

# Study of Green Credit Risk in the Steel Industry Considering Exogenous Shocks

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**Abstract:** Based on the ESG-KMV model constructed by introducing industry ESG thresholds and ESG score values into the traditional KMV model's enterprise asset value and enterprise default point, a nonlinear mathematical expectation ESG-KMV model was constructed from the perspective of a commercial bank considering exogenous shocks and other factors, in order to measure the impact of exogenous shocks on the green credit risk of iron and steel enterprises. Results: The ESG-KMV model based on nonlinear expectation modification is introduced under the consideration of exogenous shocks, and the measurement results show that the default distance in the control group is relatively stable, while the default distance in the default group becomes sharply larger and smaller, and then becomes stable and smaller, which indicates that the model can effectively measure the impact of exogenous shocks on the green credit risk of iron and steel enterprises.

**Keywords:** ESG-KMV; Exogenous Shock; Steel Industry; Green Credit.

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## 1. Introduction

General Secretary Xi Jinping pointed out that the new development concept of innovation, coordination, greening, development and sharing should be implemented unswervingly. Green development is an important part of the new development concept. The system to create a harmonious coexistence between mankind and nature as the core value orientation, focusing on the implementation of green low-carbon, circular economy principles and ecological civilization construction as the basic line of defence, and ultimately to achieve the coordination and unity of economic and social development and ecological environmental protection. In this context, as a component of green finance, green credit plays an important role in helping to promote the new development concept. The proposal of the Green Credit Guidelines signifies that green credit plays an important role in the practice of the new development concept. The Key Evaluation Indicators for the Implementation of Green Credit is an important basis for banks to implement the New Development Concept. The "Implementation programmer for Green Bank Rating in China's Banking Sector (Enforcement)" marks the green bank evaluation work carried out by the China Banking Association. 2021 The proposal of the Central Bank's "Green Finance Evaluation Programmer for Banking Financial Institutions" is an enhancement to the implementation of green credit under the New Development Concept. In accordance with national policy guidelines and the "double carbon" goal, commercial banks have developed strong green credit, opened up green credit approval channels, and become the main force of the financial industry under the implementation of the new development concept.

Research in the steel industry in the development of green credit status quo, the state put forward relevant steel industry green credit policy requires the establishment of a perfect risk management system, the need for green projects to carry out rigorous screening and assessment to implement China's green financial top-level design to accelerate the advancement. But the existing research in the steel industry development is not in place, most of the scholars' research is

mainly focused on the impact of the implementation of green credit and the impact of green credit on the "two high and one leftover" enterprises green innovation level of research, and the assessment of the risk of default on green credit less consideration of the green factors. Therefore, it is of great significance to include green indicators in the study of green credit rating of iron and steel industry under the new development concept.

## 2. Literature Review

Black and Scholes (1973) [1] proposed an option pricing model under linear conditions. Merton (1973) [2] proposed the Black-Scholes-Merton model with the same results but with more relaxed constraints. In real life, it has been found that financial markets are characterized by nonlinearity in many cases. In order to cope with risk shocks from outside the financial sector, academic researchers have embarked on the study of mechanisms based on the paradigm of nonlinear theory and further applied it to the practice of financial risk research. Choquet (1953)[3] proposed the concepts and definitions of the Choquet integral and tolerance as the beginning of the nonlinear expectation theory. On this basis, Denneberg (1994) [4] extended and developed and constructed a large class of dynamically compatible nonlinear expectations by introducing a typical backward stochastic differential equation (BSDE) on a probability space. This discovery laid the key foundation and revelation for the nearly 20 years of research into nonlinear expectation theory that followed. peng (1997)[5][6] produced a function  $g(g\text{-expectation})$  from this expectation operation being an inverted stochastic differential equation. Until 1989, Schmidler (1989) [7] proposed the nonlinear expectation Choquet expected utility. Gilboa and Schmeidler (1989) [8] proposed a maximisation principle based on the minimum expected utility, but these methods can only solve the static case. For singular cases, i.e., dynamic and continuous event cases have also been significantly studied. The nonlinear expectation-G-expectation proposed by Peng Shigo (2006) [9] which does not need to be built on a given probability space.

Buckdahn [10] empirically empiricalised the G-expectation in risk metrics. Gong Xiaolin (2014) [11] and others constructed the stochastic limit normal distribution probability statistical models R-VaR and R-ES based on G-expectation as well as G-normal distribution function, which effectively solved the situation that the data distribution presents a spiked post-tailed asymmetry in calculating the risk of financial markets. Hui Ling Yuan (2017) [12] introduced G-expectation by improving the traditional risk measure model Var model in which the uncertainty of risk in the financial market was incorporated in the study. Xu Mingyue (2022) [13] empirically analysed corporate default risk under financial market uncertainty by incorporating nonlinear expectation theory into the KMV model.

### 3. The Model

#### 3.1. KMV Model

Developed by KMV in 1997 on the basis of the Black-Scholes option pricing model of Kwahofer, McQuoW and Vascik, the KMV model is a tool for analysing a company's credit risk in terms of fluctuations in stock value. Following Moody's acquisition of KMV KMV's model has studied large global corporations over the past several decades, including the 2018 subprime crisis. The accuracy and timeliness of the model, which distinguishes between defaulting and non-defaulting companies and analyses them against the ratings of the credit rating agencies in use at the time, has been recognized by academics and subsequently by the wider academic community.

The main idea of the model is: based on the enterprise's equity market value, equity value volatility and risk-free theory as well as the stipulated time, calculate the enterprise's asset value volatility and asset value as well as asset value volatility to determine the default point (Default Point (DP)), calculate the distance to default (Distance to Default (DD)), and analyze whether there is any default risk according to the mapping relationship between the two. relationship between the two, to analyse whether there is a risk of default for the enterprise or not.

(1) Calculation of market value  $\sigma_A$  and volatility of business assets  $V_A$

$$E = V_A N(d_1) - DN(d_2) e^{-rT} \quad (1)$$

$$d_1 = \frac{\frac{\ln V_B}{D} + (r + \frac{1}{2} \sigma_A^2) T}{\sigma_A \sqrt{T}} \quad (2)$$

$$d_2 = d_1 - \sigma_A \sqrt{T} \quad (3)$$

$$N(d) = \int_{-\infty}^d \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx \quad (4)$$

Where:  $E$  is Market value of equity;  $V_A$  Market value of assets  $D$  Carrying value of debt  $N(\bullet)$  Cumulative probability distribution of the standard normal distribution  $\sigma_A$  Asset market value volatility  $r$  risk-free rate  $T$  Debt service period

(2) Calculation of DP (point of default) and DD (distance to default)

$$DP = STL + 0.5LTL \quad (5)$$

$$DD = \frac{\ln(V_A / DP) + (r - 0.5\sigma_A^2)T}{\sigma_A \sqrt{T}} \quad (6)$$

The size of the enterprise's default risk can be initially determined by the size of the default distance, if the default distance DD is gradually becoming smaller, indicating that the probability of enterprise default is increasing, and further in the enhancement of the enterprise's default risk.

(3) Relationship between distance to default and probability of default

The expected default probability EDF at future moment T ( $V_T$  indicating the market value of the asset at that moment) is:

$$EDF = \Pr(V_T \leq DP | V_0) = \Pr(\ln V_T \leq \ln DP) \quad (7)$$

$$EDF = \Pr(\ln V_0 + (r - \frac{\sigma_A^2}{2})T + \sigma_A \sqrt{T} \varepsilon \leq \ln DP) = \Pr(\varepsilon \leq -\frac{\ln(\frac{V_T}{DP}) + (r - 0.5\sigma_A^2)T}{\sigma_A \sqrt{T}}) \quad (8)$$

The expected default probability (EDF) is obtained from the nature of the standard normal cumulative distribution function as:

$$EDF = N(-\frac{\ln(\frac{V_T}{DP}) + (r - 0.5\sigma_A^2)T}{\sigma_A \sqrt{T}}) = N(-DD) \quad (9)$$

#### 3.2. ESG-KMV Model Considering Exogenous Shocks

**Definition 3.1** (*Choquet* Expectation)  $(\Omega, \lambda)$  For the previous random variable  $X$ , if

$$C_V[X] := \int_0^\infty V(X \geq t) dt + \int_{-\infty}^0 [V(X \geq t) - 1] dt \quad (10)$$

We call  $C_V[X]$  the expectation of a random variable about  $X$  the *Choquet* expectation.

In the BSM model it is assumed that the stock asset value process obeys a geometric Brownian motion viz:

$$dS_t = \alpha_t S_t dt + \sigma_t S_t dB_t \quad (11)$$

where  $\{\alpha_t, 0 \leq t \leq T\}$  is the expected return on the asset.

The only definite one  $Q$

can be found makes:

$$\frac{dQ}{dP} = \exp(-\frac{1}{2} \int_0^T (\frac{\alpha_t - r}{\sigma_t})^2 dt + \int_0^T (\frac{\alpha_t - r}{\sigma_t}) dB_t) \quad (12)$$

It is easy to see that  $Q$  is related to the extreme volatility of expected stock returns. Assume here that the exact value of  $\alpha_t$  its an interval:  $\alpha_t \in [r - k\sigma_t, r + k\sigma_t]$  where  $k$  is a given positive constant, which we will make into a fuzzy coefficient. Let  $v_t = \frac{\alpha_t - r}{\sigma_t}$  thus extends  $Q$  into a

cluster of probability measures:

$$p = \{Q^v : \frac{dQ^v}{dP} = \exp(-\frac{1}{2} \int_0^T |v_t|^2 ds + \int_0^T v_t dB_t), \sup_{t \in [0, T]} |v_t| \leq k\} \quad (13)$$

Illustration  $Q$  extends from a unique risk-neutral measure of financial markets that is complete and free of arbitrage to a cluster of probability measures. A common approach is to use the maximum and minimum pricing methods proposed by *ElKaroui* and *Choquet*.

The max-min expectation reference is *ElKaroui* :

$$\left| \bar{\varepsilon}[\xi] = \sup_{Q \in \mathcal{P}} E_Q[\xi] \right. \quad (14)$$

$$\left. \varepsilon[\xi] = \inf_{Q \in \mathcal{P}} E_Q[\xi] \right| \quad (15)$$

Corollary 3.3 Assume that  $X_T$  in Equation 15 is the value process of the underlying asset and that  $(X_T - K)^+$  denotes the expiration payment of the corresponding European call option. At this point the maximum and minimum expectations under the uncertain market are equivalent to the *Choquet* upper and lower expectations

$$\bar{C}[(X_T - K)^+] = \bar{\varepsilon}[(X_T - K)^+]$$

$$C[(X_T - K)^+] = \varepsilon[(X_T - K)^+] \quad (16)$$

Assume that the change in the value of the underlying asset satisfies the following SDE:

$$S_t = \nu S_t dt + \sigma S_t dB_t \quad (17)$$

where 1, the European call option corresponding to the value of this underlying asset has an exercise price of 1, and its pricing range under the uncertain market is:

$$\bar{C}[(S_t - K)^+] = \bar{\varepsilon}[(S_t - K)^+] = E_{Q_1}[(S_t - K)^+] = E[(xe^{(k\sigma + \nu - \frac{1}{2}\sigma^2)t + \sigma B_t} - K)^+] \quad (18)$$

$$C[(S_t - K)^+] = \varepsilon[(S_t - K)^+] = E_{Q_2}[(S_t - K)^+] = E[(xe^{(k\sigma + \nu - \frac{1}{2}\sigma^2)t + \sigma B_t} - K)^+] \quad (19)$$

upper and lower prices of European call options at this time:

$$e^{-rT} C[(S_t - K)^+] = xe^{(k\sigma + \nu - r)T} N(d_2) - e^{-rT} KN(d_1) \quad (20)$$

$$d_1(T, x) = d_1(T, x) + \sigma\sqrt{T} = \frac{1}{\sigma\sqrt{T}} \left[ \ln \frac{x}{K} + (k\sigma + \nu + \frac{1}{2}\sigma^2)T \right] \quad (21)$$

$$e^{-rT} \bar{C}[(S_t - K)^+] = xe^{(-k\sigma + \nu - r)T} N(d'_2) - e^{-rT} KN(d'_1) \quad (22)$$

$$d_2(T, x) = d_1(T, x) + \sigma\sqrt{T} = \frac{1}{\sigma\sqrt{T}} \left[ \ln \frac{x}{K} + (-k\sigma + \nu + \frac{1}{2}\sigma^2)T \right] \quad (23)$$

At this point it is possible to derive European call option pricing intervals under uncertain markets, indicating that d1 and d2 in the KMV model have been solved. it is then possible to introduce the European option pricing formulae under the nonlinear expectation introducing the fuzzy coefficient k into the ESG-KMV model:

$$V_E = V_A N(d_1) - DN(d_2) e^{-rT} \quad (24)$$

where 1 the market value of equity, d1 and d2 are the European option pricing formulas 17 and 18 under nonlinear

expectation theory

$$DD = \frac{\ln\left(\frac{V_G}{DP}\right) + \left(r - \frac{\sigma_A^2}{2} - k\sigma_A\right)T}{\sigma_A\sqrt{T}} \quad (25)$$

$$V_G = V_E \left( h_1 + h_2 \frac{ESG_i}{ESG_0} \right) \quad (26)$$

$$DP = \frac{ESG_i}{ESG_0} (STL + \frac{1}{2}LTL) \quad (27)$$

$$ESG_0 = ESG_{\min} + k(ESG_{\max} - ESG_{\min}) \quad (28)$$

$$EDF_k = N\left(\frac{\ln\left(\frac{V_A}{DP}\right) + \left(r - \frac{\sigma_A^2}{2} - k\sigma_A\right)T}{\sigma_A\sqrt{T}}\right) \quad (29)$$

Where: DD is the distance to default, ESG0 is the threshold of ESG score for the steel industry,  $V_A$  is the value of assets,  $V_G$  is the new value of assets after ESG incorporation (referred to as "green value"),  $ESG_i$  is the ESG score of the *i*th company in a certain steel industry, k is [0,1], DP is the default point, STL is current liabilities, LTL is non-current liabilities,  $h_1$  and  $h_2$  are the weights. , STL is current liabilities, LTL is non-current liabilities, and  $h_1$  and  $h_2$  are weights.

## 4. Empirical Results

### 4.1. Data Selection

Data selection is based on (1) industry classification based on the ferrous metal smelting industry in the manufacturing industry under the Shenwan Industry Classification Standard of the Wind database; (2) listed companies issued in A-shares; (3) listing date before 1 January 2019; (4) ESG ratings data of the selected listed companies exists and is complete; (5) financial data needs to exist and be complete; for the companies with missing indicator data using a culling methodology. in Table 1

**Table 1.** Data sources

variable name	Data sources
ESG rating	Wind database
Current liabilities, long-term liabilities	Wind database
Market value of corporate equity	Wind database
Enterprise equity value volatility	Wind database
risk-free rate	customisation
Debt service period	Wind database

The study year for the steel industry is 2019-2022. According to the enterprise in these four years because of the financial, operational, environmental and continuous losses are treated (\*ST) as a default group, selected default group total 13 as shown in Table 2 (data source: Wind database).

### 4.2. Results of the KMV Model

Default distance DD is the distance between the value of an enterprise's assets and the point of default in a given

interval of accounting time years. A decreasing default distance indicates that the probability of the firm's default is increasing; conversely, an increasing default distance indicates that the firm's default distance is decreasing. This metric therefore provides a good guide for equity and debt investors, as well as relevant financial regulators and commercial banks. The KMV model has been used to measure the objects to be approved and regulated, defining risk prevention warning lines and reasonable loss prevention

and risk avoidance.

**Table 2.** Enterprises in the default group in the steel industry

Company Code	company identification	Company Code	company identification
600010	Baosteel, China's largest steel maker	000898	Ansteel
600808	Maanshan Steel	300933	Centron (Chinese company)
600117	Xining Special Steel	601225	Shaanxi Coal Industry
002466	Tianqi lithium (lithium ion)	600293	Three Gorges New Material
601005	Chongqing Iron and Steel	000709	Hesteel, China's largest steel maker
002501	*ST Liyuan	600569	Anyang Steel
603878	Wujin stainless steel		

**Table 3.** Average Distance to Default for Default Groups

name	DD	name	DD
Baosteel, China's largest steel maker	1.534	Ansteel	1.943
Maanshan Steel	2.119	Centron (Chinese company)	2.432
Xining Special Steel	1.483	Shaanxi Coal Industry	3.195
Tianqi lithium (lithium ion)	2.003	Three Gorges New Material	1.823
Chongqing Iron and Steel	1.874	Hesteel, China's largest steel maker	2.052
*ST Liyuan	1.592	Anyang Steel	1.847
Wujin stainless steel	2.947		

Table 3 shows that Xining Special Steel's default distance is a minimum of 1.483, while Maanshan Iron and Steel's and Anyang Iron and Steel's default distances are 2.119 and 1.847. Maanshan Iron and Steel, due to business needs and the company's development, has become one of the mega key iron and steel enterprises while releasing more than the standard pollution in the production and consumption of iron and steel. A report in the Economic Reference News indicated that emissions of air pollutants from thermal power plants of Maanshan Co. Ltd. were found to have exceeded standards, as well as emissions of pollutants from the coking chemical industry.<sup>2023</sup> The inability of Ma Steel's subsidiary, Ma, to repay its debts payable from its available assets, among other things, was publicised.<sup>2024</sup> The report also indicated that Ma Steel was unable to meet its debt obligations from its available assets. Anyang Iron and Steel Co., Ltd. was established in 1996, is sintering, smelting, coking and research and development as one of the large-scale steel joint venture. Although Anyang Iron and Steel bigger and stronger on the way to set up a green steel development fund to optimise and upgrade the structure of its own iron and steel industry and actively promote the green transformation of the industry and support the prevention and treatment of pollution and other acts. However, from 2018 to now, every year in the pollution emission exceeds the standard and was punished. 2019 total wastewater discharge suspended solids, total nitrogen emission exceeds the standard, the essence of the measures are not in place, etc. In 2021, the environmental violations by the administrative penalties, etc. was fined 250,000 yuan. Because of these problems, the default distance calculated by KMV has a certain reference difference with the actual.

In Table 3, we can also see the high default distance of enterprises like Shaanxi Coal, Wujin Stainless, etc., which are

3.195 and 2.947, respectively. but in real life Shaanxi Coal causes dust pollution because of problems such as failure to properly manage hazardous wastes, improper operation of pollution prevention and control facilities, and material management irregularities. It has been penalised several times for reasons such as continuous violations in gas and exhaust gas and continuous creation of pollution. Wujin Stainless disclosed annual results in 2022 from a loss of 800 million yuan to 1 billion yuan. Large losses again from 2019 after completion of bankruptcy reorganisation to 2021.

In Tables 4, in addition to the fact that most of the average default distances of firms in the default group are smaller than most of the average default distances of firms in the control group, there are also some firms for which the average default distances are larger and are larger than those of the control group. This is not in line with the desired results of the KMV model. Therefore, it is not practical to use the KMV model directly to measure green credit in the context of "dual-carbon" and the transition to green development of iron and steel enterprises.

### 4.3. Results of the ESG-KMV Model with Exogenous Shocks

When  $k=0$  is consistent with the original ESG-KMV, the default distances corresponding to different values of  $k$  are investigated. As  $k$  keeps increasing, the uncertainty factor also increases, and the interval of its default distance becomes larger and larger. Our goal is to hopefully find the smallest  $k$  such that the default distance of the satisficing default group is less than the mean value of the default distance of the control group. The results of the empirical analyses in the previous chapter show that the default distance is the highest

for Baosteel and Xining Special Steel as well as Zhongchen. For this reason, we use these firms as examples to find out when the value of k will be such that the distance to default

of these firms is less than the mean value of the control group. Analysing exogenous shocks where the distance to default is smaller than the distance to default of the control group

**Table 4.** Average Distance to Default for Control Group

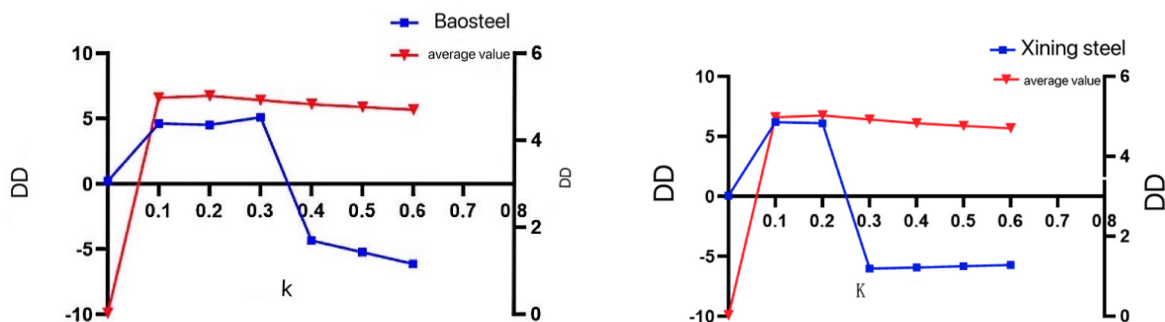
name	DD	name	DD	name	DD
Jinling Mining	2.835	TISCO	3.623	Chang Aluminium Co.	3.288
CITIC Special Steel	2.075	Fangda Special Steel	2.001	Hai Liang Co.	2.287
Hangzhou Steel	3.526	Shandong Iron and Steel	3.484	Hengbang stock	2.317
Hesteel Resources	1.877	NISCO	2.787	Shengxin Lithium	1.998
Shagang Steel	2.153	Bensteel Plate	4.703	Tianshan Aluminium	1.807
Joly Specialty Materials	2.126	emerging cast pipe	2.843	SRGNA	2.363
Changbao share	3.094	Valin Steel	4.203	Permanent material	2.529
Lingsteel	2.688	Shougang Corp.	5.014	Jinzhou Pipeline	3.157
Baosteel, China's largest steel maker	2.984	Sansteel Fujian Guang	3.458	Yongjin Stocks	3.276
Nanshan Steel	2.156	Bayi Steel	3.039	Youfa Group	3.261
JISCO Hongxing	2.828	Fushun Special Steel	4.405	Kinon Technology	1.855
Rhyme Steel Matsuyama	2.043	Yunnan Coal Energy	3.167	Shaanxi Black Cat	2.832
Liuzhou Steel	4.171	Cloud Computing	3.201	Shanxi Coking	3.491

**Table 5.** Table analysing the results of the distance to default in the default and control groups under exogenous shocks

$k$ worth	$k=0$	$k=0.1$	$k=0.2$	$k=0.3$	$k=0.4$	$k=0.5$	$k=0.6$
Baosteel, China's largest steel maker	2.621	3.638	3.538	3.428	0.276	0.254	0.127
Xining Special Steel	1.483	1.872	1.672	1.289	0.062	0.028	0.024
Centron (Chinese company)	2.232	3.751	3.651	2.661	1.451	1.351	1.251
Maanshan Steel	1.982	2.961	2.041	1.861	1.461	1.061	0.561
Anyang Steel	1.823	3.92	3.615	2.781	2.341	1.980	1.672
Control group mean	1.567	2.679	2.569	2.892	2.832	2.782	2.658

Table 5 shows that the default distance of the defaulting company Baosteel decreases with the increase of the value. When  $K=0.4$ , the default distance of Baosteel is smaller than the average default distance of the control group. When  $K=0.4$ , the default distance of Baosteel declines sharply. The meaning of the default distance is: when the default distance

becomes smaller and smaller, it indicates that the probability of default risk is larger and larger. This proves the inevitability of default risk occurring for Baosteel shares. The corresponding control group is in a steady state and does not change with the change of  $K$ . The control group is in a stable state and does not change with the change of  $K$ .



**Figure 1.** Change in default distance for Baosteel (left) and Xining Special Steel (right)

Baosteel is a steel company listed on the A-share market in 2001 and was listed relatively early. In the development of Baosteel, only in 2009 and 2015, the performance of the loss occurred, the other cases are profitable. The listing relies on a total net profit of about 8.943 billion yuan. But the occurrence of the new crown epidemic in 2019 Baosteel lost 324 million yuan, a year-on-year decline of 166.49 per cent, the main reason for which is the financial market is suddenly subjected

to the new crown epidemic. Stocks become more, the liquidity of funds is not enough to pay debts and other reasons for this. All these problems reflect the uncertainty that exists in the financial market. It is consistent with hypothesis 3.

Same as Baosteel, Xining Special Steel has a high distance to default under the original ESG-KMV model calculation. Xining Special Steel is a special steel enterprise held by Qinghai State-owned Assets Supervision and Administration

Commission. Has formed the production of 2.1 million tonnes of steel, steel 2 million tonnes of integrated production capacity after the listing of the enterprise. Xining special steel product structure is single, research and development investment is very little, economic efficiency is relatively low compared to other steel. There is also a general situation of "short-term loans and long-term investment". Also by the trade friction and the new crown epidemic and other reasons, the global economy has been hit by the higher debt ratio of the enterprise list. As of 2020, Xining Special Steel's short-term debt ratio reached 4.673 billion yuan, long-term debt of 4.69 billion yuan. It can be found that the ratio of cash flow to current debt of Xining Special Steel is small, which indicates that the liquidity of the company is poor. All these reasons suggest that Xining Special Steel will have a material default. In Table 5-5 and Figure 5.2, when  $K=0.2$  Xining Special Steel is then smaller than the average of the distance to default of the control group. It further confirms the applicability of the modified ESG-KMV model based on nonlinear expectation theory to measure the default risk of green credit in the steel industry.

## 5. Conclusion

The modified ESG-KMV model under nonlinear expectation theory measures the results of green credit default risk in China's iron and steel industry. The default distance of the default company Baosteel decreases with the increase of the value, when the default distance of Baosteel is smaller than the average default distance of the control group of companies. When the default distance of Baosteel stock starts to decline sharply, it indicates that the probability of default risk is higher. This proves the inevitability of default risk for Baosteel. The corresponding control group is in a smooth state and does not change with the change. Xining Special Steel has a high default distance under the original ESG-KMV model. Xining Special Steel has a single product mix, little investment in R&D, low economic efficiency compared to other steel and the prevalence of "short-term loans and long-term investment". Also by the trade friction and the new crown epidemic and other reasons, the global economy has been hit by the higher debt ratio of the enterprise list. When the time of Xining Special Steel is then smaller than the average of the distance to default of the control group. It further confirms the applicability of using ESG-KMV model to measure green credit default risk in steel industry based on incomplete

market. The results of the modified ESG-KMV model to measure the green credit default risk of China's iron and steel industry under nonlinear expectation theory. The two enterprises with more favourable results, Maanshan Iron and Steel and Anyang Iron and Steel, are selected, and the results show that there is no sudden increase or sudden decrease due to the inclusion. This shows that the uncertainty of the two enterprises leads to a relatively small cause.

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