The impact of corporate governance and state ownership on the default probabilities of Chinese firms

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Abstract

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Since 2014, the Chinese government has sanctioned corporate bond defaults of both state-owned and non-state-owned firms, which renders the country's firms no longer immune to bankruptcy. Actual defaults soared in 2015, and have again spiked since the onset of the global pandemic. This study investigates the impact of state ownership on corporate governance mechanisms on default risk of Chinese firms. There are some similarities observed: a) a non-linear relationship between inside ownership and default risk is observed for both state-owned and non-state-owned firms; b) Institutional ownership serves as a monitoring mechanism that reduces default risk, irrespective of state ownership. There are also some striking differences: non-state-owned firms with more independent boards are associated with higher default risk, while state-owned firms with larger boards and less independent boards have lower default risk. Pandemic effects are less severe for state-owned firms.

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I. Introduction

With the depressed state of many sectors of the global economy as a consequence of the 2020 COVID Pandemic, one would expect that companies around the world would suffer from weak performance rendering them exposed to increased default risk. China, the world's second largest economy after the U.S., has not been immune. As reported by CNN Business[1], Chinese state-owned firms are no longer bastions of stability as they too have become vulnerable to default. Amongst the victims of actual default include China Securities Co., Ltd., Unisplendour Corporation Limited, Brilliance China Automotive Holdings Ltd., etc.

According to the report, state-owned firms defaulted on a record 40-billion-yuan ($6.1 billion) worth of bonds between January and October, which is about as much as the last two years combined, and is the largest total since China first allowed defaults in 2014. This is a problem that could ripple through the country's financial system, threatening not only the nation's own economy but also the global recovery.

To further understand the unique nature of state-owned firms in China and the theories around state-owned firms, we have to first look at the definition of state-owned firms or state-owned enterprises (SOE): state-owned firms are firms that are wholly or partially (at least 50%) owned and controlled by the state (government). State-owned firms represent a crucial aspect of the world economy, producing approximately 10% of global GDP (Bruton, Peng, Ahlstrom, Stan, & Xu, 2015). Far from being a purely academic debate, the conflict over state-owned firms—or, more broadly, state ownership versus private ownership—has far-reaching political, economic, and social

[1] https://www.cnn.com/2020/12/09/economy/china-debt-defaults-state-companies-intl-hnk/index.html

implications that touch billions of people around the world (Bremmer, 2010).

Our understanding of the nature of the firm has evolved over time as a result of various prominent theories of the firm, from perceiving the firm as a property rights player to a transaction cost and agency cost minimizer, and, more recently, to a collection of resources and capabilities (Conner, 1991; Kim & Mahoney, 2005; Zenger, Felin, & Bigelow, 2011). However, most of these theories have one important thing in common: they are almost entirely based on the experience of the private, non-state-owned firm, and they have overlooked an essential aspect of the "firm": the SOEs.

The absence of coverage of state-owned enterprises in extant theories of the firm is due to two main issues. To begin with, most theories developed are affected by their own surroundings. Most extant theories of the firm, with no surprise, have been established in the context of the US economy, which has historically lacked a significant sector for state-owned firms. Because most theories of the firm focus on private firms, the underlying assumption is that the firm is profit-maximizing. Obviously, this assumption may not always hold true with state-owned firms, maximizing profits is not the sole objective of such firms, protecting jobs and minimizing social unrest are legitimate goals. As a result, it's expected that state-owned firms have remained substantially beyond the purview of current company theories.

Second, the discussion over state ownership may ended up with a debate of socialism versus capitalism, making it politically and ideologically difficult for Western researchers to openly advocate for state-owned firms' potential advantages. Many studies conclude that state-owned firms are less efficient than private firms. (Dewenter & Malatesta, 2001, p, 320). As a result, rather than being examined on their own, many academics looked at the impact of state-owned firms when they are privatized

(Filatotchev, Buck, & Zhukov, 2000; Megginson & Netter, 2001; Vickers & Yarrow, 1991). The privatization trend that has swept the globe since the 1980s appears to indicate that state-owned firms are only a transitory organizational structure destined to become historical artefacts. (Spicer, McDermott, & Kogut, 2000).

However, state-owned firms have remained steadfast in their determination to remain on the global stage. Instead of being phased out by history, state-owned firms have grown their global footprint since the 2008 bailouts. (Carney & Child, 2013; Economist, 2012b). Some of them have engaged in significant international expansion (Bass & Chakrabarty, 2014; Chen & Young, 2010; Lebedev, Peng, Xie, & Stevens, 2015; Ma, Yiu, & Zhou, 2014; Meyer, Ding, Li, & Zhang, 2014; Huang, Peng, Xie, & Zhuang, 2016). Thus, researchers need to ensure that theories of the firm can address this crucial organizational form.

Our key findings are as follows. First, we document that in the period subsequent to China's sanctioning of corporate default since 2014, non-state-owned firms in China experienced higher default risk than state-owned firms. Given the high leverage ratios of Chinese state-owned firms and the onset of the global pandemic in 2020, the default probability of state-owned firms doubled over the previous year. The pandemic related increase in default probability is even more severe for non-state-owned firms. A number of similarities are observed on how corporate governance mechanisms affect default risk for both state-owned and non-state-owned firms. a) a non-linear relationship between inside ownership and default risk is observed for both state-owned and non-state-owned firms; b) Institutional ownership serves as a monitoring mechanism that reduces default risk, irrespective of state ownership. There are also some striking differences: non-state-owned firms with more independent boards are associated with higher default risk, while state-owned firms with larger

boards and less independent boards have lower default risk. Pandemic effects are less severe for state-owned firms. Our results highlight the fact that insights from the corporate governance literature from other countries on the effectiveness of various corporate governance mechanisms may not be applicable to the Chinese context.

The remainder of this article is organized as follows. The next section provides a brief review of the literature. The hypotheses are introduced in section III. Section IV provides a discussion of the sample data and methodology. The main results and robustness tests are provided in Section V. The paper concludes with a summary in Section VI.

II. Literature Review

Although the state controls state-owned firms by definition, it cannot operate them on their own and must delegate power to the managers of the firms. A common aspect of any major modern business is the separation of the ownership and the control. In the old Soviet Union, there was a popular saying in state-owned firms: "They pretend to pay us, and we pretend to work." When the state government fails to utilize "spiritual" or "moral" incentives to make employees feel like owners, material incentives (such as bonuses) are generally used as a measure of interest to pique employees' interest in improving economic efficiency in state-owned firms. In practice, such incentive schemes in state-owned firms are typically modest, resulting in minimal motivational advantages. (Wang & Judge, 2012). Two major types of conflicts, (a) the conflict between managers and shareholders; and (b) the conflicts between shareholders and bondholders, may surface (Jensen & Meckling, 1976). The firm is viewed as a nexus of contracts between principals (such as owners) and agents (such as managers and

employees) under agency theory. Agents may have both the incentive and the opportunity to operate in a way that increases agents' personal utility at the expense of principals because they do not entirely share all of the aims of the owners and because they have more information about the assignments.

The success of any major modem business institution depends on its ability to overcome these problems. According to current researches, corporate governance is such an arrangement (Ang, Cole, & Lin, 2000; Berle & Means, 1932; Fama, 1978; Grossman & Hart, 1982; Jensen, 1986; Jensen & Meckling, 1976; Pandey & Sahu, 2017a). Jensen (1986) argues that, if a firm releases more debt than is reasonable, it reduces the availability of free cash flow in the hands of managers. Similarly, Grossman and Hart (1982) also view the use of debt as a type of internal governance mechanism that tends to restrict excessive use of free cash flow by managers due to the fear of corporate collapse. Jensen (1986) and Stulz (1990) suggest, however, that this will act as a deterrent to managers from overinvesting in ineffective initiatives. Furthermore, debt might act as an inducement for managers to decrease risk in order to protect their reputation and job security (Grossman & Hart, 1982). Increased debt financing, on the other hand, will exacerbate conflicts between bondholders and shareholders and raise the agency cost of debt. Shareholders of leveraged firms may opt to engage in riskier initiatives at the expense of creditors, therefore transferring wealth from bondholders to themselves (Jensen & Meckling, 1976). Furthermore, Myers (1977) discovered that when firms are in financial distress, equity holders are more likely to refuse to invest in value-creating projects, because if a company goes bankrupt, shareholders may lose their investments and are unable to capture the full gains of successful investments. As a result, when a company is in financial trouble, a larger degree of debt may force shareholders to reject value-enhancing investments. This is the essence of the debt

overhang problem. Firms may, of course, adopt tighter covenants to try to lower the agency cost of debt financing. Nonetheless, even with covenants in place, the risk-shifting problem persists (Smith & Warner, 1979). It's unclear if governance factors that favor shareholders benefit bondholders or not.

While numerous studies indicate that multiple governance methods may be used to resolve the conflicts outlined above, the majority of them utilize a single governance measure to account for governance quality, such as the GIM index (Gompers, Ishii, & Metrick, 2001). The GIM index focuses on antitakeover provisions that restrict shareholder rights and alter the power balance between management and shareholders. Gompers, Ishii, and Metrick (2001) constructed this index based on the prevalence of 24 governance norms as a proxy for the level of shareholder rights; a higher index indicates lower shareholder rights and greater manager rights. According to the study, firms with a high GIM index had lower firm value, lower profits, and weaker sales growth, but they had higher capital expenditures and made more corporate acquisitions. This GIM index is widely used in academic publications to assess firm performance and risk. Klock, Mansi, and Maxwell (2005) demonstrated that firms with lower GIM indexes have higher debt financing costs, indicating the presence of agency costs of debt. Despite the established negative correlation between the 24 provisions included in the index, the GIM index did not conclude that causality and business performance were demonstrated due to probable endogeneity issues. In other words, a firm's governance provisions may be endogenous, making it impossible to determine if poor performance is driven by inadequate governance provisions or vice versa (Tipurić, Dvorski, & Delić, 2014). It may also be inappropriate to use only one single index to assess the governance quality, we can anticipate that the components of the index might be replacements or complements to each other in terms of influencing firms' default

probabilities. It may be more informative to investigate individual governance variables as they impact on firms' default probabilities, as in Switzer and Wang (2013a, 2013b), Kabir et al (2020) and Balester et al (2020). This paper takes this approach and is one of the first to look at how governance factors affect the default probability of Chinese firms.

III. Hypothesis Development

The fundamental topic addressed in this paper is whether corporate governance mechanisms, as investigated by Denis and McConnell (2003), have a significant influence on default risk for Chinese firms, both state-owned and non-state-owned. There appears to be no direct evidence of this, as existing literatures are largely based on data from the United States. It is unclear if the ideas from those literatures can be applied to the Chinese context.

Given the significant regulatory variations between state-owned and non-state-owned firms that impact the nature of control and monitoring, we could anticipate that the effects of internal corporate governance factors vary across these firms. For example, with the considerable control given by the government for state-owned firms, the nature of board monitoring of the firm would change in form and content. The lack of autonomy was a prominent aspect for conventional state-owned firms in the Chinese economy and other Soviet-style economies. The state gave all inputs to SOEs for production in accordance with central plans, as well as paid all of their expenditures. In exchange, the SOEs provided all outputs and income to the state. The wages of SOE employees and managers are regulated by the state. All actions of state-owned firms required governmental permission. Because the government is the dominant

shareholder of state-owned firms, managers of state-owned firms might be induced to seek political goals rather than maximize business profits, resulting in the expropriation of minority shareholders. (Ben-Nasr et al. 2012; Lee and Wang 2017). Furthermore, it is commonly acknowledged that the government serves as both an implicit and explicit guarantor on loans issued to SOEs (Faccio 2010; Song et al. 2011). This has implications for the efficacy of certain governance mechanisms that exist between state-owned and non-state-owned firms. Li et al. (2007a) and Conyon and He (2012), for example, indicate that bigger boards are insignificant or less effective in certain tasks such as determining CEO remuneration. Huyghebaert and Wang (2012) present empirical study indicating that board size has little effect on related party transactions, but is correlated with more labor redundancies, resulting in higher agency costs in Chinese listed state-owned firms. They find that a big board of directors may encourage the expropriation of minority investors. Empirical studies on the efficacy of independent directors, on the other hand, has been mostly inconclusive. Dalton, Daily, Ellstrand, and Johnson (1998), among others, conducted meta-analyses and found no convincing evidence that a larger number of independent directors necessarily leads in better company performance. Our work adds to the body of evidence for Chinese state-owned and non-state-owned firms on this score:

H1: Internal corporate governance variables have different impacts on state-owned and non-state-owned firms.

In terms of the impacts of internal governance mechanisms on Chinese firms' default probabilities, we concentrate on the structure of the board of directors as well as the firm's ownership. We look at board size and board independence to assess the impact of board structure. According to Pfeffer and Salancik (1978), board size should be having a negative association to default probability since larger boards are more

likely to have greater expertise and more resources available for monitoring managers than smaller boards. Furthermore, insiders have an easier time controlling a small board, but a larger board is more difficult to control. Switzer and Wang (2013a, b) have given evidence to support these arguments. Jensen (1993) takes a different approach from another perspective, he argues that larger boards will generate greater problems with communication and coordination, which could lead to internal conflicts that distort monitoring efficiency. Yermack (1996) and Eisenberg and Sundgren (1998) argued that board size is inversely related to firm performance. However, none of these studies take into account default probability. To summarize, there is no clear evidence of a link between board size and default probability, and almost none for China to date. This is where our research comes in.

To determine the degree of board independence, we used two variables: (a) the proportion of independent directors on the board; and (b) CEO duality, which is a dummy variable equal to one if the CEO also acts as the chairman of the board.

Theoretically, the influence of board independence on default probability remains unclear. On the one hand, it has been claimed that the more independent the board is, the more objective the monitoring of managers will be, reducing the risk to shareholders by discouraging self-interested behavior. However, if a more independent, powerful board requires managers to behave in the best interests of shareholders at the expense of creditors, the agency cost of debt will rise, resulting in a higher default probability. Empirical research has yielded no conclusive evidence of the influence of board independence on firm performance. Black (2001) argued that there is an unclear relationship between board independence and firm performance. Kumar and Sivaramakrishnan (2008) claimed that a firm with more outside directors on its board may perform poorly. The existing literature does not investigate how these internal

mechanisms may affect default probability differently in state-owned and non-state-owned firms. Although empirical evidence on the relationship between governance and performance are mixed, the necessity of having independent directors is universally acknowledged. Uzun, Szewczyk, and Varma (2004), for example, argue that the inclusion of independent directors helps to minimize corporate fraud in US firms. Kato and Long (2006) conducted an empirical test on Chinese companies and find that, after controlling for firm performance, the appointment of independent directors increases CEO turnover, implying a stronger governance role by a more independent board. As a result, considering the relationship between board independence and default probability, we propose a mixed result:

H2: Board structure presents a mixed relation with a firm's default probability in China.

In terms of the firm's ownership structure, we will look at ownership by firms' insiders and the ownership by institutions. The firms' insiders play an essential role in managing the interaction between equity holders and bondholders. Ownership by insiders can align their interests with those of shareholders and decrease agency costs. Jensen and Meckling (1976) claim that managerial ownership should be positively correlated with firm valuation since managerial ownership better aligns the interests of managers and shareholders (alignment effect). Shareholders favor riskier investment projects, which may lead to the risk shifting issue. As a result, we predicted a positive correlation between insider ownership and default probability at low levels of insider ownership (here, we use insider ownership as a proxy for managerial ownership). However, insiders may become more risk cautious at higher degrees of ownership as a result of job security and reputation concerns, as well as concentrated wealth exposure risks at high ownership levels (the entrenchment effect, see Jensen & Murphy, 1990;

Wright & Ferris, 1997). Stulz (1990) discovered that the entrenchment effect dominates at a high level of managerial ownership. From the perspective of the creditors, this may be a positive thing. As a result, at high levels of managerial ownership, insider ownership should be adversely related to default probability. Bagnani, Milonas, Saunders, and Travlos (1994) discovered that the bond return premium is positively correlated with lower levels of managerial ownership (5 to 25%), but is negatively correlated with higher levels of managerial ownership (above 25%). Switzer and Wang (2013) similarly found a non-linear correlation between insider ownership and default probability. Consistent with the existing studies, we anticipated a nonlinear correlation between insider ownership and firm's default probability:

H3: Insider ownership has a nonlinear relationship with firm's default probability: at a lower level of insider ownership, an increase in insider ownership will increase default probability, while beyond a certain threshold level, an increase in insider ownership will reduce default probability.

In terms of the impacts of institutional monitoring, existing studies indicate that institutional ownership plays a significant role in monitoring selected portfolio firms and therefore enhances firms' information environment, thus lowering firms' default probability (Ashbaugh-Skaife, Collins, & LaFond, 2006; Cremers, Nair, & Wei, 2007). Hence, we predicted a negative relationship between institutional ownership and firm's default probability:

H4: Institutional ownership is negatively related to firm's default probability.

IV. Data and Methodology

The data used in this paper are collected from the Chinese Stock Market and Accounting Research (CSMAR) database on companies publicly listed (A-shares) on either Shanghai Stock Exchange (SSE) or Shenzhen Stock Exchange (SZSE) in China between January 2015 and December 2020, excluding delisted and financial firms such as banks, securities, insurance, etc. (Liao et al. 2014), as well as companies with transfer control in the sample interval. These exclusions were made, respectively, since: 1) there are major differences between the accounting standards of the financial industry and that of other industries. The relevant indicators are not comparable between the financial industry and the non-financial industry. Thus, according to this practice, they should be excluded. 2) Companies undergoing merger and activity will have unstable information due to the heavy activity surrounding these types of events from the market. Thus, controlling for the effects of M&A on such companies will be very difficult. Our final sample selection includes firms in the industrial, real estate, commercial, utility sectors, and others. In the following empirical analysis, our sample consists of 11,023 firm-annual observations between 2015 and 2020.

China was chosen as our data sample since it provides a unique setting to conduct our research due to the fact that only China has a huge number of state-owned firms, and all these state-owned firms are distributed in various industries.

Default Probability and Corporate Governance Variables

The dependent variable in this paper is the default probability (Def), such probability is acquired from the KMV model established by the KMV Corporation, named by its three founders, Kealhofer, McQuown, and Vasicek. The KMV model is

based on Merton's (1974) option pricing theory, which is obtained from the firm's financial reports and the market value of stock and debt data such as the likelihood of anticipated future default. The main idea behind the KMV model is to utilize stock to show the options nature, by using the stock market and its volatility as well as the value of corporate debt data to value corporate assets and volatility, and in the coming years to estimate the probability of corporate defaults, that is, the expected probability of default EDF. To calculate a company's expected default frequency, the KMV model is usually divided into four steps. The first step is to estimate the firm's asset value and its volatility from the stock market, the value of the volatility of stock price and liabilities book value. According to KMV's assumption, cash equivalent short-term liabilities are treated as sustainable long-term pension liabilities and convertible preferred stock component. In this assumption, the current market value of risk loans is defined by five factors, based on the relationship between the classic Black-Scholes-Merton model put option valuation models and default options.

Value of an option of loan default risk:

$$\mathrm{E} = f(V, B, r, \sigma_v, \tau)$$

$$f(V, \sigma_v) = E = V \times N(d_1) - B \times e^{-r\tau} \times N(d_2)$$

$$d_1 = \frac{ln\left(\frac{V}{B}\right) + \left(r + \frac{\sigma_v^2}{2}\right)\tau}{\sigma_v \tau}$$

$$d_2 = d_1 - \sigma_v \sqrt{\tau}$$

V is the assets' market value, B is the price of the loan, r is risk-free rate of interest, σ_s and σ_v are an enterprise's market value and asset volatility value, respectively, τ is the expiration date of put option or the time the loan limit.

In order to calculate the asset market value V and its volatility σ_v, the function has been established based on the relationship between observable fluctuations in corporate market value and non-observable fluctuations in the value of the company's assets:

$$\sigma_s = \mathrm{g}(\sigma_v) = \frac{V \times N(d_1) \times \sigma_v}{E}$$

Then, using a continuous iterative technique, we will be able to find the value of V and σ_v.

The second step is to identify the default point DPT. With a vast number of empirical analyses, KMV model discovered that defaults happened most frequently when a company's worth was larger than the critical threshold, which is equal to current liabilities CL plus 50% of the long-term liabilities LL, thus:

$$\mathrm{DPT} = \mathrm{CL} + 0.5\mathrm{LL}$$

The third step is to calculate the distance to default DD. The distance to default measures the distance – in asset value standard deviations – between the present market value of a company's assets and a specified default point. It is calculated using asset market value information, a pre-specified default point DPT, and asset market value volatility σ_v, and it serves as a barometer for company default risk:

$$DD = \frac{E(V) - DPT}{E(V) \times \sigma_v}$$

The fourth step is to calculate the company's expected default frequency EDF, which is a measure of the likelihood that a company would default during a certain time period (typically one year). The mapping connection between the distance to default DD and the expected default frequency determines the expected default frequency. As a result, establishing a mapping relationship is a necessary prerequisite for determining

the expected default rates. Based on the one-to-one mapping relationship between the distance to default DD and the expected default frequency EDF, the length of the distance, to a certain extent, reflects the firm's credit status, and thus evaluates the level of competitiveness of firms:

$$EDF = N(-DD)$$

Because China's credit system was not well established until recently, there is a severe lack of historical statistical data for China's corporate default or bankruptcy, making it difficult to convert the distance to default into the actual default rate and to calculate the expected default frequency EDF. However, with the perfection of such credit system in recent years and the allowance of corporate default in China since 2014, the calculation of default probability becomes easier and the result becomes more accurate and reliable.

Our dependent variable, *Lndef*, is defined as *Ln(Def / (1- Def))*, where *Ln* is the natural logarithm and *Def* is the default probability obtained from KMV model.

The corporate governance variables used in this study are defined below and fall into two categories: (a) Board structure: Board size is the total number of directors in a board; we took nature logarithm of board size, *Lnboard*, in the regression to reduce the possibility of multicollinearity; board independence (*Ind*) is the percentage of independent directors for the firm; CEO duality (D*uality*) is a dummy variable that equals to one if CEO and chairman are the same person and zero otherwise. These three variables were used as proxies for board structure, where the latter two are different measures of board independence; (b) Firm's ownership structure: Institutional ownership (*Instit*) is the percentage of stock held by institutions. Insider ownership (*Insid*) is the proportion of stock held by insiders.

Control Variables

In our analysis, we included the following control variables. First, we included firm size (*Size*), measured as the market value of the firm's equity (in millions RMB); larger firms are expected to have lower default probabilities. We also controlled for firm's leverage (*Lev*), defined as the firm's debt to asset ratio, companies with higher leverage are expected to have higher default probabilities (Molina, 2005). The firm's return on assets (*Roa*) was also used as a control variable for a firm's profitability, companies with higher profitability are expected to have lower default probabilities. Firm age is another important factor to default risk, we controlled for this variable and expected older and well-established firms to have lower default probabilities. We also included Herfindahl–Hirschman index of institutional ownership (*Hi_index*) to control for the monitoring role played by large institutional investors. In addition, we controlled for the firm's growth opportunities which is measured by firms' market to book ratio (*MB*), firms with higher MB ratios are expected to have lower default probabilities. Asset tangibility (Tang) is also beneficial for improving liquidity because payoff of tangible assets is easier to observe than that of intangible assets and it can reduce information asymmetry (Chung, Elder, & Kim, 2010). Therefore, asset tangibility might reduce default probability.

We also controlled for stock return volatility (*Vol*) and liquidity (*Liq*). Both of these factors reflect different aspects of a stock's risk, and volatility is expected to have positive relationships with the firm's default probability, while liquidity is expected to have negative relationships with the firm's default probability.

Descriptive Statistics

Table 1 presents the distribution of the average default probability for state-owned firms and non-state-owned firms by year from 2015 to 2020. It shows that during this period of time, default probabilities of state-owned firms are significantly lower than those of non-state-owned firms, the difference decreases from 0.74% in 2015 to 0.01% in 2017, while such difference increases for recent 3 years from 2018 to 2020, and there's a significance increase in such difference in 2020, indicating the effect of the pandemic on firm's default probability especially for Chinese non-state-owned firms, whose mean default probability almost doubles from 2019. It is worth noticing that the mean default probabilities for both state-owned and non-state-owned firms are extremely high in year 2015, one possible explanation might be that year 2015 is the first year after Chinese government allow corporate default since 2014. Except for year 2017, the differences between the default probabilities of state-owned firms and non-state-owned firms in other years are significant. This result doesn't surprise us, since the credibility of government guarantees has been the most important bulwark against financial crisis, and because of their strong ties to the Chinese government, these state-owned firms are usually considered as safe bets in times of difficulty. Although it is important to point out that, the relative low default probabilities of state-owned firms may not due to the higher efficiency or higher profitability, instead, the efficiency arguments for state ownership have been substantiated in just a few studies demonstrating the benefits of state ownership (e.g., police and prison ownership, see Hart et al., 1997). The majority of researches have shown that state-owned firms do not provide better service to the public. (i.e., Grossman and Krueger, 1993) and, in fact, that state-owned firms are typically extremely inefficient (i.e., Boycko et al., 1995, Dewenter and Malatesta, 2001). The conclusion from these studies is generally that

state-owned firms' disregard of social objectives combined with their extreme inefficiency is inconsistent with the idea that state ownership can lead to performance efficiency that profit maximizing private firms cannot match. Historically, the Chinese government has been reluctant to let these state-owned firms fail and enjoys tight control over wide swaths of the economy, including business, and it believes that the relationships that these companies have with the government are critical for maintaining that. Now, the government appears to be willing to allow at least some state-owned firms to collapse, starting from year 2014. However, too many loans and corporate bond failures would leave the financial system extremely exposed, making that approach fraught with risk.

Overall, Table 1 shows that non-state-owned firms in China have a significantly higher average default probability than state-owned firms for year 2015; such difference is narrowed down during year 2017 to 2019 and remain significant, implying an increasing default probability for state-owned firms in China. With the outbreak of the global pandemic in 2020, the default probabilities for both state-owned and non-state-owned firms spiked again, and the effects are less severe for state-owned firms.

[Please insert Table 1 about here]

Panel A of Table 2 reports descriptive statistics of the firm default probabilities, the governance variables, and the control variables for the full sample, Panel B and Panel C reports the descriptive statistics of state-owned firm subsample and the non-state-owned firm subsample respectively. The mean and median default probabilities are higher for non-state-owned firms than for state-owned firms during our sample period. Most of the governance and control variables of state-owned firms are different from those of non-state-owned firms, and the mean and median tests of such differences

are almost all significant. Specifically, state-owned firms have significantly larger boards, lower board independence, higher institutional ownership and lower insider ownership than non-state-owned firms. As for firm characteristics, the state-owned firms have significantly lower average and median values of stock volatility, stock liquidity, asset tangibility, but have higher market to book ratio, and Hi_index than their non-state-owned firm counterparts.

[Please insert Table 2 about here]

Table 3 displays the Pearson correlation coefficients among our variables. Panel A shows the estimates for the full sample while Panel B and Panel C shows the estimates for the state-owned firms and non-state-owned firms subsamples respectively. For both state-owned and non-state-owned firms, board size and institutional ownership are negatively related to default probabilities. CEO duality and insider ownership, on the other hand, are positively correlated with default probability for those 2 types of firms. In terms of firm characteristics, for state-owned firms, firm size, leverage ratio, return on assets, market to book ratio, and HI index are negatively related to default probability, while volatility, asset tangibility and liquidity are positively related to default probability, some of these correlations are not expected; while for non-state-owned firms, the indications of return on assets and liquidity show different signs, the indications of other variables remain the same. In general, the majority of the variables show the anticipated indications of correlations with the default probability, while some variables show the unexpected signs due to the different nature of state-owned and non-state-owned firms.

[Please insert Table 3 about here]

To test the relationship between various governance variables and default

probabilities for our state-owned firms sample and non-state-owned firms sample, we ran the following regression for our full sample, controlling for firm characteristics, and year-fixed effects when applicable. The primary model is presented below:

$$Lndef_{it} = \alpha_0 + \alpha_1(Lnboard_{it}) + \alpha_2(Ind_{it}) + \alpha_3(Duality_{it}) + \alpha_4(Insid_{it}) + \alpha_5(Insid_{it})^2 + \alpha_6(Instit_{it}) + \alpha_7(SOE_{it}) + \sum_{j=0}^{k} \beta_{ijt} Y_{ijt} + \varepsilon_{ijt} \quad (1)$$

Lndef is defined as *LN(Def / (1-Def))*, where *Def* is default probability. The governance variables and dummy variables were already defined earlier. The quadratic term for insider ownership is used to capture the nonlinear relationship between insider ownership on firm default probability. Y_{ijt} represents a set of control variables, that is, market and firm characteristic variables as defined earlier. We also considered the interaction effect between governance variables and the state-owned firms dummy, SOE, on default probability to investigate the different impacts of governance variables on default probability on state-owned firms versus non-state-owned firms. The results of the models that incorporate interaction terms are presented in the following section.

As robustness checks, we tested our hypotheses based on one-to-one matched sample approach, and using controls for firm complexity. In order to construct the one-to-one matched sample, we utilized the propensity score matching approach to find one non-state-owned firm in the same fiscal year and with the closest propensity score based on firm size and book to market ratio for each state-owned firm.

In the next section, we present results using Ordinary Least Squares (OLS) and one-to-one matched sample approach methods, as well as additional robustness tests to formally analyze the relationship between default probability and governance factors, and to explicitly evaluate our hypothesis.

V. Results and Analysis

Regression results based on full sample

Table 4 shows the regression results for our full sample. As shown, higher default probability is associated with higher stock return volatility, lower stock liquidity, lower leverage, lower profitability, as measured by ROA, and a lower Herfindahl–Hirschman index, most of those results are as expected and not out of surprise. A possible explanation for these unexpected relationship between leverage ratio and default probability is that state-owned firms, whose average default probability is significantly lower than non-state-owned ones, tend to have higher leverage. Although higher leverage is generally associated with higher default probability, it does not apply to Chinese state-owned firms that are backed by the China government. And when we refer to the panel A of descriptive statistics table, we can find that state-owned firms do to have significantly higher leverage comparing to non-state-owned ones. On the other hand, larger firms and high growth opportunity firms is associated with higher default probabilities. Firm's asset tangibility is positively associated with default probability. In terms of our governance variables, nearly all of the governance variables have differential effects for state-owned firms and for non-state-owned firms, as shown in Models 2, 4, 6, 8, 10, and 12. The coefficients of the interaction terms of governance variable and the state-owned firm dummy variable, SOE, are significant in almost all those models. Based on these findings, our first hypothesis that internal corporate governance variables have different impacts on state-owned and non-state-owned firms is well supported.

Model 1, estimated with the full sample of firms, shows that board size is significantly negatively related to default probability, which supports the resource

dependency theory. Comparing state-owned versus non-state-owned firms, Model 2 shows that the coefficient of the interaction term, Lnboard * SOE, is significantly negative. This result, taken together with the non-significant coefficient of Lnboard, implies that the significantly negative impact of board size on firm default probability is limited to state-owned firms. In terms of board independence, we used 2 measures: Ind (board independence as measured by the total number of independent directors over total directors), and Duality dummy variable. These 2 measurements of board independence show significantly different impacts on the default probability for state-owned firms versus non-state-owned firms. As we can see from Models 3 and 4, the coefficients of Ind are significantly negative, but in Models 4, the coefficient of interaction terms, Ind*SOE, is significantly positive. Those results suggest that a more independent board will reduce the default probability for non-state-owned firms but will increase the default probability for state-owned firms. The evidence of negative correlation between board independence and default probability for non-state-owned firms is consistent with the extant governance literature that an independent board provides better monitoring results in a reduced risk taking. In contrast, our finding that a more independent board is positively related to the default probability of state-owned firms may reflect the unique features of Chinese state-owned firms, maximizing profits is not the sole objective of such firms, protecting jobs and minimizing social unrest are legitimate goals, thus, a less independent board might ensure a more centralized controlling power by the government, which in turn may prevent managers from pursuing their own interests instead of the social objectives of state owners. We also found that our second measure of board independence, Duality, is not significantly related to the default probability of both state-owned and non-state-owned firms. To sum up, board structure shows mixed results for both state-owned and non-state-owned

firms: for non-state-owned firms, board size is not a significant determinant of default probability and a more independent board is associated with lower default probability; for state-owned firms, a larger board is associated with lower default risk, which supports H2, and a more independent board will increase default probability.

In terms of ownership structure, we investigated the impacts of institutional ownership and insider ownership on firm default probability. Models 7 and 8 show the results of institutional ownership regressions. From Model 7 and 8, we noticed that both the coefficient of Instit and the coefficient of interaction terms Instit*SOE are significantly negative, meaning that institutional ownership has a significantly negative relation with the default probability of both state-owned and non-state-owned firms. Such result is consistent with the contention that institutional investors play a monitoring role in corporate governance to reduce default risk (Ashbaugh-Skaife, Collins, & LaFond, 2006; Cremers, Nair, & Wei, 2007). In terms of the effects of insider ownership, both an alignment effect and entrenchment are indicated. Specifically, the relationship between insider ownership and default probability is nonlinear: at a low level of insider ownership, the alignment effect dominates (i.e., incentives of insiders are aligned with those of shareholders who are more inclined to choose more risky projects encroaching on bondholder's benefits). We can see that default probability increases with the increase of insider ownership at a low level of ownership (i.e., the coefficient of Insid is positive). As insider ownership increases and reaches its inflection point, the entrenchment effect dominates and default probability decreases with the increase of insider ownership (i.e., the coefficient of Insid2 is negative).

Our findings agree with those of Wright, Ferris, Sarin, and Awasthi (1996), Kim and Lu (2011), and Switzer and Wang (2013a). For state-owned firms, such nonlinear

relation also exists, although such relation is not significant, as shown by the insignificant coefficients of Insid and Insid2 in Model 10. Therefore, ownership structure affects the default probability for state-owned firms significantly: institutional ownership is negatively related to state-owned firms' default probability and insider ownership has a concave relationship with state-owned firms' default probability. While for non-state-owned firms, institutional ownership also shows a significant negative association with the default probability, and the concave relationship between insider ownership and default probability remains. Based on above results, H3 and H4 are well supported for both the state-owned and non-state-owned firm sample. Finally, Models 11 and 12 include all the governance variables and the control variables confirm our previous findings: governance variables have different impacts on the default probability for state-owned versus non-state-owned firms, as nearly all the interaction terms of governance variables with state-owned firm dummy variable are significant; board independence has a negative relation with default probability of non-state-owned firms, while it has a positive relation with the default probability of state-owned firms. To sum up, ownership structure is important for both state-owned and non-state-owned firms: ownership by institutional investors reduces the default probability, and insider ownership has a significant concave relation with the default probability of these firms.

[Please insert Table 4 about here]

Regression results based on one-to-one matched sample

The results reported to this point are based on our full sample firms. Table 5 below shows the regression results based on a one-to-one matched sample approach. The matched non-state-owned firms are chosen from all non-state-owned firms within

the same fiscal year and having the closest propensity score based on firm size and market-to-book ratio to their matched state-owned firms.

Overall, the results obtained from the one-to-one matched sample regressions are consistent with our full sample regression results above. We can see from Models 1 and 2 that a larger board is significantly positively related to non-state-owned firms' default probability but not to that of state-owned firms. Independent boards are negatively related to default probability of non-state-owned firms (Models 3 and 4), but are positively related to default probability of state-owned firms (Models 4). In terms of the ownership structure, the results are consistent with full sample regression results, higher ownership by institutional investors is significantly negatively related to a firm's default probability, for both state-owned and non-state-owned firms. As shown in Models 7 and 8, the coefficients of Instit and the interaction term of Instit*SOE are significantly negative. Again, there is a nonlinear relation of insider ownership and firm default probability for both state-owned and non-state-owned firms, as shown in Models 9 and 10, implying both the incentive alignment and entrenchment effects exist.

[Please insert Table 5 about here]

A further robustness check

Table 6 presents the results of further robustness check. In this test, we controlled for firm complexity. Coles, Daniel, and Naveen (2008) argue that complex firms with greater advising requirements than simple firms have larger boards. Their evidence implies that the impact of board size and firm credit risk may depend on firm's complexity. We used one of the variables used by Coles et al. (2008) to measure a firm's complexity. Specifically, we used a dummy variable Complexity that equals to one if a

firm's leverage ratio is greater than the median value of our sample firms. Results of Models 1 to 3 in Table 6 show that more complex firms have higher default probabilities. Most importantly, a larger board is still negatively related to the default probability of state-owned firms, but not for non-state-owned firms, as shown by the significant negative coefficient of interaction term Lnboard*SOE. All the control variables as well as year and industry fixed effects are included as applicable. These results support our previous findings that board size significantly affects the default probability of state-owned firms instead of non-state-owned firms.

[Please insert Table 6 about here]

VI. Summary and Conclusions

This paper examines the effects of several important governance factors on the default probabilities of state-owned and non-state-owned firms in China, after controlling for firm accounting and market performance characteristics. We show that during the recent years after China's allowance of corporate default since 2014, non-state-owned firms in China experienced higher default risk than state-owned firms. However, due the nature of Chinese state-owned firms whose leverage ratio is very high, and the 2020 global pandemic, the default probability of state-owned firms almost doubles for that of year 2019. And for the non-state-owned firms in China, the increase in default probability is even more severe. By the end of the sample period, the difference between the default probabilities of state-owned and non-state-owned firms is significantly enlarged. In terms of relationship between internal governance factors and the default probabilities of Chinese state-owned and non-state-owned firms, we observed a negative relationship between board size and the default probability of state-owned

firms, and a positive relationship between board independence and these firms' default probability. On the other hand, a negative relation of board independence and default probability of non-state-owned firms was observed. Ownership structure significantly affects the default probability of both state-owned and non-state-owned firms. Specifically, institutional ownership reduces the default probability of both types of firms, and insider ownership has a nonlinear concave relation with the default probability of these firms. Our results highlight the fact that insights from the corporate governance literature from other countries on the effectiveness of various corporate governance mechanisms may not be applicable to the Chinese context.

Contributions

This paper represents the first study to date to quantify the actual risk exposure of state-owned firms versus non-state-owned firms in China using KMV models to measure firms' default probability. Furthermore, it provides new evidence on the relationship between corporate governance mechanisms and default probability in China, which has not been well explored to this point.

Applied implications

The paper identifies governance mechanisms that contribute to the riskiness of Chinese firms after China's allowance of corporate default since 2014, and most importantly, taking into consideration of the impact of the 2020 pandemic. This should be of considerable interest to creditors, ordinary investors, portfolio managers, regulators, and policymakers concerned with both the viability of firms during periods of market weakness. The paper should also be of interest to regulators who are

interested in identifying “good governance” factors that enhance investor protection and market stability.

Limitations

This paper focuses only on market and company accounting data to capture firm default probabilities. Implicit insurance provided by governments, such as possible changes in deposit insurance coverage for financial institutions or outright government bailouts of state-owned firms in times of difficulty, may influence the real default risk faced by firms. This, in turn, may enhance or reduce from the efficacy of the governance processes, depending on whether the government interventions serve as replacements or complements to the firms' own corporate governance mechanisms. Furthermore, the governance factors may be determined endogenously, but owing to data and sample restrictions, such endogeneity concerns cannot be addressed directly at this time.

Although in this paper we included the data for year 2020 trying to capture the impact of the 2020 pandemic on default probability of Chinese state-owned and non-state-owned firms, and we do observe a huge increase of default probability for both state-owned and non-state-owned firms in 2020, however, the full impact of this pandemic might not be captured right now, considering the world economy is now still suffering from the pandemic and with further study of the data of 2021 we might come to a more clear conclusion.

These analyses could be extended to other countries having significant sector for state-owned firms. Extending the sample to these countries where state ownership is also considered an essential aspect of the "firm" might also permit comparisons of the Merton-type estimates of firm default probabilities with market-based estimates,

such as those implicit in credit default swap spreads. Contracts for the latter in China are quite illiquid and cover only a few firms at this point in time.

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Annexes

Table 1 Mean difference

This table shows the mean difference between the default probabilities of state-owned firms vs. non-state-owned firms.

	State-owned firms			Non-state-owned firms					
Year	N	Mean	Std	N	Mean	Std	Mean Difference	Std	P-value
2015	717	0.066	0.0013	1,130	0.0734	0.0012	-0.0074	0.0018	0.0001*
2016	717	0.0118	0.0005	1,147	0.0191	0.0004	-0.0073	0.0007	0.0001*
2017	708	0.0032	0.0005	1,145	0.0031	0.0002	0.0001	0.0004	0.3498
2018	729	0.0066	0.0004	1,127	0.0107	0.0004	-0.0041	0.0006	0.0001*
2019	746	0.0071	0.0005	1,091	0.0127	0.0005	-0.0056	0.0007	0.0001*
2020	737	0.0118	0.0006	1,044	0.0225	0.0007	-0.0107	0.001	0.0001*

Table 2 Descriptive Statistics

Panel A shows the descriptive statistics of variables in the full sample, Panel B and Panel C show the descriptive statistics of variables in the state-owned firms and non-state-owned firms subsample respectively. Def is the default probability. Lnboard is the nature logarithm of board size. Ind is the percentage of independent directors for the firm. Duality is a dummy variable equals to one if CEO and chairman are the same person and zero otherwise. Insid is the proportion of stock held by insiders. Instit is the percentage of stock held by institutions. Size is the market capitalization with daily frequency. Lev is the leverage defined as the firm's debt to asset ratio. Roa is the return on assets. MB is the market to book ratio. Vol is the stock return volatility. Tang is the asset tangibility. Liq is the liquidity. Hi_index is the Herfindahl–Hirschman index of institutional ownership.

Panel A Descriptive Statistics of Full Sample

Variable	N	Mean	Std	Min	P25	Median	P75	Max
Def	14874	0.023	0.035	0.000	0.001	0.008	0.029	0.631
Lnboard	14874	2.126	0.198	1.386	1.946	2.197	2.197	2.833
Ind	14874	0.376	0.056	0.143	0.333	0.357	0.429	0.800
Duality	14874	0.243	0.429	0.000	0.000	0.000	0.000	1.000
Insid	14874	11.128	17.134	0.000	0.001	0.493	18.740	83.002
Instit	14874	41.349	23.155	0.000	23.130	42.511	59.047	326.727
Size	14874	22.472	1.384	20.734	21.579	22.304	23.207	28.636
Lev	14874	43.364	20.478	0.836	27.414	42.599	58.264	326.190
Roa	14874	3.254	7.639	-185.842	1.121	3.180	6.164	81.513
MB	14874	0.490	0.384	-1.434	0.226	0.390	0.639	5.609
Vol	14874	50.627	25.751	0.000	36.727	46.761	60.942	1443.365
Tang	14874	43.077	22.894	-201.339	27.600	42.502	59.563	97.049
Liq	14874	539.640	661.499	0.000	0.000	325.477	765.567	5057.462
Hi_index	14874	0.007	0.033	-0.016	0.000	0.000	0.002	1.244

Table 2 Continued *Panel B Descriptive Statistics of State-owned Firms Subsample*

Variable	N	Mean	Std	Min	P25	Median	P75	Max
Def	5454	0.018	0.029	0.000	0.000	0.005	0.021	0.348
Lnboard	5454	2.190	0.193	1.609	2.079	2.197	2.197	2.833
Ind	5454	0.371	0.056	0.222	0.333	0.333	0.400	0.800
Duality	5454	0.088	0.283	0.000	0.000	0.000	0.000	1.000
Insid	5454	0.684	3.028	0.000	0.000	0.001	0.026	57.584
Instit	5454	52.819	17.774	0.000	40.645	53.269	65.493	124.954
Size	5454	23.004	1.346	21.793	22.060	22.895	23.804	28.636
Lev	5454	49.673	20.657	26.541	33.810	50.438	64.943	326.190
Roa	5454	2.889	5.027	-73.717	0.903	2.509	4.825	47.733
MB	5454	0.629	0.448	-1.434	0.316	0.522	0.844	5.609
Vol	5454	45.790	15.703	0.000	33.885	43.629	56.892	177.549
Tang	5454	38.237	22.556	-201.339	22.935	36.935	54.603	96.984
Liq	5454	636.360	608.970	0.000	223.670	437.340	829.830	5042.872
Hi_index	5454	0.008	0.032	-0.016	0.000	0.001	0.004	1.244

Panel C Descriptive Statistics of Non-state-owned Firms Subsample

Variable	N	Mean	Std	Min	P25	Median	P75	Max
Def	9420	0.024	0.032	0.000	0.002	0.011	0.032	0.631
Lnboard	9420	2.092	0.194	1.386	1.946	2.197	2.197	2.833
Ind	9420	0.377	0.054	0.143	0.333	0.364	0.429	0.667
Duality	9420	0.320	0.467	0.000	0.000	0.000	1.000	1.000
Insid	9420	14.712	17.459	0.000	0.200	5.929	27.245	83.002
Instit	9420	35.444	22.288	0.000	17.050	34.380	51.644	326.727
Size	9420	22.251	1.151	20.734	21.509	22.147	22.857	28.257
Lev	9420	40.607	19.331	0.836	25.051	39.951	54.389	154.828
Roa	9420	3.179	8.370	-185.842	1.139	3.323	6.440	81.513
MB	9420	0.422	0.307	-1.430	0.210	0.348	0.552	3.302
Vol	9420	51.554	29.617	0.000	38.453	48.363	62.235	1443.365
Tang	9420	44.573	21.817	-83.950	30.342	43.817	59.745	97.049
Liq	9420	779.640	706.810	0.000	282.780	547.160	934.195	5057.462
Hi_index	9420	0.005	0.029	-0.004	0.000	0.000	0.001	0.973

Table 3 Correlation Matrix of Variables

Panel A shows the Pearson correlation matrix of variables in the full sample, Panel B and Panel C show the Pearson correlation matrix of variables in the state-owned firms and non-state-owned firms subsample respectively. Def is the default probability. Lnboard is the nature logarithm of board size. Ind is the board independence measured by the percentage of independent directors for the firm. Duality is a dummy variable that equals to one if CEO and chairman are the same person and zero otherwise. Insid is the proportion of stock held by insiders. Instit is the percentage of stock held by institutions. Size is the market capitalization with daily frequency. Lev is the leverage defined as the firm's debt to asset ratio. Roa is the return on assets. MB is the market to book ratio. Vol is the stock return volatility. Tang is the asset tangibility. Liq is the liquidity. Hi_index is the Herfindahl–Hirschman index of institutional ownership.

Panel A Pearson correlation matrix of Full Sample

	Lndef	Lnboard	Ind	Duality	Insid	Instit	Size	Lev	Roa	MB	Vol	Tang	Liq	Hi_index
Lndef	1													
Lnboard	-0.1189*	1												
Ind	0.0066	-0.5515*	1											
Duality	0.0701*	-0.1949*	0.1317*	1										
Insid	0.1478*	-0.1719*	0.0648*	0.2259*	1									
Instit	-0.1978*	0.2163*	-0.0590*	-0.1930*	-0.5466*	1								
Size	-0.3936*	0.2582*	-0.0092	-0.1476*	-0.2550*	0.4247*	1							
Lev	-0.2159*	0.1207*	-0.0024	-0.0939*	-0.2469*	0.1742*	0.4854*	1						
Roa	-0.0014	0.0548*	-0.0244*	0.0065	0.0635*	0.1381*	0.0823*	-0.2730*	1					
MB	-0.4804*	0.1406*	-0.015	-0.1382*	-0.2138*	0.1843*	0.5619*	0.2177*	-0.0842*	1				
Vol	0.3225*	-0.0753*	0.0142	0.0716*	0.1078*	-0.1213*	-0.2028*	-0.0122	-0.0493*	-0.2871*	1			
Tang	0.1985*	-0.1102*	0.0072	0.0680*	0.1602*	-0.1296*	-0.4477*	-0.8406*	0.2634*	-0.2049*	0.0018	1		
Liq	0.0489*	-0.0681*	0.0135	0.0441*	0.1729*	-0.0815*	-0.1144*	-0.0726*	-0.0286*	-0.0827*	0.0749*	0.0344*	1	
Hi_index	-0.0806*	0.0564*	0.0230*	-0.0321*	-0.0041	0.0916*	0.1661*	0.0237*	0.0174	0.0769*	-0.0242*	-0.0831*	0.0250*	1

Panel B Pearson correlation matrix of State-owned Firms Subsample

	Lndef	Lnboard	Ind	Duality	Insid	Instit	Size	Lev	Roa	MB	Vol	Tang	Liq	Hi_index
Lndef	1													
Lnboard	-0.0509*	1												
Ind	-0.0525	-0.4268*	1											
Duality	0.0001*	-0.1036*	0.0822*	1										
Insid	0.0473*	-0.0046*	-0.0601*	0.0466*	1									
Instit	-0.1291*	0.1003*	0.0939*	-0.0801*	-0.1884*	1								
Size	-0.2550*	0.1806*	0.1599	-0.0566*	-0.1053*	0.4261*	1							
Lev	-0.0611*	0.0504*	0.0725*	-0.0041*	-0.0837*	0.0075*	0.4293*	1						
Roa	-0.0418	0.0426*	-0.0234	-0.0141	0.0125*	0.1748*	0.0312*	-0.4024*	1					
MB	-0.3786*	0.0649*	0.0813*	-0.0387*	-0.1042*	0.1780*	0.5673*	0.1945*	-0.0632*	1				
Vol	0.5847*	-0.0850*	-0.0387	0.0071*	0.0752*	-0.1902*	-0.2854*	0.0362	-0.1167*	-0.4252*	1			
Tang	0.0827*	-0.0728*	-0.0507*	0.0223*	0.0513*	-0.0344*	-0.4271*	-0.8756*	0.3722*	-0.2410*	-0.0049	1		
Liq	0.0314*	-0.0038*	-0.0360	-0.0278*	0.0126*	-0.0316*	-0.0657*	-0.0130*	-0.0039*	-0.0514*	0.0207*	0.0026*	1	
Hi_index	-0.0173*	0.0755*	0.0308*	-0.0177*	-0.0237	0.1454*	0.2021*	0.0020*	0.0078	0.1036*	-0.0458*	-0.0773*	-0.0193*	1

Panel C Pearson correlation matrix of Non-state-owned Firms Subsample

	Lndef	Lnboard	Ind	Duality	Insid	Instit	Size	Lev	Roa	MB	Vol	Tang	Liq	Hi_index
Lndef	1													
Lnboard	-0.0386*	1												
Ind	0.0241	-0.6376*	1											
Duality	0.0524*	-0.1534*	0.1466*	1										
Insid	0.1648*	-0.0899*	0.0761*	0.1363*	1									
Instit	-0.1500*	0.1373	-0.0929*	-0.1017*	-0.5306*	1								
Size	-0.2623*	0.1929*	-0.0848*	-0.0952	-0.2273*	0.3340*	1							
Lev	-0.1287*	0.0837*	-0.0252	-0.0561*	-0.2214	0.1507*	0.4421*	1						
Roa	0.0492	0.0540*	-0.0224*	0.0174	0.0886*	0.1138	0.0769*	-0.2802*	1					
MB	-0.3717*	0.0986*	-0.0603*	-0.1006*	-0.1747*	0.0765*	0.4764*	0.1587*	-0.1054*	1				
Vol	0.5509*	-0.0416	0.0233*	0.0582*	0.1181	-0.1230*	-0.2090	-0.0494*	-0.0075*	-0.2937*	1			
Tang	0.1406*	-0.0635*	0.0151	0.0333*	0.1630*	-0.1134*	-0.3907*	-0.8258*	0.2729	-0.1394*	0.0475	1		
Liq	-0.0296*	-0.0447*	0.0138*	0.0039	0.0086*	-0.0103	-0.0168*	-0.0087*	-0.0664*	-0.0085*	0.0076*	-0.0322*	1	
Hi_index	0.0036*	0.0258*	0.0126*	-0.0200*	0.0093*	0.0307*	0.1086*	0.0361*	0.0259*	0.0044*	-0.0096*	-0.0797*	0.0328*	1

Table 4 Regression Results - Full Sample

This table presents the OLS regression results of full sample includes 4354 state-owned firms and 6684 non-state-owned firms that have accounting, market, and governance data available. Results are presented for the period from 2015 to 2020. The dependent variable is Ln(def/1-def), where def is the default probability obtained using KMV model. The last two rows present the number of observations and the adjusted R-squared for regression. ***, **, and * denote statistical significance at the 1, 5 and 10 percent level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lnboard	-1.060**	0.786									-1.578***	-0.0469
	(-2.330)	(1.374)									(-2.833)	(-0.0634)
Lnboard*SOE		-4.829***										-4.075***
		(-5.141)										(-3.652)
Ind			-0.462	-2.177**							-1.883**	-2.08
			(-0.604)	(-2.183)							(-2.027)	(-1.623)
Ind*SOE				4.036***								1.646
				(2.579)								(0.888)
Duality					-0.193*	-0.167					-0.307***	-0.148
					(-1.893)	(-1.436)					(-2.931)	(-1.250)
Duality*SOE						-0.4						-0.718***
						(-1.513)						(-2.693)
Instit							-0.0166***	-0.00982***			-0.0205***	-0.0127***
							(-7.847)	(-3.855)			(-8.077)	(-4.137)
Instit*SOE								-0.0266***				-0.0233***
								(-5.832)				(-4.761)
Insid									0.0315***	0.0282***	0.00558	0.0139
									(3.699)	(2.998)	(0.607)	(1.378)
Insid2									-0.000627***	-0.000576***	-0.000365**	-0.000423**
									(-3.553)	(-3.087)	(-2.034)	(-2.238)
Insid*SOE										0.0227		0.00801
										(0.391)		(-0.137)
Insid2*SOE										-0.000402		-0.000302
										(-0.156)		(0.118)
SOE		3.562***		-1.662***		-0.156		1.341***		-0.0779		3.782***
		(4.927)		(-2.819)		(-1.542)		(5.643)		(-0.720)		(2.801)
Size	-0.392***	-0.381***	-0.411***	-0.412***	-0.415***	-0.409***	-0.281***	-0.246***	-0.408***	-0.406***	-0.244***	-0.220***
	(-7.989)	(-7.753)	(-8.474)	(-8.453)	(-8.562)	(-8.401)	(-5.493)	(-4.792)	(-8.389)	(-8.345)	(-4.670)	(-4.209)
Lev	-0.0265***	-0.0265***	-0.0265***	-0.0256***	-0.0269***	-0.0254***	-0.0251***	-0.0279***	-0.0241***	-0.0239***	-0.0267***	-0.0282***
	(-6.578)	(-6.502)	(-6.579)	(-6.299)	(-6.659)	(-6.247)	(-6.248)	(-6.840)	(-5.868)	(-5.804)	(-6.490)	(-6.839)
Roa	-0.0233***	-0.0244***	-0.0239***	-0.0238***	-0.0238***	-0.0238***	-0.0194***	-0.0209***	-0.0226***	-0.0226***	-0.0165**	-0.0195***
	(-3.610)	(-3.778)	(-3.691)	(-3.687)	(-3.678)	(-3.679)	(-2.996)	(-3.235)	(-3.493)	(-3.498)	(-2.545)	(-3.000)
MB	-5.702***	-5.677***	-5.707***	-5.673***	-5.725***	-5.675***	-5.778***	-5.780***	-5.656***	-5.638***	-5.848***	-5.820***
	(-37.33)	(-36.77)	(-37.34)	(-36.70)	(-37.39)	(-36.70)	(-37.85)	(-37.31)	(-36.85)	(-36.35)	(-37.85)	(-37.28)
Vol	0.0283***	0.0281***	0.0285***	0.0283***	0.0286***	0.0284***	0.0276***	0.0278***	0.0284***	0.0283***	0.0277***	0.0276***
	(14.89)	(14.76)	(14.99)	(14.86)	(15.05)	(14.9)	(14.53)	(14.62)	(14.9)	(14.86)	(14.6)	(14.55)
Tang	0.00128	0.00144	0.00134	0.00176	0.00112	0.00196	0.003	0.0024	0.00305	0.00318	0.00272	0.00259
	(0.362)	(0.404)	(0.377)	(0.494)	(0.316)	(0.552)	(0.847)	(0.676)	(0.852)	(0.887)	(0.761)	(0.725)
Liq	-0.0000919	-0.0000885	-0.000086	-0.0000914	-0.0000838	-0.0000942	-0.000102	-0.0000842	-0.0000968	-0.0000979	-0.000075	-0.0000719
	(-1.452)	(-1.397)	(-1.358)	(-1.442)	(-1.323)	(-1.486)	(-1.609)	(-1.332)	(-1.516)	(-1.533)	(-1.176)	(-1.129)
Hi index	-5.932***	-5.695***	-5.954***	-5.871***	-6.014***	-5.945***	-5.662***	-5.226***	-5.892***	-5.867***	-5.365***	-4.899***
	(-4.100)	(-3.939)	(-4.114)	(-4.056)	(-4.157)	(-4.109)	(-3.923)	(-3.620)	(-4.073)	(-4.054)	(-3.716)	(-3.396)
Constant	7.749***	6.191***	7.520***	8.208***	7.517***	7.348***	5.084***	4.171***	7.028***	7.024***	6.558***	4.633***
	(7.036)	(5.432)	(6.700)	(7.020)	(6.885)	(6.716)	(4.526)	(3.682)	(6.388)	(6.382)	(5.345)	(3.266)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Observations	11023	11023	11023	11023	11023	11023	11023	11023	11023	11023	11023	11023
Adj. R-squared	0.376	0.377	0.375	0.376	0.376	0.376	0.379	0.381	0.376	0.376	0.381	0.384

Table 5 Regression Results - One-to-one Matched Sample

This table presents the OLS regression results for one-to-one matched sample. Results are presented for the period from 2015 to 2020. Our sample includes 4337 state-owned firms and matched 4337 non-state-owned firms that have accounting, market, and governance data available. The dependent variable is Ln(def/1-def), where def is the default probability obtained using KMV model. For each state-owned firm, we use propensity score matching method to find one non-state-owned firm that is in the same fiscal year and has the closest propensity score based on firm size and market to book ratio. The last two rows present the number of observations and the adjusted R-squared for regression. ***, **, and * denote statistical significance at the 1, 5 and 10 percent level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lnboard	-0.625	1.401**									-1.076*	0.341
	(-1.192)	(1.979)									(-1.698)	(0.374)
Lnboard*SOE		-4.303***										-3.134**
		(-4.108)										(-2.492)
Ind			-0.661	-3.152**							-1.418	-2.451
			(-0.752)	(-2.540)							(-1.348)	(-1.543)
Ind*SOE				4.895***								2.746
				(2.779)								(1.302)
Duality					-0.243**	-0.216					-0.322**	-0.145
					(-1.984)	(-1.468)					(-2.543)	(-0.969)
Duality*SOE						-0.324						-0.637**
						(-1.131)						(-2.199)
Instit							-0.0140***	-0.00568*			-0.0187***	-0.00983***
							(-5.667)	(-1.812)			(-6.398)	(-2.608)
Instit*SOE								-0.0251***				-0.0215***
								(-5.025)				(-3.945)
Insid									0.0286***	0.0235*	0.00412	0.0121
									(2.618)	(1.897)	(0.352)	(0.913)
Insid2									-0.000684***	-0.000610**	-0.000417*	-0.000467*
									(-2.870)	(-2.390)	(-1.722)	(-1.805)
Insid*SOE										0.0172		0.0451
										(-0.284)		(-0.737)
Insid2*SOE										-0.00134		-0.00198
										(0.502)		(0.742)
SOE		3.156***		-1.964***		-0.15		1.236***		-0.113		2.489
		(3.927)		(-2.958)		(-1.349)		(4.799)		(-0.932)		(1.623)
Size	-0.271***	-0.264***	-0.280***	-0.286***	-0.285***	-0.283***	-0.173***	-0.141**	-0.283***	-0.282***	-0.138**	-0.121**
	(-4.859)	(-4.734)	(-5.075)	(-5.175)	(-5.177)	(-5.125)	(-2.983)	(-2.410)	(-5.130)	(-5.108)	(-2.325)	(-2.035)
Lev	-0.0325***	-0.0327***	-0.0323***	-0.0318***	-0.0325***	-0.0316***	-0.0322***	-0.0347***	-0.0312***	-0.0312***	-0.0338***	-0.0352***
	(-6.441)	(-6.453)	(-6.390)	(-6.280)	(-6.436)	(-6.245)	(-6.401)	(-6.857)	(-6.120)	(-6.118)	(-6.612)	(-6.882)
Roa	-0.00657	-0.00768	-0.00691	-0.00694	-0.00677	-0.00686	-0.00351	-0.00484	-0.00526	-0.00523	-0.000328	-0.00303
	(-0.818)	(-0.958)	(-0.861)	(-0.865)	(-0.844)	(-0.855)	(-0.437)	(-0.603)	(-0.653)	(-0.650)	(-0.0407)	(-0.376)
MB	-5.167***	-5.150***	-5.167***	-5.144***	-5.185***	-5.146***	-5.241***	-5.237***	-5.133***	-5.117***	-5.318***	-5.288***
	(-30.64)	(-30.31)	(-30.63)	(-30.28)	(-30.70)	(-30.27)	(-31.03)	(-30.66)	(-30.32)	(-30.00)	(-31.11)	(-30.70)
Vol	0.114***	0.114***	0.115***	0.114***	0.115***	0.114***	0.113***	0.113***	0.115***	0.115***	0.113***	0.112***
	(26.69)	(26.47)	(26.83)	(26.64)	(26.88)	(26.68)	(26.27)	(26.32)	(26.75)	(26.7)	(26.37)	(26.16)
Tang	0.0066	0.00657	0.00688	0.00702	0.00672	0.00718	0.00753*	0.00701	0.00782*	0.00775*	0.00728	0.00706
	(1.464)	(1.458)	(1.526)	(1.556)	(1.491)	(1.593)	(1.674)	(1.559)	(1.725)	(1.708)	(1.609)	(1.561)
Liq	-0.0000517	-0.0000485	-0.0000494	-0.0000513	-0.0000485	-0.0000554	-0.0000533	-0.0000389	-0.0000468	-0.000046	-0.0000268	-0.0000243
	(-0.662)	(-0.620)	(-0.631)	(-0.656)	(-0.620)	(-0.708)	(-0.683)	(-0.499)	(-0.596)	(-0.585)	(-0.341)	(-0.310)
Hi index	-6.242***	-6.070***	-6.242***	-6.199***	-6.313***	-6.270***	-6.070***	-5.641***	-6.119***	-6.093***	-5.761***	-5.345***
	(-3.934)	(-3.827)	(-3.933)	(-3.907)	(-3.979)	(-3.952)	(-3.832)	(-3.559)	(-3.855)	(-3.838)	(-3.634)	(-3.374)
Constant	-0.154	-1.702	-0.233	0.917	-0.296	-0.299	-2.125	-3.073**	-0.522	-0.465	-1.152	-2.516
	(-0.115)	(-1.232)	(-0.174)	-0.654	(-0.225)	(-0.228)	(-1.581)	(-2.265)	(-0.395)	(-0.352)	(-0.791)	(-1.458)
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Observations	8674	8674	8674	8674	8674	8674	8674	8674	8674	8674	8674	8674
Adj. R-squared	0.410	0.411	0.410	0.411	0.410	0.410	0.412	0.414	0.410	0.410	0.414	0.416

Table 6 Robustness Test

This table includes complexity as additional control variable and investigate its impact on the relation between board size and default probability. Complexity is a dummy variable that equals to one if a firm's leverage ratio is greater than the median of our sample, as one of the measures used by Coles et al. (2008) paper to measure a firm's complexity. We also include all the control variables, year and industry fixed effects as applicable but not reported for brevity.

	(1)	(2)	(3)
Lnboard	0.316	1.622**	0.755
	(0.499)	(2.358)	(1.317)
Lnboard*Complexity	-2.809***	-2.057**	
	(-3.176)	(-2.281)	
Complexity	2.402***	1.845***	0.296**
	(3.556)	(2.676)	(2.482)
LnBoard*SOE		-4.109***	-4.551***
		(-4.279)	(-4.838)
SOE		2.904***	3.244***
		(3.931)	(4.483)