Study on the Interest Rate Risk of China's Manufacturing Sector

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Abstract: Manufacturing sector plays a vital role in China's national economy, and its anti-risk capability should be paid special attention to. This paper analyzes empirically the interest rate risk of China's manufacturing sector by applying a nonparametric approach to examine whether there is industry effect affecting the interest rate risk across the manufacturing sector. Our major findings are as follows: 1)light industries are more vulnerable to interest rate risk than heavy industries; 2)there is statistically significant industry effect on the interest rate risk across the sector, and 3)the industry effect is quite stable in two successive years but unstable over a long time. These findings may shed some light on the interest rate risk management of China's manufacturing sector, and provide some technological supports to promote sustainable development of China's manufacturing sector.

Keywords: interest rate risk; times interest earned; Chinese manufacturing sector

1 Introduction

Manufacturing sector plays a vital role in China's national economy, and its anti-risk capability should be paid special attention to. According to China's National Economy and Social Development Statistical Data Collection 2008-2009, investment in fixed assets of manufacturing sector amounts to 4634.5 billion RMB or 31.3 percent of the total investment in fixed assets on the sector level in 2008, ranking first among all sectors. Listed companies of manufacturing sector account for a proportion of about 50 percent of the total listed companies in the stock market of China. While researches on manufacturing sector in China are extensive in some other subjects, the financial situation across the sector is rarely explored and whether interest rate risk differs across the sector is unclear (Some pioneering domestic researches in this area may refer to [8], [9] and [10]).

Interest rate risk, broadly defined as the potential for adverse changes in earnings or capital as a result of a potential change in interest rates, tends to refer to the banking book (Dumas, 2006). Dumas points out that interest rate risk exposures can result from changes in spreads between asset and liability yields. These spreads can arise from differences in basis curves (such as credit spreads), they may be attributable to embedded options (option-adjusted spreads), or they may result from differences in maturities or repricing periods. The latter spreads would be attributed to yield differences for different time horizons along the slope of the yield curve. Interest rate risk has often been investigated on the enterprise level, for interest rate risk management is of great importance and the financial data are often available, especially when the company is a listed one. After comprehensively studying on financial profile, and the interest-sensitive assets and liability, the degree of interest rate risk can be determined and some related strategy can be applied.

However, analyses on interest rate risk concerning industry effect, as which we define the difference in the interest rate risk, are rarely made in China, which is studied in this paper. The main contribution of this paper is to show whether and how the interest rate risk varies significantly across Chinese manufacturing sector. The rest of this paper is organized as follows. Section 2 reviews the financial and economic background in existing literature on interest rate risk. Section 3 describes the methodology and data used in this paper. Empirical results will be presented in Section 4 and some conclusions will be made in the last section.

2 Background on Interest Rate Risk: A Review

This section reviews the background on interest rate risk. As is shown, interest rate risk assessment mainly stems from financial ratio analysis, using all sorts of financial indicators to meet the needs of appropriate interest rate risk management. The indicator we used in this paper will also be discussed at the end of this section.

2.1 Financial Ratio Analysis

Financial ratios have been constructed to evaluate a firm's financial situations and these tools are of great use for they can provide professional insights into enterprises, industry and even the whole economy. Gupta (1969) examines four broad categories of ratios, including profitability ratios, turnover ratios, leverage ratios, and liquidity ratios, to analyze the effects of industry, size and growth on the financial structure of corporate enterprises

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of US manufacturing-industrial sector. He summarizes characteristics of financial ratios related to industry, growth situation and size. Wu Shinong and Lu Xianyi (2001) use financial ratios to establish models for predicting financial distress in China's listed companies. They note that some financial ratios are significantly related with financial distress. Shu Yan and Kong Yusheng (2002) analyze financial data of industrial enterprises in China with different size and they indicate that leverage ratios and activity ratios differ significantly across the different size groups, while liquidity ratios and profitability ratios are constant across different size firms. Lian Yujun and Li Dan (2006) show that there is significant difference between mean industry financial ratios which are statistically significant converge to the mean of industry, although the speeds of convergence are different from each other, applying a nonparametric approach to examine data collected from listed firms in China.

These studies generally focus on firms' ability to profit, pay debt and sustain development; however, firms' exposure to interest rate risk should also be explicitly examined for the requirement of interest rate risk management in modern corporate or macroeconomic management. Financial ratio analysis extends naturally to the area of interest rate risk assessment.

2.2 Interest Rate Risk Assessment

Interest rate risk ratios, ratios reflecting the potential for adverse changes in earnings or capital as a result of a potential change in interest rates, are most often studied on the enterprise level. For instance, Faff and Howard (1999) study interest rate risk of Australian financial institutions of Australia over a period of extreme regulatory change and conclude the characteristics of interest rate. They find that there is evidence of sensitivity to long-term interest rates, instability of interest rate sensitivity across subperiods, and interest rate sensitivity of large banks and finance companies. Purnanandam (2008) explains the ex-post risk-management motivation of the firm. He shows that the shareholders optimally engage in ex-post risk-management activities without a pre-commitment to do so. Vickey (2008) studies small firms which are exposed to interest rate risk. He finds that credit-constrained firms match significantly more often with fixed-rate loans, and banks originate a higher share of adjustable-rate loans than other lenders. Researches on interest rate risk considering more than enterprise factors are also made by some scholars recently. Reference [5] argues both firm and country characteristics affect the way corporate financial distress in five East Asian countries. It shows that the ownership of corporations by financial institutions varies considerably across firms and from country to country, so do different countries' institutional frameworks for resolving financial distress. In China, Li Chao (2009) constructs an anti-risk capability evaluation index system to evaluate the listed companies in communication equipment industry. These studies extend financial ratios to assess interest rate risk and inspire further research in this area.

Several kinds of interest rate risk ratios are used to assess interest rate risk in the existing literature. Due to data limitation and simplicity, we only examine times interest earned (hereafter TIE) (or interest protection multiples, interest coverage) in this paper. TIE is a measure of a company's ability to honor its debt payments[*]. Claessens, Djankov, and Klapper (2003) classify a firm as financially distressed if its TIE is less than the conventional ratio of 1, which is used most often by academics and practitioners. Typically it is said to be a warning sign when interest coverage falls below 2.5. TIE can be calculated as follows:

$$\text{TIE} = (\text{EBIT or EBITDA})/\text{Interest Charges} \quad (1)$$

Where EBIT represents earnings before interest and taxes; and EBITDA represents earnings before interest, taxes, depreciation and amortization.

3 Data and Methodology

3.1 Data Selection

According to Guidance on the Industry Classification of Listed Companies issued by China Securities Regulatory Commission in 2001, manufacturing sector consists of 28 industries. We select samples of listed companies within these industries from 2006 to 2008. Then we calculate TIE according to (1). Because financial sheet of listed company in China doesn't specifically list interest charges, we use financial expenses as substitution for interest charge since interest charges usually represent a significant proportion in financial expenses. The selection rules are as follows: first, we select listed companies appear on A-share market before January 1st, 2006, with Special Treatment stock excluded. Second, considering economic implication, we exclude those with negative numerator or negative denominator in (1), since interest charge being negative means the company has interest income inflow and doesn't expose to any interest rate risk, while negative EBIT or EBITDA means the company has already suffered from financial distress. We also exclude extreme values of TIE above 100. Finally, we only keep those industries with more than five listed companies, for the purpose of applying nonparametric approach to examine the effect of industry. We construct a database with 402 listed companies of 20 manufacturing divisions. Data description will be presented in the next section.

[*]wikipedia : http://en.wikipedia.org/wiki/Times_interest_earned.

3.2 Nonparametric Approach

In order to find out whether there is industry effect in interest rate risk across Chinese manufacturing sector, we apply a nonparametric approach called Kruskal-Wallis H test to examine TIE across the sector. We don't use parametric test like one-way ANOVA because it expects samples distribution to be normal and variance to be homogeneous, which our samples don't fit. For example, the null hypothesis that samples of 2006 come from a normal distribution are tested using one-sample Kolmogorov-Smirnov Test. We get a Kolmogorov-Smirnov Z value 4.681, with the two-tailed significance of the test statistic being very small (0.000), meaning it is significant. Thus, we reject the null hypothesis. As for the test of homogeneity, the resulting p-value of Levene's test （0.000）is less than some critical value (typically 0.05), thus, the null hypothesis of equal variances is also rejected and it is concluded that there is a difference between the variances in the population. Kruskal-Wallis H test is a nonparametric method for examining equality of population medians among groups and doesn't have to assume a normal distribution and homogeneous variance. Practical example of this method can refer to [10].

In order to test the stability of industry effect, we use Kendall's concordance coefficient for three years' test and Spearman's rank correlation for two years' test. The results will be shown in the next section.

4 Empirical Results

In this section, we describe the data and draw a conclusion about the characteristics of TIE. Then, we apply a nonparametric approach to sort out the industry effect, as well as the stability of this effect, in affecting the interest rate risk across the manufacturing sector.

4.1 Data Description

Data description is presented in table Ⅰ. After excluding all extreme values, still, we observe that minimum value and maximum value vary significantly in each industry, for example, the greatest range reaches 87.26 in Medicines Manufacturing industry, indicating the industry effect is not straightforward, and should be examined using more scientific and rational methods.

On the mean level, TIEs of Special Purpose Equipment Manufacturing, Medicines Manufacturing, and Smelting and Pressing of Nonferrous Metals make the top three, while TIEs of Paper-making and Paper Products Manufacturing, Garments and other Fiber Products Manufacturing, Nonmetal Mineral Products Manufacturing are the last three. After sorting all mean values, we would further notice that TIEs of light industries generally tend to be smaller than those of heavy industries, that is to say, in general, light industries seem more vulnerable to interest rate risk than heavy industries in China. Traditionally, light industries are said to be less capital intensive than heavy industries, so some people may come to the illusion that light industries bear less interest charges and less interest rate risk. However, our results indicate that they also generate fewer earnings to cover their interest charges than heavy industries, as a result, they expose to larger interest rate risk.

4.2 Nonparametric Tests on TIE

Our first null hypothesis is that there is no industry effect in TIE across the manufacturing sector, that is to say, there is no statistically significant difference in nonparametric test. We apply Kruskal-Wallis H test described in the previous section to examine TIE of each year. Test statistics are shown in table II. If we declare critical

Table 1. Description of TIE Across Manufacturing Sector in China (2006-2008)

Industry	Statistic					
	N [b]	*Mean*	*Median*	*Minimum*	*Maximum*	*Std. Error of Mean*
I1[a]	14	5.1478	3.3698	0.66	24.79	0.75324
I2[a]	13	6.4696	4.9480	1.73	20.96	0.72678
I3[a]	20	6.0718	3.4922	0.26	44.00	1.04203
I4[a]	7	8.1685	3.3426	0.12	37.76	2.24429
I5[a]	12	2.7418	2.3458	0.40	6.42	0.25134
I6[a]	7	4.1983	3.1096	1.07	14.69	0.77860
I7[a]	51	6.2652	4.0791	0.35	48.72	0.57416
I8[a]	7	4.4254	2.4023	0.05	16.24	0.95361
I9[a]	10	3.8539	3.1437	0.18	11.64	0.52307
I10[a]	16	5.2627	4.6162	1.43	27.28	0.61783
I11[a]	25	4.3094	3.1044	1.07	31.25	0.51000
I12[a]	21	5.8944	4.3971	1.02	21.22	0.58533
I13[a]	19	8.9370	5.4261	0.97	40.34	1.23086
I14[a]	9	7.0752	3.2513	0.58	52.07	1.95176
I15[a]	24	7.4969	4.1694	0.11	83.95	1.33589
I16[a]	27	10.5938	5.4311	0.79	70.25	1.39509
I17[a]	33	6.3641	3.8176	0.68	37.11	0.70875
I18[a]	26	7.1341	4.4963	1.17	77.53	1.16888
I19[a]	8	4.5333	3.1954	0.48	13.41	0.70938
I20[a]	53	9.0375	3.7114	0.68	87.94	1.10023

a. I1~I20, respectively represents: I1 = Food Processing; I2 = Beverages Manufacturing; I3 = Textile Industry; I4 = Garments and other Fiber Products Manufacturing; I5 = Paper-making and Paper Products Manufacturing; I6 = Petroleum Processing, coking & Nuclear Fuel Processing; I7 = Raw Chemical Materials and Chemical Products; I8 = Chemical Fiber Manufacturing; I9=Plastic Products Manufacturing; I10 = Communication Equipment, Computer and Other Electronic Equipment Manufacturing; I11 = Nonmetal Mineral Products Manufacturing; I12 = Smelting and Pressing of Ferrous Metals; I13 = Smelting and Pressing of Nonferrous Metals; I14 = Metal Products Manufacturing; I15 = General Purpose Equipment Manufacturing; I16 = Special Purpose Equipment Manufacturing; I17 = Transportation Equipment Manufacturing; I18 = Electric Equipment and Machinery Manufacturing; I19 = Instruments, Meters, Cultural and Office Equipment; I20 = Medicines Manufacturing.

b. N represents numbers of listed companies' in each sector.

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Table 2. Kruskal-Wallis Test

Test Statistics	Year		
	2006	2007	2008
Chi-Square	36.740	32.520	32.642
df	19	19	19
Asymp. Sig.	0.009	0.027	0.026

Table 3. Stability Tests of Industry Effect

Test Statistics	Variables			
	2006,2007,2008	2006,2007	2007,2008	2006,2008
Coefficient	0.113[a]	0.756[b]	0.603[b]	0.436[b]
Asymp. Sig.	0.000	0.000[c]	0.000[c]	0.000[c]

a. Kendall's Coefficient of Concordance.
b. Spearman's rho Correlation Coefficient.
c. 2-tailed.

p-value to be 0.05, as is typically used, all three years' calculated p-value is smaller than the declared one. Thus, we reject the null hypothesis and conclude that there exists statistically significant difference in TIE across the manufacturing sector, which means that there is significant industry effect in interest rate risk among different industries. This finding has an important implication that industry factors should be taken into account when interest rate risk management policies are made.

In order to find out whether the industry effect is stable, we test the null hypothesis that the industry effect is unstable, using Kendall's concordance coefficient for three years' test and Spearman's rank correlation for two years' test. The results are summarized in table III. The coefficient and asymptotic significance show that, statistically, there exists correlation in the tested variables, especially in two successive years, such as Spearman's correlation coefficients of 2006 with 2007 and 2007 with 2008 reach 0.756 and 0.603 respectively. Nonetheless, the correlation is rather subtle among more than two years, for example, three years' Kendall's coefficient of concordance is only 0.113, far from the complete correlation value of 1. To be specific, the industry effect is quite stable in two successive years, but it appears to be unstable over a long time, so the challenge may be greater to make long term interest rate risk management policy considering the industry effect instability. Further research on interest rate risk concerning more related effects may fruitfully proceed in applying methods used in this article.

5 Conclusion

This paper focuses on the interest rate risk in Chinese manufacturing sector. We use Times Interest Earned as an indicator of interest rate risk and analyze it on the industry level. Our results show that light industries are bearing more interest rate risk than heavy industries. Industry effect affecting the interest rate risk is examined using a nonparametric approach.

Generally, interest rate risk varies across the Chinese manufacturing sector significantly, which here we call industry effect. Further investigation shows this effect is quite stable in two successive years, but it appears to be unstable over a long time, posing a greater challenge to make long term interest rate risk management policy considering the industry effect instability.

More work has yet to be done to sort out some specifically- related effect in interest rate risk. The method we apply in this paper may be of some help for further research

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