The Influence of Size and Value Factors on Corporate Bond Spread Yields in China

Huang Jiemin

Abstract—**This paper selects weekly transaction data from the Shenzhen Exchange and Shanghai Exchange for 2012 to 2018 to investigate factors including corporate size, the ration of book-to-market, default risk, term and credit rating that influence the corporate bond spread. It can be concluded that small firms prefer to issue high yield spread bonds while large firms issue bonds with low yield spreads. High (low) book-to-market firms issue high (low) yield spread bonds. The most important factors influencing corporate bond spread yield are default risk, terms, and credit ratings. We suggest that China Securities Regulatory Commission should encourage small firms to issue corporate bonds and there should be more kinds of credit ratings bonds in China bond market.**

Index Terms—**Corporate bond spread, corporate size, equity market, default risk**

I. Introduction

Some scholars investigate the influencing factors of corporate bond spreads. Fama and French (1993) identify five common factors that explain bond returns [1]. Three factors i.e. whole market factor, corporate size and ratio of book-to-market are from equity market. Default risk and maturity from bond market are other factors. King and Khang (2005) use corporate bonds data between January 1985 and March 1998 to test the equity market factors that explain corporate bond yield spread variation. If the influence from default risk is excluded, they find bond β or equity market risk is not enough to illustrate the sensitivity in bond returns. Additionally, they find that the system factor has limited explanatory power [2].

Some studies research influence from default on corporate bond spread. Using panel data, Gemmill and Keswani (2011) find that default losses cause the spreads of most corporate bond. They consider downsize risk in their model, but the systematic risk factor contributes little [6]. They conclude corporate bond spread is strongly correlated to idiosyncratic risk and bond spread is correlated with equity idiosyncratic risk and bond idiosyncratic risk value. The yield spread relating to corporate and liquidity could be explained by bond idiosyncratic risk. If bond idiosyncratic risk increases, it will entail corporate value therefor the bond spread will also increases. Avramov, Jostova and Philipov (2007) explain corporate credit risk variation by a structural model. 54% of the credit spread variation could be explained by common factors and basic corporate factors. Schaefer and Strebulaev (2008) find credit risk structural model poorly forecast bond value of, but it can forecast the sensitivity between corporate bond returns and equity value variation precisely [5]. Additionally, it is tested the relation between corporate bond prices and market factors. Huang and Huang (2002) investigate how much the spread of corporate bond is influenced by credit risk with a default factor structural model. They find that the credit spread play a small role in short-term bonds but plays an important role in junk bonds [7]. Gebhardt and Hvidkjaer (2005) find that bond returns are strongly related to the possibility of default. Only maturity is correlated with bond returns if default risk and term are excluded [8]. They also find that the system risk affect corporate bonds spread. Dionne et al. (2010) show that default risk affects the spread of corporate bond, and it is a great finding in the literature studying credit risk [9]. They calculate default probability and find the high sensitivity between corporate bond default risk and former default probability term structure. Giesecke et al. (2011) study the data during the period from the year of 1866 to the year of 2008 to investigate the default probability of corporate bond. It is found that repeated default events do more harm to corporate bond market than the Great Depression. They find that the overall default was approximately 36% of the corporate bond market in the 1873-1875 railway crisis. They use regime switching model to test whether it is possible to forecast the default [10]. They find that not only equity returns, but also equity volatility and GDP variation are effective to predict, but the credit spread is not among them. In the long term, they find that the credit spread is double of default loss, and approximately 0.8% of credit risk premium is caused by credit spread . The credit spread does not correspond to the real default probability. Longstaff et al. (2005) measure the factors influencing corporate bond spread including default and other factors. They find default risk is the strongest factor influencing corporate bond spread and the conclusion is significant to the bonds of different credit rating and risk-free yield curve. Neri (2012) shows how they apply L-FABS in learning scenarios of partial or full knowledge approximate financial time series [12].

Additionally, some scholars study bond return volatility. Bao and Pan (2008) use the Merton model of corporate bonds to examine bond volatility. They use cross-sectional daily, weekly and monthly corporate bond returns from the year of 2002 to the year of 2006 and find that default model can not illustrate most of the bond volatility. When the daily and weekly volatilities are larger, the short-term liquidity in corporate bonds becomes important. The monthly extra volatility decreases, but it is still significant. Furthermore,

Manuscript received 25th August, 2020; revised 20th December, 2021. This work was supported by the Guangdong Social Science Foundation of China (grant No. 2017WT034)

Jiemin Huang is an associate professor in School of Finance and Economics, Shenzhen Institute of Information Technology, Shenzhen, P.R. China. She also is a post-doc in School of Economics and Management, University of Electronic Science and Technology of China, Chengdu, P.R. China; E-Mails: huang_jiemin819 @126.com.

they find if they want to illustrate cross-sectional volatility t liquidity is an essential factor [3].

Most of existing literature studies corporate bond spread and investigate the Fama-French (FF) factors in equity market, default risk and credit risk. Using 10 stocks on the Shanghai Stock Exchange, Shi et al. (2008) analyses the relationship among four factors which are the ratio of debt-to-equity and book-to-market, equity investment risk and corporate size [13]. They find β, corporate size and other factors determined the value of equity investment risk. After evaluating the performance by three FF factors, Tu and Zhu (2008) find that the FF factors are significant [14].

Our study investigates corporate bond spread with four FF factors in returns of equity and bond such as SMB (small-minus-big portfolio) and HML (high-minus-low portfolio). We also take default risk factor, maturity factor, and credit rating into consideration as dummy variables to analyse the robustness of our model.

II. Data and variables description

A. Data description

Bond transaction data was recorded from the year of 2007 in Shanghai Stock Exchange and 2008 in Shenzhen Stock Exchange. In order to get continuous transaction data from the Wind database with interest rate, weekly transaction data of about 50 corporate bonds from the year of 2012 to the year of 2018. We obtain data Following Duffee (1998), the bonds are divided into short-term bonds (two to seven yr maturity) [15-19], medium bonds (seven to ten yr maturity) and long-term bonds (longer than ten yr). In China, short- and medium-term bonds are dominant, and few are long-term. We also divide the bonds into three groups (aa,aa+ and aaa) by their ratings.

B. Variables description

(1) Corporate bond spread. t Corporate and treasury bonds which maturities, values date and delivery dates are similar are selected. We measure bond spreads by the return difference. Here spread denotes corporate bond spread.

(2) HMLe and SMBe. HMLe denotes the ratio of book-to-market in the FF three-factor model in equity market from which we exclude the factor of corporate size. SMBe denotes the factor of corporate size in the equity market where we do not consider the influence from the factor of ration of book-to-market.

The factors are defined as following.

Size means firm size. The value of firm size during the period of July in year t to June in year t+1, *I* is the market value in June in year t. For example, during the period of 1 January 2018 to 30 June 2018, the weekly value of firm size is the market value on 30 June 2018. During the period of 1 July 2018 to 30 June 2018, the value of the firm size is the market value on 30 June 2018.

Weekly BE/ME of stock i during the period of July in year t to June in year t+1 is the ratio of book value of equity to its market value at the end of year t-1. For example, the weekly value during of 1 January 2018 to 30 June 2018 is the ration of equity book value to the market value on 31 December 2018.

Then, firms are ranked by the firm size. The top half are small corporations, and the bottom half are considered large firms. We sort the B/M values from small to big. Top 30% are defined as low B/M, bottom 30% are high B/M, and others as medium B/M firms. We divide the firms into six groups by their size, which are S/L, S/M, S/H, B/L, B/M and B/H. The S/L group denotes small and low B/M firms, the S/H group denotes the small and high B/M firms, and the remaining four groups are similarly defined. Using the formulas below, we calculate the variables SMBe and HMLe as follows.

$$SMB=(S/L+S/M+S/H)/3-(B/L+B/M+B/H)/3 \quad (1)$$

$$HML=(S/H+B/H)/2-(S/L+ B/L)/2 \quad (2)$$

(3) HMLb and SMBb. HMLb represents the FF three-factor model in the bond market. HMLb is the ratios of book to-market ratio which the influence form firm size in bond market is not taken into consideration. SMBb is the corporate size, which the influence from the ration of book-to-market in bond market is not taken into consideration. The fomula of HMLb and SMBb are similar to those of HMLe and SMBe.

(4) DEF represents the factor of default. DEF equals the difference of return between long-term corporate bond and treasury. We select 15-yr maturity China railway corporate bonds and 50-yr maturity treasury bonds.

(5) TERM. It means the difference between long-term treasury bond returns and monthly treasury rates. We choose 50-yr maturity treasury bond with annual deposit rate because there is no monthly treasury rate in China.

(6) Dummy variables. We divide the samples into three groups of AAA, AA+ and AA according to their ratings. The bond rating is regarded as dummy variables.

III. Basic hypotheses

We propose several hypotheses. First, SMBe is the firm size factor that excludes the factor of BE/ME factor. It means the returns difference between small firm and large firm in equity market. Smaller the firm is, higher the return is because the default risk and credit risk of small firms are higher than large firms. As a result, investors need a larger risk premium.

Hypothesis 1: SMBe moves in same direction of the corporate bond spread.

The factor of size is excluded from HMLe. HMLe means the return gap of high and low B/M corporate stock. The returns of high B/M developing corporations are higher than low B/M mature corporates because high B/M developing corporations develop rapidly but they are immature and face more risk. Therefore the returns are higher. Low B/M mature corporations develop steadily and maturely, and they face less risk, so the returns are lower.

Hypothesis 2: HMLe is moves in same direction of corporate bond spread.

SMBb means f firm size. It means the return difference between small and large corporate bond. The default risk from small firms are higher than from large firms, so higher returns are required from small firms.

Hypothesis 3: SMBb moves in same direction of corporate bond spread.

HMLb means the return gap of high and low B/M corporate bond. The returns of higher B/M growing firms are higher than lower B/M mature firms because high B/M growing firms develop rapidly, but immaturely, and the risk is higher.

Hypothesis 4: HMLb moves in same direction of corporate bond spread.

If default risk (DEF) increases, bond returns should be higher because higher premiums will be required by investors. In developed markets, bonds are variable and the factor of default is an important factor to affect bond spread. But in mainland of China most of the bonds are high credit ratings and few bond defaults. Until recently, only one firm default and the guarantor pay the debts.

Hypothesis 5: DEF moves in same direction of firm bond spread.

Longer the maturity of the bond is, larger the face is and higher risk premium is required by investors.

Hypothesis 6: TERM is moves in same direction of corporate bond spread.

The credit risks of higher ratings are lower and the credit spread is also lower.

Hypothesis 7: Bond ratings moves in opposite direction of corporate bond spread.

IV. Empirical analysis

A. *Description of statistics*

From table 1 we find the descriptive statistics of the corporate bond spread, SMBe, HMLe, SMBb, HMLb, DEF and TERM.

Table 1 Panel data descriptive statistics

variables	mean	std	min	max
SPREAD	2.5377	1.2244	-7.0406	7.2756
SMB_e	0.7316	0.3979	-0.3272	1.4990
HML_e	-1.0592	0.2142	-1.3418	-0.2896
SMB_b	0.1037	1.3899	-2.5720	3.6659
HML_b	0.3067	2.3865	-4.3355	7.2568
DEF	-0.0019	0.0280	-0.0514	0.0500
TERM	1.0037	0.0557	0.8997	1.1023

B. *Series correlation test and stationary test*

(1) Correlation coefficient matrix

From table 2, we can find that the spread moves in the same direction of SMBe and the correlation coefficient is 0.3608, and moves in the opposite direction of spread and the correlation coefficient is -0.1235. SMBe and HMLe moves in the opposite direction of and the correlation coefficient is -0.4415. SMBb is negative correlated with HMLb, DEF, and TERM, with correlation coefficients of -0.2034, -0.2406 and 0.2383, respectively; and DEF is negatively correlated with TERM with a correlation coefficient of -0.9994.

Table 2 Correlation coefficient matrix

	SPREAD	SMB_e	HML_e	SMB_b	HML_b
SPREAD	1.0000				
SMB_e	0.3608	1.0000			
HML_e	-0.1235	-0.4415	1.0000		
SMB_b	0.0311	-0.0147	0.1268	1.0000	
HML_b	-0.0279	-0.0904	-0.0483	-0.2034	1.0000
DEF	-0.0136	-0.0426	-0.1026	-0.2406	-0.0981
TERM	0.0144	0.0417	0.1117	0.2383	0.1095

	DEF	TERM
DEF	1.0000	
TERM	-0.9994	1.0000

(2) Stationary test

Table 3 Unit root test

	SPREAD	SMB_b	HML_b	SMB_e	HML_e
LLC	-7.041***	-77.67***	-5.07***	10.69	-5.07***
IPS	-5.359***	-73.13***	-12.3***	13.9	-12.3***
ADF	224.47***	2484.0***	339.1***	3.68	339.1***
PP	300.86***	2518.1***	322.6***	1.86	322.6***

	DEF	TERM
LLC	-52.4***	-54***
IPS	-46.5***	-47***
ADF	1682***	1686***
PP	1683***	1687***

In Table 3, the SPREAD, SMBb, HMLb, HMLe, DEF and TERM variables are significant at the 1% significance level. They appear to be stationary. The SMBe variable does not appear to be stationary. Therefore, we take the logarithm of the SMBe series and obtain a new variable, LSMBe.

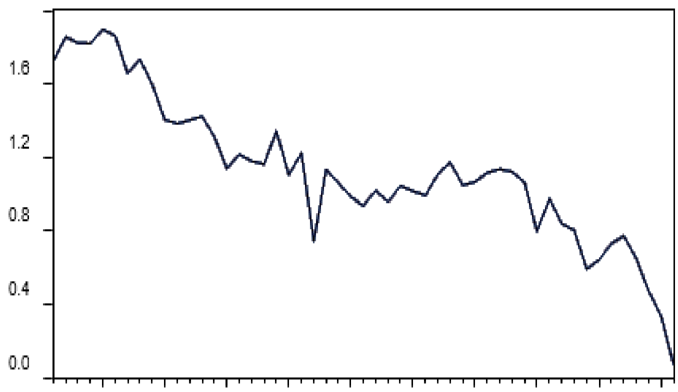

Figure 1 SMBe

In Figure 1, horizontal axis represents covered period which is 51 weeks, and vertical axis represents the values of SMBe. The series has a time trend.

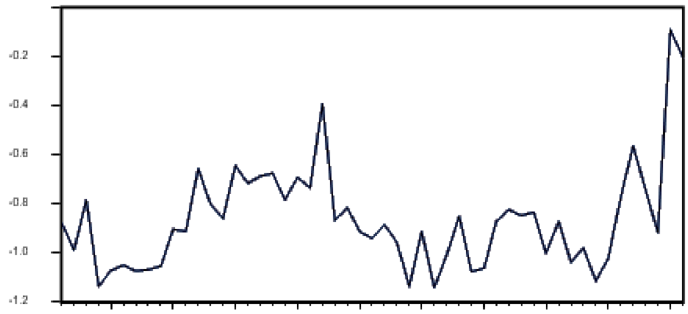

Figure 2 HML_e

In Figure 2, horizontal axis represents covered period which is 51 weeks, and vertical axis represents the values of HMLe. The HMLe series is stable.

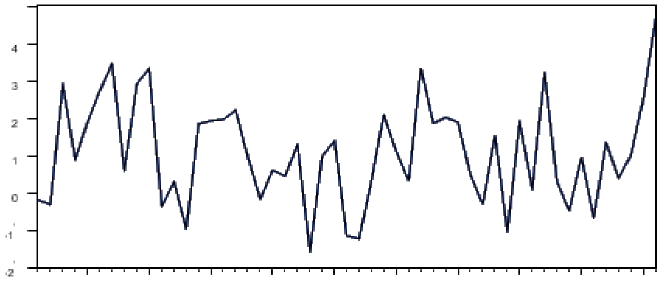

Figure 3 SMBb

In Figure 3, horizontal axis represents covered period which is 51 weeks, and vertical axis represents the values of SMBb. The SMBb series is stable.

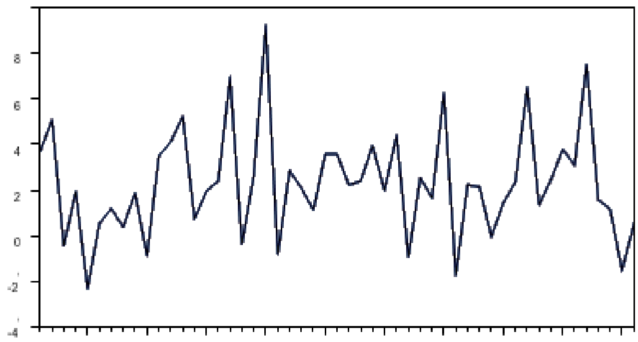

Figure 4 HMLb

In Figure 4, horizontal axis represents covered period which is 51 weeks, and vertical axis represents the values of HMLb. The HMLb series is stable.

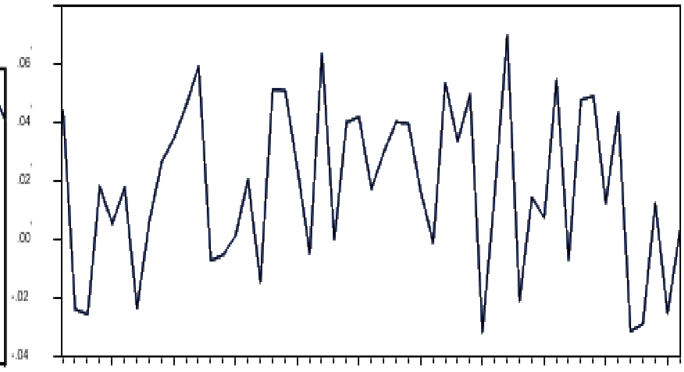

Figure 5 DEF

In Figure 5, horizontal axis represents covered period which is 51 weeks, and vertical axis represents the values of DEF. The DEF series is stable.

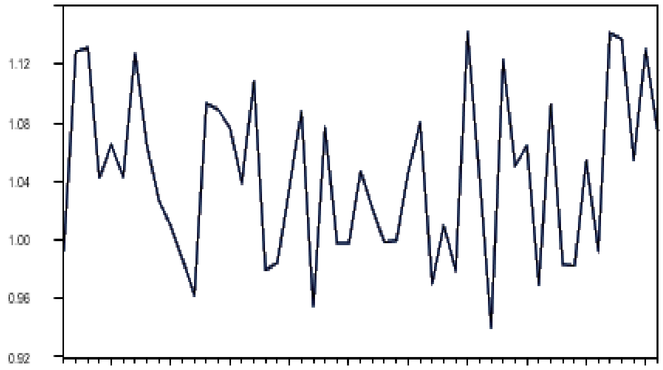

Figure 6 TERM

In Figure 6, horizontal axis represents covered period which is 51 weeks, and vertical axis represents the values of TERM. The TERM series is stable.

C. Model selecting

(1) Fixed effects test within the groups

In following table, we find that F(6,2586) =187.53 and this means that if significance level is set at 1%, it will be significant . The result of F(53,2586)=132.21 indicates if significance level is set at 1% the fixed effect model will be significant. If significance level is set at 1% all the coefficients of the variables will be significant.

Table 4 Fixed effect test results within groups

variables	Coef.	Std.	t	prob
$LSMB_e$	0.6217***	0.0206	30.17	0.000
HML_e	-0.230***	0.0748	-2.94	0.003
SMB_b	0.0244***	0.0092	2.65	0.008
HML_b	-0.016***	0.0055	-2.97	0.003
DEF	71.542***	13.597	5.26	0.000
TERM	36.313***	6.8462	5.30	0.000
constant	-33.73***	6.8664	-4.91	0.000
F(6,2586)		187.53***		
F(53,2586)		132.21***		

(2) Random effect test

In following table we can find that LR $\chi^2(6)$ = 936.31 and this means that if significance level is set at 1% the variables will be significant. Also we find that $\chi^2(01)$ = 3151.25, which indicating if significance level is set at 1% the random effect model will be significant. What's more if significance level is set at 1% the coefficients of the variables will be significant.

Table 5 LM random effect test results

variables	Coef.	Std.	t	prob
$LSMB_e$	0.6217***	0.0206	30.20	0.000
HML_e	-0.230***	0.0747	-2.94	0.003
SMB_b	0.0244***	0.0092	2.65	0.008
HML_b	-0.016***	0.0055	-2.97	0.003
DEF	71.542***	13.582	5.27	0.000
TERM	36.313***	6.8383	5.31	0.000
constant	-33.73***	6.8597	-4.92	0.000
LR chi2(6)		936.31***		
$\chi^2(01)$		3151.25***		

Table 6 Breusch and Pagan LM test

	var	sd = sqrt(Var)
SPREAD	1.391654	1.179684
e	0.3434313	0.5860302
u	0.919599	0.9589572
$\chi^2(01)$	33361.84***	

$$spread[id,t] = Xb + u[id] + e[id,t] \quad (3)$$

Table 6 shows results for tests of the random effect model. The result of χ^2 (01)= 33361.84 indicates that the random effect model is significant at the 1% significance level.

(3) Hausman test

From following table we find p=1. We accept the null hypothesis that the individual effect is not correlated with dependent variables. We add dummy variables of credit ratings in the random effect model for our analysis. The results using the fixed effect model are largely consistent.

Table 7 Hausman test

	FE	RE	Difference	S.E.
$LSMB_e$	0.6217	0.6217	2.62e-14	4.17e-09
HML_e	-0.2197	-0.2197	3.67e-14	4.75e-08
SMB_b	0.0244	0.0244	-1.23e-14	
HML_b	-0.0163	-0.0163	3.86e-14	
DEF	71.5417	71.5417	-2.39e-10	
TERM	36.3132	36.313	-1.20e-10	
p	1.000			

LSMBe represents the logarithm of the SMBe series.

D. Regression analysis

(0)Regression model with the factors of corporate size, B/M and term

Based on random effect model we build following model:

$$sp_{it}=C+\alpha_i^*+\beta_{1t}lsmbe_t+\beta_{2t}hmle_t+\beta_{3t}smbb_t+\beta_{4t}hmlb+\beta_{5t}def_t+\beta_{6t}term_t+e_{it} \quad (4)$$

We perform regression by using the software, EViews for the analysis and obtain the following results.

Table 8 Random effects test results

variables	Coef.	Std.	t	prob
constant	-33.26***	6.885	-4.8298	0.0000
$LSMB_e$	0.622***	0.021	30.1602	0.0000
HML_e	-0.216***	0.075	-2.8854	0.0039
SMB_b	0.025***	0.009	2.6580	0.0079
HML_b	-0.016***	0.006	-2.9355	0.0034
DEF	70.59***	13.63	5.17928	0.0000
TERM	35.85***	6.864	5.22193	0.0000
R^2	0.2987	S.E.	0.5861	
F	187.32***	DW	0.1751	

From above table, we find that if significance level is set at 1% the constant, LSMBe, HMLe, SMBb, HMLb, DEF and TERM are all significant. Also we find that R^2 equals 29.87% and F=187.32. The regression is significant if significance level is set at 1% and this indicate the model is well fit. Additionally, the standard error (SE) is 0.5861, and DW=0.1751. The model appears to be adequate and good.

The coefficient of LSMBe is 0.6217. The result supports the null *Hypothesis 1*, meaning that if LSMBe changes by 1%, the corporate spread will change by 0.6217%. The risk of small corporations is larger than large corporations, so the spreads are larger. The coefficient of HMLe is -0.2155 which means it is significant. It moves in opposite direction of corporate bond spread; therefore, *Hypothesis 2* is supported. The results are consistent with our expectations. That is higher B/M firms' returns are lower because low B/M firms are more mature, earn more money and can provide more stable equity value.

When HMLe increase 1%, the corporate bond spread will decrease -0.2155% and vise versa. SMBb moves in opposite direction of corporate bond spread and *Hypothesis 3 is supported*. If SMBb increase 1%, the corporate bond spread will increase 0.0245%. HMLb moves in opposite direction of corporate bond spread. Maybe this is because the model is influenced by the equity market factor. So Hypothesis 4 is rejected.

DEF moves in same direction of corporate bond spread and Hypothesis 5 *is supported*. The coefficient is 70.587, meaning that if DEF increase 1%, the corporate bond spread will increase 70.587%. If default risk is higher, the corporate bond yield will be higher because of higher risk premiums required by investors. From the result we find the most important reason for the difference between the spread of corporate and treasury bonds is default risk because there is no default risk in treasury bonds.

TERM moves in same direction of corporate bond spread.

If term increase 1% corporate bond spread will increase 35.846% and Hypothesis 6 *is supported*. This is consistent with expectations that the longer the bonds maturity is the more the risks of default credit are, so larger risk premium is required.

Table 9 The α_i^* of the model

CD	ZJ	CK	WY	JC	SD
-1.453	-1.066	-1.164	1.070	0.803	-0.182
ZJZ	LY	BB	CG	YG	SG
-0.769	-2.337	0.136	0.386	2.210	-2.457
NG	YW	SL	KEB	DYG	KM
0.093	0.066	-0.177	0.531	-0.168	-0.270
FZ	TW	ZT	HZ	HG	JKY
0.545	-0.576	-0.166	0.359	0.015	0.196
PLQ	BG	LG	HY	TX	AG
-0.253	-0.027	-0.952	0.709	-0.955	0.332
XT	ZH	YT	YD	DY	NB
-0.869	1.092	0.298	-2.108	0.435	-0.578
JN	RK	LX	LGZ	GM	SGZ
-1.398	0.430	-0.036	-0.630	1.355	0.753
WF	XY	JD	DK	ZTZ	ZF
0.730	-0.055	-0.578	0.768	0.067	0.949
HD	KD	AT	BX	XJ	XZ
0.236	1.387	-0.229	0.737	0.970	1.796

CD, ZJ,… represent the listed corporate names.

The regression model is as follows:

$$sp_{it}\text{=-33.255 }+\alpha_i^*+0.6217\,lsmbe_t - 0.2155\,hmle_t$$

$$+0.0245\,smbb_t - 0.0161\,hmlb+70.587\,def_t$$

$$+35.846\,term_t+e_{it} \quad (5)$$

From above table we find the results of the random effect model. The formula of regression of corporate CDs is as follows:

$$sp_{it}\text{=-34.708}+0.6217\,lsmbe_t - 0.2155\,hmle_t$$

$$+0.0245\,smbb_t - 0.0161\,hmlb+70.587\,def_t$$

$$+35.846\,term_t+e_{it} \quad (6)$$

The regression formula of other corporations are similar to that of corporate CDs.

(2) Add the factor of credit ratings to the original model

54 firms are taken as samples and they are divided into three groups based on credit ratings which are AAA, AA+ and AA. The average spreads are shown below.

From Table 10, we can find that when we add the factor of credit ratings to the model, it will be significant if significance level is set at 1%. LSMBe will be significant if significance level is set at 1%. If LSMBe changes by 1%, the spread will change by 0.622%. HMLe is found to be significant if significance level is set at 1%. If HMLe changes by 1%, the spread will change by -0.215%. SMBb is significant if significance level is set at 1%. If SMBb changes by 1%, the spread will change by 0.025%. HMLb is significant if significance level is set at 1%. If HMLb changes by 1%, the spread will change by -0.016%. DEF is significant if significance level is set at 1%. If the DEF changes by 1%, the spread will change by 70.59%. TERM is significant if significance level is set at 1%. If TERM changes by a 1%, the spread will change by a 35.85%.

Table 10 The model with credit ratings

variables	Coef.	Std.	t	prob
cons	-33.59***	6.886	-4.878	0.0000
$LSMB_e$	0.622***	0.021	30.160	0.0000
HML_e	-0.215***	0.075	-2.885	0.0039
SMB_b	0.025***	0.009	2.658	0.0079
HML_b	-0.016***	0.005	-2.936	0.0034
DEF	70.59***	13.63	5.179	0.0000
TERM	35.85***	6.864	5.222	0.0000
AAA	-0.980***	0.247	-3.962	0.0001
AA	0.962***	0.193	4.994	0.0000
R^2	0.3139	S.E.	0.5861	
F	150.8398***	DW	0.6368	

We can find that credit rating is significant. aaa,aa and aa+ will be significant if significance level is set at 1%. The R2 is 31.39%, and F=150.8398; therefore, if significance level is set at 1% the model will be significant. So the model is well fit.

Table 11 The α_i^* of the model

CD	ZJ	CK	WY	JC	SD
-0.146	0.237	0.140	0.443	0.178	0.149
ZJZ	LY	BB	CG	YG	SG
-0.431	-1.981	-0.481	0.711	1.569	-1.138
NG	YW	SL	KEB	DYG	KM
-0.523	0.394	-0.790	-0.090	0.162	0.062
FZ	TW	ZT	HZ	HG	JKY
-0.076	-0.240	0.165	-0.260	-0.600	0.523
PLQ	BG	LG	HY	TX	AG
-0.865	0.302	0.349	0.086	0.346	-0.287
XT	ZH	YT	YD	DY	NB
0.431	0.464	-0.321	-0.793	-0.185	-0.242
JN	RK	LX	LGZ	GM	SGZ
-0.092	-0.190	-0.651	0.667	0.725	0.129
WF	XY	JD	DK	ZTZ	ZF
0.107	0.274	-0.243	0.144	0.396	0.323
HD	KD	AT	BX	XJ	XZ
-0.381	0.756	-0.842	0.114	0.344	1.160

CD, ZJ,… represent the listed names of the firms.

The regression model used is as follows:

$$sp_{it}\text{=-33.59+ }\alpha^* + 0.622\,lsmbe_t - 0.215\,hmle_t$$

$$+0.025\,smbb_t - 0.0161\,hmlb+70.59\,def_t$$

$$+35.85\,term_t\text{-0.98aaa+0.962aa}+e_{it} \quad (7)$$

Table 11 illustrates the intercepts of the random effect. Following regression formula of corporate CDs can be obtained:

$$sp_{it}=33.736+0.622lsmbe_t - 0.215hmle_t$$
$$+0.025smbb_t - 0.0161hmlb+70.59def_t$$
$$+35.85term_t\text{-}0.98aaa+0.962aa+e_{it} \quad (8)$$

The regression equations for other firms are similar to those of firm CDs.

V. Conclusion

According to our study, the factors including SMBe, DEF and TERM, are consistent with the bond markets in USA and Europe but HMLe is different. Our study extends that of Gemmill (2011) with the SMBb and HMLb factors only in US bond market to the immature China bond market. We study the main factors influencing corporate bond spread ie corporate size, book-to-markets inequity and bond market, default and term.

Our study finds several interesting results. First, the factor of corporate size in equity and bond market is positively correlated with corporate bond spread. Smaller firms prefer to provide high corporate bond spreads and larger firms prefer to provide low corporate bond spreads. Second, not only in equity market but also in bond market the ration of book-to-market is positively correlated with corporate bond spread. High book-to-market ratio firms issue bonds with high yield spread. Third, the impact from the factor of default is huge on corporate bond spread, which is consistent with our expectations. Fourth, the influence from the factor of term on corporate bond spread is significant. The longer the bond maturity is the higher default risk, inflation risk and interest risk are, then higher yield spreads are required. Finally, when bond credit ratings are taken into consideration for the model as dummy variables, we conclude that the influence from credit ratings is significant and important. These factors are important to influence corporate bond spread. However, this model explains only approximately thirty percent of the corporate bond spread. In summary, market risk also affects the bond spread.

The findings could provide an important investment guide for bond investors who can then select the types of bonds for their investment portfolios. According to the literature, small firms face many difficulties in financing, and this hinders the development of small firms. The China Securities Regulatory Commission should allow qualified small corporations to issue low credit rating bonds. This policy can help small firms solve the financing problem, leading them to develop more rapidly. According to the data we collect, there are few short-term and long-term corporate bonds in China. China Securities Regulatory Commission should encourage firms to issue all types of bonds. In the future, it will be worthwhile to conduct more research on factors influencing corporate bond spreads by dynamic method.

References

[1] E. F. Fama, K. R. French, “Common risk factors in the returns on stocks and bonds,” *Journal of Financial Economics*, Vol.33, 1993, pp. 3-56.

[2] T. King, K. Khang, “On the importance of systematic risk factors in explaining the cross-section of corporate bond yield spreads,” *Journal of Banking & Finance*, Vol.29, 2005, pp. 3141–3158.

[3] J. Bao, J. Pan, “Excess Volatility of Corporate Bonds,” *working paper*, 2008.

[4] D. Avramov, G. Jostova, A. Philipov, “Understand-ing Changes by in Corporate Credit Spreads,” *Financial Analysts Journal*, Vol.63, 2007, pp. 90-105.

[5] S. M. Schaefer, I. A. Strebulaev, “Structural models of credit risk are useful: Evidence from hedge ratios on corporate bonds,” *Journal of Financial Economics*, Vol.90, 2008, pp. 1-19.

[6] G. Gemmill, A. Keswani, “Downside risk and the size of credit spreads,” *Journal of Banking & Finance*, Vol.35, 2011, pp. 2021-2036.

[7] J. Huang, M. Huang. “How much of the Corporate-Treasury yield spread is due to credit risk.” *Working paper*, 2002.

[8] W. R. Gebhardt, S. Hvidkjaer, “The cross-section of expected corporate bond returns: Betas or characteristics,” *Journal of Financial Economics*, Vol.75, 2005, pp. 85-114.

[9] G. Dionne, G. Gauthier, K. Hammami, M. Maurice, J. Simonato, “Default Risk in Corporate Yield Spreads,” *Financial Management*, 2010, pp.707 -731.

[10] K. Giesecke, A. Longstaff F, S. Schaefer, I. Strebulaev, “Corporate bond default risk: A 150-year perspective,” *Journal of Financial Economics*, Vol.102, 2011, pp. 233-250.

[11] F. A. Longstaff, S. Mithal, E. Neis, “Corporate Yield Spreads: Default Risk or Liquidity? New Evidence from the Credit Default Swap Market.” *Journal of Finance*, Vol.5, 2005, pp. 2213-2253.

[12] F. Neri, “Agent Based Modeling Under Partial and Full Knowledge Learning Settings to Simulate Financial Markets,” *AI Communications*, Vol.25, No.4, 2012, pp. 295-305.

[13] Y.Y. Shi, W.Z. Zhong, J. Ma, “Equity investment with corporate size and equity interest ratio,” *Financing Research*, Vol. 336, No.6, 2008, pp. 122-129.

[14] X.S. Tu, M. Zhu, “Fama-French with mutual fund performance measurement test,” *Guangdong University of Finance journal*, Vol.25, No.1, 2010, pp. 103-112.

[15] G. Duffee, “The Relation between Treasury Yields and Corporate Bond Yield Spreads,” *Journal of Finance*, Vol.6, No.53, 1998, pp. 2225-2242.

[16] J. Huang, J. Ge, and Y. Tian, "Analysis of Corporate Bond Yield Spread Based on the Volatility Clustering Effect," *IAENG International Journal of Applied Mathematics*, vol. 49, no.4, 2019, pp.605-611.

[17] J. Huang and Y. Tian, " Research on liquidity risk of corporate bond spread in China," *Engineering Letters*, vol. 28, no.2, 2020, pp. 601-608.

[18] J. Shieh, and H. Wu, "A Framework of Importance-Performance Analysis Based on the Multiple Determination Coefficient," *IAENG International Journal of Computer Science*, vol. 47, no.3, 2020, pp.463-467.

[19] F. B. Mendes, K. L. Delmondes, D. Hassan, and J. H. T. Barros, "Economic, Social and Environmental Perspectives on Organic Residues from Brazilian Amazonian Fruits (Acre)," *Lecture Notes in Engineering and Computer Science: Proceedings of The World Congress on Engineering and Computer Science 2019*, 22-24 October, 2019, San Francisco, USA, pp.33-38.