

Research on the Impact of Corporate Bond Liquidity on Credit Spread

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Abstract—Based on the credit risk pricing theory system of Merton (1974), this paper selects the monthly transaction data of the corporate bond market of listed companies from January 2008 to June 2017, and studies the impact of corporate bond liquidity of listed companies in China on credit spreads. Through empirical research, it is found that corporate bond liquidity of listed companies in China has a significant impact on credit spreads. The better the liquidity of bonds is, the smaller the risk compensation required by investors and the credit spread will be. During the period of insufficient liquidity, the impact is more significant. And it is proposed that measures such as improving the transaction final settlement system, reducing taxes and exempting restrictions on investment entities, etc., can be adopted.

Keywords—*corporate bonds; liquidity; credit spread*

I. INTRODUCTION

In recent years, the bond market, especially the credit bond market, has developed strongly. And the bond market has continued to expand. Debt financing has become an indispensable form of social financing. At the end of 2016, the stock balance of China's bond market was 485.737.34 billion yuan, climbing to the third place in the world. Its volume continued to expand and financing efficiency continued to increase. The bond market provides enterprises with new financing channels and reduces capital costs. Bonds are also an important investment target and risk hedging tool for investors. At the same time, bonds can raise special funds for key project construction, improve infrastructure construction, and vigorously develop the real economy. At present, economic growth is still facing greater pressure, and the bond market has received more and more attention from all walks of life.

Based on the credit risk pricing theory system of Merton (1974) [1], this paper has collected and compiled the transaction data of corporate bond market of listed companies from January 2008 to June 2017. It has studied the impact of corporate bond liquidity of China's listed companies on credit spreads. And then, the author has conducted a group study on samples. The "money shortage" crisis in June 2013 is a time division point. This paper analyzes the difference in the impact of liquidity on credit spread before and after the crisis.

II. THEORETICAL ANALYSIS AND RESEARCH HYPOTHESIS

In terms of credit risk, Huang (2015) [2] pointed out that regardless of the difference in bond issuance period, if the rating agency gives a higher credit rating for the bond, the credit risk can only explain a small portion of the yield spread. However, if bonds are classified as junk bonds, credit risk can explain most of the yield spreads. In order to better explain the reasons for the credit spread, many scholars began to explore the non-credit risk impact factors of credit spreads, including liquidity, taxation, economic cycle and confidence variables, and jumping risk. [3] Korteweg & Polson (2009) empirically studied 5,300 company-level market transaction data from 1994 to 2008. The structure shows that more than 40% of the credit spread can be explained by tax, liquidity and jumping risk. Of course, many scholars have specifically studied the liquidity premium.

Chinese scholars rarely study the theoretical system of credit spreads, and most of them are to sort out and summarize the existing academic achievements abroad. At present, the research on bond credit spread mainly adopts the form of empirical analysis, mainly discussing whether credit risk pricing theory is applicable to China's bond market. [4] Zhang Xueru and Sun Xueqing (2010) constructed a vector autoregressive model, and performed impulse response and variance decomposition analysis. On this basis, they believed that spot interest rate, stock price volatility, GDP growth rate and stock market return rate were significantly related to credit spreads.

Based on the existing research results, the credit spreads of corporate bonds, credit risk, taxation, bond characteristics, macroeconomic factors and liquidity are closely linked. The panel data regression model is used to analyze the impact of liquidity on bond spreads. The following basic assumptions are proposed:

Hypothesis 1: The credit spread of corporate bonds is affected by various factors such as credit risk factors, macroeconomic factors, and liquidity.

Hypothesis 2: Liquidity is an important factor affecting the credit spread of corporate bonds of listed companies.

The relationship between credit spread and bond liquidity is reversed.

Hypothesis 3: In the crisis period, liquidity is lacking, and the liquidity is more significant than that in the normal period.

III. RESEARCH DESIGN

A. Model Design

In the empirical study, this paper selects the liquidity index of the sample bond as the independent variable, and takes the credit spread of the corporate bond and the national debt risk-free interest rate as the dependent variable. First, the sample bond data is used for the single factor time series regression analysis, and the designed regression model is shown as the following:

$$CS = \phi + \beta * L$$

Among them, CS is the credit spread of corporate bonds, L is the liquidity of corporate bonds, and ϕ is constant.

In order to further analyze the impact of liquidity on corporate bond credit spreads, the basic empirical model used in this paper is a multiple regression model of credit spreads to credit risk control variables, macro-factor risk control variables and liquidity variables. Since the corporate bond had credit spread information at different time, the research can use the panel data model:

$$CS_{it} = \alpha + \beta_1 LR_{it} + \beta_2 CR_{it} + \beta_3 MF_{it} + \varepsilon_{it}$$

In the above formula, CS_{it} represents the credit spread of bond i at time t , LR_{it} represents the liquidity variable of bond i at time t , CR_{it} represents the credit risk control variable of bond i at time t , and MF_{it} represents the macroeconomic factor control variable. α is a constant term, and β_1 , β_2 , and β_3 are coefficients of a variable. Taking into account the requirements of credit risk control variables and liquidity variable calculations, as well as the frequency of macroeconomic factors controlling variable data, the monthly usage is the time unit.

B. Data Selection

The data samples in this paper are mainly taken from the wind database, CSMAR database and China Bond Information Network. The Chinese corporate bond market was formed in 2007. At the beginning of the establishment of the corporate bond market, the market capacity was small. In view of this, this paper selects the transaction data of corporate bonds (wind classification) listed on the Shanghai Stock Exchange from January 2008 to June 2017. After the data sample screening, there are a total of 3917 monthly data of 99 corporate bonds. In the empirical study, this paper uses the daily data to calculate the monthly data of the corresponding variables. In addition, the macroeconomic data of this paper comes from the National Bureau of Statistics.

IV. EMPIRICAL TEST AND ANALYSIS

A. Descriptive Statistical Analysis

TABLE I. DESCRIPTIVE STATISTICS OF THE VARIABLES

| Variable name | The average | Standard deviation | Minimum value | Maximum |
|---------------------------|-------------|--------------------|---------------|---------|
| Credit spread | 1.669 | 0.984 | 0.000761 | 10.65 |
| frequency | 0.215 | 0.269 | 0 | 1 |
| Amihud ratio | 0.306 | 0.265 | 0 | 1.284 |
| EL | 3.835 | 50.75 | 0 | 1826 |
| LnGDP | 11.92 | 0.181 | 11.14 | 12.15 |
| LnM1 | 12.67 | 0.150 | 11.92 | 12.90 |
| PPI | 97.77 | 3.364 | 91.80 | 110.1 |
| economic climate index | 96.93 | 2.509 | 93.82 | 104 |
| risk-free interest rate R | 3.701 | 0.423 | 2.854 | 4.562 |
| SLOPE | 0.422 | 0.228 | 0.130 | 1.517 |
| Equity volatility | 37.20 | 13.76 | 11.65 | 81.39 |
| residual maturity | 5.650 | 2.538 | 1.507 | 14.90 |
| credit rating | 2.662 | 0.616 | 1 | 3 |
| net assets income rate | 4.758 | 8.668 | -152.9 | 41.88 |
| liquidity ratio | 1.051 | 0.678 | 0.0936 | 4.877 |
| asset-liability ratio | 63.47 | 15.02 | 19.69 | 94.11 |

From the descriptive statistics of the above variables shown in "Table I", it can be seen that the average value of the corporate bond credit spread variable is 1.669. Compared with the interest rate level of government bonds with the same maturity date, corporate bonds have premium phenomenon due to credit risk, liquidity risk, tax and other reasons. The minimum value of the credit spread is

0.000761 and the maximum is 10.65. The difference between the two is large, which means that there is big difference in the premium between different corporate bonds.

In general, the overall liquidity of the corporate bond market of listed companies in China is relatively poor.

Compared with the premium of national debt, this has brought obstacles to issuers and investors to a certain extent, which is not conducive to the development of social economy.

B. Analysis of Regression Results

1) *Single factor time series regression model*: This paper firstly conducts a single factor regression on the corporate bond sample. From the "Table II", the regression coefficients of the Amihud ratio and the effective velocity EL index are significant, except for the trading day ratio, which are 0.0185 and -0.001 respectively, which is in line with the basic assumption of the relationship between the liquidity index and the credit spread. From the perspective of Amihud illiquidity index, the credit spread is in the same direction as the Amihud illiquidity indicator, and the credit spread is integrated into the 1.85% non-liquidity factor. The effective flow rate and the credit spread are reversed, and 0.1% liquidity factor is integrated into the credit spread. However, from the point of view of the variable trading days representing the trading behavior, the indicator is not significant. And it does not achieve the same effect as expected.

TABLE II. SINGLE FACTOR TIME SERIES REGRESSION

| Overall sample | α | β | R ² |
|----------------|-----------------|-----------------|----------------|
| frequency | 1.701(20.75)*** | -0.035(0.76) | 0.046 |
| Amihud ratio | 1.689(20.87)*** | 0.0185(0.5109)* | 0.0673 |
| EL | 1.699(20.82)*** | -0.001(2.38)** | 0.083 |

^a Note: t test value in parentheses, *p<.1, **p<.05, ***p<.01

2) *Panel data regression model*: The empirical results of the single-factor time series regression model above have confirmed that liquidity is indeed significantly correlated with corporate bond credit spreads. Next, based on the structured model, this paper studies the impact of corporate bond liquidity on credit spreads under the control of credit risk and macroeconomic factors. In terms of macro factors, LnGDP and economic sentiment index and credit spread are reversed, which means that the better the economic situation is, the smaller the credit spread will be. On the inflation index level, the production price index is proportional to the credit spread. The higher the PPI and the enterprise cost are, the smaller the profit margin will be. The higher the default risk of the bond is, the greater the credit spread will be. On the credit risk factor level, the equity volatility index comprehensively reflects that the asset volatility and financial leverage ratio is negative. It indicates that there is strong substitution effect in the stock market and bond market. When the volatility of the issuer's stock is large, the investors prefer to choose a safer bond market, which increases demand for corporate bonds and narrows credit spreads. There is no correlation between risk-free interest rates and credit spreads. According to credit risk theory, the

larger term structure slope indicates that investors have higher expectations for short-term interest rates, which will lower the credit spread. The empirical results show that the term structure slope of the risk-free interest rate is positive, which is contrary to our expectation. [14] Zhao Jing (2011) also got the same conclusion when using structural theory to study the determinants of corporate bond credit spreads. She categorized the reason for this phenomenon as: short-term interest rates are more negative than long-term interest rates. This does not mean that the expected interest rate will increase in the future, nor does it mean that investors are optimistic about the macroeconomic situation. In short, the risk-free interest rate becomes a decreasing function of the slope, which is the result of deviation from the theory. In addition, higher credit rating bonds mean lower default risk and the smaller the credit spread. In this paper, the fixed-effects model is used for empirical analysis, and the R² of the group is used to measure the goodness of fit of the model. In the following "Table III" model (1) analyzes the influencing factors of the credit spread of listed companies based on the risk level of credit risk and macro factors. R² is 0.2830 and 0.2834 respectively. The overall interpretation of the model is not high, which is exactly the same as the mystery of "credit spread". In addition to the credit risk, the credit spread is also affected by many other factors.

Next, in order to better analyze the credit spread, we add a dynamic measure to the model (1) to verify whether the liquidity of the corporate bond of the listed company will affect the credit spread. We use three liquidity measures in the models (2)-(4) such as the frequency, Amihud illiquidity ratio, and the effective flow rate (EL). Panel data regression results are shown in (2)-(4). The regression coefficient of the frequency in model (2) is negative but not significant. Model (3) incorporates the Amihud illiquidity ratio based on the price shock into the model. The results show that the greater the Amihud illiquidity ratio is, the worse the liquidity of the corporate bond and the greater the credit spread will be. It is in line with our expectations. At the same time, R² in the model (3) is 0.3565, which indicates that the model has a large improvement in the goodness of the credit spread after adding the liquidity factor. Model (4) added the last measure of liquidity—the effective flow rate (EL), with a coefficient of -0.001 and significant at 5%, which is also the same as our expectation. The larger the effective flow rate index is, the better the liquidity of corporate bond, and the smaller the credit spread will be. Through empirical tests, the results are basically in line with expectations. There is a significant relationship between liquidity and corporate bond credit spread. If the bond liquidity is poor, investors require higher returns to compensate for liquidity risk and transaction costs. This is what we usually call high-yield and high-risk. In short, the credit spread and liquidity of corporate bonds change in the opposite direction. The better the liquidity is, the smaller the credit spread, and the lower the risk premium level will be.

TABLE III. REGRESSION RESULTS OF FIXED EFFECTS OF CORPORATE BOND LIQUIDITY ON CREDIT SPREADS

| | Model (1) | Model (2) | Model (3) | Model (4) |
|---------------------------|---------------------|---------------------|---------------------|---------------------|
| frequency | | -0.045 (1.03) | | |
| Amihud ratio | | | 0.594** (2.05) | |
| EL | | | | -0.001** (2.57) |
| LnGDP | -0.540*** (2.69) | -0.538*** (2.68) | -0.541*** (2.70) | -0.534*** (2.67) |
| LnM1 | 0.321 (1.13) | 0.313 (1.10) | 0.323 (1.13) | 0.314 (1.10) |
| PPI | 0.027*** (2.59) | 0.027*** (2.61) | 0.027*** (2.59) | 0.027*** (2.59) |
| economic climate index | -0.075*** (4.19) | -0.075*** (4.21) | -0.075*** (4.19) | -0.075*** (4.17) |
| risk-free interest rate R | 0.029 (0.79) | 0.029 (0.80) | 0.029 (0.77) | 0.027 (0.72) |
| SLOPE | 0.155** (2.08) | 0.155** (2.08) | 0.156** (2.08) | 0.156** (2.09) |
| Equity volatility | -0.010*** (7.13) | -0.010*** (7.13) | -0.010*** (7.13) | -0.010*** (7.14) |
| residual maturity | 0.041 (1.45) | 0.041 (1.44) | 0.041 (1.45) | 0.040 (1.42) |
| credit rating | -0.778*** (8.95) | -0.777*** (8.91) | -0.778*** (8.91) | -0.778*** (8.91) |
| return on equity | -0.015*** (7.87) | -0.015*** (7.88) | -0.015*** (7.84) | -0.015*** (7.88) |
| liquidity ratio | -0.024 (0.49) | -0.024 (0.49) | -0.025 (0.50) | -0.023 (0.45) |
| asset-liability ratio | 0.011*** (4.17) | 0.011*** (4.17) | 0.011*** (4.17) | 0.012*** (4.26) |
| constant term | 10.072*** (3.27) | 10.189*** (3.30) | 10.063*** (3.26) | 10.071*** (3.27) |
| N | 3,917 | 3,917 | 3,917 | 3,917 |
| R ² | 0.2830 | 0.2834 | 0.3565 | 0.3558 |

^a *p<.1,**p<.05,***p<.01

3) *Liquidity and credit spread during the crisis of "money shortage"*: Money shortage means that the liquidity of funds is relatively insufficient in the circulation field. In May 2013, the capital market interest rate soared. In June, large commercial banks also began to borrow money, interbank lending market interest rates climbed.

On June 20, the capital market had to stop, and the overnight position lending rate soared to 13.44%.

The increase was 578 basis points. And the interest rate of funds for each period also rose sharply. The crisis of money shortage was out of control. Next, in June 2013, the paper uses the Amihud illiquidity ratio as the proxy variable of corporate bond liquidity to study the impact of liquidity on corporate bond credit spreads during the pre-crisis period

(January 2012-June 2013) and the money shortage period (July 2013-December 2014). And the specific empirical results are as follows:

TABLE IV. IMPACT OF LIQUIDITY ON CREDIT SPREADS BEFORE AND AFTER THE CRISIS OF "MONEY SHORTAGE"

| | Pre-crisis of "money shortage" | Post-crisis of "money shortage" |
|---------------------------|--------------------------------|---------------------------------|
| Amihud ratio | 0.000 (1.16) | 0.460*** (8.78) |
| LnGDP | -0.609*** (2.53) | -0.614** (2.55) |
| LnM1 | 0.231 (0.32) | 0.378 (1.44) |
| PPI | 0.407*** (9.25) | 0.004 (0.45) |
| economic climate index | -0.349*** (7.26) | -0.032** (2.01) |
| risk-free interest rate R | -0.015 (0.15) | -0.297*** (7.91) |
| SLOPE | 0.519*** (3.22) | -0.002 (0.02) |
| Equity volatility | -0.009*** (2.89) | -0.009*** (6.81) |
| residual maturity | 0.060 (0.79) | 0.038 (1.59) |
| credit rating | -0.771*** (6.66) | -0.730*** (4.73) |
| return on equity | -0.009* (1.74) | -0.017*** (10.08) |
| liquidity ratio | -0.137** (2.04) | -0.199*** (2.69) |
| asset-liability ratio | 0.003 (0.59) | 0.012*** (4.67) |
| constant term | 19.190** (2.04) | 5.669** (2.04) |
| R ² | 0.3241 | 0.3311 |

a. * $p < .1$, ** $p < .05$, *** $p < .01$

The empirical research shows that the crisis of "money shortage" has caused a great change in the liquidity of the corporate bond market, see "Table IV". The impact of liquidity on the credit spread in the early period of the money shortage is not significant. However, it is significant in the late stage of the crisis of "money shortage". And the explanation for liquidity index of the credit spread is 46%, which proves the argument of this paper from another perspective: liquidity has a significant impact on corporate bond credit spreads, and this effect is more pronounced in the period of insufficient liquidity.

V. CONCLUSION

On the basis of the existing theoretical system and academic research results, the author combines the actual situation of China's corporate bond market, and takes the corporate bonds of listed companies traded in Shanghai and Shenzhen as the research object, empirically studies the impact of liquidity on credit spread. The this paper has reached certain conclusions:

- The credit spread of corporate bonds of listed companies in China is affected by many factors such as macroeconomic factors, credit spreads and liquidity.

The credit spread of corporate bonds is related to many factors. At the macroeconomic level, the better the economic situation is, the greater the demand for investment and financing, and the higher the enthusiasm for production and investment will be. Therefore, it will increase the demand for bonds and lower credit spreads. At the credit risk level, the credit spread is positively related to the issuer's default risk.

- The credit spread of corporate bonds is inversely related to liquidity.

Due to many market frictions and imperfections in the capital market, market liquidity is not ideal, which has caused hindrance to issuers and investors to a certain extent. Insufficient bond liquidity means that a higher premium level is required for liquidity risk compensation, which makes the credit spread of liquidity and corporate bonds reverse. Market participants can predict the credit spread to a certain extent by grasping the changes in the liquidity of corporate bonds.

- In the period of insufficient liquidity, the impact of liquidity on credit spreads is more significant.

By dividing the time period of the sample into two sections before and after the "money shortage" crisis, it is found that during the "money shortage" crisis, the liquidity is seriously insufficient. The credit spread will expand due to the scarcity of liquidity, and the liquidity significantly affects the credit spread. In the period of crisis, liquidity indicators can explain 46% of credit spread changes.

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