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Abstract

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Keywords

firms, chinese, st, survive, study, empirical, die

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Survive or Die? An Empirical Study on Chinese Special Treatment (ST) Firms

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ABSTRACT

A number of listed firms that are experiencing financial distress have had a Special Treatment (ST) 'cap' imposed on them by the China Securities Regulatory Commission. The ST 'cap' can be removed if the firms survive financial distress by becoming profitable. Alternatively, a ST firm which goes bankrupt is delisted from the market. Using a sample of 441 ST firms tracked from 1998 to 2011, this paper employs Cox's proportional hazards model to predict turnaround probability for a distressed firm to remove the ST 'cap'. The predictor variables incorporate: (1) accounting-driven ratios, (2) market-driven variables, and (3) information on ownership structure and restructuring status throughout the process. Unlike prior distress studies, accounting variables alone are found to provide the highest prediction accuracy (of 82.2%). Given the uniqueness of the legislations surrounding the suspension and termination of ST firms, this paper adds important new empirical evidence to the current financial distress literature.

Keywords: Chinese Special Treatment firms; financial distress resolution; Cox proportional hazards model; survival analysis; corporate turnaround prediction

JEL Classification: C41, C53, G17, G32, G33

1. Introduction

This paper uses a multi-period Cox proportional hazards model to predict the eventual consequences for Chinese Special Treatment (ST hereafter) firms, i.e. firms which have had a ST 'cap' imposed on them by the China Securities Regulatory Commission (CSRC). The use of the Cox model allows for dual investigation as to (a) if and (b) when the firm will successfully exit the ST system and retain its normal listing status. The primary motivation of the study is derived from the heated public debate arising from the phenomenal windfalls returning to ST firms upon successful exiting the ST system.

In China, publicly-listed firms which are experiencing financial distress are required to use the prefix 'ST' in front of their trading stock code by the CSRC. The ST system was initiated to detect poorly-performing firms and therefore to release an early warning signal to both the firm and to investors. Under the ST system, companies granted ST face a two-way street: they must either remove the ST cap, hence return to normal listing status by improving their financial position and prospects, or must be delisted from the exchange, due to worsened financial distress.

Naturally, ST firms commonly adopt a series of restructuring/reorganization programs to improve their financial health and retrieve their listing position. What is distinctively interesting is that not only internal management of the firms but also external competitors (including government agents) possess equally strong motivations to help ST firms to recover. For instance, the external competitors consider the value of ST stock as more than just the fundamental value of the firm, but a 'shell' value, which represents the valuable stock listing right. Given the highly competitive race in the Initial Public Offering (IPO) listing regime, many capital-hungry firms that wish to go public find the ST firms become progressively more attractive, since acquiring the ownership of ST firms through corporate merger and acquisition may lead to the probability of having access to a liquid financial market. Likewise, while most of the delisted companies are originally or remain as State owned Enterprises (SOEs), such a relationship may come in handy, especially during times of crisis. Motivated by the potential loss of future IPO quota allocation and loss of personal political reputation, provincial governments are incentivized to come to the rescue of ST firms. Triggered by external interests, ST firms have been increasingly viewed as investing and speculating opportunities as the market responds favourably to firms' positive announcements and efforts in removal of their ST status. Extraordinary records of return have been documented on ST firms in spite of the firms' fundamental values.

Yet the financial distress resolution studies in the Chinese stock market are much less explored. Most extant studies on Chinese ST firms use conventional static models, which ignore the effect of time during distress on the outcome. Few literatures provide independent out-of-sample forecasts to validate the model's performance. This paper attempts to employ the Cox proportional hazard model that effectively incorporates all relevant information within the period of financial distress and to utilize the ROC curve and Brier score to provide prediction accuracy of a model based on an independent holdout sample. In addition, following the bankruptcy literature debate on the use of variables, this paper aims to shed some light on which class of variables provides the most significant predictive power in an emerging market setting. The variables used in this paper incorporate: (1) accounting-driven ratios, (2) market-driven variables, and (3) information on ownership structure and restructuring status throughout the turnaround process.

The study sample includes Chinese ST firms listed on either Shenzhen or Shanghai Stock Exchange from 1998 to 2011. By analysing the amount of time a firm stayed in ST, we find that the proportion by which ST firms successfully survived distress declines as time elapses. We find that on average, the firm remains in ST for 3.66 years until a final outcome is reached and that the overall sample turnaround probability is 65%. Using a holdout sample of 187 ST firms from 2006 to 2011, the multi-period Cox model provides an out-of-sample accuracy of 82.2% by using accounting variables alone, which outperforms the static logit model. In our result, non-accounting variables provide no significant contribution to improving forecast accuracy.

This paper contributes to the literature in three aspects. First, this paper extends the knowledge of distress resolution prediction in emerging markets where the institutional background is vastly different from that of developed markets. Given the uniqueness of the legislations surrounding the suspension and termination of ST firms, this paper adds new empirical evidence to the scant number of corporate turnaround studies on emerging markets. Second, to the best of the authors' knowledge, this is the first study to apply a multi-period Cox proportional hazard model and to provide out-of-sample forecast accuracy on the probability of Chinese Special Treatment firms' successful turnaround. The outcome of this paper will be of substantial aid to current and prospective market participants for their investing decision making. Third, based on the findings of this paper that accounting-driven variables are proven to be the strongest predictor in determining the turnaround probability of ST firms, this research contributes to the existing literature of testing Chinese market efficiency. Our result suggests that the market valuation may deviate from the fundamental values of the firm and that market variables do little in improving the predictive accuracy of the model.

2. Review of related literature

Much of the extant literature on the prediction of corporate failure or the resolution of bankruptcy is predominately developed from western countries. Variations of conventionally-utilised terminology are used in this area of research, including the prediction of bankruptcy (For example, Altman, 1968; Ohlson, 1980; Shumway, 2001), financial distress (Zmijiewski, 1984), corporate failure (Beaver, 1966); and in relation to this paper, the prediction of bankruptcy resolution (White, 1994; Barniv, Agarwal and Leach, 2002), and turnaround prediction of financial distress (Routledge and Gadenne, 2000; Smith and Graves, 2005). For Chinese studies, given the nature of the ST system, we refer to this research as turnaround prediction of financial distress.

Generally, the literatures on prediction of financial distress focus in two main directions. One direction focuses on the development of statistical models to improve the predictive accuracy; and the other searches for new predictors (variables). At the outset, Beaver (1966) presented a pioneering univariate approach (discriminant analysis) for detecting corporate failure with a group of financial ratios. Subsequently, Altman (1968) developed a multivariate discriminant analysis (MDA) combining financial ratios into a single score, (known as a Z-score) that successfully distinguishes between bankrupted and non-bankrupted firms. Logit and probit analysis were later applied by Ohlson (1980) and Zmijiewski (1984) respectively, which effectively loosen the normal distribution assumptions required for MDA.

Later, a wave of survival analysis models was applied in the literature. The effect of time that a firm spends in distress on the outcome of the bankruptcy interested a number of researchers including Bandopadhyaya (1994), Wheelock and Wilson (1995), Parker, Gary and Howard (2002) and Denis and Rodgers (2007). One of the distinct benefits of using survival analysis is its ability to account for the effect of predictors on the duration of time until the event of interest occurs – in our case, removal of the ST cap. In addition, a notable benefit of the use of survival analysis is its ability to take a longitudinal view on a single firm through time. This feature is arguably superior, as most static models ignore the fact that firm changes through time (Shumway, 2001) and cross-sectional analysis merely views a firm by taking a 'snap-shot' in a given time (LeClere, 2000). Among different survival models, a Cox proportional hazard model has been one of the most popular models due to its less restriction on the model assumptions. A notable number of studies have used the Cox model in bankruptcy prediction (Lane, Looney and Wansley, 1986; Wheelock and Wilson, 1995; Helwege, 1996; Partington, Russel, Stevenson and Torbey, 2001).

The modelling techniques employed for financial distress prediction in Chinese literature include MDA (Zhang, Chen, Yen and Altman, 2007; Qian, Feng and Zhou, 2007), Logistic regression (Zheng, Tian, Tang and Sun, 2009; Chen, Lee and Li, 2008; Wang and Deng, 2006; Li and He, 2006), probit analysis (Du, Liu and Wong, 2007), Ordinary Least Squares (Pei, Hamill and Opong, 2010) and Decision Tree Model (Zheng and Jiang, 2007), etc. In most cases, interpretation of results is based on the direction of the sign and significance of variables; however, forecast on independent holdout sample was often not provided (Zhang et al., 2007). Hence, the primary objective of this paper is to add to the existing literature on the prediction of Chinese ST firm resolution (i.e. whether they survive or die) with the use of Cox proportional hazards model and to provide an independent forecast with a holdout sample.

The second objective of the paper is motivated by prior literatures' debate on the use of variables. Conventional studies mainly adopt financial information; in other words, accounting information has been used as the basis of main predictors for the prediction of bankruptcy (Beaver, 1966; Altman, 1968, Ohlson, 1980) and the prediction of financial distress turnaround (Casey, McGee and Stickney, 1986; Robbins and Pearce, 1992; Pearce, 2007; Zeni and Ameer, 2010). Chinese studies also emphasised the predictive value of accounting variables (Zhang et al., 2007), however, more researchers are interested in the effect of the distinctive characteristics of firms' ownership structure (Wang and Deng, 2006) and state involvement (Chen et al., 2008) as well as the restructuring efforts given the shell value (Kam, Citron and Muradoglu, 2010). However, most of the Chinese studies examined the explanatory power of the predictors but ignored the predictive power of the model, since most models were not validated with an independent sample. In addition, numerous studies in the developed markets placed emphasis on the need to incorporate non-accounting variables such as market-driven variables (Shumway, 2001; Hillegeist, Keating, Cram and Lundstedt, 2004), and macroeconomic variables (Liu, 2004) since via these methods a higher level of predictive accuracy have been achieved. By classifying variables into three classes; accounting-driven variables, market-driven variables and variables that capture the unique institutional characteristics, this paper seeks to answer the question of whether variables other than accounting information improve the performance of forecasting, and of which class of variables has the most significant explanatory and predictive power from a Chinese market perspective.

3. Institutional background

Since the establishment of socialist China in 1949, the majority of enterprises have been owned and organized by the government, and are thus known as State Owned Enterprises (SOEs). The others were owned by collective entities – the quasi State Owned Enterprises. After the collapse of their central planning system, the Chinese government started to reform inefficient enterprises from 1978. The Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) were formed at the end of 1990 and early 1991. Initially, the two exchanges predominantly served the purpose of providing capital to SOEs and thus the majority of listed companies were transformed from SOEs. Later on, non-state enterprises were allowed to list on the market due to the progress of further economic reform. Ownership of the listed firms on the domestic market is officially classified into the following types: State, legal person, employee, tradable A shares and B shares. State, legal person and employee shares are non-transferable. A-shares are exclusively tradable between domestic investors. B-shares were only accessible to foreign investors before 2001 and thereafter also to Chinese domestic investors as well.

3.1. The nature of Special Treatment

Market regulations in China have been crawling in the pace of their evolution. Appropriate legislative power on bankruptcy law has fallen behind the booming economics. It was only in 1998 that CSRC promulgated the Special Treatment (ST) system to regulate financially-distressed firms. The ST system is similar to the US Chapter 11 bankruptcy process that filters out inefficient firms and retains the efficient firms in operation through reorganization (White, 1989). The 'special treatment' status represented by the prefix 'ST' is added to a listed company's stock code if the company is identified as suffering financial distress (Wang and Deng, 2006). The Market participants have given this status a rather vivid name: the ST 'cap'. Once a firm is capped with ST, relevant restrictions and requirements will be applied to the firm on share trading, financing and reporting. A ST firm will be either delisted or recovered via the removal of its cap in terms of its further performance. Alternatively, it will be merged or restructured to become a new listing firm.

The ST cap can be ST, or *ST, or PT coding, which represents different levels of financial distress and embedded risks. When a ST firm's prospect became extremely poor, the ST firm will be designated as an *ST firm by the exchange. The general stock delisting rule specified that if one of the following situations occurs, the listed company should be put on a cap of ST or *ST:

(1) The firm has incurred a net loss for two consecutive fiscal years (*ST);
(2) The value of the equity ownership was negative in the previous year (ST);
(3) The auditor issued an adverse or a disclaimer audit opinion on the financial report (ST);
(4) There is major material misstatement contained in the financial statements which amount to two consecutive years of loss (*ST);

(5) The company's operation has been stopped due to natural disaster or other related accidents, and there are no reasonable grounds to believe the operation will be restored within three months(ST); or

(6) Any other significant financial abnormality judged by CSRC (ST or *ST).

Similarly to the policy that grants a cap, a number of rules apply to how a given company should progress in getting rid of the cap. The general delisting rule states that if all of the following situations are satisfied, the ST status will then be removed:

(1) All financial abnormalities judged by CSRC have been cleared and the risk of financial distress is no longer present to stakeholders;

(2) The company has incurred a net profit after deducting non-recurring gains and losses and the net value of the share is more than the face value of the stock; and

(3) The auditor presents an unqualified opinion on the financial report.

An ST or *ST firm may be temporarily delisted or suspended from trading, according to the judgment of the CSRC in the financial distress period. The capped firm may submit an application to remove the ST or *ST status, however, it may be delisted permanently from the stock exchange, if:

After the capped firm has been temporarily delisted,

(1) The firm fails to disclose its first annual financial statement within the statutory time frame;

(2) The firm suffers an additional year of loss after two consecutive years of loss;

(3) The shareholders reach an agreement in terminate the listing;

(4) The application to CSRC from the firm to resume its normal listing status is rejected;

(5) The firm no longer meets the listing criteria, and the company cannot meet the listing criteria within the required time frame;

(6) The firm has declared bankruptcy; or

(7) Any other financial situation judged significant by CSRC.

In developed countries, whether a distressed firm quits the market due to poor performance or recovers due to improved operation is a consequence of normal market behaviours. In China, it is determined by both market and non-market activities, such as shell opportunity, local government intervention and organizational restructures. These factors are taken into account in our empirical analysis.

3.1.1. 'Shell' opportunity

Share listing in China was based on an administrative governance regime, known as the Quota System (Pistor and Xu, 2005). The annual quota for Initial Public Offering for each region was reached though an intense bargaining between provincial governments and central agencies. This has created rigorous regional competition for the limited quotas, which in turn fostered a complicated selection, administrative review and approval process (Pistor and Xu, 2005). Further, at particular times between mid-2005 to 2006 and between 2008 to mid-2009, the initial public offerings were even suspended altogether. Thus, to be a publically listed firm through IPO is very competitive and money- and time-consuming. Alternatively, investing in ST firms to a level of control ownership is a way for a firm going to public, which is called listing through 'shell' purchase.

ST firms, who are already listed on the exchange, retain the right as a listed firm to finance capital though seasoned offering if they successfully remove the ST cap. Competing companies may be willing to pay premium price to purchase ownership of these ST firms through restructuring and use the ST firm as a 'shell' to raise capital from the market. This in effect is a win-win situation where ST firms can maintain their normal listing status, while merging firms can conduct offerings on the stock exchange. Eventually, shell purchase reduces the probability or delay time of ST delisting.

3.1.2. The involvement of provincial governments

Listed SOEs often enjoy an intertwined relationship with various layers of the government. According to Fang (1995), who interviewed with agents at CSRC and the Shanghai and Shenzhen Stock exchange, the IPO review process took place behind closed doors of which the provincial governments had control. Because more listed firms from a given province would bring more capital to this province, provincial officers compete for listing rights from central government. Thus, the number of listed firms is a symbol of political achievement for provincial bureaucrats.

Delisting under the ST system essentially leads to retroactive reduction of previously allotted quota since no other company could step in and use the quota. Moreover, delisting could also result in lower quota allocation to the region in the future. Remaining listed on the stock exchange provides a pathway to attract equity capital, maintain employment and stimulate economic growth in regional areas. Also, firm delisting is viewed as low administrative ability of provincial officers. Reasonably, government's vested interests are to motivate them to come to the rescue of those distressed SOEs.

3.1.3. Restructure/Reorganisation programs

Facing pressures from provincial governments, large shareholders and potential outside bidders and tighter scrutiny from CSRS and the stock exchange, ST firms usually want to pull the operations and performance back on track as soon as possible. A given firm will initiate a range of restructure efforts to put the company back on its feet with superior earning prospects. These restructure programs can be classified as follows: asset restructure, debt restructure, ownership restructure and management restructure (Du et al., 2007).

For instance, Kam et al. (2010) documented a series of restructuring efforts of the ST firm Shandong Jintai Group. They included controlling shareholder selling of share ownership, disposing of one of product lines, initiating a joint venture and subsequently transferring assets to this joint venture, which led to major management change. In facing crisis, Huajing

Electronic Group likewise conducted a series of restructuring efforts including converting debts into stocks; initiated a joint venture and spun off part of the operation into a number of newly-created subsidiaries (Gupta and Wang, 2004). In general, these efforts of restructuring can help ST firms exit ST status, although different strategies may have different levels of effects on the outcome of ST (Du et al., 2007).

4. Data and methods

4.1. Sample Selection

The sample in our study includes ST firms that have ever been listed on either Shenzhen or Shanghai Stock Exchange in any year from 1998 to 2011. Both accounting and market data were extracted from the China Stock Market and Accounting Research (CSMAR) database. The specific information on particular ST firms was collected from annual reports. Our final sample is formed under the following criteria:

(1) The sample consists of A-shares only.

(2) Firms which are in the financial sector, as indicated by their Global Classification Standard code, are excluded from the sample.

(3) Firms that have been delisted without going through the ST process are excluded.

(4) Firms that removed the ST designation within one year are excluded from our sample to ensure that all firms have at least one year of financial data for model estimation.

(5) Firms that have been designated ST due to reasons other than poor financial performance and financial distress are excluded to ensure all firms in the sample experience some level of financial distress.

(6) Firms with incomplete data sets are excluded.

Subject to the above data requirements, our final sample consists of 441 individual firms with 1614 firm-year observations. There are 288 survived firms and 153 non-survived firms during the entire sample period (1998 to 2011). The sample selection outcome and the number of survival events of the sample are presented in Table 1. A ST firm that subsequently removes its cap and returns to normal listing status is regard as a survived firm. ST Firms that were delisted off the market or remain as an ST firm till the end of sample period are regarded as non-survived firms or censored firms.

[Insert Table 1]

In Table 1, the first column 'Year' represents the time elapsed since a firm entered into the ST system. The firm successfully exits the ST system if it experiences of the event of taking off the ST cap or is censored if it is delisted or remains in ST status till the end of the observation period. The average time spent in ST system in our sample is found to be 3.66 years. This is because many firms have performance fluctuations within ST systems and the restructuring process usually takes a few years. For instance, one of the ST firms, Guonong Technology (Stock code: 000004), was granted with *ST cap in 2006, recovered to ST status in 2007, fallen to *ST again in 2009, rebounded again to ST status in 2010 and finally removed the ST cap in 2011. Thus, this firm has duration of 6 years.

It is shown that Year 1 in Table 1 has no records of firm survival or censoring. This is because all data observations are lagged by one year as the decision of granting and removing ST is made by the CSRC based on previous-year information. In the 2nd year, 29% of the firms succeeded in removing the ST, and the ratio falls to 14% in the 3rd year, 9% in the 4th year and 6% in the 5th year. The percentage of firms' survival decreases over time. Based on initial observation, it is expected that the length of time a company spends in the ST status is negatively related to the probability of successful resolution; that is, the hazard function for removing the ST status and returning to the normal listing on the exchange is expected to exhibit negative duration dependence.[1] This trend is also shown in the Figure 1.

[Insert Figure 1]

4.2. Model specification

Given a hypothesis that the longer a firm remains in the ST status, the less likely the firm has a successful turnover from the ST status, we would argue that the inclusion of a dummy variable for a year or the measure of age may control for the time effect in the model. However, it only controls for the marginal effect of year (or age) on the probability of event occurrence with no information provided on the duration of time that preceded the event (LeClere, 2000).

A Cox's (1972) proportional hazards model is a natural choice to capture the characteristics of Chinese ST firms. It handles censored data and explains time dependence on the hazard function. Cox's proportional hazard model is stated as follows:

$$h_i(t) = h_0(t)\exp(x_i\beta)\,. \quad (1)$$

Or, equivalently it can also be written as:

$$h_i(t) = h_0(t)\exp\{\beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik}\}. \quad (2)$$

The model states that a hazard rate of any individual i at time t is the product of two factors:

(1) a baseline hazard function $h_0(t)$, and

(2) an exponentiated linear function of covariates $\exp\{\beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik}\}$,

where x_{ik} represents the value of covariate k for the individual i and β_k is the coefficient for x_k.

Specifically, this paper employs a multi-period Cox proportional hazards model. Shumway's (2001) work draws attention to the need to include multiple observations for each subject (multi-period data on covariates for each firm) by using a discrete time hazard model in the prediction of financial distress. According to LeClere (2000, p. 167), this is illustrated as:

> 'For instance, if an individual experienced an event in time period eight, it would contribute eight observations to the estimation. Seven observations would have dependent variable coded as '0' and one

observation (for the time period in which the event occurred) would be coded '1'. After time period eight, no observations would be gathered on this individual since it has experienced the event and is no longer in the risk set.'

Following LeClere (2000), multiple years of firm-specific information of each firm have been utilised in this paper. If a firm has experienced the ST designation more than once during the observation period, the subsequent designation of ST is treated as an independent event. For instance, if a firm successfully removed its ST cap in 2002 but entered the ST system again in 2004, this firm is regarded to have two distinct individuals in the study. As a result, the multi-period Cox model utilises 992 firm-year observations with 197 survived firm-year observations and 795 censored observations for model estimation.

4.3. Variable selection

4.3.1. Dependent variables

In Cox's proportional hazards model, the dependent variable is an interaction of the duration and censoring. Censoring is a binary variable indicating as to whether the event of interest has occurred. In this paper, Dummy Variable ST (DST) is set to 1 if the firm successfully removed the ST cap and regained its normal listing status in that given year, otherwise set to 0. The duration represents the period of time spent in ST system.

4.3.2. Independent variables

Table 2 summarises the independent variables used in this paper. Three classes of variables are identified, namely accounting-driven variables, market-driven variables, and institutional variables which are commonly adopted in the Chinese literature.

[Insert Table 2]

4.3.2.1 Accounting-driven variables. Financial ratios have been widely adopted for the predictors of corporate failures (Beaver, 1966; Altman, 1968; Pearce, 2007) and corporate recoveries (White, 1989; Zeni and Ameer, 2010). In the paper, we employ profitability, leverage, liquidity, and firm size to capture the strength of firm's financial position.

Profitability: The profitability of the firm is captured by the variable *Net Profit to Total Asset* (NP_TA). Profitability is a critical variable used in financial distress and turnaround studies (Ohlson, 1980; Campbell, 1996; White, 1984, 1989; Casey et al., 1986; Shumway, 2001). For example, White (1984, 1989) and Casey et al. (1986) demonstrated that firms successfully recovered through reorganization had better earnings prospect evidence than those which liquidated.

Leverage: Prior studies have found high levels of debt could lower the ability of the firm to obtain further finance as default on loans might signal loss of credibility and poor management (Ohlson, 1980; Shumway, 2001; Parker et al., 2002). Thus we hypothesise that an increased leverage (TL_TA) would lower the probability of turnaround and increase the duration of the firm remaining with the ST status.

Liquidity: Previous research posits that liquidity is of direct importance to determine firms' ability to endure periods of distress (Parker et al., 2002; Zeni and Ameer, 2010). Liquidity, measured by *Current Asset to Current Liabilities* (CA_CL), accounts for a given firm's ability to bear periods of shrinking cash flow. The likelihood of successful turnaround is expected to be positively associated with high liquidity.

Firm size: White (1984) and Campbell (1996) suggest that larger firms may have stronger borrowing capacity in times of financial distress, thus having a higher probability of enacting a turnaround. We also hypothesise that larger firms may possess more available resources to enact a successful turnaround through asset restructure, debt restructure, merger and acquisitions. A logarithm of total assets (LTA) measures the firm size.

4.3.2.2. Market-driven variables. Previous studies have found that the use of market-driven variables led to superior prediction performance to the use of accounting variables (Shumway, 2001; Hillegeist et al., 2004). Market measure of firm size, excess return, investor demand

and market leverage are used to capture the market behaviour and efficiency of Chinese ST Systems. All market variables are lagged one year.

Market measure of firm size: The firm size is measured as a logarithmic of a firm's market capitalization (including tradable and non-tradable shares)/Combined Market Capitalization of SZSE and SHSE at the end of the year, which is denoted as LMC. This variable will be modelled in substitution for accounting-driven firm size. Likewise, we predict a positive relationship to the survival probability of ST firms.

Excess return: Firms' past excess return (Shumway, 2001) is measured as the monthly cumulative Abnormal Return (CAR) of the firm minus the value-weighted SZSE/SHSE index return. Bai, Liu and Song (2002) found relevant information contained in the ST event is reflected in the monthly Cumulative Abnormal Return (CAR). The excess return is expected to have a positive impact on the successful turnaround.

Investor demand: It is defined as a ratio of a firm's yearly trading turnover to average market trading turnover (TRDTURNR). A firm's trading turnover is calculated as a firm's total trading volume on SZSE/SHSE in a year divided by the firm's total number of tradable shares outstanding. This ratio reflects the market sentiment. General market sentiment indicates investors' interest and confidence in the firm's potential to enact a successful turnaround.

Market leverage: A book value of debt divided by market value of equity is used to measure market value of leverage. Bai et al. (2002) found leverage (measured by book value of debt / sum of market equity and book value of debt) are significantly negatively related to the likelihood of successful turnaround of ST system.

4.3.2.3. Institutional variables. This class of variables is derived from Chinese context studies. A few studies have focused on examining the effect of restructuring efforts on removal of the ST cap (Li and He, 2006; Du et al., 2007; Ren 2009). Other studies incorporated the institutional background, in particular, state involvement and ownership structure as predictor variables (Fan et al., 2009; Zheng et al., 2009).

Restructure: Li and He (2006) found the probability of exiting the ST status was largely influenced by the restructuring efforts made by the firm. In this paper, we employ a dummy variable for restructuring effort (DRESTRUCTURE), which equates to 1 if the firm has successfully conducted restructuring in that year, otherwise to 0. Restructuring activities include asset restructure, debt restructure, equity restructure, and mergers and acquisition. We hypothesize that firms that conduct corporate restructure have a higher probability of securing the listing status than firms that do not.

Ownership concentration: Generally speaking, large shareholders would have stronger incentive than small and free-ride investors in monitoring the performance of firms in which they have block investment. According to Ma, Naughton and Tian (2010), ownership concentration is considerably more powerful than any category of ownership in determining performance. A more concentrated ownership structure may induce a better performance in Chinese firms. The ownership concentration is proxied by the largest shareholder ownership (TOP1SHR) and Top 10 shareholder ownership (TOP10SHR).

Government ownership: Fan et al. (2009) found state ownership significantly reduced the likelihood of distress turnaround. The results reported that state ownership increased the length of time until the company recovered. Kam et al. (2010) demonstrated that Chinese market participants reacted to privatization favourably and resisted a continuing government role in distressed resolution process. On the contrary, Zheng et al. (2009) examined the turnaround probability of ST firms using the logistic model and they found state-owned firms were more likely to achieve turnaround than non-state-owned firms. Chen et al. (2008) found that the government used government subsidy to help firms to improve their earnings, especially in times of delisting crisis. With such mixed evidence, we take the stance that government ownership could well have a positive effect on the successful turnaround probability. Government ownership is measured by the percentage of ownership shares of the ST Company held by the state (STATESHR).

4.3.3. Summary statistics

Table 3 outlines the descriptive statistics. The entire sample is divided into two separate samples; an estimation sample with 197 survived events (from 1998 to 2005) and a holdout sample with 91 survived events (from 2006 to 2011).[2] In comparison, the survived firms are found to have higher levels of profitability, liquidity, firm size, excess return, ownership concentration and restructuring activities while having lower level of debt and trading turnover. The degree of variation of financial ratios for a non-survived group is wider than that of the survived group, as evidenced through the measure of standard deviation. Contrary to our expectations, it appears in all three panels. The average relative trading turnover (proxy for the investor demand) is higher in the non-survived group than in the survived group.

[Insert Table 3]

The Wilcoxon Mann-Whitney U test is also carried out to test the significance of the differences of firm characteristics between survived and non-survived groups. For the entire sample in panel A, all variables appear to be statistically significant in degree of difference, except the state share percentage (STATESHR). This insignificance is more apparent in the estimation and holdout sample.

4.4. Assessment of predictive accuracy

In order to generate out-of-sample forecasts of survival profiles, a holdout sample of 622 firm-year observation from 2006 to 2011 is used. The coefficient estimates and the baseline hazard rate of the estimation model are used to derive the probability of survival of the holdout sample. The derived predictive survival probability is then used in comparison with the actual success and failure of removing the ST status. Two evaluation techniques are employed to measure the discriminatory power and the precision of the model prediction.

4.4.1. Receiver Operating Characteristics (ROC) curves

Receiver Operating Characteristics (ROC) Curves measure the discriminatory power by examining the hit rate (*H*) and the false alarm rate (*F*). The hit rate, *H*, denotes the proportion of observed events (ST survival) that are correctly forecast. The false alarm rate, *F*, indicates the proportion of non-events (ST non-survival) that are incorrectly forecast; that is, the model predicts the firm's survival when the firm actually fails. The combination of *F* and *H* is plotted on X-axis and Y-axis at progressive cut-off probability from 0 to 1.[3] One of the advantages in using the ROC curve is that it tests the predictive power of the forecasting model across the entire spectrum of cut-off probabilities, thus bypasses the need for selecting an optimal cut-off point.

The area under the ROC curve (AUROC) quantifies the predictive accuracy of the model. The larger the AUROC, the better is the prediction. The random prediction is 50% or 0.5, represented by a 45 degree line on the ROC Curve. A model with AUROC equal to less than 0.5 therefore has no predictive power as it cannot beat a random chance. This method is utilized by a number of distress resolution studies including Partington et al. (2001).

4.4.2. Mean probability score (Brier Score)

A mean probability score, known as Brier score, assesses the precision of predicted survival probability.[4] The Brier score is a measure of deviation from the predicted probability against the actual outcome of an event. It can be measured as followings:

$$BS = \frac{1}{N} \sum_{n=1}^{N} (f_n - a_n)^2. \quad (3)$$

f denotes the predicted probability of the event, a is the actual outcome of the event, and N is the number of occasions/predictions. In our case, when a company successfully survives ST regulation, a is equal to 1 and 0 otherwise. Clearly, when the Brier score equals 0, the forecasted probability is perfectly precise. Hence, the lower the Brier score, the higher is the model's predictive accuracy.

5. Results

5.1. Model estimation and validation

Having a multi-period Cox model in place, three base models are first estimated to examine the respective effect of each class of variables on the model performance. Model 1 contains accounting-driven variables only; Model 2 contains market-driven variables only and Model 3 includes institutional variables. Base models are extended to combine another class of variables in a pair, to test whether the augmented set of variables increments the predictive power of base models. Model 4 combines accounting and market variables. It is noted that since both Log of Total Asset (LTA) and market Capitalization of the firm to that of total market (LMC) measure the size of the firm, only one of them (LTA) is included in the estimation, to avoid duplication of measures. Model 5 combines accounting and institutional variables and Model 6 combines market and institutional variables. Lastly, all variables are combined collectively in Model 7 and 8. Model 7 leaves out the market-driven firm size variable, LMC and Model 8 excludes the accounting-driven firm size variable, LTA.

The results of parameter estimates and the goodness of fit of all eight models are presented in Table 4. For the purpose of model validation, the area under the ROC curve and the Brier score for the out-of-sample forecasting are given in Table 5. The following section discusses the results presented in Table 4 and Table 5.

[Insert Table 4]

[Insert Table 5]

5.1.1. Model 1, 2 and 3

In Model 1, all predictors' coefficients except liquidity were of their expected signs (see Table 4). The profitability ratio (NP_TA) and the size of the company (LTA) have a positive impact on the survival of the ST firms. The leverage ratio (TL_TA) has a negative impact, as expected. The negative sign on the coefficient of the liquidity ratio (CA_CL) appears to be contradictory to the assumption that more liquidity a firm has, the better the turnaround probability. However, the result is not surprising, as liquidity may exhibit nonlinear relation to the survival outcome, which has been demonstrated in Kim (2011).[5]

In Model 2, all coefficients except trading turnover to market (TRDTURNR) were of their expected signs (see Table 4). The market measure of firm size is significantly positively-related to the likelihood of survival. The market measure of leverage (DEBT_M) is negatively-related to the survival probability. Past excess return on the stock has a positive impact on the firms' survival; however, this is only marginally significant. Of interest is that the lower the trading turnover, the more likely the firm will survive. As shown earlier in Section 4.3.3, the mean value and standard deviation of trading turnover of non-survived firms are higher than that of survived firms. The result suggests non-survived firms are subject to a higher trading turnover; that is, they attract more investor trading demand.

In Model 3, all variables except STATESHR appear to be significant and are of their expected signs (see Table 4). Having a successful restructuring/reorganization program and a higher level of ownership concentration (TOP1SHR and TOP10SHR) increases the likelihood of survival. STATESHR turns out to be insignificantly related to the outcome of ST regulation. The reason for this may be that this variable does not properly capture the pyramidal ownership structure of SOEs; a factor which can be further investigated in the future research.

As shown in the result of AUROC and the Brier score in Table 5, Model 1 with accounting-driven variables provides the highest level of discriminatory power and precision compared to other models.

5.1.2. Model 4, 5 and 6

Returning to Table 4, we find all accounting-driven variables in Model 4 and 5 are significantly related to the survival probability. Again, the liquidity (CA_CL) appears to be negatively-related to the survival likelihood, but significantly so. Interestingly, all market variables and most institutional variables (except STATESHR) are found insignificant when they are combined with the accounting variables in Model 4 and 5.

The result in AUROC in Table 5 provides additional evidence of the dominant effects of accounting variables on the model prediction over others. It shows that Models 4 and 5, where accounting variables are included, have superior discriminatory power to Model 6. When compared to the result of Model 1, Models 4 and 5, with market variables and institutional variables added, do not increment the prediction accuracy. Model 6 has an AUROC of 0.775, which is the lowest forecast accuracy among Models 4, 5 and 6, although it is considerably higher than that of Model 3 (an AUROC of 0.679). This implies that the market variables add to the predictive power when combined with institutional variables. In relation to the Brier score, Model 5 shows the best precision of forecast probability.

5.1.3. Model 7 and 8

Model 7 presents a combination of all variables except market measure of firm size (LMC) while Model 8 consists of all variables except accounting measure of firm size (LTA). The results of AUROC and Brier score both indicate Model 7 provides a better forecast than Model 8, which confirms the superior contribution of accounting-driven variable, LTA to the market measure, LMC.

5.1.4. Implications

Models with accounting-driven variables have consistently outperformed other models, as shown in the validation results suggesting the highest level of prediction accuracy was contributed by accounting information solely.

The significance of this finding is substantial in two respects. First, it provides a contrary result to Shumway (2001) and Hillegeist et al. (2004), in which market-driven variables were found to significantly contribute to incremented predictive accuracy of a model using U.S. data. Second, it adds to the empirical evidence demonstrating the low level of market efficiency in the Chinese stock exchange (Feng, 2007). As recently found in Liu and Tian (2012), the Chinese idiosyncratic disproportional ownership structure of a company, especially before the Chinese Non-tradable share reform in 2005, renders the stock price irrelevant to the controlling shareholders' interest. Hence, the information on accounting-based firm performance is more reliable than that based on the market share price.

5.2. Robustness check

5.2.1. Stepwise analysis

To evaluate the model adequacy, the use of stepwise analysis is employed. Stepwise analysis is common in producing a parsimonious model, as confounding effect caused by the correlated variables is reduced. The stepwise selection process consists of a series of alternating forward selection (adds variables to the model) and backward elimination steps (removes variables from the model). Variables are added into the model one by one and each time the model is reassessed, any variable which fails to maintain the prescribed level of significance (10%) drops out of the model. The process is terminated when no further variables are added or eliminated from the model. The result of the forward stepwise analysis is shown in Table 6 and AUROC and Brier score for the holdout sample is summarized in Table 7.

[Insert Table 6]

[Insert Table 7]

Consistent with the results in the above section, accounting variables remain consistently significant to the outcome of ST resolution. An AUROC of 0.801 and Brier score of 0.118 reaffirm that market-driven variables and institutional variables add no additional predictive power.

5.2.2. Model comparison between Logistic regression vs. multi-period Cox model

Conventional statistical programs utilise firms' information at one single point in time, usually the year immediately prior to the event year (ST removal year). Shumway (2001) referred to these models as static models that ignore the dynamics of firm performance that evolve over time. To give robust reasoning on why the multi-period Cox proportional hazard model is preferred, all the above eight models are estimated with a single-period logistic model using data of 1-year, 2-year and 3-year prior to the event. The estimation sample for the Logistic model consists of 250 ST firms, with 197 survived firms and 53 non-survived firms. The holdout sample for the logistic model consists of 191 ST firms, with 91 survived firms and 100 non-survived firms.

The out-of-sample prediction results derived from logistic models are compared with those from the Cox model in Table 8. In Panel A, the AUROC of the Logistic model indicates that the discriminatory power achieved by the Logistic model reduces considerably as time elapses, with 1-year prior to event being the highest and 3-year prior to event being the lowest. 1-year prior Logistic model perform slightly better than the Cox model in Model 2 and 4, however, the Cox model overall provides superior discriminatory power over the Logistic models. The Brier score in panel B likewise shows that the forecast accuracy of Cox model performs better. All Brier scores of Logistic models are above the naive forecast, which indicate that the model performs poorly in terms of precision.

[Insert Table 8]

6. Concluding remarks

This paper investigates the process of financial distress resolution under the Chinese Special Treatment (ST) regulation. Using a sample of 441 ST firms from 1998 to 2011, a multi-period Cox proportional hazard model is developed to forecast whether the ST firm would successfully remove the ST cap and retain its normal listing status.

Key findings of the paper are as follows. First, the survivor function for ST firm's turnaround exhibits negative relation with the duration. That is, the probability of successful exit from ST system decreases the longer the firm stays in the ST system. Incorporating the effect of duration, the multi-period Cox model was found to perform superior out-of-sample to the static logit model. The predictive accuracy measured by ROC curves and the Brier Score was higher and more stable across all models of the Cox specification.

Second, accounting-driven variables were the strongest indicator to predict the outcome of the ST system. Furthermore, combining accounting variables with market-driven and institutional variables did not improve the model accuracy. This result is not consistent with findings of the developed capital markets, where market-driven variables substantially enhance the predictive power of the model (Shumway, 2001; Hillegeist et al., 2004). However, this result corresponds with the extant literature in the Chinese capital market where market efficiency is less manifested (Feng, 2007; Liu and Tian, 2012).

The paper is of course not without limitation. Variables selection for future research may consider the pyramidal ownership structure of distressed companies, the amount of fiscal subsidy given to ST firms, the different types and nature of restructuring efforts, and the macroeconomic environment.

Notes

[1] Negative duration dependence on the hazard function has been found in Li (1999).

[2] All firm-year observations of a firm that enters into ST system between 1998 and 2005 are used for model estimation. The others are included in a holdout sample to test the predictive accuracy of a model.

[3] A detailed explanation of ROC Curve can be found in Mason and Graham (1999).

[4] A detailed explanation of the Brier Score can be found in Yates (1982).

[5] Kim (2011) found that both high liquidity and low liquidity can increase the probability of financial distress of a firm.

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Figure 1. Special Treatment firm survival rate by year

This graph shows the percentage of sample firms' survival rate in a time sequence. The X- axis represents the time in years; the Y axis shows the rate of survival calculated using number of survival firms each year to the total number of firms in the sample. The graph shows a downward trend: the rate of survival decreases as time elapses.

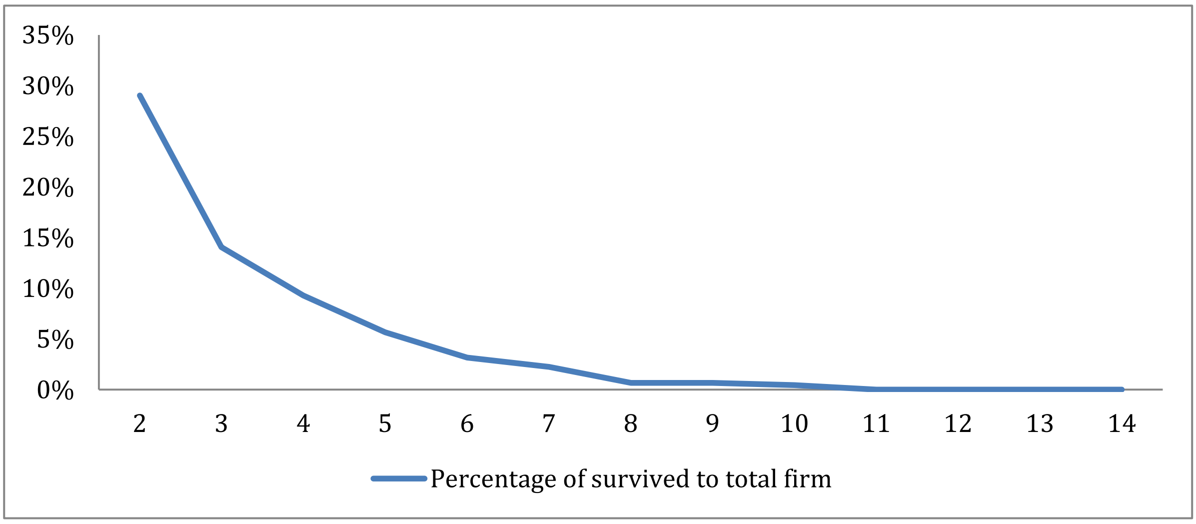

Table 1. Distribution of survived events over the sample period

This table consists of 441 ST firms in the sample between 1998 and 2011. The first column 'Year' represents the time elapsed since a firm entered into the ST system. The firm successfully exits the ST system if it experiences of the event of taking off the ST cap or is censored if it is delisted or remains in ST status till the end of the observation period.

Year	No. of firm remain in ST	No. of firm removed ST status (survived)	No. of censored firm	Percentage of survived to total firm
1	441	0	0	0%
2	441	128	42	29%
3	271	62	32	14%
4	177	41	19	9%
5	117	25	27	6%
6	65	14	13	3%
7	38	10	3	2%
8	25	3	3	1%
9	19	3	7	1%
10	9	2	4	0%
11	3	0	0	0%
12	3	0	0	0%
13	3	0	1	0%
14	2	0	2	0%
Grand Total	441	288	153	65%

Table 2. Description of independent variables

This table shows the independent variables used in this study with reference to bankruptcy and bankruptcy resolution literature. Variables are classified into three distinctive categories: accounting driven variables, market driven variables and institutional variables.

Variable	Abbreviation	Description	Source
Accounting Driven Variables			
Earnings Prospect	NP_TA	Net Income/total assets	Ohlson (1980) Campbell (1996) White (1984, 1989) Casey et al. (1986) Shumway (2001)
Leverage	TL_TA	Total Liability/Total Asset	Ohlson(1980) Shumway (2001) Parker et al. (2002)
Liquidity	CA_CL	Current Asset/Current Liability	Taffler (1983) Parker et al. (2002)
Firm Size	LTA	Log of Total Asset	White (1984, 1989) Campbell(1996)
Market Driven Variables			
Market Measure of Firm Size	LMC	Log(Market Capitalization of the firm/Total Market Capitalization)	Shumway (2001)
Excess Return	Excess_Return	Cumulative annual return in year t-1 minus the value weighted Market index return in year t-1	Shumway (2001) Bai et al. (2002)
Investor Demand	TRDTURNR	Yearly Turnover of total Tradable shares = trading volume/ Number of tradable shares outstanding	
Market Leverage	DEBT_M	Total Debt/Total Market value of Equity	Similar variable can be found in Altman (1986)
Institutional Variables			
Company Restructure	DRESTRUCTURE	Dummy variable: Company Restructure =1 if the firm has conducted a successful restructure in a particular year, and 0 otherwise	Similar variables used by Sudarsanam and Lia(2001)
Largest Shareholder’s Ownership (%)	TOP1SHR	Largest shareholder ownership/total equity	Wang & Deng(2006)
Top Ten Largest Shareholders Ownership (%)	TOP10SHR	Sum of 10th largest shareholder ownership/ total equity	Bai et al. (2002)
State Share (%)	STATESHR	The percentage of shares owned by the state	Fan et al. (2009) Wang and Deng (2006)

Table 3. Descriptive statistics of independent variables

This table shows summary statistics of independent variables for firm-year observations of the ST firms listed on SHSE and SZSE. Each firm has multiple observations according to the amount of time spent under the ST status (duration). Panel A shows summary of descriptive statistics for the entire sample from 1998 to 2011. Panel B and C shows the statistics for estimation sample and the holdout sample separately. NP_TA is firm's net profit divided by total asset; TL_TA is firm's total liability divided by total asset; CA_CL is firm's current asset divided by current liability; LTA is firm size measured by logarithm of total asset; LMC is market measure of relative firm size calculated as logarithm of the ratio of each firm's market capitalization to that of the SHSE or SZSE market capitalization; Excess Return is measured as monthly cumulative Abnormal Return (CAR) of the firm minus the value-weighted SZSE/SHSE index return; TRDTURNR is measured by firm's trading turnover (firm's yearly total trading volume divided by firm's total number of tradable shares outstanding) divided by average yearly market trading turnover; DEBT_M is measured by book value of leverage divided by market value of equity; DRESTURCTURE is a dummy variable that equals 1 if the firm has successfully conduct restructuring in that year, and equals 0 if the company has not conducted any organizational restructuring or if it was unsuccessful; TOP1SHR is measured by largest shareholder ownership (%); TOP10SHR is measured by top ten shareholders' ownership (%) and STATESHR is measured by the percentage of state ownership in the firm.

Panel A: Descriptive statistics - Entire sample : Firms entered ST system from1998 to 2010

Variables	Group	Mean	Median	Std Dev	Minimum	Maximum	Mann-Whitney U-test	p-value
NP_TA	Survived	0.65	0.03	0.20	-0.17	2.64	340.1113	<.0001
	Non-survived	-0.11	-0.08	6.72	-51.95	235.10		
TL_TA	Survived	0.57	0.60	0.23	0.01	1.74	125.4518	<.0001
	Non-survived	1.69	0.77	7.10	0.00	142.72		
CA_CL	Survived	1.44	1.09	1.98	0.16	29.71	115.7886	<.0001
	Non-survived	1.03	0.69	2.51	0.00	53.45		
LTA	Survived	8.99	8.95	0.46	7.96	10.86	35.1092	<.0001
	Non-survived	8.77	8.82	0.56	0.00	10.86		
LMC	Survived	-3.30	-3.24	0.44	-4.43	-1.93	34.6824	<.0001
	Non-survived	-3.48	-3.46	0.46	-4.97	-2.03		
Excess Return	Survived	0.29	0.13	1.05	-0.72	10.79	44.3833	<.0001
	Non-survived	-0.01	-0.04	0.48	-1.36	4.12		
TRDTURNR	Survived	0.98	0.90	0.50	0.01	3.11	37.797	<.0001
	Non-survived	1.22	1.11	0.65	0.00	8.81		
DEBT_M	Survived	0.82	0.56	1.00	0.00	12.63	5.7144	0.0168
	Non-survived	2.58	0.67	36.01	0.00	1296.04		
DRESTRUCTURE	Survived	0.81	1.00	0.40	0.00	1.00	28.9682	<.0001
	Non-survived	0.64	1.00	0.48	0.00	1.00		
TOP1SHR	Survived	0.38	0.34	0.16	0.09	0.85	28.4712	<.0001
	Non-survived	0.33	0.29	0.15	0.00	0.85		
TOP10SHR	Survived	0.59	0.60	0.15	0.19	0.96	35.1994	<.0001
	Non-survived	0.53	0.54	0.15	0.02	0.93		
STATESHR	Survived	0.25	0.21	0.25	0.00	0.85	1.2782	0.2582
	Non-survived	0.23	0.20	0.24	0.00	0.75		

Panel B: Descriptive statistics - Estimation sample: Firms entered ST system from 1998 to 2005

Variables	Group	Mean	Median	Std Dev	Minimum	Maximum	Mann-Whitney U-test	p-value
NP_TA	Survived	0.07	0.03	0.24	-0.14	2.64	247.3083	< .0001
	Non-survived	-0.30	-0.10	1.16	-16.11	2.57		
TL_TA	Survived	0.55	0.59	0.21	0.01	1.41	119.0746	< .0001
	Non-survived	1.78	0.79	5.71	0.01	96.96		
CA_CL	Survived	1.50	1.10	2.25	0.19	29.71	81.3185	<.0001
	Non-survived	1.07	0.71	3.08	0.00	53.45		
LTA	Survived	8.87	8.85	0.38	7.96	9.88	21.1436	<.0001
	Non-survived	8.69	8.74	0.45	6.70	9.88		
LMC	Survived	-3.21	-3.15	0.41	-4.20	-1.93	10.6957	0.0011
	Non-survived	-3.33	-3.27	0.44	-4.97	-2.14		
Excess Return	Survived	0.27	0.10	1.21	-0.72	10.79	43.926	<.0001
	Non-survived	-0.07	-0.10	0.47	-1.36	4.12		
TRDTURNR	Survived	0.96	0.87	0.49	0.12	3.11	25.5378	<.0001
	Non-survived	1.18	1.08	0.58	0.00	3.67		
DEBT_M	Survived	0.75	0.60	0.67	0.00	3.87	10.4516	0.0012
	Non-survived	1.89	0.76	7.15	0.00	116.99		
DRESTRUCTURE	Survived	0.81	1.00	0.40	0.00	1.00	39.7759	<.0001
	Non-survived	0.56	1.00	0.50	0.00	1.00		
TOP1SHR	Survived	0.39	0.35	0.16	0.11	0.78	14.4182	0.0001
	Non-survived	0.34	0.30	0.16	0.00	0.85		
TOP10SHR	Survived	0.60	0.61	0.13	0.26	0.93	19.337	<.0001
	Non-survived	0.55	0.57	0.14	0.02	0.93		
STATESHR	Survived	0.28	0.28	0.25	0.00	0.75	0.2057	0.6502
	Non-survived	0.27	0.26	0.25	0.00	0.75		
Panel C: Descriptive statistics - Holdout sample: Firms entered ST system from 2006 to 2010								
NP_TA	Survived	0.06	0.04	0.08	-0.17	0.43	97.8491	<0.0001
	Non-survived	0.18	-0.05	10.52	-51.95	235.10		
TL_TA	Survived	0.62	0.64	0.26	0.05	1.74	17.0287	<0.0001
	Non-survived	1.56	0.75	8.79	0.00	142.72		
CA_CL	Survived	1.31	1.09	1.21	0.16	10.16	33.6181	<.0001
	Non-survived	0.96	0.65	1.22	0.00	12.14		
LTA	Survived	9.23	9.21	0.51	8.27	10.86	28.5062	<.0001
	Non-survived	8.89	8.91	0.68	0.00	10.86		
LMC	Survived	-3.49	-3.50	0.46	-4.43	-2.11	17.5723	<.0002
	Non-survived	-3.71	-3.74	0.40	-4.71	-2.11		
Excess Return	Survived	0.34	0.24	0.58	-0.53	2.69	11.7727	0.0006
	Non-survived	0.09	0.09	0.46	-1.08	1.65		
TRDTURNR	Survived	1.01	0.92	0.52	0.01	2.67	10.8929	0.001
	Non-survived	1.27	1.13	0.74	0.02	8.81		
DEBT_M	Survived	0.97	0.49	1.48	0.01	12.63	0.0001	0.9917
	Non-survived	3.62	0.51	56.25	0.00	1296.04		
DRESTRUCTURE	Survived	0.80	1.00	0.40	0.00	1.00	0.8078	0.3688
	Non-survived	0.76	1.00	0.43	0.00	1.00		
TOP1SHR	Survived	0.38	0.34	0.18	0.09	0.85	9.9317	0.0016
	Non-survived	0.31	0.28	0.13	0.04	0.78		
TOP10SHR	Survived	0.55	0.54	0.18	0.19	0.96	7.4944	0.0062
	Non-survived	0.49	0.50	0.14	0.05	0.92		
STATESHR	Survived	0.19	0.04	0.23	0.00	0.85	0.1184	0.7308
	Non-survived	0.17	0.04	0.20	0.00	0.75		

Table 4. Parameter estimates for Cox proportional hazard model

Panel A shows the total numbers of firm-year observations, the number for survived and censored firm-year observations and the percentage of censored to total number of firm-year observations in the estimation sample. Panel B reports the parameter estimates of multi-period Cox proportional hazard model. Panel C reports the goodness of fit of each model. All the variables are defined in Table 3.

Panel A: Number of survived and censored firms in the estimation sample									
		Total		Survived		Censored	Percentage Censored		
		992		197		795	80.14%		
Panel B: Parameter estimates									
Variables	Expected Sign	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
NP_TA	+	0.71128***			0.70057***	0.68142***		0.64033***	0.37584*
TL_TA	-	-2.52688***			-2.34615***	-2.47717***		-2.10443***	-1.95257***
CA_CL	+	-0.08838**			-0.08516**	-0.10635*		-0.10544*	-0.14602**
LTA	+	1.50766***			1.58346***	1.27376***		1.36833***	
LMC	+		2.13864***				1.82894***		1.61913***
Excess_Return	+		0.09797*		0.07394		0.06647	-0.01486	0.00593
TRDTURNR	+		-0.41249***		-0.0107		-0.41712***	0.01763	-0.19644
DEBT_M	-		-0.18937**		-0.10807		-0.21134**	-0.19763	-0.03702
DRESTRUCTURE	+			0.78288***		0.14632	0.51896***	0.827	0.20668
TOP1SHR	+			0.98663*		-0.07155	0.48533	-0.11611	0.75379
TOP10SHR	+			2.69072***		0.78132	1.90657***	1.02939	0.87311
STATESHR	+			0.28317		0.62804*	0.11174	0.65639	0.36341
Panel C: Model goodness of fit									
	Without Covariates	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
-2 LOG L	2337.927	2094.098	2189.139	2258.616	2092.185	2085.997	2156.504	2082.533	2064.367
Likelihood Ratio		243.8282***	148.7875***	79.3104***	245.7412***	251.9290***	181.4227***	255.3931***	273.5592***
Degrees of Freedom		4	4	4	7	8	8	11	11

* Denotes significance at 10% level.

**Denotes significance at 5% level.

***Denotes significance at 1% level.

Table 5. Predictive accuracy - Holdout sample

This table shows area under ROC (AUROC) curve and Brier score of all models considered in Table 4. AUROC is a measure of discriminatory power, thus the higher the number, the better is the model. The benchmark for AUROC is set against a random chance of 0.5. The Brier score is a measure of deviation from the forecast probability to the actual outcome of an event; the smaller the number, the better is the model. The benchmark for Brier score is the naïve forecast, which is given by the percentage of event occurrence in the estimation sample according to years.

	AUROC	Brier Score
Random Forecast	0.5	0.25
Naive Forecast	N/A	0.199
Model 1	0.822	0.112
Model 2	0.759	0.122
Model 3	0.679	0.117
Model 4	0.818	0.114
Model 5	0.819	0.111
Model 6	0.775	0.120
Model 7	0.811	0.113
Model 8	0.799	0.118

Table 6. Stepwise analysis: Parameter estimates for Cox proportional hazard model

Stepwise estimation is set at a 10% level of significance. Panel A shows the total numbers of firm-year observations, the number for survived and censored firm-year observations and the percentage of censored to total number of firm-year observations in the estimation sample. Panel B reports the parameter estimates of multi-period Cox proportional hazard model. Panel C reports the goodness of fit of the stepwise model. All the variables are defined in Table 3.

Panel A: Number of survived and censored firms in the estimation sample			
Total	Survived	Censored	Percentage Censored
992	197	795	80.14%

Panel B: Parameter estimates		
Variables	Expected Sign	Stepwise model
NP_TA	+	0.43916**
TL_TA	-	-2.08754***
CA_CL	+	-0.11793*
LTA	+	
LMC	+	1.65803***
Excess_Return	+	
TRDTURNR	+	
DEBT_M	-	
DRESTRUCTURE	+	
TOP1SHR	+	1.38986***
TOP10SHR	+	
STATESHR	+	

Panel C: Model goodness of fit		
	Without Covariates	Model 9
-2 LOG L	2337.927	2069.859
Likelihood Ratio		268.0676***
Degrees of Freedom		5

* Denotes significance at 10% level.

**Denotes significance at 5% level.

***Denotes significance at 1% level.

Table 7. Stepwise analysis: Predictive accuracy - Holdout sample

This table shows area under ROC (AUROC) curve and Brier score of Model 9.

	Random Forecast	Model 9
ROC Curve	0.5	0.801
	Naive Forecast	Model 9
Brier Score	0.199	0.118

Table 8. Forecast accuracy of Logistic regression vs. multi-period Cox model

This table compares area under ROC (AUROC) curve and Brier score of the forecast accuracy of the Cox models and those of logistic regressions. The Cox model utilizes all information of a firm during the period of distress; hence, there is only one statistic for each model. The logistic models are cross-sectional, thus they are separately run according to number of years prior to the event.

Panel A: Area under the ROC curve

	Random forecast	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Cox Model	0.5	0.822	0.759	0.679	0.818	0.819	0.775	0.811	0.799
Logistic 1yr Prior	0.5	0.785	0.76	0.667	0.832	0.814	0.77	0.787	0.796
Logistic 2yr Prior	0.5	0.679	0.659	0.56	0.7	0.669	0.641	0.697	0.681
Logistic 3yr Prior	0.5	0.509	0.516	0.714	0.477	0.659	0.715	0.69	0.683

Panel B: Brier score

	Naive Forecast	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Cox Model	0.199	0.112	0.122	0.117	0.114	0.111	0.12	0.113	0.118
Logistic 1yr Prior	0.228	0.343	0.251	0.321	0.329	0.316	0.259	0.272	0.290
Logistic 2yr Prior	0.228	0.324	0.261	0.335	0.311	0.310	0.282	0.258	0.275
Logistic 3yr Prior	0.228	0.389	0.297	0.290	0.402	0.341	0.240	0.278	0.267