# Determinants of Industry-Specific Capital Structure: Evidence from China A-Shares Using Nonparametric Method

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*Abstract:* This paper attempts to explain the determinants of capital structure from a multi-level perspective. Instead of putting same weight on each variable, we firstly apply nonparametric methods to test the significance of industry factor, after which we build multiple linear regression to figure out the correlation between financial indicators and capital structure. Through the research, we have following conclusions: (1) There is homogeneity between corporates within the same industry. (2) The average level of capital structure differs significantly among industries in China. (3) The coefficient and significance of financial indicators have similarities and differences among industries, suggesting that industrial characteristics can influence the importance of some determinants.

## 1. Introduction

During the past decades, the determinants of capital structure has always been a hot topic, as the relationship, once confirmed, can contribute to optimal capital structure and increase firm's value.

Among all the determinants, industry factor is always treated as an important determinant. On the one hand, some scholars debate whether there is a solid relationship between industry factor and capital structure. On the other hand, considering industry factor first fits the pattern of individual investing, corporate financing and government supervision from the practical perspective. However, the main practice in most papers only put same weight on each determinant. Although some papers do highlight industry factor, few of them apply accurate statistical method to prove the relationship. Some test the hypothesis under the assumption of normal distribution, which is not the case, while others use correct method but ignore the effect of abnormal value.

Therefore, in this paper, we will first use nonparametric methods (Kruskal-Wallis test) to test the significance of industry factor. In order to avoid the effect of abnormal value and prove the universality of differences, we use Wilcoxon–Mann–Whitney test to verify whether the mean value is same in pairs. Secondly, we build multiple linear regression, which can be used to predict capital structure of a particular firm. Finally, we will try to explain the difference among industry from the perspective of industrial characteristics.

## 2. Literature Review

### 2.1 Review of Theoretical Analysis

The survey of capital structure between industries depends on the assumption that different industries have their own characteristics and there is homogeneity between corporates within the same industry. According to Schwartz and Aronson[1], firms within the same industry normally have similar capital structures. Consistent with this conclusion, Almazan, Andres and Molina[2], together with Miao[3], illustrates the existence of optimal capital structure, suggesting that most managers in the same industry would adjust source of finance in the same way in order to maximize the enterprise value.

Although it is generally accepted that companies show similar pattern within the same industry, scholars hold different views on whether industry factor is a significant variable when deciding a firm's capital structure. Scott, David, and Martin[4] concludes that a firm's capital structure is significantly related to its industry. By contrast, Markham and Sekely[5] argue that the country effect is found to be more significant than the industry effect in determining the capital structure.

### 2.2 Review of Empirical Research

The empirical research on capital structure between industries is either focused on a particular industry or on a designated country. Gill[6] and Sheikh[7] carry out in-depth study about service and manufacturing industry respectively, both of which figure out the industry-specific determinants of capital structure. Bowen et al.[8] prove that over 27% of the capital structure differences can be explained by the industry factor in America.

In China, most studies confirm the relationship between industry factor and capital structure. Wang and Yao[9] collect the financial report of China's A-share listed companies from 2009 to 2013 and point out that there are significant differences in average levels of capital structure between industries. Guo and Sun[10] explain that about 9.5% of the inter-firm differences in capital structure can be explained by industry factor. On the contrary, only a few articles show opposite conclusions. Hong and Shen[11], for example, discover that the debt level of enterprises and industry variables are independent of each other when carrying out the independence test.

## 3. Empirical Test and Result Analysis

### 3.1 Research Methods and Data Samples

#### 3.1.1 Sample

Firms listed in China A-shares in 2020, 3558 observation in 19 different industries are provided. (excluding firms with special treatment or blank value)

#### 3.1.2 Industry Classification Benchmark

According to China Securities Regulatory Commission industry classification.

*Table 1 Industry Classification And the Number of Companies Studied*

| Industry name | Industry code | Number of companies |
|---|---|---|
| Agriculture, forestry, animal husbandry and fishery | A | 38 |
| Mining | B | 68 |
| Manufacturing | C | 2252 |

| Electricity, heat, gas and water production and supply | D | 107 |
| --- | --- | --- |
| Construction | E | 90 |
| Wholesale and retail | F | 154 |
| Transportation, storage and postal services | G | 98 |
| Accommodation and catering | H | 8 |
| Information transmission, software and information technology services | I | 268 |
| Finance | J | 117 |
| real estate | K | 110 |
| Leasing and business services | L | 51 |
| Scientific research and technology services | M | 47 |
| Water conservancy, environment and public facilities management | N | 63 |
| Residential services, repair and other services | O | 1 |
| Education | P | 9 |
| Health and social work | Q | 12 |
| Culture, sports and entertainment | R | 51 |
| Comprehensive | S | 14 |

### 3.1.3 Research Methods

(1) Kruskal-Wallis test & Mann-Whitney-Wilcoxon Test

The Kruskal-Wallis test (H-test) can be used to test the hypothesis that multiple groups have the same mean value with the concept of rank without the necessity to assume the type of distribution.

Using the Mann-Whitney-Wilcoxon Test, we can test whether two groups are identical by ranking the figure in combined group and add the rank of each group without assuming them to follow the normal distribution.

(2) Regression analysis

We establish multiple regression model by taking debt-asset ratio as an argument and taking related financial indicators as responding variables.

*Table 2 Variable Description*

| Variable name | symbol | description |
| --- | --- | --- |
| Debt-asset ratio | Y | Liability/asset |
| Enterprise scale | X1 | In(total asset) |
| Return on net assets (average) | X2 | Profit/net assets |
| Growth rate of operating revenue | X3 | Operating revenue of last year/operating revenue of this year |
| Net asset value per share | X4 | Net assets/number of ordinary shares |
| Operating profit margin | X5 | Operating profit/total revenue |
| Cash liquidity | X6 | cash flow from operating activity |

### 3.2 Data Processing and Analysis

### 3.2.1 Descriptive Analysis

We classify data by industry type and the statistical indicators, including mean, standard deviation and distribution of debt-asset ratio, are presented in the form of data visualization as follows.
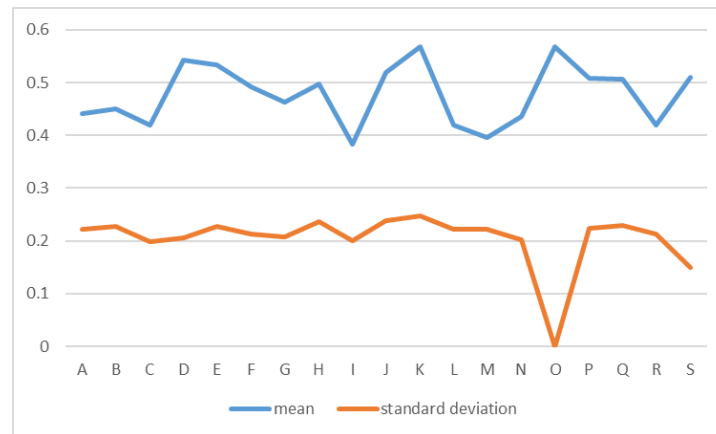
*Fig.1 Curve Diagram of Mean and Standard Deviation of Each Industry.*

From this graph, we find that the average level of capital structure in each industry is different, with K- Real estate and O- Residential services, repair and other services the highest level about 0.6, showing preference of debt finance and I-Information transmission, software and information technology services the lowest level under 0.4, showing preference of equity finance instead. The standard deviation of capital structure in almost all industries is under 0.25, suggesting that homogeneity do exist in the same industry and the only exception goes to O- Residential services, repair and other services because there is only one listed company in this category.
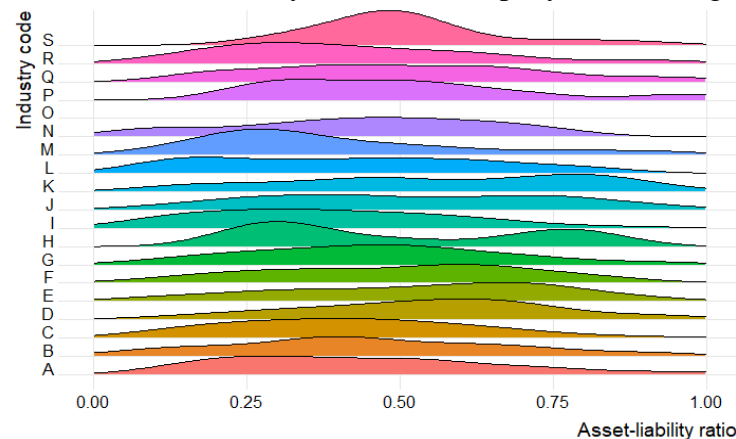


*Fig.2 Distribution of Asset-Liability Ratio of Each Industry.*

The above ridgeline diagram shows the distribution of debt-asset ratio in each industry. Consistent with the previous findings, most industries seem to have own characteristics and have dense distribution near the mean value.

### 3.2.2 Nonparametric Test

This paper puts forward the hypothesis H0: there is no significant difference in capital structure among industries. To test the hypothesis, we firstly apply Kruskal-Wallis test (H-test) using the R project for statistical computing and the results are presented as follows.

*Table 3 Results of Kruskal-Wallis Test*

| method | chi-squared | df | p-value |
|---|---|---|---|
| Kruskal-Wallis test (H-test) | 145.6 | 18 | <2.2e-16 |

According to the significance level of 0.05, we reject the original hypothesis, which means difference do exist in capital structure among industries. However, before we draw the conclusion, we need to investigate whether the difference is caused by abnormal value or ubiquitous among industries. Therefore, we use paired comparison test in the following sector.

By applying Wilcoxon–Mann–Whitney test, we find that some industries have similar average level of debt-asset ratio (p-value > 0.1) and we sort 19 industries into 5 groups. Due to the large amount of data, we here only present the results of comparison between A- Agriculture, forestry, animal husbandry and fishery and the rest industry codes.

*Table 4 Results of Wilcoxon–Mann–Whitney Test (Example a, P Value)*

| B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|
| 0.7543 | 0.7038 | 0.0094 | 0.0240 | 0.0994 | 0.4865 | 0.5031 | 0.1581 | 0.0662 |
| K | L | M | N | O | P | Q | R | S |
| 0.0059 | 0.6693 | 0.2688 | 0.8035 | 0.5128 | 0.4475 | 0.3867 | 0.6936 | 0.2224 |

After grouping, it can be seen from the table that some industries may have similar capital structure, but the average debt-asset ratio in one group is significantly different from the ratio in any other groups. As H- Accommodation and catering and L- Leasing and business services belong to none of 4 groups, we can infer that these two industries have their unique capital structure. The conclusion is consistent with the results of K-W test, suggesting that the difference of capital structure among industries is not caused by the abnormal value of capital structure , but a common phenomenon.

*Table 5 Group Assignment*

|  | Group1 | Group2 | Group3 | Group4 | Rest |
|---|---|---|---|---|---|
| Member | ADFIK | BEJ | CGS | MNPQ | HL |

### 3.2.3 Regression Analysis

We establish multiple linear regression for each industry individually in order to figure out what kinds of financial indicators does a certain industry care most about and to what extend managers make finance decisions based on these indicators. In the following table, we omit the data of variables which are not significant. (all the symbols have already been mentioned in the previous sector.)

*Table 6 Regression Analysis Of Influencing Factors*

|  | X1 | X2 | X3 | X4 | X5 | X6 | $R^2$ |
|---|---|---|---|---|---|---|---|
| A | / | / | 0.0436 | / | / | / | 0.2493 |
| B | / | -0.5670 | / | / | / | / | 0.1277 |
| C | 0.0308 | -0.1848 | / | -0.0016 | -0.0051 | / | 0.1312 |
| D | 0.0558 | -0.4508 | / | 0.0083 | / | -0.010 | 0.2744 |
| E | 0.0335 | / | 0.1851 | / | -0.2405 | / | 0.2492 |
| F | 0.0555 | / | / | / | / | -0.016 | 0.1093 |
| G | 0.0038 | / | / | / | / | / | 0.0997 |
| H | / | / | / | / | / | / | 0.9240 |
| I | 0.0222 | / | / | -0.0062 | -0.1755 | / | 0.1195 |
| J | / | -0.2711 | / | 0.0120 | / | / | 0.1807 |
| K | 0.0369 | -0.2133 | / | 0.0131 | / | / | 0.2278 |
| L | 0.0415 | -0.3646 | / | / | / | / | 0.2574 |
| M | / | / | 0.2341 | / | / | / | 0.1158 |
| N | 0.0887 | / | / | / | / | -0.1130 | 0.2102 |
| O | / | / | / | / | / | / | NA |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| P | / | 1.7536 | / | / | -0.4606 | / | 0.929 |
| Q | / | -0.5717 | / | / | / | / | 0.6082 |
| R | / | / | / | / | / | / | 0.106 |
| S | / | / | / | / | 0.7901 | / | 0.3611 |

In terms of R square, which indicates the extend that an argument can be explained by the regression model, we find that the figure of most industries falls in the range between 0.1 to 0.3($R^2$ in H,P,Q and S should not be considered due to the small sample size in these industries), which means 10% to 30% of the firm's decision about capital structure can be explained by these six financial indicators. It is reasonable to deduce that $R^2$ will be larger if we take more indicators and the effect of interaction into consideration. Among all the industries, G- Transportation, storage and postal services has the lowest $R^2$ and D- Electricity, heat, gas and water production and supply has the largest $R^2$, probably due to the fact that when judging the situation of the company, the former pay more attention to non-financial indicators, such as the delivery time or customer complaints while the latter has a stable market environment and financial indicators can reflect a lot on the company's performance.

In terms of six financial indicators, it can be found in the table that there are similarities and differences in the coefficient and significance of the variables among industries. Of all the industries which consider enterprise scale when deciding capital structure, the figure is positive, which means the larger a company is, the more likely that it has a higher level of debt. This trend can be explained by the fact that creditors always trust large companies, and companies normally accept the debt because debt has tax benefits and less risk of equity dilution. On the contrary, not all the industries show the same attitudes for net asset value per share. Some prefer higher level of debt-asset ratio when net asset value per share is large probably because they think the indicator itself is a symbol financial security, while others take opposite step because they think the indicator will attract a large number of shareholders and they can raise funds in a more beneficial way by equity financing.

On the part of key indicators each industry cares about, differences seem to outweigh similarities, and we can attribute the findings to the characteristics of industry. For example, companies in A- Agriculture, forestry, animal husbandry and fishery have a high degree of similarity in operating activities and growth rate of operating revenue is a representative indicator to put these companies into different categories. While growing companies (high tech) appreciate debt finance, other companies may face high level of financial distress (such as traditional or high-polluting companies) and have more equity than debt.

## 4. Conclusion

Through the comparisons between the capital structure of corporates in different industries, we figure out that it is a general trend that capital structure differs significantly between different industries based on the data of A-shares companies.

By establishing regression model, we find that different industries pay different degrees of attention to representative financial indicators when deciding capital structure. In addition, the coefficient of financial indicators has similarities and differences between industries, suggesting that industrial characteristics can influence the importance of some determinants.

We highly recommend stakeholders, including managers, investors and financial organizations can take the benefit of this paper and analyze whether the company reaches its optimal capital structure by using the multi-level research method. It is useful to first understand the characteristics of the industry before making further survey on relevant financial indicators.

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