Financial distress prevention in China:

Does gender of board of directors matter?[☆]

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Abstract

This paper examines the impact of diversity in board members of firms on financial distress risk in China from 2005 to 2015. Using data from CSMAR database, the research finds that firms with women directors will decrease their distress risk by one forth. Such firms enjoy access to bank loans with larger size, from more banks and at higher frequencies to resist funding risk, which implies stronger financing ability and confirms gender diversity effect. Furthermore, firms with female directors show remarkably different behavior in investment, which would significantly influence insolvency status and is consistent with male-overconfidence theory in gender. Finally, firms controlled by with-female-board reduce risk by exerting tighter internal governance, reducing agency cost and restricting the behaviors of large shareholders' tunneling. The paper indicates that the female directors' impact on firm financial distress is mainly exerted both through liquidity channels and strategic channels. The results are robust under difference-in-difference method after exogenous matching and instrument variable approach. As governments growingly contemplate board gender diversity policies, our study provides further evidences to Chinese government on this issue.

Keywords: female, board of directors, financial distress, diversity
JEL: B54, G32, G33

1. Introduction

Financial distress often occurs when a firm experiences serious loss or becomes insolvent with liabilities that are overwhelming to its assets. Corporate distress induces substantial costs to the business community such as court costs, lawyer costs, lost sales, lost profits, higher costs of credit, inability to issue new securities and lost investment abilities(e.g., Bris, Welch, & Zhu, 2006; Elkamhi, Ericsson, & Parsons, 2012; Bhattacharjee and Han, 2014).

Therefore, it is worthwhile to investigate how to prevent financial distress. The previous literature on financial distress revealed that corporate distress may result from one or a combination of internal and external factors. For instance, managerial errors are due to lack of experience, risk seeking behavior, weak commitment to company efficiency, refusal of distress to adjust managerial and operational structures of the firm to new realities, inefficient or inappropriate corporate policies,

economic climate, changes in legislation, and industry decline.

Little is known, however, about the board of directors' ex ante behavior behind the event of financial distress. In particular, do board of directors with and without female members behave the same? According to psychological research, in general men are overconfident relative to women. Overconfidence in investment field implies that women may undertake fewer external projects, or more generally make fewer significant risky decisions, than men, holding other factors constant. Therefore, with women participation is likely to mitigate agency conflicts and elevate firm value.

Based on that hypothesis, the study is aimed to empirically examine whether the existence of female members of board of directors lowers the possibility of corporate financial distress by restricting firm's behavior on less risky conducts. In addition, do firms' behaviors such as financing strategy, investment policy and corporate governance differ when a company employs female directors, and will these behavior differences indeed effectively reduce firms' distress risk? The research will employ data of gender difference in members of board of director in China from CSMAR database to illustrate the issue.

To our knowledge, this is one of the first papers to study gender differences in the financial distress setting[1]. Gender has been examined in other business settings, including stock trading behavior (Barber and Odean, 2001), start-up firms (Verheul and Thurik, 2001), the bank industry (Pathan and Faff, 2013). Adams and Ferreira (2009) and Liu et al (2014) also explore the impact of female board members on firm governance and stock performance. This research differs from previous literature as this paper focuses on gender effect on corporate financial distress, by employing sample of firms in a developing economy of mainland China.

The remainder of this paper will be organized as follows. I make literature review in section 2. Section 3 develops hypotheses. Section 4 describes our methodology. Section 5 reports main empirical results. Section 6 presents discussion on potential channels. And section 7 concludes the paper.

2. Literature review

This paper is aimed to examine gender effect of board of directors on financial distress event, thus the literature review section will be developed into three parts: gender diversity in management, factor related to financial distress.

2.1 Gender diversity in management

In recent years there has been a resurgence of focus on women in management roles, perhaps due to the fact that women have made considerable advances. Work on gender is often in the context of diversity research.

Diversity theory (Wiersema and bantel, 1992) points that diversity brings to outcomes better than monism. As for counsel and advice, increasing the number of female top managers is a method to broaden the range of cognitive perspectives as a firm's disposal, to recognize strategic opportunities, to find alternatives, and to understand market changes. In terms of legality theory, firms gain legitimacy by conforming to social norms and rules. Scott(2008) comes up with the hypothesis that firms are more likely to create goodwill and obtain external investors' approval if appointing more female employees to their work group, as gender equality has gradually become mainstream. Therefore, having top managers with various outlooks and interpretations is critical to handling complex environments, access resources both within and outside the organization so as to bump up firms' profitability (Yu et al, 2014).

Furthermore, increased gender diversity in top management roles has been shown to enhance monitoring process and may be a mechanism for stronger corporate governance control. Atkinson, Stanley, Baird, & Frye (2003) support this view,

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[1] Sila, Gonzalez and Hagendorff (2015) is the first paper to discuss the relationship between female diversity and firm risk. However, the article has a few limitations. It only depicts the firm's price volatility risk in stock market, failing to capture the fundamental distress risk from the perspective of company's real performance. As financial distress is of great importance to listed companies, interested stakeholders and even the economy of a country(Wanke, Azad & Barros, 2016; Gao, Parsons & Shen, 2018), we think it necessary to study gender setting impact on the financial distress risk.

with female managers achieving comparable performance to male managers despite adopting different risk strategies. Research also has found that gender diversity of senior managers is associated with higher earnings quality and higher stock returns after the IPO process (Krishnan and Parsons, 2008; Srinidhi et al, 2011; Wilson, Wright & Altanlar, 2014;Arun, Almahrog & Aribi, 2015; Belot and Serve,2018).

Another reason for gender diversity to make a better firm lies in that men and women have their own weaknesses. As psychological research demonstrates, men are more overconfident than women and women are more risk conservative than men. Recently, there is increasing studies that test this remarkable behavioral difference in areas such as corporate finance. Huang and Kisgen (2013) have systematically proved that men are more overconfident in corporate acquisitions conducts, debt issues and earnings estimates, Ho et al,(2015) testify that women are more accounting conservative and cautious. Thus, it seems that the so-called "conservative" females and the overconfident male board members could complement each other..

In sum, literature on gender diversity mostly study the female's influence on one side such as firms' investment decision, profitability enhancement, accounting quality or corporate governance. It hardly takes from a holistic perspective to examine the impact of gender on firms' whole lifespan, i.e, a more fundamental question that whether gender diversity directly prevent the death of the firms.

2.2 Factors related to financial distress

There has been an increasing volume of studies to verify the factors affecting corporate distress. Since financial distress is costly, numerous papers attempt to dig out the causes and figure out a way to prevent financial distress.

A direct cause of corporate distress is the inability of a company to meet debt obligations. Like z-score index put forward by Altman (1968, 1983, 2017), change in net cash/total liabilities and working capital /total assets are all surrogates for solvency. Equally, the no credit-interval has been used by Taffler (1983) as a powerful indicator of short-term liquidity, in the more general form of working capital/operating expenses.

Poor management, which is another factor related to financial distress, will results in indecision, distortion in the allocation of resources and distress to integrate and achieve corporate goals. In such a situation, operational costs increase and raising capital for future investment opportunities becomes difficult, leading to a decline in profits. Two ratios that reflect this are retained earnings/total assets and profit after tax/total asset (Lin and Piesse, 2004; Darrat et al., 2016).

Financial distress costs are non-trivial, suggesting that an optimal capital structure exists where the benefits of debt financing trade off these potential costs as the increased borrowings lead to an increase in the risk of financial distress (Altman, 1984; Stiglitz, 1972; Zavgren, 1985; Berk, Stanton & Zechner, 2010; Antill & Grenadier, 2019). Capital structure in the form of gearing ratios are used extensively as a measure of corporate risk as well (Frecka & Hopwood, 1983; Zmijewski, 1984; Chiaramonte & Casu, 2017).

Adverse economic effects have impacts on enterprise operating condition as well. Changes in the economic performance affecting an industry overall can result from various causes, for example, operational difficulties, technological change or changes in consumer tastes and preferences, all of which are exogenous to the firm. Wanke, Azad & Barros (2016) also have investigated the effects of external change of banking system on firms' financial distress risk.

Existing research has interpreted risk from financial aspect, managerial aspect and macro economy aspect. =However, the corporate financial distress risk in perspective of people's characteristics is an under-researched field, but it counts. For instance, few would doubt that Apple will be the same company if someone other than Steve Jobs had been chief executive officer(CEO), or that Alibaba would be the same if not led by Jack Ma. Examing the executive heterogeneity between the all-male directed and with female directed firms in terms of risk control would deepen the understanding of corporate financial distress problems.

To fill in the gaps in existing research, this paper studies the impact of the presence of women in the board of directors on reducing firms' financial distress risk in China. This research has contributed to literature in three aspects. Firstly, it is one of the first papers to fill in the blank of gender influence research in the financial distress setting, revealing the role of managers'

gender factor beyond the macro and corporate financial factors that have been revealed in a flood of financial distress literature. Secondly, it uncovers that gender factors reduce financial distress risk through four channels: cash flow promotion, debt management, investment strategy change and more strict governance. Thirdly, it creatively discovers that there seems to be an optimal gender ratio in the board of directors which means it's not the full proportion of women the better. In turn, it confirms the theory of pluralism.

3. Hypothesis development

This section develops hypotheses to explore gender effects on corporate financial distress problems, and to discover the channel of gender impact. Previous finance and psychology literature finds that men are overconfident relative to women (J. Huang and D.J. Kisgen, 2014). Wiersema & bantel (1992) argue that increasing number of women in top managers is one method to broaden the range of cognitive perspectives as a firm's disposal. Based on these two main theories, we develop the following hypothesis on the existence of diversity effect in the corporate financial distress issues.

To disclose overconfidence impact on firms' distress, we set up a dummy as indicator of gender diversity, showing the existence of female on the board or at positions of core power. We focus on directors because CEOs are always sole for each firm. Focusing on board of director team provides an environment for diversity experiments while still examining executives who have meaningful impacts on firm financing and operation activities. Besides, as the 46th Article of the Chinese Company Law says that it is the board of directors that decide on financial budget, investment plan and even the appointment of senior executives(CEO, CFO⋯), we believe it is more essential to study the impact of gender diversity of board of directors rather than senior executives on firms performance.

Hypothesis 1: **Existence of female directors reduces the possibility of corporate financial distress**

It is reported that women are relatively more risk averse than men, which implies women tend to reduce firm's risk level if the female are in the board and have opportunities to express different views on corporate issues such as debt structure, investment decisions, operational management and so on which will broaden the board's recognition on a particular issue and exert impact on the comprehensive decisions of the board. The diversity effect is expected to change the corporate behavior, and make firms healthier especially in terms of risk control

We also want to emphasize that it is the existence of female directors[2] rather than the female leading advantage in participation ratio in board membership that matters in reducing the possibility of corporate financial distress. The diversity indicates the optimal choice is gender balance in board. Therefore, there should be a threshold where if female ratio is higher than that, the female directors' positive effect will disappear or even reverse.

Hypothesis 2: **After the appearance of female director, at least one of cash shortage, debt overhang, aggressive investment and poor management sides are improved.**

According to literature on financial distress, the main reasons why a firm goes financial distress can be shortage of cash to repay debt obligation due, excessive external expansion, and poor management (Lin and Piesse, 2004; Berk, Stanton & Zechner, 2010; Darrat et al., 2016; Altman, 2017). If H1 hypothesis holds, there should be at least one channel improvement explaining risk reduction.

For instance, bondholders can call a lawsuit and force a firm to go liquidation if their debt can't be repaid on time. Misbehavior in management such as connected transaction, perks and corruption will certainly destroy enterprise value and push firms to the edge of financial distress in extreme cases. Moreover, excessive external expansion beyond enterprises' capacity is another common reason which triggers the sudden death of firms. This paper expects to find that women can substantially reduce the risk of financial distress by avoiding these situations.

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[2] Few boards of listed companies are composed entirely of women in reality, so we choose to compare the situation in which boards are entirely made up of male directors with that in which there are female directors.

4. Data and Methodology

4.1 data

Chinese Securities Market and Accounting Research (CSMAR) database is used for the analysis during 2006-2015. All A-market listed firms are included with the exception of data missing firms. The data for firm performance is obtained from CSMAR Financial Index Database and consists of 21,420 firm-yearly observations, which equals to 2,825 firms. For explained variable measure, ST is often used as a symbol of financial distress in several studies related to Chinese companies (Bailey, Huang, & Yang, 2011; Geng, Bose & Xi, 2015; **Altman etc., 2017**; Du and Lai, 2018; Jiang and Jones, 2018).

4.2 baseline analysis

For control variables, to rule out other factors that may influence financial distress risk, the paper includes a bunch of control variables in regression. First, we control firm financial characteristics by using variables such as *size, leverage*, and *StdEPS* et al. which have been proven to affect firm risk (Chandra et al., 2002; Rekker, Benson & Faff, 2014; Perryman, Fernando & Tripathy, 2016). Besides, *shrcr1, manashratio, boardindep and duality* variables are added to control board of directors' characteristics (variable definitions are shown in Appendix).

$$ST_{i,t+1} = \alpha_0 + \beta_1 \times Femaledum_{it} + \beta_2 \times Size_{it} + \beta_3 \times leverage_{it} + \beta_4 \times lnAge_{it} + \beta_5 \times StdEPS_{it} + \cdots + \theta$$
$$\times \text{BoD characteristics}_{it} + industry\ and\ year\ dummies + \varepsilon_{it}$$

4.3 Instrument variable

The gender of an executive could be considered as random as the color of the executive's hair or whether an executive's first name begins with the letter J or M. However, large shareholders might discriminate based on gender. For example, female directors are more highly represented at consumer products firms (Huang and Kisgen, 2013). If consumer products firms also grow more slowly, a spurious inference could be made.

Thus, to mitigate these issues, this study conducts one additional set of tests using an instrumental variable approach. The instrument we use for a firm having a female executive is based on a previous study that calibrates a province's level of gender economic status equality in China. Yongping Jiang (2006) evaluate the 31 China's provinces and assign each of them a score for its gender economic status equality. The score is out of 100, with scores ranging from 58.86 (Anhui province) to 76.34 (Xinjiang province), and a median score of 66.97 (Shandong province). While this variable is plausibly correlated with the decision to hire a female director, it is unlikely that this variable would affect the outcome variables other than through its indirect effect on the gender of the directors. For example, the gender equality friendliness of a province should not affect the business financial distress. Thus, this instrument reasonably meets the exclusion restriction.

We conjecture that the more friendly a province is to women's equality generally, the more likely a firm located in that province is to have a female director. We assign the province-level gender economic status equality value to each firm based on the firm's registration place, with higher values indicating more favorable gender economic equality.

Specifically, we estimate the following 2SLS model:

First stage: $Female_i = \varphi + \tau_t + \gamma Gender\ Equality_i + \theta X_{it} + \rho_{it}$

Second stage: $Y_{i,t+1} = \alpha + \tau_t + \beta Instrumented\ Female_i + X_{it} + \varepsilon_{it}$

4.4 Difference-in-differences approach

To rule out the concerns that the gender effect is purely resulted from director transition rather than female directors' participation, we specify two kinds of board of directors (BoD) transitions. One is non-female composition BoD transfer to with-female BoD, the other is non-female composition BoD transfer to still non-female BoD. In empirical design, we are aimed to contrast pre and post transition performance differences by these two groups.

$$ST_{i,t} = \alpha_0 + \beta_1 \times Post_{it} + \beta_2 \times Transfer_i \times Post_{it} + \varphi \times controller_{i,t-1} + \text{industry and year dummies} + \varepsilon_{it}$$

$Transfer_i$ is an indicator variable for whether firm i is a non-female composition BoD transfer to with-female BoD firm observation, $Post_{it}$ is an indicator variable for whether year t is after the BoD transition.

However, one may still wonder whether there already exists firm behavior difference between two groups or not. In other words, what if it is some other characteristics that endogenously determine the involvement of female director rather than a random appearance of female director in the transition. To mitigate the doubt that the two groups have significant difference in probability of hiring a female director before transition, this paper uses 1:5 propensity score match (PSM) process to ensure parallel trend before transition. In case of that, the possibility of a female director arising is equal between two groups, it is only a random event that treat group does employ a female director and control group not.

5. Empirical Results

Summary statistics for the sample are shown in Table 1. As panel A reports, the average gender diversity of this sample is 0.145, which indicates women directors account for almost 1/8 proportion in board of directors in Chinese public firms. The probability of distress in the sample is 3.5%, with the maximum possibility of 1 and the minimum value of 0. Panel B presents existence of female directors and female ratio in BOD by year. It is gratifying to see that more firms have hired the female as directors recently, with 82.8% of firms in our sample hiring at least one female director in 2015 versus 74.3% of firms in 2006. Meanwhile, the proportion of women in board of directors has risen continuously from 11.7% in 2006 to 16.9% in 2015. It indicates that the female has played a more important role in corporate governance. Panel C show the sum of firms labelled with special treatment by year. The statistics indicates that there are nearly 80 firms faced with financial distress each year. If we take the number of listed firms in year 2015 as reference, the average financial distress risk of firms is around 2.8%.

Table 1: Summary statistics

This table reports summary statistics for characteristics of 21,420 firm year observations that were listed in the Chinese A-share market from 2006 to 2015, all firm characteristics control variables are winsorized at 5%. Variable definition are presented in Appendix.

Panel A: Key variables

Variable	Obs	Mean	Std.Dev	Min	Max
Explanatory variables					
Femaledum	21,228	0.821	0.384	0.000	1.000
Femaleratio	21,228	0.145	0.113	0.000	0.700
Control Firm characteristics					
Size	21,279	21.762	1.205	19.888	24.351
Leverage	21,279	0.464	0.217	0.104	0.853
stdEPS	19,072	0.173	0.162	0.015	0.611
lnAge	19,527	1.989	0.837	0.000	2.944
ROA	21,220	0.039	0.046	-0.070	0.130
PPEratio	21,191	0.236	0.169	0.011	0.596
ownAratio	21,243	0.511	0.231	0.081	0.892
Soe	21,420	0.438	0.496	0.000	1.000
Control BOD characteristic					
shrcr1	21,236	0.358	0.155	0.003	0.900
Manashratio	21,218	0.074	0.163	0.000	0.891
Boardindep	21,053	0.368	0.054	0.091	0.800

Duality	20,727	0.224	0.417	0.000	1.000
Explained variables					
ST	21,420	0.035	0.185	0.000	1.000

Panel B: Existence of female directors and female ratio in BOD by year

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Exist female directors or not										
Exist	1,066	1,163	1,247	1,376	1,709	1,952	2,105	2,167	2,298	2,339
	74.3%	75.1%	77.8%	78.5%	81.1%	83.4%	85.2%	86.2%	87.3%	82.8%
No	369	386	356	376	398	389	365	348	333	486
	25.7%	24.9%	22.2%	21.5%	18.9%	16.6%	14.8%	13.8%	12.7%	17.2%
female ratio in board of directors										
Ratio	11.7%	12.0%	12.3%	13.0%	13.9%	14.7%	15.1%	15.4%	15.8%	16.9%

Panel C: ST firms

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number	80	77	81	83	84	84	82	82	81	80

Next, We conduct ordinary least square (OLS)[3] regression to evaluate whether women directors exert significant influence on corporate financial distress probability quantitatively. Results are reported in Table 2. Averagely speaking, a firm with female directors tends to reduce the financial distress possibility by 0.7%, roughly equal to an over one fourth financial distress risk decrease (average financial distress risk 2.6%) which is remarkable. The results are consistent regardless of controllers.

Table 2: OLS regression of firm distress

The dependent variable is a binary variable that equals one if a firm is identified as ST stock at year t+1, all explanatory variables are in year t. Robust standard errors are reported in parentheses. Superscripts *, **, and *** denote the significance levels of 10%, 5% and 1%, respectively.

	distress_lead1		
	(1)	(2)	(3)
Femaledum	-0.009***	-0.008**	-0.007**
	(0.003)	(0.003)	(0.003)
Size		-0.015***	-0.014***
		(0.002)	(0.002)
leverage		0.093***	0.092***
		(0.030)	(0.029)
stdEPS		0.043***	0.048***
		(0.010)	(0.010)
lnAge		0.015***	0.014***
		(0.002)	(0.002)
ROA		-0.478***	-0.489***
		(0.046)	(0.047)
PPEratio		-0.020*	-0.019*
		(0.010)	(0.011)

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[3] Since Hausman test initially assume that differences in coefficients not systematic, the result chi-square 12.25 with p-value 0.032 indicates that we should reject null hypothesis. That is, fixed effect model is supported.

ownAratio		0.043	0.045*
		(0.027)	(0.026)
Soe		0.002	0.005
		(0.003)	(0.003)
shrcr1			0.001
			(0.010)
Boardindep			0.052
			(0.035)
Manashratio			-0.014
			(0.009)
Duality			0.005
			(0.004)
Constant	0.022***	0.243***	0.215***
	(0.006)	(0.046)	(0.046)
Industry FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	21,176	18,805	18,248
Adj. R-squared	0.004	0.036	0.037

5.2 Endogeneity problems

Since the first step OLS regression unable to prove a causal relationship, we need try another method to address the issue. In consideration of endogeneity, we intends to use an instrumental variable approach and difference-in-differences to rule out any lingering concerns.

As discussed in Section 4.5, the instrument we use for a firm having a female director is based on a previous study that calibrates a province's level of gender economic status equality in year 2004 (Yongping Jiang, 2006). The IV results are shown in Table 3. Column 1 of table 3 report the results from the first-stage regressions with the female dummy as the dependent variable. The coefficient of gender equality (IV) in the first stage is 0.004 which is significant at 1%, suggesting a strong positive relation between province-level gender economic equality and having a female director, gender equality is a valid IV[4]. Columns 2 of Table 3 report the results for the second-stage regressions with special treatment as the dependent variables, the coefficient is -0.070 significantly which verifies that women participation reduce firms' financial distress risk. From column 1 and 2 to column 3 and 4, when we change OLS model to Probit model, the conclusion remains unchanged. This consistent results prove that appointing women in firm's board of directors will significantly reduce firm's financial distress probability by nearly 7%. The robust result from instrumental variable approach reveals that, the conclusion in OLS panel regression holds even after dealing with potential endogeneity problem.

While the identification of instrumental variable strategy largely excludes alternate explanations for our main results, we use a difference-in-differences with propensity score match around board transitions to rule out any additional concerns (Like beforehand self-selection concerns illustrated in Sila et al, 2016). Table 4 presents results. The results are economically and statistically significant. With female transitions reduce about 2% higher probability of financial distress compared with without female transitions, and the result is reliably statistically significant regard of more or less control variables. These results indicate that the female participations change the gender structure of board, broaden top executives' views on corporate

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[4] A valid IV should be not weak and exogenous. For correlation, based on the first stage regression, female ratio is strongly related with gender equality at 1% significance level, so we have confidence to believe this is not a weak IV. For exclusion proof, we did not put in the text because of space limitation. If necessary, please contact the author.

important decisions and more effectively control the distress risk of enterprises.

The results revealed in table 4 are highly in line with our intuition. The net effects filtered by difference-in-differences with propensity score match display that, state-owned firms are less likely to be trapped in distress by 2.1% than nonstate-owned firms (in column 3). If firm leverage increases by 10%, financial distress risk tends to increase by 0.88%. If firm ROA increases by 10%, financial distress risk will decrease by 1.15%. The significance and sign direction meet expectation well.

Table 3: Instrumental variable approach

To save space, we hide the control variable coefficient. Significance on a 10%(*), 5%(**), or 1%(***) are indicated.

	OLS		Probit	
	First stage	Second Stage	First stage	Second Stage
	(1)	(2)	(3)	(4)
Instrumented Female		-0.070***		-2.129***
		(0.027)		(0.763)
Gender equality	0.004***		0.013***	
	(0.001)		(0.002)	
Control	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	18,235	18,235	18,235	18,235
Adj/ Pseudo R^2	0.030	0.036	0.034	0.104

Table 4: Difference-in-difference regressions

Post is an indicator variable for whether year t is after the BoD composition change. Transfer is an indicator variable for whether firm i experiences a non-female composition BoD transfer to with-female BoD. And the control group is a non-female composition BoD transfer to still non-female BoD. Propensity score matching is used to ensure parallel trend before transition. We include t-1, t, t+1, t+2 firm-year observations in the regression. We require the non-female bod state or with-female bod state remain unchanged at least 3 years after transaction. Significance on a 10%(*), 5%(**), or 1%(***) are indicated.

	(1)	(2)
VARIABLES	distress	distress
Post	-0.001	-0.001
	(0.007)	(0.007)
transfer × post	-0.025***	-0.021***
	(0.008)	(0.008)
Firm control	YES	YES
Board control		YES
Industry FE	YES	YES
Year FE	YES	YES
Observations	8,825	8,442
R-squared	0.204	0.214

6. Discussion

In this section, we discuss the reason why the participation of female directors reduces the financial distress risk.

As revealed in literature, financial distress roots in shortage of cash, inability to meet debt obligations, poor in management accounts etc (Lin and Piesse, 2004; Darrat et al., 2016; Altman, 2017). This study will develop a set of tests to investigate the change of cash adequacy, debt obligation, investment spending and governance after a female appearing in firms' board, with an intention to uncover how female directors exert a decrease influence on enterprises' financial distress risk.

6.1 Solvency condition enhancement

In a downturn, "cash is king" is a sentence which has been regarded as a law for Wall Street. Historically, there were tremendous cases that fundamentally healthy enterprises were forced to suffer from financial distress merely due to running out of cash, especially in era of economic recessions. Thus, we first investigate whether female directors joined firms are easier to raise cash from financial market, and then analyze its impact on financial distress risk. If a firm's cash flow can't cover interest, we call it liquidity distress. Following variables definition of Claessens and Feijen (2008), we formally test female directors' impact on leverage structure and financial distress in table 5.

Following Fan and Wong (2005), this research further designs a system of simultaneous equations to tackle the problem of potential endogeneity. The system is comprised of two equations as follows: one model with solvency as dependent variable and the other model with solvency as independent variable on the contrary. The paper applies Three-stage least square (3SLS) method to estimate parameters of the simultaneous equations.

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\begin{cases}
Solvency_{i,t} = \beta_0 + \beta_1 * Femaledum_{i,t} + \sum \beta_j * governance_{i,t} + \sum \beta_k * Control_{i,t} + \varepsilon_{i,t} \\
ST_{i,t+1} = \beta_0 + \beta_2 * Solvency_{i,t} + \sum \beta_m * Instrument_{i,t} + \sum \beta_n * Control_{i,t} + \varepsilon_{i,t}
\end{cases}
$$

The results are reported in table 5. Firms with female directors tend to raise 1 percentage more cash from bank, increases bank leverage by 1.1% and enhance interest coverage ratio by 0.32 times, which afterward sharply reduce firm's probability of financial distress in the next year by roughly 60% (in column 2 and 4). Compared with mean level of 0.203 bank loan ratio, 0.01 ratio increase refers to a nearly 5% huge increase in bank loan amount. Additionally, column (5) and (7) show that compared with all-male-directed firms , there are 0.025 more banks making 0.047 more number of loans to firms with female directors (compared with yearly average of 0.054 banks lending 0.073 loans to firms without female directors). The findings strongly support the hypothesis 2 that the more diverse a board is, the more likely external investors (like banks) lend to firms, confirm the diversity theories stated in section 2.1.

Such micro evidence indicates that external investors (i.e banks) regard female appearance in board as positive signal. With a gender diversified board, firms are perceived as lower risk ones and should be able to make decisions from a more comprehensive perspective which will be wiser and better-informed, operate better and indicate lower distress risk, and thus banks are willing to lend more. Supported by more frequent and more abundant cash supported by banks, firms with female directors are less likely to suffer cash shortage triggered financial distress.

Table 5: Solvency enhancement and impact on distress risk

This table presents results on the cash financed from bond market and commercial banks. To deal with potential endogeneity bias, this paper employs Three-stage least square (3SLS) method which estimate two equations systematically and simultaneously to obtain instrumental variable estimates. *cash_from_loan* is the cash borrowed from bank loans. *Banks_number* refers to the number of banks lending cash loans to a firm. *Loan_times* indicates the number of cash loans banks make to a firm. *bank leverage* is calculated as the sum of short-term debt plus long-term debt divided by total asset, and *interest coverage ratio* is defined as earnings before interest and tax divided by interest. Numbers in parentheses are t-statistics, and significance on a 10%(*), 5%(**), or 1%(***) level is indicated. Column (1)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)

VARIABLES	Cash From Loan	Distress _lead1	Bank leverage	Distress _lead1	Banks number	Distress _lead1	Loan times	Distress _lead1	Interest coverage ratio	Distress _lead1
Femaledum	0.010***		0.011***		0.025***		0.047***		0.320***	
	(0.003)		(0.002)		(0.007)		(0.012)		(0.107)	
Cash from loan		-0.591***								
		(0.212)								
banks_number						-0.260***				
						(0.093)				
loan_times								-0.140***		
								(0.049)		
				-0.524**						
				(0.218)						
										-0.021*
										(0.012)
Board Control	YES		YES		YES		YES		YES	
Risk Control		YES		YES		YES		YES		YES
Firm Control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	17,067	17,067	17,271	17,271	17,303	17,303	17,303	17,303	15,966	15,966
R-squared	0.270	-0.222	0.518	-0.042	0.023	-0.329	0.020	-0.277	0.015	-0.999

6.2 Internal investment concentration

As analyzed in section 6.1, firms with diversified board are easier to borrow money from financial market. The next question is, with more money, how do the firms with female directors spend it? Follow Ulrike Malmendier, & Geoffrey Tate. (2005), we employ a series of investment proxy to capture the difference of firms with women directors and without on internal and external investment behavior.

Table 6 reports the 3SLS test for the full sample of investments. Contrast with firms without female, firms with female directors invest 6% more of profit on capital expenditure, which significantly decrease financial distress risk by -0.6%(6%*-0.115). Besides, alternative measure of internal investment (*invest_internal*) indicates the similar results. Such fixed asset investment as plant, property and equipment (PP&E) purchases enhance the stability of firms and strengthen firms' ability to resist risk.

However, we do not discover any significant behavior differences on external financing. Previous literature (Jekun Huang, 2013; Chen et al, 2016) documents that the male tend to be overconfident relative to female and carry out distinctly more acquisitions, but our testing in column (5) proves not significant. We believe this difference is acceptable since we carefully deal with endogeneity issues by employing stricter 3SLS method rather than more relaxed approach. Besides, our period cover 2007-2016 with more law restrictions of M&A in China, while Jekun Huang's experiment period is early during 1993-2005, Chen et al (2016)'s sample is of U.S.

In total, firms with female directors make 0.3 percentage more investments if standardized by total assets, including both internal and external investments. Compared with 1.1 percentage more cash flow receiving from bond and loans, such expansion is rational and temperate. Beside, such investment in total effectively reduce firms' financial distress risk by 0.5% (0.3%*1.591) which indicates the high quality of investment, too. Besides liquidity channel, this indicate that women directors also reduce firm risk through strategic channels. Women directors exert impact on firm's investment strategies.

Table 6: Internal investment concentration and impact on distress risk

This table presents the female directors' preferences on investment. We classify investment as internal investment and external investment. *Capex_ratio* is capital expenditure divided by profit, *invest_internal* is depreciation plus the net plant, property and equipment difference between this year and previous year standardized by total assets, *invest_external* is the amount of mergers & acquisition standardized by total assets, *MA_times* is the number of mergers & acquisition deals, and *invest_total* is the sum of invest_internal and invest_external. The research uses three-stage least square (3SLS) method to analyze the female's impact on investment and financial distress risk. All variables are winsorized at 5% level.

VARIABLES	(1) capex_ratio	(2) ST_lead1	(3) invest_internal	(4) ST_lead1	(5) invest_external	(6) ST_lead1	(7) MA times	(8) ST_lead1	(9) invest_total	(10) ST_lead1
Femaledum	0.060***		0.001**		-0.003		0.003		0.003***	
	(0.019)		(0.001)		(0.005)		(0.011)		(0.001)	
capex_ratio		-0.115***								
		(0.008)								
invest_internal				-3.680***						
				(0.255)						
invest_external						0.099				
						(0.072)				
MAtimes								0.028		
								(0.032)		
invest_total										-1.591***
										(0.264)
Board control	YES		YES		YES		YES		YES	
Risk control		YES		YES		YES		YES		YES
Firm control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	17,294	17,294	17,055	17,055	17,289	17,289	17,303	17,303	17,055	17,055
R-squared	0.106	-0.496	0.208	-0.407	0.129	0.024	0.143	0.037	0.108	-0.197

6.3 Improvement in Governance

We will examine corporate governance changes after firms with female directors in this section. In general, psychology researches find that the female tend to behave as a so-called *tough monitor* in personality (Adams & Ferreira, 2009), and the collapse of enterprise Enron (ever Biggest 10 firms in Fortune 500) reveals that poor internal management will cause problems such as manager corruption, shareholder tunneling, and accounting scandals etc. which lead to inevitable financial distress. Thus, another guess for female positive effect on financial distress is through the channel of governance improvement. Following the 3SLS methods stated before, we choose *agency_cost1_1, agency_cost1_2 and agency_cost2* to measure governance quality changes of firms.

Taking James S. Ang, Rebel A.Cole(2000) for reference, we employ two bunches of variables to measure agency costs. The first bunch is operating expense ratio that measures expenditure on physical consumption, including perks, which captures the agency costs between shareholders and managers. Specifically, *Agency_cost1_1* is the sum of administrative and sales cost divided by sales, *Agency_cost1_2* is administrative cost divided by sales. The second stream consists of other receivables that measures the funds occupied by large shareholders, which captures the agency costs between large shareholders and minority shareholders. *Agency_cost2* is calculated as other receivables normalized by total assets. In general, the higher the operating expense is spent (the more the other receivables appears in statements), the larger the agency cost is, and the poorer

corporate governance turns to be.

The empirical analyses is shown in Table 7. In model (1) and (3), the independent variable is Type I agency cost expressed as operating expense ratio and the dependent variable female director dummy is negatively significant at 1% level, which reveals that with female directors' participation, the agency costs associated with on-the-job consumption is lower. In model (5), the independent variable is Type II agency cost expressed as other receivable rate and the dependent variable female director dummy is negatively significant at 5% level, which indicates that after female director taking office, the agency costs associated with funds occupation by large shareholders is alleviated. These finds support our argument that the female director tend to be a tough monitor, discipline managers' behavior and help reducing double agency cost.

In model (2)(4)(6), dependent variables are special treatment indicators in the next period (*ST_lead1*) and independent variables are corporate governance proxy as *Agency_cost1_1, Agency_cost1_2, Agency_cost2*. We uncover that these three independent variables are significantly at 1%, and the positive sign is accorded with our hypothesis (the higher the agency cost which implies poor governance, and the greater financial distress risk will be). The findings combined prove that the existence of female directors reduce firms' agency cost, improve corporate governance, and effectively reduce firms' financial distress risk.

Table 7: Female directors' impact on governance and financial distress

This table presents results on corporate governance and financial distress using three-stage least square (3SLS) method. The dependent variables in column (1)(3)(5) are agency costs measured as: Agency_cost1_1, Agency_cost1_2, Agency_cost2. The dependent variables in column (2)(4)(6) are special treatment(ST) indicator for firm i in year t+1. *Agency_cost1_1* is administrative cost plus sales cost divided by sales, *Agency_cost1_2* is administrative cost divided by sales, and *Agency_cost2* is calculated as other receivables normalized by total assets. We winsorize all variables at the 5% level to reduce the effect of outliers. Significance on a 10%(*), 5%(**), or 1% level(***) is indicated.

VARIABLES	(1) agency_cost1_1	(2) ST_lead1	(3) agency_cost1_2	(4) ST_lead1	(5) agency_cost2	(6) ST_lead1
femaledum	-0.005***		-0.003***		-0.001**	
	(0.002)		(0.001)		(0.000)	
agency_cost1_1		1.073***				
		(0.066)				
agency_cost1_2				1.668***		
				(0.105)		
agency_cost2						5.816***
						(0.537)
Board control	YES		YES		YES	
Risk control		YES		YES		YES
Firm control	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	17,105	17,105	17,184	17,184	17,216	17,216
R-squared	0.341	-0.194	0.303	-0.144	0.208	-0.404

6.3 Robustness

In this section, we conduct robustness checks on our main findings by exploring results of alternative explained variable proxy and investigating whether conclusions hold for various model specifications.

(1) Alternative measures of financial distress risk

In panel A of Table 8, we make full use of six alternative measures of financial distress risk: Zscore1_lead1; Zscore2_lead1; Zscore3_lead1; Sellshell; FD1_lead1; FD2_lead1. For details, see the Appendix of variable definitions. The critical Z-value in Altman(1968) for American enterprises is 1.8, that is if a U.S firm's Z-value if lower than 1.8, it is identified as in financial distress, otherwise it is regarded as a healthy firm. However, there are considerable differences in the criteria for judging Z value among countries, like the Z value threshold for Australia, Brazil, Canada and Japan is different from United States (Jiang t al., 2009). Thus, we use continuous value of Z-models to characterize risk instead of traditional discrete cutoff point definition. The higher the coefficient in column(1)(2)(3), the larger financial distress risk is. The lower the Z-score value in variable (4)(5)(6), the severer financial distress risk is (as illustrated in Altman's paper).

From column (1) to column (6) in panel A, the consequences are indeed consistent under various measurements. Generally speaking, enterprises with female directors are confronted with lower probability of financial distress.

(2)Different models

The study also employs different models including Probit model, logit model[5] for reference, the conclusions are robust. The results are presented in panel B of table 8.

(3)Three-stage scenarios

Furthermore, we design a three-stage scenario analysis in panel C of table 8. To argue that women directors exert risk reduction effect throughout firms' all stages, we identify firms' path to financial distress as *normal* stage, *distressed* stage and *financial distress* stage and test women's impact on each stage. The results are stated in panel C of table 8. It appears that a board with female directors is related to a 1.0% lower risk of next period distress when firms are healthy. Moreover, when firms are distressed, a board with female directors is related to a 2.7% even lower risk of financial distress. Similar results are found if using Probit or logit models. The results confirms how the existence of female directors decrease firms' financial distress risk stage by stage.

Table 8: Robustness
Panel A: alternative measures of distress

Sellshell_lead1 equals one if a certain listed firm sells its shell resource to one other unlisted firm in year t+1, the sample contains 120 listed firm observations which sell shells in 2006-2015. FD1_lead1 equals one if a listed firm's net profit appears negative in year t+1. FD2_lead1 is the arithmetic average times of net profit loss in the latest three year starting from year t+1. Zscore1_lead1 is z-score calculated by using five-factor Z-score structural model in Altman(1968) for public firms, Zscore2_lead1 is z-score calculated by applying four-variable Z-score model in Altman(1983), and Zscore3_lead1 is Z-score value calculated by employing six-variable Z-score model in Almamy(2015). The higher the coefficient in column(1)(2)(3), the larger financial distress risk is. The lower the Z-score value in column(4)(5)(6), the severer financial distress risk is.

VARIABLES	(1) Sellshell_lead1	(2) FD1_lead1	(3) FD2_lead1	(4) Zscore1_lead1	(5) Zscore2_lead1	(6) Zscore3_lead1
femaledum	-0.006*	-0.014***	-0.013***	0.156*	0.377**	0.026***
	(0.003)	(0.005)	(0.004)	(0.092)	(0.172)	(0.007)
Control	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	18,235	18,235	18,235	18,235	18,235	18,235
R-squared	0.067	0.077	0.127	0.165	0.173	0.178

Panel B: different models

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[5] The cox hazard model is not appropriate for distress specification in this paper. The special treatment (ST) may last for several years and firms may get rid of ST label afterwards, while cox hazard model assumes death event (ST) happens only once for a firm and after death there is no more observations for firms (any more observations of a typical firm will be censored). The useful information contained in data will be lost if employing cox hazard model.

To avoid arbitrary conclusion resulting from an improper OLS model, we also employ Probit and logit regression to verify our findings.

	distress_lead1		
	OLS	**Probit**	**Logit**
	(1)	(2)	(3)
Femaledum	-0.007**	-0.102**	-0.207**
	(0.003)	(0.040)	(0.087)
Control	YES	YES	YES
Industry FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	18,248	18,248	18,248
Adj/ Pseudo R^2	0.034	0111	0.115

Panel C: three-stage scenarios

This table presents the three-stage scenario analysis of firm financial distress. We identify process of financial distress as three stages: normal, distress and financial distress. *Normal* stage firm means firm i's net income is positive in year t, *distressed* stage firm means firm i's net income drop to negative in year t, and *financial distress* stage firm means firm i has been continuously suffer loss at least two years and has been named with special treatment label in year t. Column (1)(3)(5) collects the sample of normal firms in year t, and column (2)(4)(6) show the sample of distressed firms in year t. We employ ordinary least square model in regression (1)(2), Probit model in regression (3)(4), and logit model in regression (5)(6).

	(1)	(2)	(3)	(4)	(5)	(6)
	distress_	ST_	distress_	ST_	distress_	ST_
VARIABLES	lead1	lead1	lead1	lead1	lead1	lead1
Femaledum	-0.010**	-0.027*	-0.072**	-0.143*	-0.134**	-0.269*
	-0.005	-0.016	-0.032	-0.079	-0.063	-0.149
Control	YES	YES	YES	YES	YES	YES
Industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	16,281	1,940	16,281	1,907	16,281	1,907
Adj/ Pseudo R^2	0.067	0.027	0.105	0.033	0.103	0.034

7. Conclusions

Using empirical evidences, this paper provides evidence showing that psychological overconfidence exactly influences firm's financial distress risk. Women are proved to be less overconfident in previous studies, and our research further indicates that existence of female in firm's board of directors will sharply shrink enterprises' financial distress risk by nearly remarkable one fourth magnitude. Compared listed firms with female directors to firms without, this research reveals that the defense mechanism how women directors reduce involved risk is mainly exerted by enhancing solvency and liquidity, concentrating on internal investment, and tightening corporate governance, which in total strengthen firms' stability. Besides, when firms deteriorate from normal to distressed or even financial distress stage, women in board could extend the firms' livespan. The results are robust for different measures and endogeneity issues and consistent with overconfidence theory.

This paper concentrates on the gender effect on corporate financial distress. Different from traditional analysis of pure

corporate characteristics and financial indicators, we cast a light on human characteristic effect on firm financial distress.

Appendix:Variable definitions

Variable	Definition
Explanatory variables	
Femaledum	Equals to 1 if there exists at least one female director for a given firm in a given year, 0 otherwise
Femaleratio	The ratio of female directors number scaled by total number of directors in Board of Directors
Control Firm characteristics	
Size	Logarithm of firm total book asset
Leverage	Total debt divided by total asset
stdEPS	Standard deviation of earnings per share(EPS) over the previous three years
lnAge	Natural logarithm of firm age, computed from the year that the firm first appeared in Shanghai/Shenzhen Stock Exchange
ROA	Return on asset
PPEratio	Plant, property and equipment divided by total asset
ownAratio	Tangible asset minus liability, scaled by total asset
Soe	Equals to 1 if the firm is a state-owned enterprise, and 0 if is a nonstate-owned enterprise
Control BOD characteristic	
shrcr1	The largest shareholder's holding share proportion
Manashratio	Proportion of executive shareholding
Boardindep	Proportion of independent directors in the board of directors
Duality	Equals 1 if the titles of chairman and CEO are vested in the same individual and zero otherwise
Other variables	
D1	Equals one if the proportion of women directors in board is positively less than 10%, and zero if there is no women director.
D2	Equals one if the proportion of women directors in board is between 10% to 20%, and zero if there is no women director.
D3	Equals one if the proportion of women directors in board is between 20% to 30%, and zero if there is no women director.
HHI	Equal weighted sum of female directors proportion square and male directors proportion square in the board
Bond ratio	Cash raised by bond issues standardized by total assets
Bankloan_ratio	Cash borrowed from bank loans standardized by total assets
Bond_loan_ratio	Cash raised from bank loan and bond standardized by total assets.
Cash_flow	Total cash flow standardized by total assets.
Banks_number	The number of banks lending to a firm.
Loan_times	The number of loans banks makes to a firm.
Short-term debt	Defined as short-term debt divided by total debt
other liability	The sum of accounts payable, bonds payable, and arrears standardized by total asset
long-term bank	Computed as long-term debt divided by total asset

leverage	
bank leverage	Calculated as the sum of short-term debt plus long-term debt divided by total asset
interest coverage ratio	Defined as earnings before interest and tax divided by interest.
Agency_cost1_1	Administrative cost plus sales cost divided by sales,
Agency_cost1_2	Administrative cost divided by sales
Agency_cost2	Calculated as other receivables normalized by total assets.

Explained variables

ST	Equals 1 if a stock at a certain year is a special treatment stock (ST or *ST)
Sellshare	equals 1 if a certain listed firm sells its shell resource to one other unlisted firm, and 0 otherwise
FD1	Dummy variable equals one if the firm suffer net profit loss in year t.
FD1	The arithmetic average times of net profit loss in the latest three year starting from year t+1
Zscore1	As in Altman(1968), Zscore1=$0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$, $X_1 =$ working capital/ total assets $X_2 =$ retained earnings/ total assets $X_3 =$ Earnings before interests and tax(EBIT)/ total assets $X_4 =$ Market value of equity/ Book value of total liabilities $X_5 =$ sales/ total asset
Zscore2	As in Altman(1983), drop X_5 to avoid industry effects noises. Zscore1=$3.25+6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$, X_1, X_2, X_3, X_4 is defined the same as in Zscore1 model
Zscore3	As in Almamy(2015), Zscore3=$1.481X_1 + 0.043X_2 + 0.390X_3 + 0.004X_4 + (-0.424)X_5 + 0.75X_6$, X_1, X_2, X_3, X_4, X_5 is defined the same as in Zscore1 model $X_6 =$ cash flow from operations/ total liabilities

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