



Analysis of Factors Influencing the Choice of Debt Refinancing Modes for Listed Public Utility Companies — A Case Study of Corporate Bonds

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Abstract. This article is based on the A-share public utility listed companies in Shanghai and Shenzhen that have issued corporate bonds as research objects. Taking corporate bonds as an example, it deeply explores the specific influencing factors and mechanisms that affect public utility listed companies' choice of debt-based refinancing. Taking 31 public utility companies listed in China that issued corporate bonds between 2008 and 2016 as the research subjects, this paper empirically examines the effects of specific factors influencing the issuance of corporate bonds by China's listed public utility companies using a Logistic regression model. The empirical results show that the main factors influencing bond issuance by listed public utility companies are corporate growth and financial leverage, both of which have a significant negative impact on the probability of these companies using corporate bonds for refinancing.

Keywords: public utilities; debt refinancing; corporate bonds

1 Introduction

1.1 Definition and Importance of Public Utilities

From perspective of the role in the national economy, public utilities belong to the infrastructure industry. The World Bank divides infrastructure into "economic infrastructure" and "social infrastructure." Economic infrastructure refers to "permanent engineering structures, equipment, facilities, and the services they provide for residential use and economic production. It consists of three major components. The first component covers public utility services including power supply, piped gas supply, telecommunication, water supply, environmental sanitation, sewage treatment, as well as solid waste collection and disposal. The second component refers to public works such as dams, roads, irrigation canals and drainage channels. The third component includes various transportation facilities covering railways, urban public transit, seaports, inland waterways and airports. By contrast, social infrastructure refers to all infrastructure excluding economic infrastructure. It mainly serves cultural development, education and

medical and health care sectors ^[1]. Subsequent studies have explored the availability of bond financing for Chinese public utility enterprises ^[2].

This paper defines the research scope of the public utility industry from two dimensions. The first dimension covers narrow-sense public businesses including power supply, gas supply, water supply and urban public transport. The second dimension refers to transportation industries including railways, highways, airports and ports. They all fall under the category of economic infrastructure, providing critical intermediate services to other industries, and their products often constitute costs for other sectors.

The public utility industry has four typical attributes, namely natural monopoly, public welfare, prominent externality and fundamental supporting function. Public utilities typically involve large investment amounts, long investment cycles, high asset specificity, significant sunk costs, and notable economies of scale and scope. In terms of industrial positioning, public utilities can meet basic social public needs and are closely correlated with public interests and macroeconomic development. At the same time, the modernization of public utilities is prerequisite for urban modernization, helping to improve the urban investment environment and enhance urban economic efficiency.

1.2 Significance of the Study

Given the ongoing urbanization process, expanding investment demand for public infrastructure projects and worsening fiscal pressure on local governments, it is of great practical value to explore the financing status quo of public utility enterprises. As core participants in market economic activities, public utility enterprises undertake the daily operational work of infrastructure services. Nevertheless, government fiscal funds can hardly meet the booming construction demand of public utilities. In this context, stimulating the independent operational vitality of public utility enterprises and introducing social private capital can effectively ease the fund supply-demand contradiction. This approach also helps realize coordinated economic, social and environmental benefits. For example, Chongqing Water Group replenished its capital for infrastructure construction and resolved fund shortages via initial public offering in 2010. In addition, relevant academic research conducted by Zhu Yikang, Lu Zhengfei and other scholars has demonstrated that Chinese listed companies are faced with bottlenecks of single and limited refinancing channels, which further proves the practical necessity of exploring diversified alternative refinancing approaches. ^[3-4].

As a core financing approach for listed companies, refinancing serves as a vital tool to allocate social resources and optimize resource allocation efficiency. In essence, refinancing refers to all direct financing activities that change corporate asset-liability structure after an enterprise completes its initial public offering. It can be divided into two major categories without parenthetical enumeration. One category is equity refinancing containing rights issues, seasoned equity offerings and convertible bonds. The other category covers debt refinancing represented by corporate bonds, enterprise bonds, medium-term notes and short-term financing bills. Admittedly, the refinancing behaviors of domestic listed companies currently face several prevalent drawbacks. These drawbacks include single financing channels, persistent equity financing prefer-

ence, excessive fundraising scale beyond actual capital demands, ambiguous investment orientation of raised funds, and insufficient protection mechanism for minority shareholders^[3]. On the other hand, it is imperative to conduct targeted research on the refinancing decisions of listed public utility enterprises based on their industry characteristics. Relevant research findings can help standardize and optimize corporate refinancing behaviors, so as to facilitate the sound and sustainable development of the public utility industry. Moreover, the classic pecking order theory, existing research on corporate debt maturity structure, and empirical studies focusing on emerging markets can provide solid theoretical foundations. These theories and prior literature not only guide the financing decisions of high-growth enterprises, but also offer valuable references for analyzing the corporate bond issuance behaviors of Chinese listed public utility companies.^[5-7]

Therefore, this paper focuses on listed public utility companies that have issued corporate bonds in accordance with relevant national policies following their IPOs. Taking corporate bonds as an example, this paper investigates the factors influencing the choice of debt refinancing behavior among public utilities. The reasons for choosing to study corporate bonds are as follows:

Since the official promulgation and implementation of the Measures for the Pilot Issuance of Corporate Bonds in 2007, China's corporate bond market has embarked on standardized and rapid development. The expanding corporate bond issuance scale has effectively broadened financing avenues for listed companies and boosted the sound development of China's capital market. However, the development of corporate bonds has been relatively slow. Furthermore, compared to corporate bonds, short-term financing bills and medium-term notes mainly meet enterprises' temporary operational capital needs and exert a relatively slight influence on corporate capital structure. These factors provide realistic research background for the subsequent empirical analysis of corporate bonds.

2 Empirical Data and Empirical Methods

2.1 Empirical Data

This study adopts the Shenying & Wanguo Industry Classification Standard and collects relevant research data from the Wind Financial Database through professional financial terminal software. In line with this classification standard, the research sample covers nine secondary industries in total. Four secondary industries are selected under the primary public utility industry, namely electric power, water service, gas supply and environmental protection. Another five secondary industries belong to the primary transportation industry, including railway operation, urban public transport, expressway operation, airport operation and port operation. The research sample consists of all Shanghai and Shenzhen listed enterprises that issued corporate bonds from 2008 to 2017. The starting year 2008 is chosen because China implemented new accounting standards in 2007, which ensures unified statistical caliber of financial data throughout the research period. Initially, 35 qualified public utility listed enterprises are screened out. Further sample screening criteria require all sample enterprises to be listed on the main boards

of Shanghai Stock Exchange and Shenzhen Stock Exchange. Four enterprises listed on the Small and Medium-sized Enterprise Board and ChiNext Board are thus eliminated. The excluded enterprises include Longyuan Power Group Corporation Limited, Shaanxi Provincial Natural Gas Co., Ltd., Dongjiang Environmental Company Limited and Nanjing Port Co., Ltd. The elimination aims to guarantee the comparability of research samples. Enterprises listed on growth-oriented secondary boards face different systematic risks and follow independent index operation systems compared with main board listed companies, which may interfere with empirical regression results. After two rounds of strict screening, the final research sample contains 31 valid public utility listed companies. In terms of sample observation rules, enterprises with multiple corporate bond issuances within a single year are recorded as one single sample. By contrast, enterprises conducting multiple bond issuances across different years are regarded as independent research samples separately.

Referring to the process of existing empirical research on issues related to corporate bonds, financing, and growth potential [8]. Table 1 shows the definitions of the relevant variables. Combined with our research objectives, the dependent variable is a dummy variable indicating whether a listed public utility company issued corporate bonds. The dependent variable in this study is set as a dummy variable. Specifically, the value is assigned as 1 if a company issues corporate bonds in a given year, and 0 if it does not. Combined with corporate governance theory and debt financing theory, this paper selects six core influencing factors affecting corporate bond issuance decisions of listed public utility companies, including corporate credit rating, firm size, growth potential, financial leverage, free cash flow and ownership structure. Besides, this study adopts the revised Altman Z-score model to conduct relevant measurement and risk evaluation. The logarithm of company assets, company profit margin, the ratio of the book value of liabilities to the book value of total assets, operating cash flow per share, and the proportion of shares held by the largest shareholder to the total share capital.

Regarding the choice of indicators for measuring company credit ratings, controversy persists in the literature. This paper selects the modified Altman Z-score, which is widely used in empirical research. Here, this paper adopts the calculation formula by Zhang Ling and Zeng Wei Huo [9].

$$Z = -8.751 + 6.3X_1 + 0.761X_2 + 1.295X_3 + 0.412X_4 + 0.015X_5 + 0.105X_6 - 21.164X_7$$

All explanatory variables in the formula are defined clearly below:

X_1 denotes net return on assets;

X_2 denotes operating cash flow per share;

X_3 denotes the natural logarithm of total fixed assets;

X_4 denotes the growth rate of main business revenue;

X_5 denotes retained earnings ratio;

X_6 denotes the ratio of market value of tradable shares to total liabilities;

X_7 denotes the book-to-market ratio of corporate equity.

Table 1. Description of Variables Used

Variable Type	Variable Name	Variable Symbol	Variable Meaning and Description
Dependent Variable	Corporate Bond Issuance ^[5-7]	C Bond	If corporate bonds were issued in the current year, C Bond=1; if no corporate bonds were issued in the current year, C Bond=0.
Independent Variables	Credit Rating Level ^[9]	Z-degree	The listed company's modified Altman Z-score
	Company Size	Size	The logarithm of the listed company's total assets
	Growth Potential ^[8]	Growth	Company profit growth rate = (Current year's profit rate - Previous year's profit rate) / Previous year's profit rate
	Financial Leverage ^[9]	F leverage	Asset-liability ratio (Debt-to-asset ratio)
	Free Cash Flow Level ^[9]	C flow	Net operating cash flow per share
	Ownership Structure ^[9]	RI	The proportion of shares held by the company's largest shareholder relative to the total share capital
Control Variables	Year Dummy Variable	Year	From 2007 to 2010, with 2007 as the baseline, dummy variables are selected
	Industry Dummy Variable	Industry	Core infrastructure=1, non-core infrastructure=0; specifically, electricity, water, gas, and environmental protection = 1; railways, public transit, highways, airports, and ports = 0
	Company Age	Age	The number of years from the company's establishment to the sample period.

2.2 Empirical Methods and Empirical Models

Since the dependent variable in this chapter is a dummy variable taking values of 0 and 1 to measure whether a company issues corporate bonds, it employs the logistic regression model from econometrics for our research. Assuming the probability of a listed company issuing corporate bonds is P , where the value of P ranges from (0, 1), then the probability of not issuing corporate bonds is $1-P$. Taking the natural logarithm of the ratio $P/(1-P)$, i.e., $\text{Ln}[P/(1-P)]$, transforms it into the logit unit $\text{Logit } P = \text{Ln}[P/(1-P)]$. Consequently, the logit model for Logistic regression is: $\text{logit } P = b_0 + b_1X_1 + b_2X_2 + \dots + b_kX_k$, from which it can derive $P = \frac{e^{b_0 + b_1X_1 + b_2X_2 + \dots + b_kX_k}}{1 + e^{b_0 + b_1X_1 + b_2X_2 + \dots + b_kX_k}}$

3 Empirical Results

Based on the above, the empirical regression model in this paper is derived as $\text{logit } P = b_0 + b_1X_i + b_2X_j + \varepsilon$, where P is the probability of a utility company issuing corporate bonds, and b_0 is the constant term; X_i is a set of explanatory variables, including company size, credit rating, ownership structure, growth potential, cash flow level, the

shareholding ratio of the largest shareholder, and corporate financial leverage; X_j is a set of control variables, primarily consisting of company age, year dummy variables, and industry dummy variables. According to the relevant theoretical knowledge of the logistic decision model, this model is relatively more sensitive to multicollinearity than other models. Based on this, it first conducted a VIF test for multicollinearity on the model; the mean value of the variance inflation factor was 2.40, which is less than 10, indicating that there is no multicollinearity problem in the model. Subsequently, a White's test for heteroscedasticity was performed on the model; the P-value was 0.3632, rejecting the null hypothesis of the existence of heteroscedasticity, meaning the logistic model does not exhibit heteroscedasticity. The specific logistic estimation results are shown in Table 2.

Table 2. Estimation Results of the Logistic Discrimination Model

	Coefficient	Standard Error	P-value
Z degree	-0.129	0.356	0.717
Size	-0.123	0.661	0.853
Growth	-1.190	0.575	0.039**
F leverage	-0.149	0.069	0.032**
C flow	-1.182	1.882	0.331
RI	-0.032	0.025	0.194
Constant	10.624	11.583	0.359
Age	-0.123	0.101	0.223
Year	Control	Control	Control
Industry	Control	Control	Control
Prob > chi2		0.0000	
Pseudo R2		0.4767	
-2loglikelihood		55.266	

Note: indicates that the correlation coefficient is significant at the 1% level, indicates significance at the 5% level, and indicates significance at the 10% level.

From the results in Table 2, it can be seen that the likelihood ratio chi-square statistic is significant at the 1% level, indicating that the model specification is good. To further verify the goodness of fit of the model, it performed the Hosmer-Lemeshow test on the logistic model. The test results are shown in Table 3 below:

Table 3. Hosmer & Lemeshow Test Results

Logistic model for cbond, goodness-of-fit test	
Peason chi2(80)	54.05
Prob> chi2	0.9885

The results indicate that the model's goodness of fit is very high.

Based on the results in Table 2, the factors influencing whether listed public utility companies issue corporate bonds are analyzed in detail as follows:

1) The company's growth potential is significantly negatively correlated with the probability of public utility company issuing corporate bonds at the 5% significance

level. It indicates that when public utility companies have more growth opportunities, there are more inclined to choose financing channels with shorter maturities. Corporate bonds have minimum maturity of 3 years and maximum of 10 years; the probability of choosing to issue corporate bonds is lower. Company growth potential measures public utility company's ability to operate continuously and expand in certain field. Generally speaking, the magnitude of company's growth opportunities not only directly affects whether the company seeks further financing but also directly influences the choice of debt maturity structure. Companies with substantial growth opportunities should utilize short-term debt for financing more often. The debt maturity faced by company is negatively correlated with growth opportunities; public utility companies with higher growth indicators are more inclined to choose short-term debt instruments.

2) From the estimated coefficient of the public utility companies' financial leverage, which is -0.149 and significant at the 5% significance level, it can be seen that the company's financial leverage is significantly negatively correlated with the probability of issuing corporate bonds. It indicates that when public utility company's financial leverage is at higher level, the company faces greater risk. The risk of debt default is relatively high, which is unfavorable for the company's bond financing.

3) Regarding control variables such as company age, year dummy variables, and industry dummy variables: due to space limitations, it has listed the estimated coefficient for company age, which was found to be insignificant. The estimated coefficients for year dummy variables and industry dummy variables vary, with some being significant and others insignificant.

4) The estimated coefficients for the remaining variables—company credit rating, company size, free cash flow level, and ownership structure—are insignificant. It is believed that these factors haven't impact on the probability of public utility companies issuing corporate bonds.

4 Conclusions and Suggestions

Through the empirical analysis in this article, it has been gained that deeper understanding of the selection behavior of public utility listed companies' bond refinancing, so as to better utilize refinancing rationally and promote the healthy development of public utilities. The empirical results of this paper provide an important reference for listed public utility companies in choosing debt refinancing behaviors: our findings indicate that variables of corporate growth and financial leverage affect the probability of listed companies issuing corporate bonds. Therefore, companies should continuously improve their governance levels, seize development opportunities, and seek various growth prospects. At the same time, companies should maintain a reasonable level of financial leverage to avoid the risk of default. companies possibly issue corporate bonds, thereby improving corporate performance and increasing corporate value.

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