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Capital structure study: Accounting and statistical issues

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Capital Structure Study:

Accounting and Statistical Issues

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Abstract

Capital structure is one of the most important topics in Corporate Finance, and still attracting many famous scholars to explain factors that affect firms' choice of capital structure. In this paper, we first discuss the importance of capital structure to a company itself, and to its investors. Secondly, I will introduce the concept of operating leases as an important component of debt. Then, we review the most famous capital structure theories to see what factors affects theoretically optimal capital structure and CFO decisions on capital structure. Finally, I point out some statistical issues in studying capital structure and suggest some remedies to these problems.

I. Background information

1) What is capital structure?

Capital structure is the composition of debt and equity the company uses to finance its business. The goal of a firm's capital structure decision is to determine the financing mixture that maximizes the value of the firm by minimizing the weighted average cost of capital (WACC). To minimize the financing costs, the company must find the optimal mixtures of debt and equity by considering the tradeoff between tax-deductibility of interest and cost of higher credit risk.

2) Why is studying capital structure important?

To understand the importance of capital structure decision, let's recall the concept of Weighted Average Cost of Capital (WACC) to see how the capital structure impacts the cost of financing. WACC represents what costs the company to raise additional capital with specified composition of debt and equity. WACC is calculated by

$$\text{WACC} = \frac{D}{V} r(1-t) + \frac{E}{V} r' \quad [1] \qquad (1)$$

where r is the before-tax marginal cost of debt, r' is the marginal cost of equity, and t is the marginal tax rate. D and E are market value of the outstanding debt and equity respectively, and V is the market value of the firm given by V = D + E.

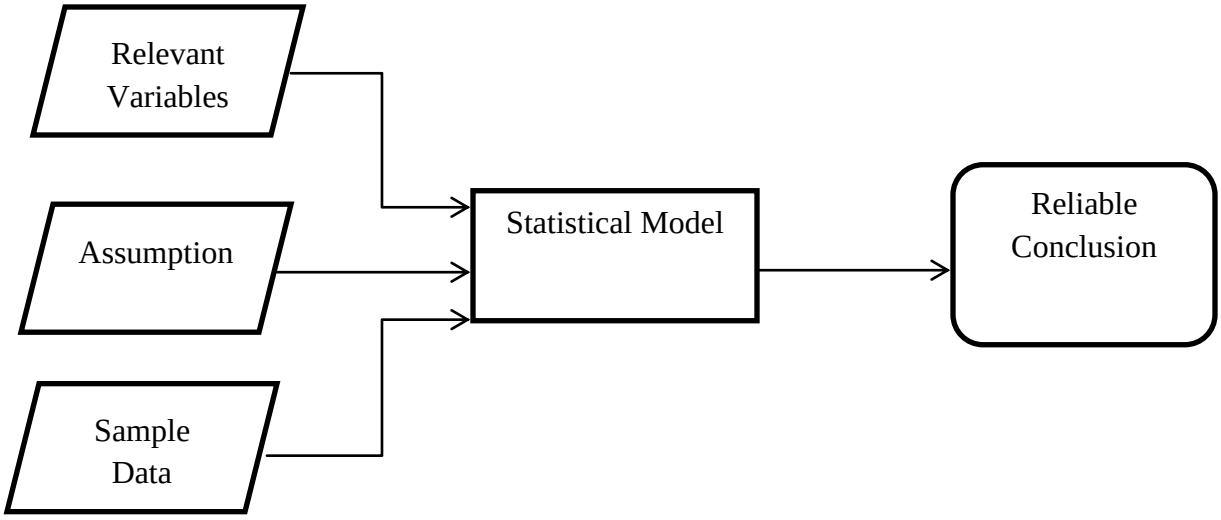
[1] CFA Level II Curriculum, Reading 26 Capital Structure. We ignore preferred stock in this discussion for simplicity

To managers, capital structure decision affects the firm value through WACC, the rate used to discount free cash flow to firm to determine the value of the firm. The choice of mixture of debt and equity allocates the weight of each cost components. Since after-tax cost of debt tends to be lower than cost of equity (due to tax-deductibility and less risk), increasing debt to a certain level decreases weighted cost of capital. However, to a certain level, increasing use of debt increases financial risk and cost of financial distress, and decreases debt rating. As a result, both cost of debt and equity increase[2].

To analysts and investors, a firm's capital structure determines the rate of return required by investors. When pricing equity assets, analysts and investors discount the future free cash flows with the required rate of return to come up with the price they want to pay for the investment. Without carefully studying the issuer's capital structure, investors might make either lose their money (or miss the potential profits) when overvaluing (undervaluing) the issue with underestimated (overestimated) required return. Analysts and investors also should be aware of announcement of wealth distribution and new issuance. For instance, announcement of new equity issuance have a negative effect on stock price, according to *Signaling Effect Theory (Guilford and Dawkins 1995, and Smith and Harper 2003)*

[2] This is consistent with Trade-off Theory.

II. Analysis process



1. First Component: The measure of dependent variable

As we discussed the importance of capital structure decision above, it is time to discuss how to evaluate a firm's capital structure.

a. What should be included in debt?

One of the most comprehensive definitions of debt I have ever known is from Dr. Aswath Damodaran from New York University. As he defines, debt is the financing source that generally has the following characteristics: (1) commitment to make fixed payments in the future (2) fixed payments are tax-deductible (3) failure to make the payments can lead to either default or loss of

control to the firm to the party to whom payment are due[3]. The reason I cited this definition is because we should include more than on-balance-sheet debts to have a better measure of financial leverage and capital structure.

Operating lease is one of the most common off-balance-sheet items that should be considered as debt. Let's recall the concept of leases and its effects on companies' financing obligation. Leases can be classified into two main categories: finance (or capital) and operating leases[4] [5]. Finance lease is economically equivalent to the lessee's purchase of some assets financed by the seller (lessor). An operating lease is an agreement that the lessee pays fee to borrow some asset for some period of time. Both leases require committed lease payment on regular basis similar to interest payments on debt.

Finance lease and operating lease are so economically similar that U.S GAAP uses four criteria to determine when a lease is a capital lease[6]:

1. Ownership of the leased asset transfers to the lessee at the end of the lease.
2. The lease contains an option for the lessee to purchase the leased asset cheaply (bargain purchase option).
3. The lease term is 75 percent or more of the useful life of the leased asset.
4. The present value of lease payments is 90% percent or more of the fair value of the leased asset.

If a lease has at least one of these four characteristics, it is classified as capital lease. Otherwise, the lease is categorized as an operating lease. How does the classification affect the accounting treatment on the two kinds of leases? While operating leases are off-balance-sheet liabilities,

[3] A.Damodaran, New York University http://pages.stern.nyu.edu/~adamodar/
[4] Reading 32 Non-current (Long-term) Liabilities, Volume 3, CFA Level I Curriculum.
[5] "Finance lease" is IFRS terminology and "Capital lease" is U.S GAAP terminology
[6] FASB ASC Topic 840 [Leases]

capital leases are on-balance-sheet obligations. Operating lease expenses are treated as operating expense and the operating lease does not show up as part of the capital of the firm. When a lease is categorized as a capital lease, the present value of the lease expenses shows up on the balance sheet as debt, and interest is imputed on this amount and shown as part of financing expense on the income statement.

From financial standpoint, operating leases should be treated as debt for these reasons. First, if we let the borrowed asset be money in an operating lease contract, the contract will become a loan contract and the periodic lease payment will become interest expense. Secondly, increase in operating leases has the same effect on debt rating as increase in debt. The credit rating agencies indeed view the accounting distinction between capital and operating leases as "substantially artificial" and convert operating lease into debt when rating a company's credit. [7]

Thirdly, many researchers initially found their findings were contrary to their expectations and the well-known capital structure theories. By including operating leases in firm debt, they could find the results become consistent with their expectations. For instance, after accounting for operating leases, Graham and Lemmon (1998) find a positive relation between taxes and financial leverage and correct their initial self-contrary result in prior studies using only balance-sheet debt.[8] Therefore, operating leases contain all of main characteristics of debt and should be treated as debt.

Logically, in our financial analysis, we should include operating leases in firm debt. However, notice that finding information about operating leases for studies with large sample size may be challenging, operating leases under current accounting rules are only required to be stated in the footnote. Only some well-known database resources such as Bloomberg and WRDS contain

[7] Standard & Poor Encyclopedia of analytical adjustments
[8] *Financial leverage and operating leases* by Graham and Lemmon (1998)

quantitative information on operating lease. Even when we have to reported amount of operating leases, we still need convert the number into debt value using Discounted Cash Flow model with different assumptions for different companies as discussed latter. One may ask whether it would be worth our efforts to include operating leases in calculation.

There is no easy answer to this question. It really depends on purpose of a research especially on the industry an analyst is studying. Operating leases have been becoming more popular as financing source especially in air-transportation, retailing, entertainment, utility industries. Enron is one of the most infamous corruptions related to off-balance-sheet financing. The collapse of Enron and consequently of Arthur Andersen led to the Reform of Accounting Treatment of many off-balance-sheet items. The ignorance of operating leases might lead to the underestimation companies' financial leverage, inaccurate findings, or even a financial disaster sometimes as shown in Enron example. Therefore, we should be careful in dealing with operating leases in our analysis.

b. How can we convert operating leases into debt?

To find the "debt value" of operating leases, we discount all the future lease payments at the rate that reflects their risks. Generally, we can use the cost of debt with duration comparable to the term of the operating lease.[9]

2. Second component: The assumptions in capital structure study

To understand the importance of assumptions in capital structure study, let's revisit several famous capital structure theories.

a. Modigliani and Miller Theories (MM Propositions)

Before starting their theories, Modigliani and Miller made these assumptions:[10]

[9] A.Damodaran, New York University http://pages.stern.nyu.edu/~adamodar/

1) There are no brokerage costs
2) There are no bankruptcy costs
3) There are no agency costs
4) Investors can borrow and lend at the risk-free rate
5) There are no asymmetric information issues.
6) Financing decisions and investment decision are independent of each other.

The following table summarizes MM Propositions with two additional different assumptions of taxes

[10] Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporate Finance, and the Theory of Investment" American Economic Review, June 1958, pp261-297

Table 1. *Summary of MM Theories*[11]	**Additional Assumption**	
	Without Corporate Taxes	**With Corporate Taxes**
MM Proposition I: Firm's value	The market value of a company is unaffected by the firm's capital structure. $V_{leverage} = V_{unlevered}$	The market value of a company increases as more debt is added, suggesting optimal capital structure with 100% debt. $V_{leverage} = V_{unlevered} + TD$, in which T is corporate tax rate and D is amount of debt used. TD represents the present value of tax shield.
MM Proposition II: Cost of capital[12] Please refer to footnote for	As financial leverage increases, cost of equity increases to exactly offset the increased use of less expensive debt, given constant WACC.	WACC falls as more debt is used because cost of equity increases at slower rate, and insufficiently offset the expanding portion of cheaper debt. $r_e = r_0 + (1-t)(r_0+r_d)\frac{D}{E}$

[11] Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporate Finance, and the Theory of Investment" American Economic Review, June 1958, pp261-297

[12] r_e is cost of leveraged equity, r_o is cost of unlevered equity, r_d is cost of debt, t is marginal tax rate, D is market value of debt, and E is market value of equity.

notations.	$r_e = r_0 + (r_0+r_d)\frac{D}{E}$	

Although most of the assumptions in MM theories are obviously unrealistic, these assumptions indicate what factors affect capital structure, and set foundation for modern capital structure research. A great number of subsequent research papers have focused on relaxing the MM assumptions to develop more realistic theories of capital structure.

Several research papers find that relaxing MM assumptions leads to different conclusions. For instance, when Modigliani and Miller incorporate the effect of tax, capital structure becomes relevant. As more debt is used, the firm's value increases by the present value of tax shield. To be precise, a firm's value increases in a linear fashion for every extra dollar of debt under MM assumption of corporate taxes. Thus, MM Proposition I suggests that optimal capital structure should be comprised 100 percent debt.

However, by relaxing the assumption of no bankruptcy cost, the trade-off theory argues that the value of a firm is equal to its unlevered value plus tax shield, and minus expected cost of bankruptcy. Contrary to the MM Proposition I with corporate taxes, the trade-off theory suggests that as debt is added to a threshold level D_1, the value of a firm increases because the probability of financial distress is still immaterial. Beyond D_1, the value of the firm starts to decrease because bankruptcy costs increase significantly and outweigh the value added by tax shield.

The MM assumption of insignificant cost of asymmetric information was relaxed by Myers and Majluf (1984).Their pecking order theory argues that there is cost of asymmetric information. Therefore, companies should choose to finance their operations first by internally generated funds with least potential information content, then by debts, and lastly by public equity offering with the most potential information content.

As discussed above, altering assumptions might lead to different conclusions on the same problem. Therefore, assumptions are critical in our analysis because they establish the basis for our reasoning. If we can imagine the development of our arguments and reasons is analogous to the growth of branches and leaves on a tree, the importance of the assumption to the reasoning process is similar to that of the root of a tree to its branches and leaves.

Next, we will discuss how data sampling determines our choice of statistical methods.

3. Third component: The data sampling in capital structure study

When we start our research, we might ask how characteristics of capital structure will change from time to time or across industries (countries). Let's define these types of data and then discuss how the type of data dictates our choice of statistical model.

a. Time series and cross-sectional data

While time series data are used to analyze how one variable changes with respect to time, cross-sectional data are used to study how a dependent variable is affected by the changes in independent variables across different environments. Panel data (also called Time Series Cross-Sectional (TSCS) data) include both characteristics of time series and cross-sectional data. Now let's discuss what statistical tools we should use to analyze each type of these data.

b. Ordinary Least Squares (OLS) method

OLS method is one of the simplest regression methods to estimate how a dependent variable is influenced by independent variables. For OLS to be best possible, all *six Classical Assumptions of OLS have to be met:*[13]

I) The relationship between dependent variables and each of the independent variables are linear in parameter.

[13] Economics (Person Custom Edition), Vipul Bhatt.

II) *The error term has a zero population mean*

III) *The error term are homoscedastic*

IV) *There is no serial correlation*

V) *There is no endogeneity problem*

VI) *The independent variables are linearly independent of each other.*

The next section will discuss my study in capital structure on U.S software companies in 2013. In my model, assumption VI is met by carefully picking variables with non-linear relationships. Moreover, assumption IV is also met because we have cross-sectional data (from companies to companies) in only one period of time (year 2013). The violation of assumption III is also remedied by using SAS programming code to allow for heteroscedasticity. The violation and suggested remedies for assumption V of exogeneity are discussed in next section. Other assumptions are assumed to be met within the scope of this paper.

III. Using SAS programming to analyze capital structure on U.S software companies in 2013

In this section, we will perform a hypothesis test on factors affecting financial leverage of firms. The data are retrieved from COMPUSTAT. The sample includes 75 U.S. firms in computer software subsector. Our dependent variable is level of financial leverage measured by debt-to-asset ratio. In the regression, we want to examine the effects of gross return on assets (namely Return), the level of intangible assets in companies' asset structure (*Intangible*), expansion rate, firm's size. The four factors are measured by the ratios of EBIT to total assets, intangible asset to total assets, capital expenditure to PPE (property, plant, and equipment), and natural log of Total Assets respectively. Our unrestricted model has the following equation:

$$Leverage_i = \beta_0 + \beta_1 Return_i + \beta_2 Intangible_i + \beta_3 Expansion_i + \beta_4 size_i + error\ term_i \quad \text{(E1)}$$

The following table is the output from SAS:

The SAS System

The REG Procedure
Model: MODEL1
Dependent Variable: debt_to_asset

Number of Observations Read	83
Number of Observations Used	75
Number of Observations with Missing Values	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.50294	0.12573	5.68	0.0005
Error	70	1.54988	0.02214		
Corrected Total	74	2.05282			

Root MSE	0.14880	R-Square	0.2450
Dependent Mean	0.12155	Adj R-Sq	0.2019
Coeff Var	122.41482		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Heteroscedasticity Consistent		
						Standard Error	t Value	Pr > |t|
Intercept	1	-0.18080	0.10293	-1.76	0.0834	0.09814	-1.84	0.0697
ebit_to_asset	1	-0.18649	0.12851	-1.45	0.1512	0.10283	-1.81	0.0740
intangible_to_asset	1	0.26501	0.08393	3.16	0.0023	0.07968	3.33	0.0014
expansion_rate	1	0.04039	0.08220	0.49	0.6247	0.07387	0.55	0.5863
size	1	0.03190	0.01346	2.37	0.0205	0.01333	2.39	0.0194

SAS report shows that our F-statistic of 5.68 is greater than F-critical (5%, 4/70) of 2.5. We conclude that our model is statistically significant, assuming that all variables are relevant. We

have two insignificant variables which are expansion rate and EBIT to assets (return on assets) since the absolute value of its t-value is less than t-critical value of 1.64. Return on asset has negative effect on level of financial leverage. Generally, finding is not consistent with MM theories' expectation.[14]However, for software sector, benefits from tax deductibility are outweighed by cost of financial flexibility. Large software firms such as Apple, and Microsoft have great profit, therefore have excess cash to support their operation and IT projects. Retaining huge cash implies less need for external financing. Additionally, we have witnessed many more profitable firms have been acquiring other less profitable and smaller firms in the software industry in recent years. This fact explained why more profitable firms reserve cash and use less debt to allow for more financial flexibility to perform mergers and acquisitions.

Positive coefficient of variable "size" indicates larger companies have employed more debt in their capital structure. The coefficient of 0.0319 (when we have linear dependent variable and log of independent variable) means that 10 percent increase in firm size (total assets) leads to an increase of 0.3 percent in debt proportion. This result is also reasonable because the larger the firm is, the more credit they have to borrow. Note that larger firms are not necessarily more profitable. This helps to resolve if we might wonder why coefficient of return variable and that of size variable are contradictory.

Positive coefficient of level of intangible assets indicates that the more intangible assets a firm has, the more financial leverage the firm uses. This is contradictory to the normal because the larger the portion of intangible assets, the fewer things the firm have as collateral to borrow money. However, in software sector, intangible asset one of the most important assets of a company. These intangible assets are valuable software and trade secret, and can become collaterals.

[14] The higher the company's taxable income, the more debt it will use to benefit from tax-deductible expense.

In OLS, the assumption of exogeneity means that error term should not be related to independent variable. This assumption is most likely to be violated for these reasons. First, the violation might be caused by measurement error in independent variables. For example, our source of data report inaccurate values of our variables. Second, the reversed causality might lead to the violation. For instance, in the regression above, we assume that larger company size leads to more use of financial leverage. However, it might be the case that because a firm uses more financial leverage to support its expansion, it becomes larger. Thirdly, we have omitted some important independent variables. The third one is the most common reason because there are many relevant variables we cannot think of or they cannot be quantified. For example, the choices of capital structure are made by human factor-the management. According to theory of agency cost, we should use more debt to control managers' ill will. However, the question is how we can quantify managers' ill will, or other factors such as effectiveness, education, or experience in handling financing decisions. Therefore, we can use dummy variables to quantify these qualitative factors to improve OLS estimations or use different methods.

IV. Summary

In this paper, we have first introduced the concept of operating leases as an important component of debt for many industries such as airlines, retails and entertainment. Ignoring significant operating leases can lead to a wrong conclusion on financial leverage. However, in our example of U.S software companies, we do not include operating leases because software industries do not employ significant use of operating leases. Then, we review MM theories and see that altering or relaxing assumptions can lead to different conclusions in our studies. Therefore, we should be careful enough to test and back up our assumptions. Lastly, I tackle several statistical problems in OLS regression and suggest that we can use dummy variables to quantify potentially relevant factors or adjust functional form of our variables.

Appendix

SAS code

```
libname honor "C:\E385";

proc import out= honor.HT
datafile= "C:\E385\HT2.csv"
dbms=csv replace;
getnames=yes;
/*data transformation*/
data honor.HT;
set honor.HT;
size=log(at);
if pstkl="." then book_equity=at-lt-pstkrv+txditc+dcvt;
else book_equity=at-lt-pstkl+txditc+dcvt;
mkt_equity=cshpri*prcc_f;
preferred_stock=pstkl;
long_term_debt=dltt;
debt_in_curr_liability=dlc;
deferred_tax=txditc;
book_val_asset=at;
mkt_val_asset=preferred_stock+mkt_equity+long_term_debt+debt_in_curr_liability-
deferred_tax;
debt_to_asset=(long_term_debt+debt_in_curr_liability)/at;
```

```
/*run regression*/

proc reg data=honor.HT;

model debt_to_asset=ebit at;

run;
```

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