Research on the Impact of the Risk on Bond Returns in China

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Abstract. In recent years, with the development of the China's bond market, the studies on bond pricing have become more and more numerous. In this paper, the impact of maturity risk, credit risk, and liquidity risk on bond pricing is analyzed, and the yield to maturity of enterprise bonds and corporate bonds is taken as the research object. Based on the Fama-French model, the liquidity risk factor measured by Amihud illiquidity is introduced, and the impact of different risks on the pricing of enterprise bonds and corporate bonds is compared. The results show that the maturity risk is not significant for the pricing of the two types of bonds, the credit risk significantly affects bond pricing, and the liquidity risk is significant for the pricing of corporate bonds.

Keywords: Bond pricing · Fama-French model · Liquidity risk · Enterprise bonds · Corporate bonds

1 Introduction

With the rapid development of China's bond market, bonds have been favored by more investors, and the types of bonds in the market have gradually increased. With bond markets constantly opening up, enterprise bonds and corporate bonds provide investors with a conduit to meet demand for yields. Existing research on bond risk compensation and pricing focuses on maturity risk, credit risk, and liquidity risk. The maturity risk and credit risk are the fundamental factors that have been studied earlier to influence bond pricing. With the rise of microstructure theory, the liquidity of bonds or the cost of transactions has gradually become a hot issue. Most of the existing relevant research conclusions believe that liquidity is an important factor in asset pricing and will also be reflected in the yield of assets. This paper examines whether the two factors proposed by Fama and French on bonds are applicable in China's bond market, and explores the impact of liquidity risk factors on bonds. Among them, enterprise bonds and corporate bonds traded on the Shanghai Security Exchange and Shenzhen Security Exchange are selected according to the different types of bonds. An empirical analysis of a three-factor model is conducted based on this sample. This paper helps explain the impact of different risks on the pricing of enterprise and corporate bonds, and provides an empirical reference.

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2 Literature Review

For bonds with no risk of default, such as Treasuries, maturity risk is considered to be the most important factor affecting the pricing of bonds. For bonds with a default risk, such as enterprise bonds or corporate bonds, in addition to maturity risk, credit risk is also an important factor affecting pricing. Fama and French [1] proposed two factors, which are the maturity risk factor (TERM) and the bond default risk factor (DEF) for bond pricing as proxy variables for maturity risk and credit risk. The results of the study showed that TERM and DEF can better characterize maturity risk and credit risk in the US bond market. In later studies, Collin–Dufresne et al. [2], Longstaff et al. [3] found that liquidity risk is a factor that affects credit spreads in addition to credit risk. Friewald et al. [4] argued that liquidity is an important price factor in the U.S. corporate bond market, with empirical studies finding that liquidity effects account for about 14% of the explained changes in corporate yield spreads across the market. Helwege et al. [5] separated credit risk from liquidity risk to examine the impact of liquidity on bond pricing. Different scholars have proposed many indicators to characterize liquidity in the study of capital market liquidity. Bao et al. [6] measured the illiquidity of corporate bonds by the negative number of covariance of the price change sequence, and the greater the negative number of the covariance of the two adjacent price change sequences, the greater the illiquidity. Amihud [7] argued that illiquidity is the price return caused by the unit transaction amount, and the higher the price return caused by the unit transaction amount, the greater the illiquidity. Pastor and Stambaugh [8] argued that market liquidity refers to the market ability of an asset to quickly complete a large number of transactions at a low cost without causing changes in asset prices. They also proposed to measure liquidity by proposing the Gamma coefficient, which was referred to as the P-S liquidity indicator. Scholars Tan Dijun, Tian Yixiang et al. [9] proposed more reasonable systemic interest rate risk factors and credit risk factors for China's bond market. Zhu Rufei [10] used four methods to measure illiquidity in the Chinese financial market, including Bao et al., Amihud, Pástor and Stambaugh, respectively, so as to study the factors affecting the illiquidity of corporate bonds at the corporate bond level and the market level in the Chinese financial market. Zhang Zheng et al. [11] compared the measurement effects of different low-frequency liquidity indicators against the Chinese stock market data from 1999 to 2009, and concluded that Amihud is the most suitable low-frequency liquidity indicator for the Chinese market.

3 Methodology

3.1 Data Screening

The research objects of this paper are enterprise bonds and corporate bonds traded on the Shanghai Security Exchange and Shenzhen Security Exchange, and the sample date is selected from January 2016 to December 2020. The sample included 2165 enterprise bonds and 5017 corporate bonds traded on the Shanghai Security Exchange and the Shenzhen Security Exchange. From China Stock Market & Accounting Research Database, the basic information and trading information about bonds can be downloaded. Basic information includes data such as bond maturity, coupon rate, size of actual bond

issuance, and issuance time. From the transaction information, the daily price, the yield to maturity, the daily transaction amount and other data can be obtained.

3.2 Variables Introduction

In the following model, the explanatory variables are the excess yield on enterprise bonds and the excess yield on corporate bonds. In order to analyze the long-term pricing effect of liquidity risk on enterprise bonds and corporate bonds, the explanatory variables selected for this paper are the maturity risk factor, credit risk factor, and liquidity risk factor.

Maturity Risk and Default Risk.
To measure the bond yield structure, Fama and French used two factors, namely the maturity risk factor (TERM) and the bond default risk factor (DEF). The TERM variable is the difference in yield to maturity between short-term and long-term Treasuries, which represents the risk compensation for the maturity of the bond. The TERM variable is derived from the difference between the yield on long-term and short-term Treasury bonds. Long-term treasury bonds include treasury bonds with a maturity of more than ten years, and short-term treasury bonds include bonds with a maturity of no more than one year. The DEF variable is the difference between the average yield to maturity of long-term bonds and the average yield to maturity of long-term Treasury bonds, representing the excess yield of the long-term bond market relative to the long-term Treasury market.

Liquidity Risk.
The liquidity level of bonds is one of the important factors affecting bond pricing. The four-dimensional liquidity theory proposed by Kyle [12] and Harris [13] is widely accepted by researchers. The four-dimensional liquidity theory indicates that there are four dimensions, namely tightness, depth, resiliency, and immediacy. Tightness represents the cost of turning around a position over a short term; depth represents the ability of the market absorbing quantities without a significant impact on price; resiliency represents the speed of price being recovered to the underlying liquidation value of the stock; immediacy represents the speed of trading. This paper uses the Amihud (2002) Illiquidity indicator to measure the liquidity risk. ILLIQ measures the period average of the absolute value of the asset's trading day rate of return and the daily trading amount ratio. This is a method that considers the tightness, depth, and resiliency at the same time, and is a three-dimensional composite liquidity measurement method that reflects fluidity. ILLIQ is a commonly used liquidity measurement method in most studies, and its calculation method is:

$$ILLIQ_{i,m} = 1/D_{i,m} \sum_{t=1}^{D_{i,m}} |R_{i,m,d}|/VOLD_{i,m,d} \tag{1}$$

In this paper, $R_{i,m,d}$ and $VOLD_{i,m,d}$ are the bond return and RMB trading volume of bond i on day d in month m, respectively. $D_{i,m}$ is the number of trading days of stock i in month m. When the ILLIQ variable increases, the market illiquidity increases, that

is, the market liquidity declines. Since ILLIQ is positive and the high level of illiquidity represents an increased difficulty in bond trading, as a result, the expected impact on bond yields is negative.

3.3 Model Construction

This paper mainly analyzes the relationship among the above three types of bond risk and bond pricing, so the following model is constructed:

$$Y_{i,t} = \alpha + \beta_1 TERM_t + \beta_2 DEF_t + \beta_3 ILLIQ_t \quad (2)$$

In the model, Y is the market excess yield of enterprise bonds or corporate bonds, TERM is the maturity risk factor, DEF is the credit risk factor, and ILIIQ is the liquidity risk factor. The model is mainly used to analyze whether the liquidity risk is reflected in the price of the bond in the Chinese enterprise bond market and the corporate bond market, or whether the risk compensation for liquidity is significant.

4 Regression Result and Analysis

It can be learned from Table 1 that the excess yield of enterprise bonds is higher than that of corporate bonds, and the compensation of enterprise bonds for credit risk is higher than that of corporate bonds. The average of the ILLIQ of corporate bonds is less than that of enterprise bonds, which means that the liquidity of corporate bonds is higher than that of enterprise bonds.

Table 2 shows the correlation between the model variables of enterprise bonds and corporate bonds. Except for a relatively high correlation between Y and DEF, the correlation between any other two variables is relatively low. The regression results are shown in Table 3.

The regression results show that the credit risk has a significant impact on enterprise bond yields and corporate bond yields, and both DEF variables have a significance of 1%. Maturity risk is not significant for both enterprise bond yields and corporate bond yields, which means that the TERM variable cannot significantly affect the yields of both bonds. Liquidity risk is not significant for enterprise bond yields, but it is 5% significant for corporate bonds. The liquidity risk of corporate bonds can be compensated, while the liquidity risk of enterprise bonds cannot. In terms of the regression coefficient of the liquidity risk factor, the liquidity risk coefficient of the corporate bond is negative, that is to say, the excess yield of the corporate bond changes in the opposite direction with the liquidity risk, and the liquidity risk factor is measured by the Amihud illiquidity indicator. The result is consistent with the previous expectations. From the perspective of the fitting effect, the interpretation of the maturity risk and credit risk for the yield of enterprise bonds reached 86.9%, higher than 62.8% of corporate bonds. Although the addition of liquidity risk factor did not have a significant impact on enterprise bonds, the three-factor explanation of yields was still higher than that of enterprise bonds. The effect of fit of both bonds improved after the addition of the Amihud illiquidity indicator based on the classic models of Fama and French.

Table 1. Descriptive statistics (original).

		Enterprise bonds			Corporate bonds			
	Mean	Std	Min	Max	Mean	Std	Min	Max
Y	0.0596	0.0436	0.0145	0.1643	0.0398	0.0277	0.0125	0.1381
TERM	0.0137	0.0104	−0.0024	0.0404	0.0137	0.0104	−0.0024	0.0404
DEF	0.0184	0.0062	0.0102	0.0286	0.0113	0.0028	0.0061	0.0161
ILLIQ	1.4872	1.2701	0.0473	6.2147	0.9367	0.4998	0.1280	2.3623

Table 2. Correlation of variables (original).

Enterprise bonds				
	Y	TERM	DEF	ILLIQ
Y	1			
TERM	0.154015709	1		
DEF	0.93219685	0.18827861	1	
ILLIQ	−0.118280424	−0.060938495	−0.08059193	1
Corporate bonds				
	Y	TERM	DEF	ILLIQ
Y	1			
TERM	0.222463447	1		
DEF	0.78953078	0.197116473	1	
ILLIQ	0.151491613	−0.070237264	0.386747692	1

Table 3. Results of regression (original).

	Enterprise bonds return		Corporate bonds return	
TERM	−0.0934	−0.1023	0.1855	0.1150
	(−0.46)	(−0.50)	(0.84)	(0.53)
DEF	6.5384***	6.5161***	7.7261***	8.4462***
	(19.22)	(19.08)	(9.42)	(9.64)
ILLIQ		−0.1528		−0.9628**
		(−0.93)		(−2.01)
R2	0.869	0.871	0.628	0.653

5 Conclusion

This paper examines the applicability of the classic model proposed by Fama and French to the Chinese bond market. The paper also explores the impact on bond pricing after adding the liquidity risk factor. There are three main risk factors that affect the pricing of bonds: maturity risk, credit risk, and liquidity risk. This paper helps explain the impact of bond liquidity risk on enterprise and corporate bond pricing. The regression results show that credit risk has significant effect on both enterprise bond and corporate bond yields, and it is found that the impact of credit risk on corporate bonds is greater than that of enterprise bonds. This shows that bond ratings have a great influence on bond yields. The regression results of liquidity risk on enterprise bonds and corporate bonds yield show that the liquidity risk is significant for corporate bonds, but not for enterprise bonds, indicating that corporate bonds have received compensation for liquidity risk.

This paper mainly compares the impact of three risks on the pricing of enterprise bonds and corporate bonds, but it can be further improved. This paper focuses on the impact of liquidity risk on the pricing of enterprise bonds and corporate bonds of exchanges, and there are many measurements for liquidity risk variables, which can further explore the effectiveness of different liquidity measurement dimensions on bond liquidity measurement.

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