Review of Quantitative Finance and Accounting (2020) 55:461–500
https://doi.org/10.1007/s11156-019-00850-3

ORIGINAL RESEARCH

Co-opted directors, gender diversity, and crash risk: evidence from China

Erin H. Kao[1] · **Ho-Chuan Huang**[2] · **Hung-Gay Fung**[3] · **Xiaojian Liu**[4]

Published online: 6 November 2019

Abstract

This study examines how the composition of the board of directors at Chinese firms affects crash risk. The results indicate that co-opted directors (i.e., directors appointed after the CEO assumed office) have a positive and significant effect on crash risk; the positive relation between board directors and crash risk is primarily driven by co-opted male directors, implying a gender difference on crash risk. Non-co-opted independent directors mitigate crash risk, but the negative relation between gender and crash risk is much stronger for female directors than for male directors. The results indicate that co-option/non-co-opted independence along with gender diversity on the board plays an important role in shaping crash risk behaviors. The director-crash risk linkage disappears at state-owned enterprises, suggesting that ownership structure affects board behaviors and board members play the role of rubber-stamp. Finally, the relation between gender and crash risk is more pronounced at crash-risk prone firms with high earnings management and high financial leverage.

Keywords Co-option · Crash risk · Gender diversity · Independent director · State-owned enterprises

✉ Xiaojian Liu
liuxiaojian@hnu.edu.cn

Erin H. Kao
erinkao@thu.edu.tw

Ho-Chuan Huang
river@mail.tku.edu.tw

Hung-Gay Fung
fungh@msx.umsl.edu

1 Department of International Business, Tunghai University, No. 1727, Section 4, Taiwan Boulevard, Xitun District, Taichung City 40704, Taiwan R.O.C.

2 Department of Banking and Finance, Tamkang University, No. 151, Yingzhuan Rd., Tamsui Dist., New Taipei City 25137, Taiwan R.O.C.

3 College of Business Administration, University of Missouri St. Louis, One University Plaza, St. Louis, MO 63121-4499, USA

4 College of Finance and Statistics, Hunan University, No. 109, Shijiachong Rd., Yuelu Dist., Changsha City 410079, Hunan, China

JEL Classification G3 · G32 · G34

1 Introduction

Top managers have incentives to conceal adverse operating outcomes and delay the disclosure of bad news for their own personal benefits, such as career concerns, empire building, and compensation. When the accumulated bad news reaches an upper limit and managers can no longer absorb losses, the unobserved negative firm-specific shocks become known to the public, leading to large crash risk, that is, a large negative tail in the return distribution (Hutton et al. 2009; Jin and Myers 2006). Empirical evidence shows that opportunistic managerial behaviors hiding information prompt crash risk. They include production of opaque financial reports (Hutton et al. 2009; Kim and Zhang 2014, 2016), tax avoidance (Kim et al. 2011a), risk-prone equity stock option incentives (Kim et al. 2011b), excessive perk consumption (Xu et al. 2014), changes in abnormal real business operations (Francis et al. 2016), and different types of political-connection setup at firms (Lee and Wang 2017; Tee et al. 2018).[1]

The board of directors plays a key role in mitigating agency conflicts and improving corporate governance (Adams and Ferreira 2007; Baldenius et al. 2014; Coles et al. 2008). Most of prior studies focus on how board of directors influences firm performance and yet no clear relationship is found between board characteristics (i.e., board size or board composition) and firm performance (Adams et al. 2010; Coles et al. 2008). As independent directors are supposed to improve monitoring, there is little evidence supporting that directors increase firm value or efficiency (Yang et al. 2011). Potential confounding effects are due to the fact that not all directors are independent, and close ties between CEOs and independent directors would likely reduce the effectiveness of the board (Adams and Ferreira 2007; Schmidt 2015).

This study uses Chinese firms to examine the effect of the composition of the board on crash risk, a proxy for declining corporate governance. We separate out the effects of co-opted directors (i.e., directors selected by the CEO in office) from non-co-opted independent directors on an analysis of crash risk to avoid the confounding issue of *co-option* by the board. Chinese firms offer a unique environment for investigating the relationship between the co-opted directors and crash risk for several reasons. In contrast to the transaction-based economy in the US and other Western developed economies, China firms operate their business using a relationship-based model (Li and Filer 2007; Luo 2000). The relationship-based cultural background of the board enables us to understand better how board culture affects crash risk. The Chinese market also uses a dual-board system, instead of the single-board structure in many countries, such as the US, to separate supervisory and advisory functions of the board of directors (Adams and Ferreira 2007). Thus, the management board in China has the primary function of providing advisory services to the CEO, promoting good performance. The board of directors, especially the co-opted directors, in China psychologically confronts two potentially conflicting forces in making advisory recommendations: push forces to go with the flow at the firm and pull forces that promote justice oriented, morally upright advice that might go against the trend. The push forces come from the tendency deeply embedded in China's

[1] Previous studies also show that engagement in corporate social responsibility (CSR) (Kim et al. 2014), religion (Callen and Fang 2015), and directors' and officer's liability insurance and social trust (Li et al. 2017) affect crash risk.

culture to advocate good *guanxi* ("relationship" or "connection") so as to achieve business success (Luo 2000; Ren et al. 2009). Having good *guanxi* implies, first, saving face (*mianzi*) of others and oneself (Hwang 1987) and, second, maintaining good reciprocal obligations (*renqing*) among people (Yeung and Tung 1996). The implication is that the board of directors can easily be motivated to engage in group-oriented behavior culturally, particularly if CEOs are powerful (Li and Tang 2010). However, the pull forces come from the drive to demonstrate the moral rectitude advocated by Confucius values, endorsing accountability and personal responsibility to behave properly in society (*Analects* 8:7). As we separate board members into co-opted board and non-co-opted independent board members, the two groups of directors have important implications in terms of how they view their role on the board in making recommendations. The co-opted board members are implicitly part of the team, and thus they, responding to push forces, are more likely to lean toward team-oriented behavior in supporting the CEO. These push forces are more likely to lead co-opted directors to help the CEO hide bad news, which could increase crash risk. The non-co-opted independent board members, by contrast, have a looser tie to the current CEO, and they believe they have an obligation to act independently by providing impartial advice to improve the firm. Thus, non-co-opted independent directors are likely to be motivated by pull forces rather than push forces. Pull forces might mitigate CEOs' withholding of bad news, which could decrease crash risk. In short, we expect the co-opted board members to lean toward having a team-oriented role and have a positive association with crash risk, whereas the non-co-opted independent board members will lean toward rectitude and have a negative association with crash risk. When board members believe that push forces and pull forces have become too strong to be reconciled, they will likely choose a strategy of playing it safe by becoming rubber stamps in their recommendations, which reduces their relevance in any meaningful decision-making.

We find that co-opted directors (i.e., directors appointed after the CEO assumed office) have a positive and significant effect on crash risk; in contrast, non-co-opted independent directors have a negative and significant effect on crash risk. Further, we show that crash risk has a gender difference. Co-opted male directors amplify crash risk while non-co-opted independent female directors significantly reduce crash risk. Our findings are robust across different model specifications after adjusting for the firm-fixed effect, cluster effect, endogeneity effect, outlier issue, and a longer forecast window analysis.

The results of the relationship between gender and crash risk found earlier at private firms disappear entirely at SOEs. They indicate how the board members on crash risk at state-owned enterprises (SOEs) behave toward rubber stamps and jumping on the bandwagon. Thus, these results are not surprising, as the board of directors at SOEs attempts to avoid any conflicts with the powerful CEOs backed by the government, and thus when serving on the board they act as rubber stamps. The results imply that the ownership structure of firms affects board behavior. In addition, we find that the relationship between gender and crash risk is most significant at crash-risk-prone firms with high financial opacity and a weak governance system.

2 Literature and hypothesis development

Crash risk refers to the negative skewness of stock returns affected by many factors. The popular rationale behind crash risk is the hoarding of bad news (Jin and Myers 2006). Managers or CEOs have incentives to suppress adverse information and exaggerate financial performance because of career concerns, compensation agreements (Jensen and Murphy 1990), or empire building (Jensen 1993). If a firm's manager withholds and accumulates too much bad news for a long time that reaches a critical threshold level, managers tend to release the negative firm-specific information, leading to a stock price crash (i.e., a large negative outlier in the distribution of stock returns). When a firm's financial reports are more opaque, less firm-specific information is available to affect its stock returns (Hutton et al. 2009). Tax-avoidance activities and a CFO's equity incentives are positively related to the risk of a stock price crash when executives enjoy excess perks by withholding bad news (Kim et al. 2011a, b; Xu et al. 2014). At the same time, firms that are more conservative in their accounting tend to have less future crash risk (Kim and Zhang 2016).[2]

Directors with close connections with the CEOs do not perform their role properly because having close ties undermines independent corporate governance (Cheung et al. 2013; Coles et al. 2014; Fracassi and Tate 2012; Khanna et al. 2015). For example, Arena and Braga-Alves (2013) suggest that powerful CEOs have the strongest effect on board size and independence. Fedaseyeu et al. (2018) find that co-opted directors in high CEO power firms receive significantly higher compensation compared to firms in which CEO power is low, suggesting that CEOs attempt to award "discretionary compensation" (i.e., compensation that is unrelated to board functions) to co-opted directors, who are likely more friendly toward CEOs. Thus, having co-opted directors will undermine board effectiveness, resulting in poor governance practices and lower firm market valuation (Cheung et al. 2013; Fracassi and Tate 2012). CEOs tend to appoint board members either directly or indirectly through consultation with the nominating committee. Directors recruited during a CEO's tenure are likely to be loyal to the CEO (Morse et al. 2011) and thus share beliefs and visions similar to those of the CEO (Landier et al. 2013). It has been shown that co-opted board members are likely to reduce the effectiveness of board and reduce CEO turnover (Coles et al. 2014). Khanna et al. (2015) show that connectedness among appointed CEOs helps conceal information, delay detection, and increase the risk of corporate fraud. Huang et al. (2019) find that co-opted boards have a lower probability of adopting claw-back provisions, suggesting that co-opted board are less willing to punish CEOs for financial misreporting than non-co-opted boards.

In contrast, Faleye (2015) finds fully independent boards are associated with poor operating performance and lower firm value because full board independence deprives the board spontaneous access to the firm-specific information and eliminates board-level discussions on strategy. It can also be argued that close ties between CEOs and directors can facilitate better exchange of information between CEOs and board members; thus it can improve the quality of board advice, increase firm innovation activities (Kang et al. 2018) and the firm's value (Adams and Ferreira 2007). Thus, the co-option issue deserves a further examination.

Unlike most Western countries, China has a relationship-based culture. In China *guanxi* is particularly important in social interaction as well as exchange and success in business. CEOs are more likely to appoint directors to a board to receive subsequent favors or reciprocity from co-opted directors, who are more inclined to maintain friendly relations with the CEO. Thus, a higher level of *co-option* implies more allegiance to the CEO, advocating go-with-the-flow behaviors. When Chinese CEOs have incentives to conceal bad news in their own self-interest, co-opted board members regard themselves

[2] Other nonfinancial reporting activities, such as having more dedicated institutional investors (An and Zhang 2013), institutional investor stability (Callen and Fang 2013), engaging in corporate social responsibility (CSR) activities (Kim et al. 2014), the religiosity factor (Callen and Fang 2015), and directors' and officers' liability insurance and social trust (Li et al. 2017) all have a significant effect on crash risk.

as part of the team and thus retain a team-oriented mentality and, thus, are more likely to be aligned with CEOs; this results in higher crash risk. We expect a higher percentage of co-opted directors to be associated with higher crash risk.

H1 Co-opted directors are positively associated with future crash risk.

Although independent directors are believed to play a better supervisory role than other directors, so far no solid empirical evidence demonstrates that independent directors add value for shareholders, as not all independent directors are effective monitors. If the independent directors were appointed when the CEO assumed office, these directors who are captive to the CEO may not be effective. Thus, only independent directors who are not co-opted by the CEO can play a more effective role (Coles et al. 2014; Ma and Khanna 2016).

Chinese CEOs are powerful because they have the final say on whether to keep an independent director. In particular, independent directors at Chinese firms may have close ties with CEOs (Jiang and Kim 2015) and are concerned about reciprocal obligations (*renqing*) that could affect board independence. In addition, independent directors might conform with CEOs to avoid hurting their feelings and to maintain good *guanxi* (Zhou et al. 2017).

We specifically address the issue of independent directors by dividing them into those with co-opted independence and non-co-opted independence. Co-opted independent directors are influenced by their CEOs (Adams and Ferreira 2007; Cao et al. 2015; Coles et al. 2008). They have close ties with the CEO, and thus when they make advisory recommendations, they consider the team's interests. Non-co-opted independent directors, who served on the board before the CEO assumed office, are expected to act more independently, and thus they will reflect this rectitude when making recommendations or suggestions. Thus, we expect that only non-co-opted independent directors can effectively mitigate bad-news-hoarding behavior to reduce crash risk. Thus, we propose following hypothesis.

H2 Non-co-opted independent directors are negatively associated with crash risk.

Although *guanxi* is an important cultural and social value in China, women have greater difficulty than men in building *guanxi* ties because of gender stereotypes. In the Chinese historical and cultural context, women have long been ascribed a role that is subordinate to that of men (Louie 2002). To assess the role of gender diversity on crash risk explicitly, we divide co-opted directors into female co-opted directors and male co-opted directors. Similarly, non-co-opted independent directors are divided into female non-co-opted independent directors and male non-co-opted independent directors.

According to Confucian values, men's role in society is superior to that of women (Bowen et al. 2007). Gender norms in Chinese families imply that men are the family breadwinners, while women are responsible for housework and child care (Zhu et al. 2016; Zuo and Bian 2001). The differentiated sex roles imply that men like to cooperate more with men than with women, forming a homophilous network (i.e., networks composed predominantly of the same sex) in social exchange (Bu and Roy 2005). These structural impediments enable men to hold most positions of power, influence, and resources, and male directors who want to advance in their career are more likely to engage in team-oriented behavior. So, we expect male directors to be more likely to work with CEOs in building *guanxi* networks aimed at career development. This is particularly true when male directors are co-opted by CEOs, which will cause them to engage even more in team-oriented behavior and go with the flow of the firm. Thus, they are likely to amplify decisions made by the CEOs.

In contrast, Chinese women are still underrepresented in positions of authority in China and have less opportunity than men to build *guanxi*. Further, in the literature on psychology and finance, women are found to be less overconfident, more risk averse, and more conservative than men (Barber and Odean 2001). Adams and Ferreira (2009) suggest that female directors have better attendance records, more likely to join monitoring committees than male directors). Cumming et al. (2015) show that in male-dominated industries, women are more effective in reducing both the frequency and severity of fraud, confirming the independence of female board members. Kim and Starks (2016) find that female directors can enhance firm value with boards' advisory effectiveness and diverse skills. Thus, it is not surprising that female directors can help firms reduce firm risk and solvency risk and improve performance (Wilson and Altanlar 2011). Indeed, increasing gender diversity in the boardroom has been proposed to enhance corporate governance and risk management (Chen et al. 2016; Gul et al. 2011; Liu et al. 2014). Governance reform worldwide shows a growing trend toward including female directors on the board (Liang et al. 2013). These studies suggest that female directors in general add value to firms and improve corporate governance. In particular, when female directors are non-co-opted independent directors, we expect that they are less likely to conform with CEOs but are more likely to play the independent role in monitoring the CEOs.

In sum, we argue the crash risk is more closely related to co-opted male directors than female co-opted directors because male co-opted directors are more likely to go with the flow of the firm. However, the negative relation between non-co-opted independent directors and crash risk is stronger among female non-co-opted independent directors than male non-co-opted independent directors because female independent directors exercise a monitoring role with more prudence and care. Thus, we propose following hypothesis.

H3a The positive relation between a co-opted director and crash risk is stronger among male co-opted directors than female counterparts.

H3b The negative association between non-co-opted independent directors and crash risk is stronger among female non-co-opted independent directors than male counterparts.

Wang (2015) suggest that the value effect and incentives of appointing independent directors with political ties are shaped by firm's ownership structures. Chen et al. (2017) find that different business objective and motivations of SOEs and non-SOEs in seeking political connection, which result in different relations between political connection and firm value. Lee and Wang (2017) focus on the effect of politically connected directors and show that the effect of politically connected directors on stock price crash risk is moderated by a firm's ownership structure.

It is generally believed that SOEs are required to pursue non-profit-related political, social, and economic goals, instead of share value maximization. CEOs at SOEs serve the same interests of the government, which facilitates the distribution of more resources to SOEs. In contrast, the resources of non-SOEs are scarce and limited. To compete with SOEs, non-SOEs have to cultivate better *guanxi* with the government or others to overcome competitive and resource disadvantages. Thus, we expect that positive co-opted director-crash risk relationship in H1 and the negative non-co-opted independent director-crash risk relationship in H2 are stronger at non-SOEs than SOEs (Liu et al. 2014).

At SOEs CEOs and directors are appointed by the government. Thus, they are expected to share the government interest in pursuing non-profit-related political, social, and economic goals, which may hamper independent directors' ability to monitor CEOs effectively with respect to efficiency. Second, directors at SOEs, whether they are co-opted or non-co-opted, face the dilemma of how to deal with the push-and-pull forces that influence their recommendations. As SOEs do not want to have dissenting opinions, the directors will not be expected to engage in debates, and thus they are likely to engage in a safe strategy to act as a rubber stamp at all decision-making levels. That means that they are not relevant in decision-making in any meaningful way. Thus, we propose following hypothesis.

H4 The positive co-opted board-crash risk relation and the negative non-co-opted independent board-crash risk relation are relevant only for non-SOEs and are entirely absent at SOEs.

3 Sample and research design

Our study utilizes a comprehensive sample of all Chinese firms listed on the Shanghai and Shenzhen Stock Exchanges trading in A shares (i.e., shares primarily for domestic investors) over the period 1999–2016. The listed firms are divided into 18 different sectors according to the *Guide to Industrial Classification of Listed Companies* published by the China Securities Regulatory Commission (CSRC). Our analysis excludes financial and public utility firms to have a cleaner sample of firms in this study.

Weekly stock trading data and annual financial data are obtained from the Chinese Securities Market and Accounting Research (CSMAR) database. To calculate the service time of directors on the board, we hand collect the starting dates of the directors elected to the board and the end date of the directors' departure from the board from the SINA Corporation's website (http://finance.sina.com.cn/stock/). Our final sample consists of nearly 13,700 firm-year observations and as many as 2112 companies. The observations used in each regression are contingent on data availability.

3.1 Measures of firm-specific crash risk

Following Chen et al. (2001), as our primary measures of firm-specific crash risk, we use *NCSKEW* and *DUVOL*. To calculate these two main indicators, we first estimate the following expanded market model regression for each firm and year:

$$r_{j,\tau} = \alpha_j + \beta_{1,j} r_{m,\tau-2} + \beta_{2,j} r_{m,\tau-1} + \beta_{3,j} r_{m,\tau} + \beta_{4,j} r_{m,\tau+1} + \beta_{5,j} r_{m,\tau+2} + \varepsilon_{j,\tau}, \tag{1}$$

where $r_{j,\tau}$ is the return on stock j in week τ, and $r_{m,\tau}$ is the return on the market index in week τ. Because our sample contains firms on both the Shanghai and Shenzhen Stock Exchanges, we use the Shanghai Component Index and the Shenzhen Component Index as the market index, respectively. As suggested by Dimson (1979), we include the lead and lag terms for the market index return to mitigate the problem of nonsynchronous trading. The firm-specific weekly return for firm j in week τ, denoted by $W_{j,n}$, is measured by the natural logarithm of one plus the residual return from Eq. (1).

The first measure of firm-specific crash risk, *NCSKEW,* is calculated by taking the negative of the third moment of firm-specific weekly returns for each firm j in year τ and dividing it by the standard deviation of firm-specific weekly returns cubed. Thus, for each firm and every year, we compute *NCSKEW* as:

$$NCSKEW = -\left[n(n-1)^{3/2}\sum W_{j,\tau}^{3}\right] / \left[(n-1)(n-2)\left(\sum W_{j,\tau}^{2}\right)^{3/2}\right]. \tag{2}$$

The second measure of crash risk, *DUVOL*, is the down-to-up volatility of firm-specific weekly returns over the fiscal year. Chen et al. (2001) argue that this indicator does not involve the third moment and therefore is less likely to suffer from extreme weekly returns. To compute this variable for each firm and year, we separate all the weeks with firm-specific weekly returns below the annual mean ("down" weeks) from those with firm-specific weekly returns above the annual average ("up" weeks). The standard deviation of firm-specific weekly returns is calculated separately for each of these two subsamples, and *DUVOL* is the natural logarithm of the ratio of the standard deviation in the "down" weeks to the standard deviation in the "up" weeks as follows:

$$DUVOL = log[\left(n_u - 1\right)\sum_{down} W_{j,\tau}^{2} / \left(n_d - 1\right)\sum_{up} W_{j,\tau}^{2}], \tag{3}$$

where n_u and n_d are the number of up and down weeks in year τ, respectively. A larger value for *NCSKEW* or *DUVOL* corresponds to a higher firm-specific crash risk and vice versa.

3.2 Measures of co-option

This study focuses on the impact of having a close connection between directors and CEOs on firm-specific crash risk. Coles et al. (2014) point out that directors appointed after the CEO assumed office have allegiance to the CEO and decrease their monitoring; thus they define co-option as the proportion of the board that consists of directors appointed after the CEO assumed office. Referring to Coles et al. (2014), we define a co-opted director (*CO-OPTION*) as the total service time of co-opted directors divided by the total service time of all directors. To account for the increased influence of co-opted directors on board decisions over time, we use an alternative measure of co-option, tenure-weighted co-option (*TWCO-OPTION*), which is the sum of the service time of co-opted directors multiplied by the corresponding tenure divided by the sum of the service time of all directors multiplied by the corresponding tenure.

The measure of a co-opted director does not differentiate between directors who are independent and those who are not. In general, independent directors are thought to be better than non-independent directors at monitoring managers. To examine whether co-opted (non-co-opted) independent directors influence firm-specific crash risk better than traditional independent directors used in prior studies that do not control for the co-opted directors, in our crash risk analysis we include traditional independent directors (*INDEP*), co-opted independent directors (*CO-IND*), and non-co-opted independent directors (*NONCO-IND*). *INDEP* is the proportion of independent directors on the board to total board size. Co-opted independent directors are independent directors appointed after the CEO assumed office*, thus CO-IND* is defined as the sum of service time of co-opted independent directors divided by the sum of the service time of all independent directors. Non-co-opted independent directors were already on the board before the CEO assumed office, thus *NONCO-IND* is defined as sum of the service time of non-co-opted independent directors divided by sum of the service time of all independent directors. We expect that co-option blunts the monitoring effectiveness of independent directors, thus, co-opted independent directors are weak monitors and should have a positive impact on future crash risk. Only non-co-opted independent directors are effective monitors and can effectively prevent managers from hiding bad news and decrease future crash risk.

As discussed in Sect. 2, male directors are more likely to engage in team-oriented behaviors than women. On the other hand, female directors are more diligent monitors and exert more audit efforts than male directors (Liu et al. 2014, Adams and Ferreira 2009). Extending our *Hypotheses 1 and 2*, we analyze whether the impacts on crash risk of having co-opted directors (*CO-OPTION*) and non-co-opted independent directors (*NONCO-IND*) will be contingent upon the gender of the board directors. Thus, we calculate female co-opted directors (*CO-FEMALE)* and male co-opted directors (*CO-MALE)* to analyze the gender co-option effect. We calculate female non-co-opted independent director (*NONCO-IND-FEMALE)* and male non-co-opted independent director (*NONCO-IND-MALE) to* analyze the gender independence effect. Female co-opted directors (*CO-FEMALE*) are the sum of the service time provided by female co-opted directors divided by the total service time of all directors, while male co-opted directors (*CO-MALE*) are the sum of the service time provided by male co-opted directors divided by the total service time of all directors. Likewise, female non-co-opted independent directors (*NONCO-IND-FEMALE*) and male non-co-opted independent directors (*NONCO-IND-MALE*) are total service time provided by corresponding female or male non-co-opted independent directors divided by the total service time of all independent directors. If female directors improve board effectiveness more than male directors, the effect of *NONCO-IND-FEMALE* on crash risk to be more pronounced than the male counterpart.

4 Empirical results

4.1 Descriptive statistics

Table 1 presents the summary statistics for crash risk metrics, co-option-related variables, and other firm characteristics. The means of two main crash risk measures for *NCSKEW* and *DUVOL* are −0.024 and −0.002. The mean value of *CO-OPTION* is 0.640, which shows that almost two-thirds of the directors are selected by the CEO. The *CO-OPTION* value is much higher than that reported in Coles et al. (2014), which is consistent with finding connected relationships between CEOs and directors more are stronger in China. The mean of *TWCO-OPTION* is 0.552, which is a bit lower than *CO-OPTION* after accounting for their tenure on the board. In terms of independent directors, the mean (median) of the independent directors on board (*INDEP*) ratio is 0.318 (0.333). The means of *CO_IND* and *NONCO-IND* are 0.189 and 0.128, which indicates that independent directors have been co-opted by the CEO more than non-co-opted independent directors, who are truly independent. These results show that a board with directors appointed after the CEO assumed office is prevalent in China. Conditional on the gender of directors, the mean of *CO-MALE and CO-FEMALE* are 0.571 and 0.070, which shows that more male directors were appointed after the CEO assumed office than is the case among female directors. The means of *NONCO-IND-MALE* and *NONCO-IND-FEMALE* are 0.106 and 0.023, which show again that more male independent directors were appointed before the CEO assumed

Table 1 Summary statistics

Variables	(1) N	(2) mean	(3) sd	(4) p5	(5) p25	(6) p50	(7) p75	(8) p95
Crash risk measures								
$NCSKEW_{t+1}$	13,617	−0.024	0.663	−1.124	−0.375	0.008	0.361	0.980
$DUVOL_{t+1}$	13,617	−0.002	0.330	−0.544	−0.210	0.006	0.212	0.520
Director variables								
$CO\text{-}OPTION_t$	13,617	0.640	0.352	0.053	0.324	0.680	1.000	1.000
$TWCO\text{-}OPTION_t$	13,617	0.552	0.404	0.008	0.141	0.507	1.000	1.000
IND_t	13,617	0.318	0.124	0.047	0.280	0.333	0.377	0.489
$CO\text{-}IND_t$	13,617	0.189	0.159	0.000	0.000	0.191	0.333	0.429
$NONCO\text{-}IND_t$	13,617	0.128	0.151	0.000	0.000	0.071	0.247	0.400
$CO\text{-}MALE_t$	13,617	0.571	0.327	0.030	0.279	0.600	0.889	1.000
$CO\text{-}FEMALE_t$	13,617	0.070	0.092	0.000	0.000	0.016	0.111	0.250
$NONCO\text{-}IND\text{-}MALE_t$	13,617	0.106	0.137	0.000	0.000	0.000	0.205	0.364
$NONCO\text{-}IND\text{-}FEMALE_t$	13,617	0.023	0.055	0.000	0.000	0.000	0.000	0.135
Other control variables								
$RETURN_t$	13,617	−0.113	0.078	−0.248	−0.155	−0.107	−0.068	−0.005
$SIGMA_t$	13,617	0.629	0.214	0.336	0.475	0.599	0.751	1.023
$DTURN_t$	13,617	−0.030	0.308	−0.470	−0.230	−0.052	0.147	0.468
$BSIZE_t$	13,617	2.201	0.207	1.792	2.197	2.197	2.303	2.565
$SIZE_t$	13,617	14.949	1.038	13.439	14.248	14.838	15.536	16.824
MB_t	13,617	0.481	0.488	−0.007	0.131	0.339	0.696	1.418
LEV_t	13,617	0.078	0.114	0.000	0.000	0.031	0.116	0.306
ROA_t	13,617	0.032	0.274	−0.088	0.009	0.032	0.064	0.148
$ABACC_t$	13,617	−3.411	1.311	−5.799	−4.104	−3.248	−2.547	−1.600
$SOEs_t$	13,617	0.608	0.488	0.000	0.000	1.000	1.000	1.000

This table reports the descriptive statistics for cash risk measures, board size and composition, and other control variables. The sample contains all Chinese firms listed on the Shanghai and Shenzhen Stock Exchanges (A shares) during 1999–2016. The listed firms are divided into 18 different sectors according to the China Securities Regulatory Commission's *Guide for Industrial Classification of Listed Companies*. All variables are defined in the "Appendix"

office than is true among female independent directors. In sum, the results show that female directors in China are smaller in number than male directors on the board.

4.2 Main results

To test H1, we estimate following regression:

$$CrashRisk_{t+1} = \beta_0 + \beta_1 CO - OPTION_t + f(OtherControls_t) + \varepsilon_{t+1}. \tag{4}$$

The dependent variable, crash risk in year *t + 1,* is represented by *NSCKEW* or *DUVOL* and regressed on the main explanatory variable *co-option* in year *t* and a set of control variables in year *t*. A positive and significant coefficient for β1 is consistent with H1.

Standard control covariates are included in Eq. (4) (see Chen et al. 2001; Hutton et al. 2009). The lagged *NCSKEW* is lagged negative skewness of firm-specific weekly returns in year *t*, and the lagged *DUVOL* is the lagged variable of the log of the ratio of the standard deviations of down-week to up-week firm-specific returns in year *t*. Both lagged crash variables are included in the regression to capture the potential persistent effect of stock returns. *RETURN* and *SIGMA* are the mean and standard deviation of firm-specific weekly returns over the fiscal year. *DTURN* is the detrended stock trading volume, a proxy for investor heterogeneity or difference of opinions among investors. *BSIZS* is the log of the number of board members, to control for firm corporate governance characteristics (Cheng 2008). *SIZE* is the market value of equity, to account for the big-firm effects on risk (Cheng 2008). *MB* is the market value of equity divided by the book value of equity. Growth stocks are more likely to experience future price crashes (Chen et al. 2001; Hutton et al. 2009). *LEV* is the ratio of total long-term debt to total assets. *ROA* (return on assets) is net income over total assets. Hutton and colleagues (2009) show that financial leverage and operating performance are negatively related to crash risk. *ABACC* is a measure of accrual manipulation, which is measured by the absolute value of discretionary accruals estimated from the modified Jones model (Dechow et al. 1995). Accrual management often increases future crash risk. In all regressions, we also include an industry dummy and year dummies to account for industry effects and systemic time variations. All the variables are listed with detailed definitions in the "Appendix".

Table 2 presents the regression results that show the effect of co-option on crash risk. The reported standard errors (in parentheses) are adjusted for the heteroskedasticity of any form. The main results using *NCSKEW* and *DUVOL* as the indicators of crash risk (dependent variables) are shown in columns (1) and (3). First, the coefficient of *CO-OPTION* in column (1) is 0.053 with a robust standard error of 0.016, which is positive and significant at the 1 percent level. On average, an increase of one standard deviation (0.353) of *CO-OPTION* is associated with an increase of 0.019 in NCSKEW (i.e., 0.053×0.352). In comparison, the mean and median value of NSCKEW are -0.024 and 0.008, respectively. Similarly, *DUVOL* in column (3), an alternative proxy for crash risk, shows that the coefficient of *CO-OPTION* is 0.029 with a robust standard error of 0.008, which continues to be positive and significant at the 1 percent level. An increase of one standard deviation of *CO-OPTION* is associated with an increase of 0.010 (i.e., 0.029×0.352) in DOVOL. In comparison, the mean and median value of *DOVOL* are -0.002 and 0.006, respectively. Thus, the effect of *CO-OPTION* on crash risk (measured by *NSCKEW* or *DUVOL*) is both statistically and economically significant. The results support H1.

Columns (2) and (4) in Table 2 use the same specifications as in columns (1) and (3), but include *TWCO-OPTION* (the sum of the tenure of co-opted directors divided by the total tenure of all directors), rather than *CO-OPTION*. The results in columns (2) and (4) of Table 2 indicate that the estimated coefficient of *TWCO-OPTION* remains significantly positive for *NCSKEW* and *DUVOL*. The statistical significance and economic effect of *TWCO-OPTION* is similar with *CO-OPTION*. Using the alternative index of co-option does not materially change our finding that crash risk becomes greater as co-option increases.

The measures of co-option do not differentiate directors who are independent from those who are not. To better understand whether co-option blunts the effectiveness of independent directors, we divide independent directors (*INDEP*) into *CO-IND* and *NONCO-IND*. We argue that only independent directors who are not co-opted by the CEO are better effective monitors. Thus, we predict that non-co-opted independent directors are associated with lower crash risk.

Table 3 reports regression results to show the effect of independent and non-co-opted independent directors on crash risk related to H2. The coefficients of *IND* in columns (1) and (3) are negative but insignificant, implying that independent director

Table 2 Co-opted director and crash risk

Variables	$NCSKEW_{t+1}$		$DUVOL_{t+1}$	
	(1)	(2)	(3)	(4)
$CO\text{-}OPTION_t$	0.053***		0.029***	
	(0.016)		(0.008)	
$TWCO\text{-}OPTION_t$		0.060***		0.032***
		(0.014)		(0.007)
$NCSKEW_t$	0.016*	0.016*		
	(0.009)	(0.009)		
$DUVO_t$			0.027***	0.027***
			(0.009)	(0.009)
$RETURN_t$	−0.293***	−0.296***	−0.134***	−0.136***
	(0.101)	(0.101)	(0.051)	(0.051)
$SIGMA_t$	−0.128***	−0.129***	−0.059***	−0.059***
	(0.040)	(0.040)	(0.020)	(0.020)
$DTURN_t$	0.013	0.014	0.006	0.007
	(0.022)	(0.022)	(0.010)	(0.010)
$BSIZE_t$	−0.014	−0.015	−0.008	−0.008
	(0.029)	(0.029)	(0.014)	(0.014)
$SIZE_t$	−0.029***	−0.029***	−0.018***	−0.018***
	(0.006)	(0.006)	(0.003)	(0.003)
MB_t	0.001	0.002	−0.001	−0.000
	(0.015)	(0.015)	(0.008)	(0.008)
LEV_t	−0.164***	−0.162***	−0.084***	−0.083***
	(0.060)	(0.060)	(0.032)	(0.032)
ROA_t	−0.026***	−0.026***	−0.013**	−0.013**
	(0.010)	(0.010)	(0.006)	(0.006)
$ABACC_t$	0.005	0.005	0.002	0.002
	(0.004)	(0.004)	(0.002)	(0.002)
Constant	0.439***	0.439***	0.278***	0.279***
	(0.105)	(0.105)	(0.053)	(0.053)
Observations	13,617	13,617	13,617	13,617
Adjusted R-squared	0.053	0.053	0.053	0.053
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

***$p < 0.01$; **$p < 0.05$, *$p < 0.1$

cannot effectively and significantly decrease firm-specific crash risk. The result echoes Yang et al. (2011), who remark that the role of independent directors in China often yields ambiguous evidence with respect to their efficiency, and Coles et al. (2014), who state that independent directors do not matter from a monitoring perspective. Columns (2) and (4) of Table 3 show that the coefficients of *CO-IND* are insignificant on crash risk (*NCSKEW* and *DUVOL*). The simultaneous presence of co-option and independence represents an interesting case that illustrates how directors make decisions in the

Table 3 Non-co-opted (co-opted) independence and crash risk

Variables	$NCSKEW_{t+1}$		$DUVOL_{t+1}$	
	(1)	(2)	(3)	(4)
IND_t	−0.167		−0.070	
	(0.114)		(0.057)	
$CO\text{-}IND_t$		0.030		0.021
		(0.048)		(0.024)
$NONCO\text{-}IND_t$		−0.121**		−0.062**
		(0.054)		(0.027)
$NCSKEW_t$	0.016*	0.016*		
	(0.009)	(0.009)		
$DUVOL_t$			0.027***	0.027***
			(0.009)	(0.009)
$RETURN_t$	−0.289***	−0.294***	−0.131**	−0.134***
	(0.101)	(0.101)	(0.051)	(0.051)
$SIGMA_t$	−0.128***	−0.129***	−0.058***	−0.059***
	(0.040)	(0.040)	(0.020)	(0.020)
$DTURN_t$	0.011	0.013	0.005	0.006
	(0.022)	(0.022)	(0.010)	(0.010)
$BSIZE_t$	−0.026	−0.020	−0.013	−0.011
	(0.030)	(0.029)	(0.015)	(0.014)
$SIZE_t$	−0.028***	−0.029***	−0.017***	−0.018***
	(0.006)	(0.006)	(0.003)	(0.003)
MB_t	0.000	0.001	−0.001	−0.001
	(0.015)	(0.015)	(0.008)	(0.008)
LEV_t	−0.165***	−0.164***	−0.085***	−0.084***
	(0.061)	(0.060)	(0.032)	(0.032)
ROA_t	−0.025**	−0.026***	−0.012**	−0.013**
	(0.010)	(0.010)	(0.006)	(0.006)
$ABACC_t$	0.005	0.005	0.001	0.002
	(0.004)	(0.004)	(0.002)	(0.002)
Constant	0.540***	0.491***	0.324***	0.305***
	(0.117)	(0.107)	(0.058)	(0.054)
Observations	13,617	13,617	13,617	13,617
Adjusted R-squared	0.052	0.053	0.052	0.053
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

face of the two opposing forces: an urge to engage in team-oriented behavior and commitment to proper independent behavior. Apparently, the two opposing forces are too strong to be reconciled. As a result, the co-opted independent directors choose the play-it-safe strategy to become rubber stamps, underlying the rationale behind why the co-opted independent directors do not have a significant effect on crash risk. In contrast, the coefficients of *NONCO-IND* are negative and significant at the 5 percent level on *NCSKEW* (−0.121) and *DUVOL* (−0.062), indicating that independent directors who are not co-opted by CEOs have more incentives for monitoring managers' behavior. Then, we investigate the economic significance of *NONCO-IND* on *NCSKEW* and *DUVOL*. In column (2), the coefficient of *NONCO-IND* shows that an increase of one standard deviation (0.151) is associated with a decrease of 0.018 in *NCSKEW* ($0.121 \times 0.151 = 0.018$). In column (4), the coefficient estimate of *NONCO-IND* shows that an increase of one standard deviation is associated with a decrease of 0.009 in DUVOL ($0.062 \times 0.151 = 0.009$). In comparison, the mean values of *NCSKEW* and *DUVOL* are −0.024 and −0.002, respectively. The economic effects of *NONCO-IND* on *NCSKEW* and *DUVOL* are economically significant. The result is consistent with *H2*. Overall, the results of Table 3 confirm that not all independent directors are the same. Only non-co-opted independent directors (*NONCO-IND*) are truly independent and have an incentive to be effective monitors and decrease firm-specific crash risk.

As shown in the literature, women appear to behave differently than men, by being more risk averse and more conservative (Barber and Odean 2001). Prior studies suggest that female directors are more diligent monitors and demand more auditing efforts than male directors (Adams and Ferreira 2009; Liu et al. 2014). Taking the gender effect into account in the association between being co-opted and crash risk as our H3, we replace *co-opted directors* (*CO-OPTION*) by co-opted male directors (*CO-MALE*) and co-opted female director (*CO-FEMALE*) in the regression to examine whether the male (female) directors would amplify (mitigate) the increasing crash risk. Also, we replace non-co-opted independent director (*NONCO-IND*) with the non-co-opted male independent director (*NONCO-IND-MALE*) and the non-co-opted female independent director (*NONCO-IND-FEMALE*) in the regression to verify whether the female (male) directors would magnify (weaken) the decreasing crash risk.

Table 4 reports results that show the effect of gender diversity on crash risk. The results indicate that the coefficient of *CO-MALE* on *NCSKEW* in column (1) is 0.051 and on *DUVOL* in column (3) is 0.025. They are significant and positive. The results are consistent with our expectation that co-opted male directors who maintain team-oriented behavior are more likely to go along with CEOs in building *guanxi*, which results in less monitoring of CEOs and exacerbate the increasing crash risk. The coefficients of *CO-FEMALE* are insignificant with crash risk. As female board members are hand-picked by the CEO, they should be expected to go along with the CEOs. However, they have a strong sense of independence and tend to work for rectitude. As they cannot reconcile the conflicting forces confronting them, they adopt a play-it-safe strategy to become rubber stamps. Thus, we find they do not have a significant effect.

The analysis of the non-co-opted independent director sheds light on how these directors face conflicting forces to act independently and properly. In Columns (2) and (4) of Table 4, the coefficient of non-co-opted male independent directors (*NONCO-IND-MALE*) is significant negative on *NCSKEW* (−0.114) and *DUVOL* (−0.064) while the coefficient of non-co-opted female independent directors (*NONCO-IND-FEMALE*) are also negative and have larger magnitude and highly significant at the 1 percent level on *NCSKEW* (−0.307) and *DUVOL* (−0.147) than non-co-opted male directors. The results have two implications. First, independent directors who are non-co-opted are truly independent. Second, female directors are more careful and diligent and thus are more effective monitors in preventing managers from withholding bad news. They mitigate crash risk more substantially than male counterparts, who appear to be somewhat influenced by the team-oriented mind-set. In sum, the findings of Table 4 confirm that the different characteristics between

Table 4 Co-opted (non-co-opted independent) directors and crash risk with gender effect

Variables	$NCSKEW_{t+1}$		$DUVOL_{t+1}$	
	(1)	(2)	(3)	(4)
CO_MALE_t	0.051***		0.025***	
	(0.018)		(0.009)	
CO_FEMAL_t	0.073		0.057*	
	(0.061)		(0.030)	
$NONCO\text{-}IND\_MALE_t$		−0.114***		−0.064***
		(0.043)		(0.021)
$NONCO\text{-}IND\_FEMALE_t$		−0.307***		−0.147***
		(0.108)		(0.053)
$NCSKEW_t$	0.016*	0.015*		
	(0.009)	(0.009)		
$DUVOL_t$			0.027***	0.027***
			(0.009)	(0.009)
$RETURN_t$	−0.293***	−0.294***	−0.133***	−0.134***
	(0.101)	(0.101)	(0.051)	(0.051)
$SIGMA_t$	−0.128***	−0.130***	−0.058***	−0.060***
	(0.040)	(0.040)	(0.020)	(0.020)
$DTURN_t$	0.013	0.012	0.006	0.006
	(0.022)	(0.022)	(0.010)	(0.010)
$BSIZE_t$	−0.014	−0.022	−0.008	−0.012
	(0.029)	(0.029)	(0.014)	(0.014)
$SIZE_t$	−0.029***	−0.029***	−0.018***	−0.018***
	(0.006)	(0.006)	(0.003)	(0.003)
MB_t	0.001	0.002	−0.001	−0.000
	(0.015)	(0.015)	(0.008)	(0.008)
LEV_t	−0.164***	−0.164***	−0.084***	−0.084***
	(0.060)	(0.060)	(0.032)	(0.032)
ROA_t	−0.026***	−0.026***	−0.013**	−0.013**
	(0.010)	(0.010)	(0.006)	(0.006)
$ABACC_t$	0.005	0.005	0.002	0.002
	(0.004)	(0.004)	(0.002)	(0.002)
Constant	0.437***	0.509***	0.275***	0.315***
	(0.105)	(0.106)	(0.053)	(0.053)
Observations	13,617	13,617	13,617	13,617
Adjusted R-squared	0.053	0.053	0.053	0.053
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

***$p<0.01$; **$p<0.05$, *$p<0.1$

male and female directors influence the association between non-co-opted independent director and crash risk, supporting our *H3*.

4.3 Endogeneity issue

The positive relation between co-option and crash risk remains strong even in light of the lagged co-opted directors used. The results indicate strong co-option predication effects on crash risk. The OLS results might still be subject to an endogeneity problem. That is, bad corporate governance leads to a higher number of co-opted directors and thus greater firm crash risk. Given that there is no effective (quasi-) natural experiment to solve the endogeneit issue in our context (Coles et al. 2014), and no suitable instrumental variables using panel data commonly exist, we address the endogeneity issue with the heteroskedasticity-based technique proposed by Lewbel (2012). This method appears a valid approach as many studies have adopted this method (Arcand et al. 2015; Colonnello et al. 2017; Anderson and Core 2018; Diallo and Koch 2018; Kao et al. 2018).

In particular, we are interested in estimating the following regression:

$$y_1 = \gamma_1 y_2 + \beta_1' x + \varepsilon_1 \tag{5}$$

$$y_2 = \gamma_2 y_1 + \beta_2' x + \varepsilon_2 \tag{6}$$

where an endogeneity problem arises due to the reverse causation from y_2(*CO-OPTION*) to y_1 (crash risk). In addition to the standard assumptions that $E(x\varepsilon_j) = 0$, j = 1, 2 and $\mathrm{cov}(x, \varepsilon_1\varepsilon_2) = 0$, we further need to assume the presence of heteroskedasticity in the data (a general assumption in the literature as most of the authors offer the heteroskedasticity-robust or clustered standard errors), i.e.,$\mathrm{cov}(x, \varepsilon_j^2) \neq 0$, j = 1, 2. Then, $x\varepsilon_2$ is a good instrument for y_2 because of the assumption that $\mathrm{cov}(x, \varepsilon_1\varepsilon_2) = 0$ warrants that $x\varepsilon_2$ is uncorrelated with ε_1, and the presence of heteroskedasticity ($\mathrm{cov}(x, \varepsilon_2^2) \neq 0$) assures that $x\varepsilon_2$ is correlated with ε_2, and thus with y_2.The model can be efficiently estimated by GMM. In case where x includes more than one covariate, the model is over-identified and the Hansen's J statistic can be used to test the validity of the instruments.[3] We use Hansen J tests to examine and confirm validity of our model. Table 5 reports the endogeneity results estimated by GMM (generalized method of moments).

The results in columns (1) and (5) of Table 5 support the earlier findings of Table 2 that the co-opted director has a positive and significant effect on future firm-specific crash risk, and the positive effect is more significant at the 1% level for male co-opted directors. In columns (2) and (6) of Table 5, the results, consistent with Table 3, confirm that the non-co-opted director independent variable has a negative and significant effect on future firm-specific crash risk. The results in columns (3) and (7) of Table 5 show that both of coefficients of *CO-MALE* on *NCSKEW* and *DUVOL* are positive and significant. The coefficient of *CO-FEMALE* is insignificant on *NCSKEW* but significant on *DUVOL*. In comparison, the effects of *CO-MALE* on crash risk are stronger than *CO-FEMALE*, which are consistent with previous findings of Table 3. In addition, the results in columns (4) and (8) indicate that the magnitude of the negative effect for non-co-opted female independent directors on *NCSKEW* (−0.291) and *DUVOL* (−0.143) are larger than non-co-opted male independent directors on *NCSKEW* (−0.110) and *DUVOL* (−0.061), which implies that the effects of

[3] We use the Stata package 'ivreg2h' (Baum and Schaffer 2012) to estimate these models.

Table 5 Robustness check: endogeneity

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CO-OPTION$_t$	0.687***				0.310***			
	(0.098)				(0.046)			
NONCO-INDEP$_t$		−0.310***				−0.147***		
		(0.064)				(0.033)		
CO-MALE$_t$			0.049***				0.024**	
			(0.019)				(0.009)	
CO-FEMALE$_t$			0.101				0.069**	
			(0.066)				(0.033)	
NONCO-INDEP-MALE$_t$				−0.110**				−0.061***
				(0.045)				(0.022)
NONCO-INDEP-FEMALE$_t$				−0.291**				−0.143**
				(0.113)				(0.057)
NCSKEW$_t$	0.016*	0.016*	0.017*	0.017*				
	(0.009)	(0.009)	(0.009)	(0.009)				
DUVOL$_t$					0.026***	0.027***	0.031***	0.031***
					(0.009)	(0.009)	(0.010)	(0.010)
RETURN$_t$	−0.375***	−0.303***	−0.237**	−0.238**	−0.170***	−0.138***	−0.114**	−0.116**
	(0.106)	(0.101)	(0.108)	(0.108)	(0.053)	(0.051)	(0.055)	(0.055)
SIGMA$_t$	−0.156***	−0.135***	−0.130***	−0.133***	−0.071***	−0.062***	−0.066***	−0.067***
	(0.042)	(0.040)	(0.042)	(0.042)	(0.021)	(0.020)	(0.021)	(0.021)
DTURN$_t$	0.036	0.014	0.024	0.023	0.016	0.006	0.013	0.013
	(0.023)	(0.022)	(0.023)	(0.023)	(0.011)	(0.010)	(0.011)	(0.011)
BSIZE$_t$	−0.057*	−0.034	−0.011	−0.019	−0.028*	−0.018	−0.009	−0.014
	(0.031)	(0.029)	(0.031)	(0.031)	(0.015)	(0.014)	(0.015)	(0.016)

Table 5 (continued)

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$SIZE_t$	−0.028***	−0.028***	−0.028***	−0.028***	−0.017***	−0.017***	−0.017***	−0.017***
	(0.007)	(0.006)	(0.007)	(0.007)	(0.003)	(0.003)	(0.003)	(0.003)
MB_t	0.010	0.002	0.000	0.002	0.003	−0.000	−0.001	0.000
	(0.015)	(0.015)	(0.016)	(0.016)	(0.008)	(0.008)	(0.008)	(0.008)
LEV_t	−0.118*	−0.157***	−0.161***	−0.160***	−0.064**	−0.081**	−0.078**	−0.078**
	(0.062)	(0.060)	(0.062)	(0.062)	(0.032)	(0.032)	(0.033)	(0.033)
ROA_t	−0.037***	−0.027***	−0.029**	−0.028**	−0.018***	−0.013**	−0.016*	−0.016*
	(0.013)	(0.010)	(0.014)	(0.014)	(0.007)	(0.006)	(0.009)	(0.009)
$ABACC_t$	0.010**	0.006	0.004	0.005	0.004	0.002	0.001	0.001
	(0.005)	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.046	0.464***	0.296**	0.371***	0.107*	0.297***	0.215***	0.256***
	(0.126)	(0.112)	(0.120)	(0.121)	(0.063)	(0.057)	(0.061)	(0.061)
Observations	13,589	13,589	11,758	11,758	13,589	13,589	11,758	11,758
R-squared	−0.051	0.055	0.059	0.059	−0.029	0.055	0.059	0.059
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

non-co-opted female independent directors on decreasing crash risk are more pronounced than non-co-opted male independent directors. In sum, Table 5 supports our three main hypotheses (*H1–H3*) after accounting for potential endogeneity.

We also run a series of robustness checks to confirm our main results. First, the standard errors of the coefficient estimates in all previous tables are robust to any form of heteroskedasticity. We adjust the standard errors clustered by both firm and year effects in the regression (Petersen 2009). Second, to avoid our results are influenced by outliers, we winsorize the top and bottom 1 percent of continuous variables and applying robust regression to mitigate the effect of outliers in our analysis. Third, it is likely that CEOs will withhold bad news for extended periods, and hence their impact may persist longer. Thus, we expand the measurement interval of future crash risk to a two-year-ahead window. After controlling for the cluster effect, outlier issue, and predictive ability of co-opted directors, we obtain similar results in Tables 2, 3 and 4. Tables 11, 12 and 13 (in the "Appendix") show that our main findings remain robust to these specifications.

4.4 Additional analysis

4.4.1 The bright side of co-opted boards[4]

In China, agency conflict between controlling families (under the Chinese guanxi culture) and minority shareholder is a serious issue (Cheung et al. 2013). Co-opted directors, who are more inclined to maintain friendly relations with the CEO, have a positive and significant effect on crash risk; in contrast, non-co-opted independent directors, who are truly independent, have a negative and significant effect on crash risk. The main arguments may be based on monitoring role of the board (Adams and Ferreira 2007; Hsu et al. 2015; Kang et al. 2018). Co-opted (friendly) board members may enhance firm value because they might be more effective in advising function.

For example, innovation or R&D expenditure is a main engine for firm growth, but the innovative activities or R&D investment processes require considerable time, communication, and coordination among directors and the management. Friendly boards who are more passive in their roles as monitors of CEOs may encourage CEOs to undertake a more long-term risky R&D expenditures. Hsu et al. (2015) show family ownership promotes more innovation and the advisory advantage of family firms outweighs the disadvantage of passive monitoring on CEOs. Consistent with Hsu et al. (2015), Kang et al. (2018) find that a positive relation between friendly boards and innovation and the friendly board facilitates greater information exchanges between CEOs and boards, thereby enabling the board to provide better advising. Thus, we examine if the co-opted board could facilitate firm's R&D spending for firm growth. The results are reported in the Table 6.

Table 6 shows the positive effect of co-option on R&D expenditures. The coefficients estimate of CO-OPTION is column (1) is 0.1197 and significant at the 1% level. Column (2), using another measure of co-option, TWCO-OPTION, the estimated coefficient is 0.0942, which remains significantly positive on R&D. Co-opted board, which have a close tie between CEOs and directors, could bring friendliness, enhance CEO-director information sharing and make them have more tolerant of failures from the long-term risky

[4] We thank an anonymous referee suggests this analysis.

Table 6 R&D and co-opted directors

Variables	(1) *RD*	(2) *RD*
CO-OPTION	0.1197***	
	(0.0419)	
TWCO-OPTION		0.0942***
		(0.0362)
ROA	0.8904***	0.8834***
	(0.2818)	(0.2823)
SIZE	−0.0899***	−0.0885***
	(0.0179)	(0.0179)
LEV	−0.7318***	−0.7288***
	(0.1462)	(0.1467)
TobinQ	0.1954***	0.1970***
	(0.0284)	(0.0285)
Revenue	−0.6540***	−0.6543***
	(0.0471)	(0.0471)
Share	0.0191***	0.0190***
	(0.0023)	(0.0023)
Z-value	−0.0263	−0.0262
	(0.0170)	(0.0170)
Constant	3.0345***	3.0299***
	(0.3882)	(0.3880)
Adjusted R-squared	0.3654	0.3652
Industry Dummies	Yes	Yes
Year Dummies	Yes	Yes

RD is the ratio of R&D expenditures to firm's total operating revenues. Tobin Q is the ratio of market value of equity to book value of total asset. Revenue is the ratio of prime operating revenue to total asset. Share is the percentage of shares owned by managers. Z-value is the ratio of shares owned by the largest shareholder to shares owned by the second largest shareholder. Other variables are defines in Table 10 (in the "Appendix")

Robust standard errors in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

investments. Thus, we find a positive relation between co-opted boards and R&D. The results are consistent with the arguments of Hsu et al. (2015) and Kang et al. (2018).[5]

[5] We further examine whether R&D serves as a mediator between the co-opted board and crash risk. Following the mediation analysis of Baron and Kenny (1986), we regress the crash risk on both CO-OPTION and R&D. The coefficient of R&D is insignificant, implying that R&D is not a mediator to cause crash risk. The result of the mediator analysis is reported in Appendix A5.

4.4.2 The effects of SOEs and non-SOEs

SOEs are owned by the government, and their CEOs and directors are appointed directly by government authorities. These politically based directorships give SOEs more advantages in obtaining resources over non-SOEs. To compete with SOEs for scarce resources, non-SOEs that have co-opted boards but lack political support have a greater need to build connections. In addition, directors and CEOs have the same interests as the government, which hamper directors' ability to monitor CEOs at SOEs. The congruent goals with the government do not change if it changes a firm's CEO. That means independent directors are sympathetic and not independent at SOEs, regardless of whether they are co-opted. In contrast, the goal of non-SOEs is usually profit-oriented, and so they are better able to establish a well-defined ownership structure that facilitates effective monitoring.

Independent directors at non-SOEs should be more capable than those at SOEs (Chen et al. 2006; Liu et al. 2014; Zhou et al. 2017). Thus we examine the association between co-opted (non-co-opted independent) directors and crash risk at non-SOEs and SOEs separately. Table 8 presents the results for non-SOEs in Panel A and for SOEs in Panel B.

In Panel A of Table 7, columns (1)–(2) show a significantly positive (negative) impact of co-opted directors (non-co-opted independent directors) on crash risk at non-SOEs. Conditioned on board gender, columns (3)–(4) show that the impact of co-opted male directors on crash risk are significantly positive at the 5 percent level and the magnitude of negative effect of non-co-opted independent female directors on crash risk are larger for non-SOEs.

The results of Panel B of Table 7 for SOEs show that the impacts of co-opted directors and non-co-opted independent directors on crash risk are insignificant. Even considering the board gender effect, most coefficients of co-opted male director and non-co-opted female independent directors become insignificant. Thus, the results in Table 7 support our *H4*. The result confirms that the board members at SOEs become rubber stamps.

4.4.3 The effects of financial leverage

Highly leveraged firms are more likely to have higher crash risk exposure because managers have more incentives to hide bad information, as firms usually need to substitute equity for debt (Kim et al. 2011b). To investigate whether the co-opted (non-co-opted independent) directors contribute to crash risk more at highly leveraged firms, we examine, in a subsample analysis, the relation between co-opted (non-co-opted independent) directors and crash risk for firms with high and low leverage.

Panel A of Table 8 shows that coefficients of co-opted directors have a positive and significant effect on crash risk while non-co-opted independent directors have a negative and significant effect on crash risk at highly leveraged firms. The significant gender-crash risk relation for co-opted male directors and non-co-opted independent female directors is also present at highly leveraged firms. Panel B of Table 8 shows that the gender-crash risk relation becomes insignificant at firms with low leverage. The results of Table 8 indicate that our three main hypotheses (*H1–H3*) are more pronounced for high-leverage firms, which provide incentives for CEOs to hide risk taking.

Table 7 Additional analysis: non-SOE and SOE subsamples

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: non-SOE subsample								
$CO\text{-}OPTION_t$	0.069***				0.036***			
	(0.025)				(0.013)			
$NONCO\_INDEP_t$		−0.238***				−0.125***		
		(0.065)				(0.033)		
CO_MALE_t			0.063**				0.030**	
			(0.028)				(0.014)	
CO_FEMALE_t			0.106				0.073*	
			(0.086)				(0.043)	
$NONCO\text{-}IND\_MALE_t$				−0.198***				−0.104***
				(0.071)				(0.036)
$NONCO\text{-}IND\_FEMALE_t$				−0.430*				−0.221***
				(0.170)				(0.084)
$NCSKEW_t$	−0.023*	−0.025*	−0.023*	−0.025*				
	(0.014)	(0.014)	(0.014)	(0.014)				
$DUVOL_t$					−0.008	−0.009	−0.008	−0.010
					(0.014)	(0.014)	(0.014)	(0.014)
Observations	5332	5332	5332	5332	5332	5332	5332	5332
Adjusted $R2$	0.011	0.012	0.011	0.012	0.012	0.014	0.012	0.014
Panel B: SOE subsample								
$CO\text{-}OPTION_t$	0.036*				0.017			
	(0.021)				(0.010)			
$NONCO\_INDEP_t$		−0.067				−0.033		
		(0.049)				(0.024)		

Table 7 (continued)

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CO_MALE_t			0.043*				0.018	
			(0.023)				(0.011)	
CO_FEMALE_t			−0.033				0.013	
			(0.090)				(0.044)	
$NONCO\text{-}IND\_MALE_t$				−0.032				−0.021
				(0.054)				(0.026)
$NONCO\text{-}IND\_FEMALE_t$				−0.283**				−0.104
				(0.142)				(0.070)
$NCSKEW_t$	−0.008	−0.008	−0.008	−0.008				
	(0.011)	(0.011)	(0.011)	(0.011)				
$DUVOL_t$					−0.003	−0.003	−0.003	−0.003
					(0.011)	(0.011)	(0.011)	(0.011)
Observations	8285	8285	8285	8285	8285	8285	8285	8285
Adjusted $R2$	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

All the controlled variables and industry dummies are controlled in Table 9 are included but not reported conciseness

Robust standard errors are in parentheses

$***p<0.01$; $**p<0.05$; $*p<0.1$

Table 8 Additional analysis: the effect of financial leverage

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: High Leverage firms								
$CO\text{-}OPTION_t$	0.062***				0.032***			
	(0.023)				(0.012)			
$NONCO\_INDEP_t$		−0.190***				−0.100***		
		(0.056)				(0.028)		
CO_MALE_t			0.057**				0.027**	
			(0.026)				(0.013)	
CO_FEMALE_t			0.102				0.074	
			(0.093)				(0.046)	
$NONCO\text{-}IND\_MALE_t$				−0.137**				−0.077**
				(0.062)				(0.031)
$NONCO\text{-}IND\_FEMALE_t$				−0.490***				−0.236***
				(0.150)				(0.076)
$NCSKEW_t$	0.003	0.003	0.003	0.004				
	(0.012)	(0.012)	(0.012)	(0.012)				
$DUVOL_t$					0.006	0.005	0.006	0.005
					(0.013)	(0.013)	(0.013)	(0.013)
Observations	6805	6805	6805	6805	6805	6805	6805	6805
Adjusted $R2$	0.011	0.012	0.011	0.012	0.012	0.013	0.012	0.013
Panel B: Low Leverage firms								
$CO\text{-}OPTION_t$	0.035				0.018			
	(0.023)				(0.011)			
$NONCO\_INDEP_t$		−0.071				−0.036*		
		(0.056)				(0.028)		

Table 8 (continued)

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CO_MALE_t			0.042*				0.018	
			(0.025)				(0.012)	
CO_FEMALE_t			0.024				0.019	
			(0.084)				(0.042)	
$NONCO\text{-}IND\_MALE_t$				−0.039				−0.024
				(0.060)				(0.030)
$NONCO\text{-}IND\_FEMALE_t$				−0.240				−0.098
				(0.157)				(0.076)
$NCSKEW_t$	−0.026**	−0.026**	−0.026**	−0.027**				
	(0.012)	(0.012)	(0.012)	(0.012)				
$DUVOL_t$					−0.016	−0.016	−0.016	−0.016
					(0.012)	(0.012)	(0.012)	(0.012)
Observations	6812	6812	6812	6812	6812	6812	6812	6812
Adjusted $R2$	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

All the controlled variables are included and industry dummies are controlled in Table 10, but not reported for conciseness

Robust standard errors are in parentheses

***$p<0.01$; **$p<0.05$, *$p<0.1$

Table 9 Additional analysis: The effects of earnings management

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: High earnings management firms								
$CO\text{-}OPTION_t$	0.073***				0.036***			
	(0.023)				(0.011)			
$NONCO\_INDEP_t$		−0.211***				−0.102***		
		(0.055)				(0.028)		
CO_MALE_t			0.071***				0.031**	
			(0.024)				(0.012)	
CO_FEMALE_t			0.085				0.080*	
			(0.087)				(0.043)	
$NONCO\text{-}IND\_MALE_t$				−0.160***				−0.081***
				(0.060)				(0.031)
$NONCO\text{-}IND\_FEMALE_t$				−0.495***				−0.219***
				(0.157)				(0.077)
$NCSKEW_t$	−0.027**	−0.028**	−0.027**	−0.028**				
	(0.012)	(0.012)	(0.012)	(0.012)				
$DUVOL_t$					−0.008	−0.009	−0.008	−0.009
					(0.012)	(0.012)	(0.012)	(0.012)
Observations	6805	6805	6805	6805	6805	6805	6805	6805
Adjusted $R2$	0.008	0.009	0.008	0.009	0.009	0.010	0.009	0.010
Panel B: Low earnings management firms								
$CO\text{-}OPTION_t$	0.020				0.012			
	(0.023)				(0.012)			
$NONCO\_INDEP_t$		−0.050				−0.035		
		(0.057)				(0.028)		

Table 9 (continued)

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CO_MALE_t			0.026				0.012	
			(0.026)				(0.013)	
CO_FEMALE_t			−0.026				−0.008	
			(0.089)				(0.044)	
$NONCO\text{-}IND\_MALE_t$				−0.020				−0.022
				(0.062)				(0.030)
$NONCO\text{-}IND\_FEMALE_t$				−0.213				−0.105
				(0.150)				(0.075)
$NCSKEW_t$	−0.001	−0.001	−0.001	−0.000				
	(0.012)	(0.012)	(0.012)	(0.012)				
$DUVOL_t$					0.001	0.001	0.001	0.001
					(0.012)	(0.012)	(0.012)	(0.012)
Observations	6812	6812	6812	6812	6812	6812	6812	6812
Adjusted $R2$	0.006	0.006	0.006	0.006	0.007	0.007	0.007	0.007

All the controlled variables are included and industry dummies are controlled in Table 12, but not reported for conciseness

Robust standard errors are in parentheses

$^{***}p<0.01$; $^{**}p<0.05$; $^{*}p<0.1$

4.4.4 The effects of earnings management

Financial opacity enables CEOs to hide bad news from investors for extended periods (Hutton et al. 2009; Jin and Myers 2006; Kim et al. 2011a, b; Xu et al. 2014). Although we have included firm-level earnings management (*ABACC*) among our control variables, it is possible that earnings management will amplify the effect on crash risk of hoarding bad news by co-opted directors. Francis et al. (2016) suggest that managers use real earnings management to hoard negative information, showing a positive and significant relation between real earning management firms and cash risk. To address the issue, we examine the association between co-opted (non-co-opted independent) directors and crash risk for two subsample firms, that is, firms with high earnings management (above median of *ABACC*) and firms with low earnings management (below median of *ABACC*).

Panel A of Table 9 reports the regression results for firms with high earnings management. As in our earlier findings, co-opted directors are positively and significantly related to crash risk while non-co-opted independent directors are negatively and significantly related to crash risk. The positive co-opted directors-crash risk relation is stronger among male directors while the negative relation of non-co-opted independent directors and crash risk is stronger among female directors. Panel B of Table 9 reports the results of board-crash risk relations for firms with low earnings management. They do not seem to be related. The results are consistent with our expectation that CEO/managers in firms with high earning management are more likely to conceal bad news, thus our three main hypotheses (H1–H3) are more pronounced for firms with high earnings management.

5 Conclusions

Using a large annual panel of Chinese listed firms covering 1999–2016, we investigate how board composition affects crash risk. The results indicate that the co-opted directors amplify crash risk, confirming that they have allegiance to the CEOs. This can be easily understood, as they are driven by the push forces from *guanxi*. At the same time, non-co-opted independent directors appear to mitigate future crash risk, implying that pull forces from the preference for rectitude dominates those push forces. When the co-opted and non-co-opted independent board members are divided into male and female directors, the positive co-opted board-crash risk relation is exacerbated among co-opted male directors, and the negative association between non-co-opted directors and crash risk is more pronounced among non-co-opted female directors. The different behaviors between male and female directors indicate that gender characteristics are an important trait associated with firm-specific crash risk and support the idea that male co-opted board members are more influenced by push forces while female non-co-opted independent board members are driven primarily by pull forces. Those findings are robust to endogeneity, the inclusion of firm and year dummies, clustered standard errors at both the firm and time levels, and the presence of outliers. These impacts of co-opted (male) director and non-co-opted (female) independent directors on crash risk persist for at least two years.

When we examine the effect of co-opted independent board members on crash risk, the gender-crash risk relation disappear. This is an interesting result because this group of co-opted independent board members is at the center of push and pull forces. As these members cannot reconcile these two powerful forces, they simply adopt a play-it-safe strategy to become rubber stamps in their recommendations. Similar results of the gender-crash risk relation are observed at SOEs, where the government often places bureaucrats on the board as directors, and SOEs promote rubber stamps.

Our results also have implications for policymakers and regulators who aim to improve corporate governance: firms should try to add more non-co-opted directors and more female directors to their board to effectively improve board monitoring, avoid the hoarding of bad news, and decrease firm-specific crash risk. Our study highlights the important role of the gender effect in board dynamics.

Acknowledgements We are grateful to the constructive comments and recommendations of the Editor, Cheng-Few Lee, and an anonymous reviewer. We also appreciate participants at 2019 27th Annual Conference on Pacific Basin Finance, Economics, Accounting, and Management (PBFEAM) at Taiwan University. This research was partly supported by the Ministry of Science and Technology (MOST) of Taiwan (Grant Nos. 107-2410-H-029-050 and MOST 107-2410-H-032-015).

Appendix

See Tables 10, 11, 12, 13 and 14.

Table 10 Definition of variables

Panel A: Crash risk measures	
NCSKEW	Negative skewness of firm weekly returns over a fiscal year
DUVOL	Log of the ratio of the standard deviations of down-week to up-week firm-specific returns
Panel B: Co-opted board variables	
CO_OPTION	The total service time of co-opted directors divided by the total service time of all directors
TWCO_OPTION	Total service time of co-opted directors multiplied by the corresponding tenure divided by the total service time of all directors multiplied by the corresponding tenure
INDEP	Number of independent directors divided by total board members
CO-IND	Co-opted independent directors who appointed after the CEO assumed office
	The sum of service time of co-opted independent directors divided by the sum of the service time of all independent directors
NONCO-IND	Non-co-opted independent directors who were on the board before the CEO assumed office
	Total service time of non-co-opted independent directors divided by the total service time of all independent directors
CO-MALE	The sum of the service time provided by male co-opted directors divided by the total service time of all directors
CO-FEMALE	The sum of the service time provided by female co-opted directors divided by the total service time of all directors
NONCO-IND-MALE	Total service time provided by corresponding male non-co-opted independent directors divided by the total service time of all independent directors
NONCO-IND-FEMALE	Total service time provided by corresponding female non-co-opted independent directors divided by the total service time of all independent directors
Panel C: Other control variables	
RETURN	Mean of firm-specific weekly returns over a fiscal year
SIGMA	Log of the standard deviation of firm-specific weekly returns over a fiscal year
DTURN	Average monthly share turnover over the current fiscal year minus the average monthly share turnover over the previous fiscal year; monthly share turnover is the monthly trading volume divided by the total number of shares outstanding during the month
BSIZE	Log of the board size (number of board members)
SIZE	Log of the market value of equity
MB	Log of the market value of equity divided by the book value of equity
LEV	Ratio of total long-term debt to total assets
ROA	Ratio of net income to total assets
ABACC	Absolute value of discretionary accruals, which are estimated from the modified Jones model (Dechow et al. 1995)
SOEs	Firms in which the government is the largest shareholder

Table 11 Robustness check: controlling for firm-fixed effect and cluster effects

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: firm-fixed effect								
$CO\text{-}OPTION_t$	0.078***				0.041***			
	(0.022)				(0.011)			
$NONCO\_INDEP_t$		−0.183***				−0.100***		
		(0.050)				(0.025)		
CO_MALE_t			0.080***				0.038***	
			(0.024)				(0.012)	
CO_FEMALE_t			0.063				0.069	
			(0.093)				(0.046)	
$NONCO\text{-}IND\_MALE_t$				−0.146***				−0.086***
				(0.056)				(0.028)
$NONCO\text{-}IND\_FEMALE_t$				−0.390***				−0.174**
				(0.141)				(0.072)
$NCSKEW_t$	−0.111***	−0.111***	−0.111***	−0.112***				
	(0.009)	(0.009)	(0.009)	(0.009)				
$DUVOL_t$					−0.106***	−0.107***	−0.106***	−0.107***
					(0.009)	(0.009)	(0.009)	(0.009)
Observations	13,617	13,617	13,617	13,617	13,617	13,617	13,617	13,617
Adjusted $R2$	0.018	0.018	0.018	0.018	0.024	0.024	0.024	0.024
Panel B: cluster effect								
$CO\text{-}OPTION_t$	0.048***				0.025***			
	(0.016)				(0.008)			
$NONCO\_INDEP_t$		−0.134***				−0.070***		
		(0.040)				(0.020)		
CO_MALE_t			0.050***				0.022**	

Table 11 (continued)

Variables	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			(0.018)				(0.009)	
CO_FEMALE_t			0.037				0.045	
			(0.064)				(0.031)	
$NONCO\text{-}IND\_MALE_t$				−0.094**				−0.053**
				(0.044)				(0.022)
$NONCO\text{-}IND\_FEMALE_t$				−0.355***				−0.162***
				(0.111)				(0.056)
$NCSKEW_t$	−0.013	−0.013	−0.013	−0.014				
	(0.009)	(0.009)	(0.009)	(0.009)				
$DUVOL_t$					−0.004	−0.004	−0.004	−0.004
					(0.009)	(0.009)	(0.009)	(0.009)
Observations	13,617	13,617	13,617	13,617	13,617	13,617	13,617	13,617
Adjusted $R2$	0.007	0.007	0.007	0.008	0.008	0.008	0.008	0.009

All the controlled variables are included and industry dummies are controlled in Table 6, but not reported for conciseness

Robust standard errors are in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

Table 12 Robustness check for controlling Outliers

	$NCSKEW_{t+1}$				$DUVOL_{t+1}$			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Winsorized at 1% and 99%								
CO-OPTION$_t$	0.045***				0.023***			
	(0.015)				(0.008)			
NONCO_INDEP$_t$		−0.120***				−0.066***		
		(0.037)				(0.019)		
CO_MALE$_t$			0.045***				0.021**	
			(0.017)				(0.009)	
CO_FEMALE$_t$			0.050				0.045	
			(0.062)				(0.031)	
NONCO-IND_MALE$_t$				−0.078*				−0.048**
				(0.041)				(0.021)
NONCO-IND_FEMALE$_t$				−0.392***				0.189***
				(0.109)				(0.055)
NCSKEW$_t$	−0.017*	−0.017**	−0.017*	−0.018**				
	(0.009)	(0.009)	(0.009)	(0.009)				
DUVOL$_t$					−0.008	−0.008	−0.008	−0.008
					(0.009)	(0.009)	(0.009)	(0.009)
Observations	13,617	13,617	13,617	13,617	13,617	13,617	13,617	13,617
Adjusted $R2$	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
Panel B: Robust regression								
CO-OPTION$_t$	0.038***				0.022***			
	(0.014)				(0.008)			
NONCO_INDEP$_t$		−0.095***				−0.062***		
		(0.034)				(0.019)		
CO_MALE$_t$			0.037**				0.020**	

Table 12 (continued)

Variables	$NCSKEW_{t+1}$ (1)	(2)	(3)	(4)	$DUVOL_{t+1}$ (5)	(6)	(7)	(8)
			(0.016)				(0.009)	
CO_FEMALE_t			0.048				0.037	
			(0.056)				(0.031)	
$NONCO\text{-}IND\_MALE_t$				−0.067*				−0.045**
				(0.037)				(0.021)
$NONCO\text{-}IND\_FEMALE_t$				−0.255***				−0.157***
				(0.092)				(0.051)
$NCSKEW_t$	−0.018**	−0.018**	−0.018**	−0.018**				
	(0.008)	(0.008)	(0.008)	(0.008)				
$DUVOL_t$					−0.012	−0.012	−0.012	−0.012
					(0.009)	(0.009)	(0.009)	(0.009)
Observations	13,617	13,617	13,617	13,617	13,617	13,617	13,617	13,617
Adjusted $R2$	0.009	0.009	0.009	0.010	0.009	0.009	0.009	0.009

All the controlled variables are included and industry dummies are controlled in Table 7, but not reported for conciseness

Robust standard errors are in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

Table 13 Robustness check for a longer forecast window (two-year window)

Variables	$NCSKEW_{[t+1,t+2]}$				$DUVOL_{[t+1,t+2]}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$CO\text{-}OPTION_t$	0.059***				0.026***			
	(0.017)				(0.009)			
$NONCO\_INDEP_t$		−0.136***				−0.061***		
		(0.041)				(0.020)		
CO_MALE_t			0.061***				0.024**	
			(0.019)				(0.009)	
CO_FEMALE_t			0.050				0.045	
			(0.065)				(0.033)	
$NONCO\text{-}IND\_MALE_t$				−0.032				−0.024
				(0.043)				(0.022)
$NONCO\text{-}IND\_FEMALE_t$				−0.321***				−0.147***
				(0.114)				(0.057)
$NCSKEW_t$	0.016	0.016	0.016	0.030***				
	(0.010)	(0.010)	(0.010)	(0.010)				
$DUVOL_t$					0.015	0.015	0.015	0.016
					(0.010)	(0.010)	(0.010)	(0.009)
$RETURN_t$	−0.147	−0.146	−0.147	−0.247**	−0.098*	−0.098*	−0.097*	−0.148***
	(0.108)	(0.108)	(0.108)	(0.103)	(0.055)	(0.055)	(0.055)	(0.052)
$SIGMA_t$	−0.067*	−0.068*	−0.068*	−0.097**	−0.049**	−0.049**	−0.049**	−0.061***
	(0.040)	(0.040)	(0.040)	(0.039)	(0.020)	(0.020)	(0.020)	(0.020)
$DTURN_t$	0.172***	0.172***	0.172***	0.049**	0.086***	0.086***	0.086***	0.028***
	(0.021)	(0.021)	(0.021)	(0.020)	(0.010)	(0.010)	(0.010)	(0.010)
$BSIZE_t$	−0.008	−0.013	−0.008	−0.019	−0.009	−0.011	−0.009	−0.012
	(0.031)	(0.031)	(0.031)	(0.030)	(0.015)	(0.015)	(0.015)	(0.015)
$SIZE_t$	−0.039***	−0.039***	−0.039***	−0.020***	−0.018***	−0.018***	−0.018***	−0.018***

Table 13 (continued)

Variables	$NCSKEW_{[t+1,t+2]}$				$DUVOL_{[t+1,t+2]}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)
MB_t	0.011	0.010	0.011	0.034**	0.007	0.006	0.006	0.0019***
	(0.014)	(0.014)	(0.014)	(0.013)	(0.007)	(0.007)	(0.007)	(0.007)
LEV_t	−0.196***	−0.196***	−0.196***	−0.139***	−0.093*	−0.093*	−0.093*	−0.062*
	(0.060)	(0.060)	(0.060)	(0.065)	(0.030)	(0.030)	(0.030)	(0.033)
ROA_t	0.017	0.017	0.017	0.007	0.012	0.012	0.012	0.009
	(0.019)	(0.019)	(0.019)	(0.015)	(0.011)	(0.011)	(0.011)	(0.008)
$ABACC_t$	−0.006	−0.006	−0.006	−0.002	−0.004	−0.004	−0.004	0.000
	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.558***	0.625***	0.558***	0.389***	0.290***	0.320***	0.289***	0.231***
	(0.105)	(0.105)	(0.105)	(0.103)	(0.054)	(0.053)	(0.054)	(0.053)
Observations	11,780	11,780	11,780	11,780	11,780	11,780	11,780	11,780
*R*2	0.019	0.018	0.018	0.006	0.019	0.019	0.019	0.006
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

Table 14 The mediation analysis of R&D between co-option and crash risk

Variables	*NCSKEW* (1)	*NCSKEW* (2)	*DUVOL* (3)	*DUVOL* (4)
RD	0.0058	0.0057	0.0017	0.0017
	(0.0113)	(0.0113)	(0.0056)	(0.0056)
CO-OPTION	0.0704*		0.0428**	
	(0.0408)		(0.0193)	
TWCO-OPTION		0.0720**		0.0408**
		(0.0354)		(0.0170)
NCSKEW	0.0192	0.0189		
	(0.0213)	(0.0213)		
DUVOL			0.0133	0.0131
			(0.0218)	(0.0218)
RETURN	−0.5613**	−0.5657**	−0.3193**	−0.3216**
	(0.2755)	(0.2755)	(0.1335)	(0.1335)
SIGMA	−0.1605	−0.1615	−0.0956**	−0.0962**
	(0.0997)	(0.0996)	(0.0483)	(0.0482)
DTURN	0.0592	0.0600	0.0302	0.0305
	(0.0567)	(0.0566)	(0.0262)	(0.0261)
BSIZE	−0.1271*	−0.1254*	−0.0756**	−0.0743**
	(0.0758)	(0.0755)	(0.0374)	(0.0373)
SIZE	−0.0120	−0.0117	−0.0098	−0.0096
	(0.0178)	(0.0177)	(0.0086)	(0.0086)
MB	0.1188***	0.1197***	0.0600***	0.0605***
	(0.0356)	(0.0355)	(0.0182)	(0.0182)
LEV	−0.0609	−0.0566	−0.0364	−0.0351
	(0.1798)	(0.1797)	(0.0862)	(0.0862)
ROA	0.1675	0.1525	0.0016	−0.0062
	(0.2161)	(0.2161)	(0.1451)	(0.1451)
ABACC	−0.0200*	−0.0200*	−0.0092*	−0.0092*
	(0.0108)	(0.0108)	(0.0054)	(0.0054)
Constant	0.1754	0.1734	0.2024	0.2019
	(0.2773)	(0.2773)	(0.1411)	(0.1411)
Adjusted R-squared	0.0178	0.0182	0.0186	0.0189
Industry Dummies	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

***$p<0.01$; **$p<0.05$; *$p<0.1$

References

Adams RB, Ferreira D (2007) A theory of friendly board. J Finance 62:217–250

Adams RB, Ferreira D (2009) Women in the boardroom and their impact on governance and performance. J Financ Econ 94:291–309

Adams R, Hermalin B, Weisbach M (2010) The role of boards of directors in corporate governance: a conceptual framework and survey. J Econ Lit 48:58–107

An H, Zhang T (2013) Stock price synchronicity, crash risk, and institutional investors. J Corp Finance 21:1–15

Anderson JD, Core JE (2018) Managerial incentives to increase risk provided by debt, stock, and options. Manag Sci 64:3971–4470

Arcand JL, Berkes E, Panizza U (2015) Too much finance? J Econ Growth 20:105–148

Arena MP, Braga-Alves MV (2013) The discretionary effect of CEOs and board chairs on corporate governance structures. J Empir Finance 21:121–131

Baldenius T, Melumad N, Meng X (2014) Board composition and CEO power. J Financ Econ 112:53–68

Barber B, Odean T (2001) Boys will be boys: gender, overconfidence, and common stock investment. Q J Econ 116:261–292

Baum CF, Schaffer ME (2012) ivreg2h: Stata module to perform instrumental variables estimation using heteroskedasticity-based instruments. http://ideas.repec.org/c/boc/bocode/s457555.html

Bowen CC, Wu Y, Hwang C, Scherer RF (2007) Holding up half of the sky? Attitudes toward women as managers in the People's Republic of China. Int J Hum Resour Man 18:268–283

Bu N, Roy JP (2005) Career success networks in China: sex differences in network composition and social exchange practices. Asia Pac J Manag 22:381–403

Callen JL, Fang X (2013) Institutional investor stability and crash risk: monitoring versus short-termism? J Bank Finance 37:3047–3063

Callen JL, Fang X (2015) Religion and stock price crash risk. J Financ Quant Anal 50:169–195

Cao Y, Dhaliwal D, Li Z, Yang YG (2015) Are all independent directors equally informed? Evidence based on their trading returns and social networks. Manag Sci 61:795–813

Chen J, Hong H, Stein JC (2001) Forecasting crashes: trading volume, past returns, and conditional skewness in stock prices. J Financ Econ 61:345–381

Chen G, Firth M, Gao DN, Rui OM (2006) Ownership structure, corporate governance, and fraud: evidence from China. J Corp Finance 12:424–448

Chen S, Ni X, Tong J (2016) Gender diversity in the boardroom and risk management: a case of R&D investment. J Bus Ethics 136:599–621

Chen CR, Li Y, Luo D, Zhang T (2017) Helping hands or grabbing hands? An analysis of political connections and firm value. J Bank Finance 80:71–89

Cheng S (2008) Board size and the variability of corporate performance. J Financ Econ 87:157–176

Cheung Y, Chung C, Tan W, Wang W (2013) Connected board of directors: a blessing or a curse? J Bank Finance 37:3227–3242

Coles JL, Daniel ND, Naveen L (2008) Boards: does one size fit all? J Financ Econ 87:329–356

Coles JL, Daniel ND, Naveen L (2014) Co-opted boards. Rev Financ Stud 27:1751–1796

Colonnello S, Curatola G, Hoang NG (2017) Direct and indirect risk-taking incentives of inside debt. J Corp Finance 45:428–466

Cumming D, Leung T, Rui O (2015) Gender diversity and securities fraud. Acad Manag J 58:1572–1593

Dechow PM, Sloan RG, Sweeney AP (1995) Detecting earnings management. Acc Rev 70:193–225

Diallo B, Koch W (2018) Bank concentration and Schumpeterian growth: theory and international evidence. Rev Econ Stat 100:489–501

Dimson E (1979) Risk measurement when shares are subject to infrequent trading. J Financ Econ 7:197–226

Faleye O (2015) The costs of a (nearly) fully independent board. J Empir Finance 32:49–62

Fedaseyeu V, Linck JS, Wagner HF (2018) Do qualifications matter? New evidence on board functions and director compensation. J Corp Finance 48:816–839

Fracassi C, Tate G (2012) External networking and internal firm governance. J Finance 67:153–194

Francis B, Hasan I, Li L (2016) Abnormal real operations, real earnings management, and subsequent crashes in stock prices. Rev Quant Financ Acc 46:217–260

Gul F, Srinidhi B, Ng A (2011) Does board gender diversity improve the informativeness of stock prices? J Acc Econ 51:314–338

Hsu P-H, Huang S, Massa M, Zhang H (2015) The new lyrics of the old folks: the role of family ownership in corporate innovation. CEPR Discussion Paper No. DP10445. https://ssrn.com/abstract=2572423

Huang S, Lim CY, Ng J (2019) Not clawing the hand that feeds you: the case of co-opted boards and clawbacks. Eur Acc Rev 28:101–127

Hutton AP, Marcus A, Tehranian JH (2009) Opaque financial reports, R2, and crash risk. J Financ Econ 94:67–86
Hwang ER (1987) Face and favor: the Chinese power game. Am J Sociol 92:35–41
Jensen MC (1993) The modern industrial revolution, exit and the failure of internal control systems. J Finance 48:831–880
Jensen MC, Murphy KJ (1990) Performance pay and top-management incentives. J Polit Econ 98:225–265
Jiang F, Kim KA (2015) Corporate governance in China: a modern perspective. J Corp Finance 32:190–216
Jin L, Myers SC (2006) *R*2 around the world: new theory and new tests. J Financ Econ 79:257–292
Kang J-K, Liu W-L, Low A, Zhang L (2018) Friendly boards and innovation. J Empir Finance 45:1–25
Kao EH, Yeh CC, Wag LH, Fung HG (2018) The relationship between CSR and performance: evidence in China". Pac-Basin Financ J 51:155–170
Khanna V, Kim E, Lu Y (2015) CEO connectedness and corporate fraud. J Finance 70:1203–1252
Kim D, Starks LT (2016) Gender diversity on corporate boards: do women contribute unique skills? Am Econ Rev 106:267–271
Kim JB, Zhang L (2014) Financial reporting opacity and expected crash risk: evidence from implied volatility smirks. Contemp Acc Res 31:851–875
Kim JB, Zhang L (2016) Accounting conservatism and stock price crash risk: firm-level evidence. Contemp Acc Res 33:412–441
Kim JB, Li Y, Zhang L (2011a) Corporate tax avoidance and stock price crash risk: firm-level analysis. J Financ Econ 100:639–662
Kim JB, Li Y, Zhang L (2011b) CFOs versus CEOs: equity incentives and crashes. J Financ Econ 101:713–730
Kim Y, Li H, Li S (2014) Corporate social responsibility and stock price crash risk. J Bank Finance 43:1–13
Landier A, Sauvagnat J, Sraer D, Thesmar D (2013) Bottom-up corporate governance. Rev Finance 17:161–201
Lee W, Wang L (2017) Do political connections affect stock price crash risk? Firm-level evidence from China. Rev Quant Financ Acc 48:643–676
Lewbel A (2012) Using heteroskedasticity to identify and estimate mismeasured and endogenous regressor models. J Bus Econ Stat 30:67–80
Li S, Filer L (2007) The effects of the governance environment on the choice of investment mode and the strategic implications. J World Bus 42:80–98
Li J, Tang Y (2010) CEO hubris and firm risk taking in China: the moderating role of managerial discretion. Acad Manag J 53:45–68
Li X, Wang S, Wang X (2017) Trust and stock price crash risk: evidence from China. J Bank Finance 76:74–91
Liang Q, Xu P, Jiraporn P (2013) Board characteristics and Chinese bank performance. J Bank Finance 37:2953–2968
Liu Y, Wei Z, Xie F (2014) Do women directors improve firm performance in China? J Corp Finance 28:169–184
Louie K (2002) Theorizing Chinese masculinity. Cambridge University Press, Cambridge
Luo Y (2000) Guanxi and business. World Scientific, Singapore
Ma J, Khanna T (2016) Independent directors' dissent on boards: evidence from listed companies in China. Strateg Manag J 37:1547–1557
Morse A, Nanda V, Seru A (2011) Are incentive contracts rigged by powerful CEOs? J Finance 66:1779–1821
Petersen MA (2009) Estimating standard errors in finance panel data sets: comparing approaches. Rev Financ Stud 22:435–480
Ren B, Au K, Birtch T (2009) China's business network structure during institutional transitions. Asia Pac J Manag 26:219–241
Schmidt B (2015) Costs and benefits of friendly boards during mergers and acquisitions. J Financ Econ 117:424–447
Tee CM, Yee ASV, Chong AL (2018) Institutional investors' monitoring and stock price crash risk: evidence from politically connected firms. Rev Pac Basin Financ Mark Polic 21:1–35
Wang L (2015) Protection or expropriation: politically connected independent directors in China. J Bank Finance 55:92–106
Wilson N, Altanlar A (2011) Director characteristics, gender balance and insolvency risk: an empirical study. Working paper. https://dx.doi.org/10.2139/ssrn.1932107
Xu N, Li X, Yuan Q, Chan KC (2014) Excess perks and stock price crash risk: evidence from China. J Corp Finance 25:419–434
Yang J, Chi J, Young M (2011) A review of corporate governance in China. Asian Pac Econ Lit 25:15–28

Yeung IY, Tung RL (1996) Achieving business success in Confucian societies: the importance of *guanxi*. Organ Dyn 3:54–65

Zhou F, Fan Y, An Y, Zhong L (2017) Independent directors, non-controlling directors, and executive pay-for-performance sensitivity: evidence from Chinese non-state owned enterprises. Pac-Bas Financ J 43:55–71

Zhu Y, Konrad AM, Jiao H (2016) Violation and activation of gender expectations: do Chinese managerial women face a narrow band of acceptable career *guanxi* strategies? Asia Pac J Manag 33:53–86

Zuo J, Bian Y (2001) Gendered resources, division of housework, and perceived fairness-a case in urban China. J Marriage Fam 63:1122–1133