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THE EFFECT OF CAPITAL STRUCTURE ON PROFITABILITY OF NORTH AMERICAN OILFIELD SERVICE COMPANIES

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Abstract:

Problem statement: The statement of whether capital structure is in fact a major part of companies' profitability in North American Oilfield Service companies remains to be a controversial topic. It is ironic that gas and oil industry is hugely profitable and always in the eyes of investors. At the same time, knowing the optimal capital structure combination is in need for those companies especially after the effects of the relatively recent pandemic.
Purpose: The paper mainly intends to find out if there is in fact a strong relationship between capital structure and profitability of the seventy-two companies and goes deeper to analyze the impact on the sector in the area.
Methodology: Cross sectional dataset for seventy-two companies from the area was obtained for the period of Q2, 2020 and regressed (using OLS multiple linear regression method) to estimate statistical relationship between the value of the firms and their capital structures.
Findings: The paper found a negative relationship between the debt financing and profitability meaning that the more they finance their operations with external debt, the less profitable they could become. Also, liquidity level in the companies turned out to be significant in affecting the value of the firms. The overall results were statistically significant and free from bias and able to explain necessary part of the model.
Value: Being able to define the relationship and proposing optimal debt and equity financing combination will be very useful for both managers of the firms and potential investors. Moreover, seeing the quantified effects of the pandemic will allow the governments to see how much of a hit the industry received since COVID-19.

Keywords:

1. INTRODUCTION

1.1. Background Information

The term "Capital Structure" of an entity describes the method which the entity uses to raise capital for either establishing or expanding its business activities. It is mainly a combination of various equity and debt capitals such as ordinary and preference shares and long-term debts which are direct attributes of a firm's financing decisions. One way or another, businesses must finance their operations to meet at least working capital requirements and costs associated with fixed assets. Without them, the businesses cannot survive, therefore, capital structure decisions are of vital importance among all other aspects of capital investment decisions.

There have been extensive research and resultant debate about the influence of capital structure on firm's value and capital costs. Those debates have actually started when Modigliani and Miller established their theory of irrelevancy of capital structure in 1958 stating that the value of a firm is independent of its capital structure. However, some others came up with different results since then. Taking the most recent studies for example, Safiuddin and Adesina in their research proved the strong relationship between capital structure and profitability in 2015. On the same date, Narayanasary even showed how debt and capital financing could affect a firm's value negatively backing up the results of earlier research conducted by Mwangi (2013). Those controversial results by different highly experienced researchers encouraged the researcher further to conduct another empirical study on the possible relationship between capital structure and profitability of North American Oilfield Service companies.

1.2. Justification

Even though several studies have already gone deep to learn the effects of capital structure decisions in businesses, few have studied the relationship in North American countries. Quite recently, Wu (2019) researched on the same topic among US manufacturing companies and earlier Fishlow and et all (2012) studied among North American banks but there is almost none

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about American and Canadian oilfield service industry in the last decade. Besides, the industry is huge and very competitive in the area and all the companies fighting over marginal growth in their profitability year after year. The sensitivity level makes it very important to study the capital structure decisions with the industry and find out the optimal combination of debt and capital financing. On a macro scale, the results could bring about benefits to the whole North American economy and oilfield service industry as companies could be more competitive having learned the optimal combinations especially after the effects of the pandemic. Moreover, the empirical results in the USA and Canada will help discern the potential problems related to capital structure and business performance which could add imperative knowledge to viability and the sphere of corporate funding. Financial managers, meanwhile, will benefit from the applied knowledge of possible financing problems and determine the optimal level of debt and capital to maximize their shareholder value. Lastly, the paper findings will provide value to academic research in the area and help other scholars by acting a reference material for further researches

2. LITERATURE REVIEW

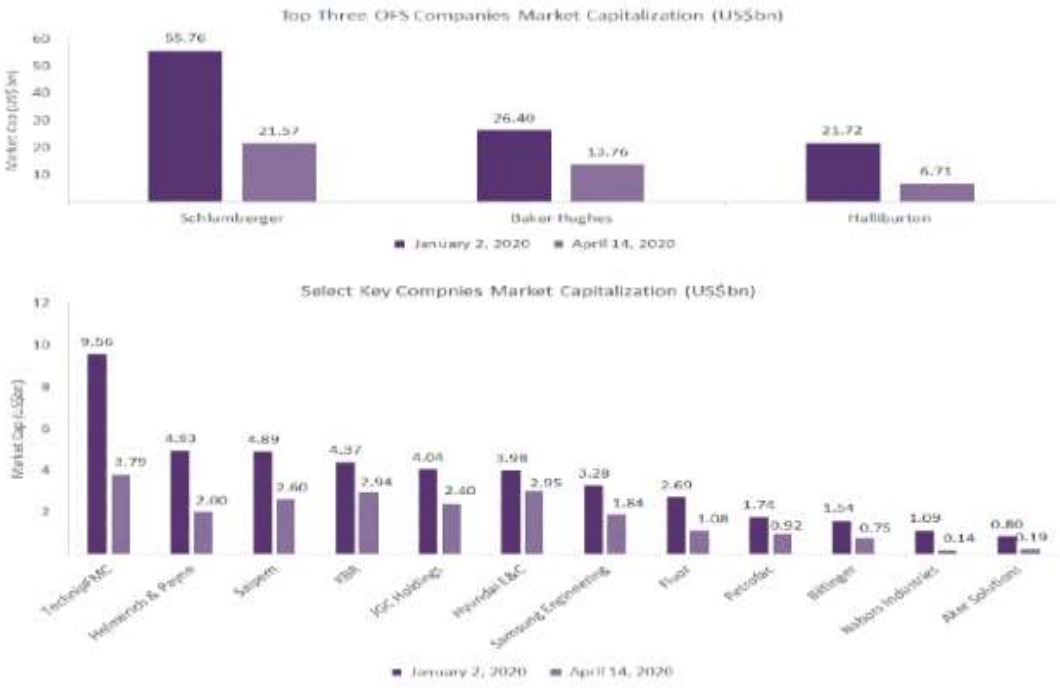
2.1. Industry overview

For oil and gas industry (IOG) to operate successfully, it needs to have efficiently working service companies which can provide them with a variety of services (Kryukov and Tokarev, 2017). Therefore, the very sector has been of crucial importance and a primary factor driving the investors whether to invest in oil and gas industry itself. Over the last two decades the oilfield service industry is soaring regardless of the stock price drops in 2008, 2014 and 2020. Every year, the main leading companies like Schlumberger, Halliburton, Baker Huges and Weatheford are investing in research and development so heavily that the investments are bringing as much as 24% of total of their revenues (e.g. Schlumberger in 2015). 1

Despite trying to be innovative every year, the industry has experienced three biggest hits in its history so far. The first one was in 2009 and obviously due to the deep global recession. In 2014 too, the oilfield service company stock prices have plummeted by 70% largely due to the boom in US shale oil production (Marc and Vorisek 2018)

Considering the most recent drop due to COVID-19, it exacerbated the situation for companies which were still struggling after 2014 price drop. The pandemic caused the oil prices into almost a free fall from mid-$50s to the low $20s during March meanwhile was being precipitated by the price war between OPEC and Russia. (Corrigan, 2020) The oilfield service companies started to face even more operational problems which was further worsened after the significant drop in forecasted capital expenditure in the upstream industry. In the light of such drops in oilfield service companies' stock prices, financing decisions to continue the operations could potentially determine the future of those companies.

The graph below can briefly illustrate the impact of pandemic on the major North American Oilfield Service companies:



[1] See Schlumberger Limited Annual Report, 2016

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Source: https://www.offshore-technology.com/comment/covid-impact-oil-gas-services/?utm_source=Army%20Technology&utm_medium=website&utm_campaign=Must%20Read&utm_content=Image

2.2. Conceptual framework

This part of the study deals with the past literature on definitions about capital structure and profitability of an entity. It is important to go through the conceptual definitions by different authors as they are the variables involved in the study.

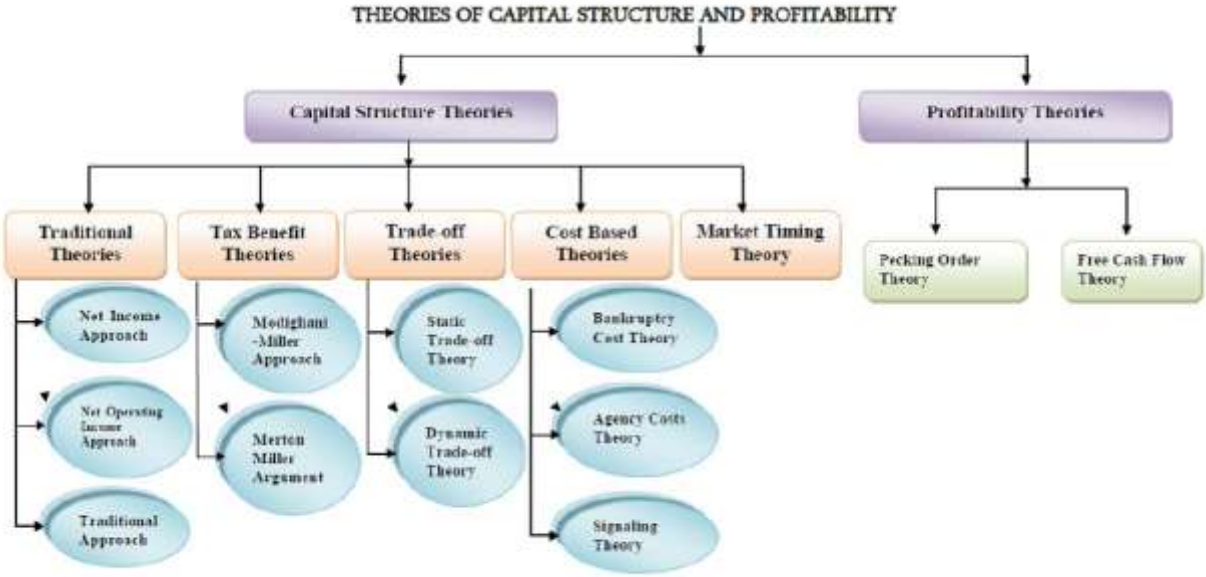
2.3. Capital structure

Capital itself is about long-term financing sources in a corporation. Corporations need funds to operate and the funds could come from either shareholders or lenders (Ross, 2003). If a firm chooses the former and shareholders decide to put up the necessary cash, they don't expect to receive fixed rates of return every year. Instead, they can own some fractions of the company and expect to get paid by the future profits. When they decide to own new equity shares, they are investing new funds into the business and from the perspective of the business, it is being financed by the new equity which is called equity financing. Meanwhile, a firm may choose to lend some funds from third parties. If it does, it is expected to pay back the debt plus fixed rate of return per annum and this is usually called debt financing. The choice as to which way to go is the capital structure decision.

Several academicians gave their definitions and suggestions as to how a firm could finance its operations so that it could perform at an optimal level. Gajurel (2005) described capital structure as different sources of money supply financing a business activity. Abhor later on in 2008 gave clearer picture of the different sources by stating that it consists of blend of equity and debt. Supporting, meanwhile, broader researches conducted by Roshan (2009) and Narayasanary (2015) mentioned about the sub-categories of equity financing (rights issues and bonus issues) and debt financing (Government backed loans and bank loans). They said that a business's economic environment and situation could affect which way to go. For instance, if it is exposed to certain risks related to its operations, capital structure does not tend to involve high levels of debt of any kind. Alternatively, when the retained earnings and share premium accounts represent huge outstanding balances, it is better to go with bonus issues and using the existing capital itself instead of issuing new one (rights issue). Some other studies conducted earlier gave their opinions on optimal levels of capital structure. Patrick in 2013 stated that "At the optimal capital structure, the incremental tax benefit obtained from debt is the same as the incremental costs of financial distress" (cited in the research by Charles and Veronica, 2018). Almost the same suggestion was given by Brealey, Mayers & Allen in 2011. They talked about how advantageous debt could be and added that too much of it can be dangerous.

2.4. Capital structure and profitability theories

Several theories have been put forward explaining the relationship between capital structure and profitability of businesses. Five of the theories (Traditional, Modigliami and Miller, Static Trade-off, Pecking Order, Agency Cost) have been the focus of the study.



Source: Compiled from secondary sources

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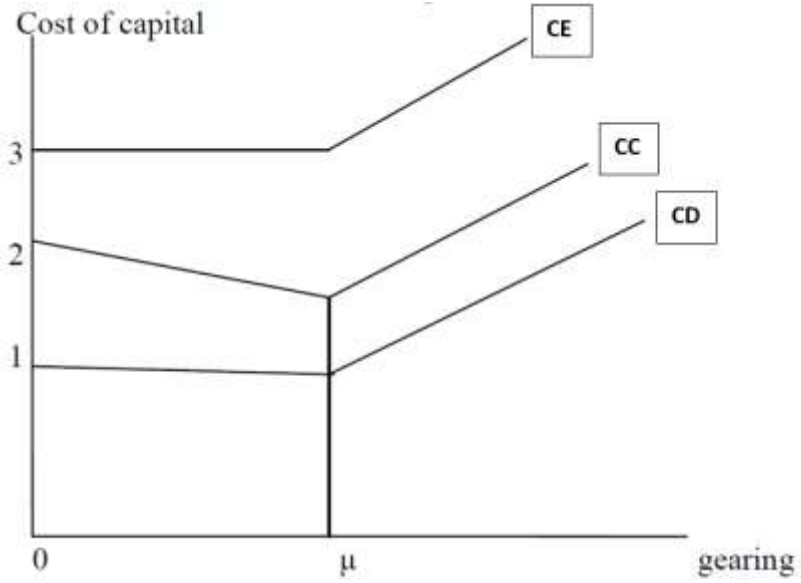
2.5. Traditional Theories

The model represents that a change in capital structure could directly affect the value of a firm. It points out the optimal structure is at the point where weighted average costs of capital is its minimum level. So, under the model, capital structure and the profitability of a firm are related. (Please see the graph below). The graph shows the cost of capital on the vertical axis whereas a firm's gearing level on the horizontal axis. CE in Line 3 represents cost of equity, CC in Line 2 represents the overall cost of capital. Meanwhile, CD in Line 1 means cost of debt after tax. μ is the profitability level where CC is minimized or a level where there is an optimal combination of debt and equity and the overall value of the firm is maximized.

But there are two main assumptions of this particular model. The first is that every earning the company makes is distributed to shareholders as dividends. The latter says that the earnings stay constant whatever happens.



It was also confirmed by the study by Frentzel (2013) where he stated that the traditional view of capital structure can offer an optimal gearing level which can potentially minimizes the CC and maximizes shareholder wealth.

2.6. Theory of Modigliani and Miller

The result that Modigliani and Miller provided is known as the theory of capital structure irrelevancy which pointed out that the financial leverage does not influence the value of a firm. In fact, their research in 1958 has been a basis for corporate finance theories. Regardless of this, the theories used in the study was built around very restrictive assumptions that do not hold in real world. For example, they did not include transaction costs, taxes, and homogenous expectations and took the markets as perfect capital markets. Resultant tax advantages in interest payments and bankruptcy costs might lead to "optimal" capital structure which in turn, maximized the profitability.

Because of these weaknesses, the researchers corrected their theories in 1963. They wanted to review their earlier position, therefore, they took tax benefits as their determinants. As taxation made them think that interest is tax-deductible expense, they believed that a firm that pays taxes can receive a partial interest – "tax shield" in the form of lower taxes they paid. Therefore, they concluded in their final study that a firm should finance its operations using as much debt as possible to maximize its overall value.

2.7. Theory of Static Trade-off

The theory puts forward that firms should go for debt as there are some tax considerations. To put it simply, the firms increase their debt levels since the more leverage is, the higher likelihood of having higher debt tax shield. In addition to the tax advantages, the theory argues that bankruptcy and agency costs may potentially encourage more profitable companies to finance their operations with more debt. As they are less likely to go bankrupt because of higher debt repayment obligations, the firms may start to demand more debt to maximize their tax advantages. So, the positive relationship between profitability and leverage levels can be concluded in this theory. We can see the whole situation visually in the following graph below:

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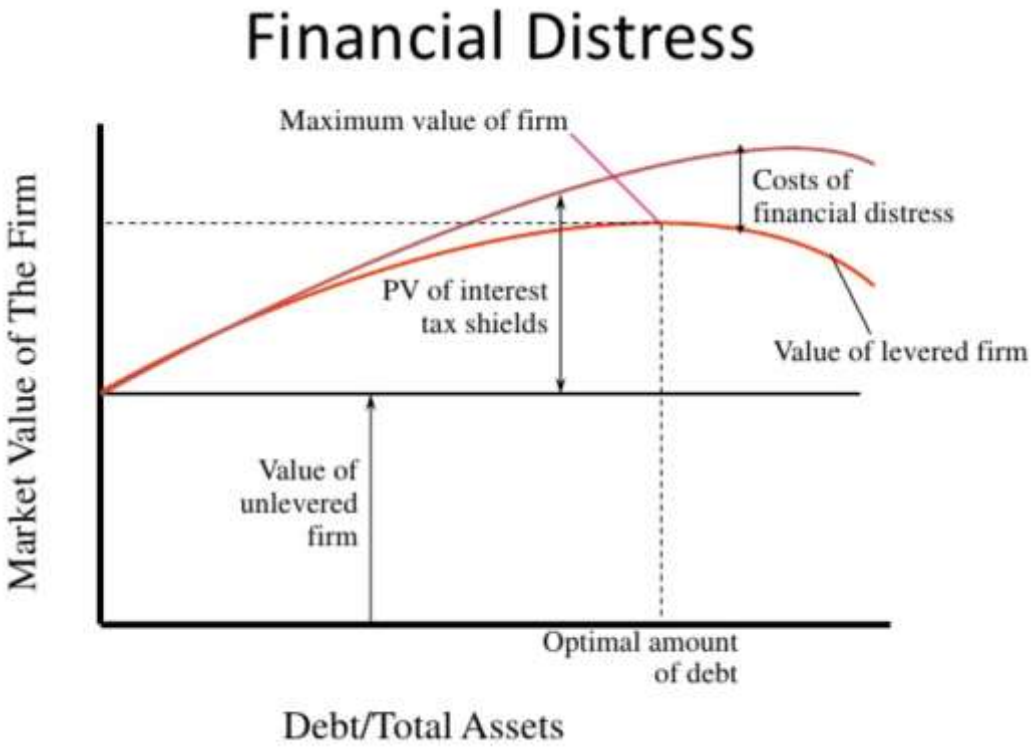

When the leverage level of a firm increases, there is usual trade-off between cost of financial distress and tax shield which leads to an optimum D/E (debt to equity). The top of the curve indicates the tax shield that the firm gained from debt financing whereas the bottom shows the tax shield gain less cost of bankruptcy.

2.8. Theory of Pecking Order

The Pecking Order Theory developed by Majluf and Myers (1984) is quite the opposite of the previous study. It says that the firms borrow because of not having sufficient cash flows to finance capital expenditures. Therefore, the finance borrowed reflects the firm's cumulative need for external sources of funding. Overall, the theory says that higher levels of profitability means that such firms can generate more capitals by using their retained earnings and consequently will have less debt-to-equity.

There were two main assumptions that the pecking theory followed. First of all, managers of a firm have an access to sensitive information – profitability level or growth potentials, hence might have asymmetric information compared to external investors. In addition to this, the managers strive to make decisions and increase the existing shareholder's wealth. Consequently, new equity financing is not mostly favored by external investors meaning that the share issue option does not work as intended. This might later on be reflected on the market as well which arouses a negative reaction to a new equity issue and this may cause falling prices of stocks of the companies.

2.9. Theory of Agency Cost

It states that high level of leverage is always better for shareholders of a firm as they can monitor their managers based on debt levels. To put it differently, debt financing can act as a monitoring tool for management because as D/E level rises, managers have higher incentive to undertake risky projects. If they turn out to be successful, shareholders will get all the resultant earnings but if not, debt holders will have to bear the losses. Kajola's study in Nigeria in 2010 supported this argument and pointed out that the higher debt-to-equity ratio, the lower agency costs leading to less inefficiency and improvement in a company's financial performance.

2.10. Determinants of Capital Structure

a) Debt to Equity Ratio

The leverage ratio has substantially been researched in the past and most of the papers describe it as a factor influencing the capital structure decisions and hence, profitability. Starting with Hantono (2015), he said that the ratio can affect Return on Equity (ROE) which is a variable defining the value of a firm. Quite recently, the study has been backed up by Asrizal et al (2019) where they proved the significant relationship between the capital structure decisions and profitability levels of automotive companies.

b) Debt to Asset ratio

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It indicates the level of a firm's assets which are being financed by long term borrowings. As in the case of debt to equity ratio, higher level of financing of the assets means that the company is highly leveraged leading to greater risks. More dependency on external debts could affect the profitability negatively (Booth et al, 2001 and Fama and French, 2002). Almost all findings on the effect of the ratio on a firm's value were robust for both developing countries and developed countries.

c) Company Size

Nearly all previous researches argue that the size of a firm is very crucial in determining its capital structure and all agree that larger companies finance their business mostly with debts as opposed to smaller firms. As such companies are usually more diversified and have resultant stable cash inflows, they have less risk of not being able to pay back their debts. In addition to debt financing, they are able to use economies of scale when it comes to issuing securities. We can measure the variable in several different ways (Booth et al, 2001) but I am going to use the most recent measurement – natural logarithm of total assets suggested by Anderson et all in 2003.

d) Growth Rate

As we learned in pecking order theory, developing firms could use its retained earnings to increase its growth rate and bolster developmental processes in the short run. Clearly, it creates extra pressure on retained earning which means that the firm should seek external funding for its growth. Previous studies regarding such leverage and chances for growth showed mixed results. Starting from the earliest one by Myers (1977), it concluded that the debt levels are negatively related to a company growth. The most recent research by Oppong-Boakye et al (2013) supported the findings and proved the correlation to be negative once more. However, in the same year another study by Tormyiva in Ghana found a positive relationship between the variables. She confirmed that the insurance companies that were growing at that time were dependent upon more debt to finance their growth.

e) Long Term Assets (LTA)

In accounting terms, tangibility of a company can be reflected on its long-assets and the very tangibility have been found to be a factor influencing the capital structure (Adhegaoncar and Indi (2012), Majumdar (2012), Mukherjee and Mahakud (2010)) Even though the first two studies in Indian companies showed it to impact on capital structure positively, the earlier research by Mukherjee and Mahakud in 2010 in India again showed quite the opposite. Such controversies continued even till today with different results even if most of them were concluded upon the same set of companies but in different periods (Chadha and Sharma, 2015)

f) Liquidity level

Availability of cash in any company is of vital importance for its day to day operations. Not only for such operations but also it is crucial aspect of analysis by potential investors and borrowers. Therefore, liquidity has long been believed to influence capital structure decisions of companies (Chadha and Sharma, 2015). Almost all previous studies found positive relationship between the two concluding that the liquidity can allow firms to secure more and more debt or potential investors (Rasoolpur, 2012 and Bhole & Mahakud, 2014)

g) Age of a Firm

This factor as the one influencing capital structure has been widely studies so far as well. The results were similar regardless of which sector or countries were chosen. (Chadha and Sharma, 2015). The overall conclusion was that the older a firm is, the more likelihood it has to secure additional finance from either debt or equity

2.11. Empirical literature

Different studies conducted on the relationship between the variables (profitability and capital structure) in different countries and industries gave rise to controversial viewpoints. Some pointed out that capital structure decisions in fact Influence Company's performance positively while others found the opposite between the variables.

Starting with the research in Ghana in 2014, Mireku found that the target companies' performance is reliant on more internal finance sources rather than debt financing. While the overall relationship between capital structure and profitability was highly positive, the relationship between debt to equity ratios and profitability ratios were highly negative. This had also been found by Christi (2013) in India. However, this research only concentrated on Debt financing without any other sources of finance. Babatunde (2014) tested the relationship in Nigeria with 10 companies within the period of 10 years. He used regression model and chose Return on Assets and Return on Equity (performance variables) as dependent variables and Debt to assets and Debt to Equity (capital structure variables) as independent variables. The results showed capital structure affecting the profitability negatively. Several more other researches too in Ukraine, America, Sri Lanka, Pakistan, Kenya and Turkey by Lavorski (2013), Tailab (2014), Leon (2013), Nasreem (2013), Marietta (2012) and Toraman (2013) respectively supported the view of negative relationship between the study variables (debt to equity and performance), though Toraman (2013) acknowledged that there is in fact positive

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relationship between leverage and return on equity in the short term. Toraman also added that Total debt to equity ratios cannot affect Return on Assets which indicates that the overall negative relationship between the capital structure and profitability of a firm mostly comes from Debt to Asset ratios. Therefore, the more funds come from long term debt financing company's assets, the more leveraged the corporation is, implying higher financial risks.

Moving on with studies which have found positive relationship between the variables, Adesina (2015), Uremagu (2012) and Olalebe (2013) in companies in Nigeria proved how capital structure components could play a positive role in determining the overall performance. Moreover, another detailed research done by Soyebo (2014) gave much clearer picture and highly contrasted the results gotten by Toraman. He used panel data with 10 companies and the period of 2000-2011 to see how debt to equity ratios influence return on equity ratios. The relationship turned out to be very significant justifying that a highly geared company could have better performance and profitability.

There were a few commonalities among the previously conducted studies. Almost all of them used panel sample data and correlation and regression models to test their hypotheses.

3. METHODOLOGY

3.1. Scope

The scope of the research involved the population of all seventy-two North American Oilfield Service companies listed in Toronto stock exchange. Forty five out of seventy-two were Canadian and the rest were American oilfield service public companies.

To determine the relationship between profitability level and capital structure, the author decided to follow the methods that other previous researchers used. Multiple regression model and correlation analysis were intended to be used with capital structure ratios being explanatory variables while profitability ratios being dependent variables. Generally, the model is:

$$Y_i=\beta_0+X_i\beta_1+\varepsilon_i$$

The model that will be used in this study is as follows:

$$ROE= \beta_0 + \beta_1 D/E + \beta_2 D/A + \beta_3 \text{Company Size} + \beta_4 LTA + \beta_5 \text{Growth Rate} + \beta_6 \text{CurRat} + \beta_7 \text{Age} + \varepsilon_i$$

$$ROA= \beta_0 + \beta_1 D/E + \beta_2 D/A + \beta_3 \text{Company Size} + \beta_4 LTA + \beta_5 \text{Growth Rate} + \beta_6 \text{CurRat} + \beta_7 \text{Age} + \varepsilon_i$$

ROE – Return on Equity
ROA – Return on Asset — **Profitability ratios**
D/E – Debt-to-Equity
D/A – Debt-to-Asset — **Capital structure ratios**
Company Size
LTA – Long Term Assets
Growth Rate
CurRat – Current ratio — **Other independent variables**
Age

The collected data were evaluated by ratios and I have estimated cross sectional multiple regression model based on the above variables and interpretations were made based on the statistics (standard deviation and mean of the parameters). To avoid omitted variable bias, I tried to include as many variables as possible and maximize R^2 – How much variation in Y variables could be explained by variation in X variables. Besides, as I have used cross sectional data in the research, there is a high possibility of having heteroscedasticity which could have affected the conclusions in the end, therefore, I run the regression analysis with and without robust standard errors. Only in that way, I was able to control the heteroscedasticity problem in the model, hence avoiding bias conclusions.

In addition, as the overall model was using Ordinary Least Squares (OLS) method of econometric analysis, I checked for OLS assumptions as well. The assumptions I covered were:

1. Linearity in parameters
2. The number on observations must be more than the number of X variables
3. Zero mean value of residuals
4. No autocorrelation of error terms
5. No correlation among residuals and X variables
6. Normal distribution of the error terms
7. Positive variability in Xs
8. There must not be perfect Multicollinearity
9. The model must be correctly specified
10. Residuals must be homoscedastic (Equality in variance)

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3.2. Research Paradigm

The main purpose of the research is to find out whether there is in fact some relationship between capital structure and profitability among American and Canadian Oilfield Service companies. At the same time, the study goes deeper and intends to:

I. Analyze capital structure variables and ratios of 72 public oilfield service performers in the area
II. Investigate profitability variables and ratios of 72 public oilfield service performers in the area
III. Study the correlation between the two variables and ratios of 72 public oilfield service performers in the area
IV. Suggest the optimal combination of debt and capital financing that North American oilfield service companies should follow.

3.3. Hypothesis of the Research

In this research, I tried to test the statement of whether capital structure decisions in a company can affect its profitability level at 10%, 5% and 1% significance levels. The main hypothesis was:

H_o (null hypothesis): Strong relationship does not exist between the value of firm and its capital structure decisions

H_A (alternative hypothesis): There is in fact a strong relationship between the way companies choose to finance its operations and their profitability

3.4. Description of the data

The paper used secondary data sources which are the financial statements of the North American oilfield Service companies. Those financial statements of the past quarter (Q2, 2020) been taken from money.tmx.com and been analyzed to achieve the intended results. The independent variables were all calculated using the financial statements published by the companies. The industry overall included seventy-two public performers and all of them were involved in the research. To run the regression and correlation analysis, STATA software has been used and it also aided the computation process and data analysis.

3.5. Variable definitions

Having looked through the several different types of capital structure theories and past literature on the below variables, it would be fair to highlight the definitions. The table below gives a summary of the variables that the research is going to go through.

Independent Variables	**Measured by:**
Total Debt to Equity (D/E)	Total Debt / Total Shareholder Equity
Total Debt to Assets (D/A)	Total Debt / Total Assets
Company Size (Size)	Log of Total Assets
Growth Rate	$(EBITDA_{Cur} - EBITDA_{prev})/ EBITDA_{prev}$
Long Term Assets (LTA)	Total Assets - Current Assets
Current Ratio (CurRat - Liquidity)	Current Assets / Current Liabilities
Age	2021 - $Founded_{year}$

a) Debt to Equity ratio

The variable represents the portion of an equity that is being financed by long term debt. It is very important as the debt level cannot exceed the shareholder's equity. Companies mostly borrow external funding in order to gauge the extent to which a firm is taking on some borrowing as a tool for leveraging. The higher the ratio is, the more aggressive the firm is in financing its operations with debt. Such actions taken by managements usually carries exponential level of risk which may potentially mean volatility in earnings due to the interest expenses.

b) Debt to Assets ratios

The ratio indicates the proportions of a firm's assets which are being financed by long term debts. If a company has increasing debt to assets ratio, it implies that the company is greatly leveraged – more and more of its assets are dependent on external or internal debts to operate and it incurs huge financial risks. The lesser the ratio, the less dependent the firm is on debt. Usually, big companies strive to finance most of their operations with debt and therefore their debt to asset ratios increase gradually. To be able to control the ratio, they are required to maintain high stream of income.

c) Control Variables

I took the company size and growth rate as control variables which may influence a firm's profitability not gained by the leverage. As a measurement of company size, I used Ln of Total assets of all companies while the change in EBITDA (Earnings before Interest and Taxes after Depreciation and Amortization) of all seventy-two North American Oilfield service companies was calculated to denote the growth rate.

d) Long Term Assets

They are the assets which owned by a company and are expected to bring economic benefits over a period of more than a year. Usually, Plant or any property

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with useful life of more than one year is listed as a long-term asset in a firm's balance sheet.

a) Current ratio

Current ratio represents liquidity level of a firm which is very important for day to day operations. It shows how much liquid cash does a firm have and in accounting terms it is calculated as current assets divided by current liabilities.

b) Age of Firm

A firm might be operating in the industry for a long time and the duration of an existence can tell us a lot. I researched on the year of foundation of all seventy-two companies from North America and subtracted it from current year of 2021 to calculate their ages.

Dependent Variable	Measured by:
ROE	EBITDA/Total Assets
ROA	EBITDA/Total Shareholder Equity

c) Return on Equity (ROE)

The ratio shows how the investments of shareholders generated certain proportions of income. In other words, it is the profitability level which reveals net income earned as a proportion of shareholder equity. If the ratio has been increasing over a period of time, it means more and more profit is being made for every unit of equity.

d) Return on Asset (ROA)

Being one more financial ratio, ROA represents the percentage of profits a company earned in relation to its assets. It acts like: "Let's say we have XXX amount of assets and what can you do with them" (Charles 2018). If a firm is using less and less assets to generate more and more profits, it means for investors and managers that the company is operating with high efficiency.

4. RESULTS AND DISCUSSIONS

4.1. Introduction

The chapter analyzed the empirical findings of the research question – Does capital structure really impact on profitability of North American Oilfield service companies? To validate the results and avoid bias conclusions, it checked for all OLS assumptions first and then interpreted the overall results.

4.2. Empirical Calculations

*Note: *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. Numbers in brackets are p values.*

Dependent Variable	ROE		ROA	
	Without Robust Standard Errors	With Robust Standard Errors	Without Robust Standard Errors	With Robust Standard Errors
D/E	0.00127878* (0.018)	0.00127 (0.236)	-0.01988* (0.048)	-0.01988 (0.574)
D/A	-0.046350** (0.002)	-0.04635* (0.013)	0.63733825* (0.020)	0.637338 (0.224)
Size	-5.731e-06 (0.999)	-5.731e-06 (0.999)	0 .1277695* (0.044)	0.12776 (0.252)
Growth Rate	2.027e-06 (0.816)	2.027e-06 (0.351)	0.0000247 (0.879)	0.00002 (0.360)
LTA	-7.200e-13 (0.592)	-7.200e-13 (0.473)	-2.815e-11 (0.263)	-2.815e-11 (0.224)
CurRat	-0.00342837 (0.087)	-0.003428* (0.047)	0.01580151 (0.669)	0.015801 (0.264)
Age	0.00003479 (0.833)	0.000034 (0.809)	-0.0034285 (0.268)	-0.00342 (0.264)
Constant	0.02482862 (0.713)	0.024828 (0.765)	-2.5071728* (0.050)	-2.50717 (0.253)
Specification Tests				
R-squared	0.2372	0.2372	0.1527	0.1527
Adj-R2	0.1538	-	0.0600	-
F-statistics	2.84*	-	1.65	-

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	(0.0120)		(0.1382)	
No. of observations	72	72	72	72

I conducted the cross-sectional regression model using OLS method above and at the same time tried to control for heteroscedasticity. Hence, I have two models for each dependent variable with and without robust standard errors. As is shown, the results were substantially different in both cases which in fact shows that the cross-sectional data used had heteroscedasticity problem.

	ROE	***ROA***	***D/E***	***D/A***	***Size***	***GrRate***	***LTA***	***CurRat***	***Age***
ROE	1.000								
ROA	-0.528	1.000							
D/E	0.285	-0.219	1.000						
D/A	-0.342	0.207	-0.017	1.000					
Size	0.131	0.056	0.069	-0.330	1.000				
Growth Rate	0.021	0.025	0.011	0.118	0.012	1.000			
LTA	-0.035	-0.037	0.018	0.004	0.564	0.040	1.000		
CurRat	-0.047	-0.053	-0.062	-0.423	-0.016	-0.201	-0.124	1.000	
Age	-0.003	-0.071	-0.030	0.022	0.341	0.117	0.333	-0.053	1.000

The above table is the correlation matrix aiming at showing the correlation between the main two dependent variables and seven independent variables.

4.3. Descriptive statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
roe	72	-0.00129	0.041934	-0.20687	0.107279
roa	72	0.112652	0.742419	-0.32737	6.163474
de	72	0.724773	8.726881	-27.5737	63.76757
da	72	0.376582	0.391599	0.000871	2.423188
size	72	19.67343	1.885894	14.18097	24.5225
growthrate	72	-66.9712	542.123	-4588.57	126.0826
lta	72	1.35E+09	4.33E+09	542590	3.03E+10
currat	72	2.807232	2.648802	0.085028	13.16783
age	72	36.18056	30.52744	4	180

I examined the value of the firm with two performance indicators of return on equity (ROE) and return on assets (ROA). If we take a look at their values from the table, mean value for ROE was negative. Even though it indicated a more peaked distribution than normal one, the spread was not much dramatic. Minimum value (negative 0.20687) implies that some of the firms were operating at loss in Q2, 2020 while the positive maximum value says that the rest were generating profits. In ROA, apart from the mean value everything as quite the same as ROE. The positive mean value in ROA means that the distribution was positively skewed.

4.4. OLS Assumptions

4.4.1. Linearity in parameters

The first assumption was easily calculated by raising one of the βs to the power of 2. The resultant figure was again linear which was in line with the first assumption

4.4.2. The number on observations must be more than the number of X variables

I had an overall of seven dependent variables in the model but I included seventy-two companies from North America which is itself a confirmation for assumption two

4.4.3. Zero mean value of residuals

I first generated the residuals in STATA by using "predict residuals" command and calculated their mean value:

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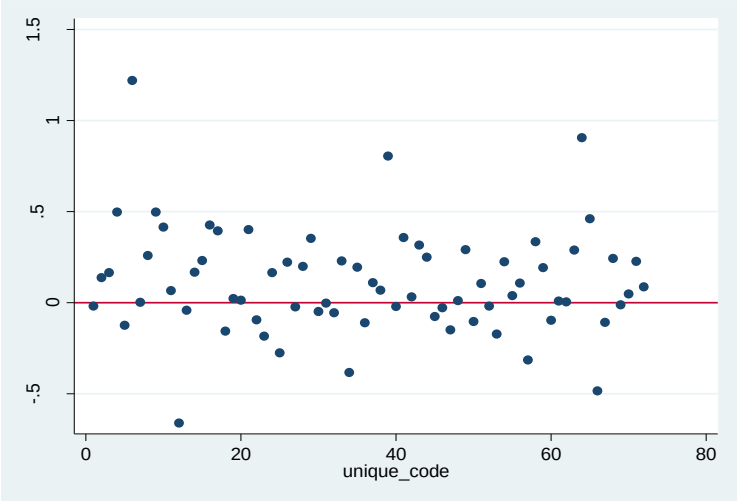
Variable	Obs	Mean	Std. Dev.	Min	Max
residuals	72	.1126524	.2901229	-.6597354	1.221491

Clearly, the mean value of the residuals is not zero which implies that the X predictors cannot be enough in explaining the variation in Y. Still, the mean value is not far from zero which pushed me to check other assumptions as well.

4.4.4. No autocorrelation of error terms

Even though autocorrelation among error terms is not a common phenomenon in cross sectional dataset, I checked it by drawing a graph.



"Fitted values" in vertical axis are residuals while the "unique_code" in horizontal axis is just sequential numbers. We can see that the random patterns are lined along zero showing upward and downward trends in different parts. It confirms the assumption that there is no autocorrelation among residuals.

4.4.5. No correlation among residuals and X variables

The assumption could easily be checked by simply drawing the correlation matrix.

	residu~s	age	currat	lta	growth~e	size	da	de
residuals	1.0000							
age	-0.1820	1.0000						
currat	-0.1347	-0.0526	1.0000					
lta	-0.0946	0.3325	-0.1236	1.0000				
growthrate	0.0634	0.1166	-0.2013	0.0395	1.0000			
size	0.1438	0.3415	-0.0163	0.5641	0.0116	1.0000		
da	0.5308	0.0221	-0.4235	0.0043	0.1182	-0.3298	1.0000	
de	-0.5603	-0.0302	-0.0624	0.0181	0.0108	0.0688	-0.0166	1.0000

As can be seen, there was not strong correlation between any of the X variables and residuals. Only, in D/E and D/A ratios showed moderate correlation while others had nothing correlated with the error terms, hence the assumption holds.

4.4.6. Normal distribution of the error terms

One way of checking normality of any variable is just to draw a histogram. I did the same for residuals and got the following graph.

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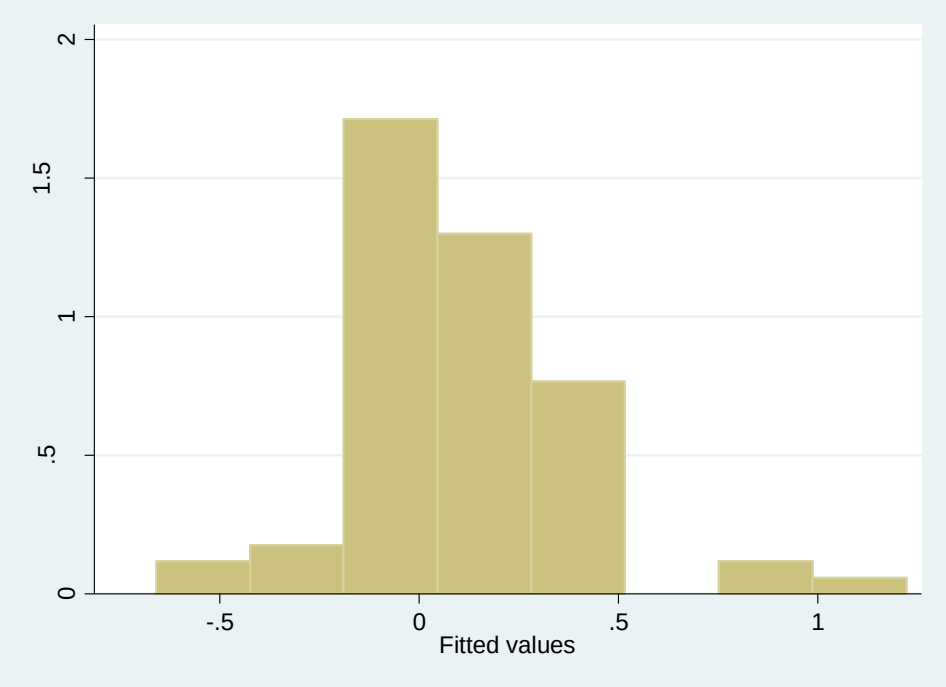

Unfortunately, the normality assumption of residuals was being violated here. I tried by logging the residuals as well but still it gave left skewed graph which might indicate that the model could be biased in some parts.

4.4.7. Positive variability in Xs

Easiest way was to calculate variances for all X variables in STATA. In order for the assumption to be hold, all of them were supposed to be positive.

Variable	Obs	Mean	Std. Dev.	Min	Max
de	72	.724773	8.726881	-27.57365	63.76757
da	72	.3765821	.3915986	.0008714	2.423188
size	72	19.67343	1.885894	14.18097	24.5225
growthrate	72	-66.97115	542.123	-4588.571	126.0826
lta	72	1.35e+09	4.33e+09	542590	3.03e+10
currat	72	2.807232	2.648802	.0850278	13.16783
age	72	36.18056	30.52744	4	180

Looking at the standard deviations we can say that the variances were positive which means that the assumption seven holds.

4.4.8. There must not be perfect Multicollinearity

Testing for the assumption could be conducted using several methods but the one u used was Variance Inflator Factor (VIF). The mathematical representation of the method is very simple:

Using software STATA gave the following results:

$$VIF=1/(1-Rsq)$$

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Variable	VIF	1/VIF
size	1.89	0.530285
lta	1.60	0.625719
da	1.50	0.668093
currat	1.30	0.767438
age	1.20	0.830938
growthrate	1.06	0.946421
de	1.01	0.987173
Mean VIF	1.37	

From the econometric textbook, if the mean VIF is above ten, it means there is a multicollinearity issue. However, the results showed 1.37 which is much less than 10 indicating that the assumption is not being violated.

```
Ramsey RESET test using powers of the fitted values of roe
       Ho:  model has no omitted variables
                 F(3, 61) =      5.85
                 Prob > F =      0.0014
```

In both cases, the probabilities were less than our p-value which was 0.05. This shows that the variables I included in the model are enough in explaining profitability of the companies. Ironically, in Assumption 3, the mean value of residuals was not zero and gave me a suspicion of having not enough X variables in the model. However, as the value was close to zero and Assumption 9 holds true, they collectively can indicate

4.4.9. The model must be correctly specified

Assumption 9 is about omitted variables. If there are some other variables explaining the profitability and which are not included in the model, then it indicates that the model is not specified correctly.

```
Ramsey RESET test using powers of the fitted values of roa
       Ho:  model has no omitted variables
                 F(3, 61) =    330.94
                 Prob > F =      0.0000
```

that the independent variables could well explain the dependent variable.

4.4.10. Residuals must be homoscedastic (Equality in variance)

To check it, I had to regress and run the *estat hettest* command in STATA. First I needed to log all variables. It allowed to transform possible highly skewed variables into more normally distributed ones. Then Cook-Weisberg test gave the following results:

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of Lnroe

         chi2(1)      =     0.00
         Prob > chi2  =   0.9786
```

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of Lnroa

         chi2(1)      =     0.68
         Prob > chi2  =   0.4080
```

In both cases, as we can see the p-values are definitely more than 0.05 which means we cannot reject the null hypothesis, namely, there is not heteroscedasticity in the data. Even if there was, as I run the regression with robust standard errors too, the problem was already controlled.

4.5. Empirical Analysis

As I finally finished all of the analysis and almost made sure that the data and model is free from bias, I am now able to make accurate conclusions about the numerical estimates. Starting with ROE, I had two significant variables at first – Debt to Equity and Debt to Asset ratios and one more variable was close to being significant – Current ratio. However, after controlling for heteroscedasticity and running regression with robust standard errors, Debt-Equity ratio lost its significant while Current ratio gained more significance with 10% each. Current ratio (liquidity) has been shown to decrease profitability (ROE) by 0.0034 for every unit increase in cash flows in companies. Even though the effect is very small, it is in line with accounting theories which say that the liquid money in a business must exist only to finance daily operations not to make profit. One more significant variable and determinant of capital structure (D/A) showed that it also decreases profitability levels for every unit increase. Looking at the R-squared, I can also say that the model is well put together as it indicated around 24%. It means that 24% variation in the dependent variable (ROE) could be explained by the variation in the independent variables. 24% is one of the optimal percentages for cross sectional regression models and therefore, I can say that the model is in itself very significant. This is supported by F statistics which was more two and naturally according to rule of thumb it is significant.

Moving on ROA and other independent variables, the results were unexpected. After controlling for heteroscedasticity, there was no significant variable left.

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None of the variables were valid to make sensible conclusions. I then decided that the ROA was not a good measurement of profitability in this particular case.

5. CONCLUSIONS

5.1. Interpretations

Results turned out to be slightly different than what I have speculated. I was expecting that I would have more significant variables and besides, I did not know that I would have to reject Return on Assets ratio (ROA) as a profitability indicator in the model.

Generally, findings indicated Debt to Assets ratio as a significant factor influencing profitability in Norm American Oilfield Service companies. The coefficient was negative which means that the higher the ratio, the less value of a firm will become. To clarify more, the seventy-two companies must not borrow debt to the level where their assets are highly at risk. If they decide to borrow more and more debt from external parties and the level of debt relative to assets increases exponentially, it might mean decreasing profitability in the long run. When it comes to the second significant variable in the model – current ratio, it was also negatively affecting profitability negatively. In fact, current ratio represents cash and other cash equivalents in a business and its existence determine if the company can pay-off its interest payments on its debts or dividends. Therefore, I can definitely say that it is one of the determinants of capital structure decisions. At the same time, it is affecting profitability negatively and it implies that more cash on hand is actually bad for profitability.

Looking at the constant (β_0), it showed that if I hold other variables constant, then profitability level in North American Oilfield companies was on average increasing by 0.025 every quarter. This might seem less as oilfield sector is ever booming industry however, taking current situation into account – COVID19, the results were still impressive. The data was from Q2 of 2020 which refers to the beginning of pandemic and international lockdown. Regardless of this, the companies were performing profitably.

When it comes to the correlation between the dependent and independent variables, there was no strong correlation at all. Besides, for ROE apart prom Size and Growth rate, all other variables were negatively correlated which indicates if the variables increase, they all decrease profitability in all seventy-two companies in North America. Based on that, I can safely conclude that overall more capital structure can negatively impact value of the firms.

5.2. Discussion

The research results offered many similarities and contrasts with previously conducted studies. Starting with similarities, the results were exactly the same with Mireku (2014) and Babatunde (2014) in terms of negative relationship between the capital structure and profitability levels. Especially, studies by Lavorski (2013), Tailab (2014), Leon (2013), Nasreem (2013) and Marietta (2012) were conducted in America and were supported in my American company analysis.

In addition to the similarities, there were contrasts with previous researches too. Mostly in African countries, the relationship between capital structure of firms and their profitability were positively correlated. Starting with the ones on Nigeria conducted by Adesina (2015), Uremagu (2012), Olalebe (2013) and Soyebo (2014) , they all stated that the financial performance gets better as companies include more and more capital structure components in their businesses. My study though as has been discussed earlier concluded the components to impact on profitability negatively in North American Oilfield Service companies.

5.3. Limitations of the research

1. One of the main limitations that I tried to control but could not as much as I wanted was to include more variables in the model. Even though I included seven most popular determinants of capital structure, the model still reached to the R-squared of 24% and it could have been improved.
2. The fact that I used cross sectional data did not allow me to compare the companies themselves over a period of time. Only in this way, one-time changes as pandemic effect would be evaluated easily and compared with previous year, consequently better conclusions.
3. As I used simple linear regression model (OLS), results can tell restricted amount of information as compared to other more sophisticated and complex econometric models. Therefore, it would be better if other research groups use more complex models in the future.

5.4. Recommendations

First and foremost, recommendation would be suggesting an optimal capital structure component. It usually depends on industry specific and could vary accordingly. But the results showed that the financing with more and more debt is actually bad for the overall value of the companies. Therefore, taking oilfield service industry benchmarking and my results into consideration, I would recommend the debt to equity ratio to become between 0.45 - 0.5. It takes into account the impacts of the current global pandemic. If say a company is having the debt to equity ratio of 0.45, then it means they are being financed through external debt more than their shareholder's investments (0.55 by shareholders).

There needs to be another research on the area using time series data as well. Because taking the movement of trends in debt and equity financing over a

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period of time could give much more accurate results with more significant explanatory variables.

The North American Oilfield service companies must not hold unnecessary cash or other equivalents on hand and invest the money into business instead.

5.5. Final conclusions

All in all, the research was able to find and cover everything it indented to find. It has reached it objectives it put forward earlier. The research found that there is in fact a relationship between the capital structure and profitability of North American Oilfield Service companies and the relationship was mainly negative. It means that the companies must be very careful of their capital structure decisions as they may decrease the value of the firms. Potential investors too can use the knowledge to make investing decisions based on the impact of the variables used in this paper.

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