RELATIVE EFFICIENCY AND PERFORMANCE IN THE INTEGRATED OIL AND GAS INDUSTRY

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Overview

The scope of this paper is to investigate the relationship between efficiency and performance in the integrated oil & gas industry (majors). We use a non parametrical method to explain the relative performances of selected companies in terms of their relative efficiencies. We expect to find out that, against intuition, in this industry more efficiency weakly leads to more profitability, while its relative size and investment strategy would play a much bigger part; a possible reason is the large differences in the profitability of upstream projects. The access to highly profitable projects in the upstream is expected to be an important performance determinant. The proposed method is to build the efficiency measure through data envelopment analysis (DEA), for it provides a non-parametric technique for measuring the relative efficiency between several decision-making units. Data for this study was obtained from the past 5 fiscal years (2003-07) files submitted to the U.S. Securities and Exchange Commission (SEC). Additional data was obtained from the investor's relation section of each company's website..

The paper is organized as follows: after a introductory section, section II describes the adopted DEA methodology; section III depicts the adopted variables, overall adopted modeling specifications and the utilized data; section IV displays the results and section V elaborates our conclusions over the findings.

Methods

Data Envelopment Analysis is adopted to assess the relative efficiency within a sample of selected major oil and gas companies. DEA was first proposed by Charnes et al. (1978) to assess efficiency in the public sector. It provides a non-parametric technique for measuring the relative efficiency between several decision-making units. This approach utilizes a piecewise linear programming to calculate, in terms of the input-output relationship, the efficient or best-practice frontier of a sample, measuring the relative performance of the others against this best-practice. Several enhancements were developed on the original technique, mainly consisting of different types of weight restrictions imposed. We follow three different methods classified in Allen et al. (1997) and Pedraja-Chapparo et al. (1997). Those include the assurance region method, the cone ratio method and the virtual variables method, proposed respectively by Thompson et al. (1990), Charnes et al. (1989, 1990) and Wong and Beasley (1990).

Performance was evaluated through the financial indicators Return on Equity (ROE), Return on Assets (ROA), and Profit Margin. Ranks were generated both for efficiency and for performance and compared through usual statistic tools such as the Spearman Rank Correlation index.

The dataset consisted of 5 years of observations (2003 to 2007), of oil and gas reserves and producing activities disclosures for publicly traded companies within the integrated oil and gas industry (majors). The data can be found within the U.S. Securities and Exchanges Commision's EDGAR Filings, on forms 10-K and 20-F, depending on whether or not the company is U.S. based. A total of 14 out of 21 companies were considered for this study: Amerada Hess Corporation, BP plc, Chevron Corporation, China Petroleum & Chemical Corporation, ConocoPhillips, Eni S.p.A, Exxon Mobil Corporation, Marathon Oil Corporation, PetroChina Company Limited, Petroleo Brasileiro S.A, Repsol YPF S.A, Royal Dutch Shell plc, StatoilHydro ASA and Total S.A. Small companies, with less than 1% of industry's share, were disregarded.

Results

First, DEA efficiency coefficients and rankings were reported for each model evaluated, suggesting several existing trade-offs between the adopted measures on input and output. Calculations were made through Coelli (1996). From the results, it was possible to divide the sample into subsamples of efficient, inneficient and intermediate companies. Efficient companies were the ones attaining the rank of 1 simultaneosly in the three models; intemediate companies attain the rank of 1 in at least one model; inneficient companies do not attain it in any models. Table 1 depicts the results.

Table 1

Firm	DEA 1	DEA 2	DEA 3	ROE AVG	ROA AVG	PM AVG
Amerada Hess Corporation	12	10	12	11	13	11
BP plc	1	9	1	6	10	7
Chevron Corporation	14	13	1	4	3	8
China Petroleum & Chemical Corporation	1	1	1	12	12	14
ConocoPhillips	11	1	1	13	11	10
Eni S.p.A.	1	1	1	10	9	3
Exxon Mobil Corporation	1	1	1	1	1	4
Marathon Oil Corporation	1	1	1	8	6	13
PetroChina Company Limited	7	14	13	9	2	1
Petroleo Brasileiro S.A.	10	8	1	3	4	2
Repsol YPF S.A.	1	6	1	14	14	12
Royal Dutch Shell plc	8	7	11	7	5	9
StatoilHydro ASA	9	12	1	2	7	6
Total S.A.	13	11	14	5	8	5

SpCorr(Column,ROE)	-0,58	-0,62	-0,58	1,00	0,74	0,56
SpCorr(Column,ROE)	-0,50	-0,50	-0,76	0,74	1,00	0,62
SpCorr(Column,PM)	-0,53	-0,66	-0,91	0,56	0,62	1,00

The comparison of performance indicators and efficiency indicators revealed a counter intuitive pattern within the industry, that is, that the most efficient companies are, in average, not the ones attaining the best performance indicators. In model 1, aside from Exxon Mobil, the remaining 7 efficient companies attain ROE and ROA rankings inferior to 6. On model 2, the same pattern persists. Out of the 5 efficient companies, we have aside from Exxon only the 8^{th}, 10^{th}, 12^{th} and 13^{th} best ROE average. Model 3, in turn, strongly supports our hypothesis. Even though our DEA procedures placed 10 companies as efficient, those companies were not the best performing ones. In fact, the two worse companies in efficiency rank 1^{st} and 5^{th} in performance. This result is backed by the Spearman rank correlation matrix above, where all the results are negative and inferior to -0.5.

Conclusions

In the oil and gas industry, attaining better productivity given the input amounts, that is, being more efficient realative to its competitors, does not by itself necesseraly entail better perfomances. There seems to be an inneficient use of resources within the sampled companies, which in turn, points to the need for a solution to induce economic efficiency within the industry.

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