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**Article**

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# Female directors and real activities manipulation: Evidence from China



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## ABSTRACT

Unlike previous studies that focus on accrual-based earnings management, this study analyzes real activities manipulation and investigates whether female directors on boards of directors (BoDs) affect managers' real activities manipulation. Using a large sample of 11,831 firm-year observations from Chinese listed companies from the 2000 to 2011 period, we find that higher female participation on BoDs is associated with lower levels of real activities manipulation, and that this negative relationship is stronger when female directors have higher ownership. These results hold for a battery of robustness checks. Overall, our findings indicate that board gender diversity may serve as a substitute mechanism for corporate governance to curb real activities manipulation and thus provide interested stakeholders with higher quality earnings reports.

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## 1. Introduction

In recent years, board gender diversity has drawn considerable attention worldwide, especially after the 2008 economic crisis (Sun et al., 2015; Terjesen et al., 2009). Despite the rapid increase in female participation in business in the last decade (Rose, 2007; Srinidhi et al., 2011), female directors are still underrepresented on corporate boards. Some European countries (e.g., Sweden, Norway and Spain) now impose legal requirements on corporations to allocate board seats to women. For example, Spain introduced legislation requiring a 40%

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threshold for female board representation by the end of 2015. In this context, the economic benefits of female directors must be determined (Gul et al., 2011). If board gender diversity was known to increase firm value, firms would be willing to accept female directors on their boards even without legislation. The purpose of this study was to explore the role of female directors in curbing managers' real activities manipulation.

Managers have professional responsibilities and ethical obligations to report high quality earnings to outside stakeholders, such as investors and regulators (Krishnan and Parsons, 2008). However, self-serving managers all over the world are inclined to manipulate earnings to beat/meet benchmarks (Burgstahler and Dichev, 1997; DeGeorge et al., 1999; Liu and Lu, 2007). Generally, there are two earnings management strategies: accrual-based and real activities earnings manipulation (Cohen et al., 2008; Cohen and Zarowin, 2010; Zang, 2012). Prior studies of the effect of female directors focus on accrual-based earnings management and produce mixed results (Fields et al., 2001; Srinidhi et al., 2011; Sun et al., 2011). We argue that analyzing only one earnings management strategy fails to capture the overall effect of board gender diversity. In particular, as managers use the two earnings management strategies as substitutes for each other (Achleitner et al., 2014; Cohen et al., 2008; Cohen and Zarowin, 2010; Zang, 2012), a focus on accrual-based earnings management can be expected to lead to inconclusive results. Furthermore, in emerging economies such as China, where investors have a relatively low demand for high quality earnings and firms face low litigation risks (Allen et al., 2005; Chen et al., 2008; Liu and Tian, 2012), it is less costly for firms to manipulate accruals (Kuo et al., 2014). Thus, in emerging economies, female directors may play a more important role in curbing real activities manipulation. Finally, unlike accrual-based earnings management, which is achieved by exercising discretion over accruals in light of accounting principles, real activities manipulation is achieved by altering the timing and scale of operations, investments or financing transactions, which have real adverse economic consequences on a firm's long-term profitability and growth (Achleitner et al., 2014; Bereskin et al., 2014; Cohen and Zarowin, 2010; Gunny, 2010; Kim and Sohn, 2013; Zang, 2012). Given this fundamental difference, we predict that female directors, who are characterized by a lower tolerance of opportunism, less overconfidence and greater risk aversion, and as better monitors (Adams and Ferreira, 2009; Barber and Odean, 2001; Gul et al., 2011; Hillman et al., 2007; Krishnan and Parsons, 2008; Srinidhi et al., 2011; Sundén and Surette, 1998), may play a stronger role than male directors in curbing managers' real activities manipulation. However, few studies examine the potential effect of female directors on real activities manipulation.

Studies of corporate governance must focus on not only how an individual mechanism works, but also how the interaction of different mechanisms mitigates agency problems (Kim and Lu, 2011). That is, understanding how board gender diversity interacts with other mechanisms to curb real activities manipulation is also an important issue. On the one hand, the role of female directors largely depends on their personal characteristics, which may change under certain conditions, as all human beings, regardless of gender, are inevitably emotional and more or less opportunistic. In other words, the effectiveness of female directors in curbing managers' real activities manipulation may be unstable. Therefore, it is important for firms to design firm-level mechanisms that formalize and even enhance the role of female directors. On the other hand, stakeholders have long been interested in mechanisms that can mitigate earnings manipulation and improve earnings quality (Krishnan and Parsons, 2008). Thus, it is meaningful to know whether the role of board gender diversity is unique and irreplaceable. If the role of female directors is unique, stakeholders should voluntarily push firms to increase female board representation, as firms would otherwise depend on traditional mechanisms rather than a gender-diverse board. However, to date, little is known about the interactions between board gender diversity and other governance mechanisms.

To fill these knowledge gaps, we develop a conceptual model of the links between female participation on boards of directors (BoDs) and real activities manipulation. As ownership structure is one of the most cited influences on agency problems (Shleifer and Vishny, 1997), we further examine the moderating effect of stock ownership on the association between female participation on BoDs and real activities manipulation. We test this model in the context of China because it is the largest emerging economy in the world, and despite its severe earnings management (Kuo et al., 2014; Liu and Lu, 2007; Qi et al., 2014), little is known about real activities manipulation there. In general, there is limited evidence from emerging economies on whether BoDs are able to discipline managers' earnings management. Hence, a focus on Chinese firms allows us to extend the boundaries of existing knowledge on the antecedents of real activities manipulation. Moreover, the social status of women in China is assumed to be relatively high due to the policy of gender equality that has been

implemented by the Communist Party of China since its founding in 1949 (Leung, 2003; Peng et al., 2009). Therefore, China provides a good setting for examining the potential effects of gender diversity on corporate behavior and decision making.

Using a large sample of 11,831 firm-year observations from Chinese A-share listed firms for the 2000–2011 period, we find that when a firm has a critical mass of women serving on its BoD, i.e., at least 3 women or a high ratio of women on BoD, its managers engage in less real activities manipulation. In addition, we find that the negative relation is more pronounced when female directors hold higher ownership, indicating that stock ownership may enhance the role of female directors in curbing real activities manipulation. To further verify our findings, we undertake a battery of robustness checks. First, we split the role of female directors from that of female CEOs/chairmen by introducing female CEOs/chairmen as a control variable in the regressions, and find that female CEOs/chairmen have no significant relation with real activities manipulation; more importantly, our results are robust to this test. Second, we differentiate the governance effects of inside and outside female directors and find that although our results are valid for both, the effects are stronger for inside directors. Third, as firms with less real activities manipulation may be more likely to appoint women to serve on BoDs, we use the Heckman two-stage selection model and the propensity score matching (PSM) approach to address the issue of endogenous selection, and our findings still hold. Fourth, given the unique context of Chinese listed firms' two-tier boards, i.e., a BoD and a supervisory board, we examine the association between female participation on two-tier boards and real activities manipulation and arrive at similar findings. Fifth, as China's split share structure reform occurred during our sample period, we explore the effect of the reform on the role of female directors and get consistent and significant findings only in the subsample after the reform. Sixth, we examine the association of female participation on BoDs for each category of real activities manipulation, i.e., sales manipulation, overproduction and discretionary fees manipulation. The results indicate that female participation on BoDs curbs managers' real earnings management mainly through reducing sales manipulation and overproduction. Finally, as several studies have documented a trade-off between accrual-based and real activities earnings management (Achleitner et al., 2014; Cohen et al., 2008; Cohen and Zarowin, 2010; Zang, 2012), we also examine the role of female directors in curbing accrual-based earnings management and rerun the regressions by adding the level of accrual-based earnings management as a control variable. The results suggest that female directors have no relation with accrual-based earnings management, while our findings still hold after controlling for the potential trade-off between two kinds of earnings management.

This study makes several contributions to the literature. First, we extend the literature on female directors by showing that female participation on BoDs can help to curb managers' real activities manipulation. Female directors have received increasing research attention all over the world (Adams and Ferreira, 2009; Bear et al., 2010; Chen et al., 2016; Fields et al., 2001; Gul et al., 2011; Jia and Zhang, 2012, 2013; Jin et al., 2014; Srinidhi et al., 2011; Sun et al., 2015; Terjesen et al., 2009). To our knowledge, we are among the first to examine whether female directors may discipline managers who are engaging in real activities manipulation. Specifically, this study finds evidence that female directors can effectively curb real activities manipulation but not accrual-based earnings management.

Second, we contribute to the growing literature on real activities manipulation in the area of earnings management. Real activities manipulation is detrimental to a firm's long-term growth and competitive advantages (Achleitner et al., 2014; Bereskin et al., 2014; Cohen and Zarowin, 2010; Gunny, 2010; Kim and Sohn, 2013; Zang, 2012). In particular, scholars argue that real activities manipulation is largely opaque to outside stakeholders and less easy to be detected than accrual-based strategies of earnings management (Ge and Kim, 2014; Graham et al., 2005; Zang, 2012). However, we have limited knowledge of the mechanisms for solving this agency problem. In this study, we find evidence showing that board gender diversity is an effective mechanism for alleviating real activities manipulation.

Finally, we not only examine how female directorships work, but also explore how female directors may interact with other governance mechanisms to curb managers' real activities manipulation. More precisely, this study finds that female directors' ownership enhances their role in curbing real activities manipulation. In this way, our study helps to deepen our understanding of the role of female directors. In addition, these results have important practical implications for firms and regulators. In particular, they suggest that firms can make full use of the role of female directors by implementing stock-based compensation schemes.

## 2. Literature review and hypotheses development

### 2.1. Literature review

To examine the role of female directors in curbing real activities manipulation, we bring together two different strands of research.

First, this study builds on studies of board gender diversity. Although gender differences have been widely discussed in the psychology, sociology and economics fields, scholars have only begun to link gender diversity to corporate behavior and outcomes in the past two decades (Terjesen et al., 2009). Scholars initially explored the association between board gender diversity and firm performance, but the results of these early studies are inconclusive. For example, some studies find that board gender diversity is beneficial to firm performance (e.g., Campbell and Mínguez-Vera, 2008; Erhardt et al., 2003), some fail to get a significant finding (e.g., Carter et al., 2010; Rose, 2007) and others conclude that board gender diversity is detrimental to firm outcomes (e.g., Adams and Ferreira, 2009; Haslam et al., 2010). Particularly, Joecks et al. (2013) document a U-shaped relationship between board gender diversity and firm performance, indicating that a critical mass of female directors achieves the best performance. Thus, the economic effect of board gender diversity is an ongoing debate.

As firm performance is a complex function of many factors, more recent research has largely examined the role of board gender diversity in specific types of corporate behavior. For instance, studies document that female directors can improve corporate social performance and particularly increase corporate philanthropy (e.g., Bear et al., 2010; Jia and Zhang, 2011, 2012, 2013; Post et al., 2011; Williams, 2003), which is consistent with the common view that women care more about others and think more highly of social responsibility than men. Apart from this, as women have long been viewed as more risk averse than men (Barber and Odean, 2001; Byrnes et al., 1999; Sundén and Surette, 1998), scholars have examined the role of female directors in shaping corporate risk-taking behavior. They find that firms with higher female director participation have lower leverage, invest less in R&D, achieve lower investment efficiency and make fewer takeover defenses (Adams and Ferreira, 2009; Chen et al., 2016; Jin et al., 2014). In addition, more gender-diverse boards are found to play a better monitoring role by promoting higher board attendance, joining more monitoring committees and demanding greater accountability for managers' poor performance (Adams and Ferreira, 2009; Hillman et al., 2007), indicating that female directors are better and more active monitors.

However, evidence on the effect of board gender diversity on corporate accounting decision making is limited and the results are mixed.<sup>1</sup> For example, Gul et al. (2011) find that female directors are associated with higher earnings quality. Similarly, Srinidhi et al. (2011) document that female directors can improve the informativeness of stock prices by disclosing more firm-specific information and stimulating the collection of private information. However, Sun et al. (2011) fail to identify an association between female directors on audit committees and the extent of accrual-based earnings management. Given these limited and inconclusive results, the role of female directors in corporate accounting decision making is still an open question and requires more research.

Second, our study builds on research on real earnings management. Generally, managers have two different strategies for managing firms' earnings: accrual-based and real activities earnings management (Cohen et al., 2008; Cohen and Zarowin, 2010; Ge and Kim, 2014; Zang, 2012). Unlike the accrual-based strategy, which does not harm corporate daily operations or have real outcomes, real activities strategies are detrimental to a firm's growth and competitive advantages due to their long-term effects on sales manipulation, overproduction and abnormal reduction of discretionary expenses (Cohen et al., 2008; Graham et al., 2005; Roychowdhury, 2006; Zang, 2012). For example, Zhang et al. (2008) document that meager-profit enterprises in China engage in real activities manipulation to avoid losses. Gunny (2010) finds that real activities manipulation is positively associated with firms merely meeting earnings benchmarks, and that such manipulation

<sup>1</sup> Likewise, evidence for the effect of gender diversity among top executives on corporate accounting decision making is also mixed. For instance, whereas Krishnan and Parsons (2008) show that earnings quality is positively associated with gender diversity in senior management, Ye et al. (2010) find insignificant differences in the discretionary accruals of firms with female and male top executives in China.



adversely affects subsequent performance. Similarly, Francis et al. (2011) show that insiders use real activities to hide bad information, which results in a higher risk of future stock price crash. Taking a step further, Bereskin et al. (2014) and Lian et al. (2014) document that managing real earnings by cutting R&D expenses significantly reduces the number of subsequent innovations and their technological importance and novelty. In addition, Kim and Sohn (2013) and Ge and Kim (2014) find that outside investors and bondholders require a higher risk premium for real activities manipulation. That is, focal firms suffer a higher cost of capital caused by real activities manipulation.

As real activities manipulation results in adverse economic consequences, it is a critical and striking issue to understand how to alleviate this opportunistic behavior, particularly after the survey by Graham et al. (2005) demonstrated that real activities management is a common practice. Roychowdhury (2006) finds that sophisticated institutional investors are able to curtail real activities manipulation. Similarly, Wongsunwai (2013) finds that IPO firms backed by higher quality venture capitalists experience lower real activities manipulation. Moreover, recent studies have found evidence indicating that media coverage and Big 4 auditors are effective external governance mechanisms for alleviating real earnings management (e.g., Qi et al., 2014; Zhu et al., 2015). Despite this progress, few studies examine the effectiveness of internal governance mechanisms. One exception is a study by Ge and Kim (2014), who find that real earnings management increases with better board governance and decreases with higher takeover protection, indicating that tough board monitoring may enhance managerial incentives for real earnings management while takeover protection may reduce it. In essence, scholars have reached a consensus that as real activities manipulation is opaque to outside stakeholders and thus largely not subject to external monitoring scrutiny (Ge and Kim, 2014; Graham et al., 2005; Zang, 2012), internal governance mechanisms should play a stronger role. However, there is limited evidence to support this consensus.

Therefore, in this study, we investigate the influence of board gender diversity on real activities manipulation.

## 2.2. Hypothesis development

Previous studies have identified three reasons why board gender diversity engenders less real activities manipulation. Although these reasons may also be applicable to accrual-based earnings management/quality (Gul et al., 2011; Srinidhi et al., 2011), we argue that they are more powerful and persuasive in explaining the mechanisms through which female directors affect real activities earnings management. We outline the three mechanisms as follows.

First, female participation on BoDs optimizes the board structure and improves boards' abilities and effectiveness in monitoring managers' real activities manipulation. Generally speaking, a board with diverse expertise will have a broader scope of action and exhibit more perspectives in making board decisions (Srinidhi et al., 2011). Accordingly, female participation on BoDs brings different experiences that enrich board discussions and thus improves the quality of board decisions (Hillman et al., 2007). Specifically, studies of organization theory suggest that female participation facilitates the discussion of tough issues and promotes board communications (Clarke, 2005; Huse and Solberg, 2006; Joy, 2008). In addition, Adams and Ferreira (2009) find that a more gender-diverse board is associated with higher board attendance by both male and female directors and more demands for accountability for managers' poor performance. Therefore, female participation improves a board's monitoring abilities and effectiveness. As real earnings management is largely nested in normal operation activities and thus difficult to detect (Ge and Kim, 2014; Graham et al., 2005; Zang, 2012), detecting it requires great diligence and energy from boards. In this sense, female participation helps boards to achieve this difficult task.

Second, as they are better at monitoring, female directors are better at curbing managers' real activities manipulation. As Adams and Ferreira (2009) find, relative to male directors, female directors have better board attendance records and are more likely to join monitoring committees such as the audit, nominating and corporate governance committees. In other words, female directors provide better oversight of managers' opportunistic behavior (Adams and Ferreira, 2009; Hillman et al., 2007). Furthermore, studies suggest that female directors tend to behave and think more independently than their male counterparts (Adams et al.,

2010; Carter et al., 2003), which is crucial for effective monitoring (Srinidhi et al., 2011). Therefore, female directors as monitors can help boards to better detect real earnings management.

Finally, female directors may exhibit less tolerance for managers' real activities manipulation and require a higher earnings quality from managers. Many studies provide evidence that women are usually more risk averse, less overconfident and less tolerant of opportunistic behavior than men. For example, Bernardi and Arnold (1997) find that women, on average, score higher than men on a moral development measure in public accounting firms, suggesting that women are more sensitive to unethical opportunistic issues. Likewise, Sundén and Surette (1998) examine gender differences in the allocation of assets in retirement savings plans and find that women are less likely than men to invest in stocks and other risky assets. Furthermore, Barber and Odean (2001) find that women, on average, hold securities for a longer period than men, indicating that women are less overconfident in their abilities and thus trade less frequently. Therefore, as real activities manipulation is unethical and risky and has profound adverse economic consequences (Achleitner et al., 2014; Bereskin et al., 2014; Cohen and Zarowin, 2010; Gunny, 2010; Zang, 2012), female directors, because of their general ethical differences from men, are more likely to reject real activities manipulation.

In summary, as female directors are more risk averse, less tolerant of opportunistic behavior and more active and better monitors than male directors, they can improve boards' total monitoring abilities and effectiveness. Thus, we predict that firms with gender-diverse boards experience less real activities manipulation. Therefore, we put forward the first testable hypothesis.

**Hypothesis 1.** Firms with gender-diverse boards engage in less real activities manipulation.

To ensure that female directors create economic benefits, it is important to understand how to make full use of their gender-specific differences. In this study, we argue that stock ownership is one of the best mechanisms for enhancing and formalizing the role of female directors in curbing real activities manipulation. As classic economics and agency theory suggest, all human beings are rational and self-interested economic beings with their own utility functions (Berle and Means, 1932; Jensen and Meckling, 1976). In particular, as organizational roles may override traditional gender roles, female directors may have values and needs more similar to the males in their organizations than to females who are not part of their organizations (Shawver and Clements, 2015). That is, female directors are also rational and self-interested actors. As stock ownership aligns the interests of female directors with other stakeholders, female directors with high ownership are more likely to have a stronger monitoring role in curbing managers' real activities manipulation. Furthermore, stock ownership, specifically getting returns based on future long-term performance, induces female directors to pursue a firm's long-term growth and value (Kim and Lu, 2011). In this regard, as real activities manipulation involves operating actions that deviate from normal business practices (e.g., sales manipulation, overproduction, cutting discretionary expenses) and harm firms' competitive advantages and long-term value (Achleitner et al., 2014; Bereskin et al., 2014; Cohen and Zarowin, 2010; Ge and Kim, 2014; Gunny, 2010; Zang, 2012), female directors with high ownership have stronger incentives to monitor managers' opportunistic activities. In short, stock ownership reinforces the role of female directors in detecting real activities manipulation. Therefore, we put forward the second testable hypothesis.

**Hypothesis 2.** Stock ownership enhances the negative association between board gender diversity and real activities manipulation.

### 3. Research design

#### 3.1. Sample and data

The initial sample includes all of the firms listed on both the Shanghai and Shenzhen Stock Exchanges in the 2000–2011 period. Panel A of Table 1 details the sample selection process. After collecting the full sample of 18,531 firm-year observations, we screen the target sample using the following step-by-step criteria: (1)

Table 1  
Sample selection and distribution.

Panel A: Sample selection process															
Initial firm-year observations														18,531	
Step 1: Eliminate firm-year observations for firms with a status of ST, *ST or PT														(1180)	
Step 2: Eliminate firm-year observations for firms that issue debt exceeding the asset value														(279)	
Step 3: Eliminate firm-year observations for firms that belong to financial industries														(264)	
Step 4: Eliminate firm-year observations for firms that issue B- and/or H-shares to foreign investors														(1359)	
Step 5: Eliminate firm-year observations where data required to measure variables used in this study are not available														(3618)	
Final firm-year observations														11,831	
Panel B: Sample distribution by year and industry															
Industry	Code	Year												Total by industry	%
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011		
Agribusiness	A	9	13	16	18	19	21	24	25	26	26	32	34	263	2.22
Mining	B	10	11	14	17	16	21	18	21	26	31	34	39	258	2.18
Manufacturing	C	291	352	416	457	486	515	576	565	619	703	760	915	6655	56.25
Public utilities	D	26	30	31	30	35	42	46	44	45	56	53	56	494	4.18
Construction	E	5	5	8	8	11	15	18	18	20	26	29	35	198	1.67
Transportation	F	10	11	15	18	19	23	26	26	28	44	45	48	313	2.65
Information technology	G	35	42	47	51	50	58	59	56	65	70	81	118	732	6.19
Wholesale, retail and trade	H	61	60	72	73	78	78	78	77	82	85	93	98	935	7.9
Real estate	J	61	65	68	73	73	69	66	60	66	76	80	90	847	7.16
Social service	K	20	20	23	26	26	29	30	30	34	38	37	45	358	3.03
Communication and culture	L	9	10	10	11	13	12	11	10	11	12	11	15	135	1.14
Conglomerate	M	46	54	55	54	55	53	51	53	54	54	56	58	643	5.43
Total by year		583	673	775	836	881	936	1003	985	1076	1221	1311	1551	11,831	
%		4.93	5.69	6.55	7.07	7.45	7.91	8.48	8.33	9.09	10.32	11.08	13.11		100

remove 1180 firm-years for firms that have a transaction status of special treatment (ST), suspension from trading (\*ST) or particular transfer (PT); (2) remove 279 firm-years for firms that issue debt exceeding the asset value; (3) remove 264 firm-years for firms belonging to financial industries; (4) remove 1359 firm-years for firms that issue B- and/or H-shares to foreign investors; and (5) remove 3618 firm-years with missing data for measured variables. Our final sample includes 1680 unique firms and 11,831 firm-year observations. Panel B of Table 1 reports our sample distribution by year and industry. We obtain the data from the China Stock Market & Accounting Research (CSMAR) database, which is designed and developed by Shenzhen GTA Information Technology Company, a major provider of Chinese data.

### 3.2. Measures

#### 3.2.1. Dependent variables

To capture *real activities manipulation*, we follow Roychowdhury (2006) and Cohen and Zarowin (2010) to estimate an aggregate measure based on abnormal levels of cash flows from operations (*RM\_CFO*), discretionary expenditures (*RM\_DISEXP*) and production costs (*RM\_PROD*). For every firm-year, we measure *RM\_CFO*, *RM\_DISEXP* and *RM\_PROD* as the differences between actual values and the normal levels calculated using the estimated coefficient from cross-sectional regressions for each industry and year, as given in Eqs. (1)–(3), respectively.

$$CFO_{i,t}/A_{i,t-1} = \beta_0 + \beta_1(1/A_{i,t-1}) + \beta_2(S_{i,t}/A_{i,t-1}) + \beta_3(\Delta S_{i,t}/A_{i,t-1}) + \varepsilon_t, \tag{1}$$

$$DISEXP_{i,t}/A_{i,t-1} = \beta_0 + \beta_1(1/A_{i,t-1}) + \beta_2(S_{i,t-1}/A_{i,t-1}) + \varepsilon_t \text{ and} \tag{2}$$

$$PROD_{i,t}/A_{i,t-1} = \beta_0 + \beta_1(1/A_{i,t-1}) + \beta_2(S_{i,t}/A_{i,t-1}) + \beta_3(\Delta S_{i,t}/A_{i,t-1}) + \beta_4(\Delta S_{i,t-1}/A_{i,t-1}) + \varepsilon_t, \tag{3}$$



where  $CFO_{i,t}$  is the net cash flow from the operations of firm  $i$  for year  $t$ ;  $DISEXP_{i,t}$  is the sum of sales expenses and administrative expenses of firm  $i$  for year  $t$ <sup>2</sup>;  $PROD_{i,t}$  is the sum of the cost of goods sold and the change in inventories of firm  $i$  for year  $t$ ;  $A_{i,t-1}$  is the total assets of firm  $i$  at the end of year  $t - 1$ ;  $S_{i,t}$  is the sales of firm  $i$  for year  $t$ ;  $\Delta S_{i,t}$  is the change in the sales of firm  $i$  between year  $t$  and year  $t - 1$ ; and  $\Delta S_{i,t-1}$  is the change in the sales of firm  $i$  between year  $t - 1$  and year  $t - 2$ .

Then, we use  $RM\_CFO$ ,  $RM\_DISEXP$  and  $RM\_PROD$  variables as proxies for real activities manipulation. At given sales levels, firms that manage earnings upward are likely to have one or all of the following: unusually low cash flow from operations, low discretionary expenses and/or high production costs. Therefore, we use Eq. (4) to aggregately measure the extent of *real activities manipulation (RM)*.

$$RM = RM\_PROD - RM\_CFO - RM\_DISEXP \quad (4)$$

In additional tests, we also use  $RM\_CFO$ ,  $RM\_DISEXP$  and  $RM\_PROD$  as direct measures of real activities manipulation.

### 3.2.2. Independent variables

Following previous studies (e.g., Adams and Ferreira, 2009; Jia and Zhang, 2013; Torchia et al., 2011; Williams, 2003), we introduce two independent variables, *critical mass of women on BoDs* and *ratio of women on BoDs*, to measure female participation on a BoD. Specifically, the *critical mass of women on BoDs* variable is a dummy variable, which equals 1 if a firm has at least three women serving on BoDs, and 0 otherwise. The *ratio of women on BoDs* variable is the proportion of female directors on a BoD. According to critical mass theory, a majority may often dismiss or devalue the opinions of a minority in the boardroom (Westphal and Milton, 2000). A relatively low level of female participation on BoDs is unlikely to have a significant effect on corporate decision making (Joecks et al., 2013; Post et al., 2011; Rose, 2007; Torchia et al., 2011). Therefore, both of our two independent variables may be needed to fully capture the potential effect of female directors on real activities manipulation.

### 3.2.3. Moderating variable

To test H2, we construct a moderating variable, i.e., *ownership of women on BoDs*, which is measured as the ratio of the average shares held by women on BoDs to total shares.

### 3.2.4. Control variables

Following Sun et al. (2011) and Qi et al. (2014), we include a number of control variables that are widely known to affect real activities manipulation. *Firm size* is measured as the natural logarithm of the number of employees. *Firm age* equals the number of years since IPO. *Firm profitability* is proxied by return on assets (ROA), which equals the ratio of profit before interest and tax over total assets. *Firm growth* is measured as the sales growth rate from year  $t - 1$  to year  $t$ . *Market to book value* is measured as the ratio of stock price to book value per share at the end of the year. *Firm loss* is a dummy coded 1 if a firm has a negative net income, and 0 otherwise. *External auditor* is a dummy coded 1 if a firm is audited by Big 4 auditors, and 0 otherwise. *External audit opinion* is a dummy coded 1 if a firm gets a qualified audit opinion, and 0 otherwise. *Adopting IFRS* is a dummy coded 1 after 2006 (not included), when China started to require listed firms to adopt IFRS, and 0 otherwise. *Ownership concentration* is measured as the ratio of top five shareholders' shares to a firm's total shares. *State ownership* is measured as the ratio of state shares to a firm's total shares. In addition, we generate industry and year indicators to control for industry and time effects. The definitions of all of the variables are listed in Table 2.

<sup>2</sup> In China, listed companies are not required to disclose their advertising expenditures and R&D expenditures separately; these expenditures are included in sales expenditures and administrative expenditures, respectively, in the fiscal reports. Therefore, the data for corporate advertising expenditures and R&D expenditures have many missing values. As an alternative, we measure discretionary expenditures as the sum of sales expenditures and administrative expenditures.

Table 2

## Variable definitions.

<i>Dependent variable</i>	
Real activities manipulation	The sum of <i>RM_CFO</i> , <i>RM_PROD</i> and <i>RM_DISEXP</i> , in which <i>RM_CFO</i> is the abnormal cash flow from operations, measured as the product of $-1$ and the residuals from model (1); <i>RM_PROD</i> is the abnormal production cost, measured as the residuals from model (2); <i>RM_DISEXP</i> is the abnormal discretionary expenses, measured as the product of $-1$ and the residuals from model (3)
<i>Independent variables</i>	
Critical mass of women on BoDs	An indicator variable that equals 1 if a firm has at least three women serving on the BoD, and 0 otherwise
Ratio of women on BoDs	The ratio of the number of women serving on the BoD to the total number of directors on the BoD
<i>Moderating variable</i>	
Ownership of women on BoDs	The ratio of the average shares held by all of the women on the BoD to the total shares
<i>Control variables</i>	
Firm size	The natural logarithm of the number of employees
Firm age	The number of years since IPO
Firm profitability	Return on assets (ROA), which equals the ratio of profit before interest and tax over total assets
Firm growth	The sales growth rate for year $t - 1$ to $t$
Market to book value	The ratio of stock price to book value per share at the end of the year
Firm loss	An indicator variable, which equals 1 when a firm has a negative net income, and 0 otherwise
External auditor	An indicator variable, which equals 1 if a firm's external auditor belongs to Big 4 auditors, i.e., Deloitte & Touche (DT), Price Waterhouse Coopers (PWC), Ernst & Young (EY) and KPMG, and 0 otherwise
External audit opinion	An indicator variable that equals 1 if a firm gets a qualified audit opinion, and 0 otherwise
Adopting IFRS	An indicator variable that equals 1 for any year after 2006 (not included), when Chinese listed firms were required to adopt IFRS
Ownership concentration	The ratio of top 5 shareholders' shares to a firm's total shares
State ownership	The ratio of state shares to a firm's total shares
Industry indicators	Each indicator variable corresponds to an industry, and equals 1 if a firm belongs to this industry, and 0 otherwise
Year indicators	Each indicator variable corresponds to a sample year, and equals 1 if an observation comes from this year, and 0 otherwise

### 3.3. The model

We conduct OLS regressions to test our hypotheses, where standard errors are corrected using the Huber–White procedure. To control for potential endogeneity between female directors and real activities manipulation, we use lagged values of the independent and control variables. Multicollinearity appears insignificant because the average variance inflation factor (VIF) for each regression model is much less than the cutoff point of 10 (Neter et al., 1990). We also center the interaction variables to further avoid the problem of multicollinearity. Finally, we winsorize the top and bottom 1% of each continuous variable to control the influence of some outliers.

## 4. Results

Table 3 reports the descriptive statistics for the main variables used in this study. In the whole sample, 8.1% of the firms have at least three female directors and the average ratio of female directors to total directors on BoDs is 10.2%, which is close to the 10.1% reported in a study by Sun et al. (2015) for a Chinese sample and higher than the 8.9% reported in Hong Kong and the 8.5% reported in the U.S., but lower than the 11.7% in the U.K. (Adams and Ferreira, 2009; Sun et al., 2015). This result suggests that although female directors are still underrepresented throughout the world, China has made great strides in increasing female participation on BoDs. However, on average, female directors own a mere 0.1% of firms' stocks, reflecting China's severe restrictions on stock-based compensation systems. In addition, 3.2% of firms use Big 4 auditors (i.e., DT, PWC, EY and KPMG), suggesting a low market share.

Table 4 displays the Pearson's correlation coefficients of the variables included in the regression models. Our two measures of female participation on BoDs, *critical mass of women on BoDs* and *ratio of women on BoDs*, are highly correlated ( $r = 0.631$ ,  $p < 0.01$ ). As expected, both measures are significantly and negatively related to *real activities manipulation* ( $r = -0.044$ ,  $p < 0.01$ ;  $r = -0.058$ ,  $p < 0.01$ ), preliminarily supporting Hypothesis 1 that female directors are able to curb managers' real activities manipulation. We also find a significant and negative correlation between female director ownership and real activities manipulation ( $r = -0.096$ ,  $p < 0.01$ ), which corroborates our argument that stock ownership may inherently motivate female directors to play a stronger role in supervising managers' earnings manipulation through real activities. In addition, almost all of the correlation coefficients for the remaining variables are less than 0.5, implying that including these variables in the regression models would create only a weak problem of multicollinearity.

Table 5 shows the results of the OLS regression analyses. Hypothesis 1 predicts that female participation on BoDs, measured by *critical mass of women on BoDs* and *ratio of women on BoDs*, has a negative relationship

Table 3  
Descriptive statistics.

Variables	N	Mean	SD	Min	Q1	Median	Q3	Max
Real activities manipulation	11,831	-0.164	0.441	-2.544	-0.181	-0.079	0.006	0.621
Critical mass of women on BoDs	11,831	0.081	0.273	0.000	0.000	0.000	0.000	1.000
Ratio of women on BoDs	11,831	0.102	0.104	0.000	0.000	0.100	0.154	0.444
Ownership of women on BoDs	11,831	0.001	0.013	0.000	0.000	0.000	0.000	0.470
Firm size	11,831	7.389	1.278	3.584	6.690	7.480	8.210	10.305
Firm age	11,831	8.779	4.161	2.000	5.000	8.000	12.000	19.000
Firm profitability	11,831	0.057	0.065	-0.184	0.030	0.055	0.086	0.258
Firm growth	11,831	0.226	0.489	-0.678	0.002	0.153	0.338	3.146
Market to book value	11,831	1.677	0.936	0.822	1.086	1.353	1.900	6.111
Firm loss	11,831	0.106	0.308	0.000	0.000	0.000	0.000	1.000
External auditor	11,831	0.032	0.175	0.000	0.000	0.000	0.000	1.000
External audit opinion	11,831	0.945	0.229	0.000	1.000	1.000	1.000	1.000
Adopting IFRS	11,831	0.519	0.500	0.000	0.000	1.000	1.000	1.000
Ownership concentration	11,831	0.531	0.144	0.192	0.431	0.542	0.639	0.830
State ownership	11,831	0.235	0.250	0.000	0.000	0.150	0.460	0.750

All of the variables are defined in Table 2.

Table 4  
Pearson's correlation matrix ( $N = 11,831$ ).

Variables	1	2	3	4	5	6	7
1. Real activities manipulation	1.000						
2. Critical mass of women on BoDs	-0.044***	1.000					
3. Ratio of women on BoDs	-0.058***	0.631***	1.000				
4. Ownership of women on BoDs	-0.096***	0.039***	0.083***	1.000			
5. Firm size	-0.027***	-0.039***	-0.094***	-0.024***	1.000		
6. Firm age	0.010	0.032***	0.050***	-0.114***	-0.033***	1.000	
7. Firm profitability	-0.150***	0.008	0.001	0.044***	0.111***	-0.053***	1.000
8. Firm growth	-0.086***	-0.009	-0.008	0.006	0.009	-0.024***	0.244***
9. Market to book value	-0.113***	0.015	0.032***	0.009	-0.160***	0.112***	0.224***
10. Firm loss	0.049***	-0.006	-0.007	-0.025***	-0.061***	0.039***	-0.637***
11. External auditor	0.008	0.003	-0.030***	-0.006	0.054***	0.008	0.061***
12. External audit opinion	-0.023**	-0.014	-0.008	0.008	0.094***	-0.002	0.295***
13. Adopting IFRS	-0.216***	0.027***	0.066***	0.076***	0.054***	0.380***	0.157***
14. Ownership concentration	0.000	-0.062***	-0.082***	0.057***	0.082***	-0.408***	0.136***
15. State ownership	0.166***	-0.080***	-0.114***	-0.081***	0.119***	-0.221***	-0.035***
	8	9	10	11	12	13	14
8. Firm growth	1.000						
9. Market to book value	-0.002	1.000					
10. Firm loss	-0.179***	-0.018*	1.000				
11. External auditor	0.008	-0.055***	-0.037***	1.000			
12. External audit opinion	0.081***	-0.037***	-0.310***	0.021**	1.000		
13. Adopting IFRS	0.012	0.347***	-0.058***	-0.002	0.111***	1.000	
14. Ownership concentration	0.094***	-0.173***	-0.081***	0.088***	0.029***	-0.232***	1.000
15. State ownership	0.017*	-0.270***	0.000	0.033***	0.002	-0.412***	0.414***

All of the variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

with real earnings manipulation. As Table 5 shows, the variable *critical mass of women on BoDs* has a significant and negative regression coefficient (**Model 1**:  $\beta = -0.021$ ,  $p < 0.10$ ). Similarly, *ratio of women on BoDs* has a significant and negative regression coefficient (**Model 3**:  $\beta = -0.069$ ,  $p < 0.05$ ). Thus, **Hypothesis 1** is supported.

**Hypothesis 2** concerns the moderating effect of ownership of women on BoDs. As shown in Table 5, the coefficients on both interactions, i.e., *critical mass of women on BoDs*  $\times$  *ownership of women on BoDs* and *ratio of women on BoDs*  $\times$  *ownership of women on BoDs*, are significantly negative (**Model 2**:  $\beta = -1.573$ ,  $p < 0.05$ ; **Model 4**:  $\beta = -9.487$ ,  $p < 0.01$ ). These results suggest that female directors' ownership intensifies the negative association between female participation on BoDs and real activities manipulation, supporting **Hypothesis 2**.

## 5. Robustness checks

### 5.1. Tests for splitting the role of female directors from female CEOs/chairmen

As CEOs have overall responsibility for most corporate business decisions (Francis et al., 2013) and previous research suggests that the individual features of CEOs may shape corporate decision making and outcomes (Bertrand and Schoar, 2003; Cai et al., 2012), one may argue that if a firm has a female CEO or chairman, the role of female directors on BoDs is limited. Furthermore, a female CEO/chairman may be naturally prone to appoint female directors to the BoDs. To mitigate this concern, we re-examine the association between female directors and real activities manipulation by controlling for the presence of female CEOs/chairmen. Specifically, female CEOs are captured by a dummy variable, denoted by *female CEO*,

Table 5

Relationship between women on BoDs and real activities manipulation and the moderating effect of ownership of women on BoDs.

	Dependent variable: Real activities manipulation			
	Model 1	Model 2	Model 3	Model 4
Critical mass of women on BoDs	<b>-0.021*</b> (-1.812)	<b>-0.017</b> (-1.485)		
Ratio of women on BoDs			<b>-0.069**</b> (-2.217)	<b>-0.060*</b> (-1.921)
Critical mass of women on BoDs × Ownership of women on BoDs		<b>-1.573**</b> (-2.212)		
Ratio of women on BoDs × Ownership of women on BoDs				<b>-9.487***</b> (-3.764)
Ownership of women on BoDs		<b>-0.705***</b> (-2.913)		<b>-0.098</b> (-0.330)
Firm size	0.004 (1.241)	0.003 (1.157)	0.003 (1.139)	0.003 (1.073)
Firm age	0.010*** (10.570)	0.009*** (9.965)	0.010*** (10.521)	0.009*** (9.843)
Firm profitability	-0.621*** (-8.871)	-0.616*** (-8.801)	-0.622*** (-8.877)	-0.616*** (-8.807)
Firm growth	-0.070*** (-10.485)	-0.071*** (-10.518)	-0.070*** (-10.484)	-0.071*** (-10.518)
Market to book value	-0.053*** (-12.165)	-0.053*** (-12.270)	-0.053*** (-12.176)	-0.053*** (-12.326)
Firm loss	-0.052*** (-3.776)	-0.052*** (-3.757)	-0.052*** (-3.780)	-0.052*** (-3.765)
External auditor	0.012 (0.677)	0.011 (0.632)	0.011 (0.612)	0.011 (0.591)
External audit opinion	0.052*** (3.482)	0.051*** (3.426)	0.052*** (3.482)	0.050*** (3.379)
Adopting IFRS	-0.005 (-0.272)	-0.002 (-0.122)	-0.004 (-0.205)	-0.001 (-0.057)
Ownership concentration	0.058** (2.162)	0.063** (2.341)	0.058** (2.157)	0.064** (2.394)
State ownership	-0.004 (-0.285)	-0.007 (-0.447)	-0.005 (-0.303)	-0.008 (-0.478)
Constant	0.071 (1.560)	0.074 (1.621)	0.078 (1.690)	0.080 (1.751)
Number of observations	11,831	11,831	11,831	11,831
VIF value	3.41	3.28	3.42	3.31
F value	242.52***	229.35***	242.61***	229.85
Adj. R <sup>2</sup>	40.25%	40.32%	40.26%	40.37%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before they are included in the regression models. *T*-statistics are in parentheses. All of the variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

which equals 1 if a firm has a female CEO/chairman, and 0 otherwise.<sup>3</sup> Table 6 presents the empirical results.

As shown in Table 6, after controlling for female CEOs, the regression results are qualitatively similar to those in Table 5. Specifically, female participation on BoDs, as measured by both *critical mass of women on BoDs* and *ratio of women on BoDs*, still has a negative relationship with real activities manipulation. In addition, female directors' ownership still significantly moderates the association between female participation on BoDs and real activities manipulation. Female CEOs are found to have no significant relationship with real

<sup>3</sup> In China, board chairmen are usually legal representatives of listed companies and take overall responsibility for corporate decision making. In other words, chairmen in China act more like CEOs in Western economies such as U.S and U.K.



Table 6

Additional test for separating the role of female directors from the effect of female CEOs/chairmen.

	Dependent variable: Real activities manipulation			
	Model 1	Model 2	Model 3	Model 4
Critical mass of women on BoDs	<b>-0.021<sup>*</sup></b> (-1.746)	<b>-0.017</b> (-1.476)		
Ratio of women on BoDs			<b>-0.069<sup>**</sup></b> (-2.149)	<b>-0.063<sup>*</sup></b> (-1.942)
Critical mass of women on BoDs × Ownership of women on BoDs		<b>-1.573<sup>**</sup></b> (-2.210)		
Ratio of women on BoDs × Ownership of women on BoDs				<b>-9.485<sup>***</sup></b> (-3.762)
Ownership of women on BoDs		<b>-0.706<sup>***</sup></b> (-2.902)		<b>-0.106</b> (-0.357)
Female CEO	<b>-0.003</b> (-0.255)	<b>0.001</b> (0.063)	<b>0.000</b> (0.031)	<b>0.004</b> (0.334)
Firm size	0.004 (1.231)	0.003 (1.158)	0.003 (1.139)	0.003 (1.080)
Firm age	0.010 <sup>***</sup> (10.566)	0.009 <sup>***</sup> (9.965)	0.010 <sup>***</sup> (10.521)	0.009 <sup>***</sup> (9.840)
Firm profitability	-0.621 <sup>***</sup> (-8.868)	-0.616 <sup>***</sup> (-8.801)	-0.622 <sup>***</sup> (-8.877)	-0.616 <sup>***</sup> (-8.809)
Firm growth	-0.070 <sup>***</sup> (-10.482)	-0.071 <sup>***</sup> (-10.517)	-0.070 <sup>***</sup> (-10.484)	-0.071 <sup>***</sup> (-10.520)
Market to book value	-0.053 <sup>***</sup> (-12.167)	-0.053 <sup>***</sup> (-12.269)	-0.053 <sup>***</sup> (-12.174)	-0.053 <sup>***</sup> (-12.324)
Firm loss	-0.052 <sup>***</sup> (-3.778)	-0.052 <sup>***</sup> (-3.757)	-0.052 <sup>***</sup> (-3.780)	-0.052 <sup>***</sup> (-3.762)
External auditor	0.012 (0.680)	0.011 (0.631)	0.011 (0.611)	0.011 (0.584)
External audit opinion	0.052 <sup>***</sup> (3.480)	0.051 <sup>***</sup> (3.426)	0.052 <sup>***</sup> (3.482)	0.050 <sup>***</sup> (3.380)
Adopting IFRS	-0.037 <sup>**</sup> (-1.984)	-0.034 <sup>*</sup> (-1.836)	-0.036 <sup>*</sup> (-1.937)	-0.033 <sup>*</sup> (-1.785)
Ownership concentration	0.059 <sup>**</sup> (2.170)	0.063 <sup>**</sup> (2.337)	0.058 <sup>**</sup> (2.154)	0.064 <sup>**</sup> (2.379)
State ownership	-0.005 (-0.294)	-0.007 (-0.445)	-0.005 (-0.302)	-0.007 (-0.469)
Constant	0.072 (1.564)	0.074 (1.620)	0.078 <sup>*</sup> (1.690)	0.080 <sup>*</sup> (1.751)
Number of observations	11,831	11,831	11,831	11,831
F value	235.38 <sup>***</sup>	222.96 <sup>***</sup>	235.45 <sup>***</sup>	223.45 <sup>***</sup>
Adj. R <sup>2</sup>	40.25%	40.31%	40.26%	40.37%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. All of the variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

activities manipulation, perhaps because the role of femaleness in curbing earnings management is not strong enough to dominate the pressure to beat/meet performance benchmarks that CEOs/chairmen face. In summary, the presence of female CEOs/chairmen does not change our main results in Table 5 and our two hypotheses are still supported.

### 5.2. Tests for differentiating the effects between inside and outside female directors

This study considers both inside and outside female directors. It is commonly accepted that outside directors (e.g., independent directors in China), who are independent of firm management and have incentives to

develop and maintain their reputations as experts, may play a stronger monitoring role than inside directors (Fama and Jensen, 1983; Jiang et al., 2016). However, inside directors are usually dual-posted by firm managers and thus are more likely to side with firm management on major decisions. Therefore, it is unclear whether inside female directors have different effects on real activities management from outside female directors. To deal with this concern, we try to differentiate the governance effects of inside and outside female directors by separating the two kinds of directors and rerunning the regressions. The results are shown in Table 7.

As Table 7 shows, both inside and outside female directors are able to help firms curb real earnings management (**Model 1**:  $\beta = -0.129$ ,  $p < 0.01$ ; **Model 3**:  $\beta = -0.341$ ,  $p < 0.01$ ). To some extent, as there are more inside female directors on the board, inside female directors are found to play a stronger role than outside female directors (**Model 4**:  $\beta = -0.027$ ,  $p < 0.10$ ; **Model 6**:  $\beta = 0.086$ ,  $p > 0.10$ ). Moreover, stock ownership is found to enhance the role of inside female directors in curbing real activities manipulation (**Model 2**:  $\beta = -8.338$ ,  $p < 0.01$ ; **Model 5**:  $\beta = -10.251$ ,  $p < 0.01$ ).<sup>4</sup> In sum, our findings are robust for both inside and outside female directors, but stronger for inside female directors.

### 5.3. Tests for endogeneity concerns using the Heckman selection model and PSM approach

A major concern is that this study's findings may be subject to a potential self-selection bias problem. That is, firms with less real activities manipulation may be more likely to appoint females to serve on their BoDs. To address this potential endogenous selection, we conduct a Heckman two-stage selection model. In the first stage, we run the Probit regression model to predict female participation on BoDs, using *female CEO* as the instrumental variable and other control variables in Table 5. Then, we generate the *inverse Mills ratio* after the Probit choice regression.<sup>5</sup> In the second stage, we add the *inverse Mills ratio* to the OLS regression models in Table 5 to control for any endogeneity in the choice of female directors.

The results of the Heckman two-stage selection model, given in Table 8, show that the variable *inverse Mills ratio* has insignificant coefficients in all of the OLS regression models (i.e., **Models 2–3** and **Models 5–6**) that take real activities manipulation as the dependent variable, indicating that the self-selection problem is weak. More importantly, the results are consistent with the main findings given in Table 5. This suggests that female participation on BoDs curbs real activities manipulation, which disproves the hypothesis that firms with less real activities manipulation are more prone to appoint female directors. In addition, the coefficient of the instrumental variable in the first-stage model, *female CEO*, is positive and significant (**Model 1**:  $\beta = 0.772$ ,  $p < 0.01$ ; **Model 4**:  $\beta = 1.272$ ,  $p < 0.01$ ), indicating that firms with a female chairman/CEO are more likely to appoint females to their BoDs.

In our sample, only 8.1% of the firms have a critical mass of female directors on their BoDs, indicating that female directors may not be randomly distributed in firms. Therefore, to make causal interpretations of the results, we apply the PSM approach to structure the non-experimental data to look like experimental data. Specifically, we take firms with a critical mass of female directors as our experimental sample and apply the PSM approach to construct a control sample consisting of firms with highly similar characteristics but without a critical mass of female directors. Then, we estimate the causal effects of female directors on real activities manipulation by comparing the two groups in the sample. For our matching process, we follow Francis et al. (2013) and run a logistic regression of *critical mass of women on BoDs* on firm size, firm leverage and the industry and year indicators. Then, we use the propensity scores obtained from the logistic regression and perform a one-to-one nearest neighbor match without replacement. After that, we rerun our regressions in the new sample. As Table 9 shows, the results are highly consistent with those in Table 5, indicating the insignificance of the endogeneity problem and providing additional support for our hypotheses.

<sup>4</sup> As outside independent directors in China are not allowed to hold stock ownership in the firms they serve, we are unable to investigate the moderating effect of stock ownership on the role of outside female directors.

<sup>5</sup> In particular, when using the continuous variable, i.e., *ratio of women on BoDs*, to measure female participation on BoDs, we construct a dummy variable, denoted by *high ratio of women on BoDs*, that equals 1 if a firm-year's ratio of women on BoDs is no less than the median ratio of women on BoDs in the full sample and 0 otherwise, for the sake of running a Probit choice regression in the first stage.

Table 7  
Additional test for differentiating the effects between inside and outside female directors.

	Dependent variable: Real activities manipulation					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Critical mass of inside women on BoDs	<b>-0.129<sup>***</sup></b> (-7.811)	<b>-0.125<sup>***</sup></b> (-7.533)				
Critical mass of outside women on BoDs			<b>-0.341<sup>***</sup></b> (-11.007)			
Critical mass of inside women on BoDs × Ownership of inside women on BoDs		<b>-8.338<sup>***</sup></b> (-2.696)				
Ratio of inside women on BoDs				<b>-0.072<sup>*</sup></b> (-1.916)	<b>-0.058</b> (-1.545)	
Ratio of outside women on BoDs						<b>0.086</b> (1.600)
Ratio of inside women on BoDs × Ownership of inside women on BoDs					<b>-10.251<sup>***</sup></b> (-2.625)	
Ownership of inside women on BoDs		-0.476 <sup>**</sup> (-2.074)			1.085 <sup>*</sup> (1.736)	
Firm size	0.003 (1.007)	0.003 (1.003)	0.002 (0.729)	0.003 (1.169)	0.003 (1.156)	0.004 (1.312)
Firm age	0.010 <sup>***</sup> (10.109)	0.009 <sup>***</sup> (9.711)	0.008 <sup>***</sup> (8.696)	0.010 <sup>***</sup> (10.582)	0.010 <sup>***</sup> (10.251)	0.010 <sup>***</sup> (10.583)
Firm profitability	-0.612 <sup>***</sup> (-8.762)	-0.612 <sup>***</sup> (-8.767)	-0.565 <sup>***</sup> (-8.090)	-0.626 <sup>***</sup> (-8.936)	-0.625 <sup>***</sup> (-8.926)	-0.624 <sup>***</sup> (-8.914)
Firm growth	-0.071 <sup>***</sup> (-10.548)	-0.071 <sup>***</sup> (-10.553)	-0.073 <sup>***</sup> (-10.866)	-0.070 <sup>***</sup> (-10.486)	-0.070 <sup>***</sup> (-10.475)	-0.070 <sup>***</sup> (-10.481)
Market to book value	-0.054 <sup>***</sup> (-12.538)	-0.055 <sup>***</sup> (-12.589)	-0.057 <sup>***</sup> (-13.177)	-0.053 <sup>***</sup> (-12.146)	-0.053 <sup>***</sup> (-12.187)	-0.053 <sup>***</sup> (-12.138)
Firm loss	-0.050 <sup>***</sup> (-3.657)	-0.051 <sup>***</sup> (-3.682)	-0.047 <sup>***</sup> (-3.420)	-0.052 <sup>***</sup> (-3.803)	-0.053 <sup>***</sup> (-3.820)	-0.052 <sup>***</sup> (-3.784)
External auditor	0.010 (0.566)	0.010 (0.569)	0.008 (0.436)	0.012 (0.652)	0.012 (0.656)	0.013 (0.698)
External audit opinion	0.051 <sup>***</sup> (3.441)	0.051 <sup>***</sup> (3.421)	0.048 <sup>***</sup> (3.277)	0.052 <sup>***</sup> (3.507)	0.051 <sup>***</sup> (3.432)	0.052 <sup>***</sup> (3.509)
Adopting IFRS	-0.025 (-1.368)	-0.023 (-1.266)	-0.008 (-0.440)	-0.021 (-1.112)	-0.019 (-1.011)	-0.021 (-1.135)
Ownership concentration	0.061 <sup>***</sup> (2.283)	0.062 <sup>***</sup> (2.325)	0.065 <sup>***</sup> (2.412)	0.059 <sup>***</sup> (2.206)	0.062 <sup>***</sup> (2.320)	0.062 <sup>***</sup> (2.301)
State ownership	-0.008 (-0.479)	-0.009 (-0.583)	-0.008 (-0.530)	-0.004 (-0.259)	-0.005 (-0.337)	-0.003 (-0.163)
Constant	0.101 <sup>**</sup> (2.209)	0.102 <sup>**</sup> (2.240)	0.098 <sup>**</sup> (2.157)	0.076 <sup>*</sup> (1.651)	0.076 <sup>*</sup> (1.651)	0.064 (1.401)
Number of observations	11,831	11,831	11,831	11,831	11,831	11,831
F value	245.460	231.992	248.5180	242.544	229.151	242.488
Adj. R <sup>2</sup>	40.54%	40.60%	40.84%	40.26%	40.30%	40.25%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. All of the variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

#### 5.4. Tests for the effects of women on two-tier boards

China does not use the Anglo–Saxon unitary board model; publically listed firms are required by the Company Law to operate a two-tier board system (e.g., a BoD and a supervisory board) (Firth et al., 2007; Xiao et al., 2004). According to China's Company Law, a BoD is a firm's decision-making unit and the supervisory board serves largely as a monitoring mechanism (Jia and Zhang, 2011). Accordingly, one concern may emerge

Table 8  
Additional test for the self-selection problem using the Heckman two-stage selection model.

	First stage	Second stage	Second stage	First stage	Second stage	Second stage
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Critical mass of women on BoDs		−0.021* (−1.742)	−0.017 (−1.471)			
Ratio of women on BoDs					−0.071** (−2.193)	−0.064** (−1.974)
Critical mass of women on BoDs × Ownership of women on BoDs			−1.573** (−2.211)			
Ratio of women on BoDs × Ownership of women on BoDs						−9.481*** (−3.761)
Ownership of women on BoDs			−0.706*** (−2.898)			−0.108 (−0.363)
Inverse Mills ratio		0.006 (0.283)	−0.001 (−0.032)		−0.004 (−0.201)	−0.010 (−0.457)
Female CEO	0.772*** (14.908)			1.272*** (20.681)		
Firm size	−0.051*** (−3.296)	0.003 (1.083)	0.003 (1.106)	−0.065*** (−5.971)	0.003 (1.146)	0.003 (1.162)
Firm age	−0.000 (−0.064)	0.010*** (10.562)	0.009*** (9.965)	−0.009** (−2.447)	0.010*** (10.457)	0.009*** (9.827)
Firm profitability	0.565 (1.463)	−0.618*** (−8.737)	−0.616*** (−8.715)	−0.125 (−0.473)	−0.621*** (−8.873)	−0.616*** (−8.798)
Firm growth	−0.024 (−0.635)	−0.071*** (−10.485)	−0.071*** (−10.501)	0.020 (0.780)	−0.070*** (−10.481)	−0.071*** (−10.527)
Market to book value	−0.038 (−1.607)	−0.053*** (−12.062)	−0.053*** (−12.122)	−0.028* (−1.704)	−0.053*** (−12.106)	−0.053*** (−12.236)
Firm loss	0.031 (0.412)	−0.052*** (−3.765)	−0.052*** (−3.756)	−0.007 (−0.131)	−0.052*** (−3.777)	−0.052*** (−3.758)
External auditor	0.113 (1.158)	0.013 (0.706)	0.011 (0.623)	−0.406*** (−5.766)	0.012 (0.643)	0.013 (0.696)
External audit opinion	−0.126 (−1.591)	0.051*** (3.402)	0.051*** (3.393)	−0.055 (−0.989)	0.052*** (3.488)	0.050*** (3.399)
Adopting IFRS	−0.161 (−1.532)	−0.038** (−2.008)	−0.034* (−1.815)	0.183*** (2.585)	−0.037* (−1.946)	−0.035* (−1.829)
Ownership concentration	−0.605*** (−4.128)	0.056* (1.955)	0.063** (2.222)	−0.320*** (−3.126)	0.059** (2.166)	0.066** (2.431)
State ownership	−0.506*** (−5.494)	−0.007 (−0.389)	−0.007 (−0.370)	−0.251*** (−4.212)	−0.004 (−0.243)	−0.006 (−0.352)
Constant	−0.284 (−1.170)	0.066 (1.357)	0.075 (1.524)	0.495*** (2.866)	0.080* (1.690)	0.085* (1.809)
Number of observations	11,831	11,831	11,831	11,831	11,831	11,831
F/Chi <sup>2</sup> value	505.22***	235.38***	222.96***	1079.78***	235.45***	223.45***
Adj. R <sup>2</sup> /Log likelihood	−3085.7013	40.25%	40.31%	−7655.7020	40.26%	40.37%

The dependent variables of **Model 1**, **Model 4** and other models are *critical mass of women on BoDs*, *high ratio of women on BoDs* and *real activities manipulation* respectively, where *high ratio of women on BoDs* is a dummy variable that equals 1 if a firm-year ratio of women on BoDs is no less than the median ratio of women on BoDs in the full sample, and 0 otherwise. The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T/Z*-statistics are in parentheses. All of the variables are defined in [Table 2](#).

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

about our findings: does female participation in the supervisory board matter to real activities manipulation? To address this concern, we generate two new variables to capture female participation on two-tier boards, i.e., *critical mass of women on two-tier boards* and *ratio of women on two-tier boards*. More precisely, the variable *critical mass of women on two-tier boards* is a dummy variable that equals 1 if a firm has at least three

Table 9  
Additional test for the endogeneity concern using the PSM approach.

	Dependent variable: Real activities manipulation			
	Model 1	Model 2	Model 3	Model 4
Critical mass of women on BoDs	<b>-0.047**</b> (-2.544)	<b>-0.044**</b> (-2.394)		
Ratio of women on BoDs			<b>-0.145**</b> (-2.200)	<b>-0.134**</b> (-2.012)
Critical mass of women on BoDs × Ownership of women on BoDs		<b>-7.007***</b> (-2.645)		
Ratio of women on BoDs × Ownership of women on BoDs				<b>-20.684**</b> (-2.506)
Ownership of women on BoDs		3.872 (1.637)		3.467 (1.489)
Firm size	0.007 (0.818)	0.007 (0.817)	0.006 (0.718)	0.006 (0.699)
Firm age	0.009*** (3.585)	0.008*** (3.171)	0.009*** (3.569)	0.008*** (3.195)
Firm profitability	-0.542*** (-2.707)	-0.519*** (-2.595)	-0.534*** (-2.663)	-0.514*** (-2.570)
Firm growth	-0.049** (-2.459)	-0.050** (-2.511)	-0.050** (-2.507)	-0.051** (-2.546)
Market to book value	-0.068** (-5.759)	-0.069** (-5.821)	-0.068** (-5.750)	-0.069** (-5.864)
Firm loss	-0.070* (-1.713)	-0.068* (-1.673)	-0.069* (-1.689)	-0.069* (-1.701)
External auditor	-0.055 (-0.996)	-0.060 (-1.092)	-0.058 (-1.052)	-0.061 (-1.105)
External audit opinion	0.034 (0.804)	0.031 (0.730)	0.036 (0.841)	0.030 (0.707)
Adopting IFRS	-0.010 (-0.181)	-0.003 (-0.055)	-0.009 (-0.157)	-0.003 (-0.047)
Ownership concentration	0.111 (1.437)	0.127 (1.638)	0.117 (1.515)	0.140* (1.809)
State ownership	-0.015 (-0.314)	-0.020 (-0.417)	-0.016 (-0.321)	-0.020 (-0.422)
Constant	0.099 (0.730)	0.089 (0.659)	0.101 (0.743)	0.093 (0.683)
Number of observations	1841	1841	1841	1841
F value	37.357***	35.870***	37.274***	35.750***
Adj. R <sup>2</sup>	39.47%	39.88%	39.42%	39.80%

For the matching process, we follow Francis et al. (2013) to run a logistic regression of *critical mass of women on BoDs* on firm size, firm leverage and industry and year indicators and then use the propensity scores obtained from the logistic regression and perform an one-to-one nearest neighbor match without replacement. The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. All of the variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

women serving on two-tier boards, and 0 otherwise; the variable *ratio of women on two-tier boards* is calculated as the ratio of women serving on two-tier boards. We then rerun the regression analyses using these two new variables as independent variables.

Table 10 presents the results for the effects of women on two-tier boards. The variable *critical mass of women on two-tier boards* in **Models 1–2** consistently has negative coefficients at the 5% significance level; *ratio of women on two-tier boards* in **Models 3–4** consistently has negative coefficients at the 5% significance level at least. For the moderating effect of ownership of women on two-tier boards, the interaction term has significant and negative coefficients (**Model 2**:  $\beta = -1.437$ ,  $p < 0.05$ ; **Model 4**:  $\beta = -11.438$ ,  $p < 0.01$ ). These results sug-



Table 10  
Additional test for the effects of women on two-tier boards on real activities manipulation and other determinations.

	Dependent variable: Real activities manipulation			
	Model 1	Model 2	Model 3	Model 4
Critical mass of women on two-tier boards	<b>-0.016**</b> (-2.284)	<b>-0.015**</b> (-2.132)		
Ratio of women on two-tier boards			<b>-0.084***</b> (-2.727)	<b>-0.076**</b> (-2.491)
Critical mass of women on two-tier boards × Ownership of women on two-tier boards		<b>-1.437**</b> (-2.142)		
Ratio of women on two-tier boards × Ownership of women on two-tier boards				<b>-11.438***</b> (-3.722)
Ownership of women on two-tier boards		<b>-1.168***</b> (-3.830)		<b>-1.019***</b> (-3.360)
Firm size	0.004 (1.251)	0.003 (1.134)	0.003 (1.066)	0.003 (0.970)
Firm age	0.010*** (10.554)	0.009*** (9.841)	0.010*** (10.549)	0.009*** (9.694)
Firm profitability	-0.623*** (-8.900)	-0.616*** (-8.801)	-0.620*** (-8.862)	-0.613*** (-8.759)
Firm growth	-0.070*** (-10.461)	-0.070*** (-10.503)	-0.070*** (-10.479)	-0.071*** (-10.531)
Market to book value	-0.053*** (-12.142)	-0.053*** (-12.284)	-0.053*** (-12.132)	-0.053*** (-12.310)
Firm loss	-0.052*** (-3.788)	-0.052*** (-3.759)	-0.052*** (-3.801)	-0.052*** (-3.775)
External auditor	0.012 (0.635)	0.011 (0.607)	0.011 (0.605)	0.010 (0.569)
External audit opinion	0.052*** (3.513)	0.051*** (3.426)	0.052*** (3.491)	0.050*** (3.357)
Adopting IFRS	-0.004 (-0.231)	-0.001 (-0.071)	-0.003 (-0.193)	0.000 (0.004)
Ownership concentration	0.058** (2.138)	0.062** (2.314)	0.057** (2.120)	0.064** (2.364)
State ownership	-0.005 (-0.287)	-0.008 (-0.485)	-0.006 (-0.375)	-0.009 (-0.594)
Constant	0.042 (0.925)	0.047 (1.038)	0.052 (1.146)	0.057 (1.251)
Number of observations	11,831	11,831	11,831	11,831
F value	242.62***	229.56***	242.74***	230.10***
Adj. R <sup>2</sup>	40.26%	40.34***	40.27%	40.40%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. The *critical mass of women on two-tier boards* variable equals 1 if at least three women serve on two-tier boards, and 0 otherwise; the *ownership of women on two-tier boards* variable equals the average ratio of ownership held by women on two-tier boards; the other variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

gest that both [Hypotheses 1 and 2](#) are still supported when we focus on female participation on two-tier boards. In summary, our main findings are robust when extended from women on BoDs to women on two-tier boards.

### 5.5. Tests for the effects of the split share structure reform

The split share structure reform has fundamentally changed large shareholders' incentives and improved corporate governance in China ([Kuo et al., 2014](#); [Liu and Tian, 2012](#)). We take advantage of the reform's

Table 11  
Additional test for the effect of the split share structure reform.

	Dependent variable: Real activities manipulation			
	Model 1 SSSR = 0	Model 2 SSSR = 1	Model 3 SSSR = 0	Model 4 SSSR = 1
Critical mass of women on BoDs	<b>0.002</b> (0.220)	<b>-0.008</b> (-0.408)		
Ratio of women on BoDs			<b>0.070</b> (1.596)	<b>-0.042</b> (-0.808)
Critical mass of women on BoDs × Ownership of women on BoDs	<b>-0.031</b> (-0.005)	<b>-1.485*</b> (-1.667)		
Ratio of women on BoDs × Ownership of women on BoDs			<b>63.911*</b> (1.957)	<b>-9.345***</b> (-2.974)
Ownership of women on BoDs	1.431 (0.826)	-0.551* (-1.827)	-1.790 (-0.747)	0.043 (0.118)
Firm size	-0.016*** (-7.638)	0.019*** (4.036)	-0.016*** (-7.644)	0.019*** (3.979)
Firm age	-0.003*** (-3.171)	0.011*** (7.858)	-0.003*** (-3.137)	0.011*** (7.759)
Firm profitability	-0.449*** (-8.604)	-0.761*** (-6.790)	-0.449*** (-8.596)	-0.759*** (-6.781)
Firm growth	-0.013*** (-2.833)	-0.123*** (-10.901)	-0.013*** (-2.846)	-0.123*** (-10.906)
Market to book value	-0.029*** (-5.355)	-0.051*** (-8.442)	-0.029*** (-5.381)	-0.051*** (-8.500)
Firm loss	-0.067*** (-7.046)	-0.016 (-0.665)	-0.067*** (-7.026)	-0.016 (-0.669)
External auditor	-0.005 (-0.422)	0.015 (0.483)	-0.005 (-0.388)	0.015 (0.473)
External audit opinion	0.018** (2.069)	0.078** (2.535)	0.018** (2.067)	0.075** (2.465)
Adopting IFRS	-	-0.069 (-0.928)	-	-0.068 (-0.908)
Ownership concentration	-0.004 (-0.178)	0.080* (1.872)	-0.004 (-0.183)	0.082* (1.925)
State ownership	0.002 (0.233)	-0.017 (-0.572)	0.002 (0.193)	-0.019 (-0.621)
Constant	-0.385*** (-3.861)	0.136 (1.428)	-0.392*** (-3.925)	0.142 (1.481)
Number of observations	5309	6522	5309	6522
F value	19.209***	146.109***	19.338***	146.452***
Adj. R <sup>2</sup>	10.17%	43.78%	10.23%	43.84%

The indicator variable *SSRN* equals 1 for the period commencing a year after a focal firm has completed the split share structure reform, and 0 otherwise. The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. *SSSR* is an indicator variable that equals 1 for the period commencing a year after a firm has completed the split share structure reform, and 0 otherwise. All of the variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

occurrence during our sample period and explore whether it affected the role of female directors in curbing real activities manipulation. The results are shown in Table 11.

As Table 11 displays, in the subsample before the reform, our main variables of interest do not have significant coefficients or coefficients with the expected signs. However, in the subsample after the reform, consistent with our expectations, both *critical mass of women on BoDs* and *ratio of women on BoDs* have negative coefficients. More importantly, their interactions with *ownership of women on BoDs* have significant and negative coefficients (**Model 2**:  $\beta = -1.485$ ,  $p < 0.10$ ; **Model 4**:  $\beta = -9.345$ ,  $p < 0.01$ ), thereby providing support for our hypotheses. Thus, our main insights are limited to firm-year observations after the split share structure

reform, perhaps because the reform creates an incentive alignment effect that induces large shareholders and BoDs to actively monitor managers' real activities manipulation. Another reason may be that firms shifted their use of earnings management methods from accruals to real activities after the reform (Kuo et al., 2014), and the increase in real activities manipulation made the role of female directors more obvious.

### 5.6. Separate tests using the three subindices of real activities manipulation

In this study, following Roychowdhury's (2006) model, we use the three kinds of real activities earnings management, i.e., sales manipulation (*RM\_CFO*), overproduction (*RM\_PROD*) and discretionary fees manipulation (*RM\_DISEXP*), to construct a comprehensive index of real activities manipulation. To further test the effect of female participation on BoDs on real earnings management and to shed light on the specific mechanisms of this process, we examine the association of female participation on BoDs for each category of real activities manipulation. In particular, as *RM\_CFO* and *RM\_DISEXP* are a pair of inverse indexes that reflect the extent of real activities manipulation, we change the value of *RM\_CFO* and *RM\_DISEXP* by multiplying it by  $-1$  for the sake of explanatory convenience. Table 12 presents the regression results.

As Table 12 shows, although the significance level is low, both *critical mass of women on BoDs* and *ratio of women on BoDs* have a negative relation with each category of real activities manipulation, i.e., *RM\_CFO*, *RM\_PROD* and *RM\_DISEXP*, consistent with our prediction in Hypothesis 1. More importantly, when taking *RM\_CFO* as the dependent variable, the interactions, i.e., *critical mass of women on BoDs*  $\times$  *ownership of women on BoDs* and *ratio of women on BoDs*  $\times$  *ownership of women on BoDs*, have significant negative coefficients (**Model 1**:  $\beta = -0.467$ ,  $p < 0.05$ ; **Model 2**:  $\beta = -1.880$ ,  $p < 0.05$ ). Similarly, when taking *RM\_PROD* as the dependent variable, the interactions, i.e., *critical mass of women on BoDs*  $\times$  *ownership of women on BoDs* and *ratio of women on BoDs*  $\times$  *ownership of women on BoDs*, also have negative coefficients (**Model 3**:  $\beta = -0.696$ ,  $p > 0.10$ ; **Model 4**:  $\beta = -7.140$ ,  $p < 0.01$ ). However, when taking *RM\_DISEXP* as the dependent variable, the interactions, i.e., *critical mass of women on BoDs*  $\times$  *ownership of women on BoDs* and *ratio of women on BoDs*  $\times$  *ownership of women on BoDs*, do not have significant and consistent coefficients (**Model 5**:  $\beta = -0.140$ ,  $p > 0.10$ ; **Model 6**:  $\beta = 0.001$ ,  $p > 0.10$ ).

In summary, these results indicate that the role of female participation on BoDs in curbing real earnings management is mainly exercised by reducing sales manipulation and overproduction rather than through by reducing discretionary expenditures,<sup>6</sup> perhaps because firms with gender-diverse boards tend to invest less in R&D projects (Adams and Ferreira, 2009; Chen et al., 2016; Jin et al., 2014). As a result, in firms with female directors, there is relatively limited space for managers to manipulate earnings by reducing discretionary expenditures such as R&D investment, so the role of female directors may over time become weak in curbing this kind of real activities manipulation.

### 5.7. Tests for the effects of women on BoDs on accrual-based earnings manipulation

Several previous studies focus on the role of female directors/executives in curbing accrual-based earnings management and improving earnings quality (e.g., Krishnan and Parsons, 2008; Srinidhi et al., 2011; Sun et al., 2011; Ye et al., 2010). Most are conducted in the U.S. context, and it is unclear whether female board participation would affect accrual-based earnings manipulation in China. To address this concern, we first estimate the extent of accrual-based earnings manipulation based on a cross-sectional version of the modified Jones (1991) model by DeFond and Jambalvo (1994), and then regress *accrual-based earnings manipulation* on female participation on BoDs. The regression results, given in Table 13, show that neither of the proxy variables for female participation on BoDs, i.e., *critical mass of women on BoDs* or *ratio of women on BoDs*,

<sup>6</sup> Our additional tests show that the degree of overproduction and sales manipulation significantly increases from year  $t$  to year  $t + 1$  and then significantly decreases from year  $t + 1$  to year  $t + 2$  in firms with a critical mass of female directors. That is, overproduction and sales manipulation do not persist over time, and there is a within-firm reversal of real activities manipulation. However, our further tests find that the cross-sectional variation of real activities manipulation persists in years  $t + 1$  and  $t + 2$ . Therefore, the within-firm reversal does not affect our main findings.

Table 12  
Additional tests for three subindices of real activities manipulation.

	Dependent variable: RM_CFO		Dependent variable: RM_PROD		Dependent variable: RM_DISEXP	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Critical mass of women on BoDs	<b>-0.002</b> (-0.536)		<b>-0.011</b> (-1.063)		<b>-0.003</b> (-1.370)	
Ratio of women on BoDs		<b>-0.007</b> (-0.722)		<b>-0.041</b> (-1.559)		<b>-0.008</b> (-1.374)
Critical mass of women on BoDs × Ownership of women on BoDs	<b>-0.467**</b> (-2.197)		<b>-0.696</b> (-1.150)		<b>-0.140</b> (-1.039)	
Ratio of women on BoDs × Ownership of women on BoDs		<b>-1.880**</b> (-2.498)		<b>-7.140***</b> (-3.330)		<b>0.001</b> (0.003)
Ownership of women on BoDs	<b>-0.022</b> (-0.304)	<b>0.090</b> (1.022)	<b>-0.531***</b> (-2.582)	<b>-0.055</b> (-0.218)	<b>-0.155***</b> (-3.365)	<b>-0.158***</b> (-2.810)
Firm size	-0.003*** (-3.635)	-0.003*** (-3.666)	0.020*** (8.461)	0.020*** (8.387)	-0.013*** (-23.627)	-0.013*** (-23.643)
Firm age	0.000 (1.618)	0.000 (1.566)	0.009*** (11.320)	0.009*** (11.191)	-0.000 (-0.834)	-0.000 (-0.826)
Firm profitability	-0.480*** (-22.955)	-0.480*** (-22.963)	-0.012 (-0.205)	-0.012 (-0.197)	-0.104*** (-7.799)	-0.104*** (-7.816)
Firm growth	0.006*** (2.826)	0.006*** (2.831)	-0.056*** (-9.878)	-0.056*** (-9.883)	-0.023*** (-17.883)	-0.023*** (-17.876)
Market to book value	-0.015*** (-11.669)	-0.015*** (-11.701)	-0.023*** (-6.205)	-0.023*** (-6.253)	-0.015*** (-17.758)	-0.015*** (-17.757)
Firm loss	-0.022*** (-5.353)	-0.022*** (-5.359)	0.002 (0.209)	0.002 (0.208)	-0.031*** (-11.705)	-0.031*** (-11.711)
External auditor	-0.003 (-0.591)	-0.003 (-0.597)	0.030** (1.966)	0.030* (1.930)	-0.009*** (-2.596)	-0.009*** (-2.631)
External audit opinion	0.003 (0.619)	0.003 (0.592)	0.041*** (3.273)	0.041*** (3.224)	0.005* (1.663)	0.005* (1.675)
Adopting IFRS	0.003 (0.601)	0.003 (0.623)	-0.013 (-0.868)	-0.012 (-0.810)	0.006* (1.746)	0.006* (1.781)
Ownership concentration	0.013* (1.664)	0.014* (1.689)	0.068*** (2.985)	0.070*** (3.041)	-0.021*** (-4.178)	-0.021*** (-4.191)
State ownership	-0.010** (-2.222)	-0.011** (-2.233)	-0.020 (-1.474)	-0.02 (-1.515)	0.022*** (7.225)	0.022*** (7.239)
Constant	0.045*** (3.353)	0.046*** (3.400)	-0.175*** (-4.562)	-0.171*** (-4.430)	0.117*** (13.616)	0.118*** (13.629)
Number of observations	11,831	11,831	11,831	11,831	11,831	11,831
F value	77.59***	77.64***	261.56***	262.11***	91.92***	91.87***
Adj. R <sup>2</sup>	18.47%	18.48%	43.53%	43.58%	21.20%	21.19%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. Please see the definitions and measurements of the three subindices of real activities manipulation, i.e., *RM\_CFO*, *RM\_PROD* and *RM\_DISEXP*, in Section 3.2. The other variables are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

has a significant coefficient (**Model 1**:  $\beta = 0.003$ ,  $p > 0.10$ ; **Model 3**:  $\beta = 0.003$ ,  $p > 0.10$ ). Moreover, the interactions between female directors' ownership and female participation on BoDs also have insignificant coefficients. These results suggest that female directors do not help to curb accrual-based earning management in China, perhaps because it is less costly for firms to manipulate accruals in China due to relatively low demand for high quality earnings and low litigation risks (Allen et al., 2005; Liu and Tian, 2012; Kuo et al., 2014).

Zang (2012) documents that managers use real activities manipulation and accrual-based earnings management as substitutes for each other in managing earnings. This suggests another potential explanation for the results: the reduction in real activities manipulation may be the result of an increase in accrual-based earnings management rather than an increase in female board participation. We investigate this possibility by including

Table 13  
Additional tests for the effects of women on BoDs on accrual-based earnings manipulation and other determinations.

	Dependent variable: Accrual-based earnings manipulation			
	Model 1	Model 2	Model 3	Model 4
Critical mass of women on BoDs	<b>0.003</b> ( <b>0.704</b> )	<b>0.004</b> ( <b>0.891</b> )		
Ratio of women on BoDs			<b>0.003</b> ( <b>0.270</b> )	<b>0.005</b> ( <b>0.436</b> )
Critical mass of women on BoDs × Ownership of women on BoDs		<b>-0.298</b> ( <b>-1.118</b> )		
Ratio of women on BoDs × Ownership of women on BoDs				<b>0.329</b> ( <b>0.348</b> )
Ownership of women on BoDs		<b>-0.217**</b> ( <b>-2.391</b> )		<b>-0.252**</b> ( <b>-2.266</b> )
Firm size	-0.005*** (-4.903)	-0.005*** (-4.977)	-0.005*** (-4.897)	-0.005*** (-4.979)
Firm age	-0.001*** (-2.581)	-0.001*** (-2.938)	-0.001*** (-2.574)	-0.001*** (-2.879)
Firm profitability	0.132*** (5.048)	0.134*** (5.102)	0.133*** (5.057)	0.134*** (5.102)
Firm growth	0.020*** (7.896)	0.020*** (7.878)	0.020*** (7.893)	0.020*** (7.879)
Market to book value	-0.006*** (-3.515)	-0.006*** (-3.598)	-0.006*** (-3.521)	-0.006*** (-3.601)
Firm loss	0.034*** (6.551)	0.034*** (6.567)	0.034*** (6.553)	0.034*** (6.563)
External auditor	-0.000 (-0.039)	-0.000 (-0.071)	-0.000 (-0.027)	-0.000 (-0.044)
External audit opinion	-0.014** (-2.481)	-0.014** (-2.524)	-0.014** (-2.490)	-0.014** (-2.519)
Adopting IFRS	0.015** (2.209)	0.015** (2.321)	0.014** (2.193)	0.015** (2.288)
Ownership concentration	0.034*** (3.338)	0.035*** (3.466)	0.034*** (3.323)	0.035*** (3.423)
State ownership	-0.015** (-2.488)	-0.015** (-2.612)	-0.015** (-2.511)	-0.016** (-2.623)
Constant	0.098*** (5.794)	0.099*** (5.853)	0.098*** (5.784)	0.099*** (5.843)
Number of observations	11,831	11,831	11,831	11,831
F value	172.99***	163.41***	172.97***	163.34***
Adj. R <sup>2</sup>	32.42%	32.45%	32.42%	32.45%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. *Accrual-based earnings manipulation* is measured based on a cross-sectional version of the modified Jones (1991) model by DeFond and Jiambalvo (1994). All of the variables except *accrual-based earnings manipulation* are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

*accrual-based earnings manipulation* as a control variable when regressing *real activities manipulation* on female participation on BoDs. The regression results, given in Table 14, show that after controlling for the potential trade-off between real activities and accrual-based earnings management, the results are highly consistent with our main finding given in Table 5, suggesting that the negative association between real activities manipulation and female participation on BoDs does not depend on the extent of accrual-based earnings management. In addition, Table 14 shows that the variable *accrual-based earnings manipulation* has a significant and negative relationship with real activities manipulation in all of the regression models, indicating a trade-off between two kinds of earnings management in the context of China and thus extending the boundary of Zang's (2012) findings.



Table 14  
Additional tests for the trade-off between real activities manipulation and accrual-based earnings manipulation.

	Dependent variable: Real activities manipulation			
	Model 1	Model 2	Model 3	Model 4
Critical mass of women on BoDs	<b>-0.020*</b> (-1.752)	<b>-0.016</b> (-1.405)		
Ratio of women on BoDs			<b>-0.068**</b> (-2.201)	<b>-0.058*</b> (-1.887)
Critical mass of women on BoDs × Ownership of women on BoDs		<b>-1.651**</b> (-2.331)		
Ratio of women on BoDs × Ownership of women on BoDs				<b>-9.402***</b> (-3.747)
Ownership of women on BoDs		<b>-0.761***</b> (-3.160)		<b>-0.163</b> (-0.552)
Accrual-based earnings manipulation	<b>-0.257***</b> (-10.506)	<b>-0.260***</b> (-10.615)	<b>-0.257***</b> (-10.513)	<b>-0.259***</b> (-10.587)
Firm size	0.002 (0.772)	0.002 (0.675)	0.002 (0.669)	0.002 (0.593)
Firm age	0.010*** (10.366)	0.009*** (9.722)	0.010*** (10.318)	0.009*** (9.605)
Firm profitability	-0.587*** (-8.414)	-0.581*** (-8.335)	-0.587*** (-8.420)	-0.582*** (-8.342)
Firm growth	-0.065*** (-9.744)	-0.065*** (-9.772)	-0.065*** (-9.743)	-0.065*** (-9.774)
Market to book value	-0.054*** (-12.555)	-0.055*** (-12.673)	-0.054*** (-12.566)	-0.055*** (-12.728)
Firm loss	-0.043*** (-3.154)	-0.043*** (-3.127)	-0.043*** (-3.158)	-0.043*** (-3.137)
External auditor	0.012 (0.677)	0.011 (0.628)	0.011 (0.612)	0.011 (0.589)
External audit opinion	0.048*** (3.257)	0.047*** (3.195)	0.048*** (3.256)	0.046*** (3.149)
Adopting IFRS	-0.035* (-1.899)	-0.032* (-1.733)	-0.035* (-1.848)	-0.031* (-1.683)
Ownership concentration	0.067** (2.494)	0.072*** (2.689)	0.067** (2.488)	0.073*** (2.737)
State ownership	-0.008 (-0.527)	-0.011 (-0.704)	-0.009 (-0.547)	-0.012 (-0.736)
Constant	0.098** (2.159)	0.102** (2.233)	0.105** (2.289)	0.108** (2.360)
Number of observations	11,831	11,831	11,831	11,831
F value	240.82***	228.22***	240.91***	228.68***
Adj. R <sup>2</sup>	40.80%	40.88%	40.81%	40.93%

The industry and year indicators are included in all of the regression models but omitted from the table to save space. The interaction terms are mean-centered before being included in the regression models. *T*-statistics are in parentheses. *Accrual-based earnings manipulation* is measured based on a cross-sectional version of the modified Jones (1991) model by DeFond and Jiambalvo (1994). All of the variables except *accrual-based earnings manipulation* are defined in Table 2.

\*\*\* Significance at the 1% level (two sided).

\*\* Significance at the 5% level (two sided).

\* Significance at the 10% level (two sided).

## 6. Summary and conclusions

This study investigates the role of female directors in curbing managers' real activities manipulation. Using a large sample of Chinese listed firms from the 2000 to 2011 period, we find that female participation on BoDs, as measured by the critical mass of female directors and the ratio of female directors, is associated with less real activities manipulation. Furthermore, this negative association is more pronounced when female directors have a higher ownership stake. These results hold for a battery of robustness checks. Overall, our findings

demonstrate that female directors help boards to curb real activities manipulation effectively, and stock ownership can enhance this effect.

Our study contributes to several strands of research. First, it contributes to the board gender diversity literature by showing that firms with a gender-diverse board exhibit less real activities manipulation. Previous studies of the consequences of female directors focus on accrual-based earnings management/quality and draw inconclusive results (Gul et al., 2011; Srinidhi et al., 2011; Sun et al., 2011). To our knowledge, our study is one of the few, if not the first, to examine the role of female directors in curbing real activities manipulation. Second, our study contributes to the literature on real activities manipulation by showing that a gender-diverse board can effectively alleviate real activities manipulation. As current research largely examines the effectiveness of external mechanisms (Qi et al., 2014; Roychowdhury, 2006; Zhu et al., 2015), we expand the scarce literature testing the role of internal governance mechanisms in curbing real activities manipulation, which is to a large extent opaque to outside stakeholders and thus more subject to internal monitoring scrutiny (Ge and Kim, 2014; Graham et al., 2005; Zang, 2012). Furthermore, responding to Kim and Lu's (2011) call for more in-depth work on the interactive effects of different governance mechanisms on mitigating agency problems, our study contributes to the corporate governance literature by showing the interactive effect between board gender diversity and stock ownership schemes.

As real activities manipulation, although detrimental to a firm's long-term growth, is a common practice among managers trying to meet short-term earnings targets, our findings are of great interest to shareholders and regulators. Our results indicate that shareholders can curb costly real earnings manipulation by increasing female participation on BoDs and implementing stock-based compensation systems. Our study is limited to Chinese firms, which have relatively weak corporate governance and underdeveloped institutions. Therefore, there may be limits to the generalizability of our findings. Future research should test our arguments and conclusions in diverse contexts. The measurement of real activities manipulation is concrete but incomplete due to potential measurement errors. Scholars should develop a better measure to fully capture the exact extent of real activities manipulation. Finally, our knowledge of the interactive effects between different governance mechanisms is still limited. More in-depth research is needed to gain a better understanding of corporate governance.

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