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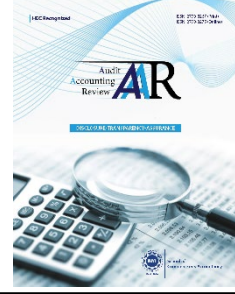
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Examining the relationship between Managerial Ability and Credit Ratings: A Case Study of USA Oil and Gas Sectors

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Abstract

The current study aims to investigate the association between a firm's managerial ability and its issued credit rating. For this purpose, Twelve companies in the USA oil and gas sectors have been selected based on their different work streams. A two-stage derived model of data envelopment analysis and the Tobit model is used for the measurement of firm's managerial ability in this paper. For data envelopment analysis, cost of goods sold, fixed assets, general and administration expenses and intangible assets are used as input variable and operating revenue is used as output variable. To retain residual as firm's managerial ability, Tobit model is estimated by using firm size, stock returns, leverage, operating cash flows and firm age as variables. The value of correlation test between credit ratings and firm's managerial ability is 0.163, which indicates that there is positive linear relationship. Moreover, it is identified that an associated managerial ability is increased by 100%, credit rating also increased by 16.3%. The relationship between managerial ability and credit rating is significant and positive for USA oil and gas sectors from the period of 2006-2020. While regression analysis for all oil and gas companies of the USA indicateds that 2.7% changes in credit rating occurred due to managerial ability. Therefore, this study suggests to enhance the managerial ability of firms, which leads to higher credit rating and consequently less cost of debt for their debt instruments.

Keywords: Credit Rating Agencies (CRA), credit rating, data envelopment analysis, managerial ability, Tobit Model

Introduction

Credit ratings are used to measure the ability of the firm to fulfill its debts or financial liability. Standard & Poor's, Moody's and Fitch are worldly recognized agencies for credit ratings. Firms and organizations that seek

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ratings from these agencies pay these agencies for the credit ratings. On the other hand, a firm's managerial ability is the proficiency of managers to make business decisions and lead subordinates within a company. The performance of a firm is directly associated with the ability of its managers and managers have a direct influence on the firm's investment decisions, financing policies, and organizational strategy policies (Ting et al., [2021](#)). Hence, the current study allows us to explore the correlation between a company's managerial competence and its credit rating.

Credit rating is based on the ability of an organization to repay the debt securities including corporate paper, notes, and bonds. Firm efficiency has a significant role to improve the ability of a firm to repay its debts and enhance the profitability of the business. If the business is more profitable, the ability to repay the short-term and long-term debts would be significantly increased. Therefore, there is a close link between credit ratings and managerial ability. Credit ratings are used to measure the ability of the firm to fulfill its debts or financial liability. A managers performance is directly associated with the performance of the firm (Andreou et al. [2013](#)). With better performance, firms would be able to earn more profit, which would help firms to repay their debts.

In the area of credit ratings, most of the past research was conducted on estimating the relationship between credit ratings and sovereign credit rating crises, debts, and bonds (Fracassi et al., [2016](#); Holden et al., [2018](#)), but in this research, a derived model of managerial ability is used to test the association between them. In previous literature, Cornaggia et al. ([2017](#)) test whether credit rating analysts consider managerial ability as a credit risk factor or not but there is hardly any study, which has examined the correlation between the managerial ability of a firm and its credit rating.

Selection of the USA in the Context of Developed Economies

According to the International Energy Agency (IEA), the demand for oil and gas would increase as strong economies would use more oil and it is expected that the demand for oil would also increase to an average annual rate of 1.2 Mb/d. The oil and gas sector includes three streams, namely upstream, midstream, and downstream. Companies from all streams were included to test the hypothesis so that a complete view of the overall industry can be determined. In this study, the petroleum industry of the USA was used to test the hypothesis. The USA is the biggest consumer and

biggest producer of oil and gas, which is also the largest economy in the world. Since 1985, after oil discovery in Titusville, Pennsylvania it has become the major industry of the USA. In 2008, the USA became the third largest oil-producing country by generating 8.5 barrels of oil per day. 4.9 billion cubic feet per day, averaging 119 billion cubic feet of natural gas, a maximum amount produced by the USA in 2022. The USA is the largest oil and gas-consuming country in the world, consuming 18.7 billion barrels per day of oil and 33.31 trillion cubic feet of natural gas in 2022.

Significance of Research

This research is significant because it determined the correlation between credit rating and managerial ability. Higher credit rating of the USA oil and gas sectors implies more debts at lower interest rates, and more chances of raising debt financing at less cost of capital. The USA is the biggest producer and consumer of the oil and gas sectors as reported by IEA. This research would be a topic of wider interest for investors, investment banks, the government of oil-producing countries, and commodity analysts across the globe. By enhancing the managerial ability of the USA oil and gas sector, the managerial ability also increases; consequently, increasing a huge financing and investment across the globe.

The main objective of this study is to examine the correlation between credit rating and a firm's managerial ability in the oil and gas sectors in the case of the USA for the period of 2006-2020.

Following research question was developed in order to achieve the objective of the current research.

- Does firm's managerial ability has an association with the credit rating of the Oil and Gas sectors of the USA from 2006-2020?

Literature Review

Managerial Ability

Beenen et al. (2021) developed a conceptual model and validated a concomitant measure of managerial interpersonal skills by suggesting a three-dimensional model, which comprised supporting, motivating, and managing conflicts that best represents MIPS, indicating a higher-order latent. MIPS factor also indicated that the MIPS scale predicted job attitudes and performance among both employees and managers and beyond personality traits and leader-member exchange, as well as constructs closely

related to MIPS. Benmelech and Frydman (2015) examined the impact of military service CEO on managerial decisions, financial policies, and corporate outcomes of firms. They concluded that military service CEOs do less investment in research and development. Military CEOs do not get more leverage and there are fewer cases of fraud and they perform better in the times of crisis. Demerjian et al. (2012) designed a new measure and validity test to calculate the managerial ability of a firm. They further concluded that their presented measure is more precise and valid to measure managerial ability as compared to other measures. Kaplan et al. (2012) examined the characteristics of managers and CEOs, which matter for companies involved in buyouts and venture capital transactions. They also concluded that talented and high-ability CEOs are associated with better firm performance as compared to low-ability managers.

Managerial Ability and Corporate Policies of Firm

Huang and Xiong (2022) examined the relationship between managerial ability and firm value and their findings suggested that managerial ability is positively associated with firm value, firm size, and board independence. Ting et al. (2021) utilized mediation analysis and bootstrapping to analyze the mediating effect of capital structure on the managerial ability and firm performance's association. They concluded their study by stating that managerial ability positively affects a firm's performance, capital structure mediates the positive relationship between managerial ability and firm performance, and low levels of debt are likely observed in firms with CEOs with high ability and vice versa. Huang et al. (2022) examined the effect of managerial ability on the financial constraints of listed Chinese companies and concluded that there is a negative relationship between managerial ability and corporate financial constraints. Chen and Lin (2018) investigated the relationship between managerial ability and profitability in mergers and acquisitions. They concluded that acquisition by firms with high-ability manager resulted in higher short-term stock market reactions, fewer takeover premiums and better post-announcement abnormal returns. They also concluded that a manager's performance is positively connected with environmental uncertainty.

Li and Luo (2017) investigated the influence of managerial ability on the audit fees of a firm. They concluded that managerial ability has an influence on audit fees when there is a relationship between auditor and client, auditor faces lower litigation risk in the post-SOX era. Their findings

suggested that in case a discount in fee is granted, the auditor should consider this factor in audit planning and pricing. De Franco et al. (2017) examined the influence of the managerial ability of a firm on its bank loan pricing policy. Their findings demonstrated that firms with talented managers enjoy low bank loan prices; managerial ability has a negative influence on firms with information asymmetry and weak business fundamentals. With the help of path analysis they concluded that business fundamentals are more important to affect the bank loan pricing.

Andreou et al. (2017) examined the impact of managerial ability on corporate investment during the crisis period. They concluded that there is a strong positive impact of pre-crisis managerial ability on crisis period capital expenditure and firms having CEO with general abilities, which have a strong positive relationship between pre-crisis managerial ability and crisis period corporate investment. Luo and Zhou (2017) investigate the relationship between managerial ability, tone of earning announcement and market reaction to that announcement. They concluded that managerial ability is an important determinant of the tone of earnings announcements as high-ability managers know more about the business so they are more able to achieve favourable operational outcomes, which results in positive earnings announcement. Their results showed a positive relationship between managerial ability and tone of earnings, which leads to positive response of market to these announcements. Bonsall IV et al. (2017) investigated the impact of managerial ability of a firm on the credit rating process and cost of capital debt. Their results suggested that there was a strong and positive relationship between managerial ability and a firm's credit risk assessment.

Koester et al. (2017) examined the relationship between high ability executives and corporate tax avoidance. Their findings showed that when compared to low-ability managers, high-ability managers were more involved in reducing income tax payments. They provided relevant evidence in which high ability managers were engaged in greater state tax planning activities, made more research and development credit claims, and made greater investments in assets, which generated accelerated depreciation, deductions, and shifted more income to foreign tax havens. In a likewise manner, Demerjian et al. (2013) investigated the association between managerial ability and earnings quality of a firm. Their findings suggested that managerial ability has a positive influence on the earnings

quality of a firm. Firm with high ability managers faced lesser restatements, higher quality accrual estimations, higher earnings and accruals persistence, and lower errors in the bad debt provision as compared to firms with low-ability managers.

Credit Rating

Saadaoui et al. (2022) investigated the influence of credit ratings on the liquidity of bonds in case of emerging countries. The answers to their findings suggested that bond's liquidity was strongly affected by the credit scores assigned to each country. Ubarhande et al. (2021) reviewed literature on credit rating agencies (CRA), credit rates, and credit rating models. By integrating bibliometric and structured reviews of research papers, they have identified that the factors determining credit worthiness were different for different sectors. Bruno et al. (2016) investigated whether ratings are comparable across asset classes or not. Their results demonstrated that it is difficult to enforce regulations requiring ratings to perform comparably across asset classes. They provided a better framework to distinguish incentives and risk in asset classes.

Aktug et al. (2015) examined the reactions of firms to the hiring of new credit rating analysts. Their results showed that there is no significant relation between analysts hiring and stock prices. They also concluded that hiring a credit rating agencies analyst increased the value of debt securities but there is no value phenomenon in case of equity of employer firm. Baber (2014) examined the role and responsibility of credit rating agencies in promoting soundness and integrity, especially with respect of their business activities. He concluded that by following IOSCO principles, code credit rating agencies can become robust and responsible participant in the financial market by improving their quality and integrity of the rating processes.

Xia (2014) investigated the impact of quality of ratings of issuer paid agency (Egan Jones Ratings) and their response towards initiated coverage of investor-paid rating agency (Standard and Poor). His results showed a positive relationship between initiated coverage of issuer- paid rating agencies and the quality of credit ratings of investor-paid credit rating agencies. He also concluded that there is a significant improvement in standard and poor's ratings, and standard and poor become more responsive to firm credit risk. Boylan (2012) examined whether the new government

reforms to improve the accuracy of ratings by credit rating agencies are effective or not. They concluded that government reforms restrain intentional decisions to compromise the rating method. These reforms are not effective to reduce unconscious biases because they do not properly address the relevant structural issues. They also concluded that in order to reduce the biases, credit rating agencies fees structure, business model, and risk management functions need more elaboration to address this issue.

Factors Affected by Credit Ratings of Firm

Abuhommous et al. (2022) tested the influence of optimal working capital and credit ratings. After applying the ordered probit model they concluded that optimal working capital has a strong impact on credit ratings. Kim and Kim (2020) investigated the influence of credit scores on dividend policy. They concluded that good credit ratings make corporate managers bolder and they pay more dividends and vice versa. Cubas-Díaz and Martínez Sedano (2018) examined the relationship between credit ratings and sustainable performance of companies by applying probit model. They concluded that companies with higher sustainability performance tend to have higher credit ratings; though having a less consistent performance over time seems to have no effect. Fracassi et al. (2016) examined the influence of a credit rating analyst on a firm's debt pricing. They concluded that analysts with higher qualifications like MBA provided higher quality of credit ratings for firms as compared to less qualified analysts. Venkiteswaran (2014) investigated the relationship between asset and firm credit risk. He concluded that higher asset sale results in improved credit quality by also increasing the chance of rating downgrades based on the predicted rating transitions.

Factors Affecting Credit Ratings of Firm

Zhao (2017) examined the manipulation of earnings to influence the credit rating agencies decision. The results indicated that the managers used to manipulate earnings to mislead credit rating agencies. Bruno et al. (2016) investigated that certification from National Recognized Statistical Rating Organization (NSRO) influences the credit rating agency's information. Their results indicated that credit rating agencies' compensation structure is a more important factor for rating policies than the Nationally Recognized Statistical Rating Organization certificate from the U.S Securities and Exchange Commission. Oikonomou et al. (2014) examined the influence of

corporate social performance on the cost of corporate debt and assessment of the credit quality. They concluded that the corporate social performance of a firm has a negative relationship with the cost of debt, which ultimately leads to higher credit rating. Alissa et al. (2013) investigated that firms with deviated credit ratings were engaged in earning management activities to influence their credit rating and to see the impact of these activities to get their expected ratings. Their findings suggested that firms use income-increasing (-decreasing) earnings management activities when they are below (above) their expected ratings, and expected ratings can get through accounting discretion. Alali et al. (2012) examined the influence of corporate governance on a firm's credit rating. They concluded that improvement in bond ratings positively influences the corporate governance of a firm and firms with higher corporate governance have significantly higher credit ratings.

Critical Review

After a detailed review of the literature, it was concluded that most of the literature in this field is based on the impact of credit ratings on stock and bond returns. Saadaoui et al. (2022) tested the influence of credit rating and liquidity of these bonds. Taekyu et al. (2020) investigated the relation of credit ratings with dividend policy. Similarly, Frescassi et al. (2015) tested the effects of credit ratings and a firms debt pricing. On the other hand, most of the research on managerial ability was based on the influence of managerial ability and corporate policies. Huang and Xiong (2022) examined the relationship between managerial ability and a firm value. Ting et al. (2021) investigated the effect of capital structure and the association between managerial ability and a firm's performance. Huang et al. (2022) examined the effect of managerial ability on financial constraints. However, none has inspected the relationship between credit rating and managerial ability. Therefore, the current study aims to investigate the abiding relationship of these two variables to indicate their associated effect on the oil and gas sectors in the USA. .

A few researchers have examined the impact of sovereign credit rating on the bond market of developed and developing countries. While some researchers investigated the impact of sovereign credit and rating on stock markets of emerging markets. It is also commonly studied relationship between corporate credit rating and debt markets of in different sectors. The current research is unique because it examined the correlation between

credit rating and managerial ability. Measurement of managerial ability is also unique in this research as Data Envelopment Analysis (DEA) estimates a firm's efficiency. After getting firm efficiency from DEA, it is used as the dependent variable in Tobit model. After the estimation of the Tobit model by firm-specific factors, residuals of this model are taken as managerial ability in this research.

Secondly, selection of oil and gas sectors of the USA is also unique, as it is the †largest producer of oil and gas in the world being the biggest consumer of oil and gas at the same time.

Methodology

In this step, the systematical process is discussed to show how research can be conducted scientifically. Sources of data collection, population, sample, and various variables were defined and discussed in this step of research.

Theoretical Framework

The current study analyzed the association between the credit ratings of firms and firm's managerial ability. Andreou et al. (2013) proved that a firm's managerial ability is directly associated with the performance of a firm. Chen et al. (2018) provided evidence that firm with better credit ratings have a better financial performance. Bonsall IV et al. (2017) explained that firm's managerial ability and firm credit risk assessment has a strong and positive relationship with each other. According to Cornaggia et al. (2017) a firm's managerial ability is to anticipate as a credit risk factor during assigning credit ratings. Demerjian et al. (2013) stated that firms having high ability managers associate with higher earnings quality of that firm. Andreou et al. (2017) explained that there is a strong positive impact of pre-crisis managerial ability of firm during the crisis period of capital expenditure. Kisgen (2006) explained that upgrade and downgrade of credit rating affect the capital structure decision of a firm. Venkiteswaran (2014) stated that higher asset sale result in improved credit quality, though it also increases the chance of rating downgrades based on predicted rating transitions.

† <https://yearbook.enerdata.net/crude-oil/world-production-statistics.html>

Conceptual Framework

Figure 1

Conceptual Framework



Research Hypothesis with Research Question

Research Question: Does the firm's managerial ability have any association with the credit rating of the oil and gas sectors of USA from 2006-2020?

Ho: There is an insignificant relationship between a firm's managerial ability and credit ratings.

H₁: There is a significant relationship between a firm's managerial ability and credit ratings.

Description of Data

The current study employed secondary data to conduct this study. Data about share prices were gathered from investing.com and finance.yahoo.com. Moreover, annual reports were gathered from annualreports.com and historical credit ratings of firms were gathered from Moody's official website. Sample data was based on the period of 1991-2020 of twenty-five oil and gas companies but due to incomplete records,

the final data set was based only on twelve companies ranging from 2006-2020.

Sampling Techniques

To conduct this research, stratified sampling technique was used. Oil and gas sectors were divided into three major streams according to their work. These streams or segments are known as upstream, midstream, and downstream. The work of an upstream company includes exploration and production. The midstream companies are responsible of transporting and marketing of oil and gas. However, downstream companies are responsible for purifying and sales of the final product.

Table 1

Selected Sample

Upstream	Midstream	Downstream
Apache Corporation	Schlumberger Limited	William Companies
Comstock Resources	Enbridge Energy Partner	Parker Drilling
Exxon Mobil	National Oilwell Varco	Chevron Corporation
EOG Resources	Enbridge Incorporation	Royal Dutch Shell Plc

Description of Variables

Credit Rating

Credit rating of a firm estimates the creditworthiness of the firm with respect to its financial liabilities. A letter grade assigned to each firm indicates ratings for that firm. Credit assessment and evaluation for companies and governments is generally done by credit rating agencies such as Standard and Poor (S&P) and Moody's or Fitch.

Following ordinal scale is used for the credit ratings. This scale is adapted from Masood et al. (2017).

- Upper Investment Grade
- Lower Investment Grade
- Speculative Grade

Table 2
Ordinal Scale

Moody's	Linear Break
Upper Investment Grade	
Aaa	21
Aa1	20
Aa2	19
Aa3	18
A1	17
A2	16
A3	15
Lower Investment Grade	
Baa1	14
Baa2	13
Baa3	12
Speculative Grade	
Ba1	11
Ba2	10
Ba3	9
B1	8
B2	7
B3	6
Caa1	5
Caa2	4
Caa3	3
Ca	2
C	1
Default	0

Managerial Ability

A two-stage model developed by Demerjian et al. (2012) was used to measure the managerial ability of the firms. In first step, Data Envelopment Analysis (DEA) was used for model operating revenue as a main function of revenue generating resources such as cost of goods sold, fixed assets, general and admin expenses, operating lease, and intangible assets. In second step, total firm efficiency was decomposed into firm specific efficiency and managerial efficiency by regressing firm efficiency into five characteristics, namely firm size, stock returns, leverage, operating cash

flows, and firm age. After estimating Tobit model, the residual was retained as a measure of managerial ability:

Firm efficiency from DEA= $\alpha + \beta_1$ Firm Size + β_2 Stock Returns + β_3 Leverage + β_4 Operating Cash flows + β_5 Age + ε

The Models

Data Envelopment Analysis

Charnes et al. (1978) designed a linear programming statistical procedure to estimate the firm efficiency of different entities. These entities are termed as “decision making units” (DMU). The main idea of this measure is that each decision-making unit produce output by using certain inputs so, the firm efficiency of each decision-making unit is measured as the ratio of weighted outputs to weighted inputs.

$$\frac{\sum_i^s u y_{ik}}{\sum_j^m v x_{jk}} \quad k = 1, \dots, n$$

In above equation:

S= outputs

M= inputs

N= number of DMU(firms)

U= wieght of output

V= weight of input

Y= quantity of output

X= quantity of input

In simple words, firm efficiency is a sum of weighted outputs divided by sum of wieghted inputs. The value of a firm efficiency using data envelopment analysis always lies between 0 and 1. In this study revenue is used as an output and cost of goods sold, fixed assets, general and admin expenses, and operating lease; whereas intangible assets are used as input variables, data for all of these variables are obtained from publicly available financial reports.

Tobit Model

Tobin (1958) proposed Tobit Model to estimate the relationship between non negative dependent variables and independent variables. It is used to measure the linear relationship when there is right or left censoring in dependent variable. Economists mostly use Tobit model with Data Envelopment Analysis (DEA). In DEA, efficiency score is always less than or equal to 1. In this study, Tobit model is applied to determine the managerial ability of the firm. Total firm efficiency using data envelopment analysis is decomposed into two parts such as firm specific efficiency and managerial efficiency by regressing firm efficiency on different firm characteristics using the Tobit model. The residual of Tobit model is used as managerial ability.

Firm efficiency from DEA= $\alpha + \beta_1$ Firm Size + β_2 Stock Returns + β_3 Leverage + β_4 Operating Cash flows + β_5 Age + ε

Regression Analysis

Regression analysis was used to explain the impact of independent variables on dependent variables. It explained the changes in credit rating due to managerial ability, which is an independent variable. Following is the equation to predict linear regression analysis:

$$CR_{it} = \alpha + \beta_1 MA_{it} + \varepsilon_{it}$$

Correlation

To test the strength of association between managerial ability and credit rating a correlation test was applied. Correlation test is also used to define the direction of relationship between two variables. Value of correlation lies between -1 to +1, which shows the strength of relationship. ± 1 state a perfect degree of association however 0 means there is no association between variables. Positivity and negativity indicate the direction of relationship between variables. Following is the equation used to measure correlation:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

In this equation:

r = correlation value

n = number of observations

x, y = variables

Data Analysis

The prime purpose of this study was to analyze the impact of high ability managers on firm's credit ratings. For this purpose, data of 15 years ranging from 2006- 2020 on yearly basis was collected from 12 firms to find the impact of their managers ability on credit ratings.

Data Envelopment Analysis

In this study, Data Envelopment Analysis was used to measure the value of firm efficiency of firms. With the help of DEA, firm efficiency was calculated as a sum of weighted outputs divided by sum of weighted inputs. The value of firm efficiency using data envelopment analysis always lies between 0 and 1.

Table 3 presented the results of DEA of the 12 selected companies of oil and gas sectors in USA, considering 3 different streams (upper stream, midstream, and lower stream) for the period of 15 years from 2006- 2020.

Data envelopment analysis was used to measure the firm efficiency for a specific period. By applying this test, it was found that how these firms efficiently utilized their inputs (cost of goods sold, fixed assets, research, and development expenses, general, and admin expenses, operating lease, and intangible assets) to produce output (revenue). After applying DEA test, it was obtained that Apache Corporation, Comstock Resources, Exxon Mobil, EOG Resources, Schlumberger Limited, National Oilwell Varco, Parker Drilling, Chevron Corporation, and Royal Dutch Shell Plc are performing 100% efficiently because the average value of their DEA is 1. However, the average value of Enbridge Energy Partner is 0.583467, which means that Enbridge Energy is 58.35% efficient and Enbridge Corporation is 0.898733 efficient, which means that Enbridge Corporation is 89.87 % more efficient than William Companies whose efficiency is 0.7468, indicating an efficiency of 74.68%, respectively.

Table 3
DEA of the 12 Selected Companies of Oil and Gas Sectors in USA

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Companies															
Apache Corporaion	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Comstock Resources	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Exxon Mobil	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EOG Resources	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Schlumberger Limited	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Enbridge Energy Partner	0.707	0.68	0.69	0.452	0.45	0.288	0.321	0.463	0.725	0.735	0.7	0.63	0.633	0.869	0.409
National Oilwell Varco	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Enbridge Incorporation	1	1	0.768	1	1	1	1	1	1	1	1	0.741	0.823	1	0.149
William Companies	1	1	1	1	0.779	0.448	0.638	0.827	0.782	1	0.538	0.393	0.663	0.827	0.307
Parker Drilling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Chevron Corporation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Royal Dutch Shell Plc	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 4
The Residuals Obtained from Tobit Model

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Companies															
Apache Corportaion	7.99	1.05	3.66	8.66	2.11	1.37	-2.44	-3.11	2.22	-9.99	2.44	-1.11	1.03	-1.93	1.2
Comstock Resources	7.33	4.12	1.95	4.07	1.9	7.77	1.3	1.84	1.44	-3.02	-5.77	-2.73	3.84	-3.97	-4.15
Exxon Mobil	4.33	2.33	1.89	-8.88	-6.66	1.55	-2.22	-6.66	-1.33	-1.78	-2.44	-2.22	1.22	-8.88	0
EOG Resources	3.77	1.89	2.22	1.78	0	1.33	-6.66	0	-2.22	-4.44	-6.66	1.11	-1.55	-3.77	1.11
Schlumberger Limited	1.32	1.01	6.66	2.02	1.9	5.36	5.55	2.2	-6.66	-9.77	3.44	1.85	-1.27	-6	-6.22
Enbridge Energy Partner	0.18014	0.0336	0.01186	-0.0925	-0.1642	-0.0574	-0.1253	0.063	-0.0575	0.106540	0.099230	0.04732	-0.1163	0.065480	0.00589
National Oilwell Varco	0.75007	0.5218	3.335930	0.963760	0.86792	2.6513	2.71238	1.1315	-3.3587	-4.8317	1.769610	0.94866	-0.6932	-2.9673	-3.1071
Enbridge Incorporation	0.040310	0.10379	-0.115	-0.0607	-0.061	0.02541	-0.072	0.0448	-0.0701	0.097010	0.15461	-0.15770	0.137580	0.31538	-0.3823
William Companies	0.04107	-0.0514	-0.0206	0.055490	0.06742	-0.0348	-0.0907	0.10701	-0.1886	0.16074	-0.0913	-0.16	0.147740	0.21324	-0.1555
Parker Drilling	9.88	2.33	2.78	4.66	8.44	1.21	1.27	6.33	8.88	-3.55	-1.69	-6.22	-2.66	-7.55	-1.13
Chevron Corporation	-2.46	7.05	8.39	2.64	6.86	-6.44	-7.24	-9.66	-3.24	1.61	2.85	1.14	-6.44	-7.15	6.46
Royal Dutch Shell Plc	-8.88	5.11	2.76	2.19	1.68	7.66	1.65	-2	1.44	-2.66	-7.33	-1.07	-1.27	-2.51	-3.51

Tobit Model

Tobit model was applied to determine the managerial ability of the firm. A firm's efficiency was measured by using data envelopment analysis, which was decomposed into two parts such as firm specific efficiency and managerial efficiency by regressing firm efficiency on different firm characteristics using Tobit model. The residual of Tobit model was retained as managerial ability (See Table 4).

From table it is clear that Apache corporation has average residual value of .4586, which is positive and it's mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Comstock resources has average residual value of 1.32, which is positive and it's mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Exxon Mobil has average residual value of -2.48, which is negative and it's mean of firm efficiency is measured by the managerial ability, is lower and model was over estimated by firm specific efficiency.

EOG Resources has average residual value of 6.99, which is positive and it's mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Schlumberger limited has average residual value of 0.099, which is positive and it's mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Enbridge Energy partner limited has average residual value of 0.065, which is positive and it's mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

National Oilwell Varco has average residual value of 0.049, which is positive and it's mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Enbridge Incorporation has average residual value of -0.0024, which is negative and it's mean of firm efficiency is measured by the managerial ability, is lower and model was over estimated by firm specific efficiency.

National Oilwell Varco has average residual value of 0.013, which is positive and its mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

William Companies has average residual value of 0.099, which is positive and its mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Parker Driller has average residual value of 1.62, which is positive and its mean of firm efficiency is measured by the managerial ability, is higher and model was under estimated by firm specific efficiency.

Chevron Corporation has average residual value of -0.402, which is negative and its mean of firm efficiency is measured by the managerial ability, is lower and model was over estimated by firm specific efficiency.

Royal Dutch Shell has average residual value of -0.481, which is negative and its mean of firm efficiency is measured by the managerial ability, is lower and model was over estimated by firm specific efficiency.

Correlation and Regression Analysis

Correlation test was applied in this study to measure the strength of association between credit rating and firm's managerial ability, regression analysis was done to show the changes observed in the dependent variable (credit ratings), which were associated with changes in one or more of the explanatory variables (managerial ability).

Table 5

Descriptive Statistics

	Mean	Std. Deviation	N
Credit Rating	14.2778	4.61726	180
Managerial Ability	-.0004	3.87630	180

Table 6

Correlations

		Credit Rating	Managerial Ability
Pearson	Credit Rating	1.000	.163
	Managerial Ability	.163	1.000
Sig. (1-tailed)	Credit Rating	.	.014
	Managerial Ability	.014	.
N	Credit Rating	180	180
	Managerial Ability	180	180

Interpretation of Correlation

In this study data of 12 companies have been taken of oil and gas sector of 3 different streams. The value of correlation is 0.163 that is not equal to zero, which indicates that there is positive linear relationship between credit ratings and firm's managerial ability. That's why null hypothesis is rejected which indicates that there is statistically significant relationship between credit ratings and firm's managerial ability. It also indicates that firm's managerial ability and credit rating is associated with 16.3%. After collective correlation analysis between credit rating and managerial ability, it was found that there is a weak but positive and significant correlation. It also explains that when managerial ability is increased by 100%, credit rating also increases by 16.3%.

Table 7
Model Summary^b

Model	R	R ²	Adjusted R ²	Std. Error	Change Statistics					Durbin-Watson
					R ² Change	F Change	df1	df2	Sig. F Change	
1	.163 ^a	.027	.021	4.56790	.027	4.889	1	178	.028	.220

Note. a. Predictors: (Constant), Managerial Ability, b. Dependent Variable: Credit Rating

Interpretation of Model Summary

F value significance is less than 5%, which means that model is overall significant. Value of R- Square is 2.7%, which indicates that 2.7% changes in credit ratings is caused by managerial ability of firm in the USA oil and gas sectors.

Table 8
ANOVA^a

	Model	Sum of Squares	df	Mean Square	F	Sig.
	Regression	102.010	1	102.010		
1	Residual	3714.101	178	20.866	4.889	.028 ^b
	Total	3816.111	179			

Note. a. Dependent Variable: Credit Rating, b. Predictors: (Constant), Managerial Ability.

Interpretation of ANOVA

According to the findings of ANOVA table, the p-value is 0.28 that is less than 0.05, which indicate that the results are significant.

Conclusion

The current research was conducted to test that managerial ability is considered as credit risk factor during assignment of credit rating of firm by rating analysts. Therefore, the findings supported the obtained results of this study.

Essentially, research work is founded on subordinate data and quantifiable research method give the imprint to answer the investigate question and to achieve the general research objective. Data composed through the financial sites like: annualreports.com, moodys.com, and investing.com was considered to conduct the current analysis. The data were gathered on yearly basis from 2006-2020 under total observations and examined through the software E-views.

Tobit Regression Model was used to measure managerial ability, which is basically, used to measure the relationship between a non-negative dependent variable and independent variables. It is also used when left or right censoring occur in data. After calculating managerial ability, Pearson Correlation Test was applied to test the significance of hypothesis.

The present study reveals that there is a positive linear relationship between credit ratings and firm's managerial ability. Findings of this study revealed that there was a weak and positive correlation between the selected two variables. The positive correlation indicates a direct relationship between managerial ability and credit ratings, in other words with increase in firm's managerial ability its credit ratings also increase and vice versa.

This research paper would be helpful for investors, oil or money traders, oil importers, or countries with surplus resources, banks, insurance companies, and other financial institutions. This paper helps investors who want to invest in oil and gas sectors. By giving evidence that provide information regarding the credit ratings of firm and their manager's performance of a company, it was observed that good ratings of firm indicates that managers and firm are performing well, hence, proving that if a firm's managerial ability increase by 100% it would lead the credit

ratings of a firm by 16.3%. It would also help investors to make a sound decision, while investing in any firm.

New researcher can expand this study by considering firms of other countries and other industrial sectors. They can also add other dimensions to analyze a firm's performance such as export performance, location, and operational complexity which are not included in this research due to the time constraint. Other researcher should study oil and gas sectors of developing countries where more variation of credit ratings could help to establish better relationship between the credit rating and managerial ability.

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