The recurrence of financial distress

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Motivations

In business

- Companies commonly suffer a period of financial distress (FD) before filing bankruptcy.
- Some of them may recover but some of them may fail eventually. It's like humans…

In medicine

- People get ill from time to time.
- Human diseases can be cured but also can return.
- We not only care about whether a person will die but also care about when he will die.
- We use survival analysis to model time to event given a series of characteristics and factors.

Motivations

In medicine

- Doctors use survival analysis to predict the survival rate (or the hazard rate) when patients can survive beyond a given time span.
- And doctors also use survival analysis to predict the recurrence of disease, for example

Zhang et al. (2003). Intratumoral T cells, recurrence, and survival in epithelial ovarian cancer. New England Journal of Medicine, 348(3), 203-213.

Motivations

In business

- Corporate credit models usually predict the final outcome (whether bankruptcy/failure or other events of interest present) using leading information. e.g. Altman (JF, 1968), Martin (JBF, 1977), Ohlson (JAR, 1980) etc.
- Lane et al (JBF, 1986) incorporate Cox's (1972) proportional hazard model into bankruptcy prediction and Shumway (JB, 2001) extended it to a discrete time format. Many others follow..
- Survival analysis is also used in cure models where some cases are immune to default.
- However, no one cares about whether the company will recover from distress and whether it will become distressed again.

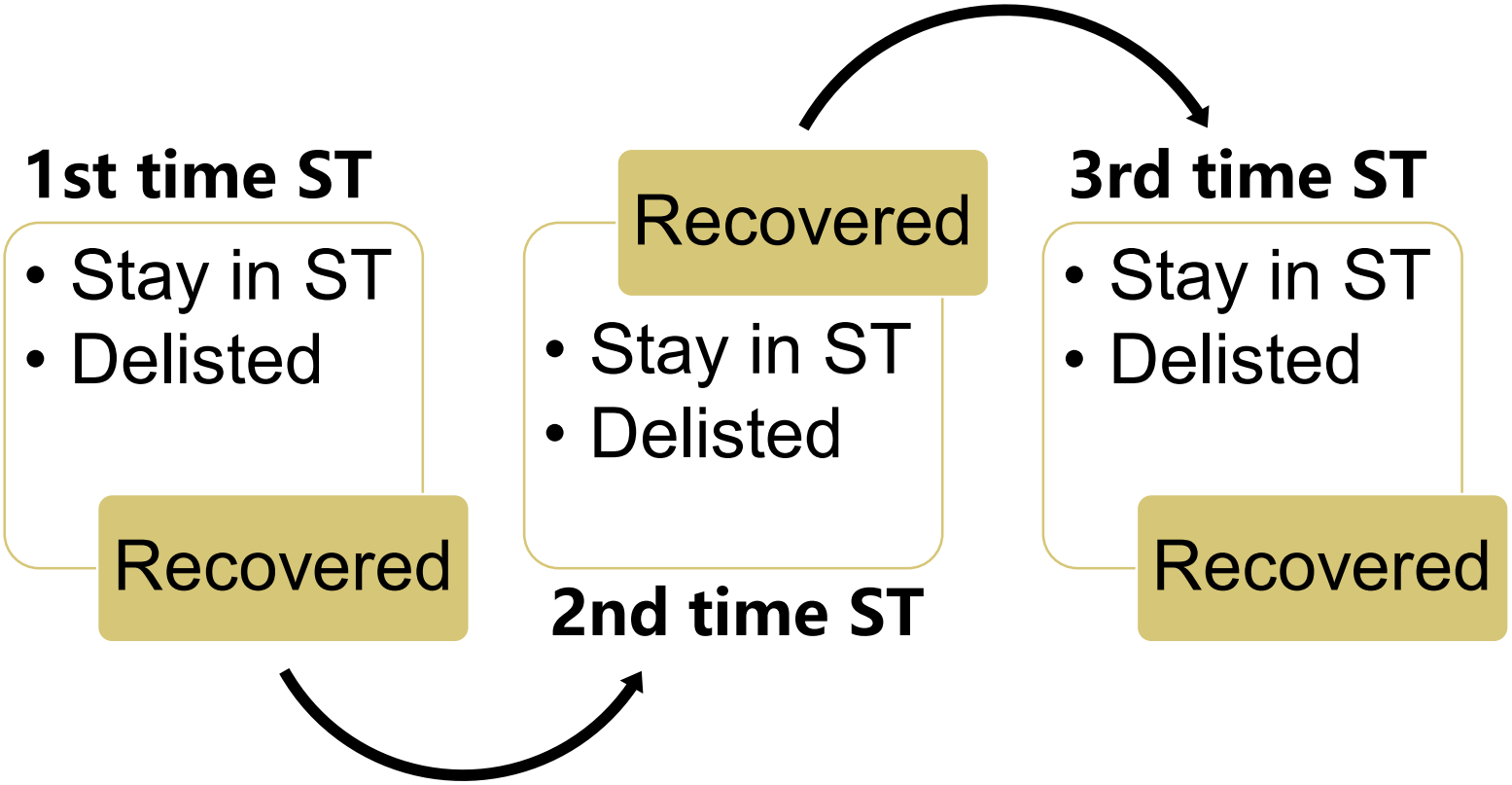
Contributions

- This paper addresses the recurrence of financial distress and predict the probabilities of repeated distress.
- Though research on financial restructuring is not new, we are the first to investigate the recurrence of financial distress and predict the time between them.
- We apply survival analysis to predict the probability of next distress given the survival time and covariates when recovers.
- We find that China listed firms are considerably risky to experience recurrent financial distress. Surprisingly one in third goes for the second.

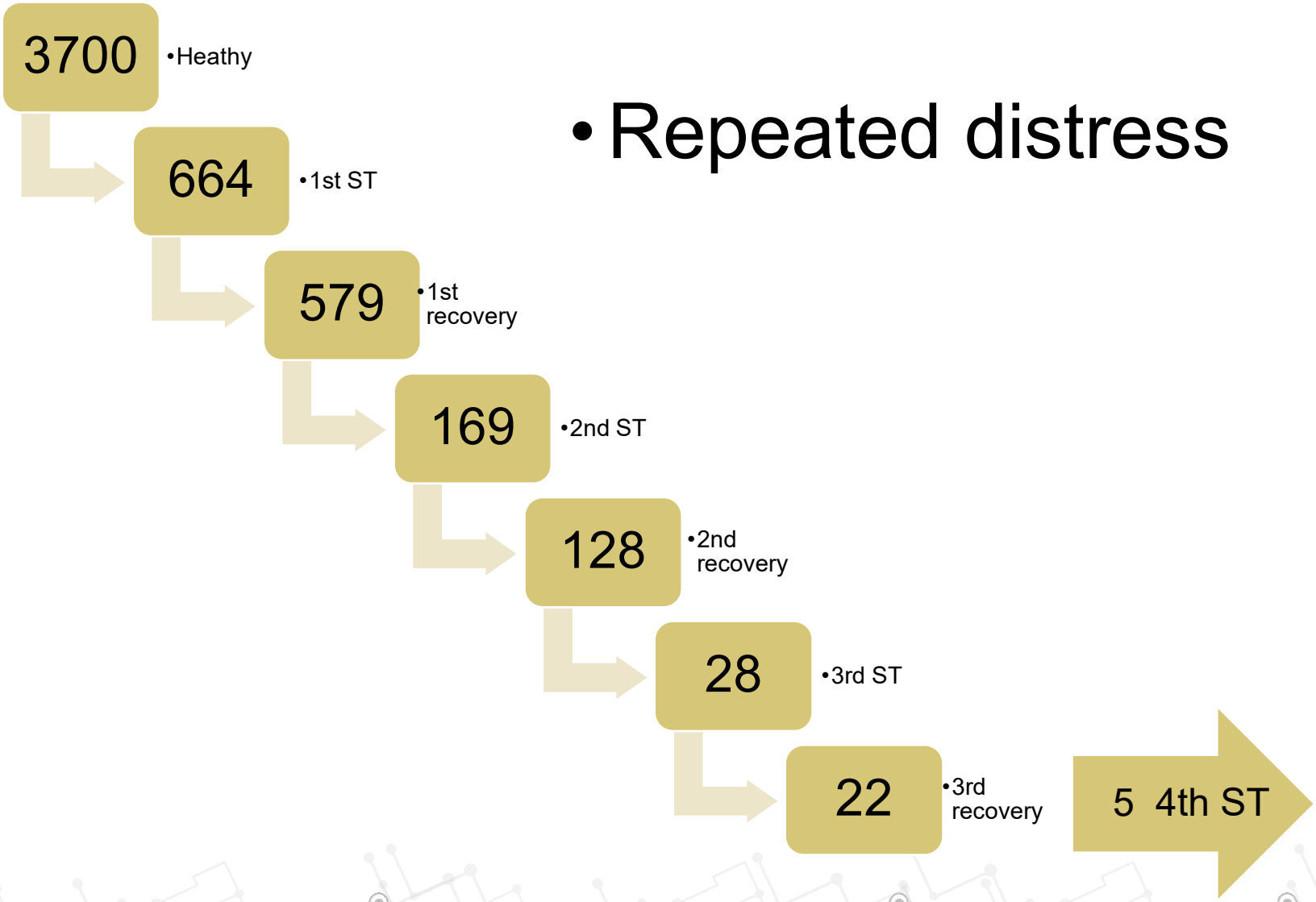
Data

- We focus on Chinese listed companies and by now there are over 3,700 companies listed in Shanghai and Shenzhen Stock Exchanges.
- The China Securities Regulatory Committee applies an official indicator of financial distress, Special Treatment (ST), to those companies of consecutive two or three year net profits to give early warnings for investors.
- While companies can stay in ST for several years, ST can also be withdrawn given their financial conditions recover. For example, there were 664 ST companies in history but only 579 have recovered and back to normal later, where 169 of them received second ST in later years.

Data

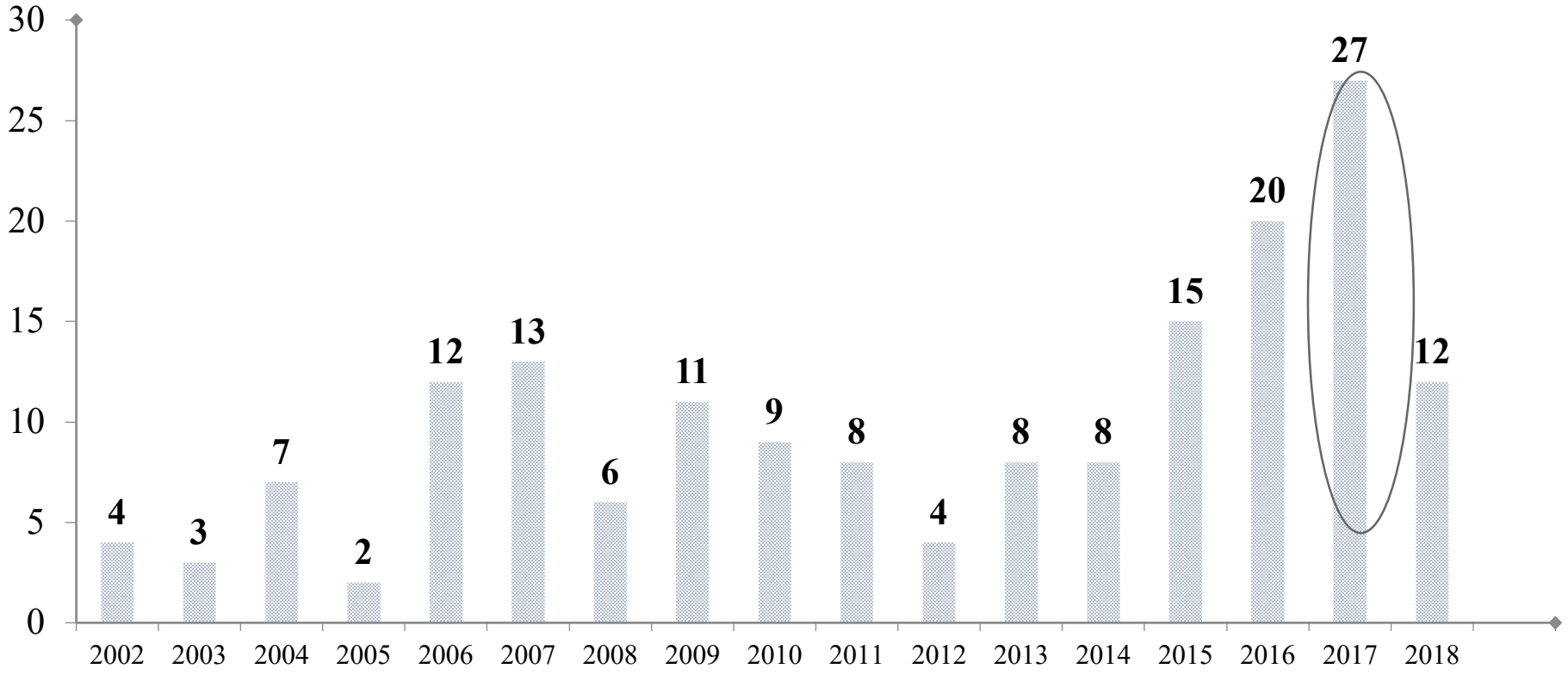

1st time ST
• Stay in ST
• Delisted
Recovered
2nd time ST
Recovered
• Stay in ST
• Delisted
3rd time ST
• Stay in ST
• Delisted
Recovered

Stats



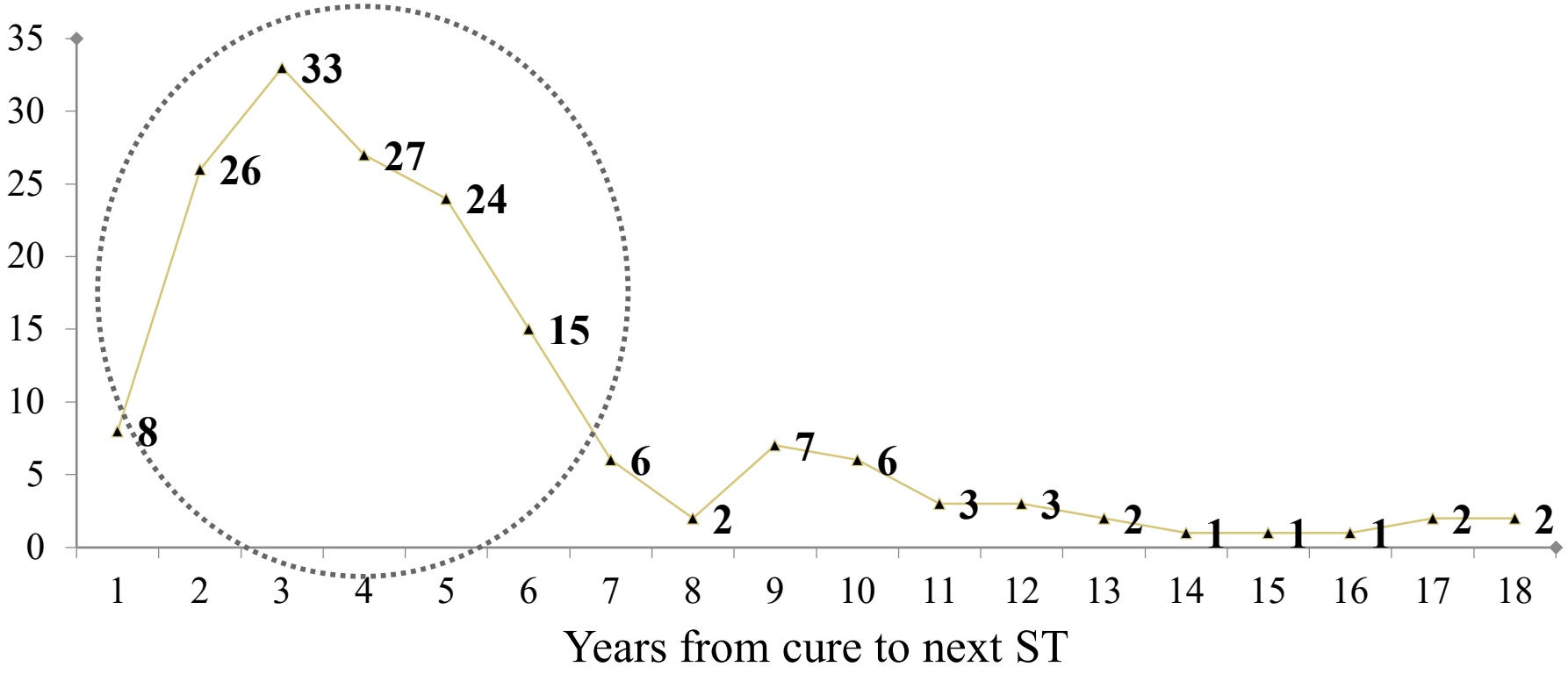
- Repeated distress

Stats



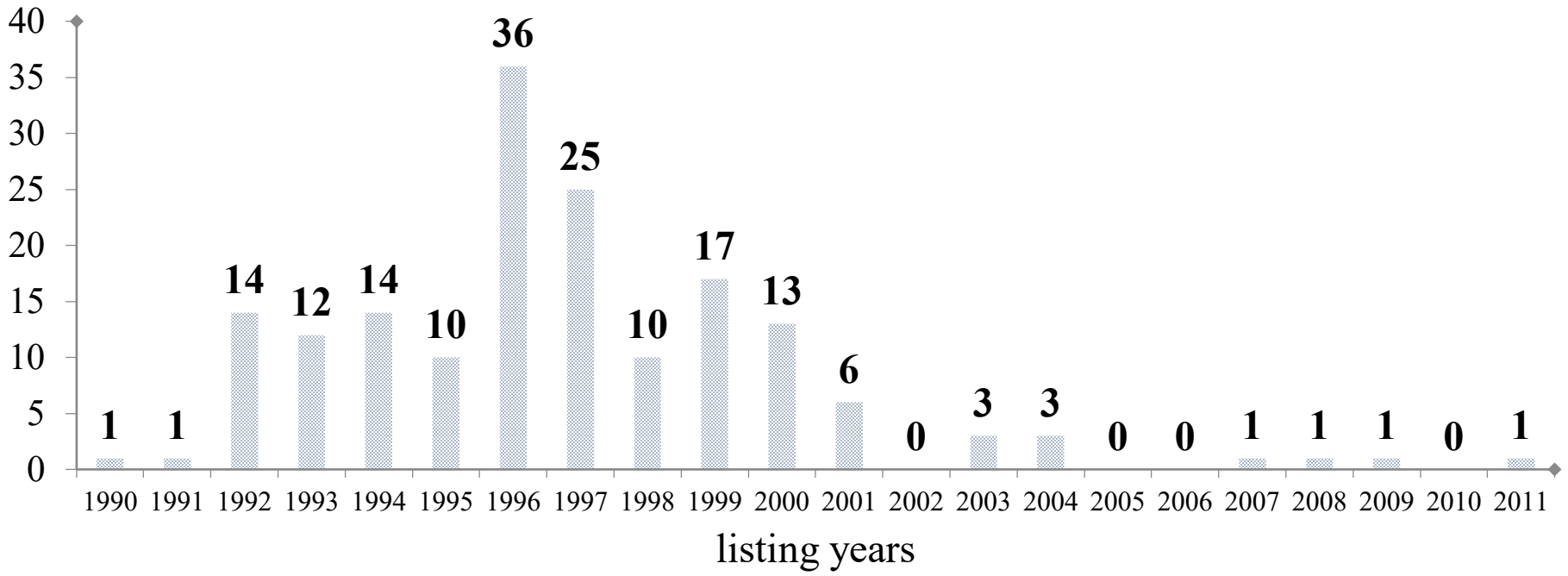
- More distressed companies relapse in recent years.
- The recurrence risk is increasing over time.

Stats



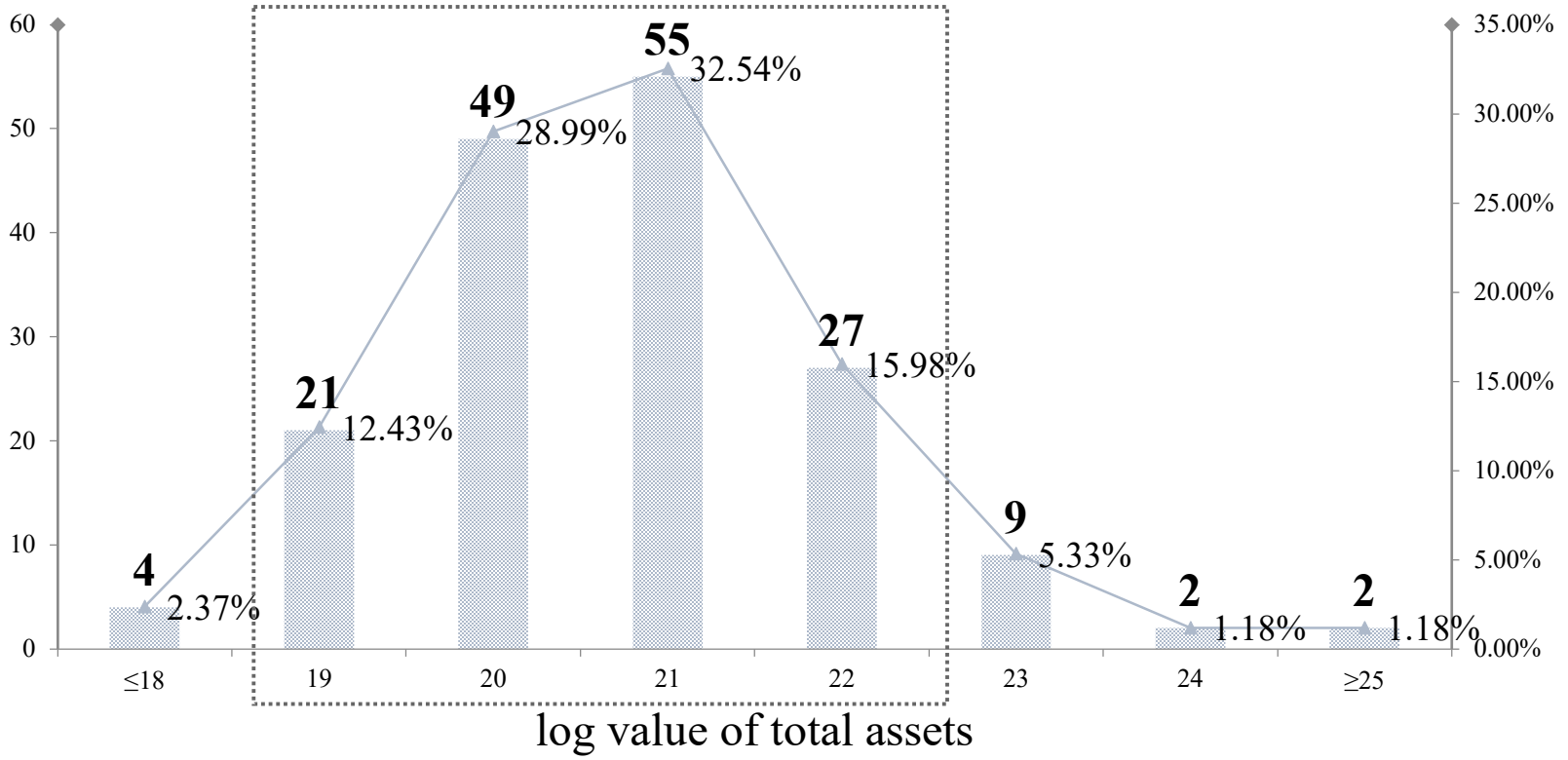
- Most companies takes less than six years to go back distressed again.

Stats



- Older companies are more likely to become distressed again.

Stats



- Firms with total assets of 0.1 to 6 billion CNY account for the majority of recurrent ST

Methodology

- Survival analysis is a statistical method to analyse the time to event of interest (ST recurrence).
- Survival/duration time is the key term defined as the time between the beginning of the birth/issuance/observation (the time when the firm in distress for the first time manages to recover) to event occurrence.
- Censoring is a form of incomplete data due to lost or unobserved cases (end of observation). STed and recovered Firms staying healthy until the end are censored.

Methodology

- Survival analysis is used to model the distribution of survival time.
- The survival function is defined as the probability that a company's survival time T is longer than a given time t

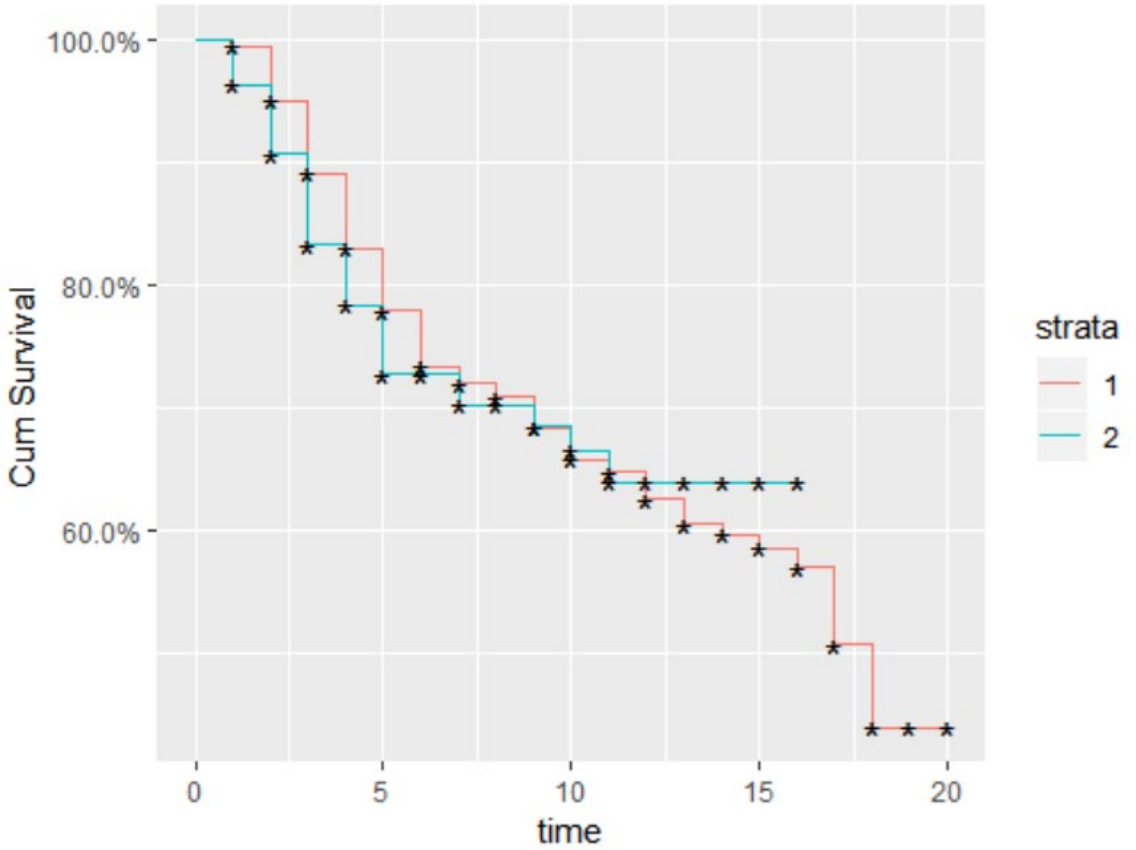
$$S(t) = \Pr(T > t) = 1 - F(t)$$

- The hazard rate is accordingly a conditional probability of a company getting in distress at period t given it is healthy before period t

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{\Pr(t < T \leq t + \Delta t)}{\Delta t}$$

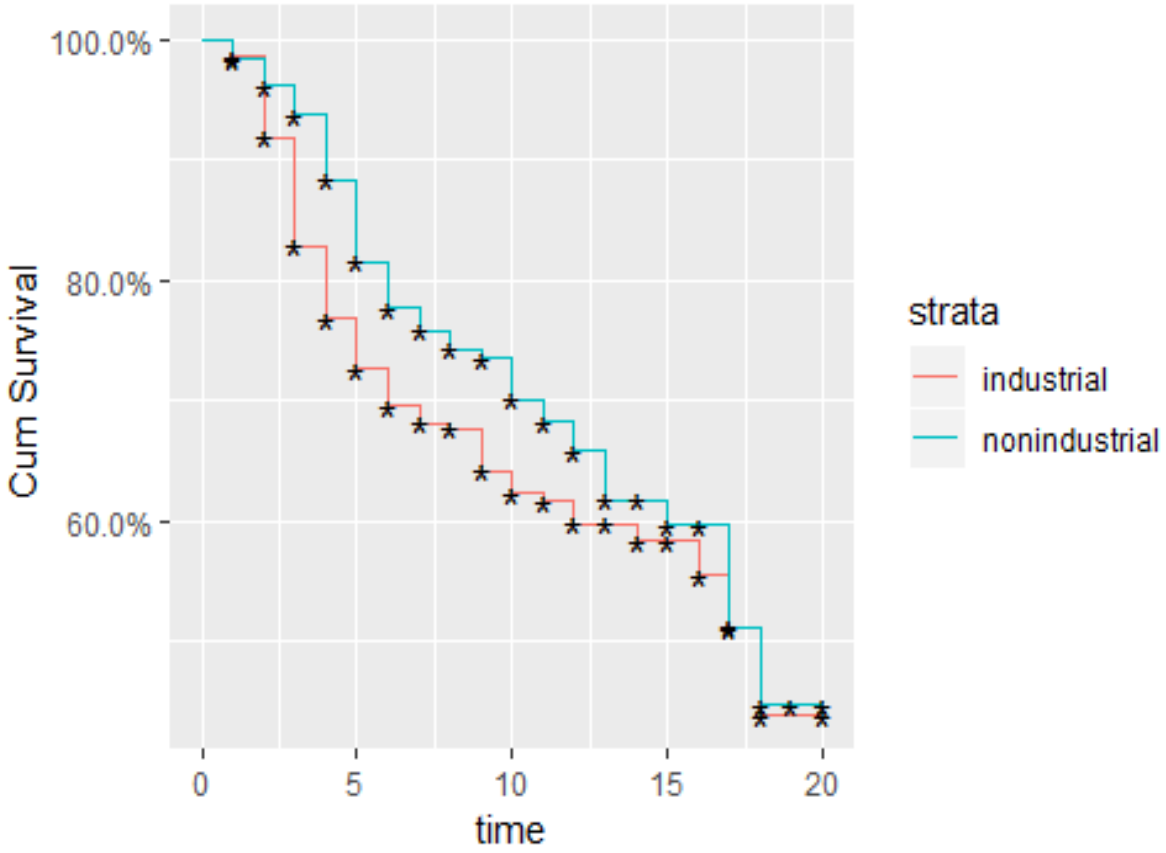
- Function estimators can be derived from Life table and Kaplan Meier methods.

KM-listing year



- The survival rate of companies listed before 1998 (red) firms falls further down than that of newly listed companies.

KM-sector



- The survival rate of manufacturing companies (red) is much lower than that of other companies.

Cox model

- Cox's proportional hazard regression model estimate the hazard rate rather than the survival function:

$$h(t,x) = h_0(t)\exp(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k)$$

- $h(t,x)$ is the hazard rate at time t
- $h_0\ (t)$ is the baseline hazard at time t
- $x_1, x_2, \ldots, x_k$ are covariates
- $\beta_1, \beta_2, \ldots, \beta_k$ are coefficients to estimate

Cox model

- Covariates: financial ratios, governance, company age, and time from first distress to first recovery.
- Wilcoxon signed-rank test & Adaptive Lasso method are used to select important covariates.
- The baseline hazard function is based on the survival rate at a given duration time.

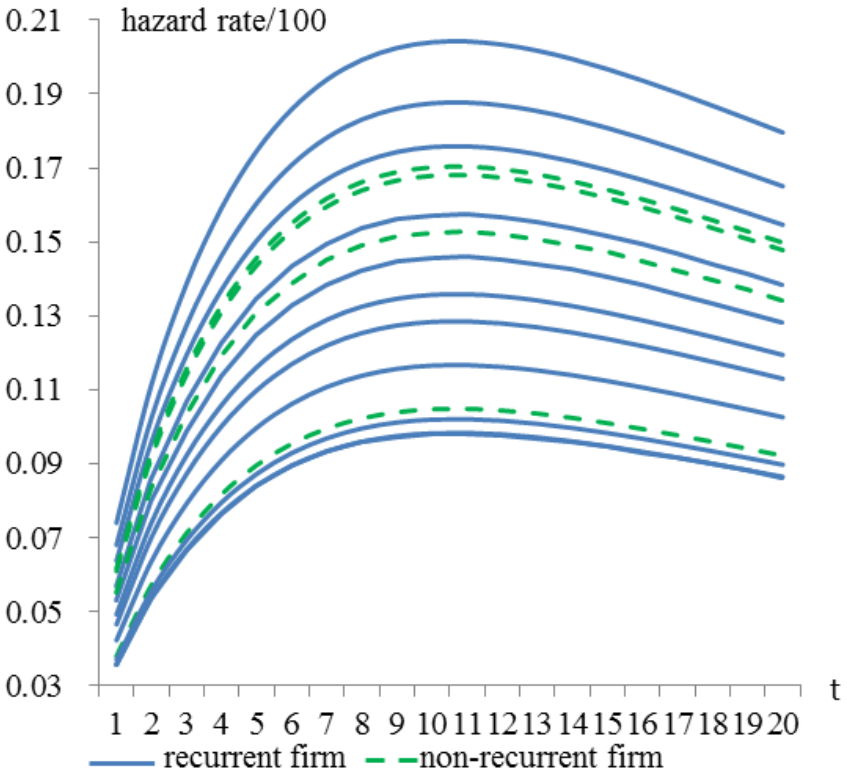
$$h(t,X)=\frac{0.0216t^{0.6291}}{1+0.0133t^{1.6291}}\exp(-0.0699X_2-9.4730X_3+0.0347X_7$$
$$-0.2739X_8-1.8450X_{33}-0.1577X_{34}+0.0229X_{37}+0.1423X_{56}-0.6979X_{69}+0.6865X_{73})$$

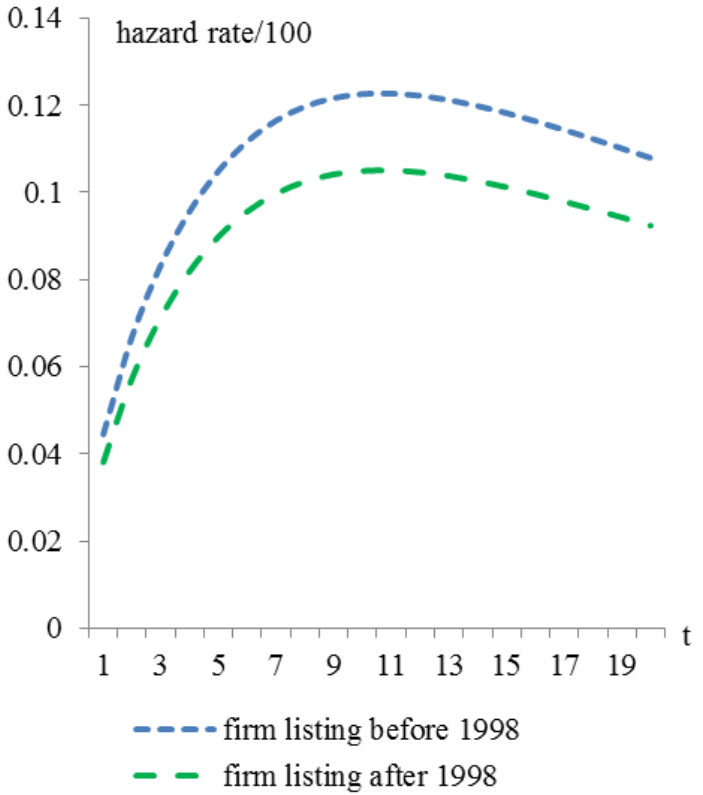
Results

Covariates	Coef	exp(coef)	se(coef)	z	Pr(>|z|)
Time from first ST to recovery	-0.0699	0.9325	0.0396	-1.7650	0.07.
Return on Assets	-9.4730	0.0001	1.9930	-4.7540	0.00***
Earning Cash Ratio	0.0347	1.0350	0.0184	1.8880	0.06.
Operating Profit to Net Income Ratio	-0.2739	0.7604	0.0950	-2.8820	0.00**
Free Asset Ratio	-1.8450	0.1580	0.3439	-5.3660	0.00***
Total Assets	-0.1577	0.8541	0.0796	-1.9810	0.04*
S Index	0.0229	1.0230	0.0062	3.6720	0.00***
Execution Times	0.1423	1.1530	0.0496	2.8710	0.00**
Total Salary of Top Three Executives	-0.6979	0.4976	0.2107	-3.3120	0.00***
Industrials	0.6865	1.9870	0.1662	4.1300	0.00***

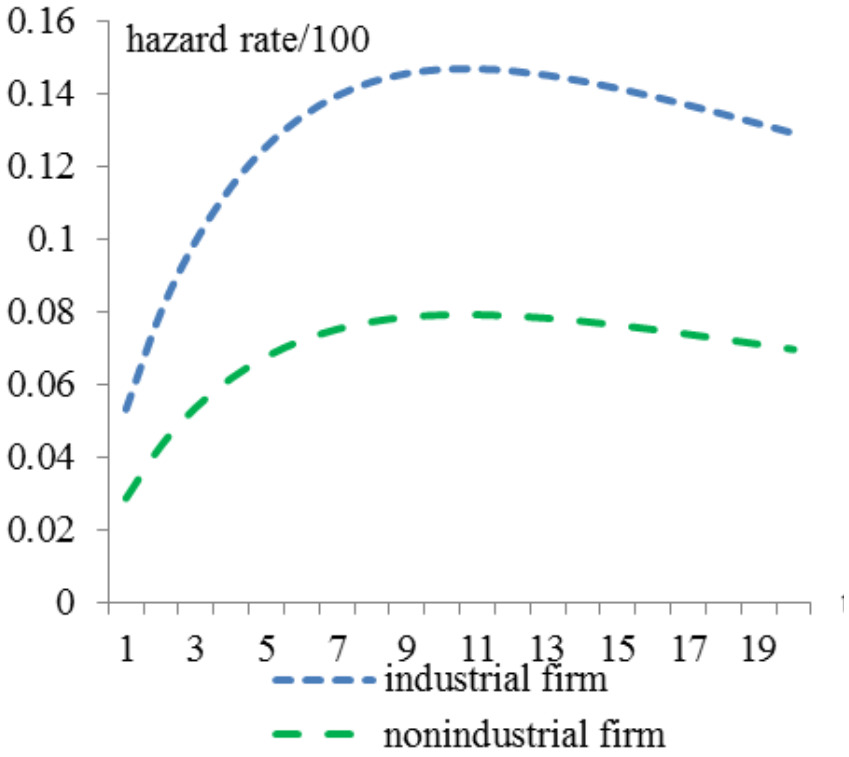
- Higher profitability and better operation lowers the recurrence risk.

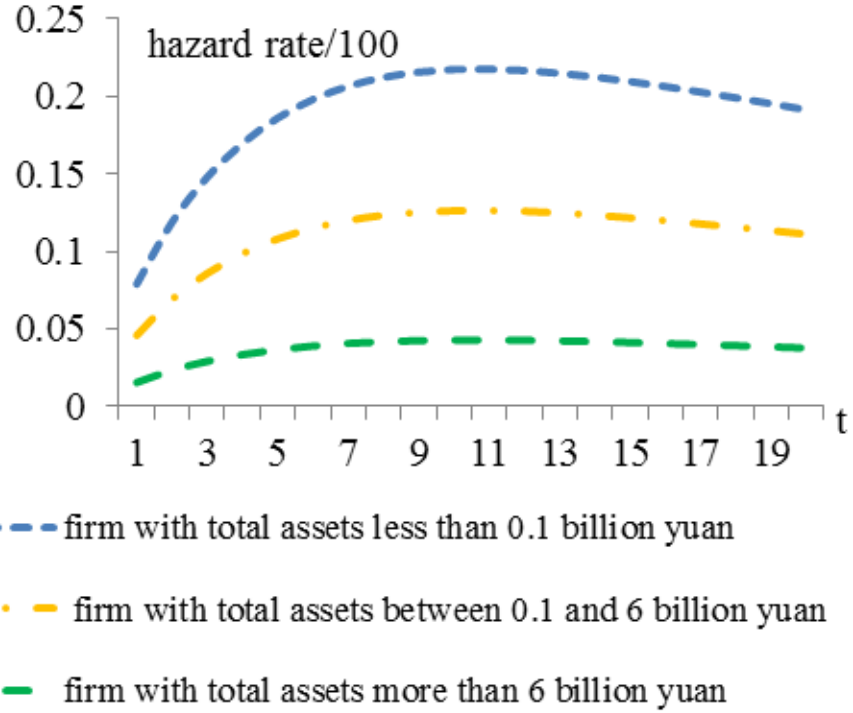
Results


hazard rate/100
0.21
0.19
0.17
0.15
0.13
0.11
0.09
0.07
0.05
0.03
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
t
recurrent firm
non-recurrent firm


hazard rate/100
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1 3 5 7 9 11 13 15 17 19
t
firm listing before 1998
firm listing after 1998

Results


hazard rate/100
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1 3 5 7 9 11 13 15 17 19
industrial firm
nonindustrial firm


hazard rate/100
0.25
0.2
0.15
0.1
0.05
0
t
1 3 5 7 9 11 13 15 17 19
firm with total assets less than 0.1 billion yuan
firm with total assets between 0.1 and 6 billion yuan
firm with total assets more than 6 billion yuan

Conclusions

- Companies with distress experiences have higher probabilities of repeated distress (hypothesis to be tested).
- The longer time it takes from distress to recovery, the easier it gets into distress again.
- Company age, sector, total assets and financial ratios are found to be associated with the recurrence of distress.

Extensions

- Test on hold-out samples
- Validate on 3rd time distress given it has two distress experience
- Model time to 1st, 2nd and 3rd recovery

Many Thanks
Q&A

Credit.Li
State of the Art Scoring