The influence of Fama-French factors in equity and bond markets on corporate bond spread

SU-SHENG WANG[1], JIE-MIN HUANG[1], XI YANG[1], JIE-YONG HUANG[3]
[1]Shenzhen Graduate School
Harbin Institute of Technology
Shenzhen University Town in Shenzhen City
People's Republic of China, 086-518055
[3]Kaifeng city, Henan Province
wangsusheng@gmail.com; jieminhuang0819@gmail.com;
727943515@qq.com; jieyong1987@126.com

Abstract: - We choose corporate weekly transaction data from the end of 2011 to the end of 2012 in Shenzhen Exchange and Shanghai Exchange, and analyze the determinant factors of corporate bond spread, mainly including company size factors in equity market and bond market, book to market ratio factors in equity market and bond market, default risk, term factor and credit rating factors. We find that small companies tend to issue bonds with high yield spreads, but big companies will issue low yield spread bonds. The companies with high book to market ratios will have high yield spread bond, while low book to market ratio corporates will have low yield spread bond. Default risk and term factor are important part in corporate bond spread. Also, the credit ratings are significant in the model. We suggest the China Securities Regulatory Commission encourage small companies to issue bonds and increase the low credit rating bonds.

Key-Words: -Bond spread company size equity market book to market ratio default risk credit rating

1 Introduction

To find the factors which influence corporate bond spreads, many scholars research on the influence of equity market factors on corporate bond spreads. The findings are below. Fama(1993) identifies five common risk factors in the returns on stocks and bonds [1]. There are three equity market factors: the whole market factor, company size factor and the book-to-market ratio of equity, and two bond market factors: maturity and default risk. Equity market factors influence equity returns. Bond market factor is included in bond returns except the low rating bonds. The five factors explain bond returns. King(2005) tests the importance of equity market systemic factors on explaining corporate bond yield spread variation. The data is 1771 corporate bonds from January 1985 to March 1998, and he finds once control variables correlate with default, the explaining power of bond β or equity market risk sensibility is limited. Also, he finds system factor express limited explaining power, and it indicates they don't make full use of the unclaimed method [2].

This is related with former study, namely once bring in market friction, the bond β is correlated. In all, the study indicates the empirical results support the hypothesis, namely the structural model contains determinant factors of bond yield spread and equity market system factor. Bao(2008) tests Merton model of corporate bond, equity and treasury on random interest rate. Focus on the bond volatility, equity volatility of the same company and treasury volatility. Using corporate bond cross-section daily, weekly and monthly returns from 2002 to 2006 do empirical bond volatility study. On the contrast of volatility in the model and empirical volatility, he finds a large part of volatility can't be explained by default based model. The daily and weekly extra volatility are larger, and it shows that short term liquidity in corporate bond takes larger ratio. The monthly extra volatility turns small but it still keeps significant. Further, he finds liquidity is important on explaining cross-sectional volatility, and this affords further evidence for corporate bond liquidity, and he finds the extra volatility which causes residuals is an important part of system risk [3].

Avramov(2007) explains corporate credit risk variation using structural model. He finds common

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factors and corporate basic factors could explain 54% credit spread variation in secondary bonds. There aren't significant potential factors in unexplained variation, and the factors he finds include most part of system variation of credit spread [4]. Schaefer(2008) finds credit risk structural model has poor forecast on bond price. Although, he testifies the model is quite precise on forecasting the sensitivity of corporate bond returns on equity value variation [5]. The main conclusion is although the simplest structural model could produce irrecusable hedge ratio in time series tests. However, he finds corporate bond rate sensitivity isn't included in Merton model. Also, the paper tests corporate bond price is correlated with market factors, such as SMB in FF, and this can't be forecast in structural model.

Some scholars study the impact of default on corporate bond spread. Gemmill(2011) using panel data finds large part of corporate bond spread is caused by default loss, although he takes downsize risk into the model, but system factor contributes little [6]. He finds corporate bond spreads strongly correlate with idiosyncratic risk: bond spread not only correlates with equity idiosyncratic risk, but also correlates with bond idiosyncratic risk and bond idiosyncratic risk value. Bond idiosyncratic risk could explain spread for the reason that it not only represents corporate value, but also represents liquidity. When bond idiosyncratic risk increases, bond spread increases, because bond idiosyncratic risk value includes corporate value left skewness distribution factors.

Huang(2002) using structural model with default factor investigates the credit risk ratio in corporate bond spread, and he finds in short term bonds credit spread takes small ratio, but big ratio in junk bonds [7]. Gebhardt(2005) finds after controlling duration, credit ratings and expiration date, bond cross-section returns strongly relates with default probability, and after controlling default risk and term factors, only maturity correlates with bond returns [8]. The important finding is system risk strongly relates with corporate bond. Dionne(2010) considers default risk causes corporate bond spread, and it's an important problem in credit risk literatures [9]. He uses history default data to calculate default probability. He finds default risk in corporate bond returns is sensitive to former default probability term structure. Giesecke(2011) using data from 1866 to 2008 investigates corporate bond default probability. He finds corporate bond market faces more harm in repeated default events than in the Great Depression. For example, in 1873-1875 railway crisis the overall defaults occupy 36% of the corporate bond market. Using regime switching model, he tests the probability of forecasting default probability by economic variables [10]. He finds equity returns, equity volatility and GDP variation are the strong anticipators. However, credit spread isn't the anticipator. In the long term, credit spread is twice of default loss, and it causes about 80 basis point credit risk premium. He also finds credit spread isn't corresponding to the real default probability. Longstaff(2005)using credit default swap measures the magnitude of default factors and other factors in corporate bond spread. He finds most of the corporate bond spread is caused by default risk. The results are significant to any credit rating bond and risk-free yield curve. He also finds that default part changes with time, and strongly correlates with individual bond illiquidity factor and macro-economic factors which measures bond market liquidity [11]. Neri(2012) shows how L-FABS can be applied in a partial knowledge learning scenario or a full knowledge learning scenario to approximate financial time series [12]. Chen(2009) predicts Taiwan 10-year government bond yield [13]. Skander(2005) add a useful tool to the systems modeling language[14]. Abdelaziz(2006) proposes a new approach for the diagnosis of the HDS based on the HPN model [15].

The foreign literatures focus on studying corporate bond spread by investigating FF factors in equity market, the default risk and credit risk. In China, Chang Kai (2012) develops a general model of the futures options valuation under the term structure of stochastic multi factors [16]. Huang Jiemin(2013) makes review on foreign study of corporate bond spread [17]. Wang Susheng(2012) investigates the differences between industrial pairs trading in different classification levels [18]. Shi Yuyou(2008) using 10 stocks in Shanghai Stock Exchange analyzes the correlation among equity debt-equity ratio, book to market ratio, company size and equity investment risk [19]. He uses clustering methodology to analyze and finds equity investment risk is not only determined by β, also by company size and other factors. Tu Xinshu(2008) using FF three factors tests fund performance evaluation, and finds FF three factors are significant, and the model shows fund has extra returns [20].

There are few literatures using FF three factors model with bond returns analyze the factors which influences corporate bond spreads. In the paper, using four FF factors in equity returns and bond returns such as SMB and HML we investigate corporate bond spread. Also, we add in default risk factor, term factor into the model, meanwhile we add in three credit ratings as dummy variables.

2 Data and variables description

2.1 Data description

AS Shanghai Stock Exchange has bond transaction data since 2007, and Shenzhen Stock Exchange has bond transaction data since 2008. In order to get continuous data, we choose nearly 50 corporate bonds weekly transaction data from December 2011 to December 2012. We get the data from Wind database, and the bonds have simple interest, fixed rate. According to Duffee(1998), we divide the bonds into three categories, including short term bonds with 2 to 7 years maturity [21]; median bonds with 7 to 10 years maturity; long term bonds with maturity more than 10 years. In the paper, most of the bonds are short term and median term bonds, also some are long term bonds. And the bonds can be divided into AAA, AA+ and AA three ratings. The sample contains Manufacturing industry, Power industry, Building industry, Mining and Quarrying industry, Transportation industry, Real Estate and Service industry bonds. The sample covers almost all the industries.

2.2 Variables description

(1) Corporate bond spread series: we choose corporate bonds and treasury bonds with similar maturity, and bond spreads are estimated by the difference of the two bond returns. We choose the difference of returns between treasury bonds and corporate bonds with similar value date and delivery date. Here spread denotes corporate bond spreads.

(2) HML_e ,SMB_e , we use HML_e to represent FF three factors model in equity market, and HML_e means Book to Market ratio factor in equity market, from which the company size factor is excluded. SMB_e means company size factor in equity market, from which the Book to Market ratio factor is excluded. The factors are calculated as below:

We use SIZE to represent company size. From July year t to June year t+1, the size value of stock i is market value in June year t. So from January 1st 2012 to June 30th 2012, the weekly size value is the circulation market value in June 30th 2011. From July 1st 2012 to June 30th 2012, the size value of stock i is the circulation market value in June 30th 2012.

From July year t to June year t+1, the weekly BE/ME of Stock i equals equity interest divides circulation market value in the end of year t-1. So the weekly B/M of stock i from January 1st 2012 to June 30th 2012 equals the equity interest divides circulation market value in December 31st 2010. The weekly B/M of stock i from July 1st 2012 to December 31st 2012 equals the equity interest divides circulation market value in December 31st 2011.

Then, companies are ordered by the size value, and the top half is small companies, the bottom half is big companies. We put the B/M value in low to high order, and the top 30% is low B/M companies, the bottom 30% is high B/M companies, and the middle 40% is median B/M companies.

And then according to the value, we divide the companies into S/L, S/M, S/H, B/L, B/M and B/H companies, and there are six groups. The S/L group means the company belongs to small company and also belongs to low B/M company, and S/H means the company belongs to small company and also belongs to high B/M company, also the left four groups is similar with them. Then we get the weekly average returns of the six group stocks, and according to the formulas below, we get the variables SMB_e and HML_e.

$$SMB=(S/L+S/M+S/H)/3-(B/L+B/M+B/H)/3 \quad (1)$$
$$HML=(S/H+B/H)/2-(S/L+ B/L)/2 \quad (2)$$

(3) HML_b, SMB_b, we use HML_b to represent FF three factors model in bond market, and HML_b means Book to Market ratio factor which excludes company size factor in bond market. SMB_b means company size factor which excludes Book to Market ratio factor in bond market. The method to calculate HML_b and SMB_b is similar with HML_e and SMB_e, so we would not repeat it any more.

(4) DEF as default factor. DEF equals long term investment grade bond returns minus long term government treasury returns. We choose Chinese railway company bond with 15 years maturity and treasury with 50 years maturity.

(5) TERM as term factor. It equals long term treasury returns minus one month treasury rates. Because there isn't one month treasury rate in China, so we choose long term treasury with 50 years maturity and one year deposit rates.

(6) Dummy variables. The sample can be divided into three credit ratings, as AAA, AA+ and AA. We take the bond ratings as three dummy variables.

3 Basic hypotheses

Hypothesis1: SMB_e correlates with corporate bond spread positively.

SMB_e is the company size factor which has excluded BE/ME factor. It means the small corporate stock returns minus big corporate stock returns. Small corporate has higher returns than big corporate, for the reason that small company will face higher default risk than big one, so the credit risk is large and investors ask more risk premium.

Hypothesis 2: HML_e correlates with corporate bond spread positively.

The size factor is excluded from HML_e. HML_e means high B/M corporate stock returns minus low B/M corporate stock returns. The growing company with high B/M has high stock returns than grown companies with low B/M. The growing company with high B/M develops rapidly, but immaturely, and it faces large risk, so it has high bond returns. The grown company with low B/M develops steadily and maturely, and it faces little risk, so it has low bond returns.

Hypothesis 3: SMB_b correlates with corporate bond spread positively.

SMB_b is the company size factor, from which the BE/ME factor has been excluded. It means the small corporate bond returns minus big corporate bond returns. Small corporate has higher returns than big corporate, for the reason that small company will face higher default risk than big one, so the credit risk is large and investors ask more risk premium.

Hypothesis 4: HML_b correlates with corporate bond spread positively.

The size factor is excluded from HML_b. HML_b means the high B/M corporate bond returns minus low B/M corporate bond returns. The growing company with high B/M has high bond returns than grown companies with low B/M. The growing company with high B/M develops rapidly, but immaturely, and it faces large risk, so it has high bond returns. The grown company with low B/M develops steadily and maturely, and it faces little risk, so it has low bond returns.

Hypothesis 5: DEF correlates with corporate bond spread positively.

When default risk becomes larger, the bond returns will be higher, because investors ask for higher premium when risk increases. In foreign countries as America or Europe, there are almost all kinds of bonds, and default factor is very important in bond spread. On contrast, In China, we have many high credit rating bonds, few low credit rating bonds. Until recently, only one corporate default, but the guarantee company will pay the capital. In China, there are few literatures on bond default.

Hypothesis 6: TERM correlates with corporate bond spread positively.

The bonds with longer bond maturity will face larger risk, and investors ask for higher risk premium. The bonds with shorter bond maturity will face less risk. So the long term bonds have high yields but short term bonds have low yields.

Hypothesis 7: Bond ratings correlate with corporate bond spread.

The bonds with higher ratings will have lower credit risk and they have lower credit spread, but bonds with lower ratings will have higher credit risk and they have higher credit spread. In China, there are many bonds with credit rating A, a few bonds with credit rating B, but few bonds with credit ratings C.

4 Empirical analysis

4.1 Descriptive statistics

Table1 indicates descriptive statistics of corporate bond spread, SMB_e, HML_e, SMB_b, HML_b, 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

4.2 Series correlation test and stationary test

4.2.1 Correlation coefficient matrix

From table 2 we can see spread correlates with SMB_e positively, and the coefficient is 0.3608; HML_e correlates with spread negatively, and the coefficient is -0.1235; SMB_e and HML_e has strong negative relation, and the coefficient is -0.4415; SMB_b correlates with HML_b, DEF, TERM, and the coefficients are -0.2034, -0.2406, 0.2383; DEF correlates with TERM strongly, and the coefficient is -0.9994.

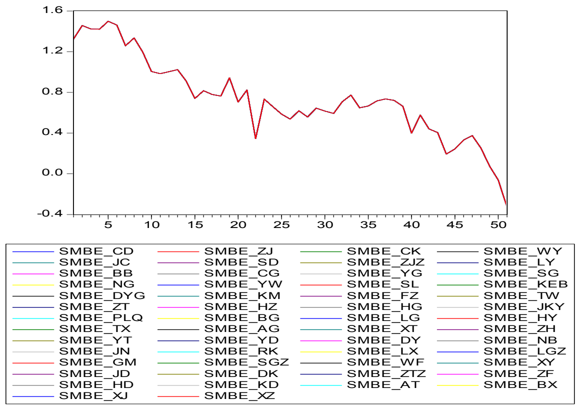
Table 2 correlation coefficient matrix

	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

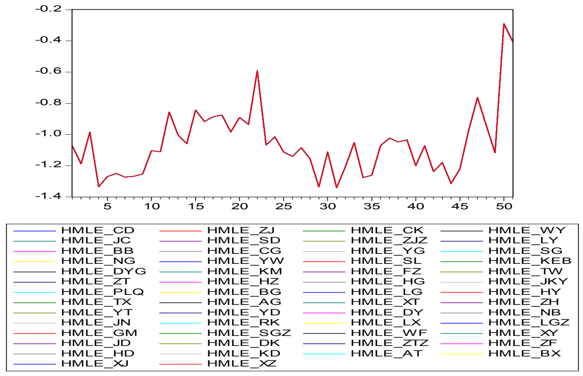
4.2.2 Stationary test

In Graph1, the horizontal axis indicates 51 weeks, and the vertical axis indicates the values of SMB_e. We can see the series has time trend.



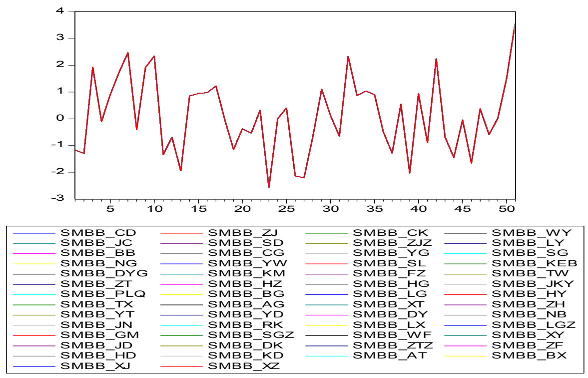
Graph 1 SMB_e series

In Graph2, the horizontal axis indicates 51 weeks, and the vertical axis indicates the values of HML_e, the series is stable.



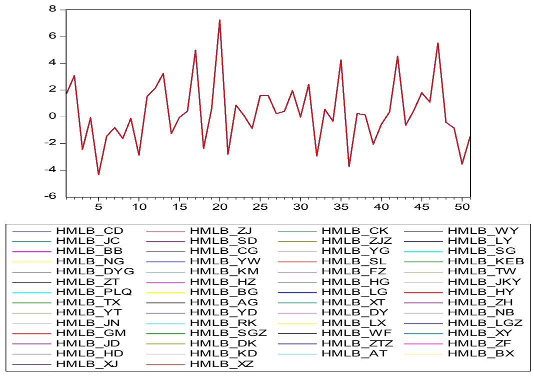
Graph 2 HML_e series

In Graph3, the horizontal axis indicates 51 weeks, and the vertical axis indicates the values of SMB_b, the series is stable.



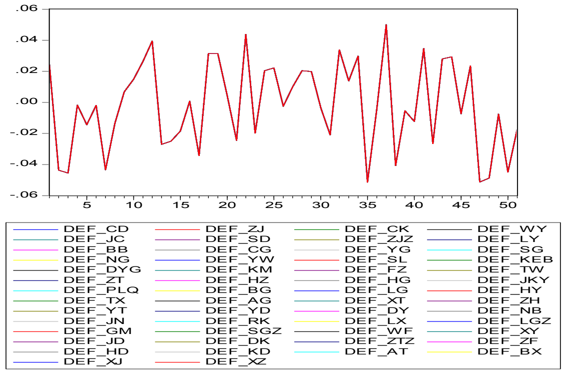
Graph 3 SMB_b series

In Graph4, the horizontal axis indicates 51 weeks, and the vertical axis indicates the values of HML_b, the series is stable.



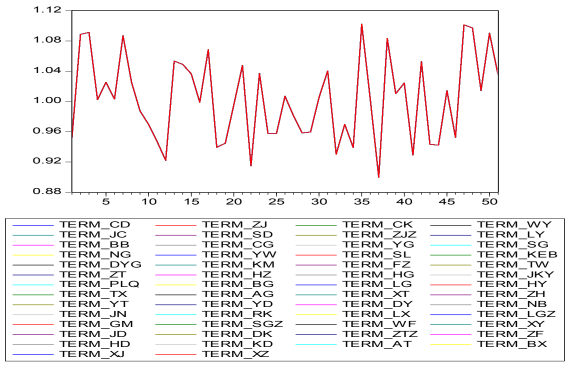
Graph 4 HML_b series

In Graph5, the horizontal axis indicates 51 weeks, and the vertical axis indicates the values of DEF, the series is stable.



Graph 5 DEF series

In Graph6, the horizontal axis indicates 51 weeks, and the vertical axis indicates the values of TERM, the series is stable.



Graph 6 TERM series

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***

*** denotes statistical variables are significant on the 1% confidence level.

From table 3 we can see that the SPREAD series, SMB_b series, HML_b series, HML_e series, DEF series, and TERM series are significant on 1% confidence level, and reject null hypothesis, and means they are stationary. But SMB_e series accepts null hypothesis, so it is not stationary. We deal with SMB_e series, and take the logarithm of SMB_e series, and get the new series $LSMB_e$.

4.3 Model selecting

4.3.1 Fixed effects test within the groups

From table 4 we can see, F(6,2586)= 187.53, F is significant on 1% confidence level, namely the variables in the model are significant. F(53,2586) =132.21, means the fixed effect model is significant on 1% confidence level, so the fixed effect model is significant. And all the coefficients of the variables are significant on 1% confidence level.

Table 4 fixed effect test results within groups

varaibles	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
cons	-33.73***	6.8664	-4.91	0.000
F(6,2586)		187.53***		
F(53,2586)		132.21***		

*** denotes statistical variables are significant on the 1% confidence level.

4.3.2 Random effect test

From table 5 we can see, LR chi2(6)= 936.31, LR is significant on 1% confidence level, namely the variables in the model are significant. Chibar2(01)= 3151.25, means the random effect model is significant on 1% confidence level, so the random effect model is significant. And all the coefficients of the variables are significant on 1% confidence level.

Table 5 LM random effect test results

varaibles	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
cons	-33.73***	6.8597	-4.92	0.000
LR chi2(6)		936.31***		
chibar2(01)		3151.25***		

*** denotes statistical variables are significant on the 1% confidence level.

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
chibar2(01)	33361.84***	

*** denotes statistical variables are significant on the 1% confidence level.

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

According to table 6, we test the random effect model, chibar2(01)= 33361.84, and it's significant on 1% confidence level. The result indicates the random effect model is significant.

4.3.3 Hausman test

According to table 7, p=1, so accept null hypothesis, and the individual effect is not correlated with dependent variables. So the fixed effect model is consistent, and for the reason that we need to add in dummy variables in the model, so we choose the random effect model.

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			

4.4 Regression analysis

4.4.1 Regression model with corporate size, B/M and term factors

We choose the random effect model, and build the model as follows:

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

We use Eviews to do regress, and get the results below:

Table 8 random effect test results

varaibles	Coef.	Std.	t	prob
cons	-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	

*** denotes statistical variables are significant on the 1% confidence level.

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

From table 8, we know constant is significant on 1% confidence level; $LSMB_e$ is significant on 1% confidence level; HML_e is significant on 1% confidence level; SMB_b is significant on 1% confidence level; HML_b is significant on 1% confidence level; DEF is significant on 1% confidence level; TERM is significant on 1% confidence level. R2 is 29.87%, and also F=187.32, it's significant on 1% confidence level, namely the model is good. Also, S.E.= 0.5861, and DW=0.1751, the model is quite good.

According to the hypothesis, the coefficients of $LSMB_e$ is 0.6217, and accept null hypothesis 1, namely when $LSMB_e$ changes for 1 unit, corporate spread changes 0.6217 in the same direction. Small company faces larger risk than huge one, so the spread of small company is lower, because investors of small company corporate bond ask for more risk premium. The coefficient of HML_e is -0.2155, and it's significant, and it's negatively correlated with corporate bond spread, so accept hypothesis 2. It's correspond with our expectation, namely the higher B/M corporate has lower equity returns, and the lower B/M company has higher equity returns, because low /B/M company is mature and earns more money and could provide stable equity interest commonly. When HML_e changes 1 unit, corporate spread changes 0.2155 in the opposite direction. SMB_b is positively related with corporate spread, and accept hypothesis3 and when SMB_b changes 1 unit, the corporate spread changes 0.0245 in the same direction. HML_b is correlated with corporate spread negatively, this is unusual, maybe because the equity market factor affects the model, and gets the unusual results, and it rejects null hypothesis 4. DEF is related with corporate bond spread positively, and accept hypothesis 5. The coefficient is 70.587, when DEF changes 1 unit, the corporate spread changes 70.587 units in the same direction. The higher default risk leads to higher corporate yield, because the investors ask for higher risk premium. The result indicates the default risk is the main reason of the spread between corporate spread and treasury. As treasury doesn't has default risk, only if the country disappears. Otherwise, even if the company has AAA credit rating, it also has default risk in the future. TERM is correlated with corporate spread positively. When term changes 1 unit, the corporate spread will changes 35.846 units in the same direction, and accept hypothesis 6. This is consistent with expectation, the bond with longer maturity will face more default risk and credit risk, so the risk premium is larger, but the shorter bond faces lower risk and so has lower returns.

The regression model as below:

$$sp_{it}=-33.255+\alpha_i^*+0.6217\,lsmbe_t-0.2155\,hmle_t+0.0245\,smbb_t-0.0161\,hmlb+70.587\,def_t+35.846\,term_t+e_{it} \quad (5)$$

Table 9 shows the random effect intercepts, and we can get the regression of company CD:

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

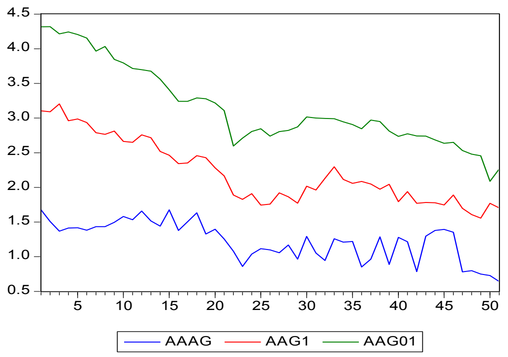
$$+0.0245smbb_t - 0.0161hmlb + 70.587def_t$$

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

The regression equations of other companies are similar with company CD.

4.4.2 Add credit ratings factor into the original model

We choose 54 companies, and they can be divided into three credit ratings, AAA, AA+ and AA. The average spread of the three rating bonds as below:



Graph 7 average spread of three credit rating bonds

From graph 7, we can see average bond spreads of three credit ratings become smaller as time moves forward. The higher credit bonds have lower credit spread. In the graph, AAA bond has the lowest average spread, but AA bond has the highest average spread. This is consistent with bond theories. The low credit rating bond will face more default risk and credit risk, and the companies will afford higher returns to attract capitals. On contrast, the high credit rating bond will afford low returns because of low risk. In China, most of the companies that issue bonds are big stated-owned companies and large listed companies, and the companies have high credit ratings. Compared with foreign bonds, there are few low credit rating bonds. And small companies can't issue bonds, so it's not good for them to attract capitals.

From table 10, we can see the model with credit rating variables is significant on 1% confidence level. $LSMB_e$ is significant on 1% confidence level, and when $LSMB_e$ changes 1 unit, spread will changes 0.622 units in the same direction. HML_e is significant on 1% confidence level, and when HML_e changes 1 unit, spread will changes 0.215 units in the opposite direction. SMB_b is significant on 1% confidence level, and when SMB_b changes 1 unit, spread will changes 0.025 units in the same direction. HML_b is significant on 1% confidence level, and when HML_b changes 1 unit, spread will changes 0.016 units in the opposite direction. DEF and SMB_b are significant on 1% confidence level, and when DEF changes 1 unit, SPREAD will changes 70.59 units in the same direction. TERM is significant on 1% confidence level, and when TERM changes 1 unit, spread will changes 35.85 units in the same direction.

Table 10 the model with credit ratings

varaibles	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
R2	0.3139	S.E.	0.5861	
F	150.8398***	DW	0.6368	

*** denotes statistical variables are significant on the 1% confidence level.

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

The credit rating factors are significant. AAA is significant on 1% confidence level, and when AAA changes 1 unit, spread will changes -0.980 units. AA is significant on 1% confidence level, and when AA changes 1 unit, spread will changes -0.980 units 0.962. AA+ is significant on 1% confidence level, and when AAA changes 1 unit, spread will changes 0.33 units. R2 is 31.39%, F=150.8398, and it is significant on 1% confidence level. The model is fit.

The regression model as below:

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

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

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

Table 11 shows the random effect intercepts, and we can get the regression of company CD:

$$sp_{it}=33.736+0.622lsmbe_t - 0.215hmle_t$$

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

$$+35.85term_t\text{-0.98aaa+0.962aa+}e_{it} \quad (8)$$

The regression equations of other companies are similar with company CD.

5 Conclusion

The results we find are almost consistent with the literatures of US and European bond markets, such as SMB_e, DEF and TERM factors, but HML_e is different from foreign study, and we have explained the reasons. Only Gemmill(2011) study the SMB_b and HML_b factors in US bond market, and our results of HML_b are different from his, and we have explained the reasons before [6]. Bond market in China is immature. We analyze corporate bond spread influencing factors, mainly including company size, book to market ratio in equity market and bond market, default factor and term factor. We find that firstly, corporate size factors which exclude book to market ratio factors in both equity market and bond market correlates with corporate bond spread positively. Small company will tend to afford high corporate bond spread, but big company will tend to afford low corporate bond spread. Secondly, book to market ratio factors in both equity market and bond market which exclude company size factor correlate with corporate bond spread positively. Companies with high book to market ratio will issue high yield spread bond, but companies with low book to market ratio will issue low yield spread bond. Thirdly, we find default factor has huge impact on corporate bond spread, and this is consistent with expectations. The main difference between corporate bond and treasury is default risk, and it determines default risk is the main factor of corporate bond spread. Fourthly, term factor has significant effect on corporate bond spread. The bonds with longer maturity will face high risk, including default risk, inflation risk and interest risk, so they provide high yield spread, but short maturity bond will afford low yield spread. Fifthly, we add bond credit rating as dummy variables into the model. We find they are significant, and they are the important factors which influence corporate bond spread. In all, these are important corporate bond spread factors. But the model only explains nearly 30% of corporate bond spread. In all, Market behavior causes corporate bond spread. The findings could provide directions for bond investors. On the other hand, according to literatures small companies have a lot of difficulty in financing, and this hinders the small companies' development. In my opinion, the China Securities Regulatory Commission could allow small corporate with promising future issue low credit rating bonds, and this could solve financing problem, and promote small company develop rapidly. According to the data we collect, in China, we have fewer short term and long term corporate bonds. The China Securities Regulatory Commission could encourage corporates issue all kinds of bonds. In the future, we will research on corporate bond spread determinant factors with dynamic method.

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