

The Transformation and Challenge of “Zombie Firms” in China’s Capital Market

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Abstract

In the context of supply-side structure reform, using industry change database of Chinese A-share listed company during 2008–2015, we investigate the driving force, direction, effect and challenge of zombie firm transformation. We find that, First, from the perspective of driving force and direction of zombie firm transformation, zombie firms are more motivated to transform than healthy ones for surviving, and it is more inclined to transfer from strategic emerging industries into traditional industries. Second, from the perspective of industry barriers and property rights, state-owned property rights help zombie firms break through industry barriers and achieve transformation goals. Third, from the perspective of the transformation effect, the transformation has failed to improve zombie firms’ living conditions, market performance and operating performance, state-owned property rights do not significantly help to improve zombie firms’ living conditions, market performance and operating performance.

Keywords : supply-side structure reform; zombie firms; transformation; state-owned property rights

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1 Introduction

“Zombie firms” which caused by the “wave phenomenon”¹⁾ and excess capacity in developing countries, has played an important role on the economies of developing countries (Lin, 2007; Lin et al., 2010). A large number of zombie firms are sleepy, but not dead (Nie et al., 2016b; Huang & Chen, 2017), leading to credit resource distortion, lower product pricing, higher labor costs, market competition distortion, decline in production (Caballero et al., 2008). Failure to properly dispose zombie firms in a time will lead to economic recession throughout the country (Kwon et al., 2015).

To adjust the irrational economic structure triggered by excess capacity, on December 9, 2015, the Executive Meeting of the State Council proposed a policy of disposing impaired firms, including shutting down or restructuring firms that do not meet the standard of national energy consumption, environmental protection, quality, safety or those suffering chronic losses. The 2016 and 2017 Government Work Reports continued to point out that mergers, debt restructuring or bankruptcy liquidation should be taken to actively, steadily and effectively dispose zombie firms and resolutely clear up the backward excessive capacity, and strictly control the new capacity of surplus industries. Due to different factors leading to zombie firms (Zhang, 2000; Nie, 2016a), State-owned Assets Supervision and Administration Commission (hereafter SASAC) proposed that zombie firms should be disposed according to their classification. First, for the firms with mismanagement, operational efficiency should be improved through strengthening management to increase profit. Second, for the firms with backward technology, innovation should be strengthened through technology upgrade, and the government should encourage industrial transformation to improve firms’ performance. Third, for the firms lack of vitality, merger and acquisition (hereafter M&A) should be enforced to help them overcome difficulties and create synergy and new vitality. Fourth, for the zombie firms which have no hope of turning around should be shut down. In conclusion, there are just two ways for zombie firms to choose, exiting from the market directly or finding ways to improve firm performance. But considering that a large number of exits will be a big shock to the market, we should firstly find the way to revitalize the zombie firms.

1) “Wave Phenomenon” describes the phenomenon that most firms are optimistic about one industry with their investment pouring into it like wave (Lin, 2007; Lin et al., 2010).

The “zombie firm phenomenon” is the outcome of combination of firm management, government guidance, banking behavior, and the macroeconomic environment. The existing literature focused on government subsidies, bank lendings, excessive bankruptcy costs, and economic stimulus policies in China (Nie et al., 2016b; He & Zhu, 2016a; Shen, 2016; Huang & Chen, 2017). The role of banks and the government is hard to blame while, the firm’s reflection is more important. From the view of actively and safely disposing zombie firms, we investigate whether the transformation improves zombie firms’ performance or promotes the clearing up zombie firms, and what is the role of state-owned property rights during disposing process. We provide empirical evidence at firm level and help to understand the root causes of zombie firms from micro-level perspective, and clarify the key point and direction of disposing zombie firms.

Using industry change database of Chinese A-share listed company during 2008–2015, we investigate the driving force, direction and economic effects of zombie firm transformation. We find that compared with the healthy firms, zombie firms are more inclined to transform for surviving and they are prefer to move back to traditional industry rather than enter strategic emerging industry, but transformation do not significantly improve the living status, market performance and operating performance of transformed zombie firms. Furthly, state-owned property rights do help zombie firms to achieve transformation goals and improve the living status of transformed zombie firms, but do not help to improve the market performance and operating performance of transformed zombie firms. According to the results, from the government level perspective, we suggest that for SOEs, the government should make more use of market mechanism to dispose zombie firms, enhance their vitality and improve their efficiency. For non-SOEs, the government should give them more support to make the transformation. From the firm level perspective, they should actively restructure the management team, adjust the operation strategy and optimize the efficiency of internal resource allocation.

There are three main contributions to the literature. First, we find a way to dispose zombie firms from the perspective of marketization. Currently, disposing zombie firms is basically government-guided, and M&A or bankruptcy is commonly used to clear up zombie firms (Fukuda & Nakamura, 2011). We investigate zombie firms with viability to reinvent them with actively adjusting their business strategies, which will avoid the “one-size-fits-all policy”. Second, from the perspective of “defensive transformation”, we investigate the transformation driving force of zombie firms. Previous studies focus on the transformation driving force of industry leaders from the perspective of competition and innovation (Aghion & Howitt, 1992). However, there will also be losers

in the competition, and defensive transformation accounts for a large proportion in transition economies (Baumol, 2005&2010). We study whether the defensive transformation contributes to the survival and performance improvement of zombie firms. Third, we study the impact of the transformation on the growth of zombie firms. This paper examines whether zombie firms have changed the nature of “zombie” for regeneration.

2 Related Literature

2.1 Identifying Zombies

The concept of “zombie firms” was defined by Korne (1987, 1993), which refers to insolvent firms that have no hope of recovering but have been temporarily supported by bank lending, and also refers to the poorly run banking system that has been plagued by these firms. According to the definition of zombie firm, Caballero et al. (2008) propose the CHK method from the perspective of bank loans to identify zombie firms, and define zombie firms as that if a firm’s interest payment is lower than its hypothetical minimum interest payment. Fukuda & Nakamura (2011) introduce additional criteria to FN-CHK standard. First is the “profitability criterion”, where those firms whose earnings before interest and taxes (hereafter EBIT) exceeded the hypothetical risk-free interest payments were excluded from being categorized as zombies. The other criterion is the “evergreen lending criterion”, where those firms that were unprofitable and highly leveraged and had increased their external borrowings were categorized as zombies. The firm whose EBIT was less than the hypothetical risk-free interest payments in period t , total external debt was over half of their total assets in period $t-1$, and borrowings increased in period t were categorized as zombies in the period t . Nie (2016b) proposed to improve the above standards again, if a firm has been identified as a zombie firm for 2 years by FN-CHK method, then the enterprise should be identified as a zombie firm. On December 9, 2015, Premier Li Keqiang stressed at the executive meeting of the State Council that firms that have been unprofitable for more than three years, and do not meet the standard of structural adjustment should be “cleared” by means of asset restructuring, property rights transfer and bankruptcy. The definition of zombie firms is based on two main criteria. First, the firm is failed to continue operating and is insolvent. Second, the firm can still receive government subsidies or bank loans

to survive in the market.

Zombie firms in developed countries are embodied in the economic cycle and industrial upgrade (He & Zhu, 2016a; Zhu & Wei, 2016). Caballero et al.(2008) find evidence that zombie lending distorted healthy firms competition on employment and investment, and did indeed distort resource reallocation in Japan’s manufacturing sector in the late 1990s (Kwon, 2015) and also in south Korea in the 2000s (Hoshi & Kim, 2012). In China, the large number of zombie firms is outcome of “backward advantage” (Lin, 2003; Lin & Zhang, 2005). The process of guiding resources allocation by industrial policy, leading to a consensus among firms on promising industries and “wave phenomenon” in investment, which may be constant in fast-growing developing countries, accompanied by excess capacity and a related series of problems (Lin, 2007). Moreover, the technique and management of the backward advantages are difficult to gradually convert to the backward advantage of system and institution (Zhang, 2005), which leave potential risks to the long-term growth (Yang, 2002) quoted from Lin (2014). In addition, Zhang (2016, 2017) finds evidence that the pursuit of control gains by SOE managers and government officials will lead to repeated construction during the industrial policy enforcement (Zhang, 2000), and wasteful investment (Zhang, 2015a). Nie et al. (2016b) details the specific causes for the long-existing zombie firms, including collusion of local government officials and providing support to zombie firms for “face engineering” and keeping employment rate etc. Large-scale and irrational expansion due to malignant competition between local government and SOEs, excessive investment and insufficient external demand triggered by government after financial crisis, and credit tilt to insolvent SOEs.

2.2 The hazard of zombie firms

Previous studies on industry, regional distribution and hazard of zombie firms help us to take action to clear zombie firms and deal with excess capacity. Shen (2016) finds evidence that the ratio of zombie firm is higher in heavy chemical industry, western region, and SOEs, which is consistent with the industry heterogeneity of excess capacity. Huang and Chen (2017) also find evidence that the number of zombie firms is relatively high in the western region and in SOEs, the size of zombie firms is relatively high in the Northeast. Zombie greatly decreases firms’ operating efficiency, creates excess capacity, ultimately reduces market efficiency and undermines the long-term economic growth (He & Zhu, 2016b). Caballero et al. (2008) find evidence that long-

existing zombie firms in Japan distorts industry patterns, job creation and productivity and competition throughout the rest economy. Tan et al. (2017) also find the evidence of zombie crowding out effect in China, especially for non-SOEs, in addition, the crowding out effect is more serious in the industries with more government intervention, and higher external financing dependence, which leads to the impairment of private investment. The long existence and poor exit of zombie firms also exacerbates the possibility of a concentrated outbreak of economic risk (Zhao et al., 2015).

2.3 Zombie firm governance

The governance experiences of zombie firms come mainly from United States, South Korea and Japan, the governance is mainly government-guided by classifying zombie firms and helping them to rebuild based on the bankruptcy law (Fukuda & Nakamura, 2011; Xiong, 2016). Previous literatures argue that Japan has more experiences in zombie firm governance. Based on classification, large and medium-sized zombie firms can be regenerated through the process of test, acquisition, reorganization and transformation (Jiang & Cai, 2017). In the process of zombie firm governance triggered by Japanese government, they judge whether the firm is inefficient and insolvent or with rebirth value according to the deadline policy, and then they invigorate the firms with rebirth value, letting the inefficient ones go bankrupt (Yin & Zou, 2017). These researches show that Japan mainly to take “rescue” measures to dispose zombie firms, Fukuda and Nakamura (2011) also find evidence that during the recovery after 2000, most Japanese zombie firms do not go bankrupt directly but just slowly recover by reducing scale of their workforce, selling inefficient fixed assets, and strengthening management.

Relevant literatures argue the causes, current situation and hazard of zombie firms to the economy. Governance experience of Japan and other countries also provide empirical evidence for us to govern zombie firms. Both literature research and governance experience show that the government-guided disposal of zombie firms helps to improve the market efficiency. Besides, firms’ initiative also plays an important role on rebirth. Proper disposal of zombie firms must take all possible means and effects into account, which is rarely referred in current Chinese research. We examine the initiative of zombie firm transformation from the market perspective, including whether zombie firms achieve self-rescue through the transformation? What are the challenges for zombie firm transformation? Has the zombie firm transformation improved its

viability? Has the zombie firm transformation improved the long-term performance? We provide new empirical evidence and suggestion for the market-oriented management of zombie firms.

3 Hypothesis development

3.1 The driving force of zombie firm transformation

Existing literatures argue that firm transformation is influenced by two opposing factors from firm-level perspective, one is innovation during industrial upgrading (Baker & Sinkula, 2009) leading to the “aggressive transformation”, the other is insolvent leading to the “defensive transformation” (Baumol, 2005 & 2010). Because innovation is usually accompanied by uncertainty, innovative firms account for only a small part and fewer of them are truly original and innovative firms (Baumol, 2010). Most firms are just followers in the market (Baumol et al., 2009) which choose transformation for survival (Mansfield, 1962; Hermani & Shapiro, 1986) and this “survival-driven” transformation is very common in developing countries (Naudé, 2009 & 2010). Due to institutional reasons, Chinese entrepreneurs are lack of the spirit of innovation (Zhang, 2015b), and survival-driven “defensive transformation” is common. Under the dual pressure of government clearance and survival, zombie firms are more likely to transform for survival. Existing research on Japanese zombie firms also suggest that while the government disposes zombie firms by mergers or bankrupt, most zombie firms are just slowly recovering through self-adjustment (Fukuda & Nakamura, 2011). Due to soft budget constraints and the control of state-owned property rights (Li & Li, 2014) in China, SOEs are more likely to achieve transformation goals than non-SOEs. We thus formulate Hypothesis 1:

H1. Compared with healthy firms, zombie firms are more inclined to transform for surviving, the state-owned property rights help zombie firms to achieve the goals of transformation.

3.2 The direction of zombie firm transformation

Bartelsman (2005) finds evidence that more than 50 % of firms exit from a new

industry within five years of entering (Dunnet et al., 1989; Johnson, 2005). Zombie firms themselves are less profitable, less innovative, and depend on subsidies or bank lending to survive, so they have to move back to traditional industries instead of re-entering emerging industries through innovation. In addition, during China's industrial policy enforcement, state-owned property rights are more easily to obtain industrial policy-related financing and investing rewards, which helping SOEs to break through industry barriers (Luo & Liu, 2009; Luo & Zhao, 2013) and enter strategic emerging industries (Guo & Song, 2011), which leads to many insolvent SOEs entering strategic emerging industries (Lin, 2007) and creates a large number of state-owned "zombie firms" (Huang & Chen, 2017). The large number of state-owned zombie firms has to move back to the traditional industries to seek survival opportunities. Compared with non-SOEs, SOEs are more easier to withdraw from strategic emerging industries. We thus formulate Hypothesis 2:

H2. Compared with healthy enterprises, zombie firms are more inclined to transform from strategic emerging industries into traditional industries, and the nature of SOEs plays an active role during transformation process.

3.3 The effects of zombie firm transformation

Referred to the economic consequences of firm transformation, Bartelsman et al. (2005) argue that the surviving probability of firms entering new industries is very low, in the first two years of entering the new industry, 20–40 % of businesses die out and only 40–50 % may survive for more than seven years. While Zhang et al. (2010) find that Chinese industry transfer is conducive to high returns and performance improvement, abnormal return of transformed firms is significantly lower than the non-transformed firms in the region with weak property rights protection. Guo and Song (2011) find that larger firms with higher state-owned shareholdings are easier to enter strategic emerging industries and enjoy "policy benefits". Although the transformation of zombie firms is a passive defensive process, the choice of transformation rather than waiting for bankruptcy signals that the transformed firms are ready to change. In addition, since the executives of SOEs are also government officials, the success of the zombie firm transformation helps to improve firm performance and obtain greater market recognition, which provides promotion opportunities for the executive. We thus formulate Hypothesis 3:

H3. Transformation helps zombie firms to survive and improve their performance,

and the nature of SOEs plays an active role on improving performance.

4 Data and methodology

4.1 Data

We adopt the data of Chinese A-share listed companies covered by the China Securities Industry Classification Index (hereafter the Industry Index) for 2008–2015, and investigate the effect of zombie firm transformation by comparing whether they have industry change, the direction of change, the zombie status change, and firm’s performance change between zombie transformation firms and healthy transformation firms. We use Industry Index to obtain firms transformation data. We use the China Stock Market and Accounting Research (CSMAR) database to obtain research and development data and main financial data. We obtain market-oriented index data from China’s market-oriented index (2015). We use China Macroeconomic Research Database to obtain per capita GDP data. After excluding insufficient data, we have 16,830 firm-year observations. In order to eliminate the effect of extreme values, we winsorize the top 1 % and bottom 1 % of the main variables.

4.2 Definitions of key variables

Zombie firm is measured as *Zom*, a dummy that takes on the value of 1 (and 0 otherwise) according to Caballero et al. (2008), Fukuda and Nakamura (2011), Nie (2016b). If a firm’s hypothetical risk-free interest payments exceeded EBIT, total external debt was over half of their total assets in year $t-1$, and had increased their external borrowings, then the firm is identified as zombie firm.

Transformation is measured as *Tran*, a dummy that takes on the value of 1 (and 0 otherwise) if a firm transfers between 4-level industry codes according to Industry Index.

The direction of transformation is measured as industry barrier and strategic emerging industry. Industry barrier is measured as *Barrier*, an index ranging from 0 to 4 for the difficulty of entering one industry, which takes value of 0 if a firm stays in same industry during research period, takes value of 1 if a firm just changes between 4-level

industry and does not change between upper-level industry, takes value of 2 if a firm changes between 3-level industry and does not change between upper-level industry, takes value of 3 if a firm changes between 2-level industry and does not change between upper-level industry, takes value of 4 if a firm changes between 1-level industry.

Strategic emerging industry is measured as *Emerge*, according to the “Strategic Emerging Industries Classification (Draft for Comments)” issued by the National Bureau of Statistics in 2012 (trial) and the 4-level industry classification of Industry Index, we identify energy conservation and environmental protection industries, new generation of information technology industry, biological industry, high-end equipment manufacturing industry, new energy industry, new material industry and new energy automobile industry as strategic emerging industries. *Emerge* is an index ranging from -1 to 1 that takes value of 1 if a transformed firm enters strategic emerging industries, takes value of -1 if a transformed firm moves back to traditional industries, and 0 otherwise.

Performance of zombie firm transformation is measured as survival status, Cumulative abnormal return and operating performance. Survival status is measured as $Zom_{i,t1,t2,t3}$, a dummy takes value of 1 (and 0 otherwise) if the zombie firms still zombie after transformed $1, 2, 3$ years. Cumulative abnormal return is measured as $CAR_{i,t1,t2,t3}$, which takes value of cumulative abnormal return of zombie firms after transformed $1, 2, 3$ years. Operating performance is measured as $\Delta ROA_{i,t1,t2,t3}$, which takes value of the operating performance increase after zombie firms transforming $1, 2, 3$ years.

Appendix 1 provides definitions of all variables.

4.3 Empirical methodology

4.3.1 Test of hypothesis H1

To test hypothesis H1, we estimate a Logit model of the following form:

$$\begin{aligned} Tran_{i,t} = & a_0 + a_1Lagzom_{i,t} + a_2Soe + a_3Lagzom_{i,t} * Soe + a_4Control_{i,t} \\ & + Industryeffect + Districteffect + Yeareffect + \varepsilon_{i,t} \end{aligned} \quad (1)$$

Where the dependent variable *Tran*, is a dummy variable equals to one if a firm transfers between 4-level industries codes according to Industry Index; 0 otherwise, and all other variables are provided in 3.2 and Appendix 1. Given that the dependent variable is dichotomous, we employ a logistic model to test out hypotheses.

4.3.2 Test of hypothesis H2

To test hypothesis H2, we estimate a Logit model of the following form, all variables are provided in 3.2 and Appendix 1:

$$\begin{aligned} Barrier(Emerge)_{i,t} = & \alpha_0 + \alpha_1 Lagzom_{i,t} + \alpha_2 Soe + \alpha_3 Lagzom_{i,t} * Soe + \alpha_4 Control \\ & + Industryeffect + Districteffect + Yeareffect + \varepsilon_{i,t} \end{aligned} \quad (2)$$

4.3.3 Test of hypothesis H3

To test hypothesis H1, we estimate a Logit model and OLS regression model of the following form, all variables are provided in 3.2 and Appendix 1:

$$\begin{aligned} Zom_{t1,t2,t3} = & \alpha_0 + \alpha_1 Tran_{i,t} + \alpha_2 Lagzom_{i,t} + \alpha_3 Soe + \alpha_4 Lagzom_{i,t} * Tran_{i,t} \\ & + \alpha_5 Soe * Tran_{i,t} + \alpha_6 Lagzom_{i,t} * Soe + \alpha_7 Lagzom_{i,t} * Soe * Tran_{i,t} \\ & + \alpha_4 Control_{i,t} + Industryeffect + Districteffect + Yeareffect + \varepsilon_{i,t} \end{aligned} \quad (3)$$

$$\begin{aligned} CAR(\Delta ROA)_{t1,t2,t3} = & \alpha_0 + \alpha_1 Tran_{i,t} + \alpha_2 Lagzom_{i,t} + \alpha_3 Soe + \alpha_4 Lagzom_{i,t} * Tran_{i,t} \\ & + \alpha_5 Soe * Tran_{i,t} + \alpha_6 Lagzom_{i,t} * Soe + \alpha_7 Lagzom_{i,t} * Soe * Tran_{i,t} \\ & + \alpha_4 Control_{i,t} + Industryeffect + Districteffect + Yeareffect \\ & + \varepsilon_{i,t} \end{aligned} \quad (4)$$

Firm transformation is the cumulative outcome of firm’s strategy, business performance and economic characteristics, and we use lagged data of zombie firm and other firm characteristics to study driving force and direction of transformation in assumptions 1 and 2.

4.4 Descriptive statistics

4.4.1 Zombie firms

We detail the share of zombie firm changes from 2008 to 2015 in Table 1. The number of zombie firms decreases from 92 in 2008 to 46 in 2009, and increases to 123 in 2015. The ratio of zombie firms accounts for 5.91 % in 2008 then decreases to 2.87 % in 2009, eventually climbs up to 4.79 % in 2015.

4.4.2 Firm transformation

We detail the firm’s transformation from 2008 to 2015 in Table 2. The number of

Table 1 Share of zombie firm changes

Year	All	Number of zombie firms	Zombie firms ratio
2008	1556	92	5.91 %
2009	1603	46	2.87 %
2010	1760	68	3.86 %
2011	2107	81	3.84 %
2012	2331	96	4.12 %
2013	2434	95	3.90 %
2014	2469	112	4.54 %
2015	2570	123	4.79 %
Total	16830	713	4.24 %

firm's industry change shows a U-shaped curve, with a total of 585 listed companies involved in first-level industry changes, accounting for 3.48 % of the total observation, 654 listed companies in the second-level industry changes, accounting for 3.89 % of the total observation, 753 listed companies in the third-level industry changes, accounting for 4.47 % of the total observation, and 808 listed companies with fourth-level industry changes, accounting for 4.80 % of the total observation.

We detail the firm's transformation between strategic emerging industry and traditional industry from 2008 to 2015 in table 3. The number of transformed firms between strategic emerging and traditional industry in the fourth-level industry changes during the period 2008–2015. A total of 128 firms enter strategic emerging industry, accounting for 16.35 % in 2008 to 11.20 % in 2011 and then to 19.72 % in 2015. A total of 164 firms return to traditional industry, accounting for 22.12 % in 2008 to 31.20 % in 2011, then to 16.92 in 2014 and 18.31 % in 2015.

4.4.3 Descriptive statistics

Table 4 provides summary descriptive statistics for 16830 firm-year observations of firms transformation observations from 2008–2015. The mean (median) level of *Zom* is 0.042 (0), accounting for that 4.20 % of firms met the zombie firm standard during 2008 to 2015. The mean (median) level of *Tran* is 0.048 (0), indicating that about 4.80 % of firms have made industry changes during the period 2008–2015. The mean (median) level of *Barrier* is 0.164 (0), and the mean (median) level of *Emerg* is -0.002 (0), indicating that the main direction of firm transformation is from strategic emerging industry back to traditional industry. The mean (median) level of SOEs is 0.447 (0), indicating that about 44.70 % of observations are SOEs. The mean (median) level of *CAR* in the first year after transformation is 0.099 (-0.002), the mean (median) level of *CAR* in the second year after transformation is 0.203 (0.065), and the mean (median) level of *CAR* in the third year after transformation is 0.275 (0.125). The mean (median)

Table 2 Firm’s transformation change

Year	All	First-level change	Second-level change	Third-level change	Fourth-level change
2008	1,556	66	77	96	104
2009	1,603	89	97	106	114
2010	1,760	81	94	109	124
2011	2,107	87	98	115	125
2012	2,331	50	53	61	64
2013	2,434	54	60	69	70
2014	2,469	54	59	63	65
2015	2,570	104	116	134	142
Total	16,830	585	654	753	808

Table 3 Firm’s transformation between strategic emerging industry and traditional industry

Year	Fourth-level change	Enter emerging industry	Return traditional industry	Ratio of Entering emerging industry	Ratio of Returning traditional industry
2008	104	17	23	16.35%	22.12%
2009	114	16	19	14.04%	16.67%
2010	124	21	16	16.94%	12.90%
2011	125	14	39	11.20%	31.20%
2012	64	8	15	12.50%	23.44%
2013	70	12	15	17.14%	21.43%
2014	65	12	11	18.46%	16.92%
2015	142	28	26	19.72%	18.31%
Total	808	128	164	15.84%	20.30%

Table 4 Descriptive statistics

Variable	N	Mean	Std.	Median	Min	Max
Zom	16,830	0.042	0.201	0.000	0.000	1.000
Tran	16,830	0.048	0.214	0.000	0.000	1.000
Barrier	16,830	0.164	0.764	0.000	0.000	4.000
Emerg	16,830	− 0.002	0.132	0.000	− 1.000	1.000
Soe	16,830	0.447	0.497	0.000	0.000	1.000
CARt1	14,656	0.099	0.456	− 0.002	− 0.690	2.063
CARt2	12,195	0.203	0.614	0.065	− 0.840	2.637
CARt3	9,897	0.275	0.699	0.125	− 0.971	2.935
DROAt1	14,656	− 0.003	0.057	− 0.002	− 0.224	0.256
DROAt2	12,195	− 0.004	0.622	− 0.004	− 0.228	0.276
DROAt3	9,897	− 0.005	0.066	− 0.006	− 0.220	0.295
Pat	16,830	64.870	437.128	5.000	0.000	19444.000
Size	16,830	21.908	1.386	21.734	18.836	26.660
Lev	16,830	0.472	0.237	0.466	0.045	1.303
Cr4	16,830	0.311	0.155	0.276	0.157	0.904
Market	16,830	7.780	1.871	7.910	− 0.300	11.800
Gdpp	16,830	10.490	0.285	10.597	9.928	10.820

level of ROA growth in the first year after transformation is -0.003 (-0.002), the mean (median) level of ROA growth in the second year after transformation is -0.004 (-0.004), and the mean (median) level of ROA growth in the third year is -0.005 (-0.006).

5 Regression results

5.1 The driving force of zombie firm transformation

Table 5 presents the logistic regression results of estimating model (1), the first column reports the driving force of zombie firm transformation, and the second column introduce the model (1) an interaction between state-owned property and zombie firms. The estimate of *Lagzom* is significantly positive, indicating that the number of zombie firm transformation is significantly higher than that of healthy firm, which is consistent with the view that zombie firms are more active to transform for surviving. After interacting with state-owned property, the estimate of zombie firms drops to 0.321 and no longer significant, the estimate of SOEs is significantly negative. The estimate of interaction is positive but not significant, which suggests that although the driving force

Table 5 Driving force of zombie firm transformation

	Tran	
	(1)	(2)
Lagzom	0.509*** (3.150)	0.321 (1.490)
Soe		-0.372*** (-4.050)
Lagzom * Soe		0.462 (-1.530)
Lagpat	-0.003*** (-3.130)	-0.003*** (-3.230)
Lagsize	-0.422*** (-13.060)	-0.373*** (-10.730)
Laglev	0.748*** (5.490)	0.762*** (5.590)
Cr4	-2.704** (-2.370)	-2.557** (-2.230)
Market	0.192 (1.550)	0.191 (1.540)
Gdpp	0.414* (1.810)	0.322 (1.400)
Indus	YES	YES
Distr	YES	YES
Year	YES	YES
Cons	2.813 (0.850)	2.760 (0.840)
N	16,830	16,830
pseudo R-sq	0.086	0.089

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

of SOEs transformation is significantly lower than that of non-SOEs, the nature of SOEs helps zombie firms to achieve transformation goal.

The results of the control variables suggest that lower level of research and development and industry concentration, smaller scale, higher level of debt, marketization and GDP per capita significantly increase the probability of firm transformation.

5.2 Industry barrier and direction of zombie firm transformation

Table 6 presents the ordered logistic regression results of estimating industry barrier broken through by zombie firms of model (2), the first and second column report the estimate of industry barriers broken through by zombie firms and the estimate of interaction variable between state-owned property and zombie firms. The estimate of *Lagzom* is positively significant, indicating that zombie firms are willing to break through industry barriers when they decide to transform, which may also suggest that zombie firms have no potential in the existing industry, and it is difficult for them to achieve fundamental performance improvement through slight adjustment. After interacting with state-owned property, the estimate of *Lagzom* drops to 0.286 and no longer significant, and the estimate of SOEs is negative significant. The estimate of interaction is positive significant, which suggests that the nature of SOEs helps zombie firms to break through industry barrier. The results of the control variables are consistent with table 5.

Furtherly, Table 7 presents the ordered logistic regression results of estimating strategic emerging industry barrier broken through by zombie firms of model (2), the first and second column report the estimate of zombie firms transforming direction and estimate of interaction variable between SOEs and zombie firms. The estimate of *Lagzom* is negatively significant, indicating that zombie firms are prefer to return to traditional industries from strategic emerging industries rather than enter strategic emerging industries. The estimate of interacting between *Soe* and *Lagzom* is negatively significant, indicating that state-owned property rights help zombie firms transform from strategic emerging industries back to traditional industries. The possible reason is that, under the influence of soft budget constraints and government-firm relationship in China, the survival pressure of state-owned zombie firms is less than that of non-state-owned zombie firms, and they are more inclined to return to the traditional industries for surviving, while non-state-owned zombie firms will choose to transfer to the strategic

Table 6 Industry barrier of zombie firm transformation

	Barrier	
	(1)	(2)
Lagzom	0.498*** (3.090)	0.286 (1.330)
Soe		-0.372*** (-4.060)
Lagzom * Soe		0.515* (1.710)
Lagpat	-0.003*** (-3.100)	-0.003*** (-3.210)
Lagsize	-0.428*** (-13.250)	-0.381*** (-10.940)
Laglev	0.766*** (5.620)	0.782*** (5.740)
Cr4	-2.818* (-2.470)	-2.673* (-2.340)
Market	0.188 (1.520)	0.186 (1.500)
Gdpp	0.425* (1.860)	0.333 (1.440)
Indus	yes	yes
Distr	yes	yes
Year	yes	yes
cut1		
Cons	-2.952 (-0.900)	-2.931 (-0.890)
cut2		
Cons	-2.874 (-0.870)	-2.852 (-0.860)
cut3		
Cons	-2.721 (-0.830)	-2.699 (-0.820)
cut4		
Cons	-2.600 (-0.790)	-2.578 (-0.780)
N	16,830	16,830
pseudo R-sq	0.071	0.074

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

emerging industry with higher conversion costs and risks, which also has higher return to make a last-ditch effort.

The results of the control variables are not consistent with Table 5 and Table 6, the larger scale, lower debt and higher industry concentration help zombie firms to break through strategic emerging industries.

Table 7 The direction of zombie firm transformation

	Emerge	
	(1)	(2)
Lagzom	-1.152*** (-4.270)	-0.607 (-1.460)
Soe		0.160 (1.120)
Lagzom * Soe		-0.989* (-1.960)
Lagpat	0.000 (0.630)	0.000 (0.600)
Lagsize	0.230*** (4.750)	0.222*** (4.220)
Laglev	-0.347 (-1.330)	-0.411 (-1.570)
Cr4	3.977* (2.120)	3.870* (2.060)
Market	-0.137 (-0.650)	-0.129 (-0.620)
Gdpp	-0.033 (-0.080)	-0.003 (-0.010)
Indus	yes	yes
Distr	yes	yes
Year	yes	yes
cut1		
cons	2.892 (0.510)	3.009 (0.530)
cut2		
Cons	13.388* (2.340)	13.525* (2.370)
N	16,830	16,830
pseudo R-sq	0.084	0.085

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

5.3 Economic consequences of zombie firm transformation

5.3.1 The survival status of zombie firm transformation

Table 8 presents regression results of estimating the survival status of zombie firm transformation of model (3). The first and second column report the estimate of survival status of zombie firms for the first year after the transition, the third and fourth column report the estimate of survival status of zombie firms for the second year after the transition, and the fifth and sixth column report the estimate of survival status of zombie firms for the third year after the transition. The estimates of *Tran* are negative but not significant, indicating that firms’ survival status will be slightly improved after transforming in the first, second and third year. After introducing lagged zombie firm

Table 8 The survival status of zombie firm transformation

	Zomt1		Zomt2		Zomt3	
	(1)	(2)	(3)	(4)	(5)	(6)
Tran	-0.170 (-0.810)	0.375 (1.480)	-0.269 (1.180)	0.129 (0.440)	-0.092 (-0.430)	0.474* (1.780)
Lagzom		1.667*** (8.570)		1.500*** (6.910)		1.548*** (6.530)
Soe		0.491*** (5.090)		0.492*** (4.860)		0.560*** (5.120)
Lagzom * Tran		-0.793 (-1.150)		-1.491 (-1.370)		-15.458 (-0.020)
Soe * Tran		-2.005*** (-2.650)		-0.789 (-1.450)		-0.988** (-1.980)
Lagzom * Soe		-0.175 (-0.710)		-0.237 (-0.860)		-0.827*** (-2.580)
Lagzom * Soe * Tran		1.352 (1.080)		1.397 (0.990)		14.989 (0.020)
Leadsiz	0.099*** (3.220)	0.042 (1.280)	0.105*** (3.270)	0.059* (1.710)	0.121*** (3.520)	0.079** (2.170)
Leadmarket	0.118 (1.290)	0.099 (1.090)	0.115 (1.250)	0.109 (1.180)	-0.051 (-0.410)	-0.059 (-0.480)
Indus	yes	yes	yes	yes	yes	yes
Distr	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes
Cons	-5.283*** (-6.070)	-4.340*** (-4.830)	-5.301*** (-6.29)	-4.613*** (-5.300)	-5.011*** (-5.320)	-4.459*** (-4.630)
N	14,539	14,442	12,029	11,943	9,661	9,581
pseudo R-sq	0.03	0.062	0.03	0.054	0.034	0.052

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

and state-owned property, the estimates of interaction between *Lagzom* and *Tran* are negative but not significant, which suggests that transformation slightly helps improving survival status of zombie firms in the first, second and third years after transformation, the probability of being zombie firms decreased. The estimates of interaction among *Lagzom*, *Soe* and *Tran* are positive but not significant, which suggests that state-owned property is not helpful for survival status of zombie firms.

5.3.2 The performance of zombie firm transformation

Table 9 and Table 10 present regression results of estimating the market performance and operating performance of zombie firm transformation of model (4). In Table 10, the first and second column report the estimate of market performance of zombie firms for the first year after the transition, the third and fourth column report the estimate of market performance of zombie firms for the second year after the transition, and the fifth and sixth column report the estimate of market performance of zombie firms for the third year after the transition. The estimate of *Tran* is negative in first year, then

positive in second year, and negative again in third year, and all the estimates are not significant, showing an invert U-shaped curve, which suggests that transformation helps firms to improve market performance slightly in short run, and then become even worse in long run. After introducing *Lagzom* and *Soe*, the estimate of interaction between *Lagzom* and *Tran* is positive in the first year and turns to negative in the following two years, and still not significant, which suggests that transformation slightly helps to improve market performance of zombie firms in short run, and then become worse in long run, the results are consistent with that of full sample. The estimate of interaction among *Lagzom*, *Soe* and *Tran* is negative in the first year and turns to positive in the following two years, and still not significant, which suggests that state-owned property slightly improve the market performance of zombie firms. The results also indicate that the market does not have enough faith in the transformation of zombie firms.

In Table 10, the first and second column report the estimate of operating performance of zombie firms for the first year after the transition, the third and fourth column report the estimate of operating performance of zombie firms for the second

Table 9 Market performance of zombie firm transformation

	CART1		CART2		CART3	
	(1)	(2)	(3)	(4)	(5)	(6)
Tran	−0.003 (−0.150)	0.000 (0.010)	0.018 (0.680)	0.002 (0.005)	−0.016 (−0.480)	−0.041 (−0.960)
lagzom		0.026 (0.870)		0.077* (1.760)		0.103* (1.830)
lagsoe		−0.038*** (−4.470)		−0.093*** (−7.350)		−0.146*** (−9.080)
Lagzom * Tran		0.008 (0.090)		−0.147 (−1.040)		−0.167 (−0.970)
Soe * Tran		−0.021 (−0.550)		0.022 (0.380)		0.027 (0.380)
Lagzom * Soe		0.012 (0.300)		−0.022 (−0.370)		−0.011 (−0.140)
Lagzom * Soe * Tran		−0.039 (−0.290)		0.179 (0.880)		0.195 (0.780)
Leadsizes	−0.036*** (−12.130)	−0.032*** (−9.890)	−0.067*** (−15.040)	−0.055*** (−11.720)	−0.070*** (−12.520)	−0.053*** (−8.880)
Leadmarket	−0.005 (−0.190)	−0.011 (−0.420)	−0.057* (−1.720)	−0.058* (−1.740)	−0.07 (−1.630)	−0.078* (−1.780)
Indus	yes	yes	yes	yes	yes	yes
Distr	yes	yes	yes	yes	yes	yes
year	yes	yes	yes	yes	yes	yes
Cons	0.232 (0.500)	1.047*** (3.330)	0.985 (1.570)	2.025*** (5.280)	0.922 (1.260)	2.032*** (4.120)
N	14,656	14,554	12,195	12,105	9,897	9,810
Adj.R ²	0.097	0.098	0.094	0.098	0.09	0.098
F	33.029	30.244	27.231	25.81	21.752	21.497

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

year after the transition, and the fifth and sixth column report the estimate of operating performance of zombie firms for the third year after the transition. The estimate of *Tran* is firstly positive and not significant in the first year after transforming, then turns to significantly negative in the following two years, which suggests that transformation just helps firms to improve operating performance slightly in short run, and then become much worse in long run. After introducing *Lagzom* and *Soe*, the estimates of interaction between *Lagzom* and *Tran* are significantly negative in the following three years, which suggests that transformation does not help improving operating performance of zombie firms in both short and long run, the results are strengthened and consistent with that of full sample. The estimates of interaction among *Lagzom*, *Soe* and *Tran* are positive and not significant in the following three years, which suggests that state-owned property slightly improves the operating performance of zombie firms. The results also indicates that the market does not have enough faith in the transformation of zombie firms. The results are consistent with that of market performance in Table 9.

Table 10 Operating performance of zombie firm transformation

	$\Delta ROAt1$		$\Delta ROAt2$		$\Delta ROAt3$	
	(1)	(2)	(3)	(4)	(5)	(6)
Tran	0.001 (0.450)	0.004 (1.340)	-0.005* (-1.860)	-0.002 (-0.580)	-0.006** (-2.010)	-0.001 (-0.250)
Lagzom		0.006 (1.600)		0.013*** (3.080)		0.021*** (4.080)
Soe		0.001 (1.340)		0.001 (0.920)		-0.001 (-0.660)
Lagzom * tran		-0.042*** (-3.740)		-0.048*** (-3.490)		-0.050*** (-3.180)
Soe * tran		-0.001 (-0.170)		-0.002 (-0.330)		-0.007 (-1.130)
Lagzom * soe		-0.001 (-0.140)		-0.010* (-1.810)		0.000 (0.030)
Lagzom * soe * tran		0.020 (1.220)		0.030 (1.520)		0.011 (0.490)
Leadsizes	-0.001** (-2.310)	-0.001*** (-2.750)	-0.002*** (-5.320)	-0.002*** (-5.270)	-0.003*** (-5.550)	-0.003*** (-4.850)
Leadmarket	0.003 (1.060)	0.000 (0.020)	0.004 (1.330)	0.002 (0.490)	-0.007* (-1.850)	-0.011*** (-2.630)
Indus	yes	yes	yes	yes	yes	yes
Distr	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes
Cons	-0.014 (-0.250)	0.025 (0.640)	0.018 (0.290)	0.048 (1.260)	0.075 (1.130)	0.143*** (3.160)
N	14,656	14,554	12,195	12,105	9,897	9,810
Adj.R ²	0.011	0.012	0.025	0.026	0.025	0.03
F	4.201	4.203	7.431	7.085	6.476	6.738

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

6 Endogeneity and robust test

6.1 Endogeneity test

6.1.1 PSM test

According to the analysis above, a reverse causality may arise between firm performance and transformation, we use PSM to mitigate such concerns. Figure 1 and Figure 2 show the propensity score before and after matching at ratio of 1: 1, the propensity score of the sample after matching almost coincides with that before matching, which means that the matching is successful. Table 11 shows the estimate of driving force of zombie firm transformation using PSM sample, and the results are consistent with that of Table 5.

6.1.2 Omitted variables bias

Perhaps one or more unobserved variables cause firm transformation, such as firm’s life cycle, growth opportunities, performance. We use long regression model to estimate the true causal effect between *Lagzom* and *Tran*. Table 12 presents the long regression results, which is consistent with that of Table 5.

6.2 Robust test

6.2.1 Financial insolvent firm transformation

Under the background of the new delisting rules and reducing capacity policy

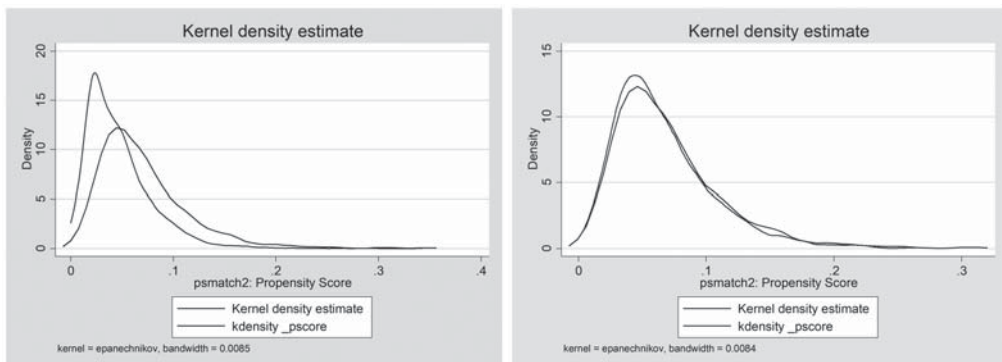


Figure1 Propensity score before matching Figure2 Propensity score after matching

Table 11 Driving force of zombie firm transformation after PSM

	Tran	
	(1)	(2)
Lagzom	0.509* (1.780)	0.487 (1.170)
Soe		-0.426*** (-3.340)
Lagzom * Soe		0.137 (0.250)
Cons	12.006** (2.460)	11.918** (2.440)
N	1,508	1,508
pseudo R-sq	0.051	0.057

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

Table 12 Omitted variables bias

	Tran	
	(1)	(2)
Lagzom	0.602*** (3.630)	0.420* (1.930)
Soe		-0.407*** (-4.360)
Lagzom * soe		0.450 (1.480)
Laglc	0.036 (1.160)	0.042 (1.360)
Laggrow	0.245*** (5.830)	0.231*** (5.510)
Lagroe	-0.063 (-0.310)	-0.062 (-0.310)
Cons	6.269*** (3.600)	5.268*** (3.000)
N	15,371	15,371
pseudo R-sq	0.093	0.097

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

enforcement of 2014, financial insolvent firms are also faced with the pressure of transformation as zombie firms. We repeat regressing the above regression using ST firms (*ST*, a dummy variable equals to one if ST firms, and 0 otherwise) and meager-profit firms (*Meager*, Index ranging from 0 to 3 that measures the frequency of a firm's Roe (Return on equity) between (0.00, 0.02) in three years before transformation). Table 13 presents the estimate of the transformation driving force of the financial insolvent firm repeated by model (1). The estimate of *Lagst* and *Meager* are significantly positive, which suggests that compared with healthy firms, ST firms and meager firms are more inclined to transform. After introducing *Soe*, the estimate of interaction

between *Lagst* and *Soe* is significantly positive, and the estimate of interaction between *Meager* and *Soe* is negative and not significant, suggesting that state-owned property is more helpful to ST firm transformation than meager firm transformation. The explanation might be that the financial status of ST firm is worse than meager firms, and they need an urgent change for surviving. The results are basically consistent with that of the transformation Table 5.

6.2.2 Alternative proxy test

Besides the transformation decision of zombie firms, the frequency of transformation

Table 13 Driving force of financial insolvent firm transformation

	Tran			
	(1)	(2)	(3)	(4)
Lagst	0.623*** (5.100)	0.450*** (3.080)		
Lagst* Soe		0.540** (2.240)		
		-2.24		
Meager			0.199*** (3.980)	0.233*** (3.560)
Meager* soe				-0.050 (-0.490)
Cons	1.148 (0.350)	1.234 (0.370)	2.373 (0.720)	2.21 (0.670)
N	16,830	16,830	16,830	16,830
pseudo R-sq	0.088	0.091	0.087	0.089

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

Table 14 Alternative proxy test

	TranF	
	(1)	(2)
Lagzom	0.383** (1.980)	0.192 (0.710)
Soe		-0.463*** (-4.340)
Lagzom* soe		0.428 (1.180)
cut1		
_cons	4.649 (1.130)	4.858 (1.180)
cut2		
_cons	6.082 (1.480)	6.294 (1.530)
N	12,862	12,862
pseudo R-sq	0.097	0.100

Note: Standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.

(*TranF*) is an important alternative proxy to measure the success of transformation. Table 14 presents the results of alternative proxy for *Tran*, which is robust and consistent with Table 5.

7 Conclusions and discuss

7.1 Research conclusions

In the context of supply-side structure reform, using industry change database of Chinese A-share listed company during 2008–2015, we investigate the driving force, direction and effect and challenge of zombie firm transformation. We focus on the driving force, industry barrier breakthrough, and economic consequence of zombie firm transformation. We further investigate the role of ownership sturcture, and find that transformation is helpful to improve the living status of transformed zombie firms, but the living status of state-owned transformed zombie firms is worse than that of non-state-owned transformed zombie firms. The transformation is helpful to improve market performance of zombie firms, but state-owned property has failed to improve market performance of transformed zombie firms. The operating performance of zombie firms decreases significantly after transformation, and state-owned property is helpful to improve operating performance of transformed zombie firms. The results above show that although the economic consequence of the transformation of zombie firms is mixed, transformation has become an important choice for zombie firms to improve their survival status, but it is difficult for zombie firms to transfer into strategic emerging industries with higher operating costs. Being faced with life or death choice, non-state-owned zombie firms without government guarantees are more willing to transform, and inclined to enter strategic emerging industries with high-risk and high-benefit to seek opportunities, and perform better than state-owned zombie firms as well.

7.2 Discuss

The long-existence of zombie firms has seriously hindered China’s economic structure transformation and market efficiency improvement. From the perspective of government level, market-based means should be applied to deal with zombie firms

instead of government interference, including providing technical support to enhance the vitality and efficiency of firms, promoting M&A to integrate resources, and providing more support (tax preference and government subsidies) to help zombie firms transform successfully. From the perspective of firm level, we need to find the cause and then “Suit the remedy to the case”. If the firm is lack of innovative technology, more investment should be put in research and development. If the firm goes to be zombie firm for strategy failure or mismanagement, then management team should be restructured and operating strategy should be adjusted to improve internal resource efficiency. In the absence of the desired effect of the mentioned supports, firms should actively cooperate with the government to implement an effective exit mechanism to avoid greater waste of resources.

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Appendix 1

Appendix 1 variable definitions

Variable	Definition
<i>Zom</i>	Dummy variable equals to 1 if a firm's hypothetical risk-free interest payments exceeded EBIT, total external debt was over half of their total assets in year t-1, and had increased their external borrowings; 0 otherwise.
<i>Tran</i>	Dummy variable equals to 1 if a firm transfers between 4-level industry codes according to Industry Index; 0 otherwise.
<i>Barrier</i>	Index ranging from 0 to 4 for the difficulty of one industry to entry that equals to 0 if a firm stays in same industry during research period, equals to 1 if a firm changes between 4-level industry and does not change between upper-level industry, equals to 2 if a firm changes between 3-level industry and does not change between upper-level industry, equals to 3 if a firm changes between 2-level industry and does not change between upper-level industry, and equals to 4 if a firm changes between 1-level industry.
<i>Emerg</i>	Index ranging from -1 to 1 that equals to 1 if a transformed firm enters strategic emerging industries, equals to -1 if a transformed firm moves back to traditional industries, and 0 otherwise.
<i>CAR</i>	Cumulative abnormal return.
<i>ROA</i>	Net income to assets ratio.
<i>Soe</i>	Dummy variable equals to 1 if SOEs, and 0 otherwise.
<i>Pat</i>	Cumulative number of valid patents.
<i>Size</i>	Log of total assets.
<i>Lev</i>	Debt to asset ratio.
<i>CR4</i>	Market share of the operating income of the top 4 firms in the current industry.
<i>Market</i>	China market-oriented index.
<i>Gdpp</i>	Per capita GDP.