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Identification and Exit Path of Zombie Firms: A Case Study of Listed Companies in China's Iron and Steel Industry

Zhi-hongSong [1], Xiang-pingWang [2]

[1.] Institute of Management and Decision, Shanxi University, Taiyuan 030006, China;

[2.] School of Economics and Management, Shanxi University, Taiyuan 030006, China

Abstract: Zombie firms are those that can only operate normally withcontinuous support from banks and governments. It occupies a large amount of social resources and has a crowding-out effect on other firms through unfair competition means, which is not conducive to the development of other new market players. Accurate identification of zombie firms and acceleration of exit from the market at the best time may contribute to protecting the interests of employees and creditors, reducing the burden of governments and banks, and better allocation of social resources. This paper identifies 20 listed companies in the iron and steel industry during 2014-2018. We find that the number of zombie firms decreased in 2014-2016, while the number of zombie firms increased in 2016-2018. Finally, we propose the following suggestions from three perspectives of the formation, identification, and selection of four different exit paths for zombie firms.In terms of the formation of zombie firms, enterprises should cooperate with governments and banks to achieve de-zombization from the root cause of zombie firms. In terms of the identification of zombie firms, regulators should continuously improve the identification method based on local conditions. In terms of exit path selection, the appropriate exit path should be selected according to the actual development of the enterprises to maximize the interests of all related parties.

Keywords: Chinese Steel industry; Zombie firms; Identification andexit path

I. Introduction

On December 4, 2018, 11 departments including the National Development and Reform Commission and the Ministry of Finance jointly issued ‘Notice on Further handling the debts of "zombie firms" and enterprises that have cut overcapacity’, requiring governments at all levels and relevant state-owned assets management departments to reasonably arrange the disposal list of zombie firms and complete the disposal work by the end of 2020 in principle. According to the Notice, local governments should actively and properly dispose of zombie firms and accelerate the liquidation of zombie firms, which will contribute to the stable development of China's economy. At present, zombie firms are mainly concentrated in steel, coal, non-ferrous metals, and other industries. Zombie firms are large and mostly state-owned enterprises, mainly concentrated in the process of economic system reform or enterprises that have lost money for several years and are insolvent. These enterprises mainly rely on governments and banks to provide them with "nutritious blood" and have lost their "hematopoietic" function.

Our study makes several empirical contributions. This paper summarizes the identification criteria for zombie firms, and some of the methods are improved. Using the improved methods for zombie firms' identification, combined with the current Chinese economic development situation, more accurate identification of zombie firms is conducive to reducing the scope of zombie firms. In addition, providing a better exit path for zombie firms is conducive to reducing the burden ongovernments and banks, and thus better allocation of social resources.

The remainder of this paper is organized as follows. In Section 2, we review previous research on the concept of zombie firms and identification methods. In Section 3, we discuss the identification of zombie firms with China's steel industry as the case. In Section 4, we present exit paths for zombie firms in China's steel industry. In Section 5, we present our conclusions.

II. Literature review

2.1The concept of zombie firms

The term "zombie firms" generally refers to firms that are insolvent but remain in operation with financial support from the government or banks(Dai,2019).Kane (1987), who first proposed the definition of zombie firms, argues that so-called zombie firms refer to lifeless firms like zombies. He sees zombie firms wreaking havoc on financial markets in two ways: (1) They translate the deposit insurance subsidies they receive into higher deposit rates and lower lending rates, dragging down industry margins. (2) Increase the annual deposit insurance premium that the surviving institution must ultimately pay. They have three characteristics: high debt, low profit, and "blood-sucking"(Liu,2019). Hoshi (2006) defines zombie firms as those firms that are insolvent and have no hope of recovery but avoid bankruptcy thanks to the support of banks. Caballero, Hoshi and Kashaya (2008) believe that whether an enterprise is a zombie firm depends on whether the enterprise is subsidized by the bank when it is in debt, and if the market interest rate is higher than the actual interest rate paid by the enterprise, then it is a zombie firm. Fukuda and Nakamura (2011) argue that CHK includes excellent firms in their definition of zombie firms. To avoid misclassifications, Fukuda and Nakamura (2011) further modified the approach by considering profitability and evergreen lending criteria.

Gao (2017) summarized the characteristics of zombie firms as follows: (1) most are state-owned enterprises, which focus on traditional industrial manufacturing. They are large-scale enterprises, which rely on the support of the government and banks to operate normally and constantly draw nutrition from the state. (2) Industry overcapacity. In the previous reform of the state, due to the mismatch of policies and non-standardized restructuring, the reform was not carried out, and mainly due to the support of the local government and banks, blindly expanding production, resulting in excess capacity. (3) As most of these enterprises are traditional industrial manufacturing, their products have low added value, low-end of the industrial field, no reform, low technology content, high cost, small profit margin, and heavy debt. Zombie enterprise is the "pain point" of economic construction. They utilize valuable social resources, such as human, material, and financial resources, which leads to huge waste (Chang, 2021). Zombie firms are more likely to hold high levels of financial assets than non-zombie firms. Because zombie firms seek to financialize themselves as a way to increase their reported earnings and avoid being classified as zombie companies in the future (Wu,2021). Qiao (2022) uses data on Chinese industrial enterprises from 1998 to 2013 to explain the "stiff" and "deathless" characteristics of zombie enterprises in terms of profit and efficiency, respectively. The results show that government subsidies are the "booster" for the development of non-zombie enterprises, but the subsidies aggravate the characteristics of zombie enterprises.

2.2Identification method

This identification method mainly compares the calculated market minimum interest rate of the year with the actual interest rate paid by the enterprise according to whether the loan between the enterprise and the bank is normal. If the interest paid by the enterprise for its liabilities is lower than the interest paid by the market minimum interest rate, then the enterprise is identified as a zombie firm. This identification method tends to misidentify even healthy, high-quality enterprises as zombie firms, due to their high quality, usually enjoy interest rates lower than risk-free lending rates (Shen,2017). Secondly, unhealthy firms may not be identified as zombie firms because some troubled firms are willing to pay the interest rates prevailing in the market as long as the lending institution grants debt to keep them from bankruptcy (Fukuda&Nakamura,2011).

The profitability standard and continuous credit standard are introduced into the CHK identification method, which excludes the high-quality and healthy enterprises wrongly identified by CHK. According to the profitability criterion, enterprises with positive actual profit are not classified as zombie enterprises. According to the continuous credit standard, highly leveraged firms are categorized as zombie firms if they could increase their external borrowings (Shen,2016). Meanwhile, enterprises with high debt ratios, low profit, and increasing external debt scale are also identified as zombie firms. Additionally, FN considers why most of these firms recovered and did not experience bankruptcy primarily utilizing listed firm data. However, the limitation of this method is that it is difficult to obtain theoretical data (Imai,2016).

On the basis of the FN-CHK identification method, the ratio of financial expenses to sales revenue and bank loans is taken into account. If an enterprise can still obtain bank loan support under the condition of insufficient profitability and debt operation, then the enterprise is identified as a zombie firm.

In summary, in recent years, under the background of supply-side structural reform and energy transformation, many scholars have conducted in-depth studies on the further accurate identification of zombie firms and the exit path selection of zombie firms. In general, the current research on the identification of zombie firms is mainly focused on theoretical studies, with relatively few relevant quantitative studies, and less relevant studies for the iron and steel industry. The iron and steel industry is not only an important part of China's GDP, but also an important basic industry required by the development of China's national economy, and an important symbol of China's overall economic level and comprehensive national strength. In view of the above deficiencies and the important influential role of China's steel industry in the economy, this paper considers the quantitative financial indicators, analyzes and summarizes the advantages and disadvantages of the existing zombie firms identification methods proposed by domestic and foreign scholars, identifies 20 listed enterprises in the steel industry, and proposes different exit countermeasures for different zombie firms in conjunction with existing government policies.

III. Identification of zombie firms: the case of China's steel industry

3.1Comparison of identification methods

3.1.1 CHK

CHK is the earliest method to identify zombie firms，which was proposed by Caballero,Hoshi and Kashyap (2008). The specific identification steps of this method are:

The first step is to calculate the minimum interest rate given the prime rate for the year. The calculation formula is as follows:

$$R^* = RS^*BS + RL^*BL$$

where R* represents the minimum interest paid based on the prime rate under the current conditions. RSstands for the lowest short-term loan interest rate enjoyed by an enterprise within a certain period, and RL denotes the lowest long-term loan interest rate enjoyed by the enterprise in a certain period. In this paper, the short-term interest rate and long-term interest rate in the lending benchmark interest rate of the People's Bank of China will be used to replace the minimum short-term loan interest rate and the minimum long-term loan interest rate. BS is the short-term loan scale of the enterprise, and BL is the long-term loan scale of the enterprise.

In the second step, R* (minimum interest paid) calculated by the above formula is compared with R (actual interest paid by the enterprise) in the enterprise data. If R<R*, it indicates that the enterprise has received credit subsidies from the bank, then the enterprise is a zombie firm under this identification method.

The CHK formula is clear and unambiguous, but it does not take into account the subsidies given to enterprises by the government. In addition, some high-quality enterprises with well operating conditions also get low interest rate loans from banks, and this identification method will misidentify such enterprises as zombie firms.

3.1.2 FN-CHK

FN-CHK was proposed by Fukuda and Nakamura (2011), and this identification method introduces two influencing factors, the profitability criterion and the ongoing credit criterion, based on the improvement of the CHK identification method. Under the condition of comparing the company's earnings before interest and tax (EBIT) with the minimum interest paid (R*) derived from the formula calculated in the above CHK identification method, the earnings criterion means that the company is recognized as a zombie company when the EBIT < R*. The introduction of this criterion is an improvement on the CHK identification method, which may misidentify healthy enterprises as zombie firms. The continuous credit standard means that under the condition of meeting the above profitability criteria, if an enterprise has an asset-liability ratio of more than 50% at year t-1, and the scale of external loans in year t has increased compared with previous years, the enterprise should be recognized as a zombie firm.

In this identification method, although the profitability criterion avoids some defectsof the CHK identification method, the identification under the continuous credit standard does not incorporate the time factor. If an enterprise experiences a short period of financial difficulties under normal operations, but then has a good performance afterwards and shifts to normal loan size, then such an enterprise may also be identified as a zombie firm under this identification method.

3.1.3Other identification methods

In China, under political, economic, and social pressure, the government gives financial subsidies, tax breaks, rebates, or other forms of subsidies to many enterprises, especially state-owned enterprises, which are also important factors affecting the formation of zombie enterprises. Therefore, aiming at the actual situation in China, some scholars put forward the following identification methods.

Nie et al.(2016) pointed out in a series of reports of the National Development Institute of the People's Congress, "Research Report on China's Zombie Enterprises -- Current Situation, Causes and Countermeasures", that those enterprises identified as "zombie enterprises" in one year, but immediately "resurrected" in the next year, probably because they encountered short-term shocks or temporary operating difficulties in that year, and are not real zombie enterprises. Therefore, Nie et al. put forward the standard of the National Development Institute: it is a real zombie enterprise that has been judged as a zombie enterprise by FN law for two consecutive years.

Premier Li Keqiang of The State Council put forward the specific cleaning criteria for zombie enterprises for the first

time at the executive meeting of The State Council on December 9, 2015, that is, if the net profit is negative for three consecutive years after deducting non-regular profit and loss and government subsidies, the enterprise is identified as a zombie enterprise.

3.2 Identification

The data and indicators used in the process of identifying zombie firms in the steel industry are as follows:

(1) The short-term loan interest rate and long-term loan interest rate used in the calculation of the minimum interest paid in CHK identification are shown in Table 1:

Table1 Benchmark lending rate of the People's Bank of China

	Less than one year(RS)	More than five years(RL)
2014.11.22	5.60	6.15
2015.10.24	4.35	4.90
2016.01.01	4.35	4.90
2017.01.01	4.35	4.90
2018.01.01	4.35	4.90
2019.01.01	4.35	4.90

(2) In the calculation of FN-CHK identification method, the asset-liability ratio is greater than 50%, but in the steel industry, it should be adjusted to 55%. The reason is that by calculating the asset-liability ratio index of all listed companies in the steel industry in the data of Orient Wealth, it is known that the average asset-liability ratio of listed companies in China's steel industry has been above 55% since 2014.

(3) This paper studies 38 listed companies in the steel industry selected from the steel industry plate of Oriental Wealth covering the period2014-2018, but after excluding the enterprises with incomplete data information, this paper finally identified 20 listed companies. Use the A-share ticker symbol instead of the company name.

The identification process (partial samples) is shown in Table 2.

In addition, according to the above data, under The State Council standard identification, companies with A-share code 600022,600117 are identified as zombie enterprises.

3.3 Identification results

The identification results of zombie enterprises listed in the steel industry are summarized in Table 3:

Table2 Identification Process of Zombie Enterprises in Iron and Steel Industry (Partial samples)

Stock Code	Year	TDR	EBIT-R*（100 million Yuan）	R（100 million Yuan）	R*-R（100 million Yuan）	Net profit (excluding non-recurring gains and losses and government subsidies)（100 million Yuan）	CHK	EBIT-R*>0	TDR>55%
	2018	0.44	259.92	3.59	15.88	206.30	Y	Y	N
	2017	0.50	219.80	5.82	20.60	179.90	Y	Y	N
600019	2016	0.55	101.37	5.59	17.53	89.94	Y	Y	Y
	2015	0.48	3.37	2.00	14.26	10.85	Y	Y	N
	2014	0.46	61.85	2.81	20.93	57.94	Y	Y	N
	2018	0.58	50.94	0.20	2.92	45.64	Y	Y	Y
	2017	0.69	27.71	0.27	2.65	26.01	Y	Y	Y
601003	2016	0.78	-1.87	0.29	4.10	2.03	Y	N	Y
	2015	0.80	-17.01	0.93	3.74	-10.91	Y	N	Y
	2014	0.77	-2.95	0.97	4.91	1.33	Y	N	Y
	2018	0.40	93.33	0.09	6.77	66.33	Y	Y	N
	2017	0.44	56.33	0.93	6.80	55.85	Y	Y	N
000898	2016	0.49	8.06	0.76	8.14	15.94	Y	Y	N
	2015	0.51	-43.39	1.81	5.76	-46.75	Y	N	N
	2014	0.47	8.76	2.03	7.03	9.17	Y	Y	N

Note: Y denote Yes, N denote No.

Table3 Identification results

Year	Number of zombie enterprises	The proportion of zombie enterprises	Identification result（Stock codes）
2014	4	0.2	600282，600010，900936，600295
2015	2	0.1	900936，600295
2016	2	0.1	900936，600295
2017	7	0.35	600282，000825，000761，600231，900936，200761，600295
2018	11	0.55	601003，600282，600010，000709，000825，000761，600569，900936，000717，200761，600295

As can be seen from Table 3,during 2014-2018, companies with A-share ticker codes 900936 and 600295 have been identified as zombie companies for five consecutive years. However, on the whole, the number of zombie firms in the

iron and steel industry began to decline since 2014, but suddenly increased from 2017, even reached 11 in 2018, which was caused by various reasons. First, driven by supply-side reform in the steel industry in 2017, the situation has improved and the market environment has been improved. Under such conditions, many enterprises that had stopped production have resumed production, and their willingness to withdraw voluntarily has weakened, thus aggravating the task of reducing overcapacity. Second, in 2017, the task of clearing "ground steel" was over-completed, and " low-quality steel made from scrap metal " has been fully banned, but with the reduction of production capacity, that is, the reduction of supply, the rise of steel prices, a few enterprises " low-quality steel made from scrap metal " production lines began to operate again. Third, with the strengthening of environmental awareness, the steel industry's environmental protection pressure increased, around the requirements of effective corporate governance emissions, which will also increase the pressure of corporate debt, operating conditions will be, net profit reduced. As can be seen from the data in the table, there is serious overcapacity in the steel industry, and the task of reducing overcapacity and de-zombizing is arduous. Different de-zombizing countermeasures should be taken for different enterprises under the premise of cooperating with national policies.

IV. Exit path for zombie firms in the steel industry

Based on the above identification of zombie firms and the exit paths, this paper provides four alternative exit paths for zombie firms in China's iron and steel industry: merger and reorganization, debt restructuring, bankruptcy reorganization, and bankruptcy liquidation.

4.1 Mergers and reorganization

Mergers and reorganization is suitable for enterprises that have certain advantages in terms of industry chain or assets in the whole industry. Mergers and reorganizations can be mergers between different steel enterprises, or mergers and acquisitions between steel enterprises and upstream and downstream enterprises in the industry chain, such as mining enterprises, coal enterprises, transportation construction, railroad construction, etc. Whatever the type of merger, it should be based on a reasonable valuation of asset prices, a clear government role and a market-driven premise. The scale effect, synergy effect and diversification after merger and reorganization can reduce the operating risk

4.2Debt restructuring

Debt restructuring is applicable to companies whose subsidiaries transfer their debts to the parent company after exiting the market due to high debts, resulting in a rise in the debt ratio of the parent company. Debt restructuring requires negotiation between debtors and creditors to ensure that creditors can get maximum benefits after debt restructuring. Under this premise, debtors can reduce their debt ratio through debt-repayment, debt-equity swap, debt maturity extension and a combination of the above three ways of debt restructuring. After the implementation of debt restructuring, the debtor's solvency may be improved

4.3Bankruptcy reorganization

Bankruptcy reorganization is an enterprise that is still insolvent after debt restructuring, but the enterprise has advanced production facilities and equipment, relatively good market prospects and high operational value. Compared with bankruptcy liquidation, bankruptcy reorganization can minimize the losses of creditors. Enterprises adopting bankruptcy reorganization should first accurately evaluate their own assets, determine the repayment ratio, and then select the upstream and downstream enterprises related to the enterprise to introduce the reorganization party, so as to restore the normal operation of the enterprise. This approach requires both shareholders and creditors to cede some of their rights and interests, and the introduction of a restructuring party also requires the local government to support and

guide the normal development of the enterprise while respecting the laws of the market. If the exit path of bankruptcy restructuring is adopted, the interests of creditors can be protected and the enterprise can be revived from the dead.

4.4Bankruptcy liquidation

Bankruptcy liquidation is aimed at enterprises that have exhausted resources and no hope of regeneration. Bankruptcy liquidation requires proper resettlement of employees. In restructuring the steel industry, enterprises that do not meet the environmental protection indicators, there is a large amount of excess capacity, and other enterprises that do not meet the industry adjustment should take bankruptcy liquidation. This method requires improving the quality of liquidators, standardize the use of liquidation expenses and standardize the liquidation process, especially the accounting process. After the bankruptcy liquidation, the social resources occupied by the enterprise for a long time will be released, so that the society can reconfigure the resources and industrial structure, and promote the sustainable development of the steel industry.

V. Conclusions

5.1Main conclusions

This paper summarizes the definition of zombie enterprises and the characteristics of zombie enterprises, and summarizes and improves the identification methods and indicators of zombie enterprises from the government, banks, and enterprises themselves. It mainly identifies zombie enterprises in the iron and steel industry from 2014 to 2018. The results show that the number of zombie enterprises in the iron and steel industry in the past five years presents a trend of first decreasing and then increasing. The number of zombie enterprises in the iron and steel industry began to decline in 2014 but suddenly increased in 2017, even up to 11 in 2018.

This study suggests that zombie enterprises, which have advantages and resource value in the steel industry chain, can be de-zombified by means of mergers and acquisitions, debt restructuring and bankruptcy reorganization. For those zombie enterprises that are insolvent, exhausted of resources, poor product quality and do not meet the requirements of national environmental protection, they should take the exit path of bankruptcy liquidation to completely withdraw from the market under the condition of proper placement of employees. In the actual operation, according to the different characteristics and circumstances of zombie enterprises, according to local conditions, choose one of the appropriate methods to deal with it, and ultimately maximize the interests of enterprises, employees and creditors.

5.2Limitation and prospects

In this paper, in the process of zombie enterprise identification for enterprises in the iron and steel industry, due to incomplete data disclosure and incomplete collected enterprise data, some enterprises were excluded, and these enterprises were not studied. Moreover, the bond information of most enterprises was not shown, and the influence of bonds on the minimum interest payment was not included in the CHK identification method. These deficiencies will inevitably lead to many enterprises not being identified as zombie enterprises. Future research can be combined with the actual development situation of the industry and future development prospects to improve the identification method of zombie enterprises, and then choose the appropriate exit path according to the existing situation of resources and prospects of the development of different enterprises. (2) There is a positive effect of equity concentration on corporate R&D intensity, demonstrating that when the equity of a company is more concentrated, the majority shareholders are more willing to pay attention to monitor the managers' decisions and the company's operation because a large portion of their own interests are involved. The number (or proportion) of state-owned shares inevitably comes to mind when equity concentration is mentioned. In this study, no significant relationship was found between the

number of state-owned shares and R&D intensity, largely due to the fact that the proportion of selected IT industry companies with state-owned shares was too small, resulting in insignificant findings.

The limitations of this paper are, firstly, for the measurement of the dependent variable, since most companies list R&D expenditure as "other cash flows paid in connection with operating activities", but there is a lack of sufficient data to support which part of it is R&D expenditure. Secondly, cross-sectional data are used in this studyfails to consider the long-term impact of corporate governance structure on R&D intensity.

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