

# Debt Effects on Profitability

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## ABSTRACT

To better understand the impact of debt ratio on the profitability of all the companies of S&P 500, and the role of tax rate, this research paper discusses not only those mentioned but also summaries them by combing relevant literatures. And we will conduct two regression models to test our theory, and with step by step explanation on how those models were built and presenting our results.

**Keywords:** *S&P500, debt ratio, profitability, tax, regression model*

## 1. INTRODUCTION

Many factors are affecting the profitability of the company. External factors like economic policies, a country's economic development, the industry structures are essential for a company. However, when investors focus on a specific industry, they are more concerned about how to select the one with the highest profitability from many competitors. Capital structure plays an extremely important role in the profitability of a company. The equity structure affects the way of operation and management of the company. Using equity financing is less risky but implies dilution of control of existing shareholders. It's possible to divert control of the company and the new shareholders can have different thoughts running the company. The capital structure may reveal if leverage financing is rational. Moreover, debt can also affect companies' profitability.

Unlike equity financing, debt financing does not only require returning of principal but also a certain amount of interest at the end of the borrowing period. When a company relies on a large portion of debt financing, it can take the benefit of low taxable income. But also, Debt enforces discipline on the company's spending. Debt financing is a double-edged sword, which can improve the company's return rate to a certain extent and also greatly increase the company's risk. On the one hand, the cost burden is relatively light and using debt financing can make good use of financial leverage. If the enterprise is doing well and gets a lot of income inflow, as long as the revenue is more than the interest paid on the debt, then it can increase the value of the company. However, debt can also hurt profitability. When maturity date comes, no matter whether the enterprise has the capital to repay, the enterprise must pay principal and interest. If it is in a financial strait, the enterprise will face the risk of bankrupted or be downgraded. Second, there are many

restrictions on the use of capital. Sometimes the enterprise will miss out high risk but high return projects due to conservative looking for solid returns. In this paper, we will examine the hypothesis that the level of debt harms profitability, both in the short term and long-term perspective. This topic will be crucial for both investors and corporations. Investors will consider companies' debt ratio when they pick a profitable portfolio including valuable companies. And corporations will be aware to make more efforts in finding the best way of financing to maximize their profits.

## 2. LITERATURE REVIEW

The discussion on this topic has been going on for a long time. The most famous theory might be MM proposition. The proposition after considering the effect of the tax, shows that the value of a leveraged firm can be expressed in terms of an unleveraged firm. They found after considering the effect of corporate income tax, interest on the debt is a tax-free expense that lowers the total cost of capital and increases the value of the business. Therefore, as long as the enterprise continuously improves the financial leverage efficiency and reduces the capital cost, the more debt, the more obvious the leverage effect and the greater the company value. When the debt capital is close to 100% in the capital structure, it is the optimal capital structure. This illustrates an extreme situation. However, MM proposition has a lot of limitations, such as the basic assumption is unrealistic. MM proposition assumes that the capital market is perfect, that is, all market subjects can conveniently obtain all kinds of relevant information they need. Information is sufficient and complete, and there is no transaction cost. These conditions can barely possible to achieve in reality.

José Marcos Carvalho de Mesquita and José Edson Lara [4] found that long-term financing return is negatively

correlated with liabilities, while short-term financing return is positively correlated with equity return. But the state of the country's economy, monetary policy can affect the level of debt companies have and how they use it.

Hassan Jan Habib, Faisal Khan and Dr. Muhammad Imran Wazir [3] also come to the same conclusion. When the company chooses the right debt financing and equity financing ratio, the decision helps to improve the profitability of the company. Although debt can allow a company to have more space to operate projects, it also increases the overall risk of the company. The high cost of debt leads to a significant negative correlation between debt and profitability in general. Profitable companies have less debt.

Overall, although the capital structure is not the only factor that affects the profitability, the above papers show that the ratio of debt is inversely proportional to the profitability of enterprises. We will develop our analysis in the following pages.

### 3. DATA EXPLANATION

#### 3.1 Data Description

For this paper, we mainly focus on the top 100 companies in the S&P 500 from the calendar year 2010 to 2019. We include current, non-current assets, and liabilities. We select top 100 companies because they have larger cash flow and are representative. Tax-free benefit makes a significant effect under large cash flow. Using basic items selected in the annual statement, we can calculate more meaningful data, such as return on equity, debt ratio, tax ratio, and asset growth.

#### 3.2 Variable

##### 3.2.1 Dependent variable

There are three major methods we will use for measuring the profitability.

$$\text{Profitability1} = \frac{\text{Net Income}}{\text{Total Assets}} \quad (1)$$

$$\begin{aligned} \text{Profitability2} &= \frac{\text{EBIT}}{\text{Total Assets}} \\ &= \frac{\text{Net Income} + \text{Interest} + \text{Taxes}}{\text{Total Assets}} \end{aligned} \quad (2)$$

$$\text{ROE} = \frac{\text{Net Income}}{\text{Total Equity}} \quad (3)$$

The reason why we used two different data of profitability is that Profitability2 does not consider the effect of tax and interest. Using two different calculations can be more

accurate and able to compare the results before and after-tax.

##### 3.2.2 Explanatory Variables

- Debt ratio

$$\text{Debt ratio} = \frac{\text{Total Debt}}{\text{Total Assets}} \quad (4)$$

Total debt includes both short term and long-term debt. It's the most common way to calculate the debt ratio, which indicates whether debt accounts for a large proportion.

- Intangible ratio

$$\text{Intangible ratio} = \frac{\text{Intangible Assets}}{\text{Total Assets}} \quad (5)$$

Intangible assets refer to the identifiable non-monetary assets without physical form owned or controlled by an enterprise. Intangible assets include monetary funds, trademarks, accounts receivable, financial assets, long-term equity investments, patents, etc., because they do not have physical entities, but are manifested as a legal right or technology. Ozgur Orhangazi [1] mentioned that intangible assets can enable enterprises to increase market power and profitability, but do not need to increase corresponding capital. We can speculate that the higher the utilization rate of intangible assets is, the higher the profits will be obtained by the enterprise under the condition of a fixed amount of capital. Thus, the higher intangible ratio, the higher the profitability.

- Tax ratio

$$\text{Tax ratio} = \frac{\text{Income Tax Expense}}{\text{EBIT}} \quad (6)$$

Every country has different tax policies. Making good use of policies and performing the reasonable tax avoidance can help enterprises to improve their profitability. But overall, the tax has a significant negative impact on profitability.

- Asset growth

$$\text{Asset Growth} = \frac{\text{Total Assets}}{\text{L.Total Assets} - 1} \quad (7)$$

When a company has more assets, the investment opportunities will increase. As net assets rise, so do after-tax profits, and vice versa. The Asset growth calculated here is the change of total assets in this year compared with the previous year.

**4. DATA**

**4.1 Simple Statistics**

In the following table, it shows the simple statistics of dependent variables, including profitability1, profitability2, and ROE.

Table 1: Statistic summaries for Profitability1, Profitability2 and ROE

Variable	Observation	Mean	Std Dev	Min	Max
Profitability1	983	.0802397	.065324	-.2371459	.3501431
Profitability2	983	.11815	.0869869	-.2242043	.4919011
ROE	983	.3331237	3.123131	-33.73333	70.38461

Because Profitability1 is calculated after tax, compared with Profitability2, Profitability1 has a slightly lower mean.

after taking the absolute value, 0-0.09 is no correlation, 0.3-weak, 0.1-0.3 is a weak correlation, 0.3-0.5 is a medium correlation, and 0.5-1.0 is a strong correlation.

**4.2 Correlation Analysis**

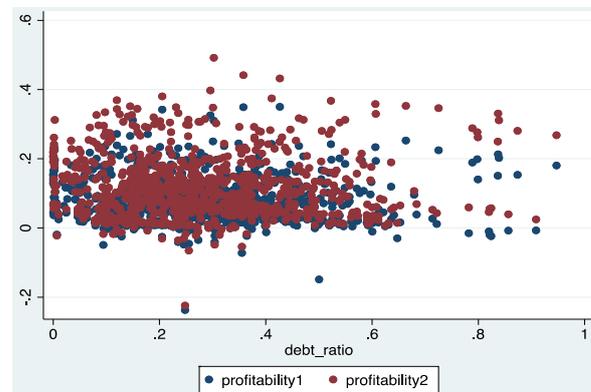
We conduct a correlation analysis between dependent variables and explanatory Variables. Generally speaking,

Table 2: Correlations table between all the variables

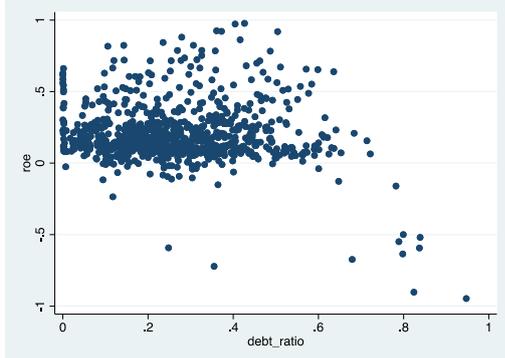
	Debt %	Intangible%	Tax %	Asset Growth	Prof1	Prof2	ROE
Debt %	1.0000						
Intangible %	0.1872	1.0000					
Tax %	-0.0788	-0.1655	1.0000				
Asset Growth	-0.0185	0.0901	-0.1470	1.0000			
Prof 1	-0.1394	-0.2217	-0.0951	-0.0509	1.0000		
Prof 2	-0.0666	-0.2535	0.0968	-0.0709	0.9453	1.0000	
ROE	-0.0478	-0.0216	-0.0427	-0.0007	0.0394	0.0270	1.0000

From the table, we can easily find debt ratio, tax ratio and intangible assets ratio has weakly negative effects on profitability. It's surprising because, from the previous session, we assume intangible assets ratio has a positive correlation with profitability. Because profitability 2 is calculated before tax, it will not be influenced by the tax ratio.

**4.3 Model and Regression Analysis**



**Figure 1:** Relationship plot for Profitability 1 and Profitability 2



**Figure 2:** Relationship plot between ROE and debt\_ratio

We exclude the data of debt ratio less than 0 because most of the time, debt is unlikely negative. Then we plot the data in a two-way line plot. The vertical axis is profitability. There is no obvious trend between debt ratio and profitability. Also, we include points when ROE is larger than -1 but smaller than 1. We can see from the graph; these points are pretty random and have no obvious positive or negative relationship. From the linear regression result, we obtained adjusted R-squared equals to 0.0102 and p-value equals to 0.0016. It means there is only 1.02% of the variance in ROE can be explained by independent variables we chose, which is the debt ratio. Although in some areas, low R squared regression can be acceptable. We can hardly use this model to make the prediction even though its p-value is small.

After multiple tests, the model we are using is a fixed effect regression model. The fixed-effect model means that the experimental results only want to compare the difference between the specific category or category of each independent variable. Also included the interaction effect with the specific category, and do not want to infer the experimental design of other categories or categories that are not included in the same independent variable. Therefore, we assume that the direction of all research results and the size of effect are the same, that is, the results of independent studies tend to be consistent, and there is no significant difference inconsistency test.

The model we selected to show the effect of multiple causes on profitability is as follows:

$$Profitability_1 = \beta_0 + \beta_1 * debt_{ratio} + \beta_2 * intangible_{ratio} + \beta_3 * tax_{ratio} + \beta_4 * asset_{growth} + \varepsilon_1 \tag{8}$$

And the model for ROE is a regression function as follows:

$$ROE = \beta'_0 + \beta'_1 * debt_{ratio} + \beta'_2 * intangible_{ratio} + \beta'_3 * tax_{ratio} + \beta'_4 * asset_{growth} + \varepsilon'_1 \tag{9}$$

$\beta_0$  is the Constant, while  $\beta_i$  is the coefficient of each explanatory variables.  $\varepsilon_1$  is the error term, which explains the difference between the model results and the actual observations. Also, we will set significance levels(alpha) equals 0.05.

Fixed-effects (within) regression		Number of obs	=	798
Group variable: <b>company_id</b>		Number of groups	=	99
R-sq:		Obs per group:		
within	= 0.1658	min	=	2
between	= 0.0061	avg	=	8.1
overall	= 0.0153	max	=	9
corr(u_i, Xb) = -0.3649		F(4, 695)	=	34.54
		Prob > F	=	0.0000

profitability1	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
debt_ratio	-.0424254	.0147534	-2.88	0.004	-.071392	-.0134588
intangible_ratio	-.1157032	.0181724	-6.37	0.000	-.1513827	-.0800238
tax_ratio	-.0740034	.0078504	-9.43	0.000	-.0894169	-.05859
asset_growth	.0004258	.0053131	0.08	0.936	-.0100058	.0108575
_cons	.1427961	.0066401	21.51	0.000	.1297591	.1558331

sigma_u	.05805942
sigma_e	.031919
rho	.76790708 (fraction of variance due to u_i)

F test that all u_i=0: F(98, 695) = 22.61	Prob > F = 0.0000
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**Figure 3:** Regression Result with F-test performed

\*Result is under condition debt ratio > 0 & profitability < 1 & profitability > -1 & tax ratio > 0 & tax ratio < 2

$$Profitability = 0.1427961 - 0.042 * debt_{ratio} - 0.115 * intangible_{ratio} - 0.074 * tax_{ratio} + \varepsilon_1 \quad (10)$$

We exclude asset growth terms because its p-value = 0.936, which is way larger than the significant level. The model's degree of freedom is 4 and residual's degree of freedom is 695, where its F-value equals to 34.54. The corresponding p value is 0.0000, which is much smaller than the

significant level of 0.05. It's a strong indicator to show this model is significant at 5% level.

Another important value is r-squared, which equals to 0.1658. It's relatively larger than other similar models, which means there is 16.58% of the variance in profitability 1 can be explained by the variables we included.

If the debt ratio increases by 1 unit, the profitability will decrease by 0.042 unit. If intangible ratio increases by 1 unit, the profitability will decrease by 0.115 unit. If the tax ratio increases by 1 unit, the profitability will decrease by 0.074 unit.

Source	SS	df	MS	Number of obs	=	742
Model	<b>1.19458181</b>	<b>4</b>	<b>.298645453</b>	F(4, 737)	=	<b>8.06</b>
Residual	<b>27.3085928</b>	<b>737</b>	<b>.037053722</b>	Prob > F	=	<b>0.0000</b>
				R-squared	=	<b>0.0419</b>
				Adj R-squared	=	<b>0.0367</b>
Total	<b>28.5031746</b>	<b>741</b>	<b>.038465823</b>	Root MSE	=	<b>.19249</b>

roe	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
debt_ratio	<b>-.123794</b>	<b>.047042</b>	<b>-2.63</b>	<b>0.009</b>	<b>-.2161463 - .0314416</b>
intangible_ratio	<b>-.0792126</b>	<b>.0320718</b>	<b>-2.47</b>	<b>0.014</b>	<b>-.1421756 - .0162495</b>
tax_ratio	<b>-.1854613</b>	<b>.0411533</b>	<b>-4.51</b>	<b>0.000</b>	<b>-.2662531 - .1046696</b>
asset_growth	<b>-.0231522</b>	<b>.0268985</b>	<b>-0.86</b>	<b>0.390</b>	<b>-.0759591 .0296547</b>
_cons	<b>.3117871</b>	<b>.0204737</b>	<b>15.23</b>	<b>0.000</b>	<b>.2715935 .3519807</b>

**Figure 4:** Coefficient result plot displaying all the variable coefficients.

\*Result is under condition debt\_ratio > 0 & roe < 1 & roe > -1 & tax ratio > 0 & tax ratio < 2

We gained the function:

$$ROE = 0.311 - 0.123 * debt_{ratio} - 0.079 * intangible_{ratio} - 0.185 * tax_{ratio} + \varepsilon_1'$$

The root MSE serves as a measurement of the quality of the estimator. The value closer to zero is better. It equals to 0.19249, which means the data is fairly concentrated around the line of best fit for a linear regression model. Asset growth is excluded again because its p-value is higher than the significant level we set.

**4.4 Limitation discussion**

The model we chose might not be 100 percent perfect. There might be some factors we didn't take in consideration such as government policy or countries' economic environment. The result might be different in developing countries. It might be a problem to reduce the model's accuracy. And we only choose the top 100 companies in the

S&P 500 for the representative. So, we might not able to apply our model to those smaller-scale companies if company size makes the result different. A larger data set and more comprehensive consideration might be helpful.

**5. CONCLUSION**

First, we talk about how other economists conclude in their research paper about debt's effect on companies' profitability. And we extend with the theory behind those conclusions.

Secondly, we discuss the simple statistic and correlation between the dependent variable, several profitability measurements, and other independent variables. However, it is not enough to prove which parameter should be ignored in the model.

Later on, we develop two possible models for profitability 1 and ROE. Because the only difference between profitability 1 and profitability 2 is if it's calculated after tax. We can use one to represent the other one. According to our model, corporate profitability is negatively correlated with debt ratio, tax ratio, and intangible assets. Asset growth is not related to corporate profitability. But our conclusion is

based on a lot of constraints, a change of constraint conditions will affect the relationship between debt ratio and profitability. This is consistent with the conclusion of the article written by Pierpaolo Pattitoni, Barbara Petracchi & Massimo Spisni [2]. The influence of debt ratio on profitability is not a simple linear relationship. Debt ratio is not only a strategic decision of a company, sometimes it is influenced by passive factors, such as financial pressure, macro-level variables and capital liquidity. If we can take the presence of nonlinear effects of debt as consideration, our model might be improved. But overall, the debt ratio has a negative impact on profitability.

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