Assessing the optimal capital structure: A case study of Afren public limited company - a small exploration and production oil and gas company

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Abstract

This study assessed the optimal financing mix for Afren Public Limited Company based on the trade-off theory and evaluated the cost to the firm from deviating from that position. In doing this, we derived a firm-specific optimal capital structure using the cost of capital approach, which involved the use spreadsheet modelling through an iterative process to determine series of discount rates based on different combinations of debt and equity under the assumption of constant earnings to the firm. The base result shows that as the debt intensity increases, the equity Beta has a multiplier effect such that the cost of equity increases more than proportionately to the increase in leverage. As more debt is introduced, the risk of loan default increases, thus increasing the credit spread over the riskless rate and effectively the pre-tax cost of debt. The result from the firm's weighted average cost of capital (WACC) and value as a function of leverage, implied optimal debt ratio is 40% and yields a WACC of 8.63% which is effectively the minimum cost of capital that maximizes the value of the firm. Between 40% and 45% leverage, the debt servicing capacity of the firm measured by the interest coverage ratio drops significantly from 4.6 to 1.4 due to high interest burden. This increased credit risk has a direct impact on the firm's credit quality rating.

Keywords: *optimal capital structure, cost of capital, trade-off theory, weighted average cost of capital, debt*

1. Introduction

According to Brealey et al. (2007), capital structure essentially refers to a firm's combination of debt and equity financing. A major distinction between the two instruments is that the former creates a financial obligation to repay a principal sum plus an interest thereupon, while the latter accrues any residual earnings to its holders. Kraus and Litzenberger (1973) argue that there exists an optimal debt level which minimizes a firm's cost of capital and maximizes its value. This level is associated with striking a balance between the costs and benefits of debt. Myers (2001) underscores that the market value of a company is determined by the future cash flows from all projects; their level, timing and variations. Discounting these cash flows by a relevant rate, gives the present value of the firm. The future cash flows from all project is independent of the proportion of debt or equity used in project financing and was a center piece of Modigliani and Miller's thinking in their 1958 seminal contribution.

Modigliani and Miller (1958) demonstrated that since debt is cheaper than equity at least from a starting point (This is because shareholders are only entitled to residual claims. However, this may not always hold because at very high debt levels increased risk of default will also increase cost of debt), the low cost of debt will be offset by the higher expected equity return keeping the weighted average cost of capital (WACC) constant. But the introduction of corporate taxes changes the dynamics; interest being tax deductible will reduce after-tax cost of debt and effectively the WACC. Note that for a leveraged company, the relevant discount rate represented by the WACC is composed of two magnitudes; cost of debt and the required return on equity, weighted by their respective proportions. Sunley et al. (2002), note that companies in high tax jurisdictions often adopt aggressive transfer pricing by taking heavy debt financing above the market rates from related parties. By implication, after-tax earnings which determine firm value will increase due to higher interest deductions and lower tax liability. Also, there will be a reduction in the WACC as corporate tax makes leverage less onerous on shareholder earnings. While debt might have an obvious appeal to companies, studies (reviewed in chapter two) have shown that firms have different tolerable debt capacities before losing corporate value. This suggests that debt financing generates benefits as well as associated costs which induce prohibitively high financial risk beyond a certain point; this accounts for why 100% debt is not observed among firms. Micro economic thinking posits that optimal decisions are made at the margin; in the same vein optimal leverage which maximizes the value of a firm will occur at the point where the marginal benefit and cost of debt are equal. Consequently, the WACC is minimized at this point.

Given the above, this study models an optimal financing mix for Afren based on the trade-off theory and assess the cost to the firm from deviating from that position.

1.1. Motivation for the study

The weakening of financial institutions, credit squeeze and rising cost of funds; direct results of the global financial crises since 2007 have redirected the corporate decisions, financing

policies and attitude of companies towards risk. These are particularly crucial for the oil and gas industry associated with heavy financial requirements, where significant risks and uncertainties are inherent features. However, while the big oil companies have robust cash flows and good access to global credit markets as a result of proven track records and strong relationships built with financial institutions over time, the implications are more severe for the small/midsized oil companies. Faced with the challenge of meeting enormous financing needs with the age of cheap and easy oil over, the credit risk perception on them is much higher in light of the fact that these companies barely have sufficient credit history or stable cash flows to give assurance of credit worthiness. A key objective function for these companies is optimizing their capital structure subject to internal and external financial constraints under the overarching goal of maximizing shareholder value. Given the above, this study pertinently studies the capital structure of small and mid-sized oil and gas independent companies in the UK, using Afren plc; a UK based company with a growing composition of assets in Sub-Saharan Africa as a case study. More so, we observed that for the five-year period trailing to 2011, Afren has used debt financing more aggressively than its peer companies, and based on 2011 financial information the company's cost of equity, debt and capital are estimated at 14.7%, 9.2% and 12.3%; significantly higher than the peer average of 10.7%, 6.4% and 10% respectively, thus the need for this study.

1.2. Brief stylized facts on Afren

Afren plc (public limited company) was founded in 2004 by the Europe-based West African entrepreneur Ethelbert Cooper, with assistance from the former OPEC president and secretary general Rilwanu Lukman, as an exploration and production company focused on Africa. Most of Afren's production is in Nigeria. It is an international independent exploration and production (E&P) company with a Premium Listing on the London Stock Exchange (symbol AFR) and a constituent of the FTSE 250 Index. Afren is a dynamic, entrepreneurial organization with a portfolio of world-class assets located in several of the world's most prolific and fast-emerging hydrocarbon basins in Africa and the Middle East. Its activities span the full-cycle E&P value chain of exploration, appraisal, and development through to production, (Afren, n.d). By 2005, it rapidly expanded its portfolio across six countries: Nigeria, Sao Tome & principle JDZ, Gabon, Republic of Congo, Cote d'Ivore, Ghana and Iraq. The Group is currently producing circa 22,000 barrels (3,500 m^3) of oil equivalent per day from its current portfolio. Among their oil fields are the Okoro Field ("Okoro") and Setu Field ("Setu" which are two oil fields located in OML 112 in shallow water offshore Nigeria. They were originally awarded to Amni – an indigenous oil company in 1993 as part of the Nigerian government's indigenous licensing programme.

First oil was achieved during June 2008 when production from the first two production wells drilled commenced at a rate in excess of 3,000 barrels (480 m^3) of oil per day from each well. A further five wells were subsequently drilled, completed and brought onstream. The wells drilled were a mixture of horizontal and highly deviated penetrations of the reservoir

intervals. The field is currently producing at a rate of 22,000 bbl/d (3,500 m^3/d) from all seven wells. There is also the Ebok which is an undeveloped oil field located in OML 67, 50 km offshore in 135 ft (41 m) of water in Nigeria's prolific south eastern producing area. The field was discovered by the ExxonMobil / NNPC JV in 1968 (M-QQ1 (Ebok-1)), and two subsequent appraisal wells were drilled in 1970 (Ebok-2 and Ebok-3). First oil was originally targeted in H2 2010 but was subsequently pushed back to February 2011. In 2013, our exploration and appraisal campaign yielded remarkable results, with the play-opening discovery in OPL 310, offshore Nigeria, one of the largest discoveries in the world last year and the successful drilling and testing results on the Ain Sifni and Barda Rash PSCs, Kurdistan region of Iraq. Our E&A success has resulted in net 2P reserves addition of 34.1 mmbbls and a 2P reserves replacement ratio for 2013 of 201%.

2. Review of the literature

The trade-off theory predicts that firms have a target debt ratio. Some authors have equated this target level to the average industry ratio (Lev 1969; Frank & Goyal 2008). Firms within an industry are generally expected to have similar range of leverage due to shared characteristics like business risks, earnings variability and reliance on similar technology and will try to adjust and stay within the average industry leverage. Although industry average could signal a firm's likely financing behavior, Ferri and Jones (1979) test this hypothesis across different industrial classes, finding a moderate and indirect relationship between industry average and firm leverage and a strong degree of leverage dispersion in some industries including mining-metal and oil and gas. In a study on intra-industry dispersion of leverage, Almazan and Molina (2005) find significant capital structure dispersion among firms in highly concentrated industries, explaining that lower competitive forces allow firms to generate economic rent such that they are not inclined to adopting stringent operational and financial policies that minimize costs to the barest minimum. Statistics show a 59% firm concentration ratio[1] of the five largest firms (BP, British Gas, Exxon Mobil, Shell and Conoco Philips) in the UK oil and gas industry (Mahajan 2006).

Although firms' financing decisions are not made in isolation, disparities in characteristics (size, opportunities, profitability) across firms in an industry suggests narrowing the entire industry to firms within a peer group which potentially have more striking similarities. Leary and Roberts (2010) in a study on peer effects provide evidence of a 'mimicking behavior' among financially constrained smaller firms with higher competitive forces. Based on a two-stage least square regression (2SLS method) they showed that peer firm average is positively related to 'own' firm leverage and its coefficient is more statistically significant than other explanatory variables after the lagged value of the firm's leverage.

Binsbergen, et al. (2011) model optimal debt financing positions on a number of case study firms at different years based on a marginal benefit-cost of debt approach, and compare the

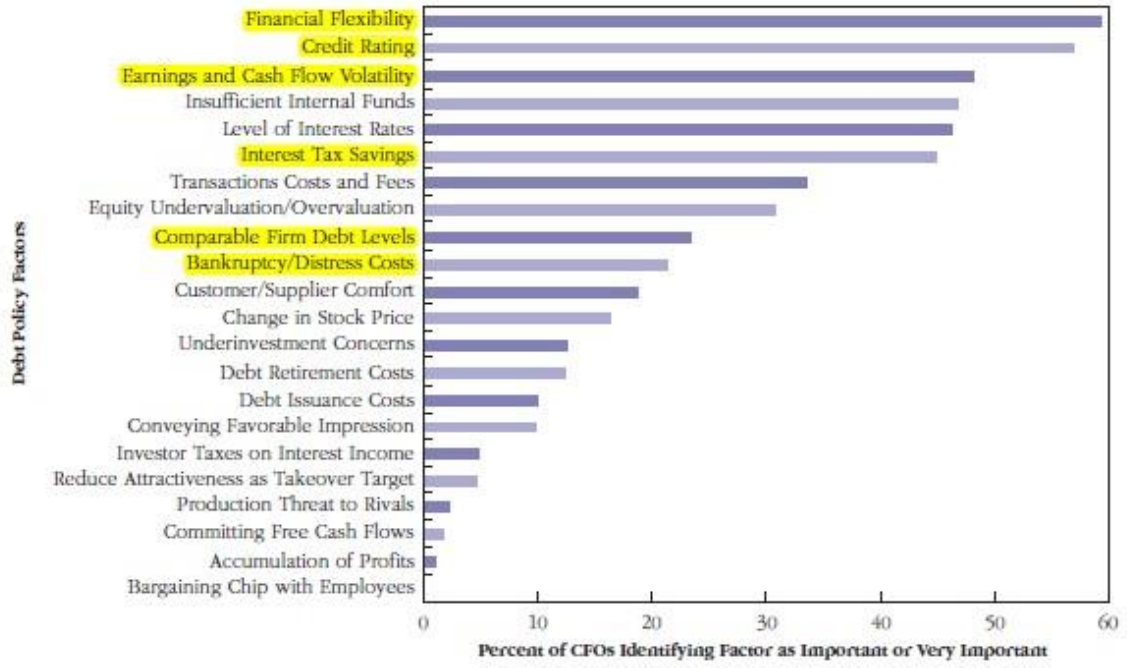
[1] Concentration ratio = sum of gross value added (GVA) for 5 largest firms divided by industry GVA

implied optimal leverage to those observed among the firms in those years. Their results showed that in 2006 the debt intensity of Six Flags entertainment was three times its optimal debt level. Conversely, other firms including Performance food group and Coca-Cola plc were over leveraged in 2006 and 1999 respectively. Black and Decker Corporation was over leveraged in 1990 following acquisitions it made through debt financing but adjusted to an optimal level in 2007. However, the company's 2009 leverage position was two times below its optimal level. Sub-optimal positions come at a cost to firms and the study also showed that the cost of being over leveraged by a certain magnitude of debt for these companies were higher than the cost of being under leveraged by debt of the same magnitude.

Authors in a number of studies, have alluded to reasons for the apparent sub-optimal leverage observed in firms including; firm strategic policies like acquisitions or the need to preserve financial flexibility (Binsbergen, et al. 2011; Byoun 2011), market limitation, timing considerations and speculations about changes in interest rate, credit rating and stock market performance (Graham & Harvey 2002). Therefore, the choice between equity and debt financing decisions is not static but require dynamic adjustments. While short-run needs may result to excessive use of debt, these factors also preclude an uncontrolled use of debt financing. Note that Byoun (2011) defines financial flexibility as "capacity to mobilize financial resources in response to uncertain future contingencies".

Based on survey results across 392 US firms on CFOs capital budgeting and financing decisions across different industries, Graham and Harvey (2002) note that "when it comes to making capital structure decisions, corporations appear to pay less attention to finance theory and rely instead on practical, informal rules of thumb".

Figure 2.1: Survey evidence on factors that affect the decision to issue debt



Source: Graham and Harvey, 2002.

Figure 2.1 provides evidence based on the percentage of CFOs (on the horizontal axis) that identify each of the factors on the vertical axis as being important in their decisions to use debt financing. Financial flexibility and credit rating are mostly critical to almost 60% of CFOs. It is important to highlight that maintaining certain high-class rating could cost a firm some unexploited benefits from extra debt; other things equal, increasing leverage worsens credit ratings and as companies try to maintain top ratings they run the risk of under leverage. The tax-shield benefit of debt is surprisingly considered very important by only about 45% of CFOs. Although CFOs also consider credit rating as being very critical, paradoxically bankruptcy/distress costs are considered important by only about 25% of CFOs. Also, the evidence is quite inconsistent with Leary's and Robert (2010) opinion on peer effects with only about 25% of CFOS's finding this factor important. These perhaps expose surveying flaw since it measures belief systems of respondents which may not necessarily indicate actual practice.

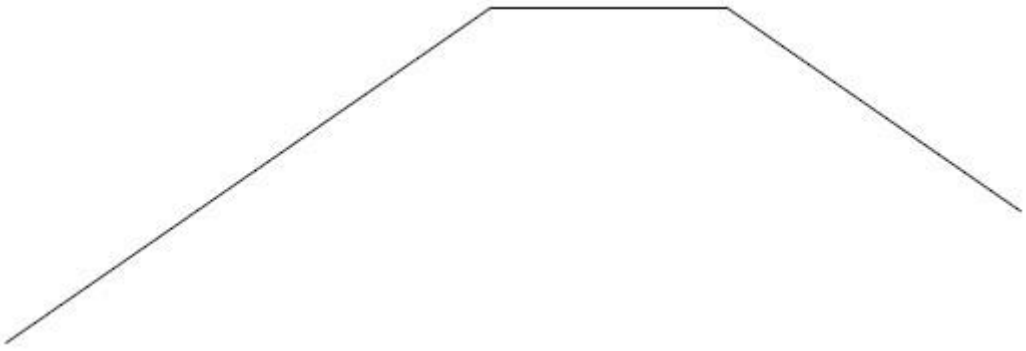
Figure 2.2: Survey evidence on factors that affect the decision to issue equity

Source**:** Graham and Harvey, 2002.

From figure 2.2 above, almost 70% of CFOs consider the likely effect of asymmetric information on stock value. This supports the pecking order prediction that managers would likely not issue equity if they consider their stock undervalued since the announcement effect might further drive down the stock prices. While 60% of CFOs consider financial flexibility very important (Fig. 2.1), about 52% consider maintaining a target debt/equity ratio as very important (Fig. 2.2). Although the difference is slight, it suggests that for majority of CFOs the most important objective function is not always to minimise the firm's cost of capital but maintaining financial flexibility. This evidence of financial flexibility being most critical to debt issue is also corroborated by Bancel and Mittoo (2004) in a survey on determinants of managers' capital structure decisions across 16 European countries.

In the process of embracing real options techniques, a firm might have to evaluate the benefits of deferring some potentially viable investment opportunities to a future period is far more than commencing immediately perhaps due to uncertainty about oil price or fiscal changes. In this respect, management will consider it worthwhile to conserve current use of debt financing to enable borrowing at a future period when such uncertainties are resolved. In a situation like this, low leverage in the short-run and higher leverage in the long-run might be observed. Byoun (2011) used strategic decisions such as to explain how the demand for flexibility influences firms' leverage policies at different stages as observed in practice. Figure 2.3 adapted from Byoun (2011) study shows that a firm which has accumulated borrowing capacities during the development phase is able to mobilize more debt to finance investments during the growth stage.

Figure 2.3: The predicted relationship between demand for flexibility and leverage



[Developing Phase]	[Growth Phase]	[Maturity Phase]
Firms are in great need of financial flexibility	**Firms with great need of external funds utilize available financial resources**	**Firms with sufficient internal funds recharge financial flexibility**
• Small firms • With low earned capital • With negative/low cash flow-to-value ratios • With no credit ratings	• Medium firms • With mediocre earned capital • With low/medium cash flow-to-value ratios • With low credit ratings	• Large firms • With large earned capital • With high cash flow-to-value ratios • With high credit ratings

Source: Byoun, 2011.

As can be seen from the figure, the startup phase is characterized by very low leverage which gradually increases up to a plateau during the growth phase as the firm takes advantage of high borrowing capacity saved up in the past to undertake investment opportunities. Consequently, as the firm attains maturity, debt intensity declines as it has accumulated sufficient retained earnings to finance operations.

In summary, the consensus of views is that optimal or a range of optimal capital structure does exist for individual firms. Although Modigliani and Miller did not embrace this idea, they paradoxically allude to it by the subtle contradiction in their 1963 correction paper

where they stated that ... "the existence of a tax advantage for debt financing- even the larger advantage of the corrected version- does not necessarily mean that corporations should at all times seek to use the maximum possible debt in their capital structures" (Modigliani & Miller, 1963). They indeed recognize that an uncontrolled use of debt is not optimal. There is no one-fit-all theory that can sufficiently explain the financing behavior of all firms through their life cycle; the trade-off, pecking order and agency theories each present incomplete but complementing explanations to capital structure decisions. In as much as this study explores an optimal debt position for Afren, it does not ignore the fact that management also consider financial flexibility critical to the survival and long-term growth of their business.

3. Methodology and data

3.1. Methodology of data analysis

The Weighted average cost of capital (WACC) approach is used to estimate the overall cost of capital used for valuation and capital budgeting. The WACC is composed of two magnitudes; the required return on equity (K_e), and post-tax cost of debt (K_d) weighted by their proportions;

$$WACC = K_e [E/D+E] + K_d [D/D+E] \quad (1)$$

The Capital Asset Pricing Model (CAPM) for pricing risky securities developed by Sharpe (1964) and Lintner (1965) are used to estimate the required return on equity for the companies. A study by Graham (2002) reveals that 74% of public firms use the CAPM in estimating equity cost of capital. The model specifies a linear relationship between the required return on equity and a firm's Beta. Beta measures the magnitude of risk or sensitivity of a company's stock in relation to a market index;

$$K_e = R_f + \beta_L [E (R_m)-R_f] \quad (2)$$

Where:

R_f = risk-free rate

β_L= firm Beta adjusted for financial leverage

$E (R_m) - R_f$ = market risk premium

Deriving the optimal leverage ratio that maximises the value of a firm can be done by several approaches including; the cost of capital approach and the Adjusted Present Value (APV) approach. These methods, though mainly driven by the assumptions of the tradeoff theory pose different estimation limitations. The APV approach directly follows the Kraus and Litzenberger model (1973). This was part of the Trade-off theory which states that in a world of market frictions, leverage brings tax benefits due to interest deductibility of pre-tax earnings, but at the risk of financial distress and potential bankruptcy. This is because debt creates a financial obligation with legal backing, a breach of which is actionable in law. Kraus and Litzenberger model (1973) stated the firms' financing decisions involve a trade-off between the tax benefits and bankruptcy costs of debt and presented a simple model for

valuation of a leveraged firm, given as the value of the firm in an unleveraged state plus the present value of tax-shield minus the present value of financial distress.

V_L = Vu + [*tax rate*debt*] – [(1-*tax rate*) * PV cost of financial distress]..... (3)

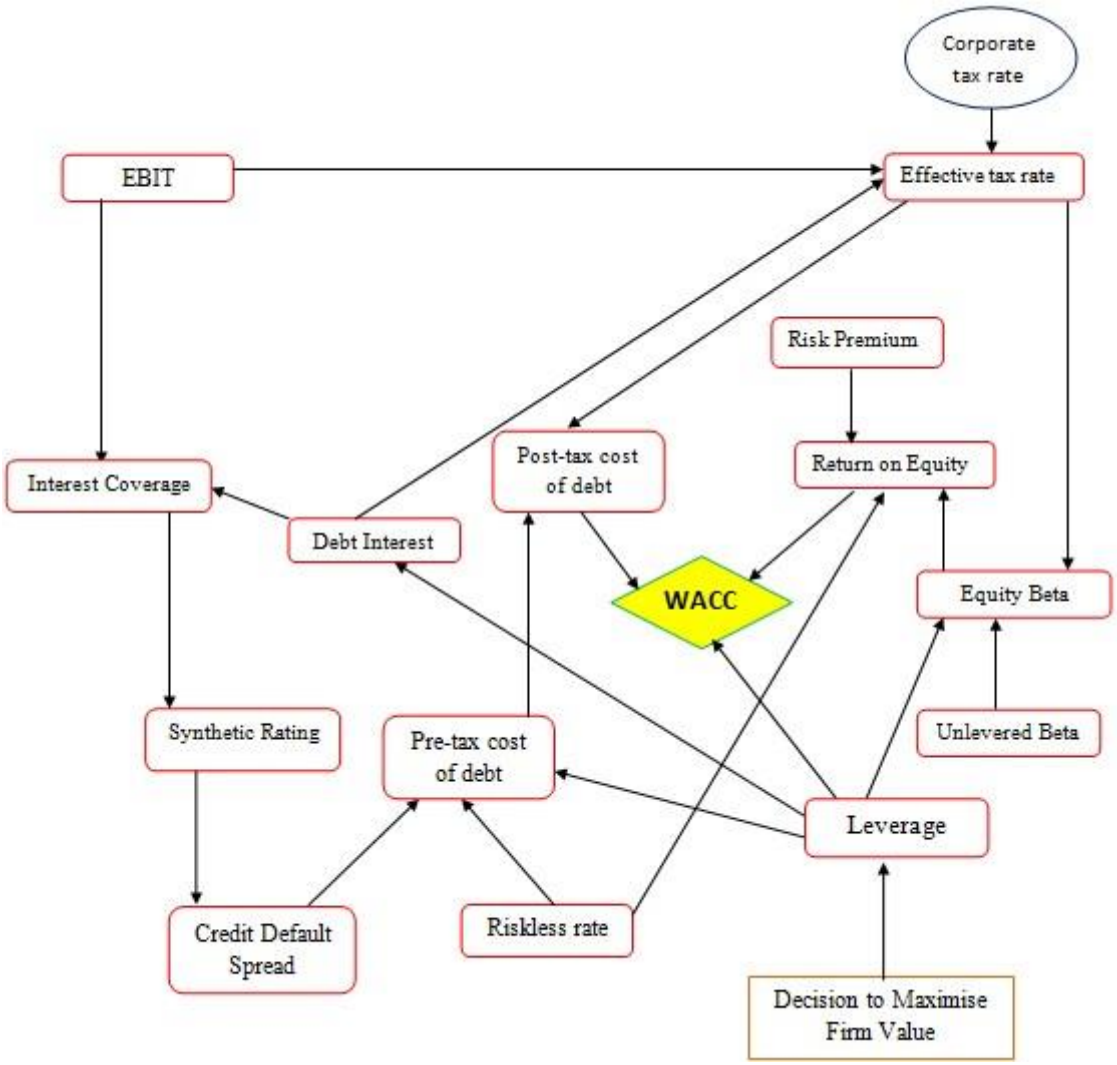
This can be rewritten as:

V_L = Vu + Present value tax shield – Present value financial distress.

It requires the estimation of the probability as well as the direct and indirect costs of bankruptcy, the latter of which is highly unobservable. Binsbergen, et al. (2011) recommend an econometric approach to deriving a firm's marginal cost of debt and optimal leverage using explanatory variables from financially 'unconstrained' similar firms that are believed to make optimal capital structure choices apriori. Afren and its peer firms are relatively new to the industry (most of which commenced operations in 2005). Based on our review of literature, it is improbable that these companies are financially unconstrained in their access to credit facilities. This factor as well as insufficient time series data limits the validity and thus usefulness of any prediction of an optimal debt position for Afren made using the approach adopted by Binsbergen et al., (2011).

Therefore, to derive a firm-specific optimal capital structure the study followed the cost of capital approach by De Wet (2006) and Damodaran (2010). This approach involved the use spreadsheet modelling through an iterative process to determine series of discount rates based on different combinations of debt and equity under the assumption of constant earnings to the firm. In doing this, the average Earnings before Interest and Tax (EBIT) for 2010 and 2011 fiscal years was used due to a major increase in 2011 earnings. The impact of changing the debt intensity was calculated starting from 0% (at 5% incremental unit) on the firm's cost of debt. Also, the required return on equity at each level of debt was simultaneously re-calculated. By substituting different debt-equity combinations and associated costs into the WACC equation (1) for each level of incremental debt, we are able to identify the leverage position that yields the minimum WACC for the firm. Holding the cash flows constant implies that for every incremental debt, the company recapitalizes by using debt proceeds to repurchase an equivalent amount of its existing shares. A snap shot of interrelations and dependencies among parameters is presented through an influence diagram and further explained.

Figure 3.1 Influence Diagram



Source: authors' Computation

Node Legend	
	Decision node
	uncertainty node; depicts unknown values
	Deterministic node; variables are dependent on the outcome of uncertain events
	Value node; objective function

The cost of debt at each level is estimated as; K_d = [Riskless rate + credit default spread]. By adjusting for the tax benefit of debt financing, the equation becomes;

K_d = [Riskless rate + credit default spread] [1-tax rate]..... (4)

Finally, some scenario analyses were carried out to help determine the impact of changes in the credit default spreads and corporate tax rates on the model implied optimal capital structure.

3.2. Data

The choice of Afren oil was selected from its peers based on the fact that it is a dynamic, entrepreneurial organization with a portfolio of world-class assets located in several of the world's most prolific and fast-emerging hydrocarbon basins in Africa and the Middle East. Its activities span the full-cycle E&P value chain of exploration, appraisal, and development through to production. It also rapidly expanded its portfolio across six countries: Nigeria, Sao Tome & principle JDZ, Gabon, Republic of Congo, Cote d'Ivore, Ghana and Iraq. Specifically, it had an edge over other small oil and gas firms in its scope of operation, market capitalization, turnover and its presence in a number of countries and its being on the UK listing.

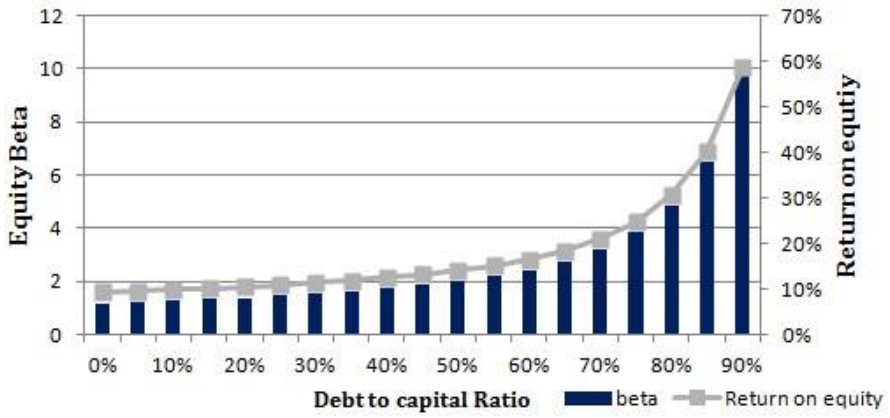
The required estimates used in the study includes cost of debt, required return on equity as well as overall cost of capital used for comparative analysis between Afren its peer group firms. Thus, this study essentially makes use of secondary based quantitative data obtained from Thomson Reuters EIKON and DataStream, Bloomberg, Morningstar, Damodaran, Companies' Annual Report and 10-k sec filings. The startup year for Afren was 2005 and 35% of its comparative companies hence we use panel data from 2005 to 2011 on debt, equity and other financial variables for the 20 Comparative firms (Rock hopper is excluded because its financial year end is different from the rest companies and would be problematic for comparison) obtained from Data stream at local currency (GBP).

4. Empirical analysis

4.1. Base case result

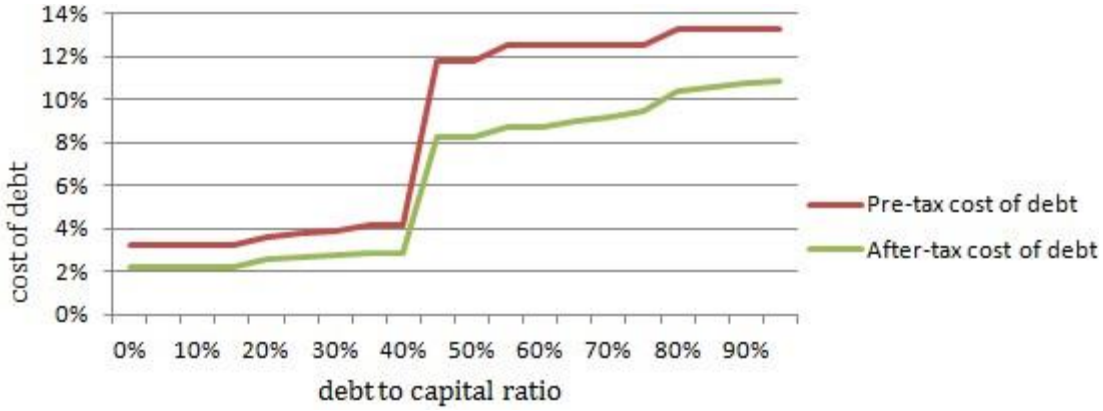
The Summary output of Afren's optimal capital structure derivation is presented in table 4.1. The Beta is the transmission mechanism through which firm's leverage affects the required return on equity. As the debt intensity increases, the equity Beta has a multiplier effect such that the cost of equity increases more than proportionately to the increase in leverage. From table 4.1, an 8% increase in leverage from 0.6 to 0.65 causes a 13.8% increase in the equity beta from 2.4 to 2.7 consequently causing a 12% increase in the required return on equity from 16.4% to 18.3% due to increased financial risk. The figure below shows that compared to the stable pattern of growth observed between 0% and 50% leverage, the return on equity curve becomes steeper at higher debt levels.

Figure 4.1: Return on equity as a function of Beta and Leverage



Source: Authors' Calculations.

Figure 4.2: Cost of debt as a function of leverage



Source: Authors' Calculations.

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Table 4.1: Summary results: The impact of leverage on the cost of debt, equity, WACC and firm value

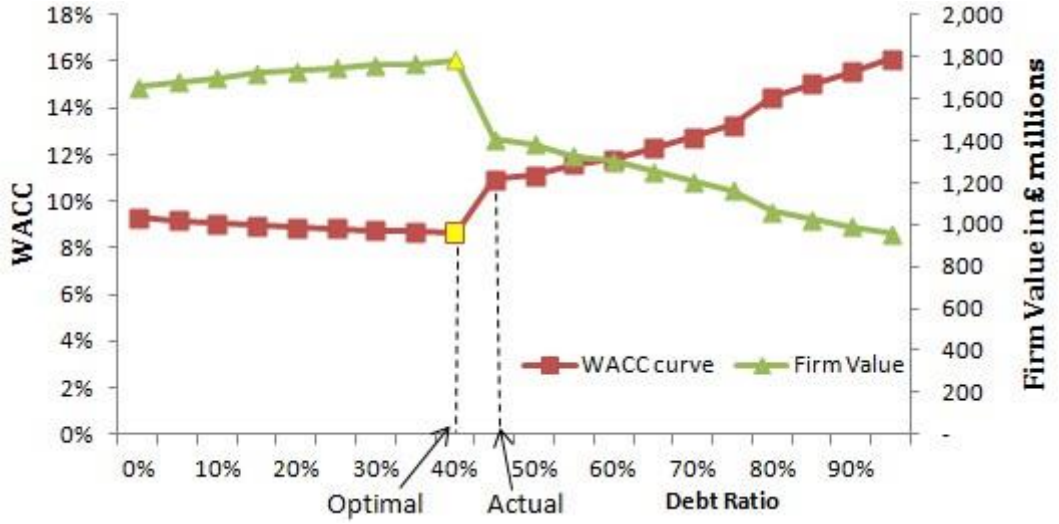
Leverage	Equity βeta	EBIT £'000	Debt value	Interest Coverage Ratio	Debt Interest £'000	Synthetic Bond Rating	Default Spread (DS)	interest rate= Rf+DS	Effective tax rate	After-Tax Kd	Return on Equity (Ke)	WACC	Firm Value £'000	Change in value £'000
0%	1.17	107,145	-	∞	-	AAA	0.7%	3.2%	30%	2.24%	9.29%	9.29%	1,657,682	
5%	1.21	107,145	70,289	47.64	2,249	AAA	0.7%	3.2%	30%	2.24%	9.5%	9.17%	1,678,430	20,748
10%	1.26	107,145	140,578	23.82	4,498	AAA	0.7%	3.2%	30%	2.24%	9.8%	9.06%	1,699,704	42,022
15%	1.31	107,145	210,866	15.88	6,748	AAA	0.7%	3.2%	30%	2.24%	10.1%	8.94%	1,721,525	63,842
20%	1.37	107,145	281,155	10.44	10,262	AA	1.2%	3.7%	30%	2.56%	10.5%	8.89%	1,731,554	73,872
25%	1.44	107,145	351,444	8.02	13,355	A+	1.3%	3.8%	30%	2.66%	10.9%	8.82%	1,745,849	88,167
30%	1.52	107,145	421,733	6.51	16,448	A	1.4%	3.9%	30%	2.73%	11.3%	8.74%	1,760,382	102,700
35%	1.61	107,145	492,021	5.25	20,419	A-	1.7%	4.2%	30%	2.91%	11.8%	8.72%	1,766,248	108,565
40%	1.72	107,145	562,310	4.59	23,336	A-	1.7%	4.2%	30%	2.91%	12.5%	8.63%	1,782,929	125,247
45%	1.84	107,145	632,599	1.44	74,330	CCC	9.3%	11.8%	30%	8.23%	13.2%	10.95%	1,406,271	- 251,411
50%	1.99	107,145	702,888	1.30	82,589	CCC	9.3%	11.8%	30%	8.23%	14.0%	11.13%	1,382,966	- 274,717
55%	2.17	107,145	773,176	1.11	96,647	CC	10.0%	12.5%	30%	8.75%	15.1%	11.60%	1,326,567	- 331,115
60%	2.40	107,145	843,465	1.02	105,433	CC	10.0%	12.5%	30%	8.75%	16.4%	11.81%	1,302,908	- 354,774

65%	2.73	107,145	913,754	0.94	114,219	CC	10.0%	12.5%	28%	8.98%	18.3%	12.26%	1,255,755	- 401,927
70%	3.19	107,145	984,043	0.87	123,005	CC	10.0%	12.5%	26%	9.23%	21.0%	12.76%	1,206,541	- 451,141
75%	3.82	107,145	1,054,331	0.81	131,791	CC	10.0%	12.5%	24%	9.45%	24.7%	13.26%	1,161,039	- 496,643
80%	4.84	107,145	1,124,620	0.72	149,574	C	10.8%	13.3%	21%	10.44%	30.6%	14.47%	1,063,596	- 594,086
85%	6.46	107,145	1,194,909	0.67	158,923	C	10.8%	13.3%	20%	10.61%	40.0%	15.01%	1,025,339	- 632,343
90%	9.69	107,145	1,265,198	0.64	168,271	C	10.8%	13.3%	19%	10.76%	58.7%	15.55%	989,739	- 667,943
95%	19.38	107,145	1,335,486	0.60	177,620	C	10.8%	13.3%	18%	10.89%	114.9%	16.09%	956,528	- 701,154

Source: Author's Calculations.

As more debt is introduced, the risk of loan default increases, thus increasing the credit spread over the riskless rate and effectively the pre-tax cost of debt. From table 4.1, the 30% effective tax rate starts falling beyond a 60% debt ratio. The implication is that the full tax benefit of debt cannot be derived since the company's debt interest of £149.6million at that level is over and above its earnings before interest and tax (£107.4million); tax deductibility of interest expense can only be realized to the extent of a company's earnings. Shown in figure 4.2 above, the after-tax cost of debt is equidistant to the pre-tax cost, but above 60% debt ratio as the effective tax rate starts to decay there is a more proportionate increase in the after-tax cost of debt.

Figure 4.3: WACC and Firm value as a function of leverage



Source: Authors' Calculations.

Figure 4.3 above shows the firm's WACC and value as a function of leverage. The model implied optimal debt ratio is 40% and yields a WACC of 8.63% which is effectively the minimum cost of capital that maximizes the value of the firm to £1,782million (table 4.1). Under the current capital structure of 45% debt to capital, the overall cost of capital is 10.95%. Note that this WACC is assuming a 30% tax rate. Further, we estimated the firm's WACC under no corporate tax. Between 40% and 45% leverage, the debt servicing capacity of the firm measured by the interest coverage ratio drops significantly from 4.6 to 1.4 due to high interest burden. This increased credit risk has a direct impact on the firm's credit quality and based on the synthetic rating approach the firm's credit rating drops from an A- to a CCC (table 4.1), a grade for high speculative bonds with greater risk of credit default. Although the tax shield benefit of debt helps to lower the firm's after-tax cost of debt, beyond the optimal debt level the higher default spread (9.3%) over the risk-free rate for a CCC bond rating reduces the impact of the tax shield such that the debt interest deductions is not sufficient to offset the increasing required return on equity.

Figure 4.3 also shows the inverse relationship between the cost of capital and value of the firm. As the WACC curve slopes downwards, the firm value curve slopes upwards and vice versa. The change in value to the firm moving from an unleveraged to a leveraged position, reaches a peak of £125 million (increase of 7.56%) at the optimal level of 40% after which it becomes negative. Note that, the change in firm value does not immediately become negative after the optimal position in all cases if the decline is more gradual. Although a 35% debt ratio (5% below optimal) adds £108.5 million (6.5%) value to the firm, this value is less than optimal under maintained assumptions since the debt policy leaves an unexploited benefit of 1.06% (7.56% - 6.5%). By contrast a 5% deviation above the optimal level causes a significant reduction of 15.2% in the firm's value to £1,406 million. This impact is observed from the kink in the WACC curve after the optimal point. This result corroborates evidence by Binsbergen et al. (2011) that on the average, the cost to a company from being over leveraged is usually higher than the cost of being under leveraged by the same magnitude of deviation.

4.2. Scenario analysis result

The study also utilized scenario analysis. The aim is to evaluate risk for a particular plan of action according to different scenarios or situations that could arise as our plan unfolds. In this type of analysis, outcomes are visible given the different scenarios envisaged and so are the paths that lead to them from the current situation, giving an organization more scope to refine and adjust plans accordingly. More extreme scenarios (which may be positive or negative) allow plans to be stress-tested and further risk mitigation to be done, if appropriate. In using the scenario analysis, all the variables that would impact a specific scenario are identified and manipulating the variables to understand the full range of outcomes. This is one reason why we utilized the method unlike the simulation analysis where results gotten depend on how good the model is and how much data was used to create it in the first place.

In the scenario analysis the impact of changes in tax rate on the optimal debt position was evaluated and also how the optimal position reacts to macroeconomic conditions through changes in credit default spreads on bond grades. The first analysis is based on the different possible tax scenarios under the Nigerian fiscal system in the oil and gas sector as Nigeria is a significant part of Afren's portfolio of assets. Form the second and third quadrants (figure 4.4 on the next page), we find that at 50% and 65.75% tax rates, the 40% debt to capital ratio derived in the base case (30% tax rate) remains optimal as it still yields the highest net benefit to firm. Also, due to the increase tax shield from higher tax rates, the weighted average cost of capital in both tax scenarios reduce from 8.63% (base case) to 7.76% and 7.07% respectively (as seen in table 4.2).

Table 4.2: Summary results from scenario analysis on corporate tax

	Corporate Tax rates			
Output	**30% (base)**	**50%**	**65.75%**	**85%**
optimal leverage	40%	40%	40%	60%
Minimum WACC	8.63%	7.76	7.07	5.45%

Source: Author's Calculations.

Under an 85% tax rate scenario in the fourth quadrant (figure 4.4), the optimal leverage position moves from 40% to 60% and yields an even lower minimum WACC of 5.45% because the very high tax rate increases the debt capacity of the company. This could explain why some companies under heavy tax regimes might adopt very thin capitalization policy and use debt financing very aggressively. They may also engage in transfer pricing with related parties in high tax jurisdictions and take advantage of higher loan interest deductions.

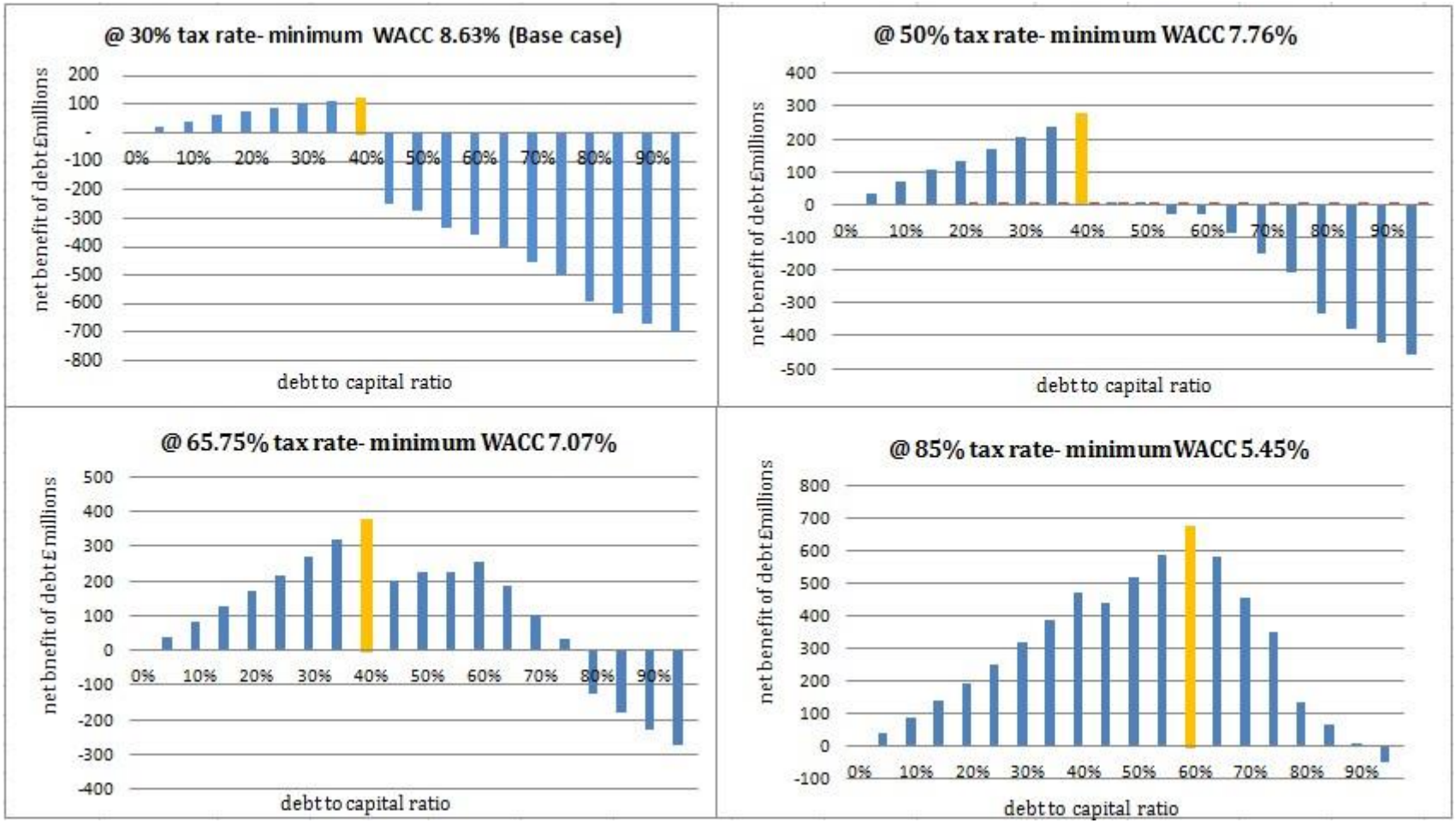
In the second scenario analysis, we assess the impact of changes in macroeconomic conditions through variations in the credit spreads on each bond grade category (*see Appendix II*). Summary results are presented in table 4.3 below. From figure 4.5A, if the spread over the Treasury rate is *decreased* by a constant 50 basis points (0.5%) for each bond grade (AAA to D), the firm's optimal debt to capital ratio increases from 40% (base case) to 45% and at a lower cost of capital at 8.39% (base WACC 8.63%). On the other hand, from figure 4.5B, an *increase* in the default spread across bond grades by a constant 50 basis points reduces the optimal leverage position to 35% and yields a higher WACC of 8.84%. This is because an increase in the credit spreads will increase the cost of debt to the firm at all debt levels and consequently reduce the firm's debt capacity.

Table 4.3: Summary results from scenario analysis on credit spreads

	Credit default spreads		
Output	**Constant Decrease by 50 bps on bond grades**	**Constant Increase by 50 bps on bond grades**	**Adjusted Incremental of 50 bps by bond grade**
Optimal leverage	45%	35%	15%
Minimum WACC	8.39%	8.84%	8.99%

Source: Author's Calculations.

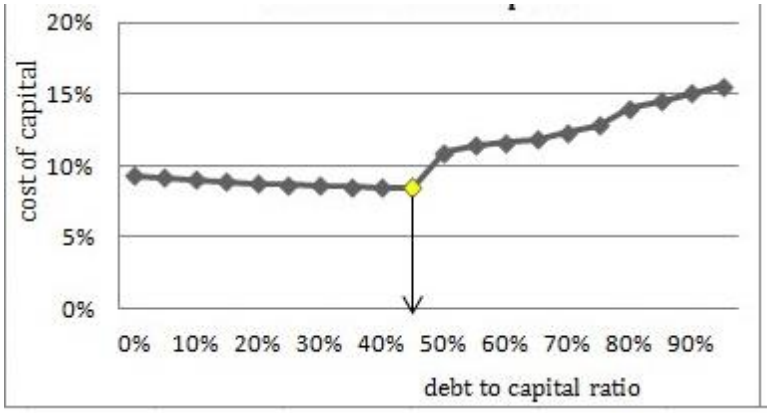
Figure 4.4: Scenario analysis of corporate tax rates on optimal capital structure



Source: Author's Analysis.

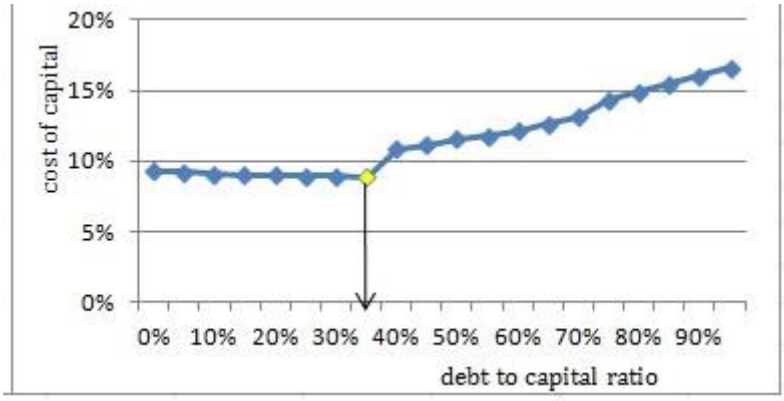
However, during periods of economic downturns characterized by a tightened credit market and higher risk of credit default, the spreads across bond categories (AAA to D) do not vary by a constant magnitude; spreads on non-investment and speculative grade bonds are expected to increase more proportionately relative to those on investment and prime grade bonds as in December 2008. By adjusting the credit spreads by an incremental 50 basis points for each subcategory in descending order of credit quality along the grade matrix (figure 4.6), we find that the debt capacity/optimal debt ratio of the company further falls to 15% and at a higher WACC of 8.99%. Again, this is clearly due to the increased risk of default for which the tax benefit of debt cannot accommodate and offset.

Figure 4.5A: Decrease in Credit Spread on Bonds Grades by Constant 50 basis Points



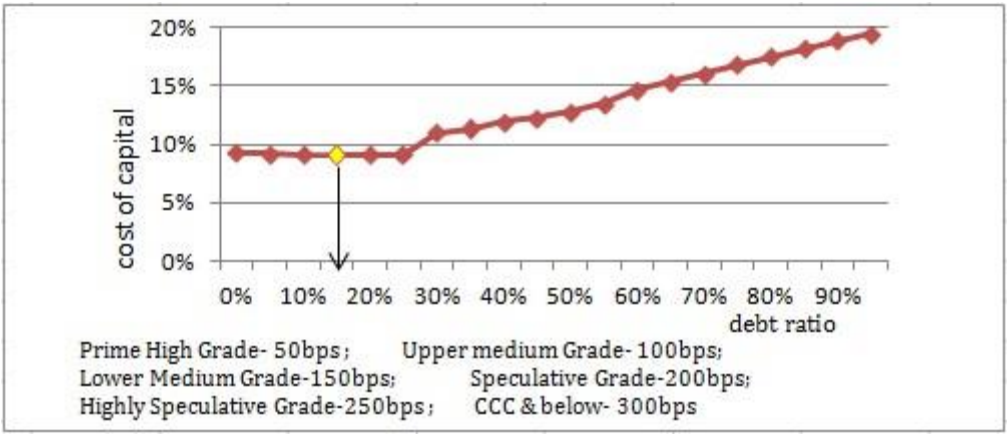
Source: Authors' Analysis.

Figure 4.5B: Increase in Credit Spread on Bonds Grades by Constant 50 basis Points



Source: Authors' Analysis.

Figure 4.6: Impact of incremental credit default spreads on optimal capital structure



Source: Author's Analysis.

4.3. Policy implications of result

Financial leverage denotes the debt intensity of a company. A broad measure of leverage vastly used in literature is the ratio of financial debt to asset; variations arise from whether long term or total debt is used and whether book or market values are used. This was done in this study and the results obtained had many implications for the company. One of the findings was that as the debt intensity increases, the equity beta has a multiplier effect such that the cost of equity increases more than proportionately to the increase in leverage. This implies that as more debt is introduced, the risk of loan default for the company increases, consequently increasing the credit spread over the riskless rate and effectively the pre-tax cost of debt. Another implication of this is that the full tax benefit of debt cannot be derived since the company's high debt interest is over and above its earnings before interest and tax (EBIT), thus tax deductibility of interest expense can only be realized to the extent of a company's earnings. The model implied optimal debt ratio is 40% and yields a WACC of 8.63% which is effectively the minimum cost of capital that maximizes the value of the firm. And with no corporate tax, the debt servicing capacity of the firm measured by the interest coverage ratio drops significantly due to high interest burden. And by implication increases the credit risk of the company which subsequently has a direct influence on the firm's credit quality. This was manifest on the results from synthetic rating approach where the firm's credit rating drops from an A- to a CCC, a grade for high speculative bonds with greater risk of credit default. Also, there was a negative relationship between the cost of capital and value of the firm and as the WACC curve slopes downwards, the firm value curve slopes upwards. Thus, the change in value to the firm moving from an unleveraged to a leveraged position reaches a peak at the optimal level of 40% after which it drops to negative. More importantly, this change in firm value does not immediately become negative after the optimal position in all cases if the decline is more gradual. With the scenario analysis, at higher

taxes, the optimal leverage position of the company increases but yields a lower WACC and this can be attributed to the fact that the very high tax rate increases the debt capacity of the company. An implication of this is that under heavy tax regimes, the company might adopt very thin capitalization policy and use debt financing very aggressively. They may also engage in transfer pricing with related parties in high tax jurisdictions and take advantage of higher loan interest deductions.

Conclusion

This study analyzed the capital structure of small/mid-size independents oil and gas companies using Afren plc as a case study. The aim was to assess the optimal capital structure for the Afren plc. The optimal capital structure was modelled at a corporate level based on the Nigerian tax system where the bulk of Afren's revenue is generated. A noted earlier, for the five-year period trailing to 2011 Afren used debt financing more aggressively than its peer companies and based on 2011 financial information the company's cost of equity, debt and capital are estimated at 14.7%, 9.2% and 12.3%; significantly higher than the peer average of 10.7%, 6.4% and 10% respectively. The results under a base case of 30% tax rate assumption shows that subject to the company's current earnings, its debt capacity is weakened beyond a 40% leverage ratio; the company can reduce its cost of debt and overall cost of capital by deleveraging. Also, if the company projects greater future investment opportunities than it currently has, a case is made for deleveraging in other to preserve financial flexibility and enhance its future borrowing capacity. Results from the scenario analysis showed that higher corporate taxes increase the tax shield benefit of debt, consequently increasing the optimal debt level at a lower cost of capital. Also, different macroeconomic conditions transmitted though changes in credit default spreads have significant effects on the optimal capital structure of the company. In conclusion, the study accentuate that the concept of optimal capital structure is not a static phenomenon but requires dynamic adjustments in line with changing financial capabilities and external constraints of a firm through time. For the oil and gas industry, these adjustments are also a function of the stage in which the bulk of a company's operations are involved in at a time. Nevertheless, some measure of deviation can be tolerated during periods of adjustments without destroying the overarching corporate value of the firm. Thus, it is recommended that in making optimal financing decisions and maximizing value, the company should actively monitor and adjust its financial leverage in response to the magnitude and direction of changes in these key parameters.

Future study and limitation

Without statistically quantifying the degree of uncertainty (standard error) associated with the data estimates (like Beta), a confidence interval on the estimated optimal debt ratio cannot be specified. Also, the fact that the WACC curve was not 'V' shaped implies that the optimal debt ratio is not a point estimate; while these factors indicate that a range of debt ratios will likely be

optimal for the firm, we emphasize that the cost to the firm from deviating above an optimal position is significantly higher than the cost of deviating by an equal magnitude below the optimal level. We reiterate that subjective judgments made by management in Afren and the comparative companies will cause real life estimates of cost of capital parameters used in project valuations to differ from the results given here. Nevertheless, the methods employed as well as results obtained are robust and give useful insight for Afren's capital structure decisions.

As much as this study has incorporated corrections in literature on past studies like the use of a revised definition of financial leverage, it is not completely free from research limitations in terms of data reliability. The data used in this work are mainly secondary and are provided from many credible sources; however, the degree of accuracy and methodologies used in generating some highly sensitive data like market risk premium and companies' Beta estimates do have an impression on the study's results. We suggest further studies in estimating the required return on equity using the three-factor model of Fama and French (2004) and comparing the results with that of the capital asset pricing model used in this study. Also, as the company's assets in other countries start production, tax systems/codes in different jurisdictions will bring more complexities such that modelling capital structure at a corporate level will be difficult. Thus, we suggest further research into incorporating different tax effects on a firm's optimal financing decision at the corporate level.

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APPENDICES

APPENDIX I: Interest Coverage Ratios, Synthetic Ratings and Credit Default Spread on Traded Bonds

Base spreads			
If interest coverage is greater than	**≤ to**	**Synthetic Rating**	**Credit spread**
-100000	0.499999	D	12%
0.5	0.799999	C	10.5%
0.8	1.249999	CC	10%
1.25	1.499999	CCC	9.25%
1.5	1.999999	B-	9%
2	2.499999	B	7.75%
2.5	2.999999	B+	6.75%
3.0	3.499999	BB	5.50%
3.5	3.999999	BB+	4%
4.0	4.499999	BBB	2.5%
4.5	5.999999	A-	1.65%
6.0	7.499999	A	1.4%
7.5	9.499999	A+	1.3%
9.5	12.499999	AA	1.15%
12.5	100000	AAA	0.7%

Source: Damodaran, 2012.

APPENDIX II: Credit Spread Scenarios

Credit Spread Scenarios		
50 basis point constant increase	50 basis point constant decrease	50 basis point incremental
12.50%	11.50%	15.50%
11.30%	10.30%	14.30%
10.50%	9.50%	13.50%
9.75%	8.75%	12.75%
9.50%	8.50%	12.00%
8.25%	7.25%	10.75%
7.25%	6.25%	9.75%
6.00%	5.00%	8.00%
4.50%	3.50%	6.50%
3.00%	2.00%	4.50%
2.15%	1.15%	3.15%
1.90%	0.90%	2.90%
1.80%	0.80%	2.80%
1.65%	0.65%	2.15%
1.20%	0.20%	1.20%

Source: Damodaran, 2012; and Author's Assumptions.