The Effects of Green Credit Policy On The Formation of Zombie Firms: Evidence From Chinese Listed Firms

Rui Chen (✉ m13476112268@163.com)

Wuhan University <https://orcid.org/0000-0002-6148-3128>

Research Article

Keywords: Green credit policy, Zombie firms, Difference-in-differences, Evergreen lending, Investment efficiency

Posted Date: February 3rd, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1276694/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

1
2
3 **The Effects of Green Credit Policy on the Formation of**
4 **Zombie Firms: Evidence from Chinese Listed Firms**
5
6
7
8
9
10
11
12
13

14 Rui Chen
15 School of Economics and Management, Wuhan University
16

17
18 Correspondence:
19 Rui Chen
20 School of Economics and Management, Wuhan University
21 Bayi Road, Wuhan, Hubei Province, 430072, China
22

23 E-mail: chenrui1995@sina.com
24 Telephone: 86+13667235060
25
26

Abstract

This paper examines the effects of the green credit policy on forming three types of "zombie firms," namely, credit-subsidized zombie firms, poorly managed zombie firms, and comprehensive zombie firms, considering the quasi-natural experiment of the implementation of the "Green Credit Guidelines" in 2004. In this paper, I implement a difference-in-differences method and use the data of all Chinese A-share non-financial listed companies from 2008 to 2017. The results show that the green credit policy attempts to inhibit the formation of credit-subsidized zombie firms by reducing bank loan subsidies and evergreen lending. However, the green credit policy promotes poorly managed zombie firms by strengthening firms' financial constraints and reducing the working capital and investment efficiency. The green credit policy has not shown a significant impact on comprehensive zombie firms. Moreover, the green credit policy has shown a more significant impact on state-owned firms, firms in industries that heavily rely on external financing and are highly competitive, and firms involved in high financial marketization areas.

Keywords: Green credit policy; Zombie firms; Difference-in-differences; Evergreen lending; Investment efficiency

1. Introduction

The existence of zombie firms induces financial and economic risks and causes inefficiency in resource allocation, which is considered one of the important obstacles in economic development. The concept of "zombie firms" was first proposed by Kane (1987), which refers to companies that are affected by financial distress (have been or are on the verge of insolvency) but can still receive subsidies from the government or obtain loans from banks to survive. Zombie firms are considered an essential factor that affected Japan's economic development over a decade, which is called the "lost decade"(Caballero et al. 2008; Hoshi 2006). After Japan's asset price bubble burst in the 1990s, commercial banks provided "zombie lending" to companies affected by financial distress and caused many zombie firms(Kobayashi et al. 2002). Kwon et al. (2015) use counter-factual analysis and show that without zombie lending, Japan's annual aggregate productivity growth would have been higher by one percentage point during the 1990s. In Europe, Storz et al. (2017) find that zombie' firms generally continued to lever up during 2010-2014, which is an impediment to economic recovery. At the micro-level, zombie firms can have negative spillover effects on non-zombie firms in credit, investment, innovation, etc. Caballero et al. (2008) and Acharya et al. (2019) demonstrate that the existence of zombie firms has congestion effects and reduces the cumulative growth rate of investments and employment.

As zombie firms have precisely induced many harmful effects on economic development, the Chinese government has paid adequate attention to zombie firms and launched schemes to dispose of zombie firms since 2015. However, a more significant and long-term task is to prevent the formation of a new zombie firm while disposing of the existing zombie firms. Therefore, a reasonable credit policy might be a key to preventing the emergence of zombie firms. From studies,

it has been observed that banks have been motivated to lend to zombie firms(Caballero et al. 2008; Peek and Rosengren 2005), but a few studies have analyzed the impact of bank credit on the formation of zombie firms based on the implementation of a certain credit policy and conducted a systematic theoretical and empirical analysis of this impact. China Banking Regulatory Commission(CBRC)proposed the green credit policy to strengthen energy conservation and emission reduction, which provides a natural setting for identifying who gets and loses from bank credit. In recent years, researchers have studied the effects of green credit on the environment(Sun et al. 2019; Zhang et al. 2021), industrial structure(Cheng et al. 2021; Hu et al. 2020; Labatt 2002), bank performance(Luo et al. 2021; Yin et al. 2021), corporate financial performance and innovation(Liu et al. 2021; Luo et al. 2017; Xi et al. 2022; Yao et al. 2021). Relative to this literature, I analyze the effectiveness of the green credit policy from a novel perspective-its impact on the formation of zombie firms.

This study explores the impacts of green credit policy on the formation of zombie firms utilizing a natural experiment in China and analyzes the underlying mechanisms. I apply the CHK method (Caballero et al. 2008), the real-net-profit method(Zhu et al. 2019), and the CHK-FN method(Fukuda and Nakamura 2011) to identify different types of zombie firms by using data the A-share non-financial listed Chinese companies from 2008 to 2017. I estimate that credit-subsidized zombie firms reduce about 5.5% in response to the implementation of the green credit policy. Poorly managed zombie firms increase about 5.2%, and comprehensive zombie firms have no significant change. Furthermore, the impacts of green credit policy concentrated on the state-owned firms, firms in industries that heavily rely on external financing and are highly competitive, and firms involved in high financial marketization areas.

This paper contributes in three aspects. First, it might be one of the first efforts to examine the relationship between green credit and the formation of zombie firms. I adopt the difference-in-differences (DID) method for examining causal identification to resolve the endogenous problems to a certain extent by considering the "Green Credit Guidelines" as a quasi-natural experiment. I further analyze the channels through which the green credit policy affects the formation of zombie firms. Second, this study complements the studies about the causes of the formation of zombie firms in developing countries. The previous research to date has tended to focus on advanced economies such as Japan and European countries rather than developing countries. My findings can help developing countries' policymakers better understand the causes of the formation of zombie firms and evaluate the impacts of the green policy. Third, this paper applies three methods for identifying the zombie firms, develops models for managing the zombie firms identified under different conditions, and examines the identification considering different dimensions. Most of the papers apply a single identification standard guideline for analyzing the causes that affect zombie firms.

The rest of this paper is organized as follows. Section 2 introduces the background of China's green credit policy and Literature Review. Section 3 presents the data and methodology. Section 4 introduces the empirical results. Section 5 is the main conclusion.

2. Policy background, literature review and hypothesis development

2.1 China's green credit policy

The green credit policy is an important credit policy proposed by China Banking Regulatory Commission (CBRC) to promote a green economy and upgrade industrial development. In November 2007, CBRC issued the "Guiding Opinions on Credit Granting for Energy Conservation and Emission Reduction," which urged banks and other financial institutions to avoid high pollution risks and adjust

their credit structure. This was the first time China formulated a credit policy relating to energy conservation and emission reduction. However, in February 2012, CBRC issued the "Green Credit Guidelines" on the establishment of the framework of the green credit system. It is proposed to strictly control loans to industries with high pollution, high energy consumption, and overcapacity and to ensure that the loans are granted for the technological transformation of firms. Therefore, bank credit plays a catalytic role in guiding the flow of social funds and resource allocation. The "Green Credit Guidelines" include two main measures: (1) actively support the development of green economy, circular economy, and low-carbon economy, and increase support for strategic emerging industries, cultural industries, productive service industries, industrial transformation, and upgrade other key areas;(2) strictly control loans to high pollution, high energy consumption, and overcapacity industries. For the outdated and excess capacity planned to be shut down and eliminated, it is necessary to do a good job of credit compression, withdrawal, and asset preservation. The excess capacity to be transformed and upgraded should be reasonably satisfied with adequate credit demand for energy conservation, emission reduction, safe production, and technological transformation. Although China's green credit policy can be traced to 2007, only after the implementation of the "Green Credit Guidelines" in 2012 did the framework of the green credit system begin to be established, and the policy boundaries, management methods, and assessment policies of green credit began to be clearly defined.

In 2013, CBRC issued the "Green Credit Statistics System" and began to regularly disclose the green credit data of major banking financial institutions. The green credit balance of 21 major banks in China increased from 5.2 trillion yuan in 2013 to 115,000 million yuan in 2020. The scale of green credit shows a steady growth trend.

2.2 Literature review

Many recent studies have shown that zombie firms are formed due to complex reasons and are often a combination of many factors. First, "zombie lending" of banks. (i) Banks continue to lend to insolvent firms in order to hide losses and gamble for resurrection (Bruche and Llobet 2014; Peek and Rosengren 2005). (ii) Bank loans are a pre-existing behavior, and the formation of zombie firms is an after-event behavior. The pre-existing banks' overly optimistic expectations of corporate profits have caused zombie firms (Zhu et al. 2019). (iii) Regulatory forbearance towards banks may lead to an increase in zombie lending practices (Chari et al. 2021). Second, excessive government intervention. According to the theory of soft budget constraint proposed by Kornai (1986), the government provides financial subsidies to state-owned firms to not go bankrupt even if they lose money for a long time. Chang et al. (2021) and Zhang et al. (2020) conclude that government intervention promotes zombie firms' formation by giving governmental subsidies, resources support, financial support, and decreasing tax. Cai et al. (2022) find that government tends to protect firms with low profitability in order to get tax revenue, thereby causing the formation of zombie firms. Third, the characteristics of zombie firms formed under marketization factors. Hoshi (2006) uses firm-level data from Japan in the 1990s and finds firms that are small, less profitable, more indebted, more dependent on banks loan, in non-manufacturing industries, and located outside large metropolitan areas are more likely to be zombie firms. Blažková and Dvouletý (2020) use a Czech sample from 2003 to 2015 and find that zombie firms tend to be found in smaller and middle-aged companies and are often located in urban areas. Urionabarrenetxea et al. (2018) use a Spanish sample from 2010 to 2014 and summarize extreme zombie firms are characterized by being less regulated, large, and textile industry. Fourth, accommodative monetary policy. Low-interest rates can reduce financial pressure on firms with low profitability, which causes the prevalence of zombie firms (Banerjee and Hofmann 2018; Boeckx et al.

2013).

The economic consequences of green credit policy on firms are still in debate. On the one hand, green credit policy reallocates credit resources between companies in heavily polluting industries and environmental protection industries. Thus, the positive effects of green credit policy increase, such as guiding those firms towards green development(Li et al. 2021; Tian et al. 2022), promoting firms' total factor productivity (Feng and Shen 2021), and green innovation(Hong et al. 2021; Hu et al. 2021; Liu et al. 2021). On the other hand, green credit policy improves firms' financing constraints and reduces the investment level, thus reducing heavily polluting firms' performance(Yao et al. 2021). Furthermore, Wei et al. (2017) show that green credit might not improve firms' financial performance and operational efficiency in energy-saving and environmental protection industries. The positive effects of green credit policy are not as obvious as policymakers expected.

Numerous studies have attempted to explain the causes of the formation of zombie firms. There is a consensus among scholars that a bank's credit is a principal determining factor in forming zombie firms. However, there is little evidence to demonstrate it in an empirical method. Therefore, this paper further examines the impact of specific credit policies on the formation of zombie firms. Bank credit affects how firms obtain credit subsidies and corporate operating performance, which enriches the empirical test of the causal identification mechanism formed by zombie firms.

2.3 Hypothesis development

First, green credit constraints will reduce bank loan subsidies to firms with high pollution, high energy consumption, and overcapacity industries and reduce the dependence of such firms on bank credit. Banks no longer stipulate loan interest rates far below the market for the original high pollution, high energy consumption, and overcapacity firms, allowing them to obtain many credit subsidies. It will be

difficult to get loans with lower than market interest rates. Besides, banks will conduct strict compliance reviews on related loans, and non-compliant loans such as "borrowing new loans for old loans" can be reduced. The direct impact of the implementation of the green credit policy on the formation of zombie firms is to reduce the company's dependence on bank loans, allocate more valuable credit resources to firms with growth and development prospects, and improve the efficiency of bank credit utilization. In addition, through the signal transmission mechanism, the bank transmits the signal of credit contraction to the firms that rely on bank credit, thereby inhibiting the formation of credit-subsidized zombie firms.

Second, the bank's discontinuing of loans to the high pollution, high energy consumption, and overcapacity industries will strengthen firms' financing constraints, thereby reducing their working capital and investment levels, which will increase the risk of corporate mismanagement. However, due to the imperfect delisting procedures of listed firms and the existence of "shell value" (Xie et al., 2013), poorly managed listed firms cannot immediately withdraw from the market, thereby promoting the formation of poorly managed zombie firms. First of all, green credit will reduce firms' working capital with high pollution, high pollution, and overcapacity. Working capital is the foundation for the survival and development of a company, and commercial bank loans are an important source of corporate working capital. Wang et al. (2013) reported that 69% of the working capital of listed firms in China came from short-term financial liabilities in 2013. The working capital was mainly allocated for corporate production and marketing channels. Short-term borrowings received by firms declined, leading to reduced working capital. Firms used to expand production, and daily business activities increased liquidity risk. The risk of the deterioration of the business conditions of firms increases causes more mismanagement of zombie firms.

Furthermore, the financing constraints imposed by green credit on firms in high pollution, high

energy consumption, and overcapacity industries will further affect such firms' investment level and investment efficiency. Richardson (2006) shows that cash flow and investment activities are positively correlated, and over-investment is concentrated in firms with the highest levels of free cash flow. In China, the major proportion of corporate finance comes from bank loans(Jiang et al. 2020). After implementing the "Green Credit Guidelines", bank loan of firms in high pollution, high energy consumption, and overcapacity industries decreased, which subsequently reduced corporate cash flow and investment level. Therefore, firms' investment sensitivity decreases, which leads to lower corporate investment efficiency. The consequent decrease in corporate finance has led to the vicious circle of "bank credit restrictions-reduction of cash flow-reduction of investment level-insufficient investment, reduction of investment efficiency-reduction of corporate returns-corporate zombification."

Third, the formation of comprehensive zombie firms is affected by both the credit subsidies provided by banks and the operational efficiencies of these firms. The green credit policy has a positive effect on firms to reduce dependence on credit subsidies. At the same time, it will also bring working capital due to credit compression. Due to the adverse effects of insufficient and insufficient investment, the impact of green credit on the formation of comprehensive zombie companies is uncertain, depending on the magnitude of these two positive and negative effects.

Hypothesis 1: The green credit policy will inhibit the credit subsidy zombie firms, promote the formation of poorly managed zombie firms, and the influence on the formation of comprehensive zombie firms is uncertain.

3. Methodology and data

3.1. Methodology

This paper uses the "Green Credit Guidelines" issued by CBRC in February 2012 as a quasi-natural

experiment and uses a difference-in-differences model to evaluate the impact of green credit policy on zombie firms. Select the firms in high pollution, high energy consumption, and overcapacity industries as the experimental group and other industry firms as the control group. The specific model is as follows:

$$Zombie_{it} = \alpha + \beta post * treat + \gamma X + \psi_t + \delta_i + \varepsilon_{it} \quad (1)$$

This paper uses a linear probability model to estimate. Here i indexes firms, t indexes year. $Zombie_{it}$ is an indicator of whether firm i is a zombie firm for the year t ; it equals 1 if the firm is a zombie firm and 0 otherwise. $Post$ represents the dummy variable in the policy processing period, $post$ equals 1 after 2012, and 0 otherwise. $treat$ is the dummy variable of the experimental group, $treat$ equals 1 if the firm is in high pollution, high energy consumption, and overcapacity industries, and 0 otherwise. The regression coefficient β of $post*treat$ measures the DID effect of the policy. X is a set of firm characteristics, and the specific definition is shown in Table 1. ψ_t is the time fixed effect, δ_i is the individual fixed effect, and ε_{it} is the random error term.

3.2. Important variables and their measures

3.2.1. Identification of three types of zombie firms

This paper uses the Caballero Hoshi Kashyap (CHK) method to identify credit-subsidized zombie firms, the real-net-profit method to identify poorly managed zombie firms, and the CHK-FN method to identify comprehensive zombie firms. (1) The Caballero Hoshi Kashyap (CHK) method. The core idea of the CHK method is to judge whether the firm receives credit subsidies from the bank. If the actual interest paid by the firm is less than the minimum required interest payment interest¹ that the firm should

¹ CHK method defined the minimum required interest payment interest R_{it}^* :

$$R_{it}^* = rs_{t-1} \cdot BS_{it-1} + \left(\frac{1}{5} \sum_{j=1}^5 rl_{t-j} \right) \cdot BL_{it-1} + rcb_{5years,t} \cdot Bonds_{it-1}$$

BS_{it-1} , BL_{it-1} , $Bonds_{it-1}$ are short-term (less than one year) bank loans, long-term (over one year) bank loans, and total bonds outstanding of firm i at the end of year t , respectively. rs_{t-1} is average short-term prime rate for $t-1$ years, rl_{t-j} average short-term prime rate for $t-j$ years, $rcb_{5years,t}$ the minimum observed rate on any convertible corporate bond issued over the previous five years prior to t . This paper uses 90% of the benchmark lending rate decided by the People's Bank of China as the lowest loan interest rate.

pay, it is considered a credit-subsidized zombie firm. Otherwise, it is a normal firm. Although the CHK method is simple, it has the problem of inaccurate identification. In particular, it may identify particularly outstanding firms with preferential interest rates as zombie firms. (2) The real-net-profit method. A firm whose net profit after deducting government subsidies is less than 0 for three consecutive years is identified as a poorly managed zombie firm. We use the actual profits of listed firms after deducting government subsidies for three consecutive years to zero. (3) The CHK-FN method. The method introduces two additional conditions based on the CHK criterion. First is the profitability criterion: the firm's profit before interest and tax is less than the minimum theoretical interest that should be paid. Another is the evergreen lending criterion: the previous year's debt-to-asset ratio is more than 50%, and borrowing can be increased during the year. The CHK-FN method is an improvement of the CHK method. It should be noted that only firms that have been listed for more than one year in this paper will be recognized as zombie firms.

Figure.1 The proportion of zombie firms to the listed firms in the three different identification methods between 2008 and 2017.
(source: the database of China Stock Market and Accounting Research)

3.2.2. Firm control variables

See Table 1 for specific variable definitions.

Table1. Variable definitions.

Variable type	Variable name	variable	measurement
Dependent variables	Zombie Z1~Z3	whether firm <i>i</i> is a zombie firm	Equaling 1 if the firm is a zombie firm, and 0 otherwise. Different types of zombie firms: credit-subsidized zombie firm(Z1), poorly managed zombie firm(Z2), and comprehensive zombie firm (Z3)
Main independent variables	Treat	A dummy variable	equaling 1 if the firm is in high pollution, high energy consumption, and overcapacity industries, and 0 otherwise.
	Post	A dummy variable	Equaling 1 after 2012, and 0 otherwise.
Control variables	Size	Firm size	The natural logarithm of total assets.
	Lev	asset-liability ratio	The natural logarithm of the ratio of total liabilities to total assets.
	Tobin Q	Growth opportunity	The natural logarithm of the ratio of market value to total assets.
	ROA	return on assets	The natural logarithm of (total profit + financial expenses)/total assets.
	Cash	Cash flow	The natural logarithm of the ratio of cash received from selling goods and providing labor services to total assets.
	ListY	List year	The year of the current year and the firm's listing year plus 1
	RST	rate of stock turnover	The natural logarithm of the ratio of operating cost to average inventory occupancy.
	Soe	ownership of firms	equaling 1 if the firm is state-owned firms, and 0 otherwise.

3.3.Data Source and Descriptive Statistics

This paper uses the data of A-share listed firms from 2008 to 2017 as the research sample. The relevant financial data of listed firms comes from the China Stock Market and Accounting Research (CSMAR) database. Since it takes three years of data to identify zombie firms using the actual profit method, this paper uses data from 2006 to 2017 when identifying zombie firms. This paper deals with the financial data Firm as follows: (1)exclude financial firms; (2) exclude firms with missing financial data; (3) winsorize the top and bottom 1% of each variable's distribution to alleviate the influence of extreme observations. Finally, the study obtained 18266 research samples. In addition, the benchmark lending rate used in this paper comes from the People's Bank of China. The lowest corporate bond interest

rate data comes from wind, and the nominal GDP growth rate comes from the "China Statistical Yearbook."

Table2. Descriptive statistical results

Panel A: Basic Statistics						
variables	N	MEAN	SD	MAX	MIN	MEDIAN
Z1	18266	0.312	0.463	1	0	0
Z2	18266	0.094	0.292	1	0	0
Z3	18266	0.025	0.156	1	0	0
Treat	18266	0.193	0.395	1	0	0
Post	18266	0.707	0.455	1	0	1
Size	18266	22.1	1.284	25.966	19.307	21.927
Lev	18266	-0.947	0.580	0.007	-2.805	-0.818
Tobin Q	18266	0.584	0.457	2.201	-0.071	0.486
ROA	18266	-2.873	0.737	-1.307	-5.252	-2.802
Cash	18266	-0.693	0.697	1.017	-2.832	-0.677
Age	18266	2.005	0.924	3.332	0	2.197
RST	18266	1.359	1.273	5.711	-2.039	1.358
Soe	18266	0.420	0.494	1	0	0
Panel B: variables variance analysis						
	Treatment Group			Control group		
	Pre-policy	Post-policy	Difference value	Pre-policy	Post-policy	Difference value
Z1	0.319	0.235	-0.084***	0.346	0.315	-0.031***
Z2	0.081	0.164	0.066***	0.060	0.093	0.033***
Z3	0.042	0.024	-0.018***	0.036	0.027	-0.009***

Note: ***, **, * indicates significance at the 1%, 5%, and 10%levels, respectively

4. Empirical results

4.1. Main results

Table3 presents the regression result regarding the impact of green credit policy on the formation of three types of zombie firms. A shown in columns (1), (3), and (5) of Table 3, the estimation results based on Eq.(1) are as follows. The coefficient of post*treat on credit-subsidized zombie firms is -5.5% and significant at the 1% level. The coefficient of post*treat on poorly managed zombie firms is 5.2% and significant at the 1% level. The coefficient of post*treat on comprehensive zombie firms is not significant

at the 10% level. In addition, we use the logit nonlinear probability model to perform regression. The regression results are shown in columns (2), (4), and (6) of Table 3, and the regression coefficient symbol and significance are consistent with Eq.(1). These results suggest that the influence of green credit policy on the formation of zombie firms is inconsistent between different types of zombie firms. The green credit policy has a significantly negative effect on credit-subsidized zombie firms, a significantly positive effect on poorly managed zombie firms, and no significant impact the comprehensive zombie firms. The previous hypothesizes are supported.

As for control variables, we note the following aspects:(1)The coefficient of Lev is significantly positive for all types of zombie firms, which indicates that the higher a firm's debt, the easier it is to become a zombie firm. (2) The coefficient of ROA is significantly negative for all types of zombie firms, which indicates that the higher a firm's debt, the easier it is to become a zombie firm, and the higher the company's cash flow, the less likely it is to become a zombie firm.

Table3.The impact of Green Credit Policy on the formation of zombie firms

	Z1		Z2		Z3	
	(1) FE	(2) logit	(3) FE	(4) logit	(5) FE	(6) logit
post * treat	-0.055** (0.022)	-0.311*** (0.078)	0.052*** (0.017)	0.893*** (0.106)	-0.005 (0.007)	-0.330 (0.202)
Size	0.077*** (0.013)	0.283*** (0.026)	-0.121*** (0.010)	-0.544*** (0.058)	0.0217*** (0.00454)	0.074 (0.069)
Lev	0.206*** (0.014)	0.259*** (0.046)	0.088*** (0.010)	1.672*** (0.118)	0.041*** (0.004)	3.841*** (0.215)
Tobin Q	0.0934*** (0.017)	0.470*** (0.066)	0.011 (0.011)	0.333*** (0.125)	0.030*** (0.005)	-0.135 (0.220)
ROA	-0.031*** (0.007)	-0.161*** (0.031)	-0.052*** (0.006)	-1.177*** (0.049)	-0.045*** (0.004)	-1.485*** (0.075)
Cash	-0.148*** (0.014)	-0.254*** (0.036)	-0.061*** (0.010)	-0.325*** (0.060)	-0.040*** (0.006)	-0.709*** (0.0856)
Age1	0.174*** (0.014)	0.0001 (0.029)	-0.012 (0.009)	0.667*** (0.069)	-0.027*** (0.005)	0.179 (0.108)
RST	0.030*** (0.009)	-0.082*** (0.022)	0.010 (0.007)	0.122*** (0.030)	-0.003 (0.004)	0.063 (0.039)

Soe	-0.055 (0.038)	-0.226*** (0.057)	0.089*** (0.029)	0.400*** (0.095)	-0.002 (0.013)	0.173 (0.147)
_cons	-1.589*** (0.272)	-7.285*** (0.582)	2.494*** (0.206)	4.453*** (1.280)	-0.510*** (0.099)	-8.954*** (1.607)
Firm FE	YES	NO	YES	NO	YES	NO
Year FE	YES	YES	YES	YES	YES	YES
observations	18266	18266	18266	18266	18266	18266
R ² /pseudo R ²	0.0839	0.0416	0.0960	0.2614	0.0481	0.3410

Notes: (1) ***, **, * indicates significance at the 1%, 5%, and 10% levels, respectively. (2) Standard errors in parentheses are calculated by clustering over firm-level.

4.2. Dynamics of Green credit

The DID method needs to satisfy that the experimental and control groups maintain the same development trend before the policy is implemented. This paper refers to Jacobson et al. (1993) by adding dummy time variables, and constructs the following model to test the dynamic effects of the policy:

$$Zombie_{it} = \alpha + \sum_{t=2009}^{2017} \beta_t * treat * year_t + \gamma X + \psi_t + \delta_i + \varepsilon_{it} \quad (2)$$

$treat * year_t$ is the interaction term between the experimental group and the dummy time variable, $year_t$ is set to 1 in the current year, and 0 in other years, β_t is the estimated coefficient of the interaction term between the experimental group and the time dummy variable, which is an indicator for the policy effect in the year. Other variables are the same as Eq. (1). Figure 2 plots the policy effect β_t in the first three years of policy implementation, the year of policy implementation, and the five years after implementation under the 95% confidence interval. As shown in figure 2, the interaction term coefficients between the time dummy variable and the experimental group were not significant at the 5% level before 2012, indicating no significant difference between the experimental and control groups before 2012, showing a significant difference in the results common development trend. After the implementation of the policy in 2012, the estimated coefficients of the time dummy variable and the interaction term between the time dummy variable and the experimental group are significant under the 95% confidence interval, indicating that the policy has a significant impact on zombie firms in after the implementation

of the policy. Therefore, the samples in this paper have passed mainly the parallel trend test.

(a) credit-subsidized zombie firm (b) poorly managed zombie firm

Figure 2. The dynamic effects of green credit policies on the formation of two types of zombie firms

4.3. Robustness test

This paper also conducted the following robustness test. First, we take a placebo test. This paper draws on the method of Cai et al. (2016), randomly selects the experimental group, and multiplies the randomly selected experimental group with the time dummy variable to form a formative policy effect. If there is a significant policy effect in the randomized treatment group, it has not passed the placebo test. This paper repeats the random process 200 times, and performs regression according to Eq. (1), extracts the coefficient of policy effect $treat*post$, and draws Figure 3. Figure 3 shows that the mean value of the regression coefficient of the 200 fictitious treatment group is close to 0, and there is no policy effect.

(a) credit-subsidized zombie firm (b) badly managed zombie firm

Figure3. placebo test

Besides, Table4 reports other robustness results of credit-subsidized zombie firm and poorly

managed zombie firm, respectively. In Column(1)and(4) of Table4, we take the first-order lag variable of the control variable and regress them again. In Column(2)and(5) of Table4, we select new data to identify zombie firms. In the process of identifying zombie firms in the CHK method, the minimum loan interest rate used here is 0.9 times the benchmark lending rate and replaced with the original benchmark lending rate. In the process of identifying zombie firms in the real-net-profit method, the government subsidy variable is replaced with non-recurring gains and losses to identify zombie firms here. In Column(3)and(6) of Table4, we introduce new variables to control the macroeconomic environment. In this paper, the nominal GDP growth rate and the benchmark long- and short-term lending rate representing the business cycle are added to Eq. (1) for regression. These robustness results are generally consistent with the main result, suggesting that the findings of this paper are robust.

Table4 Results of robustness test.

	Z1 (credit-subsidized zombie firm)			Z2 (poorly managed zombie firm)		
	(1)	(2)	(3)	(4)	(5)	(6)
post*treat	-0.060** (0.029)	-0.058** (0.023)	-0.055** (0.022)	0.062*** (0.020)	0.065*** (0.0187)	0.051*** (0.017)
_cons	0.0387*** (0.376)	-1.800*** (0.286)	1.084*** (0.356)	1.251*** (0.221)	3.0089*** (0.2259)	1.073*** (0.228)
Control variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
observations	14743	18266	18266	14743	18266	18266
R ²	0.0525	0.1331	0.0839	0.1064	0.1166	0.096

Notes: (1) ***, **, * indicates significance at the 1%, 5%, and 10%levels, respectively. (2) Standard errors in parentheses are calculated by clustering over firm-level.

4.4.Mechanism test

I next explore the mechanisms of the green credit policy with different types of zombie firms. We adopt the method of intermediary effect test(Baron and Kenny 1986), uses sequential test regression

method to verify the influence of intermediary mechanism, and constructs the following econometric model:

$$Mediation_{it} = \alpha + apost * treat + \gamma X + \psi_t + \delta_i + \varepsilon_{it} \quad (3)$$

$$Zombie_{it} = \alpha + \beta' post * treat + bMediation_{it} + \gamma X + \psi_t + \delta_i + \varepsilon_{it} \quad (4)$$

$Mediation_{it}$ is a mediating variable, and the other variables are the same as the Eq. (1).

(1) Credit-subsidized zombie firms

This paper uses loan size (loan) and whether an evergreen lending bank (evergreen) is a proxy variable for credit incentives. Loan size is calculated as the ratio of the sum of long-term loans and short-term loans to the firm's total assets. As shown in columns (2) and (3) of Table 5, after the implementation of the Green Credit Guidelines, the loan scale and evergreen lending behavior of the experimental group have decreased significantly, indicating that the banks' Loan subsidy incentives for surplus industries have declined.

Table5. Mechanism Test of the Impact of Green Credit Policy on the formation of credit-subsidized Zombie Firms

	(1)	(2)	(3)	(4)	(5)
	Z1	Loan	evergreen	Z1	Z1
Treat*post	-0.055** (0.022)	-0.010** (0.005)	-0.030* (0.018)	-0.045** (0.022)	-0.052** (0.022)
loan				1.004*** (0.0644)	
evergreen					0.111*** (0.010)
_cons	-1.589*** (0.272)	0.107 (0.078)	-1.845*** (0.226)	-1.6958*** (0.274)	-1.285*** (0.271)
Control variables	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
observations	18266	18266	18266	18266	18266
R ²	0.0839	0.3663	0.1264	0.1061	0.0919

Notes: (1) ***, **, * indicates significance at the 1%, 5%, and 10%levels, respectively. (2) Standard errors in parentheses are calculated by clustering over firm-level.

(2) Poorly managed zombie firms

This paper uses the working capital ratio (WCR) as the policy proxy variable, and its calculation formula is: $\text{working capital ratio} = (\text{current assets} - \text{current liabilities}) / \text{total assets}$, substituted into the Eq.(3), and the regression results are shown in Column (2) of Table 6. After the "Green Credit Guidelines" was issued, the working capital ratio was significantly reduced by 2%. Then, this paper adopts the investment level (invest) as the policy proxy variable. The investment level is calculated by the ratio of cash paid for the purchase and construction of fixed assets, intangible assets, and other long-term assets to total assets. This paper first substitutes the investment level into the Eq. (3). The regression results are shown in Column (3) of Table 6. After the "Green Credit Guidelines" was issued, the investment level was significantly reduced by 1.2%. Then this paper analyzes the changes in the investment efficiency of the experimental group relative to the control group after the policy is implemented. This paper refers to Mortal and Reisel (2013) and uses the reaction coefficient of investment to investment opportunities to measure investment efficiency. Investment opportunities are represented by TobinQ (TobinQ), and the interaction terms between TobinQ and Treat*post are included in the Eq. (3) instead of Treat*post. The results are shown in Column (6) of Table 6. The coefficient of investment opportunity TobinQ is significantly positive. In contrast, the interaction coefficient of TobinQ and Treat*post is significantly negative, indicating that the experimental group is considerably less sensitive to investment opportunities than the control group.

Table6. Mechanism Test of the Impact of Green Credit Policy on the formation of poorly managed Zombie Firms

	(1)	(2)	(3)	(4)	(5)	(6)
	Z2	WCR	invest	Z2	Z2	invest
Treat*post	0.052*** (0.017)	-0.02*** (0.007)	-0.012*** (0.003)	0.048*** (0.017)	0.044*** (0.017)	
WCR				-0.167*** (0.029)		
invest					-0.584*** (0.065)	
Treat*pos*						-0.007** (0.003)
tobinQ						0.011*** (0.002)
_cons	-1.589*** (0.272)	0.559*** (0.164)	-0.036 (0.032)	2.400*** (0.205)	2.464*** (0.206)	-0.047 (0.032)
Control variables	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
observations	18266	18266	18263	18266	18263	18263
R ²	0.0960	0.4954	0.1109	0.101	0.1044	0.1089

Notes: (1) ***, **, * indicates significance at the 1%, 5%, and 10%levels, respectively. (2) Standard errors in parentheses are calculated by clustering over firm-level.

4.4. Heterogeneity test

This paper further examines the heterogeneity of the impact of green credit policy on zombie firms in different corporate characteristics, different industries, and different regions. The regression results are shown in Table 7.

(1) Based on the heterogeneity of firm ownership: state-owned firms and non-state-owned firms

As shown in Columns(1a)-(1d), the green credit policy has significantly promoted the reduction of credit-subsidized zombie firms in state-owned firms and has not had a significant impact on non-state-owned firms. One reason may be that state policies have been implemented more thoroughly in state-owned firms, and state-owned firms in China generally bear policy burdens. In addition, another possible reason for the greater impact of the policy on state-owned firms is that before the implementation of the

policy, state-owned firms received more credit subsidies from banks than non-state-owned firms. The green credit policy has a more significant impact on poorly managed zombie firms among state-owned firms. State-owned firms are less adaptable to the market environment and rely more on bank financing. Thereby the credit subsidies for state-owned firms are sharply reduced, the operating performance of state-owned firms will dramatically deteriorate.

(2) Based on the heterogeneity of the degree of dependence on external financing in the industry: highly dependent external financing industries and low dependent external financing industries

We estimate external financing dependency(Rajan and Zingales 1998)by calculating financing dependency = (firm investment expenditure-corporate operating cash flow)/firm investment expenditure. Suppose external financing dependency is greater than 0, indicating that corporate operating cash flow is not enough to cover corporate investment expenditures. In that case, it means that the firm is dependent on external financing. This paper calculates the external financing dependence of firms in 2010 and 2011 and uses the median of the industry each year to represent the external financing dependence of the industry. If the external financing dependence in 2010 and 2011 is greater than 0, the industry is a highly dependent external financing industry. Otherwise, it is a low-reliance external capital financing industry. As shown in Columns(2a)-(2d), the green credit policy has a greater impact on highly dependent external financing industries. The possible reason is that highly dependent external financing industries have always borrowed more from banks, and the policy effect will be more obvious.

(3) Based on the heterogeneity of the degree of competition in the industry: high-competitive industries and low-competitive industries

We estimate the degree of competition by calculating the Herfindahl-Hirschman (HHI) index of each industry in 2010 and 2011 and using the median HHI of firms in the industry to represent the degree

of competition in the industry. If the HHI index of the industry for two consecutive years in 2010 and 2011 is higher than the average level of all industries, the industry is highly competitive. Otherwise, it is a low-competition industry. As shown in Columns(3a)-(3d), the green credit policy significantly impacts zombie firms in high-competitive industries but has no significant impact on low-competitive industries. The result may be explained by the fact that the more similar firms' investment opportunities across industries are, the more cash firms tend to hold (Haushalter et al. 2007). Firms in highly competitive industries will tend to hold more cash to avoid being eliminated. Therefore, highly competitive industries will magnify the impact of financing constraints.

(4) Based on the heterogeneity of the degree of marketization of the financial industry in the region where the firm is located: regions with a high degree of marketization in the financial industry and regions with a low degree of marketization in the financial industry

The degree of marketization of the financial industry in a region affects the scale and fairness of loans to firms by banks in the region, which affects firms' financing constraints. Love (2003) finds that a good financial environment can ease firms' financing constraints. Suppose the region's financial industry marketization index (Wang et al. 2018) ranks in the top ten in 2010 and 2012. In that case, it is considered a region with a high degree of marketization in the financial industry. As shown in Columns(4a)-(4d), the green credit policy has a more significant impact on regions with low financial industry marketization. The possible reason is that the allocation of credit funds in these regions with low financial industry marketization is more unfair. Thus high pollution, high energy consumption, and overcapacity industries receive more credit subsidies. Therefore, the policy effect is obvious.

Table 7. Heterogeneity tests

	State-Owned Firm		Non-state-owned firm	
	Z1 (1a)	Z2 (1b)	Z1 (1c)	Z2 (1d)
treat*post	-0.079** (0.033)	0.109*** (0.027)	-0.022 (0.029)	-0.009 (0.020)
observations	7679	7679	10587	10587
	Highly dependent on external financing industry		Low dependence on external financing industry	
	Z1 (2a)	Z2 (2b)	Z1 (2c)	Z2 (2d)
treat*post	-0.072*** (0.024)	0.067*** (0.019)	-0.012 (0.043)	-0.020 (0.027)
observations	17038	17038	15426	15426
	High competition industry		Low competition industry	
	Z1 (3a)	Z2 (3b)	Z1 (3c)	Z2 (3d)
treat*post	-0.053** (0.024)	0.057*** (0.019)	-0.066 (0.046)	0.025 (0.035)
observations	17615	17615	14849	14849
	High financial marketization area		low financial marketization area	
	Z1 (4a)	Z2 (4b)	Z1 (4c)	Z2 (4d)
treat*post	-0.030 (0.029)	0.041* (0.023)	-0.077** (0.032)	0.056** (0.025)
observations	10525	10525	7741	7741

Notes: (1) ***, **, * indicates significance at the 1%, 5%, and 10% levels, respectively. (2) Standard errors in parentheses are calculated by clustering over firm-level. (3) All regressions control for time-fixed effects and individual fixed effects.

5. Conclusions

This paper uses the 2012 "Green Credit Guidelines" as a quasi-natural experiment, using the data of non-financial listed firms from 2008 to 2017, using the difference-in-differences method to study the implementation of a specific credit policy that may affect the formation of zombie firms. The main findings of this paper are as follows. (1) The green credit policy inhibits the formation of credit-subsidized zombie firms significantly by 5.5%, promotes the formation of poorly managed zombie firms significantly by 5.2%, and has no significant impact on the formation of comprehensive zombie firms.

(2) The green credit policy has directly changed the bank's loan incentive mechanism. Reduce the scale of loans and evergreen lending for high pollution, high energy consumption, and overcapacity industries, thereby inhibiting the formation of credit-subsidized zombie firms. Furthermore, it has reduced the firm's working capital and investment efficiency, which further deteriorates the corporate performance and greatly promotes the formation of poorly managed zombie firms. (3) The impact of green credit on the formation of zombie firms in different firms, different industries, and different regions is heterogeneous. Green credit has a more significant impact on the policies of state-owned firms, industries highly dependent on external financing and highly competitive, and zombie firms in regions where the financial industry has a low degree of marketization.

The above research conclusions have specific policy implications for formulating differentiated credit policies. First, implement differentiated credit policies for different types of firms. The review of non-compliant loans will help reduce the firm's reliance on bank loans and reduce credit-subsidized zombie firms. Second, banks need to be more detailed about corporate loan projects and be more cautious about loan projects that meet environmental protection standards and outdated production capacity. At the same time, they should ensure the financing needed for corporate operations and support high-quality investment projects for firms in high pollution, high energy consumption, and overcapacity industries. Firms that still have market prospects and market competitiveness but are temporarily facing financial difficulties can be provided credit support to help them tide over the problems. Third, promote the further improvement of the market-oriented environment for the regional financial industry. The market mechanisms play a decisive role in allocating credit resources and promoting credit resources allocation in a more efficient and fair direction. In addition, improve the financial industry market environment by promoting competition among financial institutions, expanding the sources of financing for firms, and

improving bank performance evaluation.

Ethical approval

There are no ethical issues involved in this thesis and no harm will be caused to individual organisms.

This entry does not apply to this thesis.

Consent to Participate Not applicable

Consent to Publish Not applicable

Author Contribution

Rui Chen conducted all parts of the research

Declaration of Funding

I declare that no funds, grants, or other support were received during the preparation of this manuscript

Declaration of competing interest

I have no relevant financial or non-financial interests to disclose.

Data availability

Data sets used or analyzed in the current study are available from corresponding authors upon reasonable request.

References

- Acharya VV, Eisert T, Eufinger C, Hirsch C (2019) Whatever it takes: The real effects of unconventional monetary policy. *Rev Financ Stud* 32, 3366-3411. <https://doi.org/10.1093/rfs/hhz005>
- Banerjee RN, Hofmann B (2018) The rise of zombie firms: Causes and consequences. *BIS Quarterly Review*
- Baron RM, Kenny DA (1986) The moderator mediator variable distinction in social psychological-research - conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology* 51, 1173-1182. <https://doi.org/10.1037/0022-3514.51.6.1173>
- Blažková I, Dvoutěý O (2020) Zombies: Who are they and how do firms become zombies? *J Small*

Bus Manage, 1-27. <https://doi.org/https://doi.org/10.1080/00472778.2019.1696100>

Boeckx J, Cordemans N, Dossche M (2013) Causes and implications of the low level of the risk-free interest rate. *Econ Rev* 59, 661-669.

Bruche M, Llobet G (2014) Preventing zombie lending. *Rev Financ Stud* 27, 923-956. <https://doi.org/10.1093/rfs/hht064>

Caballero RJ, Hoshi T, Kashyap AK (2008) Zombie lending and depressed restructuring in japan. *Am Econ Rev* 98, 1943-1977. <https://doi.org/10.1257/aer.98.5.1943>

Cai G, Zhang X, Yang H (2022) Fiscal stress and the formation of zombie firms: Evidence from china. *China Econ Rev* 71, 101720. <https://doi.org/https://doi.org/10.1016/j.chieco.2021.101720>

Cai XQ, Lu Y, Wu MQ, Yu LH (2016) Does environmental regulation drive away inbound foreign direct investment? Evidence from a quasi-natural experiment in china. *J Dev Econ* 123, 73-85. <https://doi.org/10.1016/j.jdeveco.2016.08.003>

Chang Q, Zhou Y, Liu G, Wang D, Zhang X (2021) How does government intervention affect the formation of zombie firms? *Econ Model* 94, 768-779. <https://doi.org/10.1016/j.econmod.2020.02.017>

Chari A, Jain L, Kulkarni N (2021) The unholy trinity: Regulatory forbearance, stressed banks and zombie firms. NBER Working Papers

Cheng Q, Lai X, Liu Y, Yang Z, Liu J (2021) The influence of green credit on china's industrial structure upgrade: Evidence from industrial sector panel data exploration. *Environ Sci Pollut R*, 1-15. <https://doi.org/https://doi.org/10.1007/s11356-021-17399-1>

Feng YC, Shen Q (2021) How does green credit policy affect total factor productivity at the corporate level in china: The mediating role of debt financing and the moderating role of financial mismatch. *Environ Sci Pollut R* <https://doi.org/10.1007/s11356-021-17521-3>

Fukuda S, Nakamura J (2011) Why did 'zombie' firms recover in japan? *World Econ* 34, 1124-1137. <https://doi.org/10.1111/j.1467-9701.2011.01368.x>

Haushalter D, Klasa S, Maxwell WF (2007) The influence of product market dynamics on a firm's cash holdings and hedging behavior. *J Financ Econ* 84, 797-825. <https://doi.org/10.1016/j.jfineco.2006.05.007>

Hong M, Li Z, Drakeford B (2021) Do the green credit guidelines affect corporate green technology innovation? Empirical research from china. *Int J Env Res Pub He* 18, 1682. <https://doi.org/10.3390/ijerph18041682>

Hoshi T (2006) Economics of the living dead. *Jpn Econ Rev* 57, 30-49. <https://doi.org/10.1111/j.1468-5876.2006.00354.x>

Hu G, Wang X, Wang Y (2021) Can the green credit policy stimulate green innovation in heavily polluting enterprises? Evidence from a quasi-natural experiment in china. *Energ Econ* 98, 105134. <https://doi.org/https://doi.org/10.1016/j.eneco.2021.105134>

Hu Y, Jiang H, Zhong Z (2020) Impact of green credit on industrial structure in china: Theoretical mechanism and empirical analysis. *Environ Sci Pollut R* 27, 10506-10519. <https://doi.org/10.1007/s11356-020-07717-4>

Jacobson LS, Lalonde RJ, Sullivan DG (1993) Earnings losses of displaced workers. *Am Econ Rev* 83, 685-709.

Jiang F, Jiang Z, Kim KA (2020) Capital markets, financial institutions, and corporate finance in china. *Journal of Corporate Finance* 63, 101309. <https://doi.org/10.1016/j.jcorpfin.2017.12.001>

Kane EJ (1987) Dangers of capital forbearance - the case of fslic and zombie savings-and-loans.

- Contemporary Policy Issues 5, 77-83. <https://doi.org/10.1111/j.1465-7287.1987.tb00247.x>
- Kobayashi K, Saita Y, Sekine T (2002) Forbearance lending: A case for Japanese firms. Bank of Japan Research and Statistics Department Working Paper
- Kornai J (1986) The soft budget constraint. *Kyklos* 39, 3-30. <https://doi.org/10.1111/j.1467-6435.1986.tb01252.x>
- Kwon HU, Narita F, Narita M (2015) Resource reallocation and zombie lending in Japan in the 1990s. *Rev Econ Dynam* 18, 709-732. <https://doi.org/10.1016/j.red.2015.07.001>
- Labatt S (2002) Environmental finance: A guide to environmental risk assessment and financial products. *Transplantation* 66, 405-9.
- Li WA, Cui GY, Zheng MN (2021) Does green credit policy affect corporate debt financing? Evidence from China. *Environ Sci Pollut R* <https://doi.org/10.1007/s11356-021-16051-2>
- Liu S, Xu R, Chen X (2021) Does green credit affect the green innovation performance of high-polluting and energy-intensive enterprises? Evidence from a quasi-natural experiment. *Environ Sci Pollut R* 28, 65265-65277. <https://doi.org/10.1007/s11356-021-15217-2>
- Love I (2003) Financial development and financing constraints: International evidence from the structural investment model. *Rev Financ Stud* 16, 765-791. <https://doi.org/10.1093/rfs/hhg013>
- Luo C, Fan S, Zhang Q (2017) Investigating the influence of green credit on operational efficiency and financial performance based on hybrid econometric models. *International Journal of Financial Studies* 5, 27. <https://doi.org/10.3390/ijfs5040027>
- Luo S, Yu S, Zhou G (2021) Does green credit improve the core competence of commercial banks. Based on quasi-natural experiments in China. *Energ Econ* 100, 105335. <https://doi.org/10.1016/j.eneco.2021.105335>
- Mortal S, Reisel N (2013) Capital allocation by public and private firms. *Journal of Financial and Quantitative Analysis* 48, 77-103. <https://doi.org/10.1017/s0022109013000057>
- Peek J, Rosengren ES (2005) Unnatural selection: Perverse incentives and the misallocation of credit in Japan. *Am Econ Rev* 95, 1144-1166. <https://doi.org/10.1257/0002828054825691>
- Rajan RG, Zingales L (1998) Financial dependence and growth. *Am Econ Rev* 88, 559-586.
- Richardson S (2006) Over-investment of free cash flow. *Rev Account Stud* 11, 159-189. <https://doi.org/10.1007/s11142-006-9012-1>
- Storz M, Koetter M, Setzer R, Westphal A (2017) Do we want these two to tango? On zombie firms and stressed banks in Europe. IWH Discussion Papers
- Sun J, Wang F, Yin H, Zhang B (2019) Money talks: The environmental impact of China's green credit policy. *J Policy Anal Manag* 38, 653-+. <https://doi.org/10.1002/pam.22137>
- Tian C, Li X, Xiao L, Zhu B (2022) Exploring the impact of green credit policy on green transformation of heavy polluting industries. *J Clean Prod*, 130257. <https://doi.org/10.1016/j.jclepro.2021.130257>
- Urionabarrenetxea S, Domingo Garcia-Merino J, San-Jose L, Luis Retolaza J (2018) Living with zombie companies: Do we know where the threat lies? *Eur Manag J* 36, 408-420. <https://doi.org/10.1016/j.emj.2017.05.005>
- Wang X, Fan G, Hu L (2019) Report on Marketization Index by Provinces in China. Social Sciences Academic Press, Beijing. 161-422. (in Chinese)
- Wei SJ, Xie Z, Zhang XB (2017) From "made in China" to "innovated in China": Necessity, prospect, and challenges. *J Econ Perspect* 31, 49-70. <https://doi.org/10.1257/jep.31.1.49>
- Xi B, Wang Y, Yang M (2022) Green credit, green reputation, and corporate financial performance:

Evidence from china. *Environ Sci Pollut R* 29, 2401-2419. <https://doi.org/10.1007/s11356-021-15646-z>

Yao S, Pan Y, Sensoy A, Uddin GS, Cheng F (2021) Green credit policy and firm performance: What we learn from china. *Energ Econ* 101, 105415. <https://doi.org/10.1016/j.eneco.2021.105415>

Yin W, Zhu ZY, Kirkulak-Uludag B, Zhu YP (2021) The determinants of green credit and its impact on the performance of chinese banks. *J Clean Prod* 286, 124991. <https://doi.org/10.1016/j.jclepro.2020.124991>

Zhang C, Chen Y, Zhou H (2020) Zombie firms and soft budget constraints in the chinese stock market. *Asian Econ J* 34, 51-77. <https://doi.org/10.1111/asej.12194>

Zhang K, Li Y, Qi Y, Shao S (2021) Can green credit policy improve environmental quality? Evidence from china. *J Environ Manage* 298, 113445. <https://doi.org/10.1016/j.jenvman.2021.113445>

Zhu H, He F, Wang SN, Ye QL, Liang C (2019) Zombie firms and debt accumulation: A theoretical framework and chinese experience. *China World Econ* 27, 104-126. <https://doi.org/10.1111/cwe.12298>