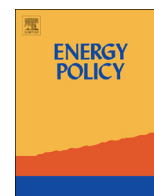




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Short communication

The role of reserves and production in the market capitalization of oil and gas companies

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HIGHLIGHTS

- We utilized Robust Least Squares to estimate a multivariate market capitalization model.
- There is a differential impact that oil and gas reserves to production ratios have on market capitalization.
- The optimal profit-maximizing intertemporal production choice is unique to the type of hydrocarbon being considered.
- Results provide new information as to the relationships between key determinants of oil and gas company market valuations.

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ABSTRACT

We examine the role proved reserves and production play in the market capitalization of publicly traded oil and gas companies engaged in the exploration and production of hydrocarbons. The paper provides two important contributions to the literature. First, we extend the existing research by utilizing the method of Robust Least Squares to estimate a multivariate market capitalization model that controls for firm type. Second, we document the impacts that oil and gas reserves to production ratios have on market capitalization. This is a key finding in the context of discounted net cash flow models and the findings suggest there is an optimal tradeoff between current and future production, given current volumes of reserves, the latter of which is valued positively by the market. Moreover, this optimal tradeoff or the optimal profit-maximizing intertemporal production choice is unique to the type of hydrocarbon being considered. Additionally, our findings highlight the importance of capital structure in the heavily capital intensive oil and gas industry. The results from this research should benefit both oil and gas companies and investors. Specifically, the results provide new and robust information as to the empirical relationships between key determinants of oil and gas company market valuations.

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1. Introduction

Market capitalization is a measure of the value of a publicly traded company. Generally speaking, the value of a company may be viewed as the present value (worth) of current and future cash flows.¹ For companies engaged in the exploration and production of hydrocarbons, this value is linked to the oil and gas reserves available for production and the ability to finance their operations and capital expenditures (Kalu, 1999; Howard and Harp, 2009). Thus, to maintain and increase value, oil and gas companies

acquire additional reserves and produce from these reserves to generate revenues.² A unique feature involved in the valuation of oil and gas companies is the decline curve³ that shows the predictable pattern of a well's production capabilities over time (Hyne, 2012). Absent additional reserves, the net income of an oil and gas company will fall for given price, technology and operating expenses (Kaiser, 2010). Not surprisingly, the industry refers to oil and gas reserves as depleting assets. As such, two key elements stand out in determining the value of oil and gas companies.

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E-mail address: mark.thompson@augusta.edu (M.A. Thompson).¹ This view is commonly referred to as the discounted cash flow model. Economists generally use the term present value while engineers tend to use the term present worth. We use the terms interchangeably.² A company may drill new wells to add reserves or purchase reserves from others. Al-Harthy (2010) examines the decision to determine the optimum number of wells to drill in order to maximize net present value of the field.³ More specifically, the decline curve or production profile is estimated by petroleum engineers and shows the well's initial (peak or maximum) production and how subsequent production drops off or decays over time.

Market capitalization should depend on the current production of hydrocarbons and on the ability of the company to replenish reserves at a rate that will sustain future production.

While the importance of reserves and production is well known, the literature lacks formal studies documenting the magnitude and extent to which these factors contribute to the market capitalization of oil and gas companies. Notable exceptions include the studies on oil and gas company valuation by Moroney and Dieck-Assad (2008), Howard and Harp (2009) and Kaiser (2013). This research specifically analyzes a cross section of 46 oil and gas companies for year ended 2012. Our work relates to that of Kaiser (2013) but we extend our investigation to a multivariate framework using Robust Least Squares, a technique that is capable of handling data outliers. We examine the empirical relationship between oil and gas production, reserves, and a measure of capital structure, the latter of which provides information as to how companies finance their activities. Moreover, we control for the type of firm, that is, independent, large independent and integrated directly in the multivariate analysis.

Our results are consistent with those of Kaiser (2013) but also provide oil and gas companies and energy industry analysts with new information to use when analyzing strategic plans and firm value. For example, we find that reserves and production are both positive and significant indicators of market capitalization. In addition, we find that our reserves to production ratios are negative and significant but their impacts differ depending on the respective hydrocarbon market (i.e., oil or natural gas).

1.1. A brief theoretical framework

The value of a company is reflected in the present value of future cash flows. In very general terms, the discounted cash flow model (DCF) for valuing companies is comprised of three main components: revenues, costs, and risk, the latter of which captures the time value of money. In applied work, many economists will use market capitalization of a publicly traded company to represent firm value. This is because market capitalization is thought of as the current value of all outstanding shares in the company. Investors purchase shares based on the perceived or expected value that these shares may generate. Consequently, economists and investors may view market capitalization as a measure of the discounted (future) cash flows of the company.

In order to understand what influences the present value (i.e., market capitalization) of a company, the major drivers of value need to be identified. Specifically, the assets and activities that lead to profits, and some measure or accounting of (relative) risk associated with the inflows and outflows of cash and the opportunity cost of money. For companies engaged in the exploration and production (E&P) of oil and natural gas, it is the reserves from which they produce that represents their major asset. However, reserves only generate cash flows if they are producing (referred to as proved developed producing or PDP). Production of oil or natural gas depletes the respective reserves. As such, the reserve life is an important element in determining the value of an E&P company. Moreover, there are costs associated with the activities of acquiring reserves and producing hydrocarbons in the form of capital expenditures and ongoing operations. The firm must decide how to best allocate its scarce resources and how to acquire financing in order to maximize value. The use of both debt and equity to finance exploration and production activities is common in the oil and gas industry and the extent of leverage may affect value of the firm.⁴ Generally speaking, market capitalization of

E&P companies should depend on some combination of reserves, production and financing.

2. Data and methodology

The main source of our data is the 2013 Ernst and Young *US Oil and Gas Reserves Study* (EY), which provides company specific information on oil reserves, natural gas reserves, oil production, and natural gas production for a cross section of publicly traded companies engaged in the E&P of hydrocarbons.⁵ EY also classify companies into three categories: independents, large independents and integrated companies. In addition to exploration and production, integrated companies are also involved in downstream activities (i.e., refining), independents are primarily engaged in E&P, and large independents have year ending reserves in excess of 1 billion barrels of oil equivalent. All data are for the year ended 2012. The data are supplemented with debt-to-equity ratios and market capitalization values from YCharts.com and Google Finance. A full set of all variables is available for 46 companies.⁶ More specifically, the variables used in this study are defined as follows. Market Capitalization (*MKTCAP*) denotes the market value of outstanding shares for a company at end of year 2012 and is reported in millions of US dollars. Oil Reserves (R^{Oil}) are a company's proved⁷ oil reserves at year end given in millions of barrels (MMbbl). Gas Reserves (R^{Gas}) are a company's proved natural gas reserves at year end given in billion cubic feet (Bcf). Ratio of Oil Reserves to Oil Production (R/P)^{Oil} and ratio of Gas Reserves to Gas Production (R/P)^{Gas} is oil (gas) reserves divided by oil (gas) production in MMbbl (Bcf).⁸ Debt-to-Equity Ratio (*D/E*) captures the capital structure of the firm and indicates the proportion of the company's assets that it has financed with debt (Park, 2004). Finally, we categorize oil and gas firms as being independent, large independent, or integrated. As such, we define the following indicator (i.e., dummy) variables and note that, for purposes of regression analysis, large independent is the excluded group:

$INDEP_i = 1$ if firm i is an independent and 0 otherwise;

$INTEG_i = 1$ if firm i is an integrated company and 0 otherwise.

Table 1 provides summary descriptive statistics. Mean market capitalization is \$36 billion with a low of \$536 million (Quicksilver Resources) and a high of \$396 billion (ExxonMobil). The average debt-to-equity ratio is 0.96 with a standard deviation of 1.97. Reserves of gas and oil vary quite a bit in the sample. Minimum for

(footnote continued)
eia.gov).

⁵ This is the most recent EY report as of the time this paper was written.

⁶ The appendix provides a list of the oil and gas companies. EY provide information on reserves and production for the 50 largest publicly traded US oil and gas companies engaged in exploration and production. Due to acquisitions and other changes in some companies year-end financial data information on market capitalization and debt-to-equity ratio, which are supplemented from other sources, are not available for all 50 firms. Moreover, CONSOL Energy did not produce any oil nor have any oil reserves in 2012 and is thus not included in the analysis. The result is a usable sample of 46 of the 50 largest US publicly traded oil and gas companies.

⁷ According to the Society of Petroleum Engineers, "proved reserves are those quantities of petroleum which, by analysis of geological and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs and under current economic conditions, operating methods and government regulations." (www.spe.org).

⁸ The ratio of reserves to production is sometimes referred to as the *reserve life ratio* and is an important metric in oil and gas accounting (Wright and Gallun, 2008).

⁴ The EIA includes leverage ratios for major global oil and gas companies in the quarterly *Financial Review of the Global Oil and Natural Gas Industry* (<http://www.eia.gov>).

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