



Discussion of the Factors Influencing the Beta Coefficient in the CAPM Model----Based on an Empirical Study of the China A-shares

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Abstract. CAPM is a revolutionary concept because it provides a quantitative method to assess investment risk and expected return. In the formula of CAPM, beta represents an investment that risk to a market portfolio. If a company has a beta higher than one, then it is seen as being higher risky than the market. Instead, a beta less than one is thought to potentially less the risk of the market. The main purpose of this article is to analysis the relevance of the three aspects of size, profitability, debt-paying ability to Beta. This article will be represented by the logarithm of Total asset, ROA, current ratio, and asset-liability ratio and profit margin, respectively. In addition, this article will use multiple OLS regression after correlation test's method to do an empirical study of the China A-shares to analyze the correlation between Beta and factors. The result of study shows that the Beta is relevant to asset-liability ratio, ROA, total asset, and Beta is irrelevant to current ratio and profit margin.

Keywords: Influencing factors, Beta, CAPM, Multi regression.

1 Introduction

1.1 History of Capital Asset Pricing Model

The capital asset pricing model (the CAPM) was created 30 years ago by researchers from 1964 to 1965[1]. This model can successfully demonstrate the expected risk of the investment project and the expected return [1]. The CAPM model can not be used in real situations, it has four assumptions: 1) Market have various portfolios, 2) Market have Single-period transaction time limit, 3) Investors can invest at the return with no risk, 4) Perfect capital market [2].

Although capital pricing models are often criticized as unrealistic, there are still many scholars willing to study them and have found many derivative models. Famous one is the Fama-French three-factor model, Fama-French five-factor model and Barra model. But this paper will use basic models to discussion.

And the formula of the CAPM is:

$$Re = Rf + \beta (Rm - Rf) \quad (1)$$

- (1) Re(return on equity): Percentage of net income to shareholder equity.
- (2) Rf(Risk-free rate): The return that can be obtained by investing funds in an investment object with no risk.
- (3) Beta(β): A risk index that gauges the volatility of individual stocks or stock funds relative to the broader market.
- (4) (Rm-Rf) (Equity Market Premium): Investors demand higher returns to compensate for the greater risk.

In the formula, Beta as an important indicator of the CAPM model, according to some studies, a stock risk is represented by its beta with the market portfolio of all invested wealth which is represented by the covariance of the return on equity (ra) and the market rate of return(rm) [3]. Beta is the only one characteristics that can influence the return required by rational investors [3]. Another formula of beta is:

$$Beta = cov(ra, rm) / var(rm) \quad (2)$$

- (1) cov(ra, rm): The covariance between the returns of securities and market returns.
- (2) var (rm): Variance of market returns.

1.2 Research purpose

This paper study the influencing factors of Beta from size, profitability and debt-paying ability to discussion. Size, profitability and debt-paying ability were treated with logarithm of Total asset, ROA, current ratio, The five financial indicators represent the asset-liability ratio and profit margin. Then multi-OLS regression these five financial indicators and Beta to conclude whether Beta is related with the financial indicators. Finally, we conclude whether size, profitability and debt-paying ability are influencing factors of Beta.

1.3 Literature review

Before this, many people have done the same research, such as Xiong Qi verified the financial data corresponding to each stock, including total assets, total liabilities, total equity, current assets, current liabilities, earnings per share (EPS), dividend (DPS per share), are influencing factors of Beta through empirical analysis in 2016 [4]. And Huy, D T N, Hang, N T found GDP, CPI, Rf and other data impacted Beta and stock price through empirical analysis in 2021 [5].

This article refers to the above two articles, but there are many differences between the others .Based on the data from China A shares in 2023, The article finds the annual Beta of listed companies in 2023 and tries to find the influencing factors of Beta through the profitability, size and debt-paying ability. And the paper will use ROA and profit margin two financial ratio to represent profitability, the total assets of the company to represent size, current ratio and quick ratio to represent debt-paying ability.

2 Research design

Firstly, the paper will choose the influencing factors of the Beta. Secondly, the paper will select sample and data from China A shares. Thirdly, the paper will use Pearson

correlation test and Pairwise correlations to analyze the correlation between the financial indicators. Lastly, the paper will use multi-OLS regression to analyze the correlation between Beta and influencing factors.

2.1 Influencing factors selection

According to the research of many scholars on Beta time-time degeneration, this paper will choose Influencing factors from three aspects: size and profitability and debt-paying ability [6].

Table 1. Classification of the explanatory variables

gene	Influencing factors
Size	logarithm of total asset
Profitability	ROA, profit margin
Debt-paying ability	Current ratio, asset-liability ratio

Logarithm of total asset can be classified into size, ROA and profit margin can be classified into profitability, current ratio and asset-liability ratio can be classified into debt-paying ability. The reason why the paper Using such a classification method is the following narrative.

ROA. The first assumption is Return on asset (ROA) from profitability.

ROA is one ratio that measures the level of profitability of a company [7]. ROA shows investors the ability to use asset to make profits. With the same total assets, companies that have more profits tend to have higher ROA. Companies with higher ROA tend to have stronger management, operational and innovation capabilities. The reason why a company have low ROA is company have too much idle assets, too much investment in inventory, too much cash, undervalued fixed asset and so on [7].

The formula of ROA is:

$$ROA = \text{Net income} / \text{Total asset} \quad (3)$$

- (1) Net income: The total profit of a company, which is the residual income or earnings left after deducting business expenses, taxes, and other costs from its total revenue.
- (2) Total asset: Economic resources that a company owns or can control and that can be measured in monetary terms, including various assets, claims, and other rights.

From the formula, finding that ROA has a positive correlation to profitability. That means the more ROA a company have, the more profitability it will be.

Profit margin. The second assumption is the profit margin from profitability.

It is a measure of a business's operational efficiency, showing the ability of firm management to profit from operations without taking into account non-operating expenses.

The calculation formula is follows:

$$\text{Operating profit margin} = \text{operating profit} / \text{operating income} \quad (4)$$

- (1) Operating profit: The profit realized by the company from all its sales activities.
- (2) Operating income: Income from institutions' non-independent accounting activities in addition to professional business activities and auxiliary activities.

The higher the operating profit margin, the less cost of goods sold is created, the higher profit in one sale, the stronger the profitability; the lower the ratio, the more cost of goods sold is created, the less profit in one sale, the weaker the profitability of the enterprise [7]. Profit margin has a positive correlation with profitability.

Current ratio. In this paper, debt-paying ability will be represented by financial ratios: Current Ratio (CR).

Current ratio is one of ratios that measure the liquidity of the company. The more liquidity of the companies, the more stronger for company to pay the short term liability. So, a high current ratio represent a strong debt-paying liability. A high CR can also give a promise for short-term creditors that very small probability of company short-term bankruptcy and debt default risk [8]. However, a much high current ratio is not good for a company. That means the company have much current asset on the hand and low leverage ratio. Low leverage ratio probably means the low profitability and low return on asset. Thus, low current ratio may lead to low profitability and low return on asset. So, investors generally do not want the company's current ratio to be much higher or lower than the industry average, because too high current ratio may lead to return on asset far lower than the industry level, too low current ratio may lead to the company not debt in the short term. All of the above are achieved in the theoretical situation. In reality, many studies have proven it current has a positive and significant influence on stock returns in the future [8]. This confirms that investors will get a higher return if the company have stronger debt-paying ability in short terms because investors begin to concern cash management, accounts receivable, and inventory of the company after the economic crisis [8].

The formula for calculating CR is:

$$\text{Current ratio} = \text{Current assets} / \text{Current liabilities} \quad (5)$$

- (1) Current assets: Assets and cash and cash equivalents expected to be realized, sold or consumed during a normal business cycle or in one fiscal year.
- (2) Current liabilities: Total debt to be repaid in one year or over one business cycle of one year.

Finding a positive correlation of current ratio on debt-paying ability through the formula.

Asset-liability ratio. Debt-paying ability will be represented by financial ratios: Asset-liability ratio.

Asset-liability ratio is the percentage of total liability in total asset [7]. A higher asset-liability indicates a higher proportion of total liability in total asset. So, the higher the asset-liability ratio, the greater the pressure on companies to pay off the debt. This

index represents the risk degree of investors providing investments like bond and stocks to enterprises, and also represents the debt paying pressure for enterprises [7].

By formula:

$$\text{Asset-liability ratio} = (\text{total liabilities} / \text{total assets}) * 100\% \quad (6)$$

- (1) Total liabilities: The liabilities that a company incurs, which can be measured in monetary terms and will be repaid in the form of assets, services, or labor, may be settled through currency, assets, or by providing services.
- (2) Total asset: Economic resources that a company owns or can control and that can be measured in monetary terms, including various assets, claims, and other rights.

Finding a opposite correlation of asset-liability ratio on debt-paying ability through the formula.

Logarithm of Total asset Size will be represented by financial ratio :total asset.

The reason why the paper use logarithm of total asset but not total asset is total asset compared with other influencing factors is huge, and the total asset gap of different companies is also huge [9]. So in this case, to avoid outliers, you can take the logarithm[9]. Even if it will bias the subsequent regression results.

Total assets refer to the resources which can be calculated to the money the company have, including total equity and liability. According to its liquidity, the assets of the enterprise are divided into: current assets, long-term investment, fixed assets, intangible assets and deferred assets, other assets, etc., that is, the total assets of the balance sheet of the enterprise. The so-called liquidity refers to the ability of liquidity and payment of enterprise assets [7].

Logarithm of total asset has a positive correlation with size.

2.2 Data sources and sample selection

According to the China A shares in 2023, this paper mainly analyzes the 4822 (excluding 250 companies that cannot available data and ST) A-share listed companies [10].

The overall situation is shown as follows:

Table 2. sample selection

sample	quantity
Analysis	4822
Total A shares	5291
Remove the missing	342
Reject St	127

In 2023, there are 5,291 listed companies in China A shares, and excluding the companies with missing data and already ST* (There is a risk of delisting at any time, with no statistical value), there are also 4,822 sample companies available for analysis in this paper.

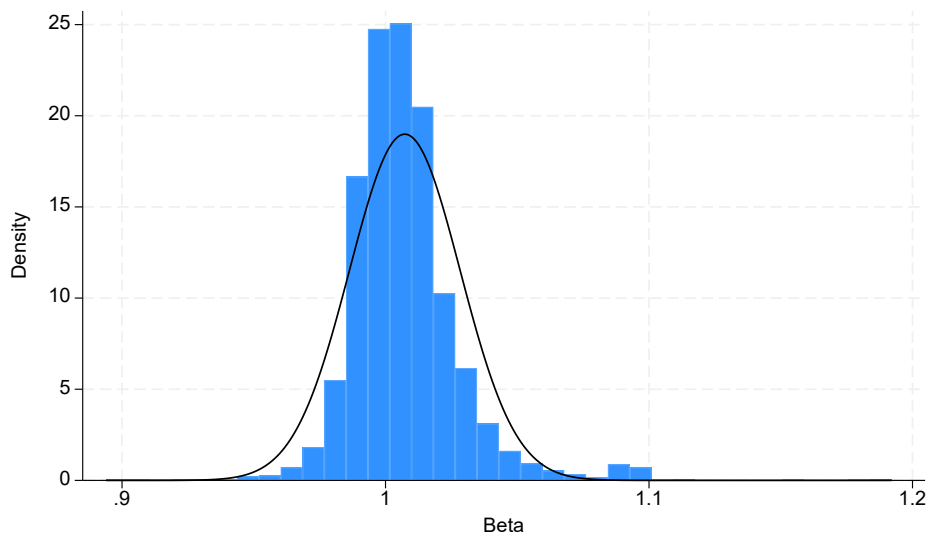


Figure 1. Distribution of Beta in the samples

By figure1, we found that most of the beta in the sample was distributed between 0.9 and 1.1. When Beta equal to one, it shows that the risk of the stock and the expected earnings fluctuate the same as the market; when Beta more than one, it shows that the risk and expected return of stocks fluctuate more than the market. When Beta is less than one, it shows that the risk and expected return of the stock fluctuate less than the market. This phenomenon shows that the yield rate and risk of most samples are consistent with the stock market. Such a sample will improve this paper to a general conclusion.

2.3 Pearson correlation test and Pairwise correlations

This article will assign a multiple linear relationship between Beta and factors according to the previous influencing factors:

$$Beta = a + b1x1 + b2x2 + b3x3 + b4x4 + b5x5 \tag{7}$$

- (1)

X1, X2, X3, X4 and X5: the financial variables (ROA, operating profit margin, current Ratio, asset-liability ratio, and logarithm of Total asset)
- (2)

b1, b2, b3, b4 and b5 as constants.

The following is the correlation analysis between the influencing factors:

Pairwise correlations.

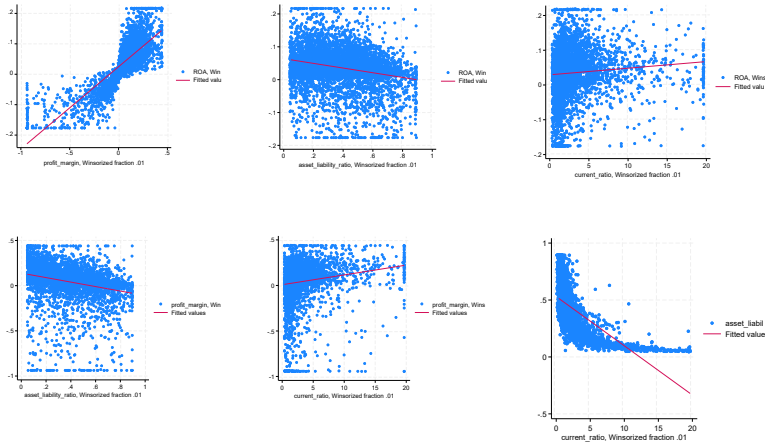
Table 3. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)
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(1) ROA_s	1.000				
(2) profit_margin_s	0.810	1.000			
(3) asset_liabilit~s	-0.226	-0.262	1.000		
(4) current_ratio_s	0.093	0.174	-0.663	1.000	
(5) log10_total_as~s	-0.043	-0.022	-0.052	0.036	1.000

Except for the strong correlation between ROA and profit margin, a strong relevance between current ratio and asset-liability ratio also exists. Moreover, ROA and profit margin have a positive effect with each other, while asset-liability ratio and current ratio have opposite effect with each other. The possible reason for this is that both ROA and profit margin are related to the company's profitability, and both asset-liability ratio and current ratio are associated with the company's debt-paying ability.

Pearson correlation test. The article will make a more direct and clearer presentation of the correlation between all the influencing factors:



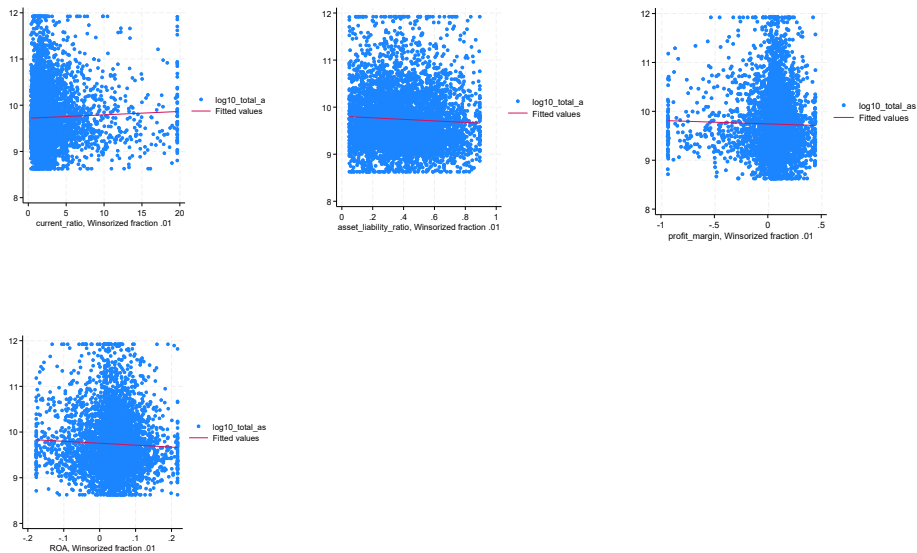


Figure 2. Distribution of Beta in the samples

By the figure 2, a strong positive correlation between ROA and profit margin and a strong negative correlation between current ratio and asset-liability ratio were clearly observed. This further suggests that both ROA and profit margin have a positive relationship with profitability. It also shows that asset-liability ratio has a opposite relevance with debt-paying ability, while current ratio has a positive relevance with debt-paying ability.

2.4 Multi-OLS regression

This article will use multi-OLS regression analysis to analyze the correlation between Beta and influencing factors.

Linear regression.

Table 4. Linear regression

Beta_s	Coef.						
	St.Err.	t-value	p-value	[95% Conf	Inter-val]	Sig	
ROA_s	-0.025	0.007	-3.85	0	-0.038	-0.012	***
profit_margin_s	-0.001	0.002	-0.61	0.541	-0.006	0.003	

asset_liabil- ity_ra~s	-0.012	0.002	-7.04	0	-0.015	-0.008	***
current_ratio_s	0	0	0.10	0.924	0	0	
log10_to- tal_asset_s	0.015	0	37.66	0	0.014	0.015	***
Constant	0.871	0.004	220.93	0	0.863	0.879	***

Mean dependent var	1.008	SD dependent var	0.020
R-squared	0.250	Number of obs	4822
F-test	321.137	Prob > F	0.000
Akaike crit. (AIC)	-25535.081	Bayesian crit. (BIC)	-
			25496.195

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

From the multi-OLS regression results, in influencing factors, ROA, asset-liability ratio, log10 (total asset) has a significant relevance with Beta. In contrast, that was no great relevance between profit margin, current ratio and Beta. And ROA, asset-liability ratio have opposite affect between with beta. Log10 (total asset) has positive affect between with beta.

Lastly, the new formula can be created:

$$\text{Beta} = b1x1 + b2x2 + b3x3 + a \quad (8)$$

Set X1 to ROA, X2 to asset-liability ratio, X3 to log10 (total asset), and a to constant term. According to the Table4 data, the formula of the regression model can be obtained as follows:

$$\text{Beta} = -0.025x1 - 0.012x2 + 0.015x3 - 0.871 \quad (9)$$

There are no profit margin and current ratio in the formula.

3 Results

In this part, the paper will report the results of the research.

Beta with ROA and profit margin representing profitability, with significant positive and no correlation, respectively. This suggests that Beta may have a strong relevance with profitability, but could not be fully determined. Debt-paying ability is comparable to profitability, and it is also impossible to determine whether Beta has a strong relevance with debt-paying ability. Fortunately, this article can almost confirm the strong relevance between size and Beta, because log10 (total asset) has a significant correlation for Beta.

The final results can be drawn as: 1) That may be a significant relevance between Beta and profitability. 2) That may be a significant relevance between Beta and debt-

paying ability. 3) There must be a significant relevance between Beta and size.

4 Conclusions

Why ROA and profit margin all represent profitability, they have different relevance between with Beta and current ratio with asset-liability ratio have the same situation?

There are some assumptions for these questions.

ROA has the same molecule as profit margin, both being net income. However, the denominator is different, and the ROA formula is total asset, and the profit margin formula is operating income. So the possibility is that Beta has a strong correlation with total asset and may not have a strong correlation with operating income. Through table 4, it can be known that Beta has a strong correlation with $\log_{10}$ (total asset), and then indirectly, Beta may have a strong correlation with total asset.

The current ratio can be split into current asset and current liability, the asset-liability ratio into current asset, non-current asset, current liability and non-current liability. So, current asset and current liability may not have a significant correlation for Beta, while non-current asset and non-current liability may have a significant correlation for Beta, indirectly leading to a significant correlation of Asset-liability ratio for Beta. In addition, current ratio showed no significant correlation between current asset and current liability to Beta, resulting in no significant correlation between current ratio to Beta.

There are some probably improvements for the research.

Firstly, An alternative research approach is a possible problem solution. For example, using factors analysis, profitability, debt-paying ability and size are set to the factors, and ROA, profit margin, current ratio, $\log_{10}$ (total asset) and asset-liability ratio classification is set below the factor.

Secondly, it is necessary to split the formula of ROA, profit margin, current ratio, $\log_{10}$ (total asset) and asset-liability ratio, such as ROA can be divided into net income and total asset. Then split the sample with Beta for a more detailed multi-OLS regression.

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