB changed its 2009 ASC (FASB, 2009) the following year (FASB, 2010) in order to accommodate the updated reporting rules from the SEC.

[5] See e.g. Zeff (1978) for a discussion on 'economic consequences'

is that the results are mixed, some provide evidence for the FC method, while others arrive at the opposite conclusions.

One strand of the literature addresses the ceiling test that FC companies are required to implement. To address the concerns that full cost accounting was too optimistic compared to the more conservative successful efforts approach, a so-called 'ceiling test' was introduced for firms applying the FC method. The ceiling test effectively makes FC accounting more conservative. Under Regulation SX (SEC, 1982), FC firms need to carry out a 'ceiling test' at the end of each quarter, by comparing historical cost of exploration and other expenses against the standardized measure. If periods of falling oil and gas prices result in a decrease in the standardized measure below the historical cost then the FC firms need to take a write-down of the assets. While FC firms have to recognize write-downs, SE firms are only required to disclose as-if-write-downs in footnotes. Although the FC approach is believed to provide opportunities for income smoothing (Bryant, 2003), high commodity price volatility might results in the opposite effect, as commented by Abraxas, an FC company, in their 2013 10-K report:

"At the time it was adopted, management believed that the full cost method would be preferable, as earnings tend to be less volatile than under the successful efforts method. However, the full cost method makes us susceptible to significant non-cash charges during time of volatile commodity prices because the full cost pool may be impaired when price are low. These charges are not recoverable when prices return to higher

levels. We have experienced this situation several times over the years, most recently in the third quarter of 2013, relating to our proved oil and gas properties in Canada. Our oil and gas reserves have a relatively long life. However, temporary drops in commodity prices can have a material impact on our business including impact from impairment testing procedures associated with the full cost method of accounting" (Abraxas 2013 10-K report)

Arguably, the FC approach may not necessarily be less conservative than SE accounting, or result in lower earnings volatility, especially under conditions of high commodity price volatility. Studies on the ceiling test find that investors differentiate between recognition (FC firms) and disclosure (SE firms) (Aboody, 1996). Furthermore, the stock market impact occurs prior to recording of the write-down (Alciatore, Easton and Spear, 2000) either due to announcements of write-downs or perhaps in anticipation of a write-down. These studies suggest that the income smoothing effect of the FC may be offset by the impact of oil and gas price volatility on earnings volatility due to the 'ceiling test'. Moreover, Boone and Raman (2007) find that differential guidance for recognizing impairment losses during a time limited jurisdictional split during 1996 to 2001 when FC and SE firms were subject to different rules, had a detrimental effect on value relevance.

Of relevance to our study, one strand of the literature addresses the relationship between accounting information and valuation. Ramakrishnan and Thomas (1992)

argue that the FC method produces considerable price-irrelevant elements to earnings through the capitalization and subsequent amortization of exploration costs associated with dry holes, i.e. assets which will not be generating future cash flows. A high quality of earnings requires that valuation relevant events, such as the recognition of a dry hole, happens in the same fiscal period in which they are recognized in returns (Bandyopadhyay, 1994 and Lev, 1989). The earliest studies found evidence of an adverse effect in oil company security returns of the propose accounting method change. Collins and Dent (1979) examines the effect of the proposed elimination of full cost accounting (SFAS No. 19) for oil and gas producers. They present evidence that the proposal is associated with a significant negative difference between risk-adjusted rates between full cost companies and successful efforts companies. An earlier study by the same authors (Collins and Dent, 1979) found that there were no differences in the information content of earnings between full cost and successful efforts methods. Moreover, Collins et al. (1981) examining the abnormal returns surrounding the timing of the announcement of SFAS No. 19, find support for an adverse effect of the announcement of the change in accounting method. Duchac and Douthett (1997) find that the strength of the returns-earnings relation is significantly greater for full cost firms than for successful efforts firms in periods of declining oil prices and reduced exploration activity. The authors argue that this is consistent with the hypothesis that accounting methods that smooth income and thus lead to less earnings volatility lead to higher value relevance of earnings. More recently, Bryant (2003) examines the value relevance of FC versus SE firms in a novel way. She creates pro forma accounting

figures for both SE and FC firms, so that the effects of accounting method choice on value relevance can be compared for the same firms irrespective of other firm characteristics. Bryant's (2003) results suggest that FC earnings are more value relevant than earnings calculated under the SE approach. This results is recently also corroborated by Misund, Osmundsen and Sikveland (2015).

Other studies find evidence in favour of the SE method. Dyckman and Smith (1979) repeated the tests of Collins et al. (1978) and found no significant effect. The author disagrees with Collins et al.'s (1978) argument that, in fact there is an adverse effect from the proposal to eliminate full cost accounting, and that the resulting social costs will be severe. Furthermore, King and O'Keefe (1986) and Larcker et al. (1983) find that FC insiders were short FC and SE company insiders were long SE firm stocks. Hence, the stock market reaction can possibly be attributed to the decisions of oil company management. Finally, Bandyopadhyay (1994) find that SE earnings have a higher earnings response coefficient (ERC) than FC earnings. Harris and Ohlson (1987) find that book values for SE firms have greater explanatory power than for FC firms. They also find that SE firms have higher market-to-book coefficients than FC firms, which is due to the SE method producing more conservative net assets (see also Sunder, 1976). Ayres and Rayburn (1991) regress abnormal returns on accounting information and supplementary reserves disclosures and find higher regression coefficients SE firms are higher than for FC firms. Hence, the literature on the relative value relevance of FC versus SE is mixed.

Several studies address the impact of the non-accounting supplementary information that oil and gas companies are required to disclose under SFAS No.69 (Clinch and Magliolo, 1992; Spear, 1994, 1996; Berry, Hasan and O'Bryan, 1998; Quirin et al., 2000; Berry and Wright, 2001; Boone, 2002). The general impression is that this body of literature find support for significant relationships between the supplementary information such as reserves and net present value of reserve and market valuation.

The literature suggests that investors, faced with the difficulties of assessing the relevance of accounting numbers for predicting future cash flows due to accounting method heterogeneity may instead turn to cash flows. In fact, a survey reports that earnings are considered unreliable by oil and gas analysts comparing firm performance (Oil and gas investor, 1993, as quoted in Defond and Hung, 2003). Moreover, DeFond and Hung (2003) find that analysts tend to forecast cash flows for firms with more heterogenous accounting method choices. There are two views on the impact of managements' accounting method discretion on the interpretability of earnings. According to the first view, accounting discretion allows managers to communicate their private information about firm performance (Holthausen and Leftwich, 1983; Watts and Zimmerman, 1986; Healey and Palepu, 1993). Managerial discretion over recognition of accruals can be used to signal private information which is expected to improve the ability to of earnings to measure firm performance and thereby also the firm's cash flow generating ability. In turn this signal can reduce information

asymmetry and increase contracting efficiency. On the other hand, DeFond and Hung (2003) argue that accounting heterogeneity can impair comparability of company probability. Moreover, as Dechow (1994) notes, "*to the extent that management use their discretion to opportunistically manipulate accruals, earnings will become a less reliable measure of firm performance and cash flow could be preferable."* Hence, if the choice between full cost and successful efforts methods are governed by financial window dressing motives, rather than signalling private information, then the accruals of oil and gas companies will likely lose their ability to predictive future cash flows. Consequently, investors are expected to turn to alternative measures.[6]

Very few studies address the relative value relevance of accrual-based earnings measures and cash flow measure. Cormier and Magnan (2002) and Misund, Asche and Osmundsen (2008) finds that cash flows are value relevant, but both studies exclude the standardized measure. Other studies include the discounted measure, but exclude cash flow from operations (e.g. Bryant, 2003). The aim of our paper is to provide insight into the relative value relevance of earnings versus cash flows.

[6] Studies examining the impact of the association between financial ratios and valuation multiples did not find a significant relation (Osmundsen, Asche, Misund and Mohn, 2006)

## 3. METHODOLOGY

Using the Ohlson (1995) as our starting point, we develop an empirical model that includes risk adjustment in the form of Fama-French-Carhart risk factors from (Fama and French, 1993; 1996; Carhart, 1997). In line with Sadorsky (2001) and Boyer and Filion (2007) we also include changes in oil and gas prices.

The crux of the empirical analysis is the relationship between earnings and total shareholder returns.[7] As the point of departure we apply the following empirical specification of the theoretical model of Ohlson (Ohlson, 1995):

$$ret_t = E_t + \Delta E_t + v + k + \epsilon, \quad (1)$$

where $ret_t$ is the total shareholder returns in excess of the risk free rate, $E_t$ is current earnings, and $\Delta E_t$ is the change in earnings. $v$ is 'other information', $k$ is the cost of capital, and $\epsilon$ is the error term. We follow Misund (2015) and apply the Fama-French-Carhart asset pricing model (Fama and French, 1993; Carhart, 1997) as a proxy for cost of capital, and use a fixed effects model to model 'other information'. The Fama-French-Carhart model is:

$$ret_t = RF + \beta_1 MRP + \beta_2 SMB + \beta_1 HML + \beta_1 MOM \quad (2)$$

[7] Total shareholder returns include both capital gains and dividend yields.

where $MRP$ is the market risk premium, $SMB$ is the small-minus-big factor, $HML$ is the high-minus-low factor and $MOM$ is the momentum factor.

By combining the asset pricing models in Eqs. (1) and (2), the resulting model captures both the impact of earnings and risk. Furthermore, variables such as SMB also control for size premiums (smaller companies tend to provide larger returns than smaller, and FC companies tend to be smaller). In addition, we also include two additional elements. The first is 'other information'. A relevant variable is the change in net present value of future oil and gas production, *SM*.[8] Moreover, we scale all accounting variables with the previous year's market value of equity to make them on the same form as returns. Moreover, this approach is also consistent with the approach of Sadorsky (2001), Boyer and Filion (2007), and Misund (2015). The resulting empirical model is

$$R_{it} = \beta_0 + \beta_1 \frac{E_{it}}{MVE_{it-1}} + \beta_2 \frac{\Delta E_{it}}{MVE_{it-1}} + \beta_3 \frac{\Delta SM_{it}}{MVE_{it-1}} + \beta_4 MRP_t + \beta_5 SMB_t + \beta_6 HML_t + \beta_7 MOM_t + \beta_8 \Delta OP_t + \beta_9 \Delta GP_t + \boldsymbol{\theta FE_i} + \boldsymbol{\pi FE_t} + \varepsilon_{it}^3, \quad (3)$$

where *i* denotes company *i* and $MVE_{it-1}$ is the previous year's market value of equity. We also include oil and gas prices changes where $\Delta OP_t$ and $\Delta GP_t$ denote the changes

[8] Ideally we would have liked to include both the standardized measure and change in standardized measure (scaled by beginning of year market value of equity) but due to very high correlations between these two variables we only included one of them in the empirical models.

(returns) in oil and gas prices from time *t-1* to *t*, respectively. Fixed effects are denoted by the vectors $\boldsymbol{FE_i}$ and $\boldsymbol{FE_t}$, for company and firm fixed effects, respectively.

In addition to the earnings model in Eq. (3) we estimate a cash flow version (Eq. (4)), where the earnings variables are replaced with cash flow variables

$$R_{it} = \beta_0 + \beta_1 \frac{CF_{it}}{MVE_{it-1}} + \beta_2 \frac{\Delta CF_{it}}{MVE_{it-1}} + \beta_3 \frac{\Delta SM_{it}}{MVE_{it-1}} + \beta_4 MRP_t + \beta_5 SMB_t + \beta_6 HML_t + \beta_7 MOM_t + \beta_8 \Delta OP_t + \beta_9 \Delta GP_t + \boldsymbol{\theta FE_i} + \boldsymbol{\pi FE_t} + \varepsilon_{it}^4, \quad (4)$$

where $CF_t$ and $\Delta CF_t$ denoted and changes in cash flow from operations, respectively.

We estimate the relationship in Eq.'s (3) and (4) for both FC and SE firms separately, resulting in four empirical models. The reason for estimating separate model for FC and SE firms is that several studies have indicated the characteristics of the two types of firms are different (Malmquist, 1990; Spear and Leis, 1997). FC firms are typically smaller, more aggressive in their exploration activities, more leveraged, and less diversified making them more exposed to volatile commodity prices. If these characteristics manifest themselves as systematic risk factors associated with the small and independent FC companies, they might be picked up by the risk factors in the four factor model. The magnitude and significance on the parameters on the risk factors will

therefore provide useful insights into the differing characteristics of the two types of companies.[9]

We include the Fama-French-Carhart risk factors and changes in oil and gas prices as fixed effects which are treated as fixed across firms. The downside of this approach is that we are not able to include firm specific exposures to the risk factors. By grouping the sample into two subsamples the characteristics of the two samples should be more homogenous. The benefit is that we are able to provide insights into the relative exposure to the risk factors and oil and gas price changes, which in itself will provide useful insights.

In addition to the year fixed effects, we assess whether to also include fixed firm effects. The benefit of a fixed effects model is that it captures the impact of unobserved variables on the returns, mitigating the negative effects of unobserved variables – the omitted variables bias. We carry out a sequence of panel data tests to determine whether to choose a pooled OLS, fixed-firm effects model or a random effects model. Moreover, we test for the presence of heteroskedasticity and serial correlation in the error terms. While heteroskedasticity is usually corrected with White's (1980) heteroskodasticity-consistent covariance matrix, this becomes a bit complicated in a fixed effects model. Using fixed effects with white correction can introduce serial

[9] An alternative approach is to use dummy variable and interact these with the explanatory variables and test the significance of coefficients on the interaction variables.

correlation in the errors can give inconsistent estimators (Stock and Watson, 2006). It is therefore preferable to use the method proposed by Arellano for fixed effects models (Arellano, 1987). If we find evidence of heroskedasticity and or serial correlation in our models, we apply the Arellano method to produce both heteroskedasticity and serial correlation consistent standard errors (HACSE).

The analysis is carried out in two steps. First, we estimate the earnings model and the cash flow model. Statistical significance of the coefficients on E and CF (likewise ΔE and ΔCF) will indicate their value relevance. A positive and significant loading on the parameter on E (CF) will provide evidence that earnings (cash flow from operations) are positively associated with total shareholder returns. We can further establish the following alternative hypotheses

$H_1^1$: Significant coefficients on E and/or ΔE in combination with non-significant coefficients on CF and ΔCF. This is a test of the hypothesis that the accounting method choice and hence accruals signals information about future profitability.

$H_1^2$: Significant coefficients on CF and/or ΔCF in combination with non-significant coefficients on E and ΔE. This is a test of the hypothesis that the accounting method heterogeneity confuses investors about the usefulness of accruals and will instead turn to cash flow from operations as measures of future profitability.

In addition we carry out Vuong tests to compare the cash flow models with the earnings models. This will help us in the case that the hypotheses above ($H_1^1$, $H_1^2$) do not provide conclusive evidence. The following null hypotheses are used

$H_0^3$: An earnings model is better than a cash flow model for FC firms. A significant Vuong z-statistic will reject the null hypothesis and we can accept the alternative hypothesis that a cash flow model is better than an earnings model for FC firms.

$H_0^4$: An earnings model is better than a cash flow model for SE firms. A significant Vuong z-statistic will reject the null hypothesis and we can accept the alternative hypothesis that a cash flow model is better than an earnings model for SE firms.

## 4. DATA

The data is collected from the John S. Herold database (www.ihs.com/herold). The Herold database contains a substantial amount of information drawn from oil and gas companies' financial reports (e.g. 10-K SEC filings) including the supplementary information from oil and gas activities. In order to improve the econometric modelling we clean the data by removing observation with missing data for some of the variables and remove outliers. Sometimes an outlier is created when dividing by a low number in the denominator. Visually inspecting the data corroborates this. We take out the

outliers by removing the observations above the 99.9 percentile and lower than the 0.1 percentile. This process results in a total of 3517 firm-years, of which 1627 are FC firm-years and the remainder of 1890 are SE firm-years. The two samples are therefore quite balanced in terms of number of observations. Table 1 provides the descriptive statistics for the resulting sample for both FC and SE firms. Table 2 provides the correlations between the variables. As Table 1 shows the average excess return and standard deviation are higher for FC firms than SE firms. On average the FC firms in the sample have appreciated by 42.4% annually compared to 28.3% for SE firms. Interestingly, the average net income (scaled by beginning of year market value of equity) for FC firms has been negative over the period, while that of SE firms has been positive. This is not the case for cash flow from operations which has been much more similar, with an average of 0.261 for FC firms versus 0.223 for SE firms. Similarly, the mean changes in cash flow for operations are also very close for both types of firms. Another interesting finding is that the standard deviations in all earnings variables are much higher for FC firms than for SE firms. Moreover, the standard deviations in all earnings variables for are higher than that of the cash flow variables for FC firms. This is not consistent with expectations since the FC approach is thought to result in an income smoothing effect. A possible explanation is that the time period over which we have collected the sample has been characterised by high commodity price volatility, and this might have resulted in numerous write-downs for FC firms.

Table 1. Descriptive statistics for Full cost firms and Successful efforts firms

| | Full Cost (N=1627) | | Successful efforts (N=1890) | |
|---|---|---|---|---|
| | mean | St.dev | mean | St.dev |
| R | 0.424 | 1.291 | 0.283 | 0.903 |
| E | -0.066 | 1.135 | 0.012 | 0.452 |
| ΔE | 0.137 | 3.348 | 0.026 | 0.527 |
| CF | 0.261 | 0.746 | 0.223 | 0.302 |
| ΔCF | 0.030 | 0.811 | 0.031 | 0.259 |
| ΔSM | 0.851 | 14.173 | 0.185 | 5.103 |
| MRP | 0.081 | 0.193 | 0.088 | 0.193 |
| SMB | 0.024 | 0.157 | 0.024 | 0.158 |
| HML | 0.030 | 0.114 | 0.031 | 0.120 |
| MOM | 0.048 | 0.248 | 0.059 | 0.238 |
| ΔOP | 0.156 | 0.397 | 0.150 | 0.401 |
| ΔGP | 0.189 | 0.764 | 0.196 | 0.764 |

The average change in the standardized measure is much higher for FC firms than SE firms. This is probably due to SE firms being more diversified. With the result that the denominator is also affected by the market values of assets other than reserves. The low difference in the averages of the remaining variables (the common factors) in Table 1 indicates that the two samples are quite balanced in terms of the years in which they have been collected. If the two samples were perfectly balanced then the means would be identical.

The correlations in Table 2 are low for most variables except the earnings and cash flow variables.[10]

Table 2. Correlation (full sample)

| | E | CF | ΔE | ΔCF | ΔDCF | MRP | HML | SMB | MOM | ΔOP | ΔGP |
|---|---|---|---|---|---|---|---|---|---|---|---|
| E | | | | | | | | | | | |
| CF | -0.359 | | | | | | | | | | |
| ΔE | -0.476 | 0.312 | | | | | | | | | |
| ΔCF | 0.702 | -0.149 | -0.686 | | | | | | | | |
| ΔDCF | -0.102 | 0.271 | 0.078 | -0.021 | | | | | | | |
| MRP | 0.007 | -0.071 | 0.003 | -0.028 | -0.028 | | | | | | |
| HML | -0.007 | 0.065 | 0.027 | -0.011 | -0.037 | 0.094 | | | | | |
| SMB | 0.007 | 0.092 | -0.037 | 0.005 | -0.012 | -0.015 | 0.420 | | | | |
| MOM | 0.025 | -0.012 | 0.026 | 0.069 | 0.030 | -0.315 | -0.468 | -0.560 | | | |
| ΔOP | -0.018 | 0.011 | 0.058 | -0.062 | 0.045 | 0.239 | 0.211 | -0.317 | -0.166 | | |
| ΔGP | 0.026 | 0.166 | 0.019 | 0.070 | 0.118 | -0.188 | -0.208 | 0.142 | 0.168 | 0.170 | |

[10] We also test some alternative variables that Bryant (2003) used in her study, e.g. the asymmetric net income variables. However, in our dataset we found very high correlations (>0.700) and chose not to include these variables in order to avoid multicollineratity issues.

Since our sample covers over 20 years we also test if the variables in the time series dimension are stationary using the augmented Dickey-Fuller test (Said and Dickey, 1984). As Table 3 shows, all variables are stationary and first differencing is not necessary.

Table 3. Stationarity tests using the augmented Dickey-Fuller test (ADF)

| | ADF |
|---|---|
| R | -36.370 *** |
| E | -33.428 *** |
| ΔE | -41.036 *** |
| CF | -29.440 *** |
| ΔCF | -37.595 *** |
| ΔDCF | -43.938 *** |
| MRP | -36.712 *** |
| SMB | -37.768 *** |
| HML | -36.424 *** |
| MOM | -31.325 *** |
| ΔOP | -49.590 *** |
| ΔGP | -34.965 *** |

Note: The table shows the test statistics for the ADF test. The null hypothesis is that the time series has a unit root (i.e. non-stationary). Significant test statistics result in rejection of the null hypothesis meaning that the time series' are stationary. Significance levels are denoted by asterisks: * $p<0.10$, **$p<0.05$ and ***$p<0.01$.

## 5. RESULTS AND DISCUSSION

In the following section we present the results of the estimation of the four empirical models after carrying out some diagnostics procedures. First, we check if a fixed effects model is better than either random effects or pooled OLS models. Then, after the final model is selected, the residuals are tested for presence of both heteroskedasticity and serial correlation in order to determine if the robust covariance matrix estimators are necessary.

We find that a fixed firm effects model is preferable to both pooled OLS (Table 4, column 4) and a random effects model (Table 4, Column 5), and will be the model of choice in the remainder of the study. We also find presence of both heteroskedasticity (Table 4, Column 2) and serial correlation (Table 4, Column 3) in the error terms of the fixed effects model and consequently apply the Arellano method for HACSE correction for fixed effects models.

Table 4. Diagnostics tests

| | Heteroskedasticity | Serial correlation | Poolability | Hausman |
|---|---|---|---|---|
| FC x E | 1870.306 *** | 21.020 *** | 1.351 *** | 59.473 *** |
| FC x CF | 626.157 *** | 11.035 *** | 1.412 *** | 107.214 *** |
| SE x E | 592.004 *** | 47.381 *** | 1.746 *** | 56.022 *** |
| SE x CF | 1061.018 *** | 24.992 *** | 2.315 *** | 165.309 *** |

Note: Heteroskedasticity tested using the Breusch-Pagan test ($H_0$: homoskedasticity), Serial correlation tested using Breusch-Godfrey/Wooldridge ($H_0$: no serial correlation), poolability using F-test ($H_0$: pooled OLS better than fixed effects model), Hausman test ($H_0$: random effects model better than fixed effects model, Hausman (1978), Durbin (1954), Wu (1973)). Values are BP-statistic (Breusch-Pagan), $\chi^2$-statistic (Breusch-Godfrey / Wooldridge and Hausman tests), and F-statistics (Poolability test). P-values denoted using asterix, * p<0.10, ** p<0.05 and *** p <0.01.

The results from the final models are shown in Table 5. The coefficients on earnings and changes in earnings are not significant for neither FC nor SE firms. Secondly, the coefficients on cash flows for both firms and changes in cash flows for SE firms are significant. In fact, the parameters on cash flow from operations are significant at the 99% confidence level. Taken together these results allow us to reject hypothesis $H_1^1$ and accept hypothesis $H_1^2$, implying that accounting method heterogeneity and management discretion does not provide a valuable signal for investors. Investors instead prefer cash flows to earnings. The Vuong tests also confirm this finding.

Table 5. Regression results

| | FC x E | SE x E | FC x CFO | SE x CFO |
|---|---|---|---|---|
| E | -0.060 (0.418) | 0.184 (0.190) | | |
| ΔE | 0.013 (0.519) | 0.124 (0.293) | | |
| CF | | | 0.638 (<0.001) | 1.218 (<0.001) |
| ΔCF | | | 0.084 (0.154) | -0.572 (0.034) |
| ΔDCF | 0.020 (0.188) | 0.057 (0.030) | 0.011 (0.193) | 0.060 (0.008) |
| MRP | 0.687 (<0.001) | 0.680 (<0.001) | 0.775 (<0.001) | 0.773 (<0.001) |
| SMB | 1.475 (<0.001) | 1.011 (<0.001) | 1.545 (<0.001) | 1.002 (<0.001) |
| HML | 0.803 (0.022) | 0.266 (0.306) | 0.298 (0.358) | 0.059 (0.802) |
| MOM | -0.110 (0.609) | 0.029 (0.857) | -0.044 (0.840) | 0.224 (0.078) |
| ΔOP | 0.449 (<0.001) | 0.398 (<0.001) | 0.527 (<0.001) | 0.380 (<0.001) |
| ΔGP | 0.393 (<0.001) | 0.124 (<0.001) | 0.287 (<0.001) | 0.095 (0.011) |
| $R^2$-adj (within) | 0.190 | 0.148 | 0.245 | 0.226 |
| F-statistic | 44.192 (<0.001) | 37.264 (<0.001) | 61.868 (<0.001) | 63.852 (<0.001) |
| Vuong test (z-statistic) | | | -2.425 (<0.001) | -1.629 (0.052) |

Note: *p*-values in parantheses.

The results are in line studies such as Cormier and Magnan (2002) and Misund et al. (2008) who find significant cash flow coefficients, but contradict other studies such as Duchac and Douthett (1997) who find a significant earnings-returns relationship.

The results also show that changes in the net present value of reserves are value relevant for SE firms, but not for FC firms. This is surprising since this measure is independent of accounting method choice. Boone (2002) attributes this to a higher measurement error for FC firms. Even though it has been criticized, some studies have previously found it to be relevant, notably Boone (2002) and Bryant (2003).

Interestingly, we find that the FC models give a higher adjusted $R^2$, but by careful inspection of the coefficients we see that this clearly not related to earnings and earnings changes, but rather the effect of other variables. This illustrates comparisons based on adjusted $R^2$ values must be interpreted with care. A higher R2 for the FC models does not imply a higher value relevance of earnings, but it could be the combinations of all the other variables.

The loadings on the risk factors provide insight into the impact of different types of systematic risk on the returns on oil companies. Prior studies vary substantially with respect to treatment of risk in returns. Some disregard risk (e.g. Bryant, 2003), while others only include the market risk premium explicitly (e.g. Sadorsky, 2001; Boyer and Filion, 2007) or indirectly through risk adjustment of the returns before regressing on the explanatory variables (e.g. Boone and Raman, 2007). Value-relevance studies typically do not included the other risk factors identified by Fama and French (1993; 1996), Jegadeesh and Titman (1993) and Carhart (1997). We find that several of the risk factors are in fact important. While the loading on the market risk premium is quite similar for FC and SE firms, the loadings on the other risk factors are more different. For instance, the loading on the SMB risk factor (small-minus-big) is higher for FC firms than SE firms and is in line with the finding that FC firms tend to be smaller. Hence the higher average return for FC firms can in part be attributed to the SMB risk factor. The significance of the loadings on the HML and MOM factors are less

consistent and vary across the earnings and cash flow models making their interpretation challenging.

Also the loadings on changes in oil and gas prices provide insight into the differences between FC and SE firms. Few value relevance studies explicitly model the change in oil and especially the gas price. Some studies, however, include fixed year effects captures some of the same effects as using fixed oil price changes, as we have done in our study. The benefit of using changes in oil and gas process separately instead of year-dummies is that we are able to assess the differential impact of oil price and gas price changes on the returns. The results show that FC firms, compared to SE firms, are slightly more exposed to the oil price (i.e. coefficients of 0.45 (FC) and 0.40 (SE)) in the earnings model, but much more exposed to the gas price i.e. coefficients of 0.39 (FC) and 0.12 (SE). This is consistent with the claims made that FC are more exposed to the commodity price.

The results show that FC and SE firm characteristics are different and that the investors place different loadings on the variables and thus able to distinguish between the two types of firms. The overall impression from the results is that the returns on both FC and SE firms are determined by fundamental factors consistent with financial economic theory, rather than accounting based profitability measures. This is consistent with the theory that when faced with accruals that do not provide valuable signals investors will turn to cash flows measures. In addition, some of the differing characteristics of FC

versus SE firms are prices by the markets. For instance, the smaller size of FC firms result in a higher loading on the SMB factor. Given the controversy surrounding the accounting method heterogeneity for oil and gas exploration activities (including longstanding debate, lobbying activities, interference by regulators, etc..) combined with specific characteristics in the oil and gas industry, it should therefore not be surprising that the financial markets turn to fundamental information contained in cash flows, financial asset pricing models and net present values of expected future cash flows. It is indeed a triumph of economics over politics.

## 6. CONCLUSION

In this paper, we have examined the relative value-relevance of cash flow versus earnings for oil and gas firms as a function of accounting method heterogeneity. We use an empirical model based on Ohlson (1995) that provides insight into the impact on oil and gas firm total shareholder returns of short term profitability (earnings or cash flow from operations), long term profitability (net present value of reserves) and Fama-French-Carhart and commodity price risk factors. We find that the accounting method heterogeneity combined with management discretion does not provide a valuable signal to investors. Instead it seems that the returns on both FC and SE firms are determined by fundamental factors consistent with financial economic theory, rather than accounting based profitability measures. This is in line with theory suggesting that when an investor is faced with accruals that do not provide valuable signals, she will turn to cash flows measures. In fact, we find a positive association of both short-term

and long term cash flow measures with returns for oil and gas firms that use the SE approach. The results also suggest that although FC and SE firm characteristics are different, this seems to be recognised and priced by investors.

Given the controversy surrounding the accounting method heterogeneity for oil and gas exploration activities (including longstanding debate, lobbying activities, interference by regulators, etc..) combined with specific characteristics in the oil and gas industry, it should therefore not be surprising that the financial markets turn to fundamental information contained in cash flows, financial asset pricing models and net present values of expected future cash flows. It is indeed a triumph of economics over politics. Moreover, the results provide support for the SEC's and FASB's efforts in developing a fair value measure of oil and gas reserves as an alternative to historical cost in light of the SE and FC debacle in the late 1970s. This result should be of interest to standard setters if they in the future again would like to promote a unified accounting method for exploration activities.

The results from our study also highlight the importance of requiring the disclosure of alternative measures or supplementary disclosures in the instances where accounting method heterogeneity leads to reduced importance of accruals for forecasting future cash flows. Given the apparent importance to investors of the supplementary oil and gas disclosures, regulators and standard setters should consider recommending that this

type of information is disclosed on a more frequent basis, e.g. quarterly disclosures, for oil and gas producers.

## REFERENCES


Aboody, D. (1996). Recognition versus disclosure in the oil and gas industry. Journal of Accounting Research 34, 21-32.

Alciatore, M, Easton P. and N. Spear (2000). Accounting for the impairment of long-lived assets: Evidence from the petroleum industry. Journal of Accounting and Finance 29, 151-172.

Arellano, M. (1987). Computing robust standard errors for within-groups estimators. Oxford Bulletin of Economics and Statistics, 49 (4), 431-434.

Ayres, F.L. and J.D. Rayburn (1991). Selectivity bias and the association between unexpected returns, earnings and supplementary reserve disclosures in the petroleum industry. *Working paper, University of Oklahoma, Norman, OK and University of Minneapolis, MN*.

Bandyopadhyay, S.P. (1994). Market reaction to earnings announcements of SE and FC firms in the oil and gas industry. The Accounting Review 69 (October), 657-674.

Berry, K.T. and C.J. Wright (2001). The value relevance of oil and gas disclosures: An assessment of the market's perception of firm's effort and ability to discover reserves. Journal of Business Finance and Accounting, 28(5/6), 741-769.

Berry, K.T., Hasan, T. and D. O'Bryan (1998). Relative information content of proved reserves: The BOEs-Revenue vs BOEs-Energy. Journal of Energy Finance and Development 3 (1), 1-11.

Boone, J. (2002). Revisiting the reportedly weak value relevance of oil and gas asset present values: The roles of measurement error, model misspecification, and time-period idiosyncrasy. The Accounting Review 77 (1), 73-106.

Boone, J. and K.K. Raman (2007). Does implementation guidance affect opportunistic reporting and value relevance of earnings? Journal of Accounting and Public Policy 26, 160-192.

Boyer, M.M. and D. Filion (2007). Common and fundamental factors in stock returns of Canadian oil and gas companies. Energy Economics 29, 428-453.

Breusch, T.S. (1978). Testing for autocorrelation in dynamic linear models. Australian Economic Papers 17, 334-355.

Breusch, T.S. and A.R. Pagan (1979). A simple test for heteroskedasticity and random coefficient variation. Econometrica 47 (5), 1287-1294.

Bryant, L. (2003). Relative value relevance of the successful efforts and full cost accounting methods in the oil and gas industry. Review of Accounting Studies 8 (1), 5-28.

Carhart, M.M. (1997). On persistence in mutual fund performance. The Journal of Finance 52 (1), 57-82.

Clinch, G. and J. Magliolo (1992). Market perceptions of reserve disclosures under SFAS No. 69. The Accounting Review 67(4), 843-861.

Collins, D. and W. Dent (1979). The proposed elimination of full cost accounting in the extractive petroleum industry: An empirical assessment of the market consequences. Journal of Accounting and Economics 1, 3-44.

Collins, D.W., Dent, W.T. and M.C. O'Connor (1978). Market effects of the elimination of full cost accounting in the oil and gas industry. Financial Analyst Journal, 34(6), 48-.

Collins, D.W., Rozeff, M.S. and D.S. Dhaliwal (1981). The economic determinants of the market reaction to proposed mandatory accounting changes in the oil and gas industry: A cross-sectional analysis. Journal of Accounting and Economics 3(1), 37-71.

Cormier, D. and M. Magnan (2002). Performance reporting by oil and gas firms: Contractual and value implications. Journal of International Accounting, Auditing and Taxation 11 (2), 131-153.

Cortese, C.L. (2011). Standardizing oil and gas accounting in the U.S. in the 1970s: Insights from the perspective of regulatory capture. Accounting History 16 (4), 403-421.

Cortese, C.L. and Irvine, H.J. (2010). Investigating international accounting standard setting: the black box of IFRS 6. Research in Accounting Regulation 22, 87-95.

Cortese, C.L., Irvine, H.J. and M.A. Kaidonis (2009). Extractive industries accounting and economic consequences: Past, present and future. Accounting Forum 33, 27-37.

Cortese, C.L., Irvine, H.J. and M.A. Kaidonis (2010). Powerful players: How constituents captured the setting of IFRS 6, an accounting standard for the extractive industries. Accounting Forum 34, 76-88.

Deakin, B.E. (1979). An analysis of differences between non-major oil firms using successful efforts and full cost methods. The Accounting Review 54 (4), 722-734.

Dechow, P.M. (1994). Accounting earnings and cash flows as measures of firm performance: The role of accounting accruals. Journal of Accounting and Economics 18, 3-42.

DeFond, M.L. and M. Hung (2003). An empirical analysis of analysts' cash flow forecasts. Journal of Accounting and Economics 35, 73-100.

Dhaliwal, D.S. (1980). The effect of the firm's capital structure on the choice of accounting methods. The Accounting Review 55 (1), 78-84.

Duchac, J. and Douthett, E. (1997). The effect of accounting for oil and gas reserves on the relation between returns and earnings. Journal of Accounting and Finance Research 4 (2), 20-32.

Dyckman, T.R. and A.J. Smith (1979). Financial accounting and reporting by oil and gas producing companies: A study of information effects. Journal of Accounting and Economics 1, 45-75.

Fama, E.F. and K.R. French (1993). Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33 (1), 3-56.

Fama, E.F. and K.R. French (1996). Multifactor explanations of asset anomalies. The Journal of Finance 51 (1), 55-84.

Fields, T.D., T.Z. Lys and L. Vincent (2001). Empirical research on accounting choice. Journal of Accounting and Economics 31, 255-307.

Financial Accounting Standards Board (1982). *Statement of Financial Accounting Standards No. 69: Disclosures about Oil and Gas Producing Activities*. FASB: Stamford, CT.

Financial Accounting Standards Board (2009). *Financial Accounting Codification Topic 932: Extractive Activities – Oil and Gas.* FASB: Stamford, CT.

Financial Accounting Standards Board (2010). *Financial Accounting Series. Accounting Standards Update. Extractive Activities – Oil and Gas (Topic 932): Oil and Gas Reserves Estimation and Disclosures. An Amendment of the FAB Accounting Standards Codification.* FASB: Stamford, CT.

Harris, T.S. and J.A. Ohlson (1987). Accounting disclosures and the market's valuation of oil and gas oroperties. The Accounting Review 62 (4), 651-670.

Hausman, J.A. (1978). Specification tests in econometrics. Econometrica 46 (6), 1251-1271.

Healey, P. and K. Palepu (1993). The effects of firms' financial disclosure strategies on stock prices. Accounting Horizons 7, 1-11.

Holthausen, R. and R. Leftwich (1983). The economic consequences of accounting choice: Implications of costly contracting and monitoring. Journal of Accounting and Economics 5, 77-117.

Jegadeesh, N. and S. Titman (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. The Journal of Finance 48 (1), 65-91.

King, R.D. and T.B. O'Keefe (1986). Lobbying activities and insider trading. The Accounting Review (1), 76-90.

Larcker, D.F., Reder, R.E. and D.T. Simon (1983). Trades by insiders and mandated accounting standards. The Accounting Review, 606-620.

Lev, B. (1989). On the usefulness of earnings and earnings research: Lessons and directions from two decades of Empirical Research. Journal of Accounting Research 27 (Supplement), 153-201.

Lilien, S. and V. Pastena (1981). Intramethod comparability: The case of the oil and gas industry. The Accounting Review 56 (3), 690-703.

Malmquist, D.H. (1990). Efficient contracting and the choice of accounting method in the oil and gas industry. Journal of Accounting and Economics 12, 173-205.

Misund, B. (2015). Reserves replacement and oil and gas company shareholder returns. University of Stavanger Working Paper.

Misund, B., F.Asche and P. Osmundsen (2008). Industry upheaval and valuation: empirical evidence from the international oil and gas industry. The International Journal of Accounting 43 (4), 398-424.

Misund, B., P. Osmundsen and M. Sikveland (2015). International oil company valuation: The effect of accounting method and vertical integration. Petroleum Accounting and Financial Management Journal, 1-19.

Ohlson, J.A. (1995). Earnings, book values, and dividends in equity valuation. Contemporary Accounting Research 11 (2), 661-687.

Osmundsen, P, Asche, F., Misund, B. and K. Mohn (2006). Valuation of international oil companies. The Energy Journal 27 (3), 49-64.

Quirin, J.J., Berry, K.T. and D. O'Brien (2000). A fundamental analysis approach to oil and gas firm valuation. Journal of Business Finance and Accounting, 27(7/8), 785-820.

Ramakrishnan, R.T.S. and J.K. Thomas (1992). Valuation of permanent, transitory and price-irrelevant components of reported earnings. *Working paper, Columbia University*. New York, NY.

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

Said, S.E. and D.A.Dickey (1984). Testing for unit roots in autoregressive-moving average models of unknown order. Biometrika, 71(3), 599-607.

Securities and Exchange Commission (1979). *Accounting Series Release No. 269: Oil and Gas Producers – Supplemental Disclosures on the Basis of Resereve Recognition Accounting.* Washington, D.C.: Securities and Exchange Commission.

Securities and Exchange Commission (1982). *Financial Reporting Release No. 9: Supplemental Disclosures of Oil and Gas Producing Activities.* Washington, D.C.: Securities and Exchange Commission.

Securities and Exchange Commission (2008). *Modernization of oil and gas reporting*. Washington, D.C.: Securities and Exchange Commission.

Spear, A. and M. Leis (1997). Artificial neural networks and the accounting method choice in the oil and gas industry. *Accounting, Management and Information Technologies* 7 (3), 169-181.

Spear, N. (1994). The stock market reaction to the reserve quantity disclosures of U.S. oil and gas producers. Contemporary Accounting Research 11(1), 381-404.

Spear, N. (1996). The market reaction to the reserve-based value replacement measures of oil and gas producers. Journal of Business Finance and Accounting, 23(7), 953-974.

Stock, J.H. and M.W. Watson (2010). *Introduction to Econometrics 3rd Edition*. Pearson Eduction.

Sunder, S. (1976). Properties of accounting numbers under full costing and successful efforts costing in the petroleum industry. *The Accounting Review* 51 (), 1-18.

Sutton, T.G. (1984). Lobbying of accounting standard-setting bodies in the U.K. and the U.S.A.: A downsian analysis. *Accounting, Organizations and Society* 9 (1), 81-95.

Van Riper, R. (1994). *Setting standards for financial reporting: FASB and the struggle for control of a critical process*. Connecticut, USA: Quorom Books.

Vuong, Q.H. (1989). Likelihood ratio test for model selection and non-nested hypotheses. *Econometrica* 57, 307-333.

Watts, R.L. and J.L. Zimmerman (1986). *Positive accounting theory*. Englewood Cliffs, NJ: Prentice-Hall.

White, H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test from heteroskedastcity. *Econometrica*, 40(4), 817-838.

Wright, C.J. and R.A. Gallun (2005). *International Petroleum Accounting*. Tulsa, Oklahoma: PennWell.

Wu, D.-M. (1973). Alternative Tests of Independence Between Stochastic Regressors and Disturbances. *Econometrica* 41 (4), 733-750.

Zeff, S.A. (1978). The risk of 'economic' consequences. *Journal of Accountancy* 146 (6), 56-63.