

On Measuring the Performance of National Oil Companies (NOCs)

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Previously, Dr. Victor was a Research Associate in the Economics Department at Yale University under Prof. William Nordhaus, where she developed a new spatially referenced economic database. At the same time she was involved in research at the Program for the Human Environment at Rockefeller University. There she analyzed the technical changes bearing on the environment, rates and patterns of technical change in the information and computer industries, and R&D in the energy sector.

Before she moved to the US in 1998, Dr. Victor was a Research Scholar at the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria. Her IIASA research included analysis of the long-term development of economic & energy systems, energy modeling at regional and global scales, scenarios of infrastructure financing, trade in energy carriers and environmental impacts. She had extensive collaboration with international organizations, including the World Energy Council (WEC) and the Intergovernmental Panel on Climate Change (IPCC). She holds a Ph.D. and a B.A. in Economics from Moscow State University.

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Abstract

National oil companies (NOCs) appear resurgent in the global energy markets and now control a sizeable majority of the world's oil and gas reserves. Their performance therefore plays a key role in these markets and has implications for the supply of oil and gas resources. This paper analyzes available macro-level data on oil and gas companies in order to quantitatively compare the performance of NOCs with international oil companies (IOCs) including the global majors. Due to performance shortcomings or government-dictated strategies that differ from those of purely profit-maximizing enterprises, NOCs are seen to extract resources far less efficiently than IOCs. Much of the oil and gas reserves in NOC hands are thus effectively “dead.” At the same time, NOC performance is far from monolithic – some national oil companies are able to perform at or near the level of the global majors, while others fall significantly short.

Introduction

The oil industry has experienced numerous periods of expansion and contraction caused by a variety of economic and political drivers. The present period is marked by a relative decline of the private sector major operators and a surge in the apparent importance of national oil companies (NOCs) as the leaders of the global energy industry. NOCs control about 80% of world oil reserves and account for 73% of production.

The literature on NOCs is limited. Most of it is anecdotal and based on individual histories. Some of the more systematic analysis has been aimed at understanding the efficiency and pattern of investment in NOCs.¹ One of the difficulties in evaluating NOCs is that most of the enterprises have a variety of missions—“national” and “commercial”—and thus do not perform as profit-maximizing enterprises. The many non-commercial directives that the government gives to the NOC include employment,

¹ For example, see the recent effort to develop a theoretical framework of the operation and development of NOCs and to analyze the empirical data are presented by the Rice University's working papers (see Hartley, P.R., Medlock III, K.B., 2007 and Hartley, P.R., Medlock III, K.B., Eller, S.L. 2007). Key conclusions of their analysis are that relative to an economically efficient producer, NOCs are likely to favor excessive employment, are forced to sell oil products to domestic consumers at subsidized prices and are under-invested. For an earlier assessment see, e.g., Obaidan and Scully (1992).

public infrastructure, and a variety of other tasks that are not strictly related to core industrial functions. This paper is part of a larger study that aims to unravel those various missions and to understand how the management of NOCs affects their performance (see PESD, 2007).

The present paper looks at broad indicators of NOCs to judge their performance. The analysis, of course, is confounded by the lack of systematic and reliable information. According to some observers, companies seldom report their true findings for commercial reasons, and governments - which own the reserves - often find it useful to be elastic with data. For example, in 1984 the Kuwaiti government increased its reserve estimate due to the implementation of an OPEC production quota system that set country production levels based on country reserves. In 1987-1988 Saudi Arabia, Iran and Iraq all significantly increased their reported reserves for political reasons. The estimates for the OPEC countries were systematically exaggerated in the late 1980s and Middle East official reserves jumped 43% in just three years despite no new major finds.

While OPEC has consistently overstated its reserves, industry on the other hand has had mixed incentives. The pressure on companies from the analyst community to show reserves growth coupled with conservative engineering-based reserve assessment techniques has created a gross misunderstanding of how much oil is actually being discovered. Most company estimates create the illusion of growing reserves when in fact previously discovered oil is merely being reclassified into the proven category for reporting purposes. Also in evidence in recent years has been an opposite pattern—the overstating (then restating) of reserves to boost stock performance.

Mindful of these difficulties in obtaining reliable data, this paper is an early assessment and discussion of systematic data on NOCs and IOCs (see References).² It identifies the relationships between companies' ownership, size and varied performance indicators. We analyzed available macro data on oil and gas companies and used the 1999-2006 editions of Energy Intelligence's Top 100 with data published through 2004 (the list of indicators is presented in the Appendix 1). The paper presents the data and analysis along with some initial interpretation. Our ultimate goal is to use this data for an analysis that allows us to identify different "types" of oil and gas companies based on their characteristics that explain performance.

² The abbreviation "IOCs" means different things for different people:

- International Oil Companies: the non state-owned (normally publicly floated) oil and gas companies that have operations spanning the globe.
- Integrated Oil Companies: the companies engaged in the exploration and production of oil and gas, as well as at least one other significant activity in oil refining, marketing and transportation, or in the chemicals industry.
- Independent Oil Companies: oil and gas companies that are usually relatively small in size compared to companies that integrate these activities with transportation, refining and marketing of hydrocarbons.

In our study we defined IOCs in the first manner—oil and gas companies that are not owned by governments and operate in the international arena.

A. Market Capitalization Estimations

Market capitalization, or market value, indicates what investors believe a publicly traded company is worth. Market capitalization is calculated by multiplying the number of outstanding shares of a company by the current market price of one share. It is related to company reserves, production and financial performance, and typically scales with company size. Thus, market capitalization is related to a company's total output, revenues and number of employees (see Figures A1-A3 in Appendix 2).

Market capitalization is higher for the companies that hold bigger reserves and the only exceptions to this relationship are Russian companies (see Figure 1). Lukoil, Surgutneftegas, Tatneft and Gazprom are relatively undervalued given their large reserves and sizable production levels as, despite good financial performance, investors do not award them with better market values. Concerns that Russian oil companies' performance is driven by political factors rather than good management have kept investors away.

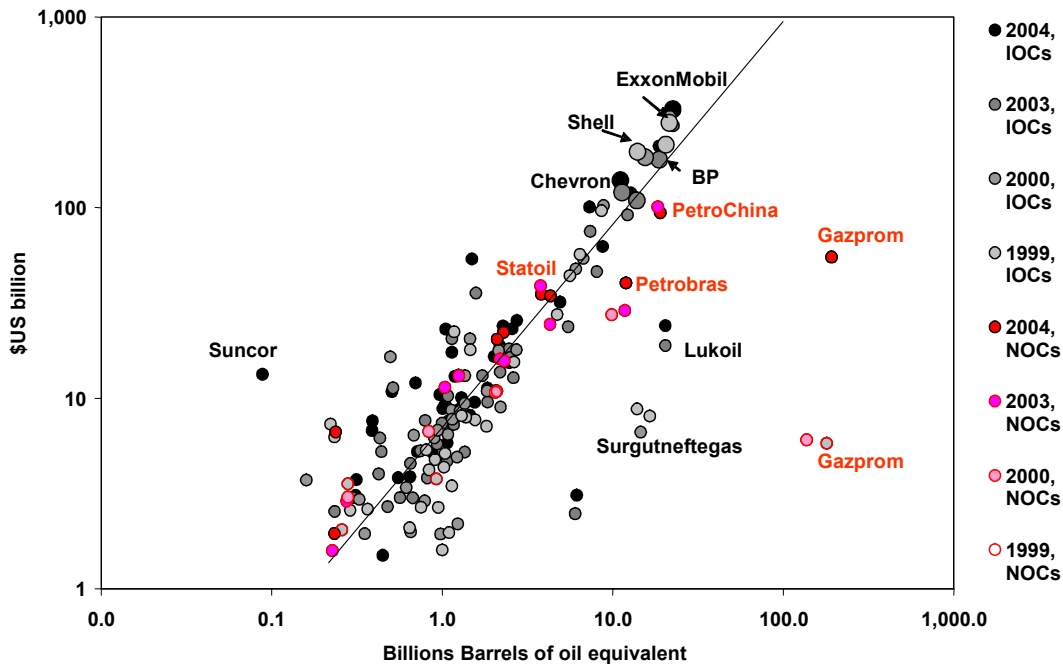


Figure 1. Market capitalization versus combined oil and gas reserves for publicly traded IOCs (black, grey and white) and NOCs (red and pink) in 1999-2004. The “Majors” are indicated by larger dots. A regression line is fit to all the data except for the Russian oil companies, which the market values differently as discussed in the text.

Market capitalization is an imperfect indicator for measuring performance, not least because many NOCs (especially from the Middle East) are not publicly traded. Indeed, the world's largest oil producers are unlisted NOCs. We explore whether it is possible to derive estimates for market capitalization by looking at the factors that explain market capitalization for listed companies. To this end, we applied regression analysis to 55 listed oil companies. We created three different regression equations for market capitalization estimations using a simple power function with varied independent variables (total output, reserves, revenues and employees).

The results of nonlinear regression analysis are presented in the Appendix 3. While the fit (R-squared) is high for all regressions, the analysis of regressions outputs and statistics led us to conclude that two variables ("number of employees" and "reserves") should be excluded from the equations and that total output and total revenues are the best predictors of market capitalization for listed companies.

On the basis of these equations we estimated market capitalization for all 100 companies—NOCs and IOCs— as a function of total output and revenues, and Figure 2 shows the results of our estimations for the top 40 companies. The red columns show regression estimations for the companies that are not publicly traded. The grey columns show the real market capitalization values for traded companies—NOCs and IOCs. The white columns show the regression-based estimations of market capitalization's overvaluation (if negative) and undervaluation (if positive) for companies traded on the market.

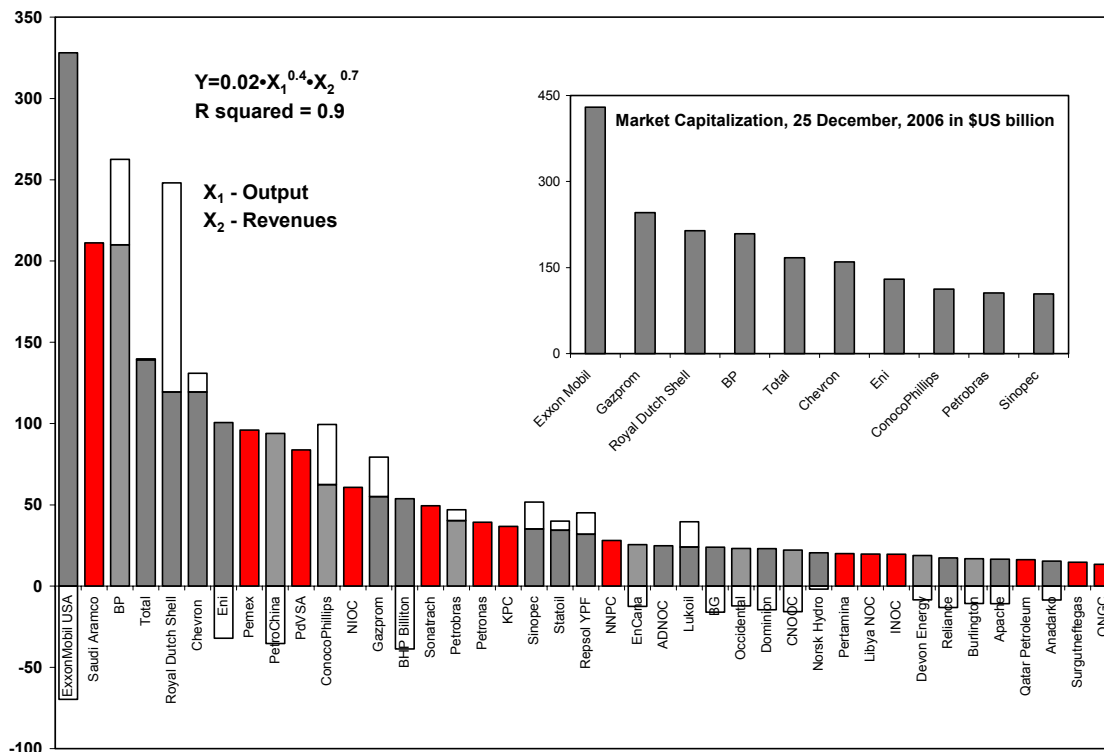


Figure 2. The value of major oil companies (real and from regressions) in 2004. The red columns show regression estimations for the companies that are not publicly traded. The grey columns show the real market capitalization data. The white columns show our estimations of overvaluation (if negative) and undervaluation (if positive) for listed companies based on our simple regression model. The window on the right shows actual market capitalization of the top 10 companies at the end of 2006.

The current 2006 rankings of the top ten oil companies based on the reported data at the end of 2006 (see right hand window in Figure 2) are in rough agreement with the 2004 rankings. The exception is Gazprom, which jumped into second place as a result of liberalization and extensive merger and acquisition activity, such as acquisition, with Kremlin support, of a controlling stake in Sibneft in 2005.

B. Reserves and Production Distributions: NOCs versus IOCs

Currently about 80 percent of the world's proven oil reserves are held by NOCs (the share has grown relative to the 2004 data shown in Figure 3). The ten largest upstream companies in the world measured by reserves are all NOCs, and ExxonMobil is only the twelfth-largest upstream company in terms of reserves. This means that NOCs and their governments, not IOCs and their shareholders, largely control the pace of development of upstream oil and gas resources. This has raised concerns because states and politics tend to have strong effects on the investment and operational decisions of NOCs. At best NOCs appear to be characterized by inefficiencies, overstaffing, under-

investment—all claims we will examine more systematically below. At worst, the business of producing and selling oil is largely submerged in politics and leads to lower oil production at higher cost.

**Worldwide Oil Reserves in 2004:
1197 thousand million barrels of oil equivalent**

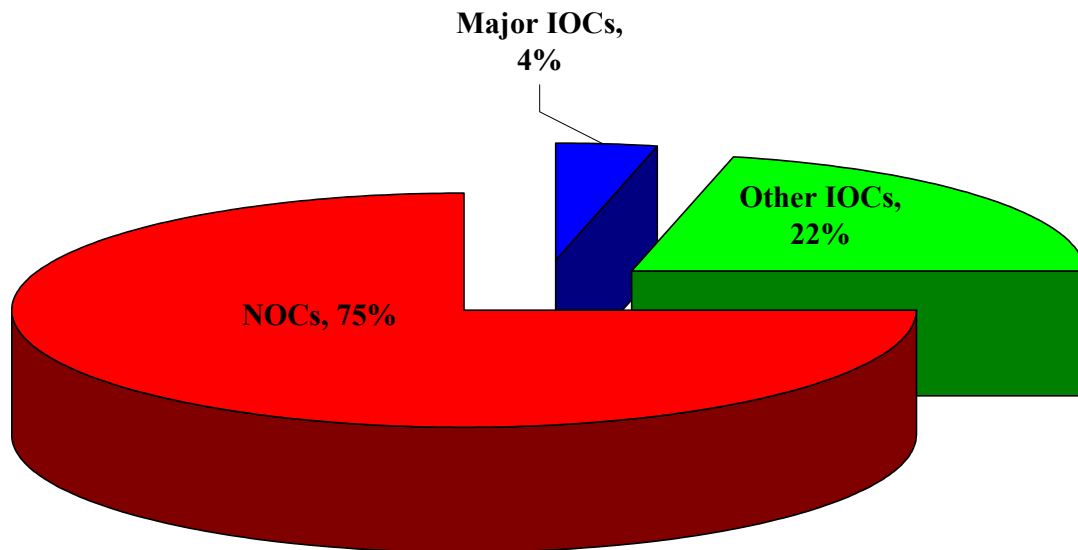


Figure 3. Shares of NOCs, IOCs and 5 Majors, Global Oil Proved Reserves (2004). Data Source: BP (2007), Energy Intelligence Top 100 (2006). Note: the 5 Majors are BP, Chevron, ExxonMobil, Total and Royal Dutch Shell.

We analyzed oil and gas reserves data in order to understand how global reserves are distributed between the companies. Figure 4 shows the histogram of combined oil and gas reserves for the 93 largest companies (excluding seven firms whose operations were exclusively petrochemical and oil refining); Figures 5 and 6 show oil and gas reserves separately.

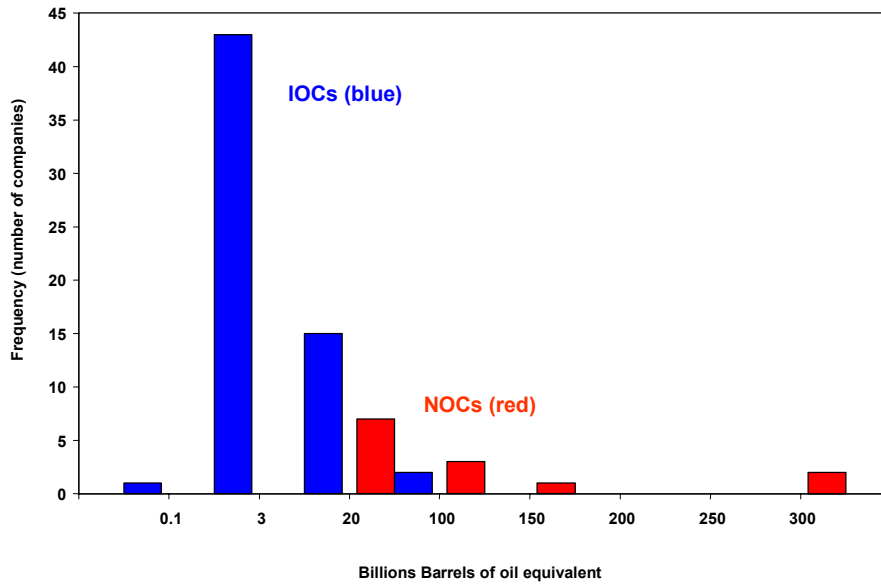


Figure 4. Histogram of NOCs (red) and IOCs (blue) combined oil and gas reserves in 2004.

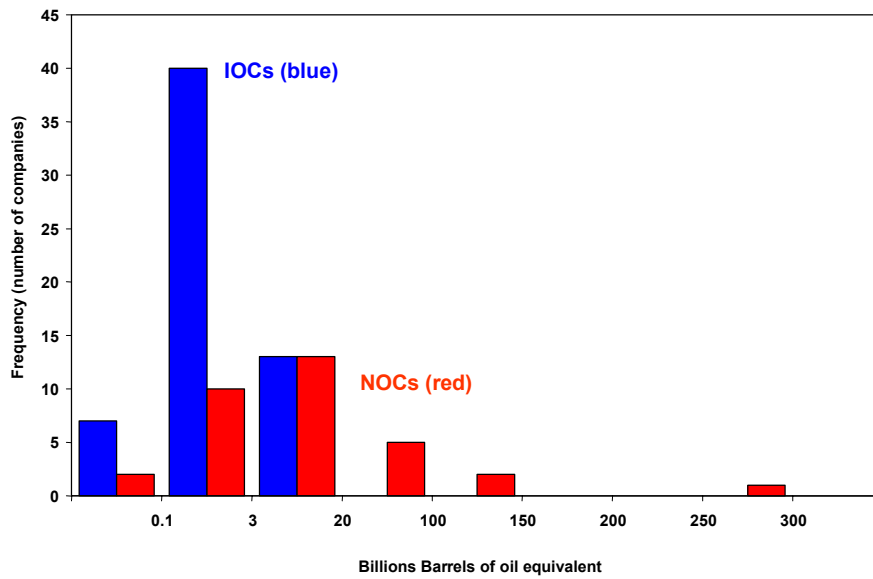


Figure 5. Histogram of NOCs (red) and IOCs (blue) oil reserves in 2004.

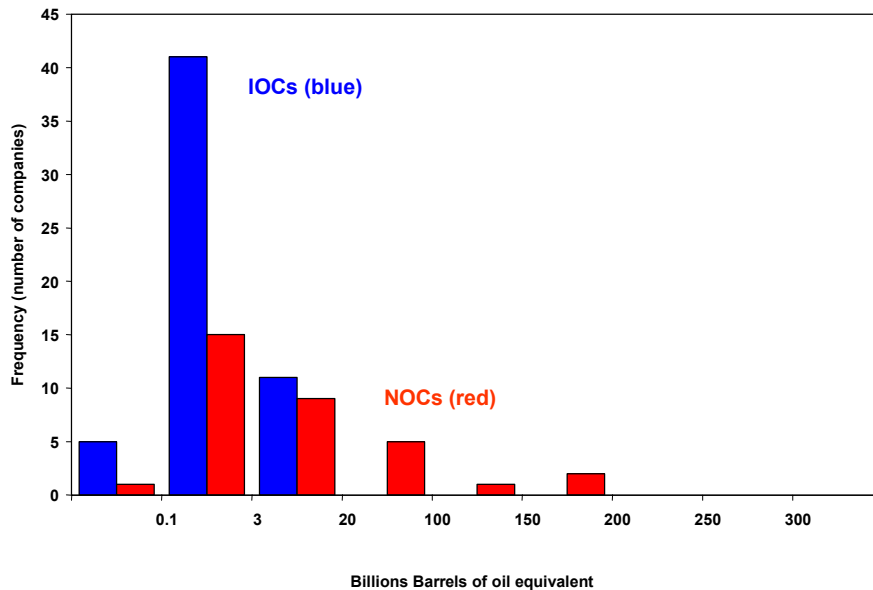


Figure 6. Histogram of NOCs (red) and IOCs (blue) gas reserves in 2004.

The reserves distribution across the companies is not “normal” but Poisson-like with a long tail. Most of the companies hold combined oil and gas reserves between 0.1 and 3 billion barrels of oil equivalent (BBOE) with median 2.29 BBOE. Two super-size companies (NIOC and Saudi Aramco) dominate the field. Figure 7 shows combined reserves ranked by company.

Another “size” indicator for oil companies is the level of production. Figure 8 shows the distribution of total output between NOCs and IOCs. The distribution of production, like reserves, across the companies is Poisson-like. Most of the companies (67 out of 93) have total output between 0.01 and 1.2 Mboe per day. The top producers are also NOCs. However, IOCs do much better in the production rankings – taking, for example, slots 5, 6 and 7 (Figure 9).

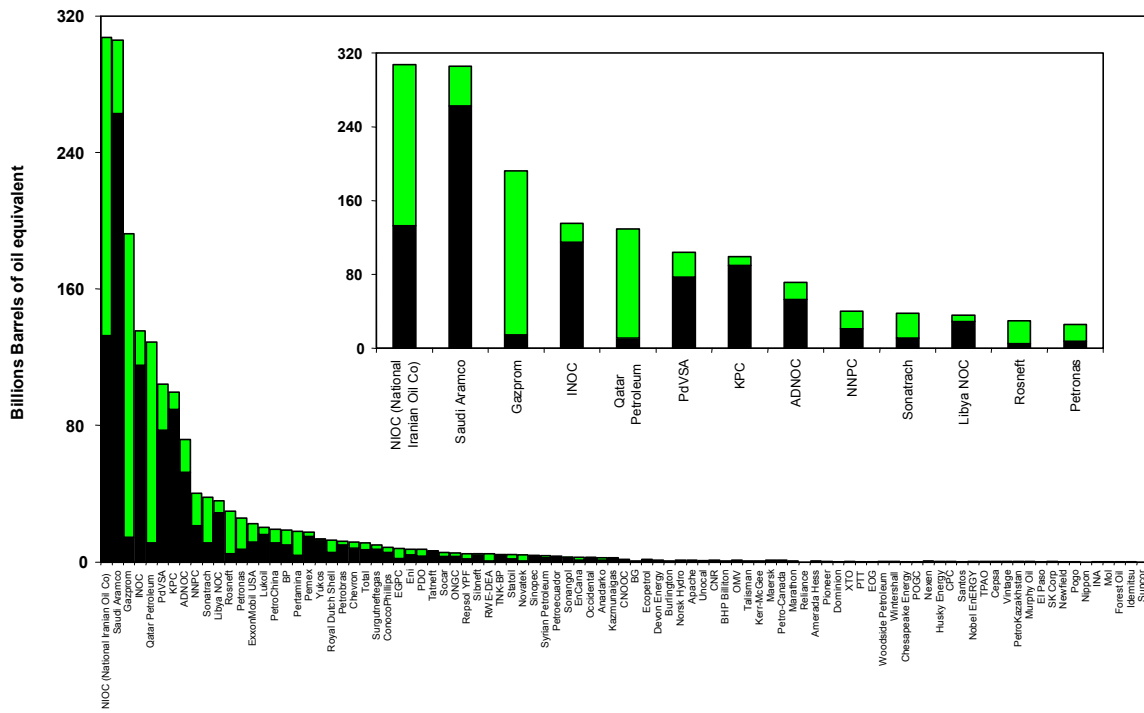


Figure 7. Combined Oil (black) and Gas (green) Reserves for 100 largest companies in 2004. The right-hand window shows oil and gas reserves for 13 top companies (with combined reserves larger than 25 BBOE).

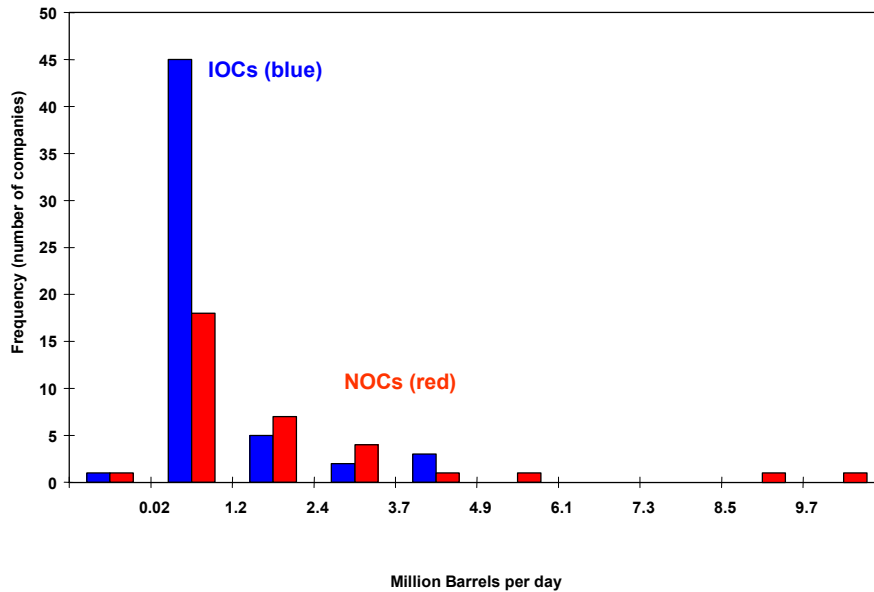


Figure 8. Histogram of NOCs (red) and IOCs (blue) – total output in 2004.

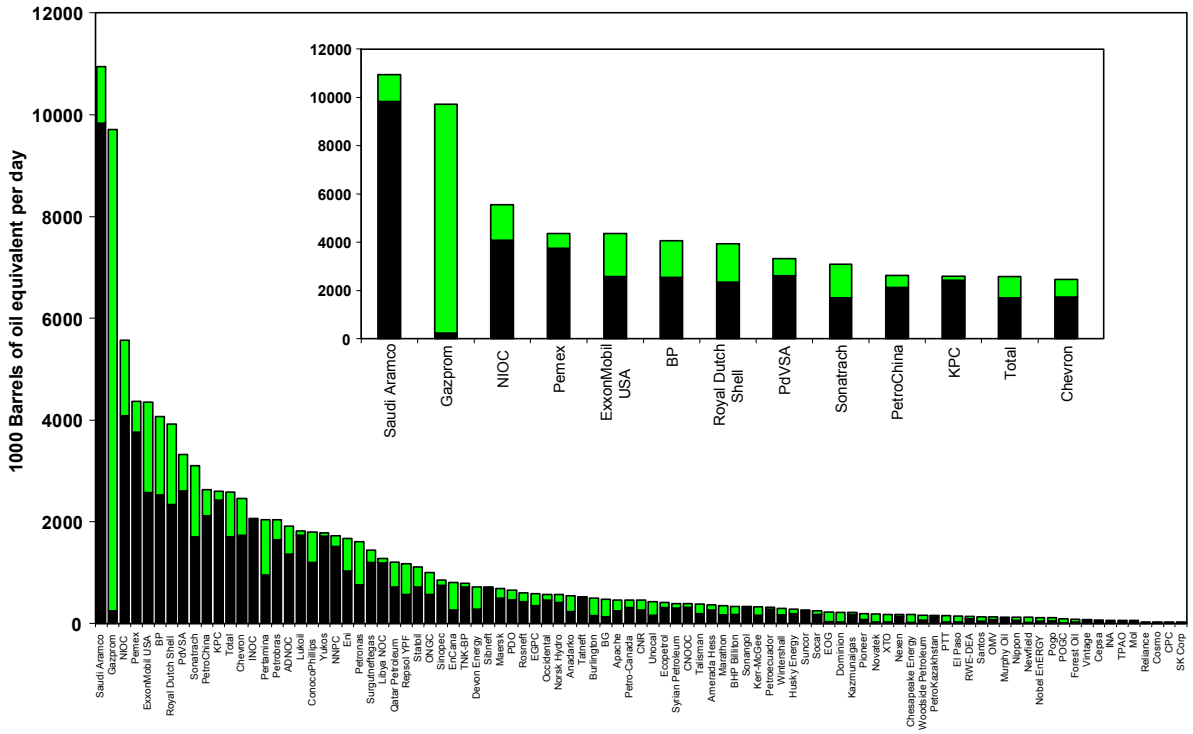


Figure 9. Combined Oil (black) and Gas (green) Output for 100 Oil and Gas Companies and for top 13 oil and gas producers in 2004.

C. Financial Performance: NOCs versus IOCs

One of the simplest measures of financial performance is revenue, for which Figure 10 shows the distribution and Figure 11 shows a rank ordering.

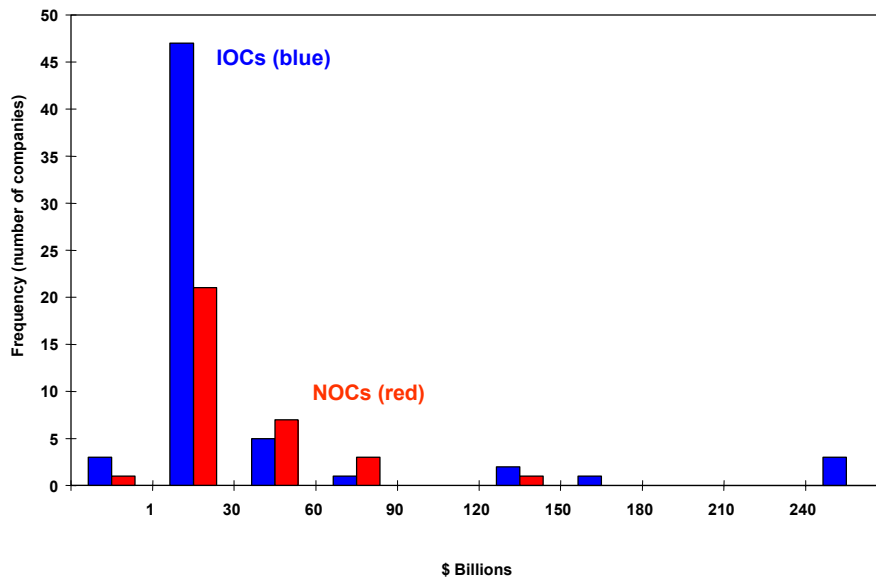


Figure 10. Histogram of revenues from NOCs (red) and IOCs (blue) in 2004.

Figure 10 shows the distribution of revenues across NOCs and IOCs in 2004. Only 3 companies had revenues higher than US\$240b: ExxonMobil with \$270b, Royal Dutch Shell with \$271b, and BP with \$287b. The distribution is Poisson-like (the same type of distribution as for reserves and production). Despite the fact that NOCs are associated with the highest level of output and reserves, the highest revenues were produced by IOCs (see Figure 11) – the explanations for this are discussed in Section D under “Dead Revenues”.

One of the possible ways to evaluate performance is to analyze revenue per employee ratios. Figure 12 shows the revenue per employee histogram for NOCs and IOCs. The distribution for NOCs is Poisson-like, but the distribution for IOCs is closer to a normal distribution (with mean \$1,807,000 and median \$1,532,000 per employee). The mean and median for NOCs are almost half the level of the total sample. This normal distribution, in contrast to the skewed distribution for total revenue, suggests that size is less advantageous in the oil and gas industry than commonly thought. In particular, large size appears to be a handicap for NOCs. We turn to these hypotheses next.

Figure 13 shows revenue per employee versus number of employees for NOCs and IOCs (including the “Majors”—the large IOCs) along with the related regressions (the results are presented in Appendix 4). Though the negative relationship is not very strong, increasing the number of employees for IOCs means decreasing revenue per employee. However, the Majors are associated with the highest level of revenue per employee and no relationship between revenue per employee and the number of employees. For NOCs the negative relationship is strong (doubling the number of employees reduces the revenue per employee by 32%). Compared with IOCs, NOCs

with less than 3000 employees have 20% less revenue per employee, and NOCs with 300,000 employees are associated with 2.2 times lower revenue per employee than IOCs of the same size. Thus, NOCs generally have lower revenue per employee and more employees compared with the private companies, and in general, the larger the NOC, the more bloated the payroll. NOCs that are particularly overpopulated include PetroChina, Sinopec, Gazprom, NIOC and Pemex.

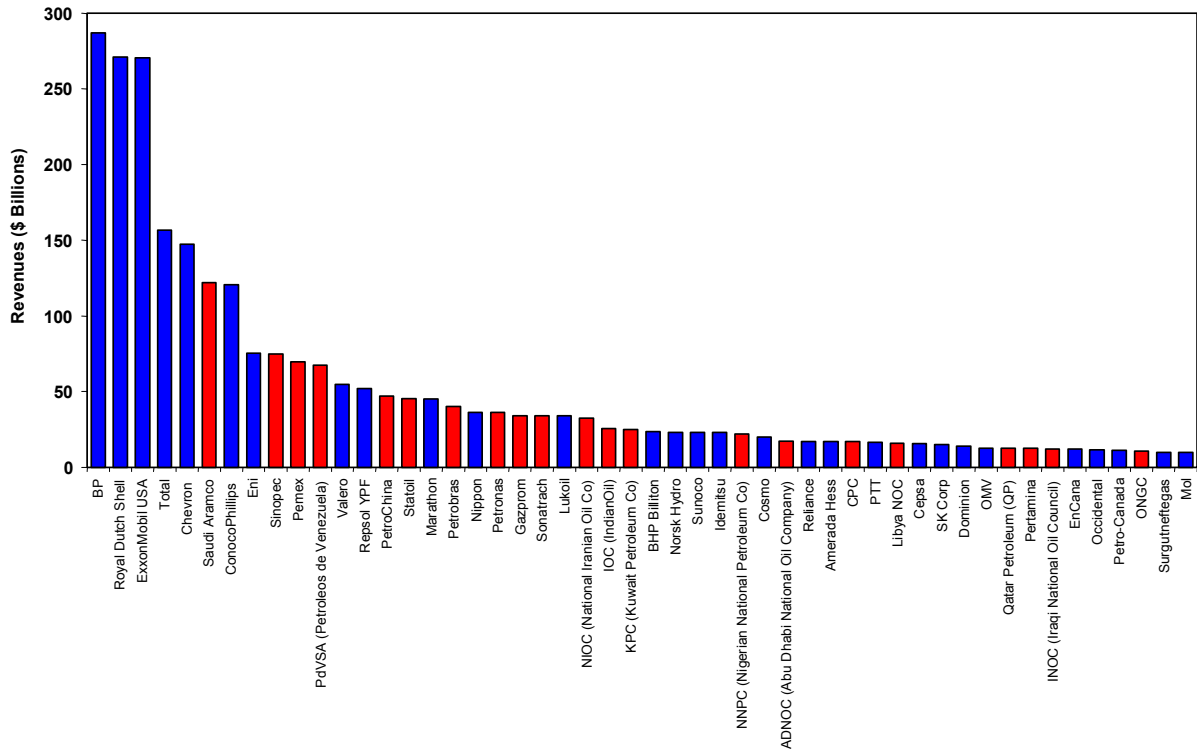


Figure 11. Revenues for Top 50 NOCs (red) and IOCs (blue) in 2004

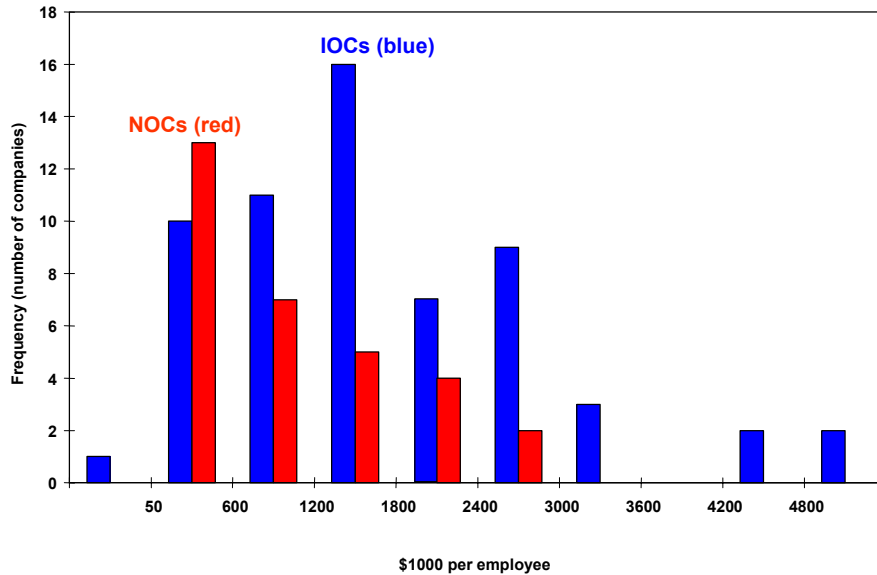


Figure 12. Histogram of NOCs (red) and IOCs (blue) Revenue per Employee in 2004. Statistics for NOCs: Mean = \$962,000; Median = \$773,000. Statistics for IOCs: Mean = \$1,807,000; Median = \$1,532,000.

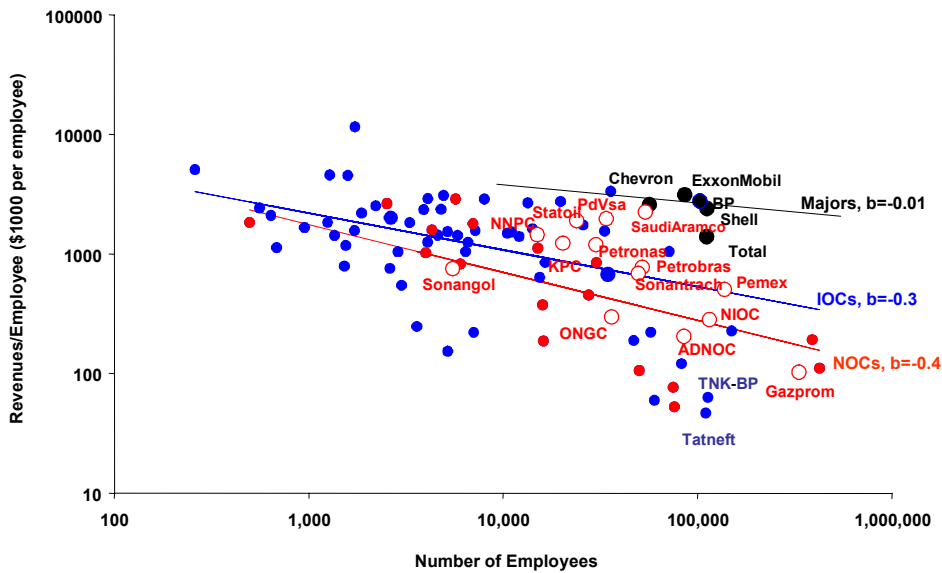


Figure 13. NOCs (red), Majors (black) and IOCs (blue) Revenue/Employee versus Number of Employees in 2004

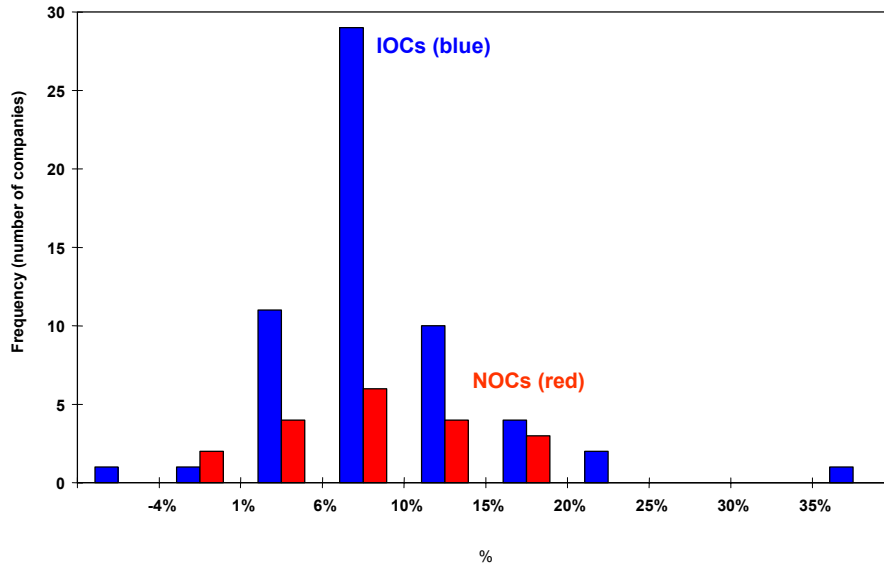


Figure 14. Histogram of NOCs (red) and IOCs (blue) Return on Assets (ratio of Net Income to Total Assets) in 2004

Return on assets – the ratio of net income to total assets - is an important indicator of the company’s performance. Figure 14 shows that profitability has a normal distribution for both NOCs and IOCs. Mean and median for IOCs is 9%, higher than for NOCs (8%). The following IOCs have return on assets greater than 18%: PetroKazakhstan, Sibneft, Tatneft, TNK-BP, TPAO, Vintage and Woodside Petroleum.

Figure 15 considers the return on assets as a function of total assets for each company. No strong relationship is observed between profitability and asset base, although it should be noted that there is some ambiguity in company comparisons due to the possibility that different state energy sectors could be applying different definitions of net income or assets. In general, within-country conclusions should be reasonably valid – among Russian companies, for example, TNK-BP performs better than Lukoil and much better than Gazprom.

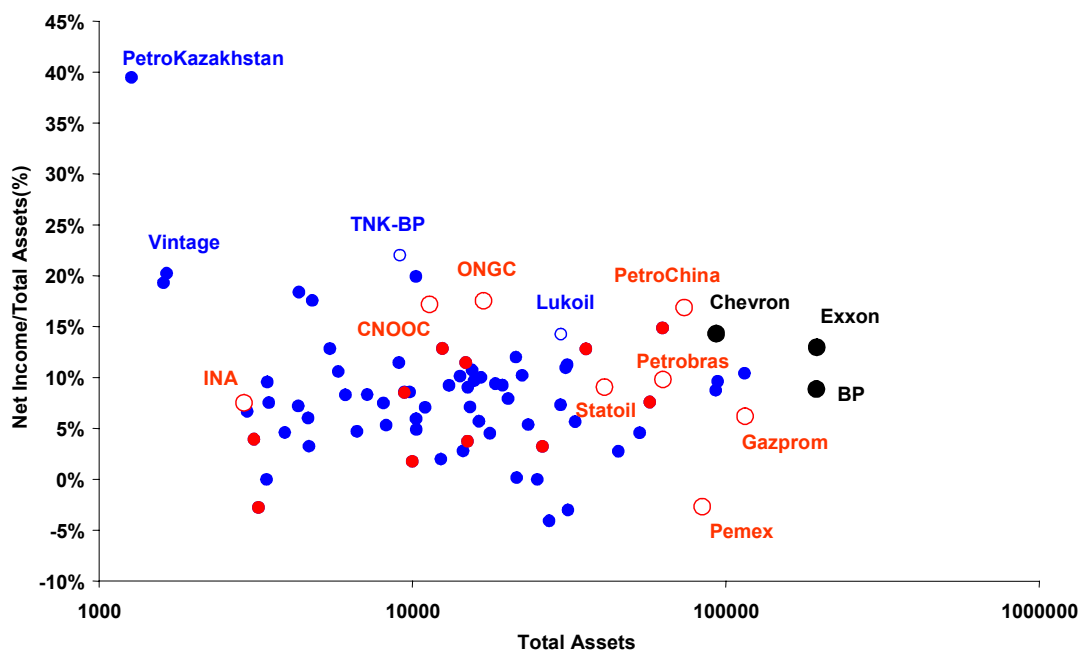


Figure 15. Return on Assets versus Total Assets for NOCs (red), IOCs (blue), and Majors (black) in 2004

Overall, the financial indicators considered in this section suggest that economy of scale is of lesser advantage than often thought—especially for NOCs. NOCs are systematically associated with much larger reserves bases, but their efficiency is generally lower than IOCs, lower than small NOCs, and especially deficient when compared with the major IOCs.

D. Production Function Analysis: NOCs versus IOCs

1. “Dead” Oil and Gas

We apply a simple production function in order to analyze how NOCs and IOCs actually transform their reserves base into productive output. As inputs to production we used liquid and gas reserves (separately) and estimated production through a following simple regression equation:

$$Y = a \cdot X^b,$$

where Y is production (oil or gas), X is oil or gas reserves and b is estimated by regression.

The full results of the analysis are shown in Appendix 5 for the IOCs and NOCs as well as the Majors. The relationship between oil and gas output and oil and gas reserves (R^2) is strong. The relationships are stronger for oil than for gas, which probably reflects that it is harder to develop and market gas resources when compared with oil as well as the fact that many companies are more attentive to oil opportunities than gas.

The results of regression analysis for the Majors show that they are most efficient in using their reserves: doubling reserves leads to a 50% increase in oil production by the majors, a 43% increase for IOCs and a 38% increase for NOCs. Put differently, the majors are nearly one-third better than NOCs at converting oil reserves into actual output. (A thought experiment: if all the oil reserves controlled by the NOCs were in the hands of the Majors, world production would be about 140 mbd higher.) Current NOC production could be achieved by the majors with a reserve base that is about 700 billion barrels smaller—suggesting that in the hands of NOCs 700 billion barrels of reserves is “dead oil.” That implies that much of the discussion about classification of reserves has actually missed the point. The characteristics of the producing firm are, arguably, more important than geology in determining the actual level of productive reserves.

For gas, the IOCs and Majors are about equal in their ability to convert reserves to production. (A doubling of reserves leads to a 43% increase in output for both.) However, the Majors and IOCs are more than twice as effective as the NOCs in converting gas reserves to output. Perhaps 55% of the world’s gas reserves are presently “dead” because their title is held by NOCs.

Figures 16 (oil) and 17 (gas) show these results and include regression lines for the different categories of firms. Using the lines for the Majors as a production frontier—a line that suggests the behavior of an efficient firm—indicates the enterprises that fall short of (below) the frontier.

The reason for the larger “dead” reserves associated with NOCs is that they have different economic drivers than IOCs. IOCs try to produce rapidly in order to maximize their financial returns. NOCs, by contrast, often reflect the interests of their host government, which often includes prolonging time of recovery and spreading revenues over future generations. Put differently, IOCs and NOCs operate with different desired depletion rates.

Figure 18 and Figure 19 show “dead” oil and “dead” gas versus states’ oil and gas reserves per capita. The figures show that estimations for “dead” oil and gas increase with reserves. These figures also show that three general types of NOCs can be identified. First, there are NOCs of the countries with high reserves per capita level that belong to OPEC (for example, Saudi Aramco, NIOC, ADNOC, KPC, PdVSA) and, thus, are supposed to follow the OPEC’s quotas arrangement for oil production. Second, there are NOCs from large oil-importing countries with low reserves per capita level, which are focused on building reserves and production domestically and internationally, and meanwhile are trying to keep the reserves of their countries for the “rainy” days (for example, PetroChina, ONGC, CNOOC). Third, there are NOCs that we can’t see on

these figures that have reduced state control to increase value through greater access to international financial markets, and have minimal or no “dead” reserves.

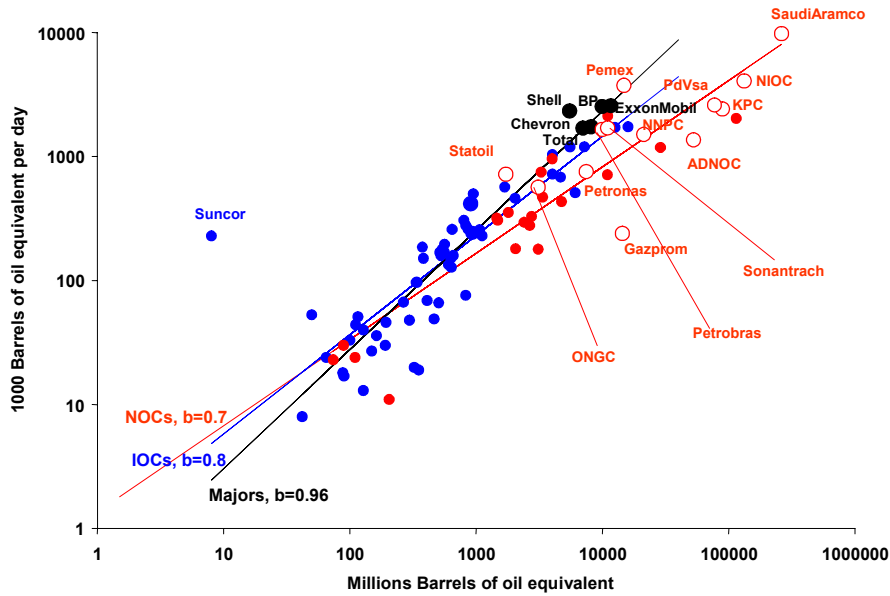


Figure 16. NOCs (red), IOCs (blue) and Majors (black) Liquids Output versus Liquids Reserves in 2004

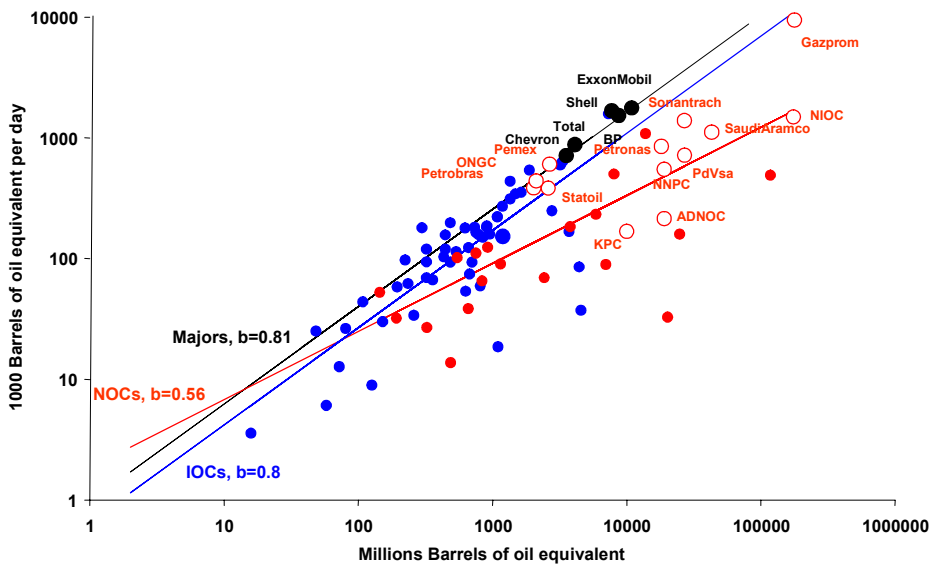


Figure 17. NOCs (red), IOCs (blue) and Majors (black) Gas Output versus Gas Reserves in 2004

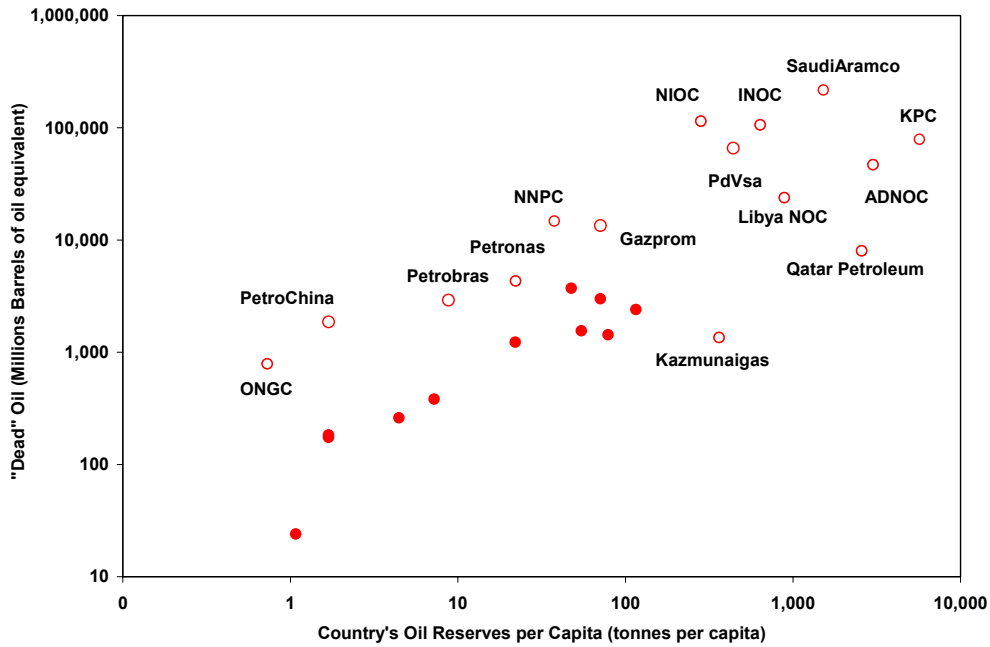


Figure 18. "Dead" oil by NOC versus country oil reserves per capita in 2004. Data source: PIW (2006), BP (2006), WB (2006). Note: Ecopetrol and Statoil are not shown on this figure as they are extracting their oil reserves with the same efficiency as the global majors.

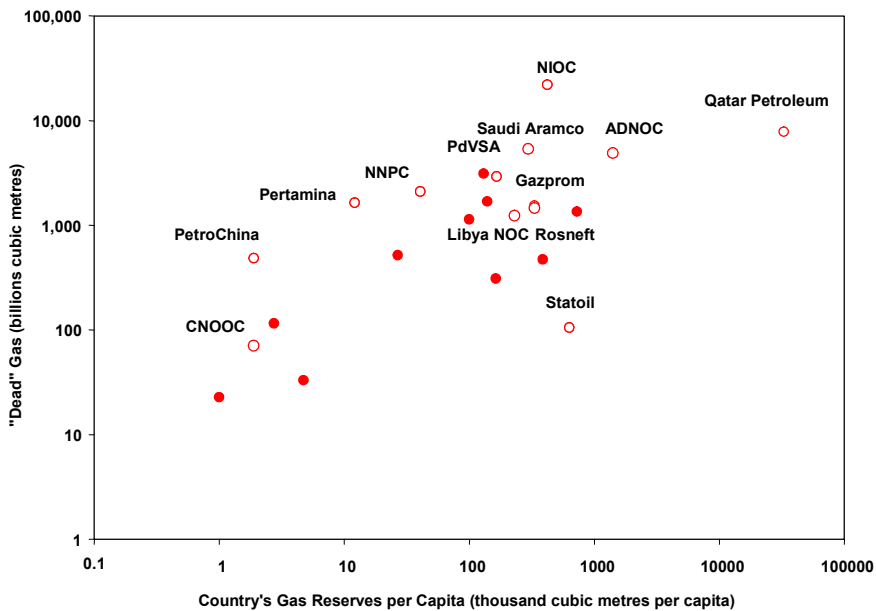


Figure 19. "Dead" gas by NOC versus country gas reserves per capita in 2004. Data source: PIW (2006), BP (2006), WB (2006). Note: Pemex, Petrobras and Sinopec are not

shown on this figure as they are extracting their gas reserves with the same efficiency as the global majors.

2. “Dead” Revenues

We can perform a similar analysis of the efficiency with which the companies generate revenues. Figure 20 shows NOCs, IOCs and the Majors’ revenues plotted against their total output and regression equations lines. We estimated revenues through the following simple regression equation:

$$Y = a \cdot X^b,$$

where Y is revenues (total sales), X is oil and gas production and b is estimated by regression. Results of the regressions for each category of firm—NOCs, IOCs, and Majors—are shown in Appendix 6.

For the Majors, increasing output by 100% leads to an almost 60% increase in revenues. For IOCs, revenues would rise 43% from a doubling of output. For NOCs the increase is only by 32%. The NOCs located below the “NOCs” regression line indicate firms that do poorly even by the standards of NOCs—for example, Gazprom and NIOC. (However, Gazprom’s performance has improved relative to the field in the two years since.) These results partially reflect the situation when NOCs are required to sell of products at lower prices on the internal market, with the result that losses mount as output increases. The NOCs of PdVSA, Pemex, Petrobras and Saudi Aramco are located on the IOCs regression line, which indicates that they are about as efficient in generation of their revenues as the IOCs. These results may be surprising for Pemex, which is often thought to be far off the efficient frontier, and may reflect the firm’s relatively large revenues from non-crude operations such as petrochemicals and refining. They are also surprising for PdVSA, although 2004 was a year of transition for the firm and performance is likely to be worse in more recent years. Norway’s Statoil, generally considered to be a high performing NOC, is on the Major’s regression line.

Companies that have a large weight in downstream activities, rather than being concentrated in upstream, are at the left side of Figure 20 – for example, Cosmo, SK, and CPC. The relatively high revenue levels earned in refining and marketing suggest that conditions in the petroleum products markets, including the gasoline, diesel, and jet fuel segments, contributed to earned revenues above and beyond the effect of higher crude oil prices.

If we apply the IOCs regression equation to estimate NOCs revenues we find that lost (“dead”) revenues are equal to the earnings from selling more than 20 million barrels of oil per day. The Gazprom case is particularly remarkable as in 2004 it generated much less revenue even in comparison with other NOCs. If we apply the NOCs regression equation to estimate Gazprom’s possible revenues in 2004 and take into account the

difference between oil and gas prices, we find that 3 million barrels a day of gas output (or about 170 BCM) was “dead” for the company.³

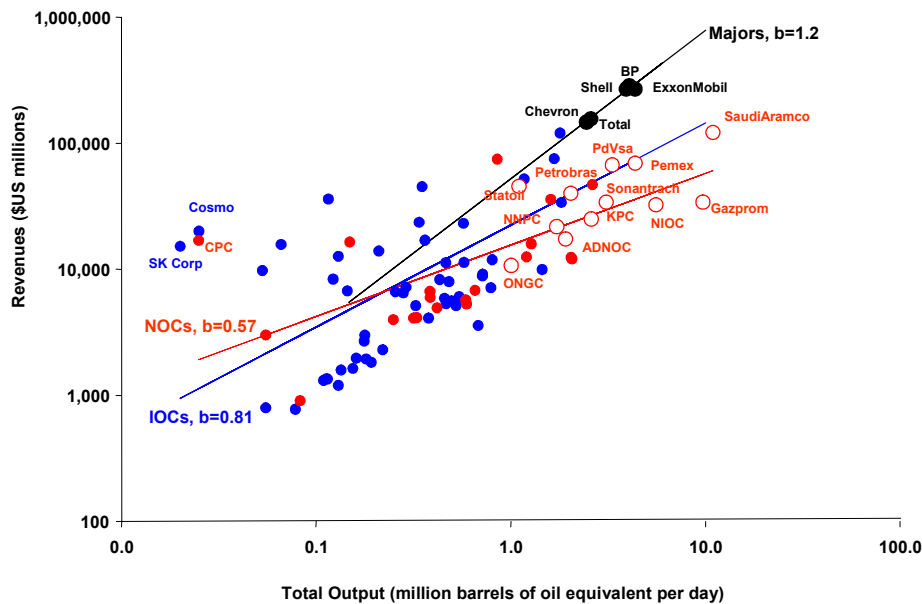


Figure 20. NOCs (red), IOCs (blue) and Majors (black) Revenues versus Total Output in 2004

Similar analysis of other financial indicators, such as profit margin or total assets, could be misleading for the following reasons. IOCs face a significant degree of depletion of existing oil fields and depreciation on previous capital investments, meaning huge investments are required just to maintain the status quo. Standard accounting conventions recognize this by subtracting depreciation and depletion as an operating expense, with the presumption being that the investment that would be necessary in order to maintain current production would be counted as a regular business expense rather than something one needs to pay for out of profits. NOCs that have the largest asset base also generally have easy oil and gas, so they can generate revenues with lower expenses. In addition, some of the NOCs with large asset bases earn profit on fields that are operated by IOCs.

³ According to Gazprom’s annual reports, in 2004 Gazprom sold inside of Russia 209 BCM of gas (at average price that was about one quarter of European price) and in the countries of Former Soviet Union 66 BCM of gas (at average price that was about third of European price). On the base of Gazprom’s financial reports we estimated that Gazprom lost \$25 billion in 2004 or about 180 BCM of gas because of the artificially low prices.

Conclusions

The first conclusion is rather a trivial one: NOCs and their governments, not IOCs and their shareholders, largely control the development of upstream oil and gas resources. This has raised concerns as states tend to have strong effects on investment and operational decisions of NOCs, and most NOCs are substantially less efficient than IOCs.

Second: though market capitalization is an imperfect indicator for measuring performance, our analysis shows that reported market values for IOCs are close to regressions estimations and this simple approach can be used to estimate market capitalizations of NOCs that are not publicly traded.

Third: the analysis of distributions across different indicators suggests that size matters less in the oil and gas industry than commonly thought, especially for NOCs. While NOCs are systematically associated with much larger reserves bases, their efficiency is generally lower than in IOCs.

Fourth: Majors are more efficient in using their reserves and are nearly one-third better at converting reserves into actual output. Current production by NOCs could be achieved by the majors with a reserve base that is about 700 billion barrels smaller—suggesting that in the hands of NOCs 700 billion barrels of reserves is “dead oil.” That implies that much of the discussion about classification of reserves has actually missed the point and that the characteristics of the producing firm are, arguably, more important than the geology.

Fifth: if NOCs are under tight state control, they not only tend to develop their reserves to a lesser extent, but also do not generate revenue from their output with the same efficiency as IOCs. “Dead” revenues from NOCs are due to many factors, such as investment strategies, government-required slower depletion rates, and subsidies for employment and delivered products.

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Appendix 1

The indicators from Energy Intelligence's Top 100 used in this paper provide the following information on oil and gas companies⁴:

- Ownership (%)
- PIW Index
- Liquids Reserves (Millions Barrels of oil equivalent)
- Gas Reserves (Bcf)
- Liquids Output (1000 Barrels per day)
- Gas Output (MMcf per day)
- Refinery Capacity, 1000b/d
- Product Sales, 1000b/d
- Revenues, \$ Millions
- Net Income, \$ Millions
- Total Assets, \$ Millions
- Number of employees
- Market Value, (\$US Bill.)
- Share Price Change
- 2003 Sales (US\$mn)
- % share of total sales

On the base of above indicators we have calculated the following values:

- Return on Assets (Net Income/Total Assets)
- Total Output per Employee
- Revenues per Employee
- Revenues per Output
- Net Income and Revenue Ratio
- Net Income per Employee
- Net Income per Output
- Total Assets and Combine Oil & Gas Reserves Ratio

⁴ Though this information is available on IOCs, the financial indicators for NOCs usually are not available and the information is limited by oil and gas reserves, output and number of employees.

Appendix 2

100 Oil Companies: Market Capitalization versus Total Output, 2004

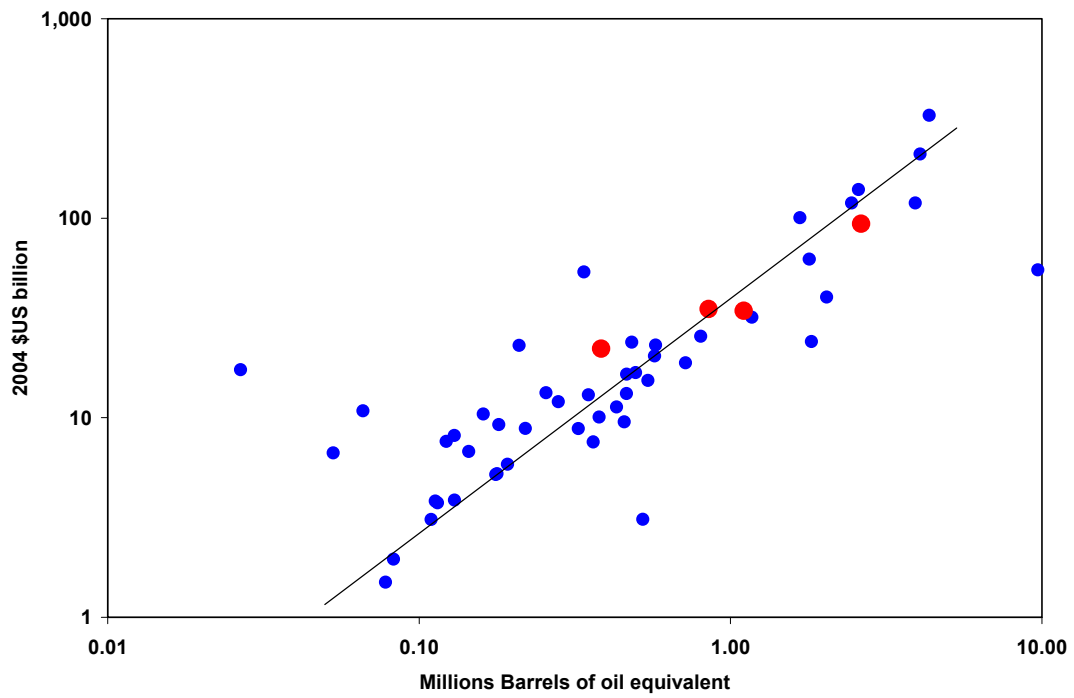


Figure A2-1.

100 Oil Companies: Market Capitalization versus Revenue, 2004

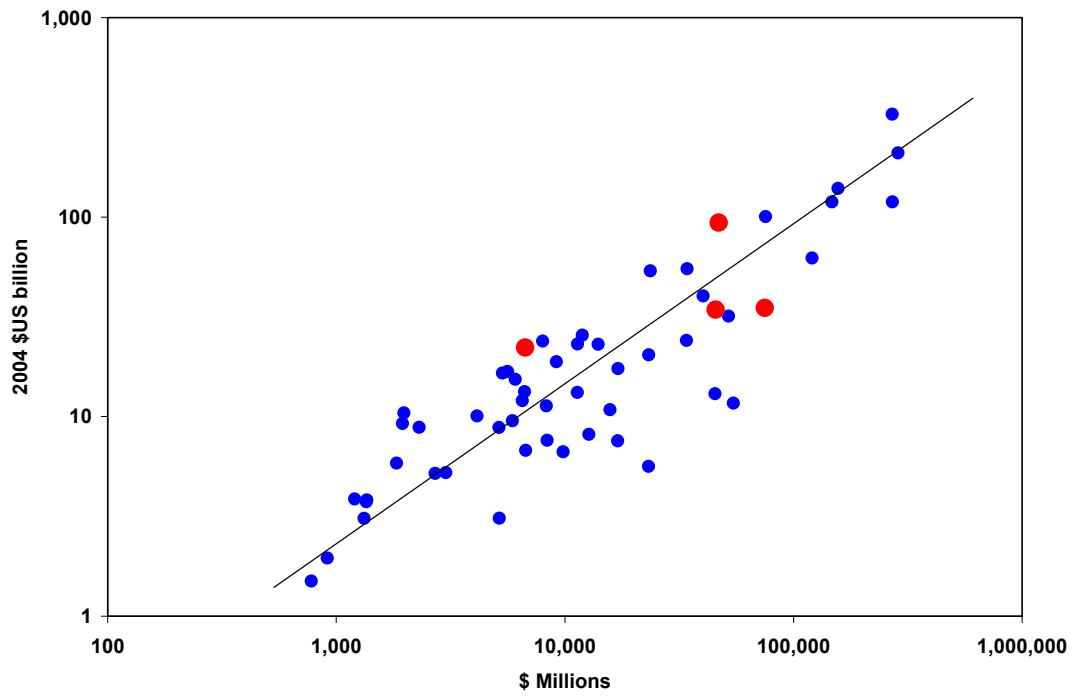


Figure A2-2.

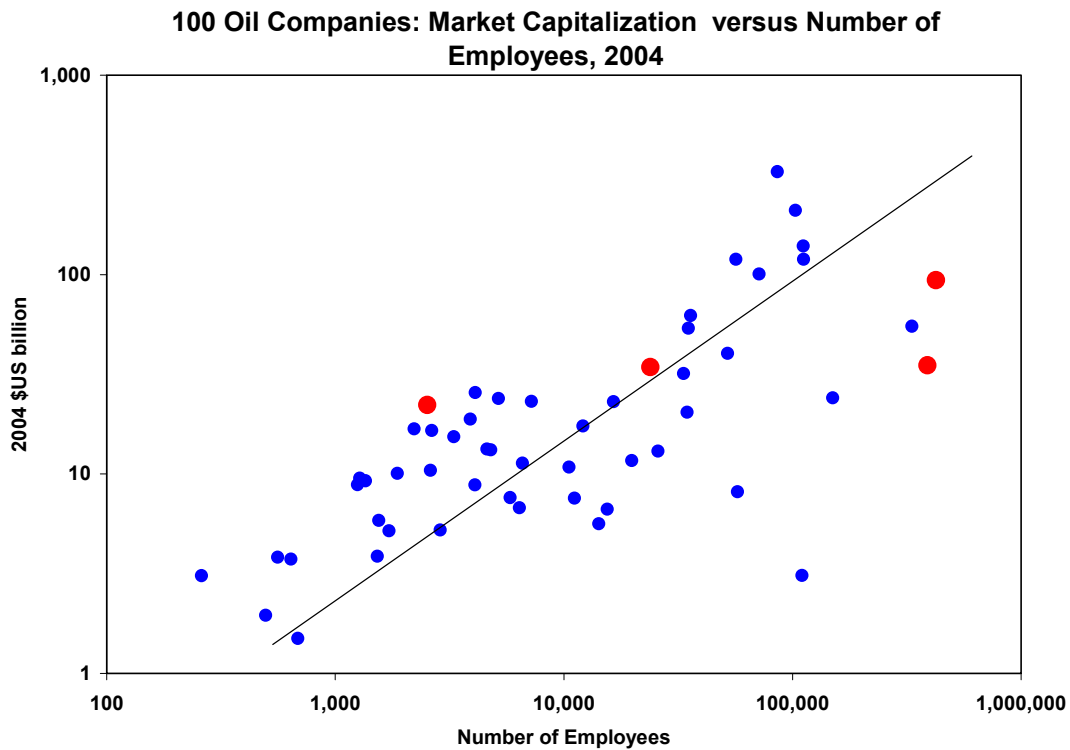


Figure A2-3.

Appendix 3

Results of Nonlinear Regression Analysis of Market Capitalization

Regression Equation #1

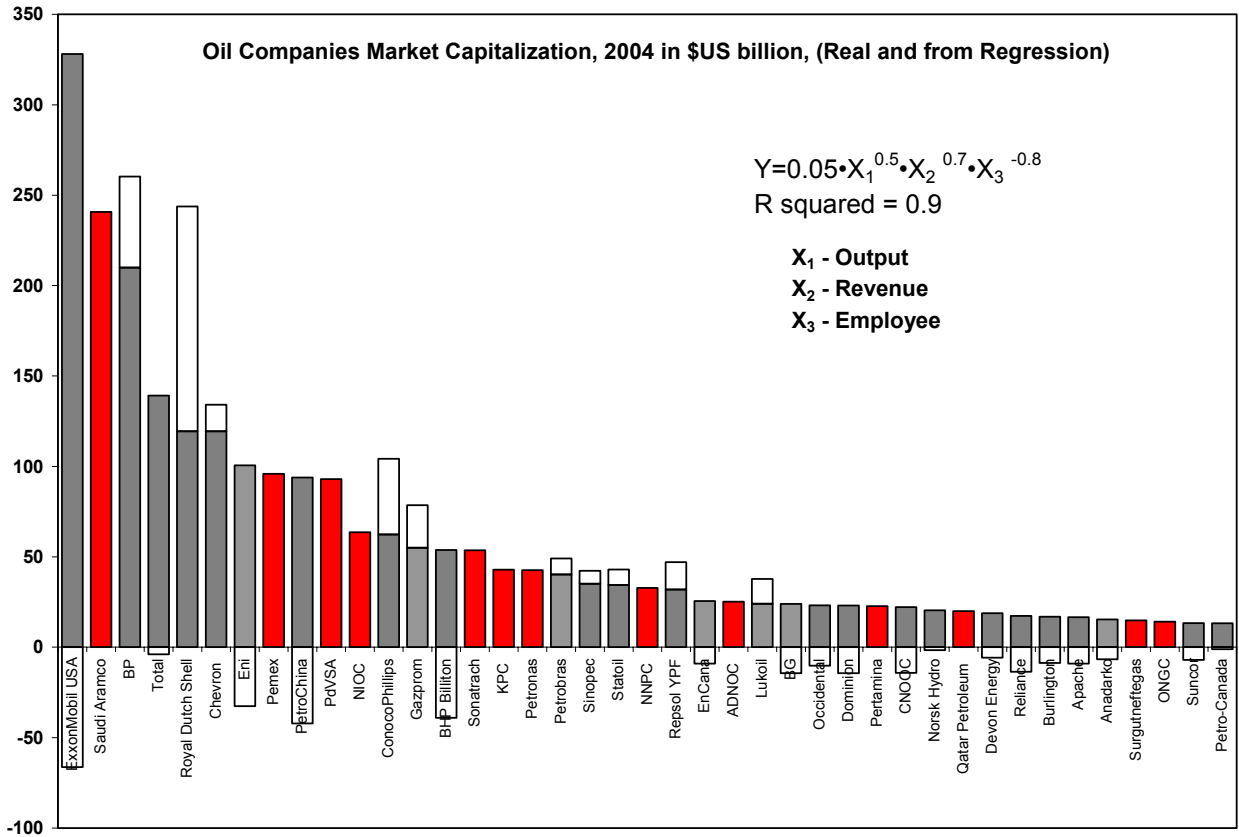


Figure A3-1. Oil Companies market capitalization (real and from regressions) for model #1. The red columns show regression estimations for the companies that are not introduced on the market. The grey columns show the real market capitalization data. The white columns show our estimations of market capitalization's overvaluation (if negative) and undervaluation (if positive) for the companies are presented in the market.

$$Y = a \cdot X_1^b \cdot X_2^c \cdot X_3^d$$

Where Y is market capitalization; X₁ is total output; X₂ is revenue and X₃ is number of employees

Parameter Estimates

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	.048	.073	-.100	.196
b	.478	.134	.207	.748
c	.711	.078	.554	.868
d	-.087	.099	-.287	.112

Correlations of Parameter Estimates

	a	b	c	d
a	1.000	.717	-.746	-.831
b	.717	1.000	-.588	-.622
c	-.746	-.588	1.000	.256
d	-.831	-.622	.256	1.000

ANOVA(a)

Source	Sum of Squares	df	Mean Squares
Regression	209630.313	4	52407.578
Residual	16152.585	46	351.143
Uncorrected Total	225782.898	50	
Corrected Total	165936.938	49	

Dependent variable: capitalization

a R squared = 1 - (Residual Sum of Squares) / (Corrected Sum of Squares) = .903.

Regression Equation #2

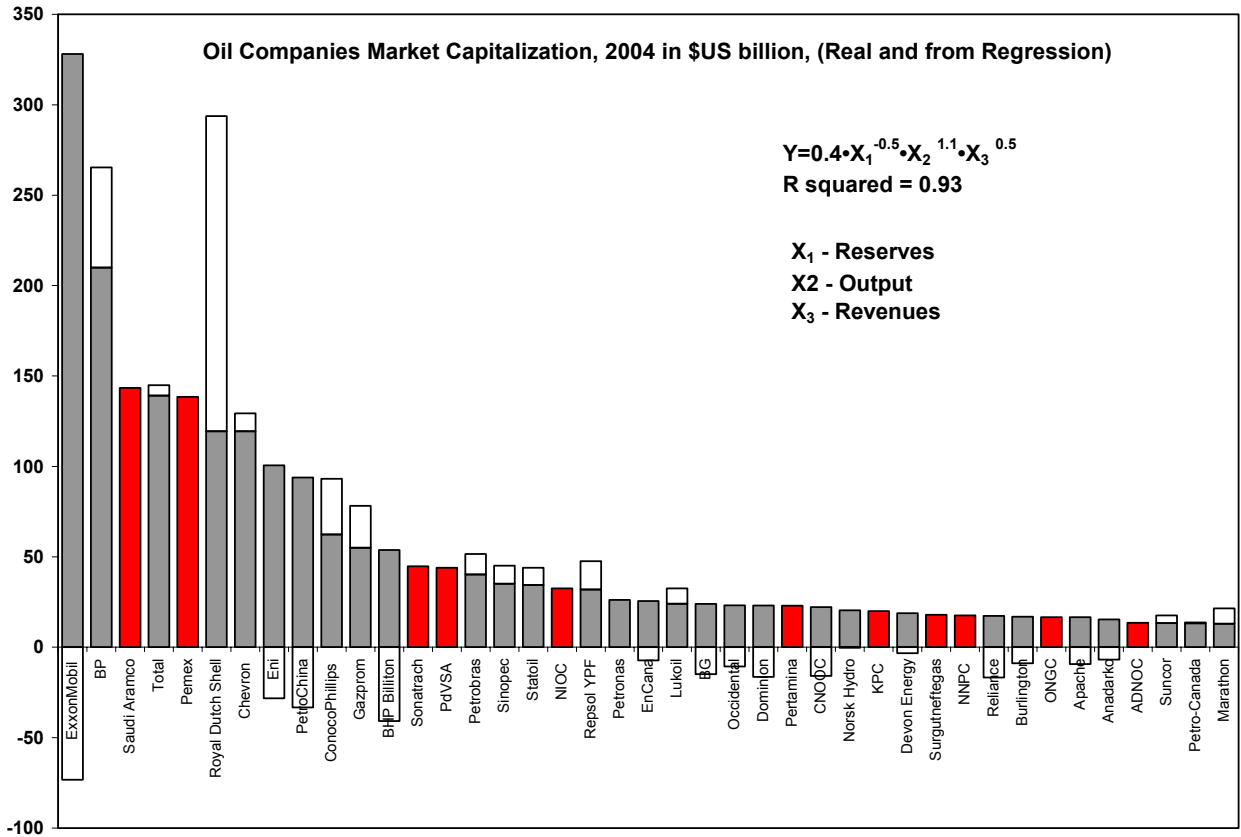


Figure A3-2. Oil Companies market capitalization (real and from regressions). The red columns show regression estimations for the companies that are not introduced on the market. The grey columns show the real market capitalization data. The white columns show our estimations of market capitalization's overvaluation (if negative) and undervaluation (if positive) for the companies are presented on the market.

$$Y = a \cdot X_1^b \cdot X_2^c \cdot X_3^d$$

Where Y is market capitalization; X₁ is reserves; X₂ is total output and X₃ is revenues.

Parameter Estimates

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	.239	.636	-1.041	1.520
b	-.459	.446	-1.357	.439
c	1.137	.716	-.304	2.579
d	.538	.190	.156	.920

Correlations of Parameter Estimates

	a	b	c	d
a	1.000	-.949	.960	-.995
b	-.949	1.000	-.989	.920
c	.960	-.989	1.000	-.943
d	-.995	.920	-.943	1.000

ANOVA^a

Source	Sum of Squares	df	Mean Squares
Regression	209678.2	4	52419.545
Residual	16104.719	46	350.103
Uncorrected Total	225782.9	50	
Corrected Total	165936.9	49	

Dependent variable: capitalization

a. R squared = 1 - (Residual Sum of Squares) / (Corrected Sum of Squares) = .903.

Regression Equation #3

$$Y = a \cdot X_1^b \cdot X_2^c$$

Where Y is market capitalization; X₁ is total output and X₃ is revenues.

Parameter Estimates

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
a	.015	.013	-.011	.041
b	.411	.103	.203	.619
c	.732	.075	.581	.882

Correlations of Parameter Estimates

	a	b	c
a	1.000	.431	-.991
b	.431	1.000	-.540
c	-.991	-.540	1.000

ANOVA^a

Source	Sum of Squares	df	Mean Squares
Regression	209400.7	3	69800.227
Residual	16382.217	47	348.558
Uncorrected Total	225782.9	50	
Corrected Total	165936.9	49	

Dependent variable: capitalization

a. $R^2 = 1 - (\text{Residual Sum of Squares}) / (\text{Corrected Sum of Squares}) = .901$.

Appendix 4

1. Summary output for IOC's (including Majors) regression of revenue per employees as a function of number of employees.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.44
R Square	0.20
Adjusted R Square	0.18
Standard Error	0.44
Observations	61

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	2.83	2.83	14.31	0.00
Residual	59	11.67	0.20		
Total	60	14.50			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	4.27	0.32	13.17	0.00	3.62	4.92	3.62	4.92
X Variable 1	-0.31	0.08	-3.78	0.00	-0.47	-0.15	-0.47	-0.15

2. Summary output for IOC's (including Majors) regression of revenue per employees as a function of number of employees.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.61
R Square	0.37
Adjusted R Square	0.34
Standard Error	0.40
Observations	23

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	1.959	1.959	12.344	0.002
Residual	21	3.333	0.159		
Total	22	5.292			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	4.45	0.51	8.72	0.00	3.39	5.51	3.39	5.51
X Variable 1	-0.40	0.11	-3.51	0.00	-0.64	-0.16	-0.64	-0.16

Appendix 5

1. Summary output for IOC's (including Majors) of oil production as a function of oil reserves production

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.86
R Square	0.75
Adjusted R Square	0.74
Standard Error	0.33
Observations	60

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	18.5	18.51	171.30	5.84463E-19
Residual	58	6.3	0.11		
Total	59	24.8			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.04	0.18	-0.20	0.84	-0.39	0.32	-0.39	0.32
X Variable 1	0.80	0.06	13.09	0.00	0.68	0.92	0.68	0.92

2. Summary output for Majors' of oil production as a function of oil reserves production

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.93
R Square	0.87
Adjusted R Square	0.81
Standard Error	0.04
Observations	4

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.025996	0.025996	13.89965	0.065007
Residual	2	0.003741	0.00187		
Total	3	0.029737			

	<i>Coefficient</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.48	1.02	-0.47	0.69	-4.86	3.91	-4.86	3.91
X Variable 1	0.96	0.26	3.73	0.07	-0.15	2.07	-0.15	2.07

3. Summary output for NOCs of oil production as a function of oil reserves production

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.91
R Square	0.83
Adjusted R Square	0.82
Standard Error	0.29
Observations	33

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	12.28	12.28	149.75	0.00
Residual	31	2.54	0.08		
Total	32	14.82			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.13	0.22	0.60	0.55	-0.31	0.58	-0.31	0.58
X Variable 1	0.70	0.06	12.24	0.00	0.58	0.81	0.58	0.81

4. Summary output for IOCs (including Majors) of gas production as a function of gas reserves production

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.83
R Square	0.69
Adjusted R Square	0.68
Standard Error	0.32
Observations	57

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	12.52	12.52	122.73	0.00
Residual	55	5.61	0.10		
Total	56	18.12			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	-0.18	0.21	-0.86	0.39	-0.60	0.24
X Variable 1	0.80	0.07	11.08	0.00	0.66	0.94

5. Summary output for Majors' of gas production as a function of gas reserves production

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.98
R Square	0.95
Adjusted R Squar	0.94
Standard Error	0.04
Observations	5

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>ignificance F</i>
Regression	1	0.117815	0.117815	59.24648	0.004557
Residual	3	0.005966	0.001989		
Total	4	0.12378			

	<i>Coefficients</i>	<i>andard Err</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>ower 95.0%</i>	<i>pper 95.0%</i>
Intercept	-0.01	0.40	-0.02	0.98	-1.29	1.27	-1.29	1.27
X Variable 1	0.81	0.11	7.70	0.00	0.48	1.15	0.48	1.15

6. Summary output for NOCs of gas production as a function of gas reserves production

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.76
R Square	0.58
Adjusted R	0.56
Standard E	0.41
Observatio	32

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>ignificance F</i>
Regressior	1	6.992023	6.992023	40.86754	4.68E-07
Residual	30	5.132698	0.17109		
Total	31	12.12472			

	<i>Coefficients</i>	<i>andard Err</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>ower 95.0%</i>	<i>pper 95.0%</i>
Intercept	0.27	0.33	0.82	0.42	-0.41	0.95	-0.41	0.95
X Variable	0.56	0.09	6.39	0.00	0.38	0.74	0.38	0.74

Appendix 6

1. Summary revenues for IOC's (including Majors) regression of revenue as a function of total output.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.660204
R Square	0.43587
Adjusted R	0.425423
Standard E	0.492906
Observatio	56

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>ignificance F</i>
Regressor	1	10.13677	10.13677	41.72256	3.1E-08
Residual	54	13.11965	0.242957		
Total	55	23.25642			

	<i>Coefficients</i>	<i>standard Err</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>ower 95.0%</i>
Intercept	4.351747	0.088243	49.31545	1.36E-46	4.17483	4.528664	4.17483
X Variable	0.809085	0.125259	6.4593	3.1E-08	0.557955	1.060214	0.557955

2. Summary revenues for Majors' regression of revenue as a function of total output.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.986041
R Square	0.972276
Adjusted R	0.963035
Standard E	0.027422
Observatio	5

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regressor	1	0.079114	0.079114	105.2104	0.00197569
Residual	3	0.002256	0.000752		
Total	4	0.08137			

	<i>Coefficient</i>	<i>standard Err</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>ower 95.0%</i>
Intercept	4.708947	0.062459	75.39242	5.14E-06	4.510173845	4.90772	4.510174
X Variable	1.189772	0.115994	10.25721	0.001976	0.820627802	1.558916	0.820628

3. Summary revenues for NOC's regression of revenue as a function of total output.

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.715259
R Square	0.511595
Adjusted R Square	0.495315
Standard Error	0.347504
Observations	32

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>ignificance F</i>
Regression	1	3.794783	3.794783	31.42449	4.22E-06
Residual	30	3.622764	0.120759		
Total	31	7.417547			

	<i>Coefficient</i>	<i>standard Err</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>ower 95.0%</i>
Intercept	4.193575	0.061536	68.14885	1.87E-34	4.067902	4.319247	4.06790
X Variable 1	0.566697	0.101092	5.605755	4.22E-06	0.36024	0.773155	0.3602

Appendix 7

Ranking Oil Companies: The Platts Top 250 Global Energy Companies List and PIW Ranking

There has been surprisingly little systematic research on oil companies' performance evaluation and comparison NOCs and IOCs performances. One of the information sources in addition to Energy Intelligence (used in this paper) is the Platts Top 250 global survey which measures financial performance by examining each company's assets, revenues, profits, and return on invested capital. The underlying data come from a database- Compustat®-compiled and maintained by Standard & Poor's. Energy companies were grouped according to their Global Industry Classification Standard (GICS) code and include the following industries (see <http://www.platts.com/top250>):

- Coal and Consumable Fuels
- Diversified Utility
- Electric Utility
- Exploration and Production
- Gas Utility
- Independent Power Producers
- Integrated Oil and Gas
- Refining and Marketing
- Storage and Transfer

The company rankings are derived using a special Platts formula that is added each company's numerical ranking by different financial indicators. It assigned a rank of 1 to the company with the lowest total, 2 to the company with the second-lowest total, and so on. All energy companies ranked have assets greater than (U.S.) \$2 billion and of the top 20 companies, 16 are integrated oil and gas companies (IOCs). The following 32 oil and gas companies from the Platts Top 250 Global Energy Companies' list are relevant for our study:

- ExxonMobil Corp (1)
- Royal Dutch Shell (2)
- BP (3)
- Total (4)
- ConocoPhillips (5)
- Petrochina Co (6)
- Chevron Corp (7)
- Petrobras Brasileiro (8)
- ENI SpA (9)
- Statoil ASA (10)
- Marathon Oil (12)

- Occidental Petroleum (13)
- China Petroleum (14)
- LUKoil (15)
- Repsol YPF SA (16)
- Gazprom OAO (19)
- Imperial Oil Ltd (24)
- PTT Pcl (31)
- BG Group plc (33)
- OMV AG (40)
- Hess Corp (45)
- CEPSA (50)
- Petro-Canada (52)
- Shell Canada Ltd (53)
- Gazprom Neft (54)
- YPF SA (60)
- Husky Energy Inc (61)
- MOL (62)
- Murphy Oil Corp (73)
- Suncor Energy Inc (85)
- Petrobras Energia SA (182)
- Origin Energy Ltd (216)

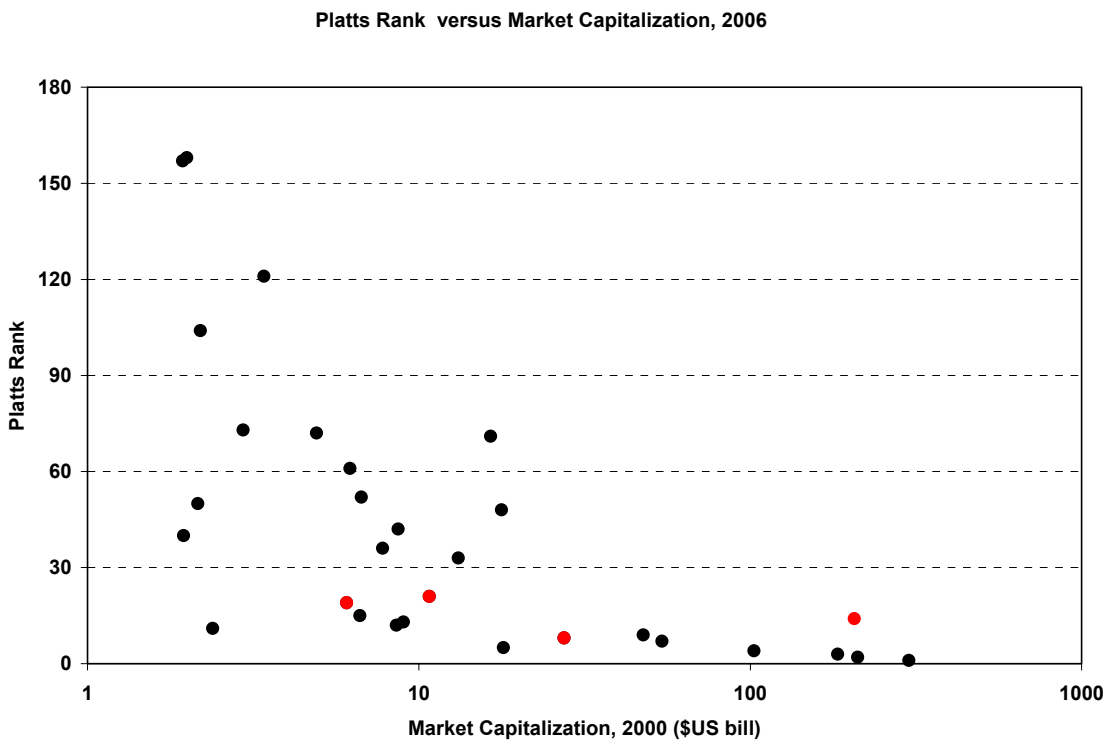


Figure A7-1.

The Platts ranking method, based on financial indicators, should correlate with market capitalization's figures (the aggregate value of a company or stock). However, the relationship between the Platts ranks and market capitalization actually is not very strong (see Figure A7-1). It seems that market capitalization figures are able to provide more relevant information for performance evaluation than ranking.

Petroleum Intelligence Weekly annually ranks the world's 50 largest oil companies. The ranking is based on six operational criteria (not only financial indicators) that allow the comparison of private sector and state-owned oil companies. Firms are compared in six different operational areas with companies assigned a separate rank within each category. The six individual ranks are then added together to determine the cumulative, overall position, with each of the six criteria given an equal weighting. Where feasible, real data are used. Estimates are used mainly for state-owned oil companies that do not release regular or complete annual reports in a timely fashion. PIW's system of ranking tends to favor national oil companies with large oil and gas reserves and to favor integrated concerns over firms that specialize in one industry sector. Table 1 shows the list of NOCs with PIW ranking.

In 2005, according to PIW, Saudi Aramco and Exxon Mobil remain entrenched at the top. With high oil prices continuing to fuel resource nationalism among the traditional 100% state-owned national oil companies, the most impressive gains came from hybrid, partly state-owned firms from emerging economies including Russia, China and India. Half of the 20 firms advancing in Top 50 are state-controlled, evidence of their continued and increasing dominance. Saudi Aramco is a permanent holder of the top spot. Gazprom, aided by its acquisition of Sibneft, continues to forge ahead and PetroChina moved into the top ten to reach 7th place.

Figure A7-2 shows the imperfect relationship between PIW and Platt's ranks.

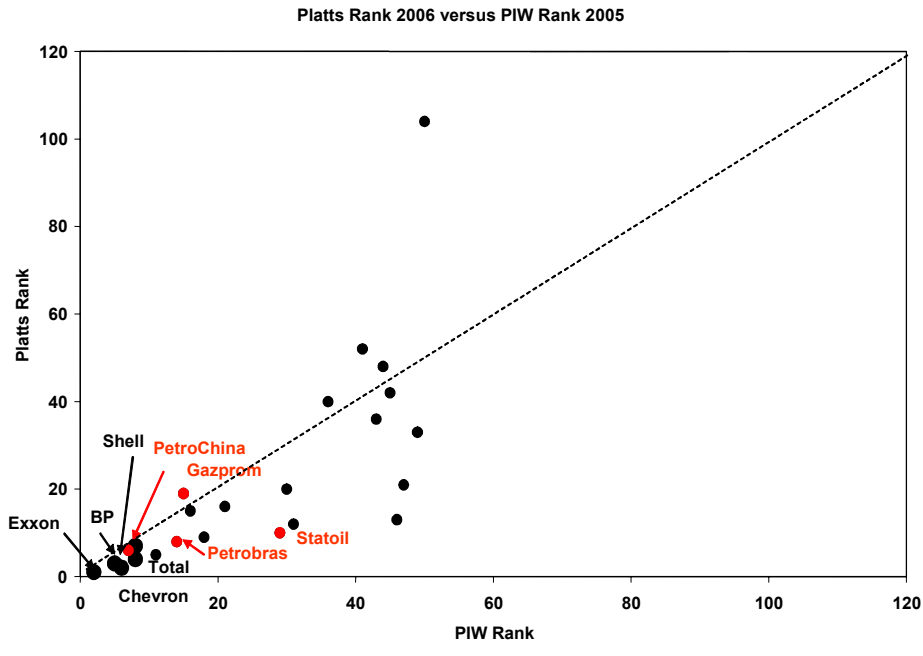


Figure A7-2.

Table A7-1. NOC's in PIW ranking of the world's 50 largest oil companies.

Rank 2005	Rank 2004	PIW Index	Company	Country	State Ownership (%)
1	1	30	Saudi Aramco	Saudi Arabia	100
3	4	39	NIOC	Iran	100
4	3	44	PDV	Venezuela	100
7	9	68	PetroChina	China	90
10	9	83	Pemex	Mexico	100
12	12	96	Sonatrach	Algeria	100
13	13	100	KPC	Kuwait	100
14	14	106	Petrobras	Brazil	32
15	24	108	Gazprom	Russia	50
17	16	132	Adnoc	UAE	100
19	18	137	Petronas	Malaysia	100
20	21	143	NNPC	Nigeria	100
22	25	156	LibyaNOC	Libya	100
23	22	168	INOC	Iraq	100
24	23	183	EGPC	Egypt	100
24	26	183	QP	Qatar	100
26	31	185	Rosneft	Russia	75
28	28	189	Sinopec	China	55
29	30	191	Statoil	Norway	71
30	32	224	ONGC	India	74
33	15	253	Pertamina	Indonesia	100
34	37	277	SPC	Syria	100
35	34	283	PDO	Oman	60
36	36	292	Socar	Azerbaijan	100
40	35	310	Ecopetrol	Colombia	100

Source: Petroleum Intelligence Weekly (2007), on line:
http://www.energyintel.com/DocumentDetail.asp?document_id=137158

Note: PIW's ranking of the world's oil companies is based on operational data and firms are compared in six different operational areas, with companies assigned a separate rank within each category. The six individual ranks are then added together to determine the cumulative, overall position, giving each of the six criteria an equal weighting. The rankings above are based on the 2005 operational results for the companies as they existed at the end of that year or as they reported them.