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The Cross-market Effects of Stock Market System Risk Factors on the Corporate Bond Pricing: Empirical Study Based on the Panel Data Model

LES EFFETS DE LA CROIX-MARCHE DES FACTEURS DE RISQUES DE MARCHE STOCK SUR LE SYSTEME DE TARIFICATION CORPORATE BONDÉTUDE D'EMPIRIQUE FONDEE SUR LE MODELE DE DONNEES EN PANEL

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Abstract
The research in capital asset pricing focuses on the pricing within the market, and the research on cross-market pricing are relatively small. Using corporate bonds in Shanghai and Shenzhen Stock Exchange from January 1st, 2001 to March 31st, 2010 as the sample, this paper investigates the cross-market effects of stock market system risk factors on the corporate bond pricing in China. The results shows that in the longer term and the lower the credit rating of corporate bonds, the stock market system risk factors receive higher risk compensation; system risk factors of stock market have strong cross-market effects on corporate bond yields; bond pricing structure model variables and target firm characteristics variables significantly affects the bond yield spreads.
Key words: Systematic risk factor; Cross-market; Pricing; Corporate bonds
Résumé
La recherche en matière de tarification des immobilisations se concentre sur les prix dans le marché, et la recherche sur la croisée du marché de prix sont relativement faibles. Utiliser des obligations d'entreprises à Shanghai et à Shenzhen Stock Exchange du 1er Janvier 2001 au 31 Mars 2010, comme l'échantillon, cette étude examine les effets croisés de marché des facteurs de risque de marché d'actions sur le système de fixation des prix des obligations d'entreprises en Chine. Les résultats montrent que dans le long terme et la baisse la cote de crédit des obligations de sociétés, les facteurs de risque du marché actions du système recevoir une indemnisation plus élevée de risque, les facteurs de risque du système des marchés boursiers ont fortement effets croisés sur les rendements des obligations d'entreprises; modèle de la structure des prix obligataires variables et les variables caractéristiques de l'entreprise cible affecte de manière significative les écarts de rendement obligataire.
Mots clés: Facteur de risque systématique; Croix-marché; Tarification; Obligations de sociétés

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INTRODUCTION
How important do the systematic risk factors of stock market affect corporate bond yield spreads? The structural model of corporate bond pricing suggests that the effects of the system risk factors are small, and the characteristics of firm and the issuer are important determinants of bond pricing. The structural model can effectively explain the value of corporate debt and yield spreads. However, the research of King and Khang (2005), Bakshi, Madanand and Zhang (2006) shows that systematic risk factors of stock market significantly affect the expected corporate bond spreads. Therefore, Understanding the effects of systemic risk factors on the bond yield spread of corporate bond is important for the rational pricing of corporate bonds.

Through researches the spreads between corporate bonds and government bond, Elton et al (2001) find that

the systematic risk factors of stock market play a decisive role in the decision of bond spreads. In particular, they find that the yield spreads primarily depends on three factors: the likelihood of default, tax differences between corporate bonds and government bonds and the systematic risk factors of stock market. Through the cross-sectional regression of bond yield spreads on systematic risk factors, they think that systematic risk factors are most important factors in determining corporate bond yield spreads. These research results contradict to structure model of corporate bond pricing. Collin-Dufresne et al (2001) find that corporate bond yield spreads is linked to the changes of corporate bond markets, and corporate bonds cannot be replicated using a position in the underlying firm's equity and risk-free bonds and therefore cannot be completely hedged. Eom, Helwege and Huang (2004) empirically examine five structure models of corporate bond pricing: Merton (1974), Geske (1977), Lonstaff and Schwartz (1995), Leland and Toft (1996), Collin-Dufresne et al (2001). The results show that all the models have forecast errors and tend to underestimate the yield spreads of safe corporate bonds (small leverage and asset volatility) or overestimate the yield spreads of risky bonds.

The researches of Chinese scholars is focused on single market (stock or bond market) pricing, and is lack of cross-market pricing effects of systematic risk factors. Moreover, compared with foreign capital markets in developed countries, Chinese capital market is not mature, too small, and with a special background. Therefore, this paper empirically analyzes the cross-market pricing impacts of systematic risk factors of stock market on corporate bonds. This paper selects three Fama-French factors as a proxy for systematic risk factors of stock market to examine the cross-market pricing impact and to examine whether Fama-French factors can gain cross-market risk premium. Empirical results show that Fama-French factors can gain cross-market risk premium and systematic risk factors of stock market significantly impact on corporate bond yield spreads.

The rest of the paper is structured as follows. Section 2 describes the sample and data. Section 3 empirically analyzes the cross-market pricing impact of systematic risk factors of stock market on corporate bonds. Section 4 examines robustness. Section 5 is the research result.

1. SAMPLE AND DATA

This paper selects corporate bonds in Shanghai and Shenzhen Stock Exchange from January 1st, 2001 to March 31st, 2010 as research sample. After excluding bonds issued by non-listed companies, there are 36 bonds, and there are a total of 4924 sets of data, from the RESSET Financial Research database.

Table 1 presents the descriptive statistics of corporate bonds. From the first part of Table 1, we can see that the average coupon rate is 6.89%, the average issuance size is 19.403 Billion yuan, and the average maturity period is 6.002 years. The second part of Table 1 shows that the average nominal interest rate from 2001 to 2005 is 0.59% higher than that from 2006 to 2010, indicating that financing costs of our enterprises is higher from 2001 to 2005. The main reason is that the issuance size is larger and the average maturity is longer. Therefore, the corresponding nominal interest rate is higher during the period. This is consistent with Junbo Wang and Chunchi Wu (2008).

Table 1
Descriptive Statistics

Variable	Mean	Std error	Medium	Maximum	Minimum
Panel A: Full sample					
coupon(%)	6.89	1.12	6.65	9.00	3.87
size(Billion yuan)	19.403	11.396	15.000	43.000	5.000
maturity(year)	6.002	2.169	5.153	9.997	1.986
Panel B: Subsample					
Interval 1: 2001-2005					
coupon(%)	7.32	1.15	7.13	9.00	4.05
size(Billion yuan)	21.387	11.465	14.000	40.000	10.000
maturity(year)	6.493	1.964	7.640	10.000	2.912
Interval 2:2006-2010					
coupon(%)	6.73	1.26	6.73	8.20	3.87
size(Billion yuan)	17.411	10.974	15.000	43.000	5.000
maturity(year)	5.718	2.414	4.484	9.899	1.986

Table 2 describes the average return of different credit ratings and different maturities of corporate bonds in different samples. Table 2 shows that the return of corporate bonds increases with maturity increasing, and declines with the credit ratings increasing in full samples. By comparison of subsample, we can see that corporate bond return is higher before 2005, mainly due to the liquidity of corporate bonds is worse before 2005, and liquidity risk need to be compensated. In addition, the return of credit rating of AAA-grade corporate bonds is

lower than the AA-grade, because the defaults of AA-grade corporate bonds are more likely to occur, so they require a higher risk premium.

Table 2
Average Return

maturity	Full sample: 2001-2010		Subsample 1: 2001-2005		Subsample 2: 2006-2010	
	AAA	AA	AAA	AA	AAA	AA
3	0.3532	0.3937	0.3893	0.4375	0.3285	0.3643
5	0.5120	0.5929	0.5684	0.6835	0.5028	0.5634
6	-	0.6104	-	0.6431	-	0.5989
7	-	0.7404	-	0.7207	-	0.7012
8	0.5992	0.7004	0.6025	0.7105	0.5733	0.6683
10	0.6259	0.7293	0.6449	0.7216	0.6047	0.6923
15	-	0.7638	-	0.7971	-	0.7176

2. EMPIRICAL ANALYSIS

2.1 Variable Selection

2.1.1 Dependent variable

Excess return (ExcessR): First of all, grouping corporate bonds according to bond rating and maturity, the same rating and maturity of the bonds are divided into one group, and calculate equal weighted average return of each group for each month. Then, calculate excess return for each group (ExcessR), namely: the return of each group minus the risk free rate. This paper selects the Shanghai and Shenzhen Stock Exchange three-month Treasury bond repurchase rate as the risk-free interest rate.

Yield spreads (Yldsprd): Bond return minus interest rates the closing of the same maturity Treasury bond.

2.1.2 Independent variable

Systematic risk factors: Fama and French (1993) studied the factors affecting the stock and bond return. They found that market factor, firm size and book value ratio are factors affecting stock return, and interest rate risk factors and credit risk factors affecting bond return. Fama and French (1996) proposed a three-factor model, and found that the market factor (MKT), firm size (SMB) and book value ratio (HML) can fully explain the cross-section of stock returns. An intuitive idea is that whether stock market risk factors have cross-market pricing effects, and have explanatory power for bond return. Therefore, this paper selects Fama-French three factors: market risk premium (MKT), firm size (SMB), book value ratio (HML) as a proxy for systematic risk factors.

Leverage ratio (Lev), asset return volatility (Vol), credit rating (Rat): Structural model shows that the default possibility of bond issuer is an important determinant of yield spreads. This paper selects leverage ratio, asset return volatility and credit rating as bond pricing structural model variables. Highly leveraged companies are more likely to default, requiring a higher credit spreads to compensate investors for credit risk. Leverage ratio is equal to the ratio of total liabilities to total assets value. Asset return volatility is positive related to credit spreads and higher volatility implies coupon and principal payments may not be timely repayment. We use Hamada's Equation to calculate asset return volatility, namely: $\sigma_A = (1-lev)\sigma_E + lev\sigma_D$, σ_E is equity volatility, σ_D is liabilities volatility. The higher the bond's credit rating, the lower the likelihood of default.

Maturity (Dur), coupon rate (Cou), bond issuance size (Bsiz), issued period (Age): These four variables are bonds characteristic control variables associated with yield spreads. If the coupon rate and maturity date of corporate bonds are the same, maturity is a factor affecting yield spreads. The analysis of Edwards, Harris and Piwowar (2007) shows that the coupon rate is positive related to credit risk and high coupon rate requires higher risk premium. Bond issuance size and issued period gain compensation by affecting liquidity of bonds, namely: liquidity premium.

2.2 Empirical Results

In order to study the effects of systemic risk factors on corporate bond yields, using the method of King and Khang (2005), this paper regress the excess return for each portfolio on the Fama-French three-factor (MKT, SMB, HML), and builds model as follows:

$$\text{Excess } R_i = \beta_0 + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \varepsilon_i$$

Table 3 lists the regression results of corporate bonds return of different maturity and different credit ratings on system risk factors. As can be seen from Table 3, coefficients of MKT, SMB and HML of AA-grade corporate bonds are greater than AAA-grade, indicating AA-grade bonds gain higher risk compensation. At the same time, corporate bonds of 3 years, 5 years and 8 years generally perform a good characteristics: the same credit rating of corporate bonds and the longer the maturity, the greater the coefficients of Fama-French risk factors; the same maturity of corporate bonds and the higher of credit rating, the coefficients Fama-French risk factors are smaller. This shows that corporate bonds of longer maturity and lower credit rating obtain higher compensation.

Table 3
Cross-market Risk Compensation of System Risk Factors

Maturity	Const	MKT	SMB	HML	Adj.R-square
Panel A: AAA bonds					
3	-0.0624	0.0813	0.0495	0.0934	0.2285
5	0.1163	0.09218	0.0985	0.1323	0.2849
8	0.1242	0.1204	0.1359	0.1638	0.3034
10	0.0296	0.1435	0.1818	0.1775	0.1985
Panel B: AA bonds					
3	-0.1338	0.0898	0.0627	0.1184	0.3103
5	-0.2457	0.1132	0.1019	0.1484	0.2932
8	0.0485	0.1301	0.1784	0.1889	0.3211
10	0.0313	0.1476	0.1729	0.1726	0.2192

Note: For comparison, Panel B doesn't list AA grade corporate bonds of 6, 7 and 15 years.

For further discussion, we introduce the Panel Data Model, select systematic risk factors, bond pricing structural model variables and characteristic variables of the target enterprise, and deeply analyze cross-market effects of systematic risk factors in stock market on corporate bond pricing. The Panel Data Model is as follows:

$$Yldsprd_i = \beta_0 + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \beta_4 Lev_i + \beta_5 Vol_i + \beta_6 Dur_i + \beta_7 Rat_i + \beta_8 Cou_i + \beta_9 Bsiz_i + \beta_{10} Age_i + \varepsilon_t$$

Table 4 presents the model estimation results for the full sample and the rating subsamples. In each case, we use two models to estimate. Model 1 only contains bond pricing structural model variables and characteristic variables of the target enterprise; model 2 contains all variables, including the Fama-French factors.

Seen from estimation results for the full sample, the adjusted R-square of model 1 is 0.347, so the model is well fitted. Each variable of bond pricing structural model and each characteristic variable of the target enterprise is generally significant; indicating that they can well explain bond yield spreads. The adjusted R-square of model 2 is 0.523, increasing by 17.6% than model 1, and the coefficients of Systematic risk factors are significant at 5% significance level, indicating that systematic risk factors have strong explanatory power on the bond yield spreads in China's bond market. Estimation results for the rating subsamples shows the adjusted R-square of model 2 increases by 21.1% and 10.3% than model 1, and the coefficients of systematic risk factors are generally significant. This indicates that systematic risk factors have strong impact on bond yield spreads. Thus, by adding bond pricing structural model variables and characteristics variables of the target enterprise, Fama-French three-factor has a good explanation for the bond yield spreads. The study concludes consistent with the Elton et al (2001).

Table 4
Cross-market Effects of System Risk Factors on Corporate Bonds Pricing

	full sample		AAA bonds		AA bonds	
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
MKT		2.243		1.762		2.63
		(5.83)**		(2.18)*		(6.42)**
SMB		1.185		0.141		0.926
		(4.47)**		(3.53)**		(1.83)
HML		1.372		1.573		1.159
		(2.03)*		(2.32)**		(1.97)*
Lev	0.353	0.438	0.217	0.204	0.301	0.283
	(2.78)**	(5.35)**	(2.01)*	(2.09)*	(2.58)**	(2.39)**
Vol	2.873	2.789	2.732	2.218	2.841	2.347
	(6.21)**	(7.86)**	(2.04)*	(1.63)	(2.47)**	(2.17)*
Dur	0.143	0.184	0.104	0.082	0.533	0.482
	(2.07)*	(2.06)*	(2.46)**	(1.32)	(3.54)**	(1.87)
Rat	0.212	0.184	0.102	0.118	0.327	0.424
	(13.52)**	(9.84)**	(1.35)	(1.02)	(2.12)*	(2.53)**
Cou	0.436	0.592	0.025	0.328	0.645	0.483
	(2.54)**	(3.48)**	(1.52)	(1.99)*	(2.09)*	(2.18)*
Bsiz	0.023	0.068	-0.015	-0.039	0.093	0.057
	(0.82)	(0.93)	(-0.29)	(-0.16)	(0.52)	(0.427)
Age	0.185	0.181	0.167	0.179	0.357	0.601
	(4.36)**	(3.92)**	(3.54)**	(3.28)**	(10.53)**	(13.92)**

To be continued

Continued

	full sample		AAA bonds		AA bonds	
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Hausman Test	33.72**	42.12**	38.65**	32.53**	11.53	27.48**
Individual Effect	Random	Random	Random	Random	Fixed	Random
Form	Effects	Effects	Effects	Effects	Effects	Effects
Adj. R-square	0.347	0.523	0.418	0.639	0.394	0.497

Note: The values in parentheses are t statistics, **,*, represents 1% (5%) significant level respectively. The same is in the following table.

As can be seen from Table 4, consistent with the bond pricing structural model, asset return volatility, leverage ratio, maturity, coupon rate and issued period are generally significant in the full sample, as well as the rating subsamples, and compared with AAA-grade, the coefficient of AA-grade bonds is greater, indicating these variables have greater impact on the yield spreads of AA-grade bonds, demanding higher risk compensation. The results show that the characteristics variables of the target enterprise have significant influence on bond yield spreads, and significantly impact China's corporate bond yield spreads.

3. ROBUSTNESS TEST

When time is different, the security market risk is different. According to Tang Hengzhao (2005)[14], Zhang Huilian (2009)[15], the Nontradable Shares Reform exacerbated the stock market risk. Therefore, using the year of Nontradable Shares Reform as the time point, we divide all bonds into two categories for robustness test, to examine the effects of systematic risk factors on bond yield spreads in different time periods. One is publicly traded bonds from 2001 to 2005, and the other is from 2006 to 2010.

Table 5
Robustness Test Results

	2001-2005		2006-2010	
Variable	Model 1	Model 2	Model 1	Model 2
MKT		3.384		4.216
		(3.52)**		(4.94)**
SMB		2.593		3.185
		(1.98)*		(2.83)**
HML		1.059		1.92
		(2.33)**		(2.17)*
Lev	0.431	0.727	0.328	0.485
	(2.31)**	(2.66)**	(2.29)**	(2.04)*
Vol	2.483	2.962	2.144	1.817
	(3.68)**	(2.37)**	(2.95)**	(2.13)**
Dur	0.137	0.295	0.252	0.219
	(2.49)**	(3.57)**	(1.56)	(1.33)
Rat	0.281	0.192	0.397	0.702
	(8.73)**	(5.63)**	(6.43)**	(9.56)**
Cou	0.195	0.271	0.203	0.318
	(1.97)*	(2.04)*	(2.08)*	(2.37)**

To be continued

Continued

	2001-2005		2006-2010	
Variable	Model 1	Model 2	Model 1	Model 2
Bsiz	0.188	0.179	0.209	0.197
	(1.08)	(1.47)	(2.17)*	(1.53)
Age	0.939	0.852	0.781	1.163
	(4.92)**	(3.64)**	(3.29)**	(5.41)**
Hausman Test	25.84**	36.53**	26.34**	31.82**
Individual Effect	Random	Random	Random	Random
Form	Effects	Effects	Effects	Effects
Adj. R-square	0.392	0.517	0.416	0.584

Table 5 lists robustness test results. Consistent with the third part, model 1 only contains bond pricing structural model variables and characteristic variables of the target enterprise; model 2 contains all variables, including the Fama-French factors. In the two sub samples, the adjusted R-squares of model 2 increase by 12.5% and 16.6% than model 1, Fama-French three-factor coefficients are significant at the 5% level, indicating that systematic risk factors have stronger impact on bond yield spreads. The results show that the conclusions of this paper have good robustness.

CONCLUSION

This paper uses corporate bonds in Shanghai and Shenzhen Stock Exchange from January 1st, 2001 to March 31st, 2010 as the sample, to empirically study the cross-market effects of stock market system risk factors on the corporate bond pricing in Chinese immature stock and bond of markets. By the regression analysis of excess return for each portfolio on the Fama-French three-factor, we find that with maturity increasing and credit rating reducing, Fama-French three-factor gain higher compensation. By introducing panel data model, we find that systematic risk factors in stock market have strong explanatory power on the corporate bond yield spreads, and have significant cross-market effects on corporate bonds pricing. Moreover, the bond pricing structural model variables and characteristic variables of the target enterprise also significantly affect bond yield spreads. Therefore, we should consider the impact of systematic risk factors in stock market when pricing corporate bonds in China.

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