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# High Oil Prices: A Non-OPEC Capacity Game

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**Abstract**

*The current high oil price is partly due to low investments in the oil industry the last decade. According to economic theory, exploration and development of new oil and gas fields should respond positively to increasing petroleum prices. But since the late 1990s, financial analysts have focused strongly on short-term accounting return measures, like RoACE, for benchmarking and valuation of international oil and gas companies. Consequently, the demand for strict capital discipline among oil and gas companies may have reduced their willingness to invest for future reserves and production growth. Thus, we have experienced an unusual combination of high oil prices and low investment levels in exploration and development.*

*In many ways, the oil companies' focus on RoACE, at the expense of reserve replacement, resembles an implicit co-ordination on low capacity among non-OPEC petroleum producers. This is a partial explanation of the current high oil prices. By examining actual parameters used by the financial markets in pricing of oil companies, we address the issue of whether the low investment outcome could represent a long-term equilibrium. This is hardly likely, as oil companies are made aware that stronger emphasis is put on reserve replacement.*

## 1. Introduction

Over the last few years, global energy demand has been fuelled by healthy economic growth, both in the OECD area and in emerging economies – like China. On the other hand, production among international oil and gas companies has been stagnant, and OPEC's market share and influence has increased correspondingly. Tight market conditions, political unrest in important supplying regions and increasing concerns for security of supply have caused a sharp increase in oil prices.

Several commentators and analysts have linked the current high oil prices to the lack of investments in the oil sector:

"*I am disappointed about the shortfall of investments on the supply side. Large, international oil companies seem to prefer looking for oil at the NYMEX trading floor, instead of exploring for resources around the world. They have a social responsibility, but prefer to buy back their own shares*," Fatih Birol, IAE Chief Economist

Casual observation and aggregate data support the view that oil and gas exploration and investment spending has failed to respond to increasing oil prices over the last years. Figure 1 illustrates that total exploration spending across the 12 international companies of our data set fell by some 30 % from 1998 to 2003, whereas oil prices doubled over the same period (see figure 1).

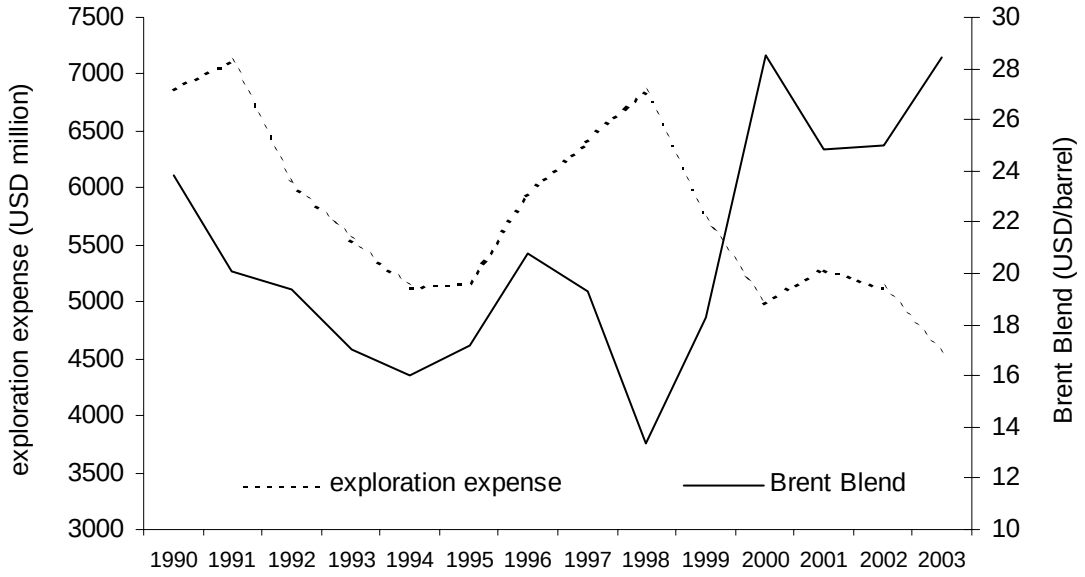


**Figure 1:** Exploration spending (USD millions) and the oil price, 1990-2003. Exploration spending is calculated as the sum of across the 12 companies in our data set. Source: *Deutsche Bank: Major Oils 2003.*

Empirical research suggests that cash-flow variables dominate capital-cost variables in the explanation of investment behaviour (Chirinko, 1993). Current cash flows among oil and gas companies are fuelled by high oil and gas prices, and risky investments like exploration are usually funded by internal funds. Adaptive expectations may also cause price expectations to increase in periods of high spot prices. However, exploration activity and the oil price seem to have decoupled over the last few years. The huge cash flows that have been built among oil and gas companies find instead their way back to investors, through increased dividends and share buyback programmes.

At the same time, there has been an increasing focus in the oil industry on short term accounting profitability, or more precisely, Return on Average Capital Employed (RoACE). This simple measure of capital return is a vital input to valuation analyses among stock market analysts. But RoACE has its flaws. Inherent in the unit of production depreciation method in the oil sector, RoACE will fall in the first years of a project cycle. Later in the project cycle, when investments fall and the capital asset depreciates, RoACE will rise. Correspondingly, RoACE is boosted in periods of divestment. The short-term negative effect on corporate income accounts is particularly strong for exploration expenses as only successful wells are capitalized, whereas costs related to dry wells are expensed immediately[1]. As the lead times for exploration projects are generally long, the focus on short-term return on capital may have caused a shift in management attention to cost-cutting and value-maximisation of existing reserves (efforts to increase oil recovery).

In effect, the strong focus on RoACE by analysts and investment banks may therefore have put a cap on oil companies' investment budgets. This would not have been the case if a reasonable trade-off were made between short-term profitability and long run production growth (development of new reserves).

In many ways, the oil companies' focus on RoACE, at the expense of reserve replacement, resembles an implicit co-ordination on low capacity among non-OPEC petroleum producers. We should emphasise that we are not talking of a cartel in a traditional sense, as no collusion has taken place. Our point is simply that a group of oil companies that relates actively to analysts' rankings of simple financial indicators can generate a competitive market equilibrium with some of the same features as that of a production cartel.

In this article we present and analyse financial indicators used in the petroleum industry and present previous literature. Furthermore, we try to ascertain if an equilibrium of low capacity is sustainable. We benefit from econometric testing of the actual relation between pricing multiples and financial indicators for oil companies undertaken in Osmundsen *et al.* (2004), who test whether the presumed positive relationship between pricing multiples and RoACE actually exists. In the present paper we explore the policy implications of this analysis.

The conclusion of our study is that the stock market seems not to have bought into the analysts' tendency to over-weight RoACE. Investors are probably concerned that the short-term return on capital is unsustainable, and would therefore like a more balanced trade-off between short-term indicators like return on capital and long-term indicators like reserve replacement. There is now more focus on reserve replacement and signs of a higher risk acceptance for new projects. Thus, we do not perceive the market equilibrium of strong capital discipline and short-term focus to be stable, i.e., the period 1997-2001 stands out as a fairly unique period of high cash flows and low investments.

## 2. A capacity game in the oil industry

In the vocabulary of game theory, the financial analysts' focus on RoACE-benchmarking has served as a focal point[2] for the international oil companies, securing cartel stability. We will illustrate this by a very simple example.

Say the oil industry consisted of only two companies that were to select one of two strategies: exploration (for growth) or passivity (for short-term profitability)[3]. A possible payoff matrix for the game could be:

Table 1. Payoff matrix in simplified capacity game.

| | | *Company 2* | |
|---|---|---|---|
| | | Passive | Explore |
| *Company 1* | Passive | 125, 125 | 75, 150 |
| | Explore | 150, 75 | 100, 100 |

The numbers in each cell give the payoff to company 1 and 2, respectively. Observe that there is a strategic interaction between the companies payoff to company 1 depends on the actions of company 2, and vice versa. The outcome where both companies invest, generate high production capacity, thus increasing the likelihood of a fall in oil prices. The payoff in this case is 100 to each of the companies. If they instead were able to coordinate on an outcome with lower capacity, oil prices and profits would be higher (125 to each of the companies). The problem with this outcome is that it usually does not represent a stable equilibrium. The reason is that each of the companies has an incentive to invest at high prices. If one company is not investing it will be profitable for the other firm to invest, thus benefiting from the higher oil price. For the active company this would generate a profit of 125 (lower price but higher volumes), whereas the passive company would get 75 (lower price). But since investing is the dominant strategy of both companies, the typical Nash-equilibrium is the low-price/high-investment case, where both companies have low profits of 100.

In deciding on its investment levels, an oil company faces a trade-off between the short-term gain of high investments (and high production volumes) in periods of high prices against even-higher long-term profits if both companies were to abstain from additional capacity expansion. Most oil companies have a high required rate of return, which would indicate that they would opt for the short-term strategy of capacity expansion. However, the stock market analysts' system of relative valuation - and emphasis on RoACE - introduces a countervailing incentive, as high investments would generate a temporary decline in RoACE due to the features of the accounting system. Thus, focus on short-term financial indicators (a focal point) may have the interesting effect of supporting an equilibrium of low investments, which otherwise typically is characteristic for companies having low discount rates.

This simplistic model of course abstracts from many important aspects of the oil market. Since we want to ascertain how an accounting construct such as RoACE affects the investment behaviour of the majors, we only consider investment behaviour in the OECD region. This simple model leaves out the national oil companies, OPEC and other non-traded global producers; producers that obviously play an important role with respect to determining global oil production and price fluctuations. For simplicity, however, we omit these producers from our model. Another limiting aspect of our model is that we only consider the non-repetitive game. It can be argued that the producers are in a constantly repeated game, instead

of a one period game, something that may alter the dynamics and logic of the prisoner's dilemma outcome. This may prove an interesting expansion of our basic setup.

To understand the shift in strategy by the oil companies, towards a stronger focus on short-term rate of return, it is useful to examine the development of share prices among oil and gas companies, relative to other industries.

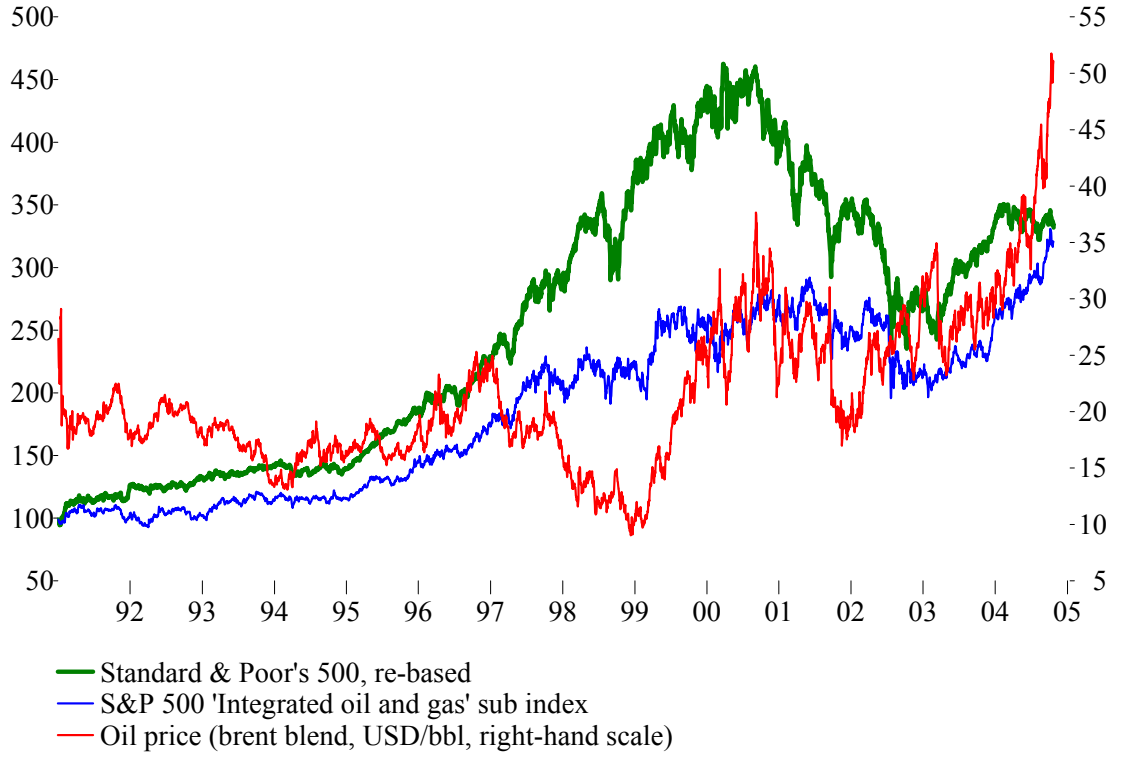


**Figure 2**: Stock price development for oil companies (Amex OIX) and *general index (S&P500), 1991-2004. Source:* EcoWin.

In Figure 2 we see that the value of oil stocks fell when oil prices started to fall in 1996, but not to the same extent as the reduction in oil prices. One reason could be that the market generally expects the oil price to return to its historical average (mean reversion). The low oil prices, reaching 10 dollars per barrel in 1998, have probably affected the later decisions by international oil and gas companies in terms of low price assumptions in investment analyses.[4] International oil and gas companies have been slow to update price expectations in the aftermath of 1998. Temporary financial distress led to a stronger focus on cost discipline and short-term profitability. When oil prices rose strongly after 1998, the stock market response was muted, and oil and gas stocks general underperformed the general market development. One significant reason for this development was the so-called "new economy". The IT-bubble of the late 1990s made it hard to raise money for conventional risky investments like oil and gas exploration. Moreover, the relative low value of oil stock made acquisition costs for reserves lower than finding and development costs, thus capping the potential for organic growth.[5]

## 3. RoACE over a project's life cycle

Accounting returns do not always reflect internal rates of return. With the system of depreciations in the oil industry, unit of production depreciation, accounting returns are lower than internal rates of return when investment activity is higher than usual (or for a firm with many new projects in its portfolio). When investments are low (or for firms dominated by legacy assets), accounting returns are higher than internal rates of return. Only at an average investment level (or a balanced portfolio of old and new projects) do accounting returns reflect the internal rate of return. For the oil industry, characterised by large and lumpy investments with long lead times, this is a challenge. It may be hard to get investment funds to good projects in periods where companies are lagging behind their RoACE targets.

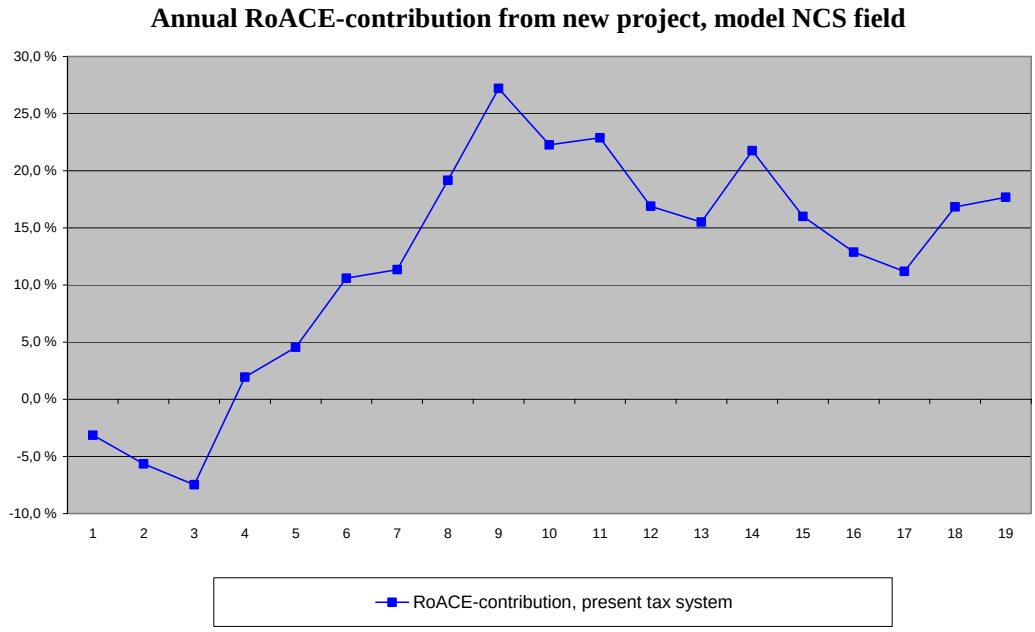


**Figure 3**: Illustration of RoACE-contribution over a project's life cycle.
Data: Model field from the Norwegian continental shelf.

In Figure 3 we provide a simple illustration of how a new project contributes to the RoACE of a small company. The project is a small satellite development on an existing field on the Norwegian continental shelf, requiring relatively small investments and having a very short lead time. For a large company this would have a negligible effect on the RoACE of the entire portfolio (large projects or groups of smaller projects, however, may have a significant impact on RoACE). For illustration purposes, therefore, we have constructed a synthetic portfolio of a small company, consisting of the project and some fixed income. Figure 3 clearly illustrates that the new project will have a negative impact on RoACE in the first years, and thereafter contribute well. Note that this can be seen as a best case for the initial negative impact on RoACE. Larger, stand alone development projects have considerably longer lead times, and hence a longer period of negative RoACE impact. Exploration projects, of course, is even worse in this respect, and may be hard to sell in periods of strong short-term focus.

## 4. Financial indicators used in the oil industry

Being a successful stock market analyst can be very rewarding, but is indeed also demanding. One single person often has to keep track of a wide range of companies, and provide superior advise and consistent investment recommendations to exacting investors with no concerns but to maximise their returns and to outperform their benchmarks. No wonder, therefore, that both analysts and investors have to relate to some simplified indicators that can help them in developing relative valuations and investment rankings.

Ideally, valuation should be undertaken by means of net present value analyses. The value of a firm is then determined by the cash flow, growth and risk characteristics. As analysts lack the necessary data to do such analyses in a proper manner (asymmetric information), they often resort to relative valuation. According to Damodaran (2002), the use of relative valuation is widespread. The reasons are that valuation based on multiples can be completed with far fewer explicit assumptions and far more quickly than an exhaustive discounted cash flow (DCF) valuation. Furthermore, relative valuation is simpler to understand and easier to present to clients. Finally, relative valuation is according to Damodaran much more likely to reflect the current mood of the market, since it is an attempt to measure relative and not intrinsic value.

First we give a brief presentation of the relation between cash flow valuation and valuation by use of multiples. Discounted cash flow (DCF) analysis, which is widely accepted as the ideal theoretical valuation model, can be used to derive valuation multiples such as the price-earnings ratio (P/E) and the enterprise value-free cash flow ratio (EV/FCF). The value of a stable growth firm (enterprise value, EV) is the discounted value of the free cash flow to the firm (FCF):

$$(1) \qquad EV = \frac{FCF}{WACC - g},$$

where WACC denotes weighted average cost of capital and $g$ is the growth rate of the cash flow. Dividing by FCF we get the multiple:

$$(2) \qquad \frac{EV}{FCF} = \frac{1}{WACC - g}$$

While pre-tax cash flow measures such as EBITDA (earnings before interest, taxes, depreciation and amortization) are commonly used in other sectors, they lack relevance in the oil and gas industry as tax rates differ substantially. Hence, the analysts use a so-called debt-adjusted cash flow measure (DACF), which in its simplest form is a post-tax EBITDA. The free cash flow to the firm can be written in terms of DACF:

$$(3) \qquad FCF = (EBIT\ (1\text{-}t) + DD\&A) - (Capex + \Delta\ Working\ capital),$$

where DD&A is depreciation, depletion and amortization, capex is capital expenditure and *t* is the tax rate on operating income.

Defining (EBIT (1-t) + DD&A) as DACF and (Capex + Δ Working capital) as long-term (capex) and short-term (working capital) investments, equation 2 becomes:

(4) $$\frac{EV}{DACF} = \frac{1 - \frac{Investments}{DACF}}{WACC - g}$$

Since DACF can be viewed as the funds available for investments (short term and long term), debt repayment and distribution to shareholders, the numerator in the term on the right hand side of the equation, (1-investments/DACF), can be interpreted as the ratio of funds available for repayment of debt and distribution to shareholders. In other words, EV/DACF is positively related to the fraction of available cash flow distributed to debt and equity holders. Note that this relation only applies if all other things are kept equal, i.e., the company remains a stable growth firm. It does not apply, e.g., if increased distribution to equity holders were to negatively affect growth. From the denominator on the right hand side of equation (4) we see that the valuation multiple EV/DACF is increasing with the growth rate in the company's cash flow and decreasing with the company's WACC.

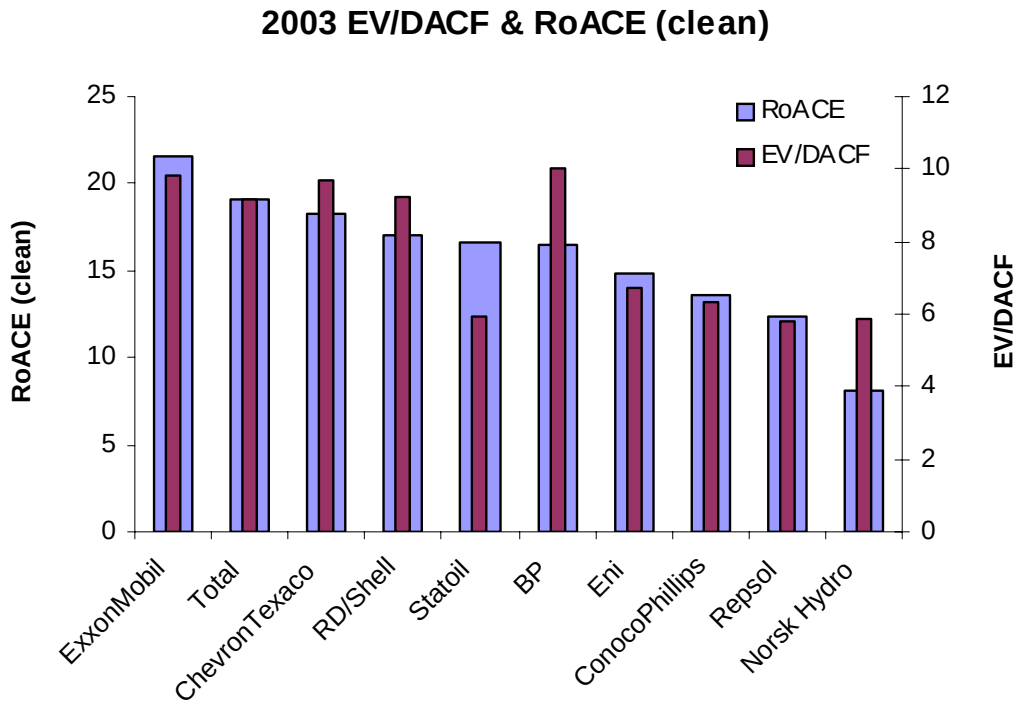


**Figure 4**: EV/DACF and RoACE ranking for international oil companies, for 2003.
Data source: Deutsche Bank.

In Figure 4 we list EV/DACF and RoACE for some international oil companies, ranked according to RoACE. Such benchmarking by investment banks makes oil companies focus on the development in their RoACE-figures. Note, however, that the relation between EV/DACF and RoACE in the diagram is not clear-cut.

A crucial issue for valuation analyses, of course, is to determine key indicators that may cause valuation multiples to vary across firms in the same sector. For the international oil and gas industry, the most common financial indicators and valuation benchmarks are Return on Average Capital Employed (RoACE), unit cost, production growth, reserve replacement rate, and average tax rate. These indicators can be perceived as a simplified implicit incentive

scheme presented to the companies by the financial market. In responding to these incentives, the companies need to strike a balance between short-term goals of return on capital and long-term goals of production growth and reserve replacement.

RoACE is usually defined as net income adjusted for minority interests and net financial items (after tax) as a percentage ratio of average capital employed, where capital employed is the sum of shareholders' funds and net interest-bearing debt. DACF, or debt-adjusted cash flow, normally reflects after-tax cash flow from operations plus after-tax debt-service payments; where after-tax cash flow is the sum of net income, depreciation, exploration charge and other non-cash items.

Given the data that is available for external analysts, it is common to use market comparative multiple analyses. Cash flow multiples stand out as especially important in this respect, and one widely used indicator is the relation between enterprise value (EV) and debt-adjusted cash flow (DACF) – or EV/DACF. An estimate for the value of a company, P, is thus found by taking the mid-cycle *DACF* for company *i* and multiplying it with the multiple for the comparable companies (peer group), *EV/DACF* . Thus, $P_i=(EV/DACF)xDACF_i$. Positive investment recommendations are awarded to "cheap" companies, where valuation estimates go beyond current market capitalisation. On the other hand, cautiousness is usually recommended for the more "expensive" companies, where simple valuation estimates fall short of their market capitalisation.

In their *Global Integrated Oil Analyzer*, UBS Warburg states: "Our key valuation multiple is EV/DACF". The key arguments are that it is an after-tax value (important in an industry with substantial resource rent taxes) and that it is independent of financing decisions (thus facilitating comparisons between companies with different capital structure).

UBS Warburg appreciates the influence of oil price volatility on their analysis. For valuation purposes, they concentrate on what they call mid-cycle market conditions. Given the considerable volatility in oil and gas prices, this is clearly important for the international oil and gas industry. For a given year, UBS Warburg claim to identify a clear relationship between RoACE and the EV/DACF multiple, and conclude:

"Each of the stocks which we rate a 'Buy' is trading below the average level relative to its returns. EV/DACF versus RoACE provides the key *objective* input into the process of setting our target prices."

Similar statements about valuation, multiples and return on capital are made in Deutsche Bank's publication *Major Oils*.

## 5. Previous research

The interest for the relationship between financial performance and valuation of oil companies is not new.[6] A typical result from previous studies is that accounting information, such as earnings and capital employed, is insufficient in the equity valuation process for oil and gas exploration firms. Thus, there is a potential hazard in relying solely on accounting measures, such as RoACE, in equity valuation. Indeed, some researchers have voiced their concern about the accuracy of historical cost accounting in conveying financial performance among oil and gas companies (Deakin and Deitrich 1982; Harris and Ohlson, 1987; Koester 1990). Most of these studies emphasize the necessity of disclosing both financial and non-financial information.

McCormack and Vytheeswaran (1998) point out particular problems in valuation of oil and gas companies, since the accounting information in the upstream sector "does a distressingly poor job of conveying the true economic results". There are measurement errors in petroleum reserves. The response to new information is asymmetric; bad news is quickly reflected in the reserve figures whereas good news takes more time to be accounted. Moreover, reserves may be exposed to measurement errors since they are noted in current oil price (and not the mid cycle price), and since they do not include the value of any implicit real options. Finally, McCormack and Vytheeswaran claim a bias in the reported figures, as the large and profitable oil companies are more conservative in their reserve estimates than most of the others. This may explain the importance that many analysts have put on company reputation, a factor that has been partially jeopardised by the recent reserve write-down in Royal Dutch/Shell.

As for depreciation, the successful-efforts method produces initial depreciations that are too high. The unit-of-production method also has the effect of depreciating assets too quickly. A possible implication is that an extra cost is added to new activity, whereas inertia is rewarded.. Other measurement challenges specific to the oil business are cyclical investment patterns and long lead times, and these features can exacerbate the measurement errors. Similar effects may occur from the fact that discoveries are discontinuous and stochastic.

McCormack and Vytheeswaran (1998) perform econometric tests on financial relations for the largest oil and gas companies. Total shareholder return is tested against EBITA (earnings before interest, taxes and amortization), RONA (return on net assets), after-tax earnings, ROE (return on equity), and free cash flow. Estimated relations between valuation and financial indicators were very weak or non-existent. More robust relations were established when Economic Value Added (EVA[7]) and reserves were introduced in the model.

Antill and Arnott (2002) address the strategic dilemma between return on capital and production growth in the petroleum industry. They claim that the 2002 RoACE-figures of some 15 % were due to the fact that the companies possess legacy assets that have low book values but still generate a considerable cash flow. If market values of the capital employed were applied, Antill and Arnott estimate that RoACE would fall to approximately 8-9 %, which is more consistent with the cost of raising capital. One problem with RoACE, they add, is that capital employed will always reflect a mixture of legacy and new assets. The implication is that RoACE does not adequately reflect incremental profitability[8], and therefore falls short of being a good measure for current performance. Antill and Arnott (2002) argue that the oil companies should accept investment projects with lower internal rate of return (IRR), as the growth potential would add value to the companies.

Chua and Woodward (1994) perform econometric valuation tests for the American oil industry, 1980-1990. They test P/E-figures for integrated oil companies against dividend payout, net profit margin, asset turnover, financial leverage, interest rate, and Beta. However, they fail to uncover robust relations in the data set. The estimated interactions are weak, and some of them even have "wrong" signs. Chua and Woodward do not find support for the P/E-model. They therefore go on to test the stock price against cash flow from operation (following year and preceding year), dividend payout, net profit margin, total asset turnover, financial leverage, interest rate, Beta, and proven reserves. Future cash flow and proven reserves are statistically significant explanatory factors, thus offering support for a fundamental approach to valuation. An increase in proven reserves of 10% produced an average increase in the stock price of 3.7%, in the model estimated by Chua and Woodward.

Quirin *et al.* (2000), in their analysis of US oil and gas exploration firms 1993-1996, find that certain ratios such as the reserves replacement ratio, reserves growth, production growth and the finding costs-to-depreciation ratio are perceived by analysts as being instrumental during the equity valuation process of oil and gas firms. Their results indicate that these ratios provide incremental information over accounting information, including earnings and book value of equity. Recently, Cormier *et al.* (2003) found that cash flows and changes in reserves provide incremental information over reported earnings for a data set of Canadian petroleum firms.

## 6. Empirical specification and results

For this study, UBS Warburg has kindly provided us with a panel data for the period 1997-2002, including the following companies:

| | | | |
|---|---|---|---|
| Amerada Hess | Eni | Hydro | Repsol YPF |
| BP | Exxon | Occidental | Royal Dutch |
| Chevron | Marathon Oil | Petro-Canada | Total |

Massive structural changes took place in the international oil and gas industry over the period 1998-2002. Exxon merged with Mobil, Repsol acquired YPF, Chevron merged with Texaco and Conoco merged with Phillips. The particular time period in our study is chosen to include this period of consolidation and industry restructuring, as it may have influenced the relation between EV/DACF and RoACE.

The econometric analyses are included in a supplementary paper (Osmundsen et al., 2004). We undertake econometric testing of the actual relation between pricing multiples and financial indicators for oil companies, and examine whether the presumed positive relationship between pricing multiples and RoACE actually exists. We find no support for the perceived relationship between pricing multiples and financial indicators, such as RoACE.

## 7. Conclusion

Do low investments and high oil prices represent a sustainable equilibrium for the non-OPEC oil companies? The equilibrium rests on a vital assumption that return on capital employed (RoACE) is the main indicator when capital markets price oil companies. (Market analysts' RoACE-ranking of the international oil companies may have constrained new investments, as investments typically generate a temporary drop in RoACE.) To test this hypothesis we have undertaken regression analyses on market and accounting data from oil companies for the years 1997-2002. The objective is to ascertain key valuation drivers. The valuation multiple EV/DACF is tested against a number of financial indicators and dummy variables. Making use of year dummies in addition to RoACE, we find from regression analyses on the panel data set that the year dummies (reflecting the oil price) are strongly significant, i.e., EV/DACF responds negatively to the oil price. This supports the perception that oil companies are priced at mid cycle oil prices.

The effect of RoACE on the valuation multiple, however, is not in accordance with common perceptions. In our multivariate specifications there is a significant *negative* relation between EV/DACF and RoACE. We have offered some possible explanations to this result. First, the RoACE figures used in external analyses (and in our regressions) are non-normalised. To evaluate performance we would have preferred to normalise for changes in refinery margins and petroleum prices. Such data, generated in a consistent manner, are not readily available. Second, the RoACE figures suffer from the traditional shortcomings that financial accounts have in measuring true profitability (measurement errors). Third, in a multivariate econometric specification, the effect of short-term return on capital can be crowded out by interdependent explanatory factors. Fourth, the high RoACE figures in this period may prove to be non-sustainable, as ambitious return on capital targets effectively reduce the investment capacity. The last explanation seems to be acknowledged by many of the international oil companies, as we now see less emphasis on RoACE and more emphasis on risk-taking and reserve replacement strategies in business plans. This indicates that the current low-capacity/high-price equilibrium is not sustainable.

### Endnotes

[1] Successful efforts accounting
[2] Schelling (1960).
[3] For a good overview of game theory, see Gibbons (1992).
[4] The very strong focus on cost discipline in the oil industry in the last decade should also be seen in context with over-investment in exploration in the late 1970's and early 1980's.
[5] See Antill and Arnott (2002).
[6] For general analyses of valuation multiples, see Damodaran (2002), and Liu, Nissim, and Thomas (2001).
[7] EVA is a trade mark of Stern Stewart & Co.
[8] Using measures as RoACE thus favors companies having a large fraction of legacy assets in their portfolio.

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