
Macro-Factors of Credit Spreads in Corporate Bonds

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Abstract:

This study emphasizes on analysis of the macro factors of the credit spreads (CS) of the fixed-rate corporate bonds of non-financial enterprises. Firstly, industry growth (IG) has a significant negative impact on CSs. IG reflects the prosperity of the real economy. The increase of investment demand promotes the rise of bond prices and narrows the CSs; Secondly, consumer price index (CPI) has a significant positive impact on CS. On the one hand, the increase of inflation will reduce bond investment demand, on the other hand, it will increase investors' expectations of future tightening monetary policy. Uncertainty increases while default risk rises and CS widen. Thirdly, spreads of treasuries have a significant negative impact on CS. When the slope of the treasury yield curve increases and the expectation of interest rate increases, macro-economy is in an upward stage, and CS narrow. Fourthly, the analysis of VAR, variance decomposition and impulse response function show that the impact of CPI, IG and interest rate difference of national debt on spreads has time lag. While money supply affects CS by affecting CPI. This study discusses the CS which is very important for the asset allocations of investors. The investors and market participants should consider the macro-factors while invest in corporate bonds.

Keywords: *Credit spreads, Macrofactors, Corporate bonds, CPI, Industry growth.*

I. INTRODUCTION

Bonds have become the main force of the bond market to release the systemic risks in financial market. Corporate bonds are an important channel to raise funds. In China, the proportion of bond financing is still lower than that of western developed countries. Various types of credit bonds issued in China from 2011 to 2018 are shown in TABLE I.

Since 2015, the working procedure for pre-examination and examination of corporate bond while expanding the issuing entities, the issuance process has been simplified and the liquidity of the bond market has been enhanced. Meanwhile the investor group has been expanded in the secondary market, the policy level has been improved, and the institutional dividends have been released continuously. Since then, it has entered a channel of super-rapid development, stepping into the trillion level, and has become an important way of financing the real economy. It has

increased the proportion of direct financing in the whole society and promoting the steady development of the economy.

TABLE I. Scales of corporate bonds issued

Bond issuance (10,000 RMB)	Enterprise bond	Corporate bond	Convertible bond	Medium-term note	Commercial paper
2011	2,857.03	517.50	717.30	4,924.00	6,917.35
2012	2,553.88	1,291.20	413.20	7,279.70	10,122.30
2013	6,590.31	2,626.81	163.55	8,453.30	14,807.47
2014	4,836.30	1,699.86	544.81	6,948.20	19,055.70
2015	6,985.98	1,553.42	320.99	9,768.40	25,979.43
2016	3,470.02	10,614.95	98.00	12,724.20	35,559.90
2017	5,962.70	28,320.18	212.52	11,418.10	34,896.45
2018	3,745.95	11,133.99	947.11	10,341.45	24,168.90

In the past, scholars have discussed the CS of corporate bonds from different points-of views. The interbank market, exchange market and commercial bank counter have their own bond products and investors, and are regulated by different regulatory authorities. This situation not only weakens the liquidity of the bond market, but also is not conducive to the unification of interest rates in multiple trading places. Therefore, the macro-factors of CS of corporate bonds in China are worth analyzed.

This study aims to discuss the macro factors that affect CS with a more comprehensive perspective. For corporate bonds, the company's future operating conditions and cash flow level are highly uncertain. Therefore, besides interest rate risk, credit risk is also an important factor in investment decision-making. Accurate measurement of credit risk and characterization of factors affecting CS are helpful to more comprehensive management of corporate bond risk.

II.LITERATURE REVIEW

Many researches have proved that macro-factors significantly affects CS [1-3].CS of corporate bonds is determined by the credit rating of the bonds, macro-factors and government credit risks and global factors in a particular country[4]. Monetary policy can influence CS [5]. Expansionary monetary policy will improve cash flow level, and reduce the expected default risk of corporates and CS will expand in the downturn of the commercial and credit markets[6-7]. The long-term negative relationship between CS and interest rate levels and a less direct relationship between CS of corporate bonds and the slope of the US Treasury yield curve exists [8,9].CPI was positively correlated with bond CS, and CS would expand when inflation was serious [10].The relationship between IG and CS, and found that the duration of the period will affect the mechanism of CS [11].Investors tend to be conservative when the stock market fluctuates sharply, and pursue the security and liquidity of assets more. Stock market volatility

has a negative correlation with CS of bonds [12]. The reason is the substitution effect of stock investments and bond investments. When the stock market fluctuates sharply, bond investment demand increases, while the price rises, the CS decreases.

III.DATA AND ANALYSIS

3.1 Data

This study investigates macro-factors on CS of corporate bonds. Firstly, it makes a qualitative analysis of the selected macroeconomic explanatory variables, clarifies the theoretical mechanism and then carries out quantitative empirical research. First, the basic regression analysis of CS is used. All non-financial corporate bonds from 2011 to 2018 are selected as samples, and corporate bonds with redeemable and saleable terms are excluded. Multivariate regression model is constructed with macroeconomic variables as explanatory variables, and stepwise regression is used to determine the optimal model. Secondly, vector autoregressive model (VAR) is applied to study the impact intensity and lag of each macro variable. This study synthetically considers the structured model and the decomposition theory of CS. CS and Macro-factors selected as variables for empirical study are shown in TABLE II.

TABLE II Definition of explanatory variables

	VARIABLES	DEFINITION
CS	credit spread of corporate bonds	the average of the difference between the yield of all corporate bonds
ΔMS	growth rate of money supply	change of MS compared with the previous year in current month
R_f	risk-free rate	monthly average of interbank lending rate for 7 days
YS	yield spread	monthly average of the yield difference between 10-year treasury bond and 1-year treasury bond
R_s	stock return	return of the CSI 300 Index
σ	volatility of stock market	standard deviation of CSI 300 index in 30 days
ΔIG	growth rate of IG	change of IG compared with the previous year in current month
ΔCPI	change of CPI	change of CPI compared with the previous year in current month

3.1.1 Growth Rate of Money Supply (ΔMS)

MS includes deposits and cash provided by financial institutions, including central banks. MS is an important policy tool. It can reflect the capital stock and lending market growth in the real economy of China. When MS increases, abundant funds will flow to the capital market, which will push up the bond market price and narrow the CS. When MS decreases, the tightening of money will cause the shortage of funds, and the bond price will decrease with the

decrease of demand, so the CS will expand.

3.1.2 Risk-free Rate (R_f)

The price of options is derived from the expected future cash flow discounted according to R_f . Therefore, the higher R_f level will reduce the price of options. At the same time, this study constructs an asset group equivalent to corporate debt by holding certain risk-free assets and selling put options based on corporate assets. It can be seen that the increase of R_f will make the price of put options decline, while the yield on maturity will decrease, and the CS will decrease. In addition, the negative correlation between the two from two perspectives of macroeconomic cycle and bond supply and demand: when the riskless interest rate is in the ascending channel, the macroeconomy is mostly in the ascending stage of development, the economy is basically good-oriented, asset value is rising, the probability of default of companies is decreasing, CS are decreasing, and vice versa; from the perspective of supply and demand, when demand of money is on the rise, then R_f is on the rise. When R_f rises, the cost of financing by issuing bonds is higher, so the supply of bonds will decrease, which will cause bond prices to rise and CS to decrease. When R_f has a stronger impact on the corporate yield than on the bond yield, R_f has a positive correlation with the CS. When R_f increases, the debt of the company increases, and the solvency weakens. When R_f is reduced, investors will expect lower default rate and lower CS, and vice versa.

3.1.3 Yield Spread (YS)

When the slope of the yield curve of Treasuries increases, forward rates are higher than current interest rates, and market interest rate may increase. The steeper the yield curve of Treasuries, the stronger the expectation of future inflation. If the change of slope has a impact on CS of corporate bonds, the CS may also expand.

3.1.4 Stock Market Returns (R_s)

Theoretically, R_s and CS can be negatively correlated: when R_s is high, the economic growth is strong, the value of enterprise equity assets increases, the market anticipates that the solvency of enterprises is enhanced and the default risk is reduced, so CS are narrowed. On the contrary, when R_s is low, the market is depressed, the economic recession and the equity assets of enterprises are reduced. When CS increases as the value decreases, the market expects the solvency of enterprises to weaken and the risk of default to increase.

3.1.5 Volatility of Stock Market (σ)

The impact of σ on CS can be analyzed from the perspective of model and risk. The higher σ , the higher the CS. From the points of view of risks, frequent price fluctuations of stock market increase the market risk of the capital market. Therefore, the default risks of bond market may also increase then further lead to the increase CS of bonds.

3.1.6 Growth Rate of IG (ΔIG)

ΔIG can reflect the trend of macroeconomic operation to a great extent. The steady IG indicates that the overall macroeconomic is in a good rising cycle. The operation status and cash flow level of real enterprises are relatively ideal. Investors expect that the profitability of future enterprises is better. Therefore, default is a small probability event, and the development of real

economy. The exhibition boosted bond prices and reduced CS, and vice versa.

3.1.7 Change of CPI (Δ CPI)

When CPI increases, with the total income level unchanged, the consumer expenditure increases, the income available for investment decreases, and the demand for bonds decreases. On the other hand, from the perspective of investors' expectations, the growing CPI will increase investors' expectations of future central bank tightening monetary policy and shake investors' confidence. The above two factors superimpose on the demand of bond market, which leads to the decrease of market price and the increase of CS. When CPI decreases, the income available for investment increases, and the demand for bonds increases. At the same time, the continuous decline of CPI will increase investors' expectations and enhance investors' confidence. Δ CPI will affect the demand of the bond market and narrow CS.

Descriptive statistics and correlation matrix are shown in TABLE III and TABLE IV.

TABLE III. Descriptive statistics

	MEAN	STD. DEV.	MAXIMUM	MINIMUM
CS	0.70	0.30	1.59	0.13
Δ MS	13.86	3.29	25.52	8.80
R_f	3.57	0.91	5.95	1.69
YS	0.73	0.43	1.88	0.13
R_s	0.35	6.77	17.91	-15.57
σ	74.27	59.28	345.79	16.88
Δ IG	9.41	3.25	17.80	5.60
Δ CPI	2.62	1.35	6.36	0.8

TABLE IV. Descriptive statistics

	CS	Δ MS	R_f	YS	R_s	σ	Δ IG
Δ MS	0.5						
R_f	-0.29	-0.35					
YS	0.5	-0.57	0.75				
R_s	-0.02	0.07	-0.24	-0.17			
σ	0.21	-0.01	0.31	-0.09	0.04		
Δ IG	0.22	-0.08	0.53	-0.15	-0.1	0.77	
Δ CPI	0.12	0.19	0.15	-0.12	-0.09	0.74	0.38

3.2 Results of OLS

TABLE V shows the results of OLS. The regression results show that Δ MS, Δ IG, Δ CPI and YS have significant effects on the CS of corporate bonds. The coefficient is significantly positive at the level of 1%. The increase of one percentage of Δ MS will cause the CS to rise by

0.070 percentage points. The coefficient of ΔIG is significantly negative at the level of 1%. The increase of ΔIG by 1 percentage point will cause the CS to decrease by 0.07 percentage points. The coefficient of ΔCPI is significantly positive at the level of 1%. The increase of 1 percentage point over the same period will cause the CS to rise by 0.09 percentage points.

TABLE V. Results of OLS

	DEPENDENT VARIABLE: CS			
	MODEL A	MODEL B	MODEL C	MODEL D
ΔMS			0.090 (0.000)	0.070 (0.000)
R_f	-0.002 (0.965)			0.004 (0.921)
YS	0.354 (0.000)			0.221 (0.070)
R_s		0.000 (0.977)		0.005 (0.188)
σ		0.001 (0.047)		0.000 (0.623)
ΔIG			-0.071 (0.000)	-0.073 (0.000)
ΔCPI			0.071 (0.024)	0.086 (0.008)
INTERCEPT	0.450 (0.010)	0.625 (0.000)	-0.056 (0.625)	0.009 (0.964)

Note: Values in parentheses are p-values of corresponding coefficients.

3.3 Results of VAR

To explore CS from a dynamic point of view, on the basis of multivariate basic regression, this chapter constructs a vector autoregressive. ADF stationarity test was carried out for eight variables in the model, and the test results were reported in TABLE VI. As ADF test, the variables included in the model can be regarded as stationary series.

VI. ADF test

	ADF TEST T-STATISTIC
CS	-5.17
ΔMS	-4.81
R_f	-4.10
YS	-8.63
R_s	-3.23

σ	-2.81
ΔIG	-3.20
ΔCPI	-4.27

When the lag order is 2, VAR model is stable. VAR results are in TABLE VII. The results show that CS are significantly affected by the lag of the first period of the CS at the level of 1%. The lag of the CPI and the lag of the IG have significant effects on the CS at the level of 5%. The lag of the CPI and the lag of the national debt interest rate is at the level of 10%. CS have a significant impact. TABLE VIII shows the 10-period variance decomposition of corporate bond CS. The variance decomposition values of the first to tenth forecast periods of corporate bond CS. It is found that the variance contribution rate of the interest rate spread of treasury bonds to CS increases with the increase of the forecast period. In the first five periods, the first three contribution rates to the variance of CS equation are CS, treasury bond spreads and interest rates, while in the sixth and subsequent periods, the first three contribution rates to the variance of CS equation are CS, treasury bond spreads and IG. Through VAR and variance decomposition, ΔCPI , ΔIG and YS all have significant effects on CS of corporate bonds and have time lags. ΔMS affects CS of corporate bonds.

TABLE VII. Results of VAR

	CS	ΔMS	R_f	YS	R_s	σ	ΔIG	ΔCPI
CS_{t-1}	0.713 (6.478)	0.628 (1.430)	0.175 (0.432)	0.046 (0.455)	-0.813 (-0.213)	-1.478 (-0.054)	-0.573 (-1.286)	0.116 (0.479)
CS_{t-2}	-0.145 (-1.333)	-0.631 (-1.456)	0.134 (0.336)	0.013 (0.132)	3.904 (1.034)	36.517 (-1.342)	0.921 (2.091)	0.09 (0.379)
ΔMS_{t-1}	0.022 (0.780)	0.615 (5.417)	0.237 (2.269)	0.009 (0.354)	-0.119 (-0.121)	0.532 (0.075)	0.04 (0.347)	0.117 (1.880)
ΔMS_{t-2}	-0.024 (-0.961)	0.155 (1.536)	-0.240 (-2.574)	0.007 (0.314)	0.129 (0.146)	-3.598 (-0.567)	0.158 (1.533)	-0.099 (-1.779)
R_{ft-1}	-0.009 (-0.257)	-0.049 (-0.369)	0.488 (3.969)	-0.025 (-0.802)	0.602 (0.518)	1.13 (0.135)	0.035 (0.259)	-0.072 (-0.977)
R_{ft-2}	0.001 (0.038)	0.201 (1.501)	0.054 (0.441)	0.014 (0.451)	-0.799 (-0.685)	0.387 (0.046)	0.038 (0.282)	0.024 (0.324)
YS_{t-1}	0.255 (1.905)	1.268 (2.372)	-0.836 (-1.699)	1.007 (8.211)	-3.5 (-0.752)	13.717 (0.409)	0.395 (0.728)	-0.566 (-1.924)
YS_{t-2}	-0.126 (-0.872)	-0.027 (-0.048)	0.338 (-0.638)	-0.409 (-3.094)	-4.604 (-0.918)	-16.332 (-0.452)	-0.125 (-0.213)	0.392 (-1.239)
R_{st-1}	0.003 (0.782)	0.001 (0.061)	-0.007 (-0.558)	0.005 (1.639)	0.076 (0.678)	1.517 (1.883)	0.018 (1.357)	-0.008 (-1.193)
R_{st-2}	0.002 (0.623)	0.012 (0.944)	0.008 (0.658)	-0.003 (-0.930)	-0.139 (-1.238)	0.42 (0.518)	-0.008 (-0.634)	0.01 (1.347)

σ_{t-1}	0.000 (-0.082)	-0.001 (-0.417)	0.000 (0.093)	0.000 (-0.373)	-0.022 (-1,353)	0.277 (2.346)	-0.002 (-1.184)	0.001 (1.223)
σ_{t-2}	0.000 (0,127)	0.001 (0.542)	0.000 (-0.277)	0.001 (2.666)	0.013 (0.811)	0.411 (3.488)	0.000 (-0,135)	-0.001 (-0.874)
ΔIG_{t-1}	-0.059 (-2.304)	0.06 (0.580)	0.056 (0.590)	-0.002 (-0.095)	-0.494 (-0.552)	-0.429 (-0.067)	0.524 (5.020)	0.067 (1.194)
ΔIG_{t-2}	0.067 (2.816)	-0.045 (-0.472)	-0.022 (-0.249)	0.026 (1.203)	1.176 (1.415)	6.003 (1.002)	0.184 (1.893)	-0.011 (-0.209)
ΔCPI_{t-1}	0.092 (-1.823)	0.218 (-1.089)	-0.08 (-0.436)	-0.045 (-0.982)	1.211 (-0.694)	-8.121 (-0.646)	-0.046 (-0.226)	0.626 (-5.678)
ΔCPI_{t-2}	-0.105 (-2.186)	-0.183 (-0.954)	0.131 (0.745)	0.009 (0.214)	-11804 (-1.906)	-2.723 (-0.226)	0.287 (1.477)	0.229 (2.173)
ADJ-R ²	0.638	0.934	0.495	0.823	0.213	0.424	0.947	0.913
LL	26.672	-103.367	-95.6	35.007	-306.8	-492.466	-104.848	-47.171

Note: Values in parentheses are t-values of corresponding coefficients.

TABLE VIII. Results of variance decomposition of CS(%)

Period	CS	ΔMS	R_f	YS	R_s	σ	ΔIG	ΔCPI
1	100.000							
2	92.986	0.401	0.893	2.419	0.431	0.004	1.647	1.219
3	88.974	0.461	2.212	4.600	1.050	0.058	1.506	1.139
4	85.071	0,526	2.813	6.277	2.189	0.165	1.805	1.153
5	82.964	0.615	2.814	6.651	2.522	0.328	2.493	1.613
6	81.594	0.657	2.778	6.558	2.512	0.498	3.120	2.283
7	80.602	0.656	2.824	6.498	2.484	0.577	3.510	2.849
8	79.957	0.655	2.881	6.472	2.465	0.586	3.732	3.252
9	79.550	0.675	2.905	6.442	2.452	0.583	3.858	3.534
10	79.262	0.710	2.905	6.421	2.444	0.588	3.931	3.739

IV. CONCLUSION

From the analysis of the changes of the CS of corporate bonds in China from 2011 to 2018, the empirical results show that IG affects CS negatively. IG reflects the prosperity of the real economy. The increase of investment demand promotes the rise of bond prices and narrows the CS. Meanwhile, CPI positively affects CS. The change of inflation will affect the demand of bonds, therefore, it will increase investors' expectations of future tightening monetary policy. Uncertainty increases while default risk rises and CS widen. YS negatively affects CS. When the slope of the treasury bonds yield curve increases then macro-economy is in an upward stage and CS narrows.

The recommendations of this study are as follows. First, establish a reliable third-party credit

rating system to enhance the reliability of credit rating. Credit rating plays an absolute reference role for Chinese investors in judging bond prices. At present, China's rating system generally has the problem of high rating, which leads investors to underestimate the default risk of debt issuing enterprises. Therefore, it is very important to guide rating agencies to formulate effective rating standards, and at the same time, it can also reduce the losses caused by investors due to information asymmetry. Secondly, regulators can grasp the quantitative analysis of CS of corporate bonds, analyzing various macroeconomic indicators, corporate operating conditions indicators and bond characteristics. CS of corporate bonds can measure the default risk of corporate bonds. Regulators can also monitor the index to achieve the purpose of monitoring market risk.

REFERENCES

- [1] Krainer, J. (2005) What determines the credit spread?. *Frbf Economic Letter*
- [2] Huang, J. Z., Lai Y., Shi Z. (2012). New evidence on the determinants of credit spread changes. Available at SSRN: <https://ssrn.com/abstract=2024757>
- [3] Azad, A. S. M. S., Chazi, A., Cooper, P., Ahsan, A. (2017) What determines the Japanese corporate credit spread? A new evidence. *Research in International Business and Finance* 41: 354-361 doi:10.1016/j.ribaf.2017.04.029
- [4] Champagne C., Coggins F., Sodjahn A. (2017) Corporate bond market interdependence: Credit spread correlation between and within U.S. and Canadian corporate bond markets. *North American Journal of Economics and Finance* 41: 1-17
- [5] Cenesizoglu, T., Essid D. (2012) The effect of monetary policy on credit spreads. *Journal of Finance Research* 35(4): 581-613
- [6] Wang, C., Qu, J. (2020) Analysis of the pro-cyclical behavior of credit spread in Chinese bond market. *Journal of Applied Finance and Banking* 10(4): 157-176
- [7] Brown, D. T. (2001) An empirical analysis of credit spread innovations. *The Journal of Fixed Income*. 11(2): 9-27
- [8] Joutz, F. L., Maxwell, W. F. (2002) Modeling the yields on noninvestment grade bond indexes: Credit risk and macroeconomic factors. *International Review of Financial Analysis* 11(3): 345-374
- [9] Miloudi, A., Moraux, F. (2009) Relations between corporate credit spreads, treasury yields and the equity market. *International Journal of Business* 14(2)
- [10] Kang, J., Pflueger, C. E. (2015) Inflation risk in corporate bonds. *The Journal of Finance* 70(1): 115-162
- [11] Nordström, M. (2020) Credit spread and employment growth—a time-varying relationship?. *Applied Economics Letters* 1-9
- [12] Bewley, R., Rees, D., & Berg, P. (2004) The impact of stock market volatility on corporate bond credit spreads. *Mathematics and Computers in Simulation* 64(3-4): 363-372