Aims and Scope

The focus of the *China Journal of Accounting Research* is to publish theoretical and empirical research papers that use contemporary research methodologies to investigate issues about accounting, corporate finance, auditing and corporate governance in the Greater China region, countries related to the Belt and Road Initiative, and other emerging and developed markets. The Journal encourages the applications of economic and sociological theories to analyze and explain accounting issues within the legal and institutional framework, and to explore accounting issues under different capital markets accurately and succinctly. The published research articles of the Journal will enable scholars to extract relevant issues about accounting, corporate finance, auditing and corporate governance related to the capital markets and institutional environment.

China Journal of Accounting Research

Website: http://www.cnjar.com
http://www.cb.cityu.edu.hk/research/cjar

10/4 China Journal of Accounting Research Vol. 10/4 (2017) 295–378

ELSEVIER

Volume 10 • Issue 4 • December 2017

China Journal *of* Accounting Research

Do independent directors play a political role? Evidence from independent directors' death events
Qing Ye, Zengquan Li 295

Accruals quality, underwriter reputation, and corporate bond underpricing: Evidence from China
Si Xu, Guangming Gong, Xun Gong 317

The mystery of zombie enterprises – ''stiff but deathless''
Xinfeng Jiang, Sihai Li, Xianzhong Song 341

How does smog affect firms' investment behavior? A natural experiment based on a sudden surge in the PM2.5 index
Jingbo Luo 359

HOSTED BY
ELSEVIER

Available online at www.sciencedirect.com
ScienceDirect

ISSN 1755-3091

CYAN MAGENTA YELLOW BLACK

Production and hosting by Elsevier
Radarweg 29, 1043 NX Amsterdam, The Netherlands

ISSN 1755-3091

Founded by Sun Yat-sen University and City University of Hong Kong

Sponsored by: CPA Hong Kong Institute of Certified Public Accountants 香港會計師公會

Published quarterly in March, June, September, and December

China Journal of Accounting Research has been indexed by Emerging Sources Citation Index (ESCI), Cabell's Directory, Scopus, CNKI, Australian Business Deans Council (ABDC) Journal Quality List and Excellence in Research for Australia (ERA) Journal List.

Guidelines for Manuscripts Submitted to The China Journal of Accounting Research

The **China Journal of Accounting Research** "CJAR" (ISSN 1755-3091) publishes quarterly. It contains peer-reviewed articles and commentaries on accounting, auditing and corporate governance issues that relate to the greater China region.

We welcome the submission of both theoretical and empirical research papers pertinent to researchers, regulators and practitioners. Authors should note:

1 Submissions must be original contributions and not under consideration by any other journal. The author must state the work is not submitted or published elsewhere.

2 Authors submitting articles, notes and comments will be entitled to two free copies. Each author of a book review will receive a copy of the relevant issue.

3 Authors should submit their manuscripts (in Word format) via email to china.jar@gmail.com. All text, including endnotes, must be double-spaced. Authors will be notified when manuscripts are received by *CJAR*.

4 Authors should note:

- a cover page showing the title of the paper, the author's name, title and affiliation, e-mail address, and any acknowledgement should be included.
- to promote anonymous review, author(s) should confine his/her identify (such as name, affiliation, biographical information, and acknowledgment) to the cover page only.
- supply an abstract of about 120 words, stating the study's findings, sample and methodology in that order.
- key terms used in the text should be defined or explained as early as possible after they are first introduced.
- words in a foreign language are to be in italics.
- all citations in the text should refer to the author's (or authors') name and the year of publication.

  Examples: "the debt contracting explanation for conservatism (Watts and Zimmerman, 1986; Basu, 1997; Ahmed et al, 2002). Using the Basu (1997) asymmetric timeliness regression"
- include a list of reference for works cited as follows:
  - reference to a journal publication:

    Basu, S., Waymire, G.B., 2006. Record keeping and human evolution. Accounting Horizons 20 (3), 201–229.
  - reference to a book:

    Watts, R.L., Zimmerman, J.L., 1986. Positive accounting theory. Prentice Hall, Englewood Cliffs, NJ.
  - reference to a chapter in an edited book:

    Ball, R., 2001. Infrastructure requirements for an economically efficient system of public financial reporting and disclosure, 127–169. In: Litan, R., Herring, R. (Editors), Brookings-Wharton Papers on Financial Services. Brookings Institution Press, Washington, DC.
- omit all full stops in abbreviations. Example: 'eg', 'ie', 'Co', 'Ltd', 'etc'
- dates are in the order – date, month, year, eg '5 May 1975'
- quotation marks are single, but within a quotation are double.
- use endnotes rather than footnotes.
- put each table on a separate sheet; do not embed in the text but indicate where the table would best be inserted.

5 China Journal of Accounting Research copyright in works published by *CJAR*.

For additional information, please contact Irene Li, Department of Accountancy, City University of Hong Kong, Tat Chee Avenue, Kowloon Tong, Hong Kong. Telephone: +852 3442 7932. Fax: +852 3442 0349. E-mail: acwoo@cityu.edu.hk.

CHINA JOURNAL OF ACCOUNTING RESEARCH

Volume 10/4 (2017)

China Journal of Accounting Research 10 (2017) 295–316

HOSTED BY

Contents lists available at ScienceDirect

China Journal of Accounting Research

journal homepage: www.elsevier.com/locate/cjar

Do independent directors play a political role? Evidence from independent directors' death events

Qing Ye [a,b], Zengquan Li [c,*]

[a] Center for Accounting, Finance and Institutions, Sun Yat-sen University, China
[b] Sun Yat-sen Business School, Sun Yat-sen University, China
[c] School of Accountancy and The Institute of Accounting and Finance, Shanghai University of Finance and Economics, China

ARTICLE INFO

Article history:
Received 12 October 2015
Accepted 1 November 2016
Available online 10 December 2016

Keywords:
Independent directors
Political connections
Political role

ABSTRACT

We propose that independent directors are likely to play a political role in an institutional setting featuring weak investor protection and strong government intervention. Using Chinese data for 2001–2014, we investigate whether the stock price reaction to an independent director's death is related to his or her political connection. We find a stronger negative reaction to the death announcements of politically connected than politically unconnected independent directors. The magnitude of the reaction is positively related to directors' political rank, and cannot be offset by their firms' political capital. However, we document no evidence of politically connected independent directors exhibiting superior monitoring or consulting performance. Additional analyses show that firms are more inclined to appoint a politically connected independent director as a successor if his or her predecessor also had political connections. Our study broadens scholarly understanding of independent directors' role in a non-Anglo-American setting.

1. Introduction

Independent directors are considered to constitute an important corporate governance mechanism by academics, practitioners and policymakers alike. The traditional view is that they enhance firm value by playing a monitoring or consulting role, although empirical tests do not unanimously support that view, partly due to the endogeneity problem (Adams et al., 2010). Another view is that independent directors are little more than window dressing, offering little real value, particularly when they fall into the vortex of public opinion during

* Corresponding author.
E-mail address: zqli@mail.shufe.edu.cn (Z. Li).

http://dx.doi.org/10.1016/j.cjar.2016.11.001
1755-3091/

corporate scandals. Hence, the issue of whether independent directors can play a role, and if so what role they play, is by no means settled. Further investigation is needed.

Scholars have increasingly begun to recognize the importance of the institutional environment in shaping the role of independent directors[1] (Liu et al., 2012, 2015). As firms face different constraints and opportunities in different institutional settings, the roles that they need independent directors to play and the roles that such directors can play are also likely to differ across settings. However, the extant literature focuses narrowly on independent directors' monitoring and consulting role in the context of developed markets. Little attention has been paid to their role in emerging markets, even though the institutional characteristics of those markets are likely to shape that role in significant ways. In this paper, we fill this research gap by proposing and empirically testing an alternative view. We posit that in addition to their monitoring and consulting role, independent directors can also play a political role in China, an emerging market setting characterized by weak investor protection and strong government intervention, and that firms in China need them to play such a role.

China offers weak legal protection for investors. To gain private benefits of control, the largest shareholders in a firm are often able to manipulate the selection process of independent director candidates and dismiss those incumbent who are "unfriendly" and thus likely to monitor them strictly, thereby impeding the monitoring role of independent directors (Liu et al., 2013; Tang et al., 2010). China is also characterized by strong government intervention, which means that firms' business strategies are severely affected by frequent policy changes and political disturbances, thereby weakening the consulting role of independent directors. At the same time, the regulatory power underscoring government intervention creates strong demand for rent-seeking. Independent directors with political connections can build a bridge for communication between firms and politicians, thereby helping firms to avoid policy risks and gain regulatory rent, through which they can play a crucial political role. In this context, a firm is likely to view politically connected independent directors primarily as a rent-seeking tool, with their potential monitoring or consulting role having little relevance.

To mitigate concern about the potential endogeneity problem, we empirically test the foregoing proposition by considering independent directors' death events from 2001 to 2014. Using this quasi-natural experiment, we investigate two issues. First, we compare the stock price reactions to the death announcements of politically connected and politically unconnected independent directors, allowing us to determine whether there is a political role that is restricted to the former. Second, we investigate whether firms are more inclined to appoint a politically connected independent director if his or her predecessor also had political connections. The China Securities Regulatory Commission (CSRC) requires that the proportion of independent directors on a board cannot be less than one-third, and most firms thus have to appoint a new such director to meet this regulatory requirement in the event of a director's death, allowing us to confirm firms' need for independent directors to play a political role.

The empirical results reveal a stronger negative stock price reaction to the death announcements of politically connected independent directors than to those of their politically unconnected counterparts. Further, the magnitude of the negative market reaction is positively related to the deceased director's political rank and cannot be offset by his or her firm's political capital, regardless of whether that capital takes the form of state-owned property rights or chairperson or CEO political connections. However, we document no evidence to indicate that politically connected independent directors perform better in their monitoring or consulting roles than their politically unconnected counterparts. Finally, in our test of the selection of successors, we find that firms are more inclined to appoint a new politically connected independent director if his or her predecessor had political connections, thus suggesting that politically connected independent directors are not randomly distributed and that firms need such directors to play a political role and actively select those capable of doing so.

This study contributes to the literature in several respects. First, it broadens the traditional perspective on the roles of independent directors. Most previous research focuses on their monitoring and consulting role, whereas this paper proposes and tests their political role by taking into account distinct features of China's institutional environment. Our findings emphasize the need for researchers to pay closer attention to the char-

[1] Liu et al. (2012) document the consulting role played by independent directors with a banking background in China, an institutional setting featuring financial repression. Liu et al. (2015) investigate the consulting role of nonlocal independent directors in nonlocal merger and acquisition activity in the context of a Chinese setting characterized by local protectionism.

acteristics of different institutional contexts in which independent directors may play different roles. Second, this study complements the literature on political connections. Most extant studies in this area explore the causes and consequences of the political connections of a firm's core executives, overlooking the potentially important role of independent directors' political connections. In practice, firms expand their political capital not only by seeking core executives with political titles, but also by appointing politically connected individuals as independent directors. A recent study shows that the latter's political connection is even more powerful and valuable than those of core executives (Du et al., 2014). Researchers would thus be advised to pay greater attention to the political connections of independent directors. Third, in terms of research methodology, by considering independent directors' death events as the research setting and utilizing the CSRC's "one-third" regulatory requirement concerning the proportion of independent directors on the board, our study effectively mitigates the endogeneity problem that is a major concern in the independent director literature.

This study also has important policy implications for regulatory bodies looking to further improve the independent director system. Although the CSRC introduced the current system in 2001 to improve corporate governance and strengthen investor protection, these policy objectives are far from being fulfilled in practice. Politically connected independent directors have been captured by firms as rent-seeking tools, which suggests that regulators need to restrict the qualifications of independent directors and establish related support systems (e.g., granting small shareholders more nomination rights concerning independent directors) to help independent directors to play more effective monitoring and consulting roles, and in turn to strengthen corporate governance.

The remainder of this paper is organized as follows. Section 2 reviews the literature. Section 3 describes the institutional background and theoretical analyses, and Section 4 details the research design. A statistical summary and empirical tests are presented in Section 5, and Section 6 concludes the paper.

2. Literature review

2.1. Research on independent directors

Extant studies examine the monitoring and consulting roles of independent directors from the governance perspective. For example, Adams et al. (2010) propose that independent directors play a monitoring role by appointing, assessing and dismissing top executives, thereby reducing agency costs between management and shareholders. Borokhovich et al. (1996) find that independent directors are more inclined to hire CEOs from the outside rather than promote them internally. Core et al. (1999) show that independent directors can prevent CEOs from receiving excess compensation. Weisbach (1988) reports that independent directors can strengthen the negative relationship between CEO turnover and firm performance by dismissing unqualified CEOs. However, all of this research is carried out in developed markets, in which conflicts of interest between management and shareholders are the dominant concern. In emerging markets, where those conflicts are between large and small shareholders, independent directors' monitoring role operates primarily by curbing the expropriation of minority shareholders by large shareholders. Ye et al. (2007) find that independent directors can reduce fund embezzlement by large shareholders. They also show that independent directors are likely to vote against management proposals only when firms are performing poorly, although the proportion of independent directors on the board is not related to such dissent (Ye et al., 2011).

Another strand of the independent director literature focuses on these directors' consulting role. Demb and Neubauer's (1992) survey indicates that the majority of independent directors see themselves as playing an advisory role, i.e., providing professional suggestions for corporate strategy-building. Adams and Ferreira (2007) argue that independent directors' consulting role depends on inside information on the firm, and thus greater independence decreases a CEO's willingness to share information, thereby weakening that role. Coles et al. (2008) find complex firms, which have greater advising requirements than less complex firms, to have larger boards with more independent directors. Finally, Liu et al. (2015) report that nonlocal independent directors play a consulting role in nonlocal mergers and acquisitions.

Although extant studies have documented considerable evidence on the roles that independent directors play, there are some notable gaps. First, most studies focus on developed markets, thus ignoring the specific role of independent directors in emerging markets. As Williamson (2000) argues, the country-level institu-

tional environment determines and shapes corporate governance practices at the firm level. Hence, the institutional environments in which firms operate influence the role of corporate governance mechanisms. For example, audit firms play a monitoring role in developed markets. However, in China, firms hire politically connected audit firms whose partners are members of the CSRC's IPO screening committee to help them to lobby for favorable regulatory decisions (Yang, 2013). Accordingly, audit firms' role is more akin to a facilitator than a watchdog. There is clearly a need for independent director research in emerging markets to pay close attention to the specific institutional features that differ from those in developed markets, and yet work in this area remains scant. One exception is Du et al. (2014), who document the positive influence of politically connected independent directors on private firms' entry into high-barrier industries in China, an institutional context with many restrictions on the scope and depth of private economic development because of "implicit discrimination."

Second, the endogeneity problem impairs the internal validity of much independent director research, resulting in potentially erroneous conclusions. For example, it remains unclear whether independent directors add firm value. Rosenstein and Wyatt (1990) and Wang et al. (2006) find a positive relationship between the two, whereas Hermalin and Weisbach (1991) and Klein (1998) find no relationship between them, and Agrawal and Knoeber (1996) document a negative relationship. One important reason for these mixed results is that most research has failed to resolve the endogeneity in the independent director selection process. There may be unobserved firm characteristics (omitted variables) that determine who firms appoint independent directors and what role they play, and the same characteristics may influence firm value (Coles et al., 2008). Therefore, we need a quasi-experimental setting to identify the role of independent directors and its influence on firm value.

This study fills the gap in the literature and offers an improved research design. Specifically, we examine the specific institutional features (i.e., weak investor protection and strong government intervention) responsible for the different roles that independent directors play in China relative to their counterparts in developed economies. Besides, we consider a death event setting, which mitigates the endogeneity concern and allows us to establish the causal effect of politically connected independent directors on firm value and firm demand for such directors.

2.2. Research on politically connected independent directors

In the independent director literature, only a small number of studies investigate the causes and consequences of politically connected directors. Agrawal and Knoeber (2001) find that such directors are more prevalent in firms that make sales to the government, are export-oriented and engage in lobbying. Goldman et al. (2009) document a positive abnormal stock return following the announcement of the nomination of a politically connected individual to the board. They also report that when the Republican Party won the 2000 U.S. presidential election, firms connected to that party increased in value, whereas those connected to the Democratic Party decreased in value. In the Chinese setting, Du et al. (2014) show politically connected independent directors to exert a positive effect on private firms' entry into high-barrier industries.

These studies contribute useful insights to the literature on politically connected independent directors, but most conduct cross-sectional tests, and are thus subject to the endogeneity concern. Even though try to identify the casual effect of directors' political connections by utilizing a shock event of the U.S. presidential election, it also faces the challenge of some alternative explanations. For example, recent studies show politicians to have different ideology and policy orientations, and hence the outcomes of elections may affect some firms positively and others negatively (Julio and Yook, 2012; Pastor and Veronesi, 2012). Fisman et al. (2012) considered a setting clearly unrelated to policy change, former U.S. Vice-President Cheney's heart attacks, and found connections with Cheney to suffer little change in value during the event window.

The independent director death setting considered in this paper is unrelated to firm characteristics or policy change, thereby allowing us to mitigate the endogeneity problem in previous research and identify the influence of independent directors' political connections on firm value more clearly.

2.3. Research using death events

Johnson et al. (1985) constitute the seminal work using death events as a quasi-experiment to study corporate governance issues. They utilize the sudden deaths of 53 top executives to analyze the effects of management characteristics on firm value. In a subsequent paper, Slovin and Sushka (1993) analyze how ownership concentration affects firm value and control by examining the effects of the deaths of 85 inside blockholders. Hayes and Schaefer (1999) explore the influence of managers' ability on firm value by using the deaths of 29 CEOs. Nguyen and Nielsen (2010) investigate the contributions of outside directors' independence to shareholder value by examining stock price reactions to the sudden deaths of 108 directors.

The political connection research also draws on quasi-experimental death-event methodology. For example, Fisman (2001) examines the stock price reactions of firms connected to former Indonesian president Suharto when rumors of his deteriorating health spread to the market. Faccio and Parsley (2009) analyze the contribution of political connections to firm value using the deaths of 192 politicians in 35 countries. It is worth noting that the death-event setting helps researchers to identify the causal effect of certain factors on the dependent variables with few concerns over potential endogeneity. However, because death events are rare, sample sizes are often limited in this strand of the literature. This study is no exception in that regard. However, although not perfect this methodology at least provides a solution to the tricky problem of causality identification.

3. Institutional background and theoretical analysis

La Porta et al. (1998) state that due to the weak legal protection for investors' rights in code-law countries, ownership concentration is an alternative mechanism for property rights protection. Such institutional divergence is accompanied by significant differences in corporate governance practices. For example, the primary conflict of interest in code-law countries is between large and small shareholders rather than between management and shareholders.

China is typical in this respect. The country lacks a civil law tradition,[2] and it still lags far behind developed countries in the establishment and enforcement of laws governing property rights protection. China has yet to introduce any mechanism for shareholder class action. Further, judicial independence and enforcement in civil infringement cases are also hindered by the government (Chen et al., 2009). As a result, the large shareholders of listed firms regularly expropriate the interests of small shareholders through fund embezzlement, related party transactions, mergers and acquisitions and other means (Li et al., 2004, 2005). Although the CSRC introduced an independent director system to the Chinese capital market in 2001, requiring that at least one-third of the boards of all listed firms be made up of independent directors to strengthen investor protection, large shareholders are still able to gain and retain private benefits of control by adjusting the board structure to restrict the number of independent directors (Liu et al., 2013). In addition, large shareholders can dismiss independent directors who vote against their proposals (Tang et al., 2010). For these reasons, scholars have increasingly begun to recognize that the weak legal protection of property rights in China seriously hinders independent directors from playing a monitoring role.

The Chinese business environment is also characterized by strong government intervention. To achieve the multiple objectives of fiscal revenue, employment, social stability and political promotion, Chinese local governments actively intervene in economic activities, resulting in frequent interruptions and distortion of firm production and operating activities. For example, Pan et al. (2008) document serious intervention in firms' merger and acquisition activities by local governments. Xu et al. (2013) show that firms' investment behavior is influenced by the political cycle of government official turnover. Xue et al. (2013) discuss a case in which power-rationing was forced upon firms by the local government as part of an energy-savings and emission reduction initiative. In such an uncertain environment characterized by frequent government interference in

[2] China has not traditionally been a society ruled by law. Chinese law focuses on criminal law, and the main task of the law is not to protect the interests of individuals or corporations, particularly their economic interests, against incursions by other individuals or corporations (Bodde and Morris, 1973).

firms' strategy implementation, independent directors' consulting role with regard to strategy-building is also weakened.

At the same time, strong government intervention also means that local governments have considerable discretion in the approval and regulation of various types of commercial behavior, which can benefit or harm firms' interests. They also have numerous policy instruments at their disposal, including industrial policies, lands, quotas, credits, taxes and subsidies, through which to exert a significant impact on resource allocation, thereby directly affecting firms' survival and development. Consequently, firms have a strong motivation to build a close relationship with the government to avoid policy risks and obtain regulatory rents.

In these conditions, independent directors with political connections can easily establish a communication bridge between firms and government officials. They can also help firms to avoid policy risks and obtain regulatory rents by exploiting their influence with the government. This kind of political role[3] is of course of great value for the firm, and cannot be acquired by hiring an independent director without political connections. Du et al. (2014) provide supporting evidence to show that politically connected independent directors can help firms to enter high-barrier industries and that the positive effect of their connections is even stronger than that of top executives.

Based on the foregoing analysis, we posit the following expectation. If politically connected independent directors play a political role that is not available to their politically unconnected counterparts, a firm's stock price will react more negatively to the announcement of the death of a politically connected independent director than to that of his or her unconnected counterpart. In addition, if firms need independent directors to play a political role, firms are more likely to appoint an independent director with political connections if his or her predecessor was also politically connected. Stated formally, we propose the two following hypotheses.

H1. Stock prices react more negatively to politically connected independent directors' death announcements than to those of their politically unconnected counterparts.

H2. Firms are more likely to appoint a politically connected independent director as a successor if the deceased director also had political connections.

The logic of our hypothesis development is illustrated in Fig. 1.

4. Research design

4.1. Sample and data

We first search the "Corporate Announcement" section of the WIND database using keywords carrying the meaning of death from 2001 to the end of 2014,[4] obtaining 251 announcements of top executive deaths. After deleting announcements of the deaths of executive directors, managers and supervisors, we obtain 55 death announcements for 46 independent directors. Panel A of Table 1 shows that the time span is large (ranging from 2003 to 2014), with the distribution of deaths varying across the years (ranging from one death to 10 deaths in a year). By reading through the relevant firm announcements and media reports, we collect and analyze information on the causes of death among the 46 independent directors. Panel B shows the majority to have died of illness, with the remainder (15%) dying in traffic accidents, being murdered or dying suddenly from disease. Panel C describes the directorships they held. Most held only one directorship, although five held two and one held five.

We obtain stock price and financial data from the China Stock Market and Accounting Research database, and independent directors' personal attributes from the WIND database. We hand-collect missing data from firms' annual reports and the online Baidu Encyclopedia.

[3] We use "political role" as a neutral term with no relevance to value judgments, as in Agrawal and Knoeber (2001). It includes but is not limited to rent-seeking behavior, and hence is not necessarily illegal.

[4] These keywords include *siwang*, *qushi*, *shishi*, *cishi*, *wanggu*, *bingshi*, *siqu*, *guoshi* and *lishi* (Chinese phonetic alphabet).

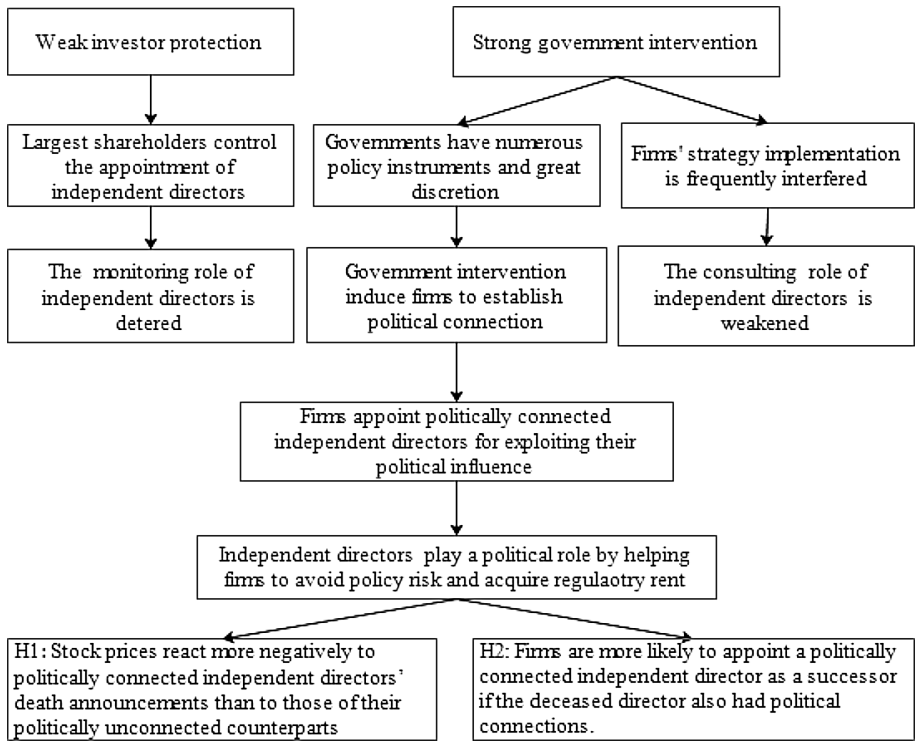


Figure 1. Logic chain of hypothesis development.

Table 1
Distribution of independent directors' death year, death causes and directorships.

	N (person)	Percent (%)	N (directorship)	Percent (%)
Panel A: Year distribution of independent directors' deaths				
2003	1	2.17	1	1.82
2006	1	2.17	1	1.82
2007	1	2.17	1	1.82
2008	6	13.04	6	10.91
2009	1	2.17	1	1.82
2010	6	13.04	7	12.73
2011	10	21.74	11	20
2012	2	4.35	2	3.64
2013	10	21.74	12	21.82
2014	8	17.39	13	23.64
Total	46	100.00	55	100.00
Panel B: Cause of death				
Traffic accident	2	4.35	2	3.64
Murder	1	2.17	2	3.64
Sudden disease	4	8.7	4	7.27
Illness	39	84.78	47	85.45
Total	46	100.00	55	100.00
Panel C: Directorships				
1	40	86.96		
2	5	10.87		
5	1	2.17		
Total	46	100.000		

4.2. Model specification and variable definitions

Following Nguyen and Nielsen (2010), we construct model (1) to test hypothesis 1:

$$car = \alpha_0 + \alpha_1 pc + \alpha_2 edu + \alpha_3 female + \alpha_4 age + \alpha_5 tenure + \alpha_6 difprov + \alpha_7 bank + \alpha_8 law + \alpha_9 acc + \alpha_{10} c\_stgy + \alpha_{11} c\_audt + \alpha_{12} c\_nomn + \alpha_{12} c\_comp + \varepsilon. \quad (1)$$

In model (1), the dependent variable is *car* (cumulated abnormal return), which is the market-adjusted return calculated as the difference between the firm return and market return.[5] In the data collection process, we find that some firms did not receive notice of an independent director's death from his or her family, and thus did not release that information, until several days after his or her death (the mean [median] delay is 3.87 [3] days). To fully cover the market reaction to the death news, we set the event window to (−5, +5) around the announcement date.[6]

With reference to Li et al. (2006) and Xu et al. (2013), we define politically connected independent directors as those with work experience in the party, government or military hierarchies and/or membership in the People's Congress or Chinese People's Political Consultative Conference (CPPCC) (the dummy variable *pc* is equal to 1). We expect the sign of *pc* to be negative, suggesting that the stock price reacts more negatively to the death announcement of a politically connected independent director than to that of politically unconnected counterparts.

In addition, model (1) also includes a number of control variables measuring the human capital of independent directors, including education (*edu*), banking experience (*bank*), law background (*law*) and accounting background (*acc*), with their signs expected to be negative. Also, because female independent directors are known to monitor management more effectively (Adams and Ferreira, 2009), we control for *female*, and expect its sign to be negative. Because the young are more likely to be concerned about reputation than the old, we control for *age*, and expect its sign also to be negative. In addition, we control for *tenure*, and predict its sign to be positive, because an independent director with a shorter tenure is expected to be more independent. Also, because nonlocal independent directors (*difprov*) can play an advisory role but may monitor management less effectively due to a lack of local information (Liu et al., 2015), we control for *difprov*, but make no prediction concerning its sign. Finally, because crucial board functions provide a valuable service to shareholders, we control for membership of strategy (*c_stgy*), auditing (*c_audt*), nomination (*c_nomn*) and compensation (*c_comp*) committees, and expect their signs to be negative. Table 2 reports the variable definitions.

We construct model (2) to test hypothesis 2:

$$newpc1 = \beta_0 + \beta_1 pc + \beta_2 size + \beta_3 roa + \beta_4 board + \beta_4 independence + \mu, \quad (2)$$

where the dependent variable *newpc1* is equal to 1 if the successor independent director is politically connected (i.e., has work experience in the party, government or military hierarchies or membership in the People's Congress or CPPCC). We expect the sign of *newpc1* to be positive. With reference to Agrawal and Knoeber (1996) and Coles et al. (2008), we also control for such firm characteristics as firm size (*size*) and performance (*roa*) and such governance variables as board size (*board*) and board independence (*independence*).

5. Empirical analysis

5.1. Descriptive statistics and univariate tests

Table 3 reports the descriptive statistics. To avoid the influence of outliers, we winsorize the top and bottom 1% of each continuous variable. Table 3 shows the mean (median) of the (−5, +5) cumulated abnormal return to be −2.1% (−1.7%), and significantly negative at the 10% level. The average education is above

[5] In a robustness check, we calculate *car* by the capital asset pricing model (CAPM), but the results remain the same.

[6] In a robustness check, we reset the event window to (−3, +3) around the announcement date. The results remain the same, although the magnitude of *car* decreases.

Table 2
Variable definitions.

Variable	Definition
car	Market-adjusted return calculated as the difference between the firm return and market return over the (−5, +5) days around the announcement date
pc	A dummy variable equal to 1 if the independent director has work experience in the party, government or military hierarchies or is a member of the People's Congress or CPPCC, and to 0 otherwise
edu	A discrete variable equal to 0 if the independent director holds a college degree or below, to 1 if he or she holds a Bachelor's degree and to 2 if he or she holds a Master's degree or higher
female	A dummy variable equal to 1 if the independent director is female, and to 0 otherwise
age	Age of independent director (in natural logarithm form when entered into the regression)
tenure	Tenure of independent director (in the form of the natural logarithm of (1 + tenure) when entered into the regression)
difprov	A dummy variable equal to 1 if the independent director is nonlocal, and to 0 otherwise
bank	A dummy variable equal to 1 if the independent director has banking experience, and to 0 otherwise
law	A dummy variable equal to 1 if the independent director has law background and zero otherwise
acc	A dummy variable equal to 1 if the independent director has an accounting background, and to 0 otherwise
c_stgy	A dummy variable equal to 1 if the independent director serves on the strategy committee, and to 0 otherwise
c_audt	A dummy variable equal to 1 if the independent director serves on the auditing committee, and to 0 otherwise
c_nomn	A dummy variable equal to 1 if the independent director serves on the nomination committee, and zero otherwise
c_comp	A dummy variable equal to 1 if the independent director serves on the compensation committee and to 0 otherwise
soe	A dummy variable equal to 1 if the listed firm if ultimately controlled by the government
ceopc	A dummy variable equal to 1 if the firm' chairperson or CEO has work experience in the party, government or military hierarchies or is a member of the People's Congress or CPPCC, and to 0 otherwise
absence	Number of an independent director's board meeting absences in a year
otherrec	Other receivables scaled by total assets
TFP	Total factor productivity of the firm
turnover	Asset turnover ratio calculated as sales scaled by total assets
newpc1	A dummy variable equal to 1 if the successor independent director has work experience in the party, government or military hierarchies or is a member of the People's Congress or CPPCC, and to 0 otherwise
newpc2	A dummy variable equal to 1 if the successor independent director has work experience in the party, government or military hierarchies, is a member of the People's Congress or CPPCC or is a leader of an industry association, and to 0 otherwise
size	Natural logarithm of total assets
roa	Return on assets
lev	Long-term loans scaled by total assets
board	Number of board members
independence	Proportion of independent directors on the board
meets	Number of board meetings in a year (in the form of the natural logarithm of (1 + *meet*) when entered into the regression)
block	Largest shareholder's holding
dual	A dummy variable equal to 1 if the CEO also holds the position of board chair
mgtshare	Managerial shareholding

the undergraduate level. The sample includes only two female independent directors (3.6%). The average age of the sample independent directors is 60, and their mean length of tenure is four years. Twenty-seven percent are nonlocal, 3.6% have banking experience, 12.7% a law background and 21.8% an accounting background. The membership percentage of various board committee is approximately 40%.

We conduct univariate tests comparing politically connected independent directors with their politically unconnected counterparts. As shown in Table 4, the deaths of the former are associated with a stock price drop of more than 4% (mean = −4.2%, significant at the 1% level), whereas the stock price reaction to the deaths of politically unconnected directors is roughly 0 (mean = 0.3%, non-significant), and the difference between the two groups is significant at the 5% level. There is no significant between-group difference in education, age, sex, tenure or localness, but a significant difference in accounting and law background, and auditing and nomination committee membership. Although these univariate tests support hypothesis 1, to ensure that the between-group difference in the stock price reaction can be attributed to political connections, we also conduct multiple regression analysis with more control variables included.

Fig. 2 depicts the cumulated abnormal returns of the two groups during the event window.

Table 3
Descriptive statistics of full sample.

Variable	N	Mean	Median	Std.dev.	Min	Q1	Q3	Max
car	55	−0.021	−0.017	0.080	−0.168	−0.055	0.004	0.199
pc	55	0.491	0	0.505	0	0	1	1
edu	55	1.291	1	0.658	0	1	2	2
female	55	0.036	0	0.189	0	0	0	1
age	55	60.927	65	11.687	39	51	69	78
tenure	55	3.818	4	2.373	1	2	5	13
difprov	55	0.273	0	0.449	0	0	1	1
bank	55	0.036	0	0.189	0	0	0	1
law	55	0.127	0	0.336	0	0	0	1
acc	55	0.218	0	0.417	0	0	0	1
c_stgy	55	0.364	0	0.485	0	0	1	1
c_audt	55	0.400	0	0.494	0	0	1	1
c_nomn	55	0.418	0	0.498	0	0	1	1
c_comp	55	0.382	0	0.490	0	0	1	1

Table 4
Univariate comparison.

Variable	$pc = 1$		$pc = 0$		Difference of mean	P-value	Difference of median	P-value
	Mean	Median	Mean	Median				
car	−0.046	−0.042	0.003	−0.007	−0.048	0.023	−0.045	0.027
edu	1.259	1	1.321	1	−0.062	0.730	−0.321	0.595
female	0.037	0	0.036	0	0.001	0.980	−0.036	0.979
age	62.037	67	59.857	64.5	2.180	0.494	7.143	0.458
tenure	3.704	3	3.929	4	−0.225	0.729	−0.929	0.371
difprov	0.185	0	0.357	0	−0.172	0.158	−0.357	0.156
bank	0.000	0	0.071	0	−0.071	0.163	−0.071	0.161
law	0.222	0	0.036	0	0.187	0.039	−0.036	0.040
acc	0.074	0	0.357	0	−0.283	0.010	−0.357	0.012
c_stgy	0.370	0	0.357	0	0.013	0.921	0.000	0.920
c_audt	0.185	0	0.607	1	−0.422	0.001	−1.000	0.002
c_nomn	0.296	0	0.536	1	−0.239	0.074	−1.000	0.075
c_comp	0.333	0	0.429	0	−0.095	0.477	0.000	0.471

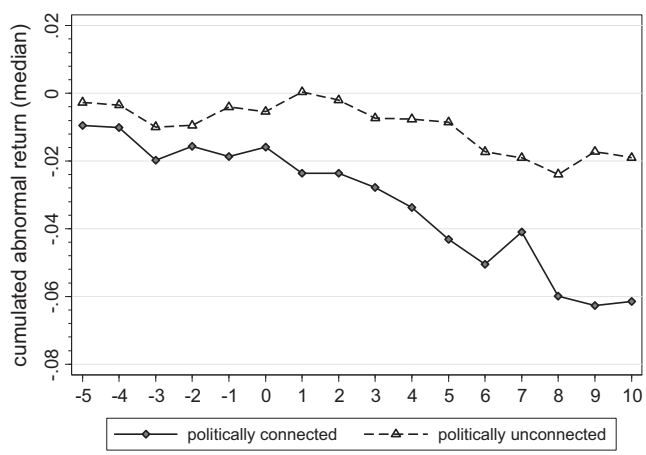


Figure 2. Stock price reaction to independent directors' death announcements.

5.2. Regression analysis of stock price reaction to independent directors' death announcements

Here, we first report the main results of multiple regression analysis, and then those of several robustness checks. Further, we also examine whether firms' political connections can offset the loss of the political connections of independent directors. Next, we analyze the potential channels through which politically connected independent directors play a political role. Finally, we examine the monitoring and consulting roles of politically connected independent directors.

5.2.1. Main results

Table 5 reports the main results of multiple regression analysis on the stock price reactions to the deaths of independent directors. In column 1, without control variables, the coefficient of *pc* is −0.048 and significant at the 1% level, which is consistent with the univariate comparison in Table 4, suggesting that stock prices drop more than 4.8% when the independent directors concerned are politically connected. In column 2, in which the personal attribute variables are included, the coefficient of *pc* becomes more strongly negative and remains significant at the 1% level. There are two implications of these results. First, the difference in the stock price reaction to politically connected and unconnected independent directors can be attributed to political connec-

Table 5
Regression results of stock price reaction to an independent director's death announcement.

Variables	(1) *car*	(2) *Car*	(3) *car*
pc	−0.048**	−0.079***	
	(−2.33)	(−3.48)	
govrank			−0.017***
			(−2.94)
edu		−0.003	−0.005
		(−0.22)	(−0.34)
female		0.105*	0.077
		(1.76)	(1.41)
age		−0.004	−0.011
		(−0.06)	(−0.15)
tenure		0.049**	0.043*
		(2.45)	(1.93)
bank		−0.014	−0.004
		(−0.49)	(−0.14)
law		−0.025	0.037
		(−0.69)	(0.78)
acc		−0.047	−0.042
		(−1.66)	(−1.44)
difprov		−0.038	−0.027
		(−1.39)	(−1.05)
c_stgy		−0.024	−0.029
		(−0.92)	(−1.08)
c_audt		−0.041	−0.050
		(−1.02)	(−1.24)
c_nomn		−0.020	−0.010
		(−0.60)	(−0.31)
c_comp		0.028	0.016
		(1.02)	(0.57)
N	55	55	50
Adj. R^2	0.076	0.221	0.171

All variables are defined in Table 2. The effect of the constant term is omitted. Values of robust t-statistics are in parentheses.

*** Indicates significance at the 1% level.

** Indicates significance at the 5% level.

* Indicates significance at the 10% level.

tions because column 2 includes other control variables. Second, after controlling for the other attributes of independent directors, the importance of political connections becomes more prominent. These results further support hypothesis 1.

With regard to the control variables, the coefficient of *female* is positive and marginally significant, suggesting that the market reacts more negatively to the death of male independent directors. The coefficient of *tenure* is positive and significant at the 5% level, consistent with the prediction that independent directors with a shorter tenure are more independent in monitoring management (Nguyen and Nielsen, 2010). The coefficient of *acc* is negative and marginally significant, which suggests that an accounting background matters as a form of human capital. None of the other variables is significant, suggesting they are not the main causes of the differing stock price reactions to the death announcements of the two types of independent directors.

In addition, we also examine whether the stock price decline is related to independent directors' political rank. Because high-ranking officials have more power and influence and cultivate higher-level contacts than their low-ranking counterparts, we replace the dummy variable *pc* with the ordinal variable *gov_rank*, which equals 0 as a benchmark for politically unconnected independent directors, and assigns values of 1–6 to their politically connected counterparts in accordance with their political rank[7] in the order of under deputy division level, deputy division level, division level, deputy departmental level, departmental level and vice-ministerial level. We remove observations with membership in the People's Congress or CPPCC but no work experience in the party, government or military hierarchies because we cannot determine their political rank. As shown in column 3 of Table 5, the coefficient of *gov_rank* is −0.017 and significant at the 1% level, suggesting that the higher an independent director's political rank, the greater the stock price decline resulting from his or her death, thus providing further support for hypothesis 1.

5.2.2. Robustness checks

We conduct several robustness tests for hypothesis 1. First, if firms announce other major events in the same event window as directors' deaths, the stock price reaction will be contaminated by those confounding events. Therefore, we reexamine the results after excluding contaminated observations. Table 6, column 1 shows the magnitude and significance level of the *pc* coefficient to remain unchanged, suggesting that the potential noise of confounding announcements does not exert a serious effect on our main results. Given our limited sample size, we retain all observations in the following analyses to increase the test power.

Second, the stock price reaction to independent directors' deaths may depend on their importance relative to other incumbent independent directors. Hence, in column 2, we include *numpc_indir*, the number of incumbent independent directors with political connections, in the regression. It can be seen that the coefficient of *numpc_indir* is positive, but insignificant, whereas that of *pc* is still significantly positive at the 1% level. In column 3, we include the interaction term *pc***numpc_indir*, but the result does not change. Column 4 adds *numhigh_indir*, the number of incumbent politically connected independent directors whose political rank is the same as or higher than that of the deceased. The sign, magnitude and significance remain almost the same, although the coefficient of *numhigh_indir* is positive but insignificant.

Third, we use CAPM to calculate the cumulated abnormal return as the dependent variable.[8] As shown in column 5, the coefficient of *pc* is now −0.062, and significant at the 1% level.

Fourth, we exclude independent directors with multiple directorships to mitigate concern that these observations are driving our results. As shown in column 6, when the independent directors with five directorships are excluded, the coefficient of *pc* is −0.070 and significant at the 1% level. When those with two directorships are further excluded, the coefficient of *pc* becomes −0.087 and still significant at 1% (unreported). Hence, we can exclude the possibility that observations with multiple directorships are driving the results.

Fifth, when we shorten the event window from (−5, +5) to (−3, +3), as shown in column 7, the coefficient of *pc* becomes significantly negative at the 5% level and decreases in magnitude to −0.027, which indicates that the effects of independent directors' deaths are not fully covered in a shorter event window. Fig. 2 also shows the gap between the cumulated abnormal returns of the deaths of politically connected and unconnected

[7] In our sample, the vice-ministerial level is the highest political rank.
[8] The estimation window is (−220, −20).

Table 6
Robustness check of stock price reaction to an independent director's death announcement.

Variable	(1) *car*	(2) *car*	(3) *car*	(4) *car*	(5) *car*	(6) *car*	(7) *car*
pc	−0.084**	−0.084***	−0.078**	−0.088***	−0.062***	−0.070***	−0.027**
	(−2.70)	(−3.71)	(−2.58)	(−3.78)	(−2.86)	(−2.82)	(−2.11)
edu	0.016	0.001	−0.000	0.003	0.003	−0.004	0.000
	(0.83)	(0.05)	(−0.01)	(0.19)	(0.20)	(−0.26)	(0.03)
female	−0.017	0.114*	0.115*	0.106*	0.088	0.061	0.049
	(−0.33)	(1.96)	(1.94)	(1.82)	(1.52)	(1.10)	(1.58)
age	0.035	−0.027	−0.033	0.002	0.068	−0.028	−0.102**
	(0.33)	(−0.47)	(−0.53)	(0.04)	(1.05)	(−0.41)	(−2.66)
tenure	0.059*	0.061***	0.059**	0.056**	0.036*	0.047**	0.036**
	(2.06)	(2.91)	(2.70)	(2.60)	(1.97)	(2.05)	(2.63)
bank		−0.024	−0.032	−0.010	−0.050*	−0.005	0.007
		(−0.77)	(−0.89)	(−0.35)	(−1.72)	(−0.15)	(0.22)
law	−0.084	−0.029	−0.031	−0.020	−0.006	0.042	−0.034
	(−1.12)	(−0.85)	(−0.88)	(−0.56)	(−0.15)	(0.91)	(−1.22)
acc	−0.057	−0.050*	−0.050*	−0.051*	−0.043	−0.044	−0.026
	(−1.52)	(−1.85)	(−1.84)	(−1.86)	(−1.63)	(−1.53)	(−1.45)
difprov	−0.074*	−0.036	−0.037	−0.033	−0.025	−0.036	−0.042***
	(−1.77)	(−1.40)	(−1.42)	(−1.23)	(−0.92)	(−1.27)	(−3.31)
c_stgy	−0.015	−0.024	−0.024	−0.026	−0.022	−0.021	−0.016
	(−0.32)	(−0.90)	(−0.88)	(−0.97)	(−0.87)	(−0.75)	(−1.15)
c_audt	−0.100**	−0.038	−0.037	−0.036	−0.022	−0.048	−0.022
	(−2.17)	(−0.95)	(−0.90)	(−0.90)	(−0.57)	(−1.09)	(−0.96)
c_nomn	0.046	−0.022	−0.024	−0.019	−0.019	−0.007	−0.015
	(0.92)	(−0.67)	(−0.69)	(−0.56)	(−0.62)	(−0.18)	(−0.74)
c_comp	0.041	0.021	0.023	0.016	0.013	0.018	0.023
	(1.14)	(0.76)	(0.86)	(0.60)	(0.51)	(0.64)	(1.30)
numpc_indir		0.018	0.025				
		(1.24)	(1.25)				
pc∗*numpc_indir*			−0.010				
			(−0.37)				
numhigh_indir				0.028			
				(1.39)			
N	34	55	55	55	55	50	55
Adj. R^2	0.192	0.234	0.216	0.229	0.164	0.140	0.195

All variables are defined in Table 2. The effect of the constant term is omitted. Values of robust t-statistics are in parentheses.
*** Indicates significance at the 1% level.
** Indicates significance at the 5% level.
* Indicates significance at the 10% level.

independent directors to widen over time. Because the announcement date lags the death date by 3.87 days on average, a time window of (−5, +5) is appropriate.

Finally, because our death sample is small, there may be concern that the results are sensitive to outliers. To mitigate that concern, we conduct a median regression. However, the result remains almost the same, i.e., the coefficient of *pc* is still significantly negative at the 5% level (unreported).

The foregoing robustness checks confirm the validity of the empirical results concerning hypothesis 1.

5.2.3. Further analysis of the role of firms' political connections

An important issue worth further exploration is the relationship between the political connections of independent directors and firms. To shed light on this issue, we focus on the question of whether firms' political capital can mitigate or even entirely counteract the negative market reaction to the deaths of politically connected independent directors. To answer that question it is necessary to discuss the types of and motivations for firms' political connections. Theoretically, firms can have two types of political connections: impersonal

political connections, which are determined by the state-owned property rights of the firm, and personal political connections, which are attached to firms' core executives (e.g., chairperson or CEO). From the perspective of property rights, state-owned enterprises (SOEs) by their nature have political connections and enjoy policy favoritism with respect to land, credit, quotas and access, whereas private firms are subject to government discrimination. It thus seems plausible to draw the conclusion that independent directors' political connections are more important for private firms than for SOEs. However, once we take into account the central government's "seize big, drop small" and "SOE strategic restructuring" reform strategies, it becomes clear that property rights are endogenous, i.e., larger firms and firms in monopoly industries are more likely to be controlled by the government (Xia and Chen, 2007). These SOEs undoubtedly face higher political costs due to their monopoly status, and demand more policy favoritism to maintain that status, and hence politically connected independent directors also play an indispensable role in SOEs. It is not surprising that SOEs who command considerable political capital still need to hire high-ranking ministerial-level officials as independent directors. As a result, the question of the type of firm to which politically connected independent directors are more important remains an empirical one.

Similarly, the personal political connections attached to firms' core executives are also endogenous, depending on the strength of the firms' need for such connections. Li et al. (2006) find that entrepreneurs are most likely to establish political connections with the government when they seek to protect their property rights, avoid unfavorable regulations and/or seek preferential policies and rents. Thus, at first glance, it seems that politically connected independent directors are more important for firms whose chairpersons or CEOs have no political connections. When we take into account that whether those executives have such connections may reflect their firms' need for them, however, it is clear that politically connected independent directors are also important for these firms. Consequently, whether top executives' political connections can mitigate

Table 7
Further analysis of the role of firms' political connections.

Variable	(1) *car*	(2) *car*	(3) *car*
pc∗soe	−0.086**		
	(−2.70)		
pc∗(1-soe)	−0.076***		
	(−3.32)		
pc∗ceopc		−0.080**	
		(−2.57)	
pc∗(1-ceopc)		−0.083**	
		(−2.11)	
pc∗soe∗ceopc			−0.088**
			(−2.24)
pc∗soe∗(1-ceopc)			−0.091*
			(−1.72)
pc∗(1-soe)∗ceopc			−0.082**
			(−2.09)
pc∗(1-soe)∗(1-ceopc)			−0.073*
			(−1.88)
soe	0.017		0.017
	(0.64)		(0.61)
ceopc		0.011	0.011
		(0.29)	(0.31)
control variables	yes	yes	yes
N	55	55	55
Adj. R^2	0.188	0.187	0.126

All variables are defined in Table 2. The effect of the constant term is omitted. Values of robust t-statistics are in parentheses.
*** Indicates significance at the 1% level.
** Indicates significance at the 5% level.
* Indicates significance at the 10% level.

Table 8
Identification of the channels of independent directors' political role.

Code	Firm name	Primary business	Registration location	Independent director's position	Political role
000301	Eastern Market	Real estate, thermal electricity, gasoline	Wujiang, Jiangsu	Deputy Mayor of Wujiang Government	Land, bank loan, approval
000612	Jiaozuo Wanfang	Aluminum production	Jiaozuo, Henan	Deputy Director of Henan Environmental Protection Bureau	Environmental supervision
000686	Northeastern Securities	Securities brokerage, underwriting	Changchun, Jilin	Deputy Minister of Finance	Preferential policy, regulation
000997	New Continent	Communications, finance, government information system	Mawei District, Fuzhou, Fujian	Deputy Mayor of Fuzhou, Director of Mawei Development District	Government orders, tax benefits
002117	Donggang	Commercial note printing	Jinan, Shandong	Vice President of Jinan Intermediate Court	Legal disputes
002152	Guangdian Currency	Automatic currency processing equipment and software	Guangzhou, Guangdong	Director of Guangdong Electronic Machinery Department	Preferential policy
002695	Huangshanghuang	Meat processing	Nanchang, Jiangxi	Executive of Frozen Meat Processing Department of State Internal Trade Bureau	Preferential policy, regulation
600069	Yinge Investment	Papermaking	Luohe, Henan	Director of High-tech District in Luohe	Preferential policy
600094	Daming City	Real estate	Shanghai and Fujian	Deputy Secretary-general of Fujian Provincial Government	Land, bank loan, approval
600120	Zhejiang Dongfang	Import and export trade	Hangzhou, Zhejiang	Deputy Director of Zhejiang Economic System Reform Committee	Regulation, approval
600318	Chaodong	Cement production and sales	Hefei, Anhui	Deputy Secretary-general of Anhui Provincial Government	Preferential policy, subsidy
601390	China Railway	Infrastructure construction	Beijing	Director of Construction Management, Department of Ministry of Construction	Preferential policy, approval, regulation
601965	China Qiyan	Automotive technology services and detection	Chongqing	Director of Automobile Department of Ministry of Machinery Industry	Preferential policy, approval, regulation
601989	China Shipbuilding	Military trade	Beijing	Chief Engineer of Naval Equipment Department	Military orders

or even offset the important role played by independent directors' political connections remains an open question.

To test these ideas, we construct the variable *soe*, which equals 1 if the firm is ultimately controlled by the government, and the variable (1-*soe*), which is equal to 1 if the firm is ultimately controlled by a private entity. We also construct *ceopc*, which equals 1 if the firm's chairperson or CEO has political connections, and (1-*ceopc*), which equals 1 if he or she has no such connections. We then add *soe*, *ceopc* and their interaction term with *pc* to model (1). Column 1 of Table 7 shows that the coefficients of *pc***soe* and *pc***(1-soe)* are both significantly negative, with no significant difference between them, suggesting that independent directors' political connections are equally important for SOEs and private firms. Column 2 reports the coefficients of *pc***ceopc* and *pc***(1-ceopc)* both to be significantly negative, with no significant difference between them, indicating that independent directors' political connections are important for firms regardless of whether their top executives also have political connections. Finally, in column 3, we take into account both impersonal and personal political connections. It can be seen that the coefficients of the interaction term are all significantly negative, with the difference between any two non-significant, which suggests that a firm's political connections, regardless of the form they take, cannot offset the role played by those of independent directors.

5.2.4. Channels through which politically connected independent directors play a political role

In the previous section, we propose that politically connected directors can play a political role by exploiting their contacts and influence in the government. Here, we further investigate the channels through which they play such a role. However, due to sample size limitations, we can make only preliminary analysis based on information on firms' primary business and registered location. Table 8 reports such information, from which we summarize three characteristics.[9]

First, independent directors can play a political role through a rich variety of channels. Because firms face different situations, the specific political roles they need independent directors to play are accordingly different. As shown in Table 8, they can play such a role by helping firms to avoid environmental regulations, resolve legal disputes, facilitate government approval, acquire land and other resources, and seek preferential policies, tax benefits and subsidies.

Second, firms precisely target independent director candidates who can meet specific needs rather than hire them blindly. For example, firms in the real estate sector require land, capital and approval, and thus seek out government officials such as vice mayors and secretary generals who have relatively comprehensive functions in these aspects. Similarly, because firms in heavily polluting industries face severe regulations, they are inclined to hire government officials who are in charge of environmental supervision. If firms want to obtain government or military orders, they will seek out government officials or military leaders who can facilitate such deals.

Finally, firms appoint their politically connected independent directors considering and following the territorial jurisdiction and industry jurisdiction principle. As shown in Table 8, the office location of most politically connected independent directors is the same as their firms' registered location or main business location, which can be explained by China's territorial jurisdiction principle, i.e., politically connected independent directors have a say only in the territory in which their office is located. When a firm's business is affected by industry policies more than regional policies, it is likely to turn to an official in relevant state ministries or commissions in charge of the corresponding industry, following the principle of industry jurisdiction.

Again, the foregoing discussion constitutes only a preliminary identification of the possible channels through which politically connected independent directors play a political role. We look forward to future research engaging in a more systematic examination of this issue.

5.2.5. Analysis of the monitoring and consulting performance of politically connected independent directors

We also examine the monitoring and consulting performance of politically connected independent directors to determine whether the negative stock price reaction to their deaths is the result of their better such performance relative to that of their politically unconnected counterparts. Although the behavior of independent

[9] For academic discussion alone, we do not disclose the names of independent directors.

Table 9
Analysis of monitoring and consulting performance of politically connected independent directors.

Variable	(1) *absence*	(2) *otherrec*	(3) *TFP*	(4) *turnover*
pc	0.802*	0.646*	0.091	0.136
	(1.86)	(1.84)	(1.41)	(0.97)
control variables	yes	yes	yes	yes
N	109	107	97	105
Adj./Pseudo R^2	0.097	0.108	0.076	0.092

All variables are defined in Table 2. The effect of the constant term is omitted. Values of robust t-statistics are in parentheses.
*** Indicates significance at the 1% level.
** Indicates significance at the 5% level.
* Indicates significance at the 10% level.

directors cannot be observed directly, several variables help us to evaluate their monitoring and consulting performance. For example, if politically connected independent directors take part in firms' affairs diligently, they will actively attend board meetings. If they monitor their firms strictly, large shareholders' expropriation of the interests of minority shareholders will be more effectively constrained. If they provide effective consultation, their firms will display greater productivity and operational efficiency. If we fail to observe these phenomena, or observe their opposite, then we cannot conclude that politically connected independent directors do a better job of monitoring and consulting than their unconnected counterparts, and thus cannot attribute the negative stock price reactions following their deaths to their monitoring or consulting performance rather than to their political connections.

Accordingly, we construct models (3)–(6) to examine whether politically connected independent directors play a superior monitoring or consulting role by examining their board meeting attendance, fund embezzlement by related parties and firm productivity and operating efficiency:

$$absence = \theta_0 + \theta_1 pc + \theta_2 meets + \theta_3 difprov + \mu \tag{3}$$

$$otherrec = \gamma_0 + \gamma_1 pc + \gamma_2 size + \gamma_3 lev + \gamma_4 roa + \gamma_5 soe + \gamma_6 block + \omega \tag{4}$$

$$TFP = \lambda_0 + \lambda_1 pc + \lambda_2 size + \lambda_3 lev + \lambda_4 soe + \lambda_5 block + \lambda_6 dual + \lambda_7 mgtshare + \zeta \tag{5}$$

$$turnover = \rho_0 + \rho_1 size + \rho_2 lev + \rho_3 soe + \rho_4 block + \rho_5 dual + \rho_6 mgtshare + \theta \tag{6}$$

Model (3) examines whether politically connected independent directors are absent from board meetings less often than their politically unconnected counterparts in the three-year window prior to their deaths. The dependent variable *absence* is defined as the number of absences in each year. Because independent directors should attend board meetings regardless of their firm's condition, we do not include firm characteristics as control variables. However, because the likelihood of absences is greater when the board has numerous meetings and/or the directors are nonlocal, we control for the number of board meetings (*meets*) and the nonlocalness of independent directors (*difprov*). Because *absence* is a discrete variable, we use a negative binomial model to run the regression.

Model (4) examines whether politically connected independent directors can deter large shareholders from embezzling funds more effectively than their unconnected counterparts. Following Ye et al. (2007) and Jiang et al. (2010), we include firm size (*size*), leverage (*lev*), operating performance (*roa*), property rights (*soe*) and largest shareholder ownership (*block*) as control variables.

Finally, models (5) and (6) test whether politically connected independent directors provide more valuable advice that improves firms' productivity and operating efficiency relative to independent directors without such connections. The dependent variables are firms' total factor productivity (*TFP*)[10] and asset turnover ratio

[10] Following Giannetti et al. (2015), we regress the natural logarithm of sales on the natural logarithm of total assets, natural logarithm of the total number of employees and natural logarithm of cash payments for raw materials and services by year and industry. A firm's *TFP* is computed as the residual of this regression. If the number of firms in a given industry in a given year is fewer than 20, we delete these observations.

(*turnover*). With reference to Giannetti et al. (2015), we control for such firm characteristics as size (*size*) and leverage (*lev*) and such governance variables as property rights (*soe*), largest shareholder holding (*block*), CEO duality (*dual*) and managerial ownership (*mgtshare*).

Table 9 reports the regression results for all four models. To save space, we report only the coefficient of *pc*. The significantly positive coefficient of *pc* in column 1 suggests that politically connected independent directors are more likely to be absent from board meetings and less likely to diligently attend to firm affairs than their politically unconnected counterparts. Column 2 also shows that *pc* is also significantly positive, indicating that large shareholders embezzle more funds from firms with politically connected independent directors, and thus that these directors deter expropriation less effectively than their unconnected counterparts. Columns 3 and 4 report a positive but insignificant coefficient for *pc*, suggesting that politically connected independent directors do not provide superior advice that aids firms' decision-making and operations.

To summarize, there is no evidence showing politically connected independent directors to exhibit better monitoring or consulting performance than their politically unconnected counterparts. Therefore, to some extent, we can rule out the alternative explanation that the more negative stock price reaction to the former's death is the result of their more effective monitoring or consulting role. The foregoing results thus lend support

Table 10
Analysis of the political connections of successor independent directors.

Variable	(1) *newpc1*	(2) *newpc1*	(3) *newpc1*	(4) *newpc1*	(5) *newpc2*	(6) *newpc2*	(7) *newpc2*	(8) *newpc2*
pc	0.885*				1.368***			
	(1.66)				(2.60)			
pc∗soe		0.744				0.741		
		(1.02)				(0.90)		
pc∗(1-soe)		1.005				2.057***		
		(1.37)				(2.79)		
pc∗ceopc			0.020				0.797	
			(0.02)				(0.95)	
pc∗(1-ceopc)			1.400*				1.745***	
			(1.89)				(2.58)	
pc∗soe∗ceopc				0.225				0.673
				(0.21)				(0.62)
pc∗soe∗(1-ceopc)				0.627				0.514
				(0.63)				(0.47)
pc∗(1-soe)∗ceopc								0.988
								(0.86)
pc∗(1-soe)∗(1-ceopc)				1.922**				2.938***
				(2.06)				(3.67)
size	−0.278	−0.325	−0.254	−0.369	−0.371	−0.398*	−0.361	−0.484*
	(−1.19)	(−1.24)	(−1.06)	(−1.41)	(−1.58)	(−1.65)	(−1.51)	(−1.92)
roa	0.408	0.298	−1.535	−0.287	−1.289	−1.405	−2.611	−1.199
	(0.08)	(0.05)	(−0.28)	(−0.05)	(−0.21)	(−0.25)	(−0.41)	(−0.21)
board	0.138	0.155	0.199	0.271	0.160	0.292*	0.219	0.396**
	(0.89)	(1.02)	(1.18)	(1.59)	(0.98)	(1.67)	(1.21)	(2.07)
independence	5.682*	5.943*	6.427*	7.317	0.089	0.764	0.678	1.050
	(1.70)	(1.68)	(1.79)	(1.56)	(0.03)	(0.20)	(0.19)	(0.27)
soe		0.302		0.457		0.078		0.201
		(0.37)		(0.52)		(0.09)		(0.23)
ceopc			0.629	0.614			0.286	0.230
			(0.86)	(0.83)			(0.41)	(0.31)
N	34	34	34	32	34	34	34	34
Pseudo R^2	0.106	0.109	0.139	0.171	0.140	0.191	0.157	0.242

All variables are defined in Table 2. The effect of the constant term is omitted. Values of robust t-statistics are in parentheses.
*** Indicates significance at the 1% level.
** Indicates significance at the 5% level.
* Indicates significance at the 10% level.

to the proposition that it is politically connected independent directors' political role that contributes to the negative market reactions to their death announcements. However, the validity of these results may be hampered by the endogeneity problem, as they are based on cross-sectional tests. It is therefore necessary to emphasize that this evidence is suggestive rather than conclusive.

5.3. Regression analysis of successors' political connections

We now examine hypothesis 2, that is, whether firms are more likely to appoint a politically connected independent director if his or her predecessor was also politically connected. Given that the CSRC requires that at least one-third of the boards of all Chinese listed firms be made up of independent directors, a firm has to appoint a new independent director to succeed the deceased independent director if it fails to meet the one-third requirement. Death events in this regulatory environment provide us with a quasi-experimental setting to explore whether politically connected directors are randomly distributed or purposefully selected and appointed by firms who need them to play a political role. If the former is the case, then the political connections of a predecessor will not predict those of his or her successor. If the latter is the case, however, they will because the firm will still need an independent director with political connections to fill the vacancy.

In collecting data on independent directors who succeeded directors who had died, we find one firm that had been delisted, 14 firms that changed their overall boards of directors and two that did not appoint successors as they were already compliant with the CSRC's one-third requirement. In these situations, it is impossible to obtain information on successors or accurately identify which successor corresponds to which predecessor. After deleting these firms, we obtain 34 successors. We next collect information on these successors' political connections. If a successor is politically connected (i.e., has work experience in the party, government or military hierarchies or is a member of the People's Congress or CPPCC), we assign *newpc1* a value of 1, and otherwise 0.

Table 10 reports the regression results for model (2). In column 1, the coefficient of *pc* is significantly positive at the 10% level, which means that there is a 29% greater likelihood of the firm appointing a politically connected independent director as a successor if the deceased predecessor was also politically connected. We can thus reject the notion of a random distribution of politically connected independent directors and support the supposition that they are intentionally selected and appointed by firms to play a political role. In columns 2–4, we further analyze the moderating role of firms' political connections, i.e., state-owned property rights and core executives' political connections. The results show that the coefficient of *pc∗(1-ceopc)* is significantly positive in column 3 and the coefficient of *pc∗ (1-soe) ∗(1-ceopc)* is significantly positive in column 4,[11] suggesting that the demand for politically connected independent directors is mainly concentrated in firms without political connections.

It is worth noting that a firm may fail to appoint a politically connected independent director even though it intends to make such an appointment because there is a limited supply of director candidates capable of playing the specific role required by the firm. As a result, as shown in column 1 of Table 10, the significance level of the coefficient of *pc* is just 10% rather than 1%. In these circumstances, firms may hire their second-best choice by seeking out the leaders of industry associations. Because most industry associations in China are closely affiliated with the government, and some even have administrative power, their leaders are often regarded as quasi-government officials. Thus, they are also able to play a political role to some extent. To analyze the possibility that these leaders may be hired as independent directors for their political role, we broaden our definition of a successor director's political connections (*newpc2*) to encompass the leadership of industry associations.

As reported in columns 5–8 of Table 10, when we use *newpc2* as the dependent variable, the coefficients of *pc* increase in both magnitude and significance. For instance, in column 5, the coefficient of *pc* is significantly positive at the 1% level, which means that there is a 50% greater likelihood of a firm appointing a (broadly defined) politically connected independent director as a successor if his or her predecessor was also politically connected. In columns 6 and 7, the coefficients of *pc∗(1-soe)* and *pc∗(1-ceopc)* are both significantly positive,

[11] In column 4, *pc∗(1-soe)∗ceopc* is dropped due to the perfect predictability of the dependent variable.

whereas those of *pc*soe* and *pc*(1-ceopc)* are both positive but insignificant, indicating that the appointments of politically connected independent directors as successors are concentrated primarily in firms without political connections (i.e., private firms or firms whose core executives have no political connections). Finally, in column 8, the coefficient of *pc*(1-soe)*(1-ceopc)* is significantly positive at the 1% level, which provides further confirmation.

In summary, the foregoing analysis shows that firms in China require politically connected independent directors to play a political role. When such a director dies, the firm will try to appoint another independent director who is also politically connected to succeed him or her. However, because of the limited supply of suitable candidates, a firm may seek out a quasi-government official, i.e., the leader of an industry association, as an alternative choice. Compared with his or her predecessor, such a director is expected to be less powerful and to have less influence. It is thus reasonable to expect the firm's stock price to react negatively to the death announcement of a politically connected independent director.

6. Conclusion

We propose that in addition to their traditional monitoring and consulting roles, independent directors can also play a political role in institutional contexts featuring weak investor protection and strong government intervention. Using Chinese data from 2001 to 2014, we test this proposition by investigating whether the market reaction to news of an independent director's death is related to his or her political capital. We find a more negative stock price reaction to the death announcements of politically connected independent directors than to those of their unconnected counterparts. The magnitude of the negative market reaction is positively related to the deceased director's political rank and cannot be offset by the firm's political capital. However, we find no evidence of superior monitoring or consulting performance among politically connected independent directors relative to their unconnected counterparts. Additional analysis also shows that firms are more likely to appoint a new independent director with political connections if his or her predecessor was also politically connected. Taken together, the evidence reported herein suggests that politically connected independent directors do play a political role in China and that firms value that role.

The academic contributions of this study are as follows. First, by taking into account specific institutional features of China that differ from those of developed markets, it broadens the traditional view of the role of independent directors, emphasizing that researchers need to pay closer attention to the characteristics of the institutional contexts in which independent directors operate, as they may play very different roles depending on the context. Second, the paper adds complementary evidence to the political connections literature. Most of that literature focuses on the political connections of a firm's core executives (i.e., chairperson or CEO), whereas we demonstrate that the political connections of independent directors are also of considerable importance. Third, in methodological terms, by using independent directors' death events as the research setting, the paper mitigates the endogeneity problem that is a major concern in independent director research and helps to resolve several disputes in the literature.

This study also has important policy implications for regulatory bodies seeking to improve the independent director system. Although the CSRC introduced the current system in 2001 to improve corporate governance and strengthen investor protection, these policy objectives are far from being achieved in practice. Politically connected independent directors have been captured by firms as rent-seeking tools. Therefore, the regulatory bodies need to restrict the qualifications of independent directors and establish additional rules (e.g., granting small shareholders more nomination rights over independent directors) to ensure that these directors play a more effective monitoring and consulting role.

Despite its important research and policy implications, this study also has several limitations. First, although death events help us to identify causal relationships and avoid the endogeneity problem, our sample size is also constrained by the rarity of those events. Second, although we try our best to identify some of the channels through which politically connected independent directors play a political role, sample limitations render our identification and induction highly preliminary. Hence, further research with a larger sample and more systematic examination is needed.

Acknowledgment

We would like to thank Xingqiang Du (the discussant), the anonymous referee, and participants of the CJAR annual conference (Changsha, 2015). We also acknowledge financial support from the National Natural Science Foundation of China (Nos. 71302105, 71372041, and 71572100), the MOE Project for Key Research Institutes of Humanities and Social Science (No. 13JJD790019), and the MOE Foundation for Humanities and Social Science (No. 13YJA790057). All remaining errors and omissions are our own.

References

Adams, R.B., Ferreira, D., 2007. A theory of friendly boards. J. Financ. 62 (1), 217–250.
Adams, R.B., Ferreira, D., 2009. Women in the boardroom and their impact on governance and performance. J. Financ. Econ. 94 (2), 291–309.
Adams, R.B., Hermalin, B.E., Weisbach, M.S., 2010. The role of boards of directors in corporate governance: a conceptual framework and survey. J. Econ. Lit. 48 (1), 58–107.
Agrawal, A., Knoeber, C.R., 1996. Firm performance and mechanisms to control agency problems between managers and shareholders. J. Financ. Quant. Anal. 31 (03), 377–397.
Agrawal, A., Knoeber, C.R., 2001. Do some outside directors play a political role? J. Law Econ. 44 (1), 179–198.
Bodde, D., Morris, C., 1973. Law in Imperial China. University of Pennsylvania Press, Philadelphia, PA.
Borokhovich, K.A., Parrino, R., Trapani, T., 1996. Outside directors and CEO selection. J. Financ. Quant. Anal. 31 (3), 337–355.
Chen, X., Li, M., Rui, M., Xia, L., 2009. Judiciary independence and the enforcement of investor protection laws: market responses to the "1/15" notice of the Supreme People's Court of China. China Econ. Quart. 9 (1), 1–28 (in Chinese).
Coles, J.L., Daniel, N.D., Naveen, L., 2008. Boards: does one size fit all? J. Financ. Econ. 87 (2), 329–356.
Core, J.E., Holthausen, R.W., Larcker, D.F., 1999. Corporate governance, chief executive officer compensation, and firm performance. J. Financ. Econ. 51 (3), 371–406.
Demb, A., Neubauer, F.F., 1992. The Corporate Board: Confronting the Paradoxes. Oxford University Press, Oxford.
Du, X., Zeng, Q., Du, Y., 2014. Do politically connected independent directors help Chinese listed private firms enter high-barrier industries? China Account. Financ. Rev. 16 (4), 90–146 (in Chinese).
Faccio, M., Parsley, D.C., 2009. Sudden deaths: taking stock of geographic ties. J. Financ. Quant. Anal. 44 (3), 683–718.
Fisman, D., Fisman, R.J., Galef, J., Khurana, R., Wang, Y., 2012. Estimating the value of connections to vice-president Cheney. B.E. J. Econ. Anal. Pol. 13 (3), 1–20.
Fisman, R., 2001. Estimating the value of political connections. Am. Econ. Rev. 91 (4), 1095–1102.
Giannetti, M., Liao, G., Yu, X., 2015. The brain gain of corporate boards: evidence from China. J. Financ. 70 (4), 1629–1682.
Goldman, E., Rocholl, J., So, J., 2009. Do politically connected boards affect firm value? Rev. Financ. Stud. 22 (6), 2331–2360.
Hayes, R.M., Schaefer, S., 1999. How much are differences in managerial ability worth? J. Account. Econ. 27 (2), 125–148.
Hermalin, B.E., Weisbach, M.S., 1991. The effects of board composition and direct incentives on firm performance. Financ. Manage. 20 (4), 101–112.
Jiang, G., Lee, C.M., Yue, H., 2010. Tunneling through intercorporate loans: the China experience. J. Financ. Econ. 98 (1), 1–20.
Johnson, W.B., Magee, R.P., Nagarajan, N.J., Newman, H.A., 1985. An analysis of the stock price reaction to sudden executive deaths: implications for the managerial labor market. J. Account. Econ. 7 (1), 151–174.
Julio, B., Yook, Y., 2012. Political uncertainty and corporate investment cycles. J. Financ. 67 (1), 45–83.
Klein, A., 1998. Firm performance and board committee structure. J. Law Econ. 41 (1), 275–304.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1998. Law and finance. J. Polit. Econ. 106 (6), 1113–1155.
Li, H., Meng, L., Zhang, J., 2006. Why do entrepreneurs enter politics? Evidence from China. Econ. Inq. 44 (3), 559–578.
Li, Z., Sun, Z., Wang, Z., 2004. Tunneling and ownership structure of a firm: evidence from controlling shareholder's embezzlement of listed company's funds in China. Account. Res. 12, 3–13 (in Chinese).
Li, Z., Yu, Q., Wang, X., 2005. Tunneling, propping and M&A: evidence from Chinese listed companies. Econ. Res. J. 1, 95–105 (in Chinese).
Liu, C., Li, S., Sun, L., 2015. Do independent directors have the consulting function? An empirical study on the function of independent directors in strange land. Manage. World 3, 124–136 (in Chinese).
Liu, H., Tang, S., Lou, J., 2012. Independent directors: monitoring or consulting? A study on the impact of independent directors' banking background on firms' loan financing. Manage. World 1, 141–156 (in Chinese).
Liu, H., Zhao, L., Liu, F., 2013. Private benefits of control and dynamics of board structure adjustment: evidence from the CSRC's compulsory introduction of independent directors. China Account. Financ. Rev. 15 (3), 1–66 (in Chinese).
Nguyen, B.D., Nielsen, K.M., 2010. The value of independent directors: evidence from sudden deaths. J. Financ. Econ. 98 (3), 550–567.
Pan, H., Xia, X., Yu, M., 2008. Government intervention, political connections and the mergers of local government-controlled enterprises. Econ. Res. J. 4, 41–52 (in Chinese).
Pastor, L., Veronesi, P., 2012. Uncertainty about government policy and stock prices. J. Financ. 67 (4), 1219–1264.
Rosenstein, S., Wyatt, J.G., 1990. Outside directors, board independence, and shareholder wealth. J. Financ. Econ. 26 (2), 175–191.

Slovin, M.B., Sushka, M.E., 1993. Ownership concentration, corporate control activity, and firm value: evidence from the death of inside blockholders. J. Financ. 48 (4), 1293–1321.

Tang, X., Shen, H., Du, J., 2010. The monitoring incentive of independent directors: evidence from independent directors' opinions. Manage. World 9, 138–149 (in Chinese).

Wang, Y., Zhao, Z., Wei, X., 2006. Does independence of the board affect firm performance? Econ. Res. J. 5, 62–73 (in Chinese).

Weisbach, M.S., 1988. Outside directors and CEO turnover. J. Financ. Econ. 20, 431–460.

Williamson, O.E., 2000. The new institutional economics: taking stock, looking ahead. J. Econ. Lit. 38 (3), 595–613.

Xia, L., Chen, X., 2007. Marketization, SOE reform strategy, and endogenously determined corporate governance structure. Econ. Res. J. 7, 82–95 (in Chinese).

Xu, Y., Qian, X., Li, W., 2013. Political uncertainty, political connections, and private firms' investments: evidence from the turnover of the secretaries of municipal party committees. Manage. World 5, 116–130 (in Chinese).

Xue, S., Hong, Y., Chen, X., 2013. Ownership property, political connections, and power rationing of local governments: evidence from the nonferrous metals industry. J. Financ. Res. 3, 130–142 (in Chinese).

Yang, Z., 2013. Do political connections add value to audit firms? Evidence from IPO audits in China. Contemp. Account. Res. 30 (3), 891–921.

Ye, K., Lu, Z., Zhang, Z., 2007. Can independent directors deter the tunneling of large shareholders? Econ. Res. J. 4, 101–111 (in Chinese).

Ye, K., Zhu, J., Lu, Z., Zhang, R., 2011. The independence of independent directors: evidence from board voting behavior. Econ. Res. J. 1, 126–139 (in Chinese).

China Journal of Accounting Research 10 (2017) 317–339

HOSTED BY

Contents lists available at ScienceDirect

China Journal of Accounting Research

journal homepage: www.elsevier.com/locate/cjar

Accruals quality, underwriter reputation, and corporate bond underpricing: Evidence from China

Si Xu [a], Guangming Gong [b], Xun Gong [c,*]

[a] School of Economics and Management, South China Normal University, China
[b] Business School of Hunan University, China
[c] College of Finance and Statistics, Hunan University, China

ARTICLE INFO

Article history:
Received 21 September 2015
Accepted 19 April 2017
Available online 11 July 2017

JEL classification:
G10
M41

Keywords:
Bond underpricing
Accruals quality
Reputable underwriters
Information asymmetry

ABSTRACT

This study examines the relationship between accruals quality and the underpricing of corporate bonds in China and how underwriter reputation affects this relationship. We find that (1) accruals quality is negatively associated with the magnitude of bond underpricing and (2) the impact of low accruals quality on underpricing is partially offset by hiring reputable underwriters. A path analysis shows that approximately 11% of the effect of accruals quality on underpricing is attributable to the indirect path through reputable underwriters, suggesting that accruals quality is more effective than reputable underwriters in lowering bond underpricing. These findings are significant for initial bond offerings, but not for secondary bond offerings. We also find that low accruals quality is associated with more restrictive non-price contract terms such as greater collateral requirements and stricter covenants.

1. Introduction

A growing number of studies have documented that information asymmetry theory can explain the underpricing of firms' initial public offerings (IPOs) (Rock, 1986; Cai et al., 2007; Zheng and Stangeland, 2007). Jog and McConomy (2003) find that IPO firms that do not include earnings forecasts face higher underpricing, although this difference is concentrated among small firms. Schrand and Verrecchia (2005) conclude that firms with more frequent disclosures before the IPO are associated with lower underpricing. Leone et al. (2007) document that IPO underpricing decreases when issuers disclose more specific information in the "uses of

* Corresponding author.
E-mail address: b1218s004@hnu.edu.cn (X. Gong).

http://dx.doi.org/10.1016/j.cjar.2017.04.001
1755-3091/

proceeds" section of their prospectus. In addition, Boulton et al. (2011) study the relationship between earnings quality and international IPO underpricing and find that IPOs are underpriced less in countries where public firms produce higher quality earnings information.

Although there is a sizable body of research on the impact of information asymmetry on IPO underpricing, the vast majority of that research focuses on equity markets. Given the inherent differences between equity markets and bond markets, such as market liquidity, conclusions drawn from studies of equity underpricing may not provide reliable indications of the patterns of bond underpricing (Cai et al., 2007; Liu and Magnan, 2014). Due to the asymmetric payoff function and their fixed claims on corporate assets, bondholders have stronger incentives than equity investors to demand high-quality financial reporting to reduce the information asymmetry problem (Ball et al., 2008). More specifically, Bessembinder and Maxwell (2008) point out that a corporation issues bonds at different points in time with contracts that vary in terms of bond features, and that these distinct bonds are traded separately. From this perspective, bonds differ substantially from equity; therefore, bond and equity investors could have different expectations of the supply of financial information. In this study, we consider corporate bond offerings made by public firms (including initial bond offerings (IBO) and secondary bond offerings, (SBO)).[1]We then focus on the quality of borrowers' financial information and examine how it relates to bond underpricing in the context of the information asymmetry problem in China.

In addition, a growing number of studies have documented that reputable underwriters can signal and certify the quality of issuers' financial information during IPOs (Chemmanur and Krishnan, 2012; Yang et al., 2017). Cooney et al. (2001) show that there is a negative relation between underwriter reputation and underpricing, which is consistent with the certification role of underwriters. Brau and Fawcett (2006) find that hiring a top investment bank to underwrite an IPO is a positive signal, and Kim et al. (2010) also provide evidence that reputable underwriters are able to differentiate the quality of issuers and to reflect this information in the underwriting spread. Thus, reputable underwriters can reduce information asymmetry between issuers and public investors (Dong et al., 2011), which to some extent can mitigate the negative impact of low information quality on bond underpricing.

Based on these findings, this study focuses on the effect of accounting information quality on the costs of corporate bonds. We argue that more precise and reliable earnings mitigate adverse selection costs by reducing information asymmetries between the issuer and bondholders. Accordingly, we first document that firms with lower accruals quality are associated with higher bond underpricing. One mechanism that can mitigate this uncertainty is the presence of a reputable underwriter, which can signal and certify issuer accruals quality. Thus, we infer and verify the second conclusion, that is, the impact of low accruals quality on underpricing is partially offset by employing a reputable underwriter. However, in our additional tests, we find that this association is only robust for initial bond offering, whereas no significant association is found for the secondary bond offering.

To broaden our tests, we use path analysis to evaluate the extent to which reputable underwriters reduce the negative effect of poor accruals quality on underpricing. In our path model, we posit an indirect link through reputable underwriters between accruals quality and bond underpricing. We follow the procedure in Bhattacharya et al. (2012) to weight the relative importance of both direct and indirect paths. Our path analysis results show that although high-quality underwriters have a significant mediation effect on the relationship between accruals quality and bond underpricing, only approximately 11% of the total effect of accruals quality on underpricing can be attributed to the indirect path through reputable underwriters. The results again indicate the predominant role of accruals quality in determining bond underpricing and highlight the importance of information quality in bond financing.

We perform a battery of sensitivity tests to assess the robustness of our findings. First, we use a treatment effects model to mitigate the potential endogeneity problem of accruals quality. In addition, as previous studies show that corporate governance, issuer market risk and coupon rate are likely to impact bond underpric-

[1] Glushkov et al. (2014) indicate that public companies can be divided into three categories through their choice on listing paths: (1) traditional IPOs with no public debt outstanding; (2) private firms undertaking an initial public debt offering; and (3) all public firms that undertake public debt offering for the first time. They find significant differences between these types of firms in several aspects. As all issuers of Chinese corporate bonds are listed firms, our research focuses on the third category.

ing, we control for these factors in our regression analyses and find qualitatively similar results. Finally, our hypotheses are generally supported when we adopt alternative measures of underwriter reputation.

In the additional analysis, we find that firms with low accruals quality face more restrictive non-price contract terms such as greater collateral requirements and stricter covenants than firms with high accruals quality. The other non-price term such as bond issuing amount, it shows expected signs in the regression but does not turn out to be statistically significant.

Our study contributes to the literature in several ways. First, it complements previous studies of underpricing by investigating the association between accruals quality and the underpricing of corporate bonds. However, prior studies typically focus on equity underpricing (Rock, 1986; Allen and Faulhaber, 1989; Sherman and Titman, 2002; Ellul and Pagano, 2006; Boulton et al., 2011), the role of financial information in bond underpricing is unclear due to the inherent differences between the bond market and equity market (Cai et al., 2007). As an extension, our study uses firms' accruals quality to explain the underpricing of newly issued corporate bonds by focusing on the Chinese setting.

Although Cai et al. (2007) provide support for the information asymmetry view of corporate bond underpricing, our study differs from theirs in three ways. First, we study whether information asymmetry theory can explain bond underpricing by focusing on Chinese firms. Second, our study extends the underwriter literature by examining the role of underwriters in mitigating the adverse impact of poor accruals quality on bond underpricing. Third, we use path analysis to evaluate the extent of the mediation effects of reputable underwriters. While Boulton et al. (2011) argue that the impact of low accruals quality on underpricing is partially offset by hiring reputable underwriters, we provide empirical evidence that a firm's accruals quality outweighs its use of reputable underwriters in reducing bond underpricing. To the best of our knowledge, this is the first study to estimate the mediation effects of underwriters between accruals quality and bond underpricing. Our results show that the direct link between accruals quality and underpricing dominates the indirect link mediated by reputable underwriters.

Finally, our study has important implications for management strategy. Our evidence indicates the nature of the association between accruals quality and bond underpricing, implying that when there is a trade-off between accruals quality and reputable underwriters, increasing the quality of information has a bigger payoff, in the sense that it has a greater impact on lowering bond underpricing than employing high-quality underwriters. Overall, our study shows how important it is to improve the accruals quality in bond financing.

The rest of this paper is organized as follows. We present an overview of China's institutional background in Section 2, develop the hypotheses in Section 3 and describe the data and variables in Section 4. We present the research design and discuss the results of our main tests in Section 5. We provide robustness tests and additional tests in Sections 6 and 7, respectively. We present our conclusions in Section 8.

2. Institutional background[2]

In 2004, the Chinese Communist Party recognized the usefulness of capital markets and the importance of developing the corporate bond market in its *Opinions of the State Council on Promoting the Reform, Opening and Steady Growth of Capital Markets* (Pessarossi and Weill, 2013). In 2007, the government made a major regulatory change in the market with the decision to issue corporate bonds. This reform was regarded as a milestone in market development.

Since the reform, the traditional quota issue system has been replaced by a more market-oriented approval system, which immensely simplifies the issuing process. Corporations are no longer required to provide collateral, and the uses of bonds have been expanded beyond fixed asset investment to include the repayment of bank loans, supplement of working capital, etc. The most important reformation is that the People's Bank of China (PBOC) no longer controls the offering yield of corporate bonds. Before the reform of mid-August 2007, there was an upper limit on offering yields; they had to be less than 1.4 times the comparable bank deposit rate for enterprise bonds. In the post-2007 period, there are still several requirements that issuers

[2] We are especially grateful to the referee who suggested that we should provide more detailed information about the development of corporate bonds in China.

must meet before bond issuance. According to corporate bond issuance rules published by the China Securities Regulatory Commission (CSRC), corporations that are allowed to issue corporate bonds must meet the following requirements: (1) the average distributable profits over the latest three years must be sufficient to pay the one-year interest of the corporate bonds; (2) the accumulated outstanding balance of the company's corporate bonds must not exceed 40% of its net asset value after this issuance; and (3) the bond must be highly rated. Therefore, we infer that bond issuers are generally financially healthy and less likely to default. After this reformation, China's corporate bonds market developed rapidly. In 2013, the corporate bond issuance amounted to about RMB170 billion. Notably, as of March 2014, the first corporate bond default occurred when a Shanghai-based solar power company failed to pay out interest. Shortly thereafter, in May 2015, Xiangeqing Co., Ltd became the first corporate bond issuer to fail to repay principal.

As capital providers, bondholders are interested in ensuring the timely repayment of the bond and interest that are claims on the borrower's future cash flow and assets. Reliable financial statements provide important information to lenders, who need to evaluate the borrower's credit worthiness and default risk; however, unreliable financial statements, e.g., those associated with earnings management, distort the quality of reported earnings, which can impact bondholders' estimates of future cash flows (Cohen and Zarowin, 2010; Ge and Kim, 2014). The Chinese corporate bond market is more of an institutional investor's arena than the equity market; approximately 90% of corporate bonds are institutionally owned. Institutional investors are generally believed to be more professional than individual investors, and are thus more likely to take the issuer's accounting quality under consideration when allocating the wealth they manage. In conclusion, as the default events become more frequent, investors pay more attention to firms' accounting quality.

3. Related literature and hypothesis

3.1. Accruals quality and corporate bond underpricing

Although various models are used to explain underpricing in the literature, the most common is information asymmetry model.[3] Therefore, it is natural to examine the impact of the quality of financial information. Rock's (1986)theoretical model shows that information asymmetry between informed and uninformed investors necessitates that underwriters use underpricing to compensate uninformed investors to offset the losses they incur due to the "winner's curse" that results in the uninformed investors' disproportionate allocation of shares issued by low-quality firms. In Benveniste and Spindt's (1989) model, informed investors use bids to communicate to underwriters the intrinsic values of issuers; underwriters use underpricing to reward these informed investors for accurately revealing the "true" value of issuers. Thus, we can infer that underpricing is merely compensation to investors for the costs of becoming informed and that the lower the fundamental uncertainty about a bond issue, the lower the required compensation to investors for becoming informed. Therefore, we document that the level of corporate bond underpricing can be reduced for firms with a high accruals quality.

The vast literature offers several insights into the influence of financial reporting quality on underpricing. Willenborg and McKeown (2000) find that audit opinion can reduce information asymmetry and thereby induce less underpricing, and Schrand and Verrecchia (2005) conclude that more disclosures before the IPO are associated with lower underpricing. Similarly, using credit ratings as proxies for information risk, Cai et al. (2007) find that bond issuers with unfavorable credit ratings experience greater underpricing than issuers with favorable credit ratings. Other studies investigate this relationship from the perspective of earnings management (Ball and Shivakumar, 2008) and accounting conservatism (Lin and Tian, 2012). Boulton et al. (2011) reach a similar conclusion in an international setting. In contrast, Allen and Faulhaber (1989) suggest a signaling explanation in which, to mitigate the effect of the adverse selection problem, good firms distinguish themselves from bad firms through underpricing. However, we do not find much evidence in support of signaling theory in the accounting literature.

[3] Cai et al. (2007) also suggest a liquidity model to explain corporate bond underpricing, although they do not find evidence in favor of this model.

Overall, a high accruals quality gives outside investors better knowledge of the value of issuing firms, and the information asymmetry between issuers and investors and between informed investors and uninformed investors can be lessened. Thus, the level of corporate bond underpricing can be reduced. These arguments lead to the following hypothesis.

H1. Accruals quality is negatively associated with the underpricing of corporate bonds.

3.2. Underwriter reputation moderation effect

Our second hypothesis addresses how underwriter reputation affects the association of accruals quality with bond underpricing. The larger context of the securities-issuing literature suggests that investors face greater information asymmetry in the evaluation of issuing firms when accruals quality is low. One way to alleviate information asymmetry in the offering process is via third-party certifiers, such as auditors, underwriters and attorneys, who can certify a firm's financial reporting quality. Here, we focus on underwriters.

There are two rational explanations for the presence of reputable underwriters. First, reputable underwriters are used to mitigate information asymmetry (Brau and Fawcett, 2006; Kim et al., 2010; Chang et al., 2010). Reputable underwriters keep their valuable reputation by mitigating the issuer's earnings management (Lee and Masulis, 2011). Jo et al. (2007) study a related issue in the seasoned equity offering market and document an inverse association between underwriter quality and issuer earnings management. Second, Titman and Trueman (1986) find that an issuer with favorable information about firm value is more likely than an issuer with less favorable information to choose a high-quality underwriter. In other words, issuers that are confident of their financial reporting quality are more likely to hire high-quality underwriters, providing a signal to the market.[4] The preceding discussion leads to our second hypothesis.

H2. The negative relation between accruals quality and bond underpricing is moderated when the borrower hires reputable underwriters.

4. Data and variables

This section explains the sample and data sources. We then describe the measures of the key variables used in this study.

4.1. Sample and data sources

Our sample period ranges from 2007, when Chinese firms issued their first corporate bond, to 2013. The relevant data are extracted from the Wind database.[5] Specifically, this database provides data on the year of the bond issuing, its underwriters, the issuing amounts, maturity and pre-issuing financial data. All of the financial statement data are measured at the end of the fiscal year before the bond issuance.[6] To measure underwriter reputation, we hand-collect data from the website of the Securities Association of China (SAC). We consider only public bonds issued by China's industrial companies. We exclude bond issues by financial institutions, as they are subject to different accounting rules and regulations. We then exclude bond issues for which data on underwriters are not available. We also exclude all of the bond issues that are missing coupon rate, offering date, maturity date or accounting data. In short, we are careful to ensure that the sample includes

[4] The signaling effect will be further discussed in the later section.

[5] The Wind database was developed according to the international standards for databases to meet the requirements of academic research, and it has been used in several recent studies. See, for example, Chen et al. (2013), Chen and Zhu (2013) and Gong et al. (2017).

[6] As suggested by Ge and Kim (2014), we use the lagged accounting variables which has two advantages. First, bond underpricing is more affected by past accounting information than by current accounting information, as past accounting information is already available to bondholders at the time of bond trading. Second, the regression of bond underpricing on lagged accounting information alleviates a potential endogeneity concern.

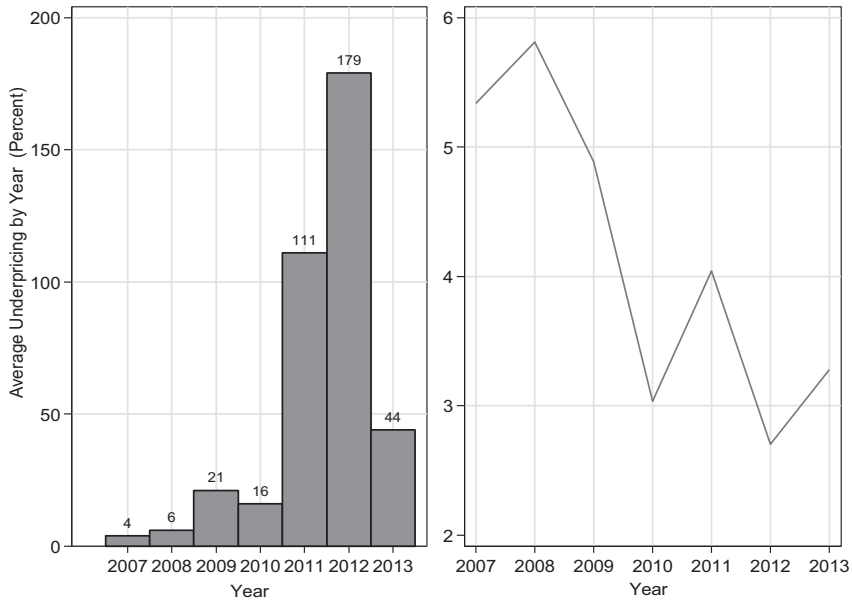


Fig. 1. Yearly distribution of bond issuance (left graph) and average underpricing (right graph) over the sample period.

only corporate bonds with valid information about underwriters and other bond characteristics. This procedure results in a sample of 381 bonds.

Fig. 1 displays the distribution of bond issuance and the average underpricing over the 2007–2013 sample period. The number of bond issuances in each year is plotted in the left graph of Fig. 1, which demonstrates considerable time-series volatility in the Chinese market. For example, bond issuance activity peaked in 2012 with a record of 179 firms issuing public debt, but only 4 bonds were issued in 2007. The right graph shows that bond underpricing in the Chinese market can be divided into two stages. There is a decreasing trend in bond underpricing from 5.34% in 2007 to 3.04% in 2010. In the second stage, the average level of bond underpricing fluctuates within the range of 2.5–4.0%.

4.2. Measure of accruals quality

To measure accruals quality, we use proxies that have been used extensively in research (Francis et al., 2005; Bharath et al., 2008; Lu et al., 2010).[7] Similar to these studies, we focus on the accuracy with which accruals convey information about cash flows to stakeholders, particularly bond investors. We use three measures of accruals quality: (1) the measure proposed by Dechow and Dichev (2002); (2) the measure developed by Dechow and Dichev (2002) as implemented by Francis et al. (2005); and (3) the measure developed by Ball and Shivakumar (2006). We measure all of the proxies at the end of the fiscal year before bond issuance.

(1) Dechow and Dichev (2002) model. In this model, accruals quality is measured by the extent to which current working capital accruals map onto the operating cash flows of the prior, current and future periods. Thus, Dechow and Dichev (2002) regress current working capital accruals (TCA_t) on operating cash flows in the previous year (CFO_{t-1}), current year (CFO_t) and subsequent year (CFO_{t+1}), all deflated by average total assets.

[7] The implicit assumption is that the measures of accruals quality are appropriate measures of information asymmetry in the bond market. Regular equity IPO firms are likely to be young with significant growth opportunities that drive a large part of the information asymmetry. For these firms, accounting numbers may capture a small part of what the firm is worth and may not be an adequate proxy for information asymmetry. Although bond issuance firms are not the same as equity IPOs and are likely to be made by older firms, it is appropriate to use an accrual-based metric to measure information asymmetry.

$$\frac{TCA_{i,t}}{AvgAssets_{i,t}} = \beta_0 + \beta_1 \frac{CFO_{i,t-1}}{AvgAssets_{i,t}} + \beta_2 \frac{CFO_{i,t}}{AvgAssets_{i,t}} + \beta_3 \frac{CFO_{i,t+1}}{AvgAssets_{i,t}} + \varepsilon_{i,t}, \quad (1)$$

where $TCA_{i,t}$ is the working capital accruals of firm i in year t, calculated as the change in current assets (ΔCA), minus the change in cash and cash equivalents ($\Delta Cash$), minus the change in current liabilities (ΔCL), plus the change in short-term bank debt ($\Delta Debt$). CFO_t, CFO_{t-1} and CFO_{t+1} signify cash flow from the operations of firm i in years t,$t-1$ and $t+1$, respectively. Average total assets are calculated for firm i in year t as the mean of the firm's total assets in years $t-1$ and t.

The model is estimated for each year for each of the industry groups identified in the 2001 CSRC classification.[8] The residual vector reflects the variation in working capital accruals unexplained by the cash flows of the previous, current and subsequent periods. Thus, the absolute value of the residual for each firm-year observation is an inverse measure of accruals quality ($IAQ\_dd_{i,t} = |\varepsilon_{i,t}|$; the higher the residual, the lower the accruals quality). To facilitate the interpretation of this variable, we use the negative value of IAQ_dd, which we define as AQ_dd.

(2) Francis et al. (2005) model. This model adds two variables to those in the Dechow and Dichev (2002) model:

$$\frac{TCA_{i,t}}{AvgAssets_{i,t}} = \beta_0 + \beta_1 \frac{CFO_{i,t-1}}{AvgAssets_{i,t}} + \beta_2 \frac{CFO_{i,t}}{AvgAssets_{i,t}} + \beta_3 \frac{CFO_{i,t+1}}{AvgAssets_{i,t}} + \beta_4 \frac{\Delta Sales_{i,t}}{AvgAssets_{i,t}} + \beta_5 \frac{PPE_{i,t}}{AvgAssets_{i,t}} + \varepsilon_{i,t}, \quad (2)$$

where $\Delta Sale$is the change in revenues and PPE is the net value of fixed assets. The model is estimated in its cross-sectional version for each industry-year combination. The absolute value of the residual for each firm-year observation is an inverse measure of accruals quality ($IAQ\_francis_{i,t} = |\varepsilon_{i,t}|$). We use the negative value of $IAQ\_francis$, defined as $AQ\_francis$.

(3) Ball and Shivakumar's (2006) model. This model adds three variables to those in the Dechow and Dichev (2002) model:

$$\frac{TCA_{i,t}}{AvgAssets_{i,t}} = \beta_0 + \beta_1 \frac{CFO_{i,t-1}}{AvgAssets_{i,t}} + \beta_2 \frac{CFO_{i,t}}{AvgAssets_{i,t}} + \beta_3 \frac{CFO_{i,t+1}}{AvgAssets_{i,t}} + \beta_4 \frac{\Delta CFO_{i,t}}{AvgAssets_{i,t}} + \beta_5 D + \beta_6 D \frac{\Delta CFO_{i,t}}{AvgAssets_{i,t}} + \varepsilon_{i,t,} \quad (3)$$

where ΔCFO is the change in the cash flow from operations, D is a dummy variable that takes the value 1 if $\Delta CFO$is negative and 0 otherwise and $D\Delta CFO$is the interaction between these two variables. This model tries to incorporate the asymmetry that can be recognized between gains and losses into the conventional linear accruals model. As in the previous model, this model is estimated in its cross-sectional version for each industry-year combination, and the absolute value of the residual for each firm-year observation is an inverse measure of accruals quality ($IAQ\_bs_{i,t} = |\varepsilon_{i,t}|$). We also use the negative value of IAQ_bs, defined as AQ_bs.

4.3. Measure of underwriter reputation

Previous studies measure underwriter reputation based on either (1) underwriter ranking in the IPO tombstone or (2) the underwriter's market share, where a larger market share indicates a higher underwriter reputation (Chen et al., 2013). As data on underwriter rankings from authoritative organizations are not

[8] On 4April 2001, the CSRC issued the Index of Listed Companies' Industry Classification, which serves as the industry classification standard. They include 13 industry categories. In this study, we drop the financial industry because of its different operating characteristics and debt financing activities.

available in China, we estimate underwriter reputation based on the second measure. To effectively capture the effect of underwriter reputation, we define the dummy variable, *Top_underwriter*, as equal to 1 if the underwriters' ranks in the top 25% in terms of their number of bond deals in the year prior to a bond issuance and 0 otherwise.[9]

4.4. Measure of bond underpricing

Consistent with previous studies, we measure the market-adjusted abnormal returns for the first trading day to proxy for corporate bond underpricing (Lin and Tian, 2012). The measurement is described as follows.

The return of bond "*i*" at the end of the first trading day is calculated as

$$R_{i1} = \left(\frac{P_{i1}}{P_{i0}}\right) - 1, \tag{4}$$

where P_{i1} is the closing price of bond "*i*" on the first trading day, P_{i0} is the offering price and R_{i1} is the total first-day return on the issuing bond.[10] The return on market index for the corresponding period is

$$R_{m1} = \left(\frac{P_{m1}}{P_{m0}}\right) - 1, \tag{5}$$

where P_{m1} is the closing value of the corresponding corporate bond market index on the first trading day, P_{m0} is the opening value for the index and R_{m1} is the first day's comparable market return.

Using these two returns, the market-adjusted abnormal return for each bond on the first trading day, which we use to measure bond underpricing, is computed as

$$MAAR_{i1} = 100 * \left\{\left[\frac{1 + R_{i1}}{1 + R_{m1}}\right] - 1\right\}. \tag{6}$$

5. Empirical tests

5.1. Descriptive statistics

Table 1 summarizes the descriptive statistics of the variables. All of the variables are winsorized at the extreme 1% and 99% to mitigate the possible effect of outliers. The average magnitude of bond underpricing is 3.37% for the entire period. In our sample, the average offering amount is approximatelyRMB1.46 billion, with an average maturity of 5.89 years.[11] On average, 56%of bonds are secured. For the accruals quality proxies, the average accruals quality is −0.06. Turning to firm characteristics, the average market-to-book ratio (*MB*) is 1.49 and the average sales growth ratio (*Growth*) is 23.91. The mean value of *Leverage* shows that, on average, 52% of total assets are financed from debt. SOEs comprise 60% of the sample. Various performance and risk measures indicate that on average our sample firms are financially healthy.

Table 2 provides the Pearson correlations of the variables. As expected, the proxies for accruals quality show negative and significant correlations with bond underpricing (*MAAR*). Thus, these results present preliminary evidence of a negative association between accruals quality and bond underpricing. In addition, most of the correlation coefficients are generally within a normal range, suggesting that our variables are free of multicollinearity problems. Furthermore, we check the variance inflation factors (VIFs) of our regression.

[9] Note that underwriter reputation is measured by the number of IPO deals one year prior to the IPO year, instead of the IPO year, as underwriter reputation is established before the occurrence of a particular underwriting task. In the robustness test, we use alternative measures of underwriter reputation and the results are statistically similar.

[10] Notably, the CSRC requires that all Chinese corporate bonds be issued at their par value (RMB100 for each bond), which means discount or premium issuing is forbidden.

[11] Table 1 Panel A reports the natural logarithm values of the offering amount (in hundred million), and natural logarithm of maturity (in month).

Table 1
Descriptive statistics. The sample period is from 2007 to 2013. The variables are defined as follows. *AQ_francis* reports the negative value of the $|\varepsilon_{i,t}|$ according to the Francis et al. (2005) model, *AQ_dd* according to Dechow and Dichev (2002) model and *AQ_bs* according to the Ball and Shivakumar (2006) model. The higher the value of *AQ_francis*, *AQ_dd* or *AQ_bs*, the higher the accruals quality. *MAAR* is a measure of underpricing with market-adjusted initial returns on the first trading day of a bond. *BondAmt* is the natural logarithm of the bond offering amount measured in RMB hundred million. *Maturity* is the natural logarithm of the maturity period of the bond in months. *Secured* is an indicator variable that equals 1 if the bond is secured with collateral, and 0 otherwise. *Size* is the natural logarithm of total assets. *Leverage* is a firm's financial leverage ratio, calculated as the total debts divided by total assets. *ROA* is return on assets. *MB* is market-to-book ratio. *Growth* is growth in sales, measured as ending sales revenue divided by one-year lagged sales revenue. *Altman Z-score* is the borrower's Altman's Z-score, which proxies for borrower's default risk. Altman's Z-score is computed as $Z = 1.2^{*}$ (working capital/total assets) + 1.4^{*} (retained earnings/total assets) + 3.3^{*} (EBIT/total assets) + 0.6^{*} (public value of equity/book value of total liabilities) + 1.0^{*} (sales/total assets). *Loss Incidence* is loss incidence, defined as the proportion of income losses over the past eight quarters. *SOE* is a dummy variable that equals 1 if its ultimate shareholder is the government, and 0 if it is an NSOE. *Institutional* is the percentage of shares held by institutional owners. *Largesh* is the percentage of shares owned by the largest shareholder. *VC* is the separation degree of ownership and controlling right. This table presents the description of the variables for the entire sample of 381 bond IPOs. All of the variables are winsorized at the extreme 1% and 99% levels.

Variable	Obs.	Mean	SD	P25	Median	P75
Panel A: Accruals quality variables						
AQ_francis	381	−0.06	0.05	−0.08	−0.05	−0.02
AQ_dd	381	−0.06	0.05	−0.09	−0.05	−0.02
AQ_bs	381	−0.06	0.05	−0.08	−0.05	−0.02
Panel B: Bond-specific variables						
MAAR	381	3.37	3.10	1.54	3.58	5.30
BondAmt	381	2.27	0.83	1.61	2.2	2.77
Maturity	381	4.21	0.32	4.09	4.09	4.43
Secured	381	0.56	0.5	0	1	1
Panel C: Firm-specific variables						
Size	381	23.18	1.54	22.09	22.83	24.08
Leverage	381	51.98	16.79	41.02	53.51	64.48
ROA	381	6.09	4.06	2.99	4.94	8.4
MB	381	1.49	0.75	1	1.22	1.64
Growth	381	23.91	24.95	9.62	21.44	36.76
Altman Z-score	381	1.31	0.64	0.83	1.21	1.72
Loss Incidence	381	0.03	0.1	0	0	0
SOE	381	0.6	0.49	0	1	1
Institutional	381	45.84	27.64	23.19	47.77	67.94
Largesh	378	42.85	17.24	30.15	42.10	52.21
VC	381	6.04	8.73	0	0	11.70

Our test indicates that the mean VIFs are less than 2, indicating that multicollinearity does not appear to be a concern.[12]

5.2. Relation between accruals quality and bond underpricing

This section uses multivariate analysis to empirically test our hypothesis. Bond underpricing is the dependent variable and the proxy of accruals quality is the key explanatory variable. We use the following model to estimate the relation between accruals quality and bond underpricing:

$$\begin{aligned} MAAR_{i,t} = {} & \beta_0 + \beta_1 AQ_{i,t-1} + \beta_2 Size_{i,t-1} + \beta_3 Leverage_{i,t-1} + \beta_4 ROA_{i,t-1} + \beta_5 MB_{i,t-1} + \beta_6 Growth_{i,t-1} \\ & + \beta_7 Altmanz_{i,t-1} + \beta_8 LossInc_{i,t-1} + \beta_9 SOE_i + \beta_{10} BondAmt_{i,t} + \beta_{11} Maturity_{i,t} + \beta_{13} Secured_{i,t} \\ & + \beta_{14} Rating_{i,t} + \beta_i IndustryDummy + \beta_y YearDummy + \varepsilon_{i,t}, \end{aligned} \quad (7)$$

[12] For independent variables, we only detect a high correlation between *Size* and *BondAmt* (0.79); the analysis in the robustness section shows that this does not affect our results.

Table 2
Pearson correlations. This table reports the correlation of the variables. *AQ_francis* reports the negative value of the $|\varepsilon_{i,t}|$ according to the Francis et al. (2005) model, *AQ_dd* according to the Dechow and Dichev (2002) model, and *AQ_bs* according to the Ball and Shivakumar (2006) model. A higher value of *AQ_francis*, *AQ_dd* or *AQ_bs*, indicates a higher accruals quality. *MAAR* is a measure of underpricing with market-adjusted initial returns on the first trading day of bond. *Size* is the natural logarithm of total assets. *Leverage* is a firm's financial leverage ratio, calculated as the total debts divided by total assets. *ROA* is return on assets. *MB* is market-to-book ratio. *Growth* is growth in sales, measured as ending sales revenue divided by one-year lagged sales revenue. *Altman Z-score* is the borrower's Altman's *Z*-score, which proxies for borrower's default risk. Altman's Z-score is computed as $Z = 1.2^{*}$ (working capital/total assets) + 1.4^{*} (retained earnings/total assets) + 3.3^{*} (EBIT/total assets) + 0.6^{*} (public value of equity/book value of total liabilities) + 1.0^{*} (sales/total assets). *Loss Incidence* is loss incidence, defined as the proportion of income losses over the past eight quarters. *SOE* is a dummy variable that equals 1 if its ultimate shareholder is the government, and 0 if it is an NSOE. *BondAmt* is the natural logarithm of bond offering amount measured in RMB hundred million. *Maturity* is the natural logarithm of the maturity period of the bond in months. *Secured* is an indicator variable that equals 1 if the bond is secured with collateral, and 0 otherwise. All of the variables are winsorized at the extreme 1% and 99% levels. Correlations that are significant at the 5% level or less are in bold-faced.

	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*O*
MAAR (A)	1														
AQ_francis (B)	**−0.15**	1													
AQ_dd (C)	**−0.15**	**0.98**	1												
AQ_bs (D)	**−0.13**	**0.95**	**0.96**	1											
Size (E)	**−0.19**	**0.17**	**0.19**	**0.17**	1										
Leverage (F)	**−0.10**	0.04	0.06	0.06	**0.48**	1									
ROA (G)	0.04	−0.10	**−0.11**	−0.10	**−0.14**	**−0.55**	1								
MB (H)	**0.20**	**−0.15**	**−0.15**	**−0.17**	**−0.40**	**−0.38**	**0.44**	1							
Growth (I)	0.05	−0.08	−0.06	−0.04	−0.02	0.09	**0.17**	**0.13**	1						
Altman Z-score (J)	−0.04	0.02	0.01	0.01	**−0.19**	**−0.36**	**0.47**	**0.29**	**0.15**	1					
LossIncidence (K)	0.07	0.03	0.04	0.03	**−0.11**	0.08	**−0.16**	−0.04	**0.14**	−0.01	1				
SOE (L)	−0.05	0.07	**0.10**	0.08	**0.47**	**0.29**	**−0.14**	**−0.25**	**−0.14**	**−0.26**	0.02	1			
BondAmt (M)	**−0.11**	**0.16**	**0.17**	**0.14**	**0.79**	**0.31**	−0.02	**−0.28**	0.01	**−0.10**	**−0.15**	**−0.35**	1		
Maturity (N)	−0.08	−0.02	−0.02	−0.03	**0.23**	**0.14**	−0.04	−0.05	0.01	**−0.13**	0.05	**0.19**	**0.20**	1	
Secured (O)	−0.05	−0.03	−0.03	−0.05	**0.19**	**0.17**	**−0.14**	**−0.14**	**−0.11**	−0.08	0.10	**0.29**	0.09	**0.23**	1

where all of the variables are as defined in Table 1.

Following prior studies of the determinants of underpricing (Cai et al., 2007; Lin and Tian, 2012), we include a number of firm- and bond-specific control variables in model (7). As new bonds issued by large firms are less risky than those of small firms, we expect the coefficient of *Size* to be negative. A higher leverage ratio implies a higher default risk, so we predict that the coefficient of *Leverage* is positive. We include the market-to-book ratio (*MB*) and sales growth ratio (*Growth*) to control for the firm's growth potential. However, the accounting literature suggests that this ratio is also a proxy for risk, so its effect on bond underpricing is unclear. We expect that *ROA* and *Altman Z-score* are negatively associated with risk premiums, as higher ratios indicate a lower default risk for bonds. *Loss Incidence* is the incidence of loss; thus, we predict that the coefficient of *Loss Incidence* is positive. Additionally, we include the *SOE* variable. *SOE* is a dummy variable that equals 1 if the firm is an SOE and 0 if it is an NSOE. We classify borrowers as SOEs and NSOEs based on the ownership type of their ultimate controlling shareholders.[13]

The bond-specific variables in model (7) include *BondAmt*, *Maturity*, *Secured* and *Rating*. To the extent that bond issue size (*BondAmt*) is a measure of marketability, we expect this variable to be inversely correlated with risk premiums. The more years to maturity, the higher the interest risk exposure. Thus, we expect the coefficient of *Maturity* to be positive. A secured bond exposes bondholders to less default risk than an unsecured bond. Thus, the impact of *Secured* is negative. Furthermore, credit ratings may contain information about firm performance beyond those provided by publicly available financial ratios (Dichev and Piotroski, 2001). Thus, we run our regressions with credit ratings. We also include year and industry indicators. In our study, we estimate the regression models with the pooled sample and report *t* statistics based on

[13] SOEs are defined as those borrowers directly or indirectly owned or controlled by state asset management bureaus or other state-owned enterprises controlled by the central government or local governments (Chen et al., 2013).

Table 3
Impact of accruals quality on bond underpricing. Columns (1)–(3) report the results of estimating the relation between accruals quality and bond underpricing. Columns (4)–(6) present the OLS regression of bond underpricing on different accruals quality measures and the interaction of underwriter reputation and accruals quality. The dependent variable is *MAAR*, a measure of underpricing with market-adjusted initial returns on the first trading day of the bond. *AQ_francis* reports the negative value of the $|\varepsilon_{i,t}|$ according to the Francis et al. (2005) model, *AQ_dd* according to the Dechow and Dichev (2002) model, and *AQ_bs* according to the Ball and Shivakumar (2006) model. A higher value of *AQ_francis*, *AQ_dd* or *AQ_bs* indicates higher accruals quality. *Top_underwriter*, a dummy variable, equals 1 if the underwriter is ranked in the top 25% in terms of the number of their bond issuing deals in the year prior to a bond issuance, and 0 otherwise. *Size* is the natural logarithm of total assets. *Leverage* is firm's financial leverage ratio, calculated as the total debts divided by total assets. *ROA* is return on assets. *MB* is market-to-book ratio. *Growth* is growth in sales, measured as ending sales revenue divided by one-year lagged sales revenue. *Altman Z-score* is the borrower's Altman's Z-score, which proxies for the borrower's default risk. Altman's Z-score is computed as $Z = 1.2^{*}$ (working capital/total assets) + 1.4^{*} (retained earnings/total assets) + 3.3^{*} (EBIT/total assets) + 0.6^{*} (public value of equity/book value of total liabilities) + 1.0^{*} (sales/total assets). *Loss Incidence* is loss incidence, defined as the proportion of income losses over the past eight quarters. *SOE* is a dummy variable that equals 1 if its ultimate shareholder is the government, and 0 if it is an NSOE. *BondAmt* is the natural logarithm of bond offering amount measured in RMB hundred million. *Maturity* is the natural logarithm of the maturity period of the bond in months. *Secured* is an indicator variable that equals 1 if the bond is secured with collateral, and 0 otherwise; All of the bond credit ratings include AA−, AA, AA+ and AAA. *YEAR* and *IND* are year and industry dummies, respectively. *t* values are based on two-way, cluster-robust standard errors adjusting for cross-sectional and time-series dependence. ***, ** and * indicate that the coefficient is statistically significant different from zero at the 1%, 5% and 10% level of significance, respectively.

	Pred.	Test for H1			Test for H2		
	Sign	(1)	(2)	(3)	(4)	(5)	(6)
Intercept		15.192***	15.278***	15.467***	14.442***	14.397***	14.745***
		(4.51)	(4.53)	(4.57)	(3.52)	(3.51)	(3.60)
AQ_francis	−	−9.625***			−12.161***		
		(−3.56)			(−4.37)		
AQ_dd	−		−9.129***			−11.540***	
			(−3.32)			(−3.79)	
AQ_bs	−			−7.720***			−10.34***
				(−2.70)			(−3.47)
Top_underwriter	−				−0.204	−0.194	−0.256
					(−0.85)	(−0.75)	(−1.10)
*AQ*Top_underwriter*	+				11.945***	12.041***	11.32***
					(3.84)	(3.66)	(4.11)
Size	−	−0.132***	−0.132***	−0.123***	−0.124***	−0.116***	−0.107***
		(−2.76)	(−2.74)	(−2.95)	(−3.40)	(−2.91)	(−2.70)
Leverage	+	−0.023	−0.023	−0.022	−0.027	−0.027	−0.026
		(−1.18)	(−1.14)	(−1.06)	(−1.41)	(−1.36)	(−1.29)
ROA	−	−0.056	−0.057	−0.049	−0.079	−0.080	−0.071
		(−0.93)	(−0.96)	(−0.80)	(−1.14)	(−1.15)	(−0.98)
MB	?	0.579***	0.580***	0.567***	0.640***	0.642***	0.625***
		(6.55)	(6.51)	(6.30)	(6.99)	(6.92)	(6.80)
Growth	?	0.002	0.003	0.003*	0.002	0.002	0.002
		(1.01)	(1.43)	(1.74)	(0.84)	(0.93)	(1.16)
Altman Z-score	−	−0.460***	−0.459***	−0.472***	−0.399***	−0.400***	−0.411***
		(−7.48)	(−8.55)	(−9.04)	(−6.85)	(−6.73)	(−7.85)
Loss Incidence	+	1.426	1.387	1.273	1.470	1.405	1.330
		(0.94)	(0.91)	(0.87)	(0.94)	(0.89)	(0.87)
SOE	+	0.464***	0.485***	0.474***	0.393**	0.404**	0.409**
		(2.80)	(2.86)	(2.74)	(2.10)	(2.24)	(2.16)
BondAmt	+	0.354*	0.347*	0.325*	0.395**	0.387**	0.370**
		(1.78)	(1.71)	(1.73)	(2.14)	(2.07)	(2.12)
Maturity	?	−1.393**	−1.398**	−1.394**	−1.346**	−1.349**	−1.354**
		(−2.23)	(−2.27)	(−2.23)	(−2.27)	(−2.29)	(−2.28)
Secured	−	−0.105	−0.110	−0.076	−0.116	−0.124	−0.099
		(−0.52)	(−0.54)	(−0.36)	(−0.65)	(−0.66)	(−0.49)
Rating		Yes	Yes	Yes	Yes	Yes	Yes
YEAR		Yes	Yes	Yes	Yes	Yes	Yes
IND		Yes	Yes	Yes	Yes	Yes	Yes
Observations		381	381	381	381	381	381
Adjusted R^2		0.142	0.140	0.133	0.160	0.158	0.152
F		3.704	3.674	3.523	3.775	3.787	3.590

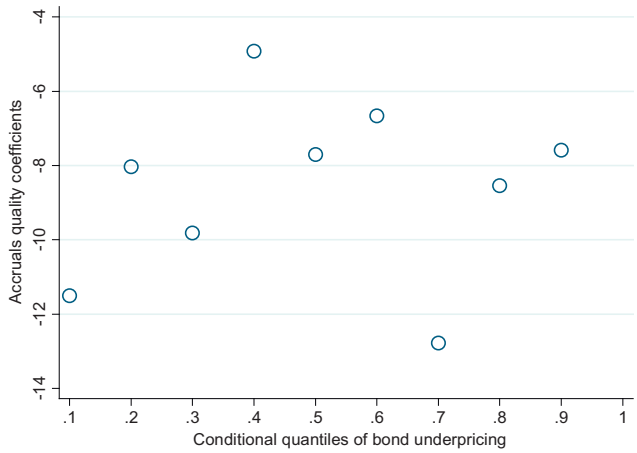


Fig. 2. Effect of accruals quality on conditional quantiles of bond underpricing. This figure plots the size of the effect of accruals quality on various conditional quantiles of bond underpricing. The first quantile (0.10) refers to a firm with one of the lowest bond underpricing in the sample firms, and the last quantile (0.90) refers to a firm with one of the highest bond underpricing in the sample. We measure accruals quality according to the Francis et al. (2005) model.

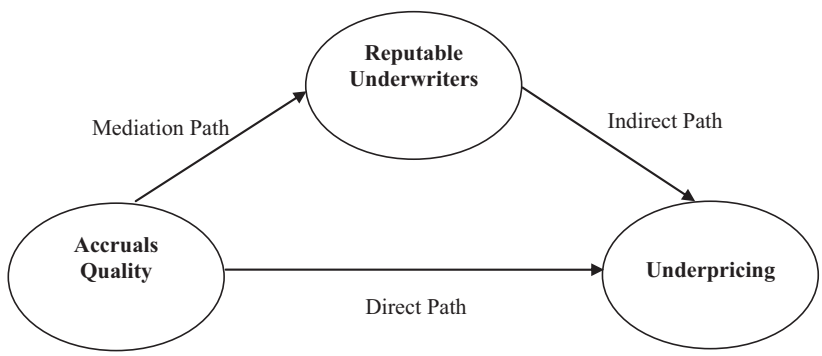


Fig. 3. Basic path diagram showing the posited direct and indirect paths between accruals quality, reputable underwriters and bond underpricing.

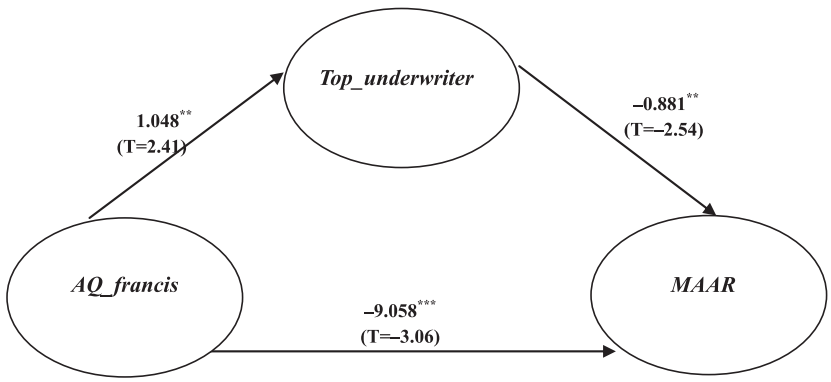
two-way, cluster-robust standard errors to control for both cross-sectional and time-series dependence (Petersen, 2009).

Regarding the effect of accruals quality on bond underpricing, β_1 is predicted to be negative for H1; thus, higher accruals quality should reduce bond underpricing. Columns (1)–(3) in Table 3 present the results of the cross-sectional analyses of the impact of accruals quality on underpricing in the Chinese corporate bond market based on Eq. (7). The main independent variables are *AQ_francis*, *AQ_dd* and *AQ_bs*, respectively. The model is reasonably well specified with an adjusted R^2 of 13–14% at the significance level of 1%. As we predict, the coefficients on accruals quality measures are −9.625, −9.129 and−7.720 at the 1% significance level, suggesting that accruals quality is negatively and significantly related to bond underpricing in the Chinese market. These findings support H1.

Turning to control variables, we find that larger firms and firms with higher *Altman Z-score* ratios receive a lower underpricing. Market-to-book ratio (*MB*) is strongly positively associated with underpricing, implying that borrowers with a high growth opportunity incur higher underpricing. In addition, the underpricing is higher for bonds issued by SOEs. This result is consistent with those of Chaney et al. (2011) who argue that politically connected firms have a large degree of information asymmetry, which causes a large IPO underpricing.[14] As for the *Maturity* variable, the relationship between *Maturity* and underpricing is negative, which is

[14] Cheung et al. (2009) find similar evidence of a relationship between state ownership and IPO underpricing in the Chinese stock market.

Table 4
Path analysis with reputable underwriters as a mediator. The table presents path coefficient estimates using the mediation procedures in Baron and Kenny (1986). We use three measures, *AQ_francis*, *AQ_dd* and *AQ_bs*, of accruals quality as the source variables, *MAAR* as the outcome variable and *Top_underwriter* as the primary mediating variable. For each source variable, we report the Goodman and Sobel test of the significance of mediation, and calculate the percentage of the total effect that is mediated.[a] We also calculate the ratio of the indirect effect to the direct effect. ***, ** and * indicate that the coefficient is statistically significant different from 0 at the 1%, 5% and 10% level of significance, respectively.



Mediation results for each source variable

Test method	Source variable	Test statistic	*p*-value
Goodman I	*AQ_francis*	−1.682	0.09
	AQ_dd	−1.728	0.08
	AQ_bs	−1.624	0.10
Goodman II	*AQ_francis*	−1.825	0.07
	AQ_dd	−1.868	0.06
	AQ_bs	−1.768	0.08
Sobel	*AQ_francis*	−1.749	0.08
	AQ_dd	−1.794	0.07
	AQ_bs	−1.691	0.09

Percent mediated for each source variable

	AQ_francis (%)	*AQ_dd* (%)	*AQ_bs* (%)
Percent of the total effect mediated	10.19	11.19	11.46
Percent of the total effect not mediated	89.81	88.81	88.54
Ratio of the indirect effect to direct effect	11.35	12.60	12.94

[a] Goodman I is computed as $\frac{\alpha\beta}{\sqrt{\alpha^2\sigma_\beta^2+\beta^2\sigma_\alpha^2+\sigma_\alpha^2\sigma_\beta^2}}$, Goodman II is computed as $\frac{\alpha\beta}{\sqrt{\alpha^2\sigma_\beta^2+\beta^2\sigma_\alpha^2-\sigma_\alpha^2\sigma_\beta^2}}$ and Sobel is computed as $\frac{\alpha\beta}{\sqrt{\alpha^2\sigma_\beta^2+\beta^2\sigma_\alpha^2}}$. In our indirect link, $Top_{underwriter} = \alpha * \mathrm{AQ} + \varepsilon$, where α is the coefficient of accruals quality.$\mathrm{MAAR} = \beta * Top_{underwriter} + c' * \mathrm{AQ} + \epsilon$, where $\beta$is the coefficient of *Top_underwriter*. σ_α^2 and σ_β^2 are the variances of α and β, respectively.

inconsistent with Cai et al. (2007). Interestingly, the positive (and significant) coefficient for the size of bond offering (*BondAmt*) is inconsistent with the notion that this variable is a good measure of aftermarket liquidity, which should be negatively associated with underpricing (Ellul and Pagano, 2006). This result does conform to those reported by Cai et al. (2007), who also find that *BondAmt* is not actually a proxy for liquidity, but is correlated with information problems. These results suggest that the larger the bond offerings, the more difficult it is for investors to understand issuing firms; hence, larger bond offerings incur higher underpricing. For the other control variables, although they do not show a statistically significant link to underpricing, the variables generally have the expected sign.

As shown in Table 3, the regression model can answer the question, "Does accruals quality reduce the bond underpricing?" However, it cannot answer another important question: "Does accruals quality affect bond underpricing differently for firms with already low underpricing compared to those with high underpricing?" By using quantile regression, we can obtain a more comprehensive picture of the effect of accruals quality on the corporate bond underpricing. Fig. 2 reports the quantile regression estimates of accruals quality at various conditional quantiles of the bond underpricing distribution. It shows that there is no clear trend in the accruals

Table 5
Reverse causality test using treatment effects model. This table reports the results for correcting the self-selection bias using the treatment effects model. The first column presents the first-stage probit analysis of firms' decision to use high accruals quality. The dependent variable is an indicator variable that takes the value of 1 if a firm's accruals quality measure (*AQ_francis*) at one year before bond issuance is above the sample median, and 0 otherwise. The other two measures have similar results. The explanatory variables include firm size (*Size*), leverage (*Leverage*), return on assets (*ROA*), market-to-book (*MB*), sales growth (*Growth*), Altman-Z score (*Altman Z-score*), the loss incidence (*Loss Incidence*), *SOE*, institutional ownership (*Institutional*) and the percentage of shares owned by the largest shareholder (*Largesh*). The second column presents the results of the effects of accruals quality on bond underpricing. The dependent variable is *MAAR*, a measure of underpricing with market-adjusted initial returns on the first trading day of the bond. All of the other variables are defined in Table 1. All of the bond credit ratings include AA−, AA, AA+ and AAA. *YEAR* and *IND* are year and industry dummies, respectively. ***, ** and * indicate that the coefficient is statistically significantly different from 0 at the 1%, 5% and 10% level of significance, respectively.

	Top_AQ	MAAR
Intercept	-1.959^{**} (−2.18)	15.137^{***} (5.75)
Top_AQ		-4.315^{***} (−7.67)
Size	0.175^{***} (5.02)	0.135 (1.25)
Leverage	-0.020^{***} (−8.74)	-0.048^{**} (−2.21)
ROA	-0.074^{***} (−7.01)	-0.148^{**} (−2.10)
MB	0.035 (1.04)	0.684^{***} (4.00)
Growth	-0.003^{*} (−1.90)	−0.002 (−0.75)
Altman Z-score	0.035 (0.71)	-0.525^{***} (−4.61)
Loss Incidence	1.179 (1.45)	2.451 (1.09)
SOE	−0.115 (−0.67)	0.182 (0.47)
Institutional	0.002 (0.80)	
Largesh	0.002 (0.44)	
BondAmt		0.306 (1.19)
Maturity		-1.385^{***} (−2.61)
Secured		−0.085 (−0.41)
Rating		Yes
YEAR	Yes	Yes
IND	Yes	Yes
Observations	378	378
ρ	0.722	
LR test of $\rho = 0$ chi2(1) = 41.41		
Probability > chi2(1) = 0.000		

quality coefficients. We also test whether the coefficients are the same for various conditional quantiles of underpricing; the results support the findings presented in Fig. 2. That is, the underpricing reduction benefit from the firm's accruals quality is symmetric, which provides support for the results of the OLS regression.

5.3. Moderation effect of underwriter reputation

We also examine the moderating effect of underwriter reputation on the relationship between accruals quality and bond underpricing. To test H2, we include the *Top_underwriter* variable and interactions between the *Top_underwriter* variable and accruals quality measures. If reputable underwriters (*Top_underwriter*) certify firms' earnings and thereby reduce the uncertainty faced by investors, we expect that the interaction terms will have the opposite sign of the relevant accruals quality measures.

We test our second hypothesis, which examines the impact of reputable underwriters on the relationship between accruals quality and bond underpricing, using the results presented in columns (4)–(6) of Table 3. As expected, we find that the coefficients on AQ are consistently negative, and that the interactions between AQ and the reputable underwriter measure are always positive and significant. The results reveal that the less transparent a firm's accounting information, the more issuers benefit from underwriter quality. We obtain similar results when examining the interactions between the other proxies for accruals quality and reputable underwriters. These results are consistent with the hypothesis that the presence of a reputable underwriter acts as a certification for new issues, particularly for firms with lower accruals quality.

5.4. Path analysis: mediation effects of underwriter reputation

We next examine how effectively reputable underwriters alleviate the information problem and in turn reduce the adverse impact of poor accruals quality on bond underpricing. Based on the model proposed by Bhattacharya et al. (2012), we posit an indirect link between accruals quality, for which we use accruals quality (*AQ*) as the primary proxy, and bond underpricing (see Fig. 3).

The indirect link is mediated by reputable underwriters. Using path analysis, we then test the existence of this indirect path and weight the relative importance of the direct and indirect links from accruals quality to bond underpricing.

Path analysis provides persuasive explanations of correlation structures, by decomposing a correlation between the source (causal) variable—accruals quality and the outcome variable—underpricing into a simple or direct path and a compound or indirect path that includes a mediating variable (in our case, reputable underwriters). The decomposition provides evidence for the existence and relative importance of the direct and indirect paths between accruals quality and underpricing.

We first use the reputable underwriter variable (*Top_underwriter*) as the mediating variable and focus on *MAAR* as the proxy for bond underpricing in our path model. As shown in Table 4, the overall correlation between *AQ_francis* and *MAAR* is −9.058. The direct and mediated paths decompose this correlation into the portions attributable to the direct link between *AQ_francis* and *MAAR* and the indirect link, mediated by *Top_underwriter*. The path coefficients for the two segments (the path from *AQ_francis* to *Top_underwriter* and the path from *Top_underwriter* to *MAAR*) of the indirect path are both strongly significant at 5%, implying a strong mediated effect of *Top_underwriter* on the relation between *AQ_francis* and *MAAR*. Sobel and Goodman (I, II) mediation statistics confirm the strong mediation effect ($p < 0.10$) of *Top_underwriter*. Therefore, the indirect path through reputable underwriters exists.

The positive path coefficient between *AQ_francis* and *Top_underwriter* suggests that lenders tend to hire reputable underwriters to signal their accruals quality. Therefore, with the signaling hypothesis, we find a positive relation between accruals quality and underwriter reputation, consistent with the finding of Chen et al. (2013). The path coefficient between *Top_underwriter* and *MAAR* is negative, implying that the presence of a reputable underwriter can mitigate the uncertainty regarding the values of IPO firms, which, in effect, certifies the earnings of IPO firms and thus reduces the level of underpricing. Carter and Manaster (1990) report results consistent with a certification effect (i.e., lower underpricing) when firms go public with the assistance of reputable underwriters. Thus, reputable underwriters can mitigate a portion of the information risk the lenders may face. The results further show that about 89.8% of the correlation between *AQ_francis* and *MAAR* is attributable to a direct path between *AQ_francis* and *MAAR*, but only about 10.2% is attributable to the indirect path through reputable underwriters, suggesting that the indirect influence of accruals quality mediated by *Top_underwriter* on *MAAR* is much less important than the direct influence. Thus, consistent with Bhattacharya et al. (2012), who show the nature of the association between information risk and the cost of capital in the equity market, we provide evidence for the nature of the association between information risk and underpricing in the bond market.

We then use *AQ_dd* and *AQ_bs* as alternative source variables in our path model, and the results are similar. Taken together, the empirical results presented in Table 4 confirm that lenders hire reputable underwriters to mitigate the information risk confronting them, and that reputable underwriters can serve as a possible channel through which accruals quality influences the level of underpricing. However, our evidence that the mediated effect of reputable underwriters is much less important than the direct effect of accruals quality on bond underpricing suggests that reputable underwriters mitigate only a limited portion of information risk, and that the relationship between accruals quality and bond underpricing is fundamental.

6. Robustness

6.1. Reverse causality test

In the previous sections, we do not address the potential endogeneity problem of accruals quality. An alternative explanation of the negative relationship between accruals quality and underpricing is that firms with

Table 6
Summary of robustness checks. This table reports the results of accruals quality (*AQ_francis)* on bond underpricing across robustness checks discussed in the text. Specification 1 controls for firms' governance variables. Specification 2 uses alternative measures of reputable underwriters. Specification 3 controls for issuers' market risk. Specification 4 controls for bond characteristics, such as coupon rate. Specification 5 removes either the firm size or bond offering amount variable to mitigate the multicollinearity issue. *t* values are based on two-way, cluster-robust standard errors adjusted for cross-sectional and time-series dependence. ***, ** and * indicate that the coefficient is statistically significantly different from 0 at the 1%, 5% and 10% level of significance, respectively.

Specification	Test for H1	Test for H2	
	AQ_francis	*AQ_francis*	*AQ_francis*Top_underwriter*
1. Governance variables:			
Institutional	−9.647***	−12.267***	12.272***
Largesh	−9.810***	−12.487***	12.522***
VC	−9.620***	−12.157***	11.998***
2. Alternative measure of reputable underwriters:			
Total underwriting amounts	−9.625***	−12.877***	13.652***
Total firm assets	−9.625***	−12.486***	10.728***
3. Issuer market risk	−8.782***	−10.934***	10.672***
4. Coupon rate	−7.882***	−9.950***	9.477***
5. Multicollinearity issue:			
Remove *Size* variable	−9.660***	−12.086***	11.543***
Remove *BondAmt* variable	−9.487***	−11.913***	11.542***

higher levels of underpricing are more likely to have lower accruals quality. Firms with stronger corporate governance better align the interests of all of their stakeholders, which mitigates agency problems and results in less information asymmetry, leading to less underpricing (Watts, 2003). We deal with this reverse causality issue in the following two ways. First, we add an institutional ownership variable (*Institutional*), a shareholding variable (*Largesh*) and a separation degree variable (*VC*) to the set of control variables.[15] Second, we apply the treatment effect model to purge the endogenous component of accruals quality. In the first stage, we estimate a selection model (probit model) to explain firms' decisions to choose high accruals quality. The dependent variable is an indicator variable that gets the value of 1 if a firm's accruals quality measure is above the sample median and 0 otherwise. The explanatory variables include firm size, leverage, return on assets, market-to-book, sales growth, Altman Z-score, the loss incidence, SOE, the institutional ownership and the largest shareholder ownership. Conditional on this first-stage analysis, we analyze in the second stage the relationship between accruals quality and bonds underpricing.

We report the results of the treatment effects model in Table 5. We find that larger firms and firms with low financial leverage are more likely to have higher accruals quality. High return on assets and high sales growth are associated with lower accruals quality. The second column reports the endogeneity-adjusted estimate of accruals quality on underpricing. The coefficient on *Top_AQ* is −4.315 (significant at the 1% level), consistent with the interpretation that firms with higher accruals quality tend to have lower underpricing.[16] Therefore, we conclude that our results are robust to the correction of potential self-selection bias due to the tendency of higher underpricing firms to choose lower accruals quality.

6.2. Further robustness checks

Our results remain qualitatively similar in the following robustness tests (See Table 6).

(1) Alternative measures of reputable underwriters. In addition to ranking underwriters according to the number of their bond issuance deals in the main test, we conduct robustness tests that rank underwriters in terms of their total underwriting amounts and total assets.

[15] The variables are described in Table 1. We report these results in Table 6.
[16] We also examine the estimated correlation between the error terms in the two equations, ρ, which equals 0.722, and is positive and significant at the 1% level, thus providing support for the treatment effect model.

Table 7
Relation between accruals quality and bond underpricing after controlling for the level of marketization. Columns (1)–(3) report the results of estimating the relation between accruals quality and bond underpricing. Columns (4)–(6) present the OLS regression of bond underpricing on different accruals quality measures and the interaction of underwriter reputation and accruals quality. The dependent variable is *MAAR*, a measure of underpricing with market-adjusted initial returns on the first trading day of bond. *AQ_francis* reports the negative value of the $|\varepsilon_{i,t}|$ according to the Francis et al. (2005) model, *AQ_dd* according to the Dechow and Dichev (2002) model and *AQ_bs* according to the Ball and Shivakumar (2006) model. A higher value of *AQ_francis*, *AQ_dd* or *AQ_bs* indicates higher accruals quality. All of the other variables are defined as in Table 1. All of the bond credit ratings include AA−, AA, AA+ and AAA. *YEAR* and *IND* are year and industry dummies, respectively. *t* values are based on two-way, cluster-robust standard errors adjusted for cross-sectional and time-series dependence. ***, ** and * indicate that the coefficient is statistically significantly different from 0 at the 1%, 5% and 10% levels of significance, respectively.

	Additional Test for H1			Additional Test for H2		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	15.066***	15.150***	15.330***	14.291***	14.244***	14.581***
	(4.64)	(4.67)	(4.70)	(3.57)	(3.55)	(3.64)
AQ_francis	−9.517***			−12.129***		
	(−3.53)			(−4.38)		
AQ_dd		−9.067***			−11.539***	
		(−3.34)			(−3.83)	
AQ_bs			−7.659***			−10.371***
			(−2.68)			(−3.49)
Top_underwriter				−0.195	−0.185	−0.248
				(−0.81)	(−0.71)	(−1.05)
*AQ*Top_underwriter*				12.163***	12.226***	11.521***
				(3.87)	(3.65)	(4.07)
Market	−0.067**	−0.074***	−0.071**	−0.062**	−0.068**	−0.064**
	(−2.27)	(−2.58)	(−2.33)	(−2.25)	(−2.54)	(−2.26)
Size	−0.100*	−0.097	−0.089*	−0.094**	−0.083*	−0.075
	(−1.66)	(−1.61)	(−1.69)	(−2.05)	(−1.68)	(−1.52)
Leverage	−0.025	−0.025	−0.023	−0.029	−0.029	−0.028
	(−1.29)	(−1.25)	(−1.17)	(−1.51)	(−1.48)	(−1.40)
ROA	−0.055	−0.056	−0.048	−0.078	−0.079	−0.070
	(−0.97)	(−1.02)	(−0.84)	(−1.18)	(−1.20)	(−1.02)
MB	0.578***	0.579***	0.567***	0.639***	0.641***	0.624***
	(6.47)	(6.40)	(6.14)	(7.12)	(7.04)	(6.85)
Growth	0.002	0.002	0.002	0.002	0.002	0.002
	(0.89)	(1.25)	(1.48)	(0.71)	(0.78)	(0.93)
Altman Z-score	−0.409***	−0.402***	−0.417***	−0.350***	−0.346***	−0.359**
	(−6.83)	(−7.95)	(−9.06)	(−6.11)	(−5.94)	(−7.03)
Loss Incidence	1.218	1.162	1.055	1.276	1.195	1.132
	(0.86)	(0.82)	(0.78)	(0.85)	(0.79)	(0.78)
SOE	0.409***	0.424***	0.415***	0.345**	0.350**	0.359**
	(2.83)	(2.85)	(2.68)	(2.07)	(2.19)	(2.11)
BondAmt	0.299	0.289	0.268	0.342*	0.330	0.315
	(1.39)	(1.32)	(1.31)	(1.68)	(1.60)	(1.63)
Maturity	−1.372**	−1.377**	−1.372**	−1.325**	−1.328**	−1.333**
	(−2.14)	(−2.17)	(−2.13)	(−2.18)	(−2.19)	(−2.19)
Secured	−0.126	−0.132	−0.098	−0.139	−0.147	−0.124
	(−0.61)	(−0.64)	(−0.46)	(−0.75)	(−0.78)	(−0.60)
Rating	Yes	Yes	Yes	Yes	Yes	Yes
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
IND	Yes	Yes	Yes	Yes	Yes	Yes
Observations	380	380	380	380	380	380
Adjusted R^2	0.142	0.140	0.133	0.160	0.159	0.152
F	3.548	3.511	3.362	3.625	3.628	3.440

Table 8
Accruals quality and the non-price contract terms. This table shows estimates of the effects of accruals quality on various non-price bond contract terms. *BondAmt* is the natural logarithm of the bond offering amount measured in RMB hundred million. *Secured* is an indicator variable that equals 1 if the bond is secured with collateral, and 0 otherwise. *Covenants* is a count variable obtained by counting the number of financing-related and asset-sale covenants included in a bond contract. *AQ_francis* reports the negative value of the $|\varepsilon_{i,t}|$ according to the Francis et al. (2005) model, *AQ_dd* according to the Dechow and Dichev (2002) model and *AQ_bs* according to the Ball and Shivakumar (2006) model. A higher value of *AQ_francis*, *AQ_dd* or *AQ_bs* indicates a higher accruals quality. Firm and bond characteristics are defined as in Table 3. All of the bond credit ratings include AA−, AA, AA+ and AAA. *YEAR* and *IND* are year and industry dummies, respectively. *t* values are based on two-way, cluster-robust standard errors adjusted for cross-sectional and time-series dependence. ***, ** and * indicate that the coefficient is statistically significantly different from 0 at the 1%, 5% and 10% level of significance, respectively.

	A. OLS: *BondAmt*			B. Probit: *Secured*		
	(1)	(2)	(3)	(4)	(5)	(6)
AQ_francis	0.388			−2.397		
	(1.25)			(−1.44)		
AQ_dd		0.333			−2.586*	
		(0.86)			(−1.66)	
AQ_bs			0.134			−2.215*
			(0.40)			(−1.74)
	C. Poisson: *total covenants*			D. OLS: *total covenants*		
AQ_francis	−2.567***			−1.705***		
	(−2.70)			(−2.68)		
AQ_dd		−2.398**			−1.490**	
		(−2.22)			(−2.08)	
AQ_bs			−3.053***			−1.914***
			(−3.06)			(−2.90)
Firm and bond controls	Yes	Yes	Yes	Yes	Yes	Yes
Credit rating	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year dummy	Yes	Yes	Yes	Yes	Yes	Yes

(2) Control for issuer market risk. Ge and Kim (2014) suggest that bondholders may consider issuer market risk when pricing bonds. We calculate the standard deviation of daily stock returns as a proxy for the issuer's market risk and include it in our regression. The results remain unaltered.
(3) Control for coupon rate. We also examine whether our results are sensitive to the inclusion of bond characteristics such as coupon rate. A higher coupon rate may affect after-market liquidity, which affects bond underpricing.
(4) As previously noted, there is a strong correlation between firm size and bond offering amount (0.79). To address this issue, we remove the control for one of these variables. The conclusions are the same as those presented previously.

7. Additional test

7.1. Does accruals quality matter in the SBO subsample?

The previous section presented evidence that lower accruals quality is associated with high underpricing in general. Here, we further investigate if there is any difference in the effects of accruals quality on the underpricing of IBO and SBO issuances. In the additional tests, we analyze Hypothesis 1–2 using IBO and SBO subsamples.

The results for the IBO subsample are qualitative similar to the main conclusion; however, inconsistent with prior evidence, we find that neither accruals quality nor the presence of a reputable underwriter affect the SBO sample (untabulated).[17] This implies that if a firm taps the bond market more frequently, issuers

[17] For brevity, we do not report these results, but they are available upon request from the authors.

Table 9
Event study of corporate bonds default cases. This table shows the event study of how corporate bond default affects the issuer's stock price. The event date ($t = 0$) is the day when the corporate bond was declared to default. The estimation window is [−150, −60], the event windows are $[-t, t]$ ($t = 2, 5, 10, 20, 30$), the CAR $[-t, t]$ values are calculated based on original data from CSMAR. The t values are presented in parentheses. ***, ** and * indicate that the coefficient is statistically significantly different from 0 at the 1%, 5% and 10% level of significance, respectively.

Stock code	Event date	CAR [−2, 2]	CAR [−5, 5]	CAR [−10, 10]	CAR [−20, 20]	CAR [−30, 30]
000659	28 May 2015	−0.029 (−0.312)	−0.101 (−0.787)	0.081 (0.473)	−0.256 (−1.106)	−0.465 (−1.595)
002306	7 April 2015	0.030 (0.265)	−0.116 (−0.704)	−0.196 (−0.931)	−0.252 (−0.846)	−0.183 (−0.571)

are less likely to benefit from improved accruals quality or the hiring of a reputable underwriter, perhaps for the following reasons. First, as China issued the first corporate bond in 2007, we know that in every case the time gap between the IBO and SBO must be short. In our sample, there is on average only 13.6 months between an IBO and an SBO. Within such short time gaps, there may be very little change in the issuers' conditions, so investors can make decisions based on the information generated from the IBO book-building process. Given the little change in accruals quality and lower requirements for the guarantee of underwriters, it is reasonable to infer that the effect of accruals quality and underwriters' reputation on bond underpricing in these circumstances maybe limited. Second, as the main investors in Chinese corporate bond market are institutional investors, who have the ability to effectively collect and make use of information, it is more difficult for underwriters to collect or generate material private information within such short time intervals. This further constrains the influence of underwriters.

7.2. Controlling for the level of marketization[18]

A survey by Fan et al. (2007) and the World Bank (2006) concludes that due to regional differences in history, natural environment, regional development and social culture, there are large institutional gaps across Chinese provinces, including in the process of marketization and the investment climate. Wei et al. (2011) also indicate that research on China-related issues cannot simply ignore these differences in institutional environment across provinces. Therefore, we repeat our main tests after controlling for the level of institutional environment.

Following Xia and Fang (2005), we use the marketization index (*Market*) as a proxy of institutional environment. The marketization index is taken from the NERI Index of the Marketization of China's Provinces: 2011 Report (Fan et al., 2011). *Market* is a comprehensive index that proxies for the institutional quality of each province in China. A higher value of *Market* indicates a faster process of regional marketization and a better regional institutional environment.[19] We expect that companies in better regional institutional environments face lower underpricing as they are supervised by relatively sound legal systems and monitored by more professional government agencies, which can ensure a better information environment and higher levels of investor protection.

The results of the re-testing of our two hypotheses are presented in Table 7. Consistent with our main results, we find a significantly negative association between accruals quality and underpricing after controlling for the level of marketization. This reinforces H1, which predicts that bondholders, on average, value accounting quality and reduce underpricing for firms with higher accruals quality. The significantly positive coefficients on $AQ^{*}Top\_underwriter$ are consistent with H2, suggesting that the relation between accruals quality and underpricing (after controlling for the regional marketization) is moderated when the borrower hires reputable underwriters. Turning to the market variable, we find that *Market* is negatively related to bond underpricing (significant at the 5% level).

[18] We are very grateful to one of our referees for the suggestion that we should control for the level of marketization in the firms' localities.

[19] We measure the institutional environment using the lagged marketization index at the end of the fiscal year before the bond issuance. However, as Fan et al. (2011) provide data for the marketization index across various regions in China for only the 2001 to 2009 period, we use the regional marketization index measured in 2009 for bonds issued after 2010.

7.3. Accruals quality and the non-price bond contract terms

To gain a comprehensive understanding of the role of the issuer's accruals quality in the corporate bond market, in this section we focus on some non-price contract terms, i.e., bond amount, secured and covenants, which are the most widely used non-price terms in the literature (Graham et al., 2008; Bharath et al., 2011; Gong et al., 2016). Table 8 reports our regression estimates. Panel A shows the effects of various measures of accruals quality on bond issuing amount. The dependent variable in the regression is the natural logarithm of the bond offering amount measured in RMB hundred million. The results show that the coefficients of accruals quality are not statistically significant, which suggests there is no systematic difference in the bond amounts issued by firms with high and low accruals quality.

Panel B of Table 8 presents the regression results estimating the effect of accruals quality on the likelihood of using security for the bond. The dependent variable is a dummy variable that is equal to 1 if the bond is secured and 0 otherwise. The regression is estimated using a probit model. The results show that accruals quality is negatively related to the collateral requirement of the bond in columns (5) and (6). This suggests that firms with high accruals quality are subject to fewer security requirements, implying yet another advantage of a better information environment.

Panel C of Table 8 presents the regression results for the determinants of covenant intensity. Following Gong et al. (2017), we measure the dependent variable, covenant intensity, by counting the total number of financing-related and asset-sale covenants included in the bond prospectus.[20] Thus, the dependent variable in Panel C is the total number of covenants associated with a bond. As the number of covenants is a positive integer, we estimate the equation using a Poisson regression. In Panel D, we also use the OLS procedure to examine the association between accruals quality and covenants. The estimated coefficient of accruals quality is significantly negative at the 5% level, suggesting that firms with higher accruals quality are less subject to covenant restrictions than those with lower accruals quality.

7.4. Impact of corporate bond default on issuer's stock price[21]

Although there is no default observation in our sample, we try to check the market reaction to corporate bond defaults with an event study. As a corporate bond default is certainly a passive signal, we predict that the market reaction is negative.

We first try to collect the trading data of the stock of *Chaori* Co., Ltd. (Code 002506),[22] which is the issuer of the first default corporate bond in China. However, *Chaori*'s stock was suspended from trade in the exchanges seven months before the default date due to its huge losses in 2012 and 2013. Therefore, we cannot conduct an event study using this default case. We further check another four corporate bonds default cases, and find that only two issuers' data are suitable for an event study. These two companies are *Zhuhai Zhongfu* Co., Ltd. (Code 000659) and *Beijing Xiangeqing* Co., Ltd. (Code 002306), and their stocks have not been suspended from trading on the exchange. We use 28 May 2015 and 7 April 2015, the respective dates on which the corporate bonds issued by these two companies were declared to default, as the event days. We choose $[-150, -60]$ as the estimation window and compute CAR $[-t, t]$ ($t = 2, 5, 10, 20, 30$) based on original data from CSMAR.

Table 9 reports the results. It shows that most of the cumulative abnormal returns are negative, except for the CAR $[-10, 10]$ of *Zhuhai Zhongfu* Co., Ltd. and the CAR $[-2, 2]$ of *Beijing Xiangeqing* Co., Ltd. However, not all of these cumulative abnormal returns are statistically significant. From these results, we cannot con-

[20] Bond prospectuses also include event-related covenants and accounting-related covenants. However, event-related covenants are often written loosely by lawyers, using boilerplate language. They are designed to protect bondholders upon default by increasing the recovery amount and decreasing the possible losses, which usually serves a minor role in settling the coming default. Accounting-related covenants are seldom used in public bond contracts; only 3.09% of bond contracts include them (Gong et al., 2017). Therefore, we only consider financing-related and asset-sale covenants in this study.

[21] We thank our referee for this valuable suggestion.

[22] We also try to conduct an event study based on the price of those default bonds in the bond market. However, we find that there was no trading on all of those bonds around the event date due to the suspension order from the exchange. Therefore, we only focus on the stock market reaction to the issuers' corporate bonds default.

clude that the bond default events have significant effects on the issuers' stock price. There are two possible explanations for this result. As we know, the stock market in China experienced a great irrational boom from November 2014 to June 2015 when the stock index doubled over a six-month period. Stock investors blindly trusted that the bull market would keep going for a long time. Both of the aforementioned two default events happened one or two months before the stock market crash, when investors were most overconfident. In such - cases, investors are more likely to neglect the passive information of bonds default. Therefore, our first explanation is that in these cases, the influence of the bonds default on issuers' stock price might have been offset by the irrational upward trends of the stock market. The other possible explanation is that defaults of corporate bonds indeed have little effect on the issuers' stock price in the Chinese market. As there is no precedent for a bankruptcy caused by corporate bond default, and the government always gets involved to ensure repayments, defaults of corporate bonds may have limited influence on stock price.

8. Conclusions

The purpose of this study is to investigate two hypotheses. The first hypothesis examines how firms' accruals quality impacts underpricing in the Chinese corporate bond market. Our regression analyses reveal that bond underpricing in China is inversely associated with accruals quality, after controlling for bond- and firm-specific characteristics. This evidence is consistent with the asymmetric information theory that underlies discussions of IPO underpricing in the literature. According to this theory, higher accruals quality helps to reduce information asymmetry and mitigate bond underpricing. The second hypothesis investigates whether the presence of reputable underwriters reduces the adverse effect of poor accruals quality (information risk) on bond underpricing. Our results indicate that reputable underwriters play a role in mitigating the effects of low accruals quality on bond underpricing. To examine the effectiveness of reputable underwriters in alleviating information problems, we specify the direct path and indirect path based on the model in Bhattacharya et al. (2012). Using path analysis, we test for the existence and relative importance of both paths. We then provide statistically reliable evidence of both a direct path and an indirect path, with the direct path (accruals quality) having greater (often, much greater) importance than the indirect path (reputable underwriters). However, in our additional tests, we find there is no significant association between accruals quality, underwriters and bond underpricing for secondary bond offerings. Furthermore, we find that firms with low accruals quality are associated with more restrictive non-price contract terms such as greater collateral requirements and stricter covenants.

Our results provide evidence of the nature of the association between information risk and bond underpricing and suggest the importance of accruals quality in bond financing. Security regulations, such as the Regulation on Fair Disclosure and prohibitions on insider trading, have been promulgated to improve accruals quality (Bhattacharya et al., 2013) and may be equally important in the bond market. If there is a trade-off between improving accruals quality and employing reputable underwriters, our results suggest that the former effect dominates the latter effect.

A potential limitation of our study is that we focus on information asymmetry to investigate the impact of accruals quality on bond underpricing. However, there are other theories about the causes of bond underpricing in the literature, such as signal and liquidity theory. Factors other than information asymmetry could be explored to investigate the association of bond underpricing with accruals quality in future research.

Acknowledgements

We are grateful for funding support from the Ph.D. Programs Foundation of the Ministry of Education of China (Grant no. 20130161110045). We thank the scholars attending the 9th Symposium of the China Journal of Accounting Research (CJAR). We are also thankful for the comments from Prof. Oliver Rui at the China Europe International Business School and the suggestions made by one anonymous referee. We appreciate the comments and suggestions from Prof. Zhang Huai at Nanyang Technological University. We take full responsibility for this paper.

References

Allen, F., Faulhaber, G.R., 1989. Signalling by underpricing in the IPO market. J. Financ. Econ. 23, 303–323.

Ball, R., Shivakumar, L., 2006. The role of accruals in asymmetrically timely gain and loss recognition. J. Account. Res. 44, 207–242.

Ball, R., Shivakumar, L., 2008. Earnings quality at initial public offerings. J. Account. Econ. 45, 324–349.

Ball, R., Bushman, R.M., Vasvari, F.P., 2008. The debt-contracting value of accounting information and loan syndicate structure. J. Account. Res. 46, 247–287.

Baron, R., Kenny, D., 1986. The moderator-mediator variables distinction in social psychology research: conceptual, strategic, and statistical considerations. J. Pers. Soc. Psychol. 51, 1173–1182.

Benveniste, L.M., Spindt, P.A., 1989. How investment bankers determine the offer price and allocation of new issues. J. Financ. Econ. 24 (2), 343–361.

Bessembinder, H., Maxwell, W., 2008. Markets: transparency and the corporate bond market. J. Econ. Perspect. 22, 217–234.

Bharath, S.T., Sunder, J., Sunder, S.V., 2008. Accruals quality and debt contracting. Account. Rev. 83, 1–28.

Bharath, S.T., Dahiya, S., Saunders, A., Srinivasan, A., 2011. Lending relationships and loan contract terms. Rev. Financ. Stud. 24, 1141–1203.

Bhattacharya, N., Ecker, F., Olsson, P.M., Schipper, K., 2012. Direct and mediated associations among accruals quality, information asymmetry, and the cost of equity. Account. Rev. 87, 449–482.

Bhattacharya, N., Desai, H., Venkataraman, K., 2013. Does accruals quality affect information asymmetry? Evidence from trading costs. Contemp. Account. Res. 30, 482–516.

Boulton, T.J., Smart, S.B., Zutter, C.J., 2011. Accruals quality and international IPO underpricing. Account. Rev. 86, 483–505.

Brau, J.C., Fawcett, S.E., 2006. Initial public offerings: an analysis of theory and practice. J. Financ. 61, 399–436.

Cai, N.K., Helwege, J., Warga, A., 2007. Underpricing in the corporate bond market. Rev. Financ. Stud. 20, 2021–2046.

Carter, R., Manaster, S., 1990. Initial public offerings and underwriter reputation. J. Financ. 45, 1045–1067.

Chaney, P.K., Faccio, M., Parsley, D., 2011. The quality of accounting information in politically connected firms. J. Account. Econ. 51, 58–76.

Chang, X., Lin, S.H., Tam, L.H.K., Wong, G., 2010. Cross-sectional determinants of post-IPO stock performance: evidence from China. Account. Financ. 50, 581–603.

Chemmanur, T.J., Krishnan, K., 2012. Heterogeneous beliefs, IPO valuation, and the economic role of the underwriter in IPOs. Financ. Manage. 41, 769–811.

Cheung, Y., Ouyang, Z., Tan, W., 2009. How regulatory changes affect IPO underpricing in China. China Econ. Rev. 20, 692–702.

Chen, C., Zhu, S., 2013. Financial reporting quality, debt maturity, and the cost of debt: evidence from China. Emerg. Mark. Financ. Tr. 49, 236–253.

Chen, J.Z., Lobo, G.J., Wang, Y., Yu, L., 2013. Loan collateral and financial reporting conservatism: Chinese evidence. J. Bank. Financ. 37, 4989–5006.

Chen, C., Shi, H., Xu, H., 2013. Underwriter reputation, issuer ownership, and pre-IPO earnings management: evidence from China. Financ. Manage. 42, 647–677.

Cohen, D.A., Zarowin, P., 2010. Accrual-based and real earnings management activities around seasoned equity offerings. J. Account. Econ. 50, 2–19.

Cooney, J.W., Singh, A.K., Carter, R.B., Dark, F.H., 2001. IPO Initial Returns and Underwriter Reputation: Has the Inverse Relationship Flipped in the 1990s? University of Kentucky, Working Paper.

Dichev, I.D., Piotroski, J.D., 2001. The long-run stock returns following bond ratings changes. J. Financ. 56, 173–203.

Dechow, P.M., Dichev, I.D., 2002. The quality of accruals and earnings: the role of accrual estimation errors. Account. Rev. 77, 35–59.

Dong, M., Michel, J., Pandes, J.A., 2011. Underwriter quality and long-run IPO performance. Financ. Manage. 40, 219–251.

Ellul, A., Pagano, M., 2006. IPO underpricing and after-market liquidity. Rev. Financ. Stud. 19, 381–421.

Fan, G., Wang, X., Zhu, H., 2007. NERI Index of Marketization of China's Provinces: 2006 Report. Economic Science Press, Beijing (in Chinese).

Fan, G., Wang, X., Zhu, H., 2011. NERI Index of Marketization of China's Provinces: 2009 Report. Economic Science Press, Beijing (in Chinese).

Francis, J., LaFond, R., Olsson, P., Schipper, K., 2005. The market pricing of accruals quality. J. Account. Econ. 39, 295–327.

Ge, W., Kim, J.B., 2014. Real earnings management and the cost of new corporate bonds. J. Bus. Res. 67, 641–647.

Glushkov, D., Khorana, A., Rau, P.R., 2014. Why Do Firms Go Public Through Debt Instead of Equity? University of Pennsylvania, Working Paper.

Gong, G.M., Xu, S., Gong, X., 2017. Bond covenants and the cost of debt: evidence from China. Emerg. Mark. Financ. Tr. 53 (3), 587–610.

Gong, G.M., Xu, S., Gong, X., 2016. On the value of corporate social responsibility disclosure: an empirical investigation of corporate bond issues in China. J. Bus. Ethics 5, 1–32.

Graham, J.R., Li, S., Qiu, J., 2008. Corporate misreporting and bank loan contracting. J. Financ. Econ. 89 (1), 44–61.

Jo, H., Kim, Y., Park, M.S., 2007. Underwriter choice and earnings management: evidence from seasoned equity offerings. Rev. Account. Stud. 12, 23–59.

Jog, V., McConomy, B.J., 2003. Voluntary disclosure of management earnings forecasts in IPO prospectuses. J. Bus. Financ. Account. 30, 125–168.

Kim, D., Palia, D., Saunders, A., 2010. Are initial returns and underwriting spreads in equity issues complements or substitutes. Financ. Manage. 39, 1403–1423.
Lee, G., Masulis, R., 2011. Do underwriters or venture capitalists restrain earnings management by IPO issuers? J. Corp. Financ. 17, 982–1000.
Leone, A.J., Rock, S., Willenborg, M., 2007. Disclosure of intended use of proceeds and underpricing in initial public offerings. J. Account. Res. 45, 111–153.
Lin, Z.J., Tian, Z., 2012. Accounting conservatism and IPO underpricing: China evidence. J. Int. Account. Audit. Tax. 21, 127–144.
Liu, M., Magnan, M., 2014. Conditional conservatism and underpricing in US corporate bond market. Appl. Financ. Econ. 24, 1323–1334.
Lu, C.W., Chen, T.K., Liao, H.H., 2010. Information uncertainty, information asymmetry and corporate bond yield spreads. J. Bank. Financ. 34, 2265–2279.
Petersen, M.A., 2009. Estimating standard errors in finance panel data sets: comparing approaches. Rev. Financ. Stud. 22, 435–480.
Pessarossi, P., Weill, L., 2013. Choice of corporate debt in China: the role of state ownership. China Econ. Rev. 26, 1–16.
Rock, K., 1986. Why new issues are underpriced. J. Financ. Econ. 15, 187–212.
Schrand, C.M., Verrecchia, R.E., 2005. Information Disclosure and Adverse Selection Explanations for IPO Underpricing. University of Pennsylvania, Working Paper.
Sherman, A.E., Titman, S., 2002. Building the IPO order book: underpricing and participation limits with costly information. J. Financ. Econ. 65, 3–29.
Titman, S., Trueman, B., 1986. Information quality and the valuation of new issues. J. Account. Econ. 8, 159–172.
Watts, R.L., 2003. Conservatism in accounting part II: evidence and research opportunities. Acc. Horizons 17, 287–301.
Wei, Z., Wu, S., Li, C., Chen, W., 2011. Family control, institutional environment and cash dividend policy: evidence from China. China J. Account. Res. 1, 29–46.
Willenborg, M., McKeown, J.C., 2000. Going-concern initial public offerings. J. Account. Econ. 30, 279–313.
World Bank, 2006. China, Governance, Investment Climate, and Harmonious Society: Competitiveness Enhancements for 120 Cities in China. World Bank Report 37759-CN.
Xia, L., Fang, Z., 2005. Government control, institutional environment and firm value. Econ. Res. J. 5, 40–51 (in Chinese).
Yang, S., Gong, X., Xu, S., 2017. Underwriting syndicates and the cost of debt: evidence from Chinese corporate bonds. Emerg. Mark. Financ. Tr. 53 (2), 471–491.
Zheng, S.X., Stangeland, D.A., 2007. IPO underpricing, firm quality, and analyst forecasts. Financ. Manage. 36, 1–20.

China Journal of Accounting Research 10 (2017) 341–357

HOSTED BY

Contents lists available at ScienceDirect

China Journal of Accounting Research

journal homepage: www.elsevier.com/locate/cjar

The mystery of zombie enterprises – "stiff but deathless"

Xinfeng Jiang [a], Sihai Li [b,*], Xianzhong Song [c]

[a] College of Economics and Management, Huazhong Agricultural University, China
[b] School of Accounting, Zhongnan University of Economics and Law, China
[c] School of Management, Jinan University, China

ARTICLE INFO

Article history:
Received 4 January 2017
Accepted 15 August 2017
Available online 19 September 2017

Keywords:
Zombie enterprise
Government subsidy
Enterprise contribution
Private interests of officials
Enterprise value

ABSTRACT

Drawing on social exchange theory, this study uses data on China's Shanghai and Shenzhen A-share listed companies from 2009 to 2016 to examine why zombie enterprises are "stiff but deathless." We find that these enterprises are able to "linger breathlessly" due to government support in the form of increased subsidies and bank loans. The government is more inclined to grant subsidies to zombie companies that assume greater policy burdens, specifically those offering more jobs. Furthermore, an enterprise's property rights do not influence the level of "blood transfusions" received, and government assistance fails to bolster operating efficiency or value. This phenomenon is further explored in the context of the incentives local government officials have to maintain employment stability. Our conclusions highlight the necessity and urgency of cleaning up zombie enterprises.

1. Introduction

China's economic development has entered a new normal. The significant slowdown in economic growth has led to upgrades of the industrial infrastructure (Zheng, 2016), and it also provides an opportunity to adjust production capacities and advance market-clearing processes. On November 4, 2015, the State Council held an executive meeting to discuss Chinese industry's location in a critical period of transformation and advancement. The current focus is to stabilize industrial growth and to continually improve the efficiency of enter-

* Corresponding author.
E-mail address: lshhhy0420@163.com (S. Li).
☆ We acknowledge financial support from the National Natural Science Foundation of China (Project Nos. 71502174 and 71372166) and Guangzhou Regional Low Carbon Economy Research Base.

http://dx.doi.org/10.1016/j.cjar.2017.08.001
1755-3091/

prises. The meeting stressed the need to "accelerate the zombie enterprise reorganization and integration or help them exit the market, and increase support for state-owned enterprises to solve historical baggage." Zombie enterprises are characterized by low operational efficiency and production, and they suffer from long-term losses or insolvency. They consume social funds and resources, and although they should have been eliminated by the market, they continue to exist (Chen, 2015). Since the end of the 20th century, overcapacity has gradually become one of China's most important macroeconomic phenomena. Since 2009, the State Council has issued three important documents on managing overcapacity due to its serious economic and social impacts. Research shows that overcapacity is more prominent in industries that have more zombie enterprises (Caballero et al., 2008). In the process of "supply side" structural reform, cleaning up zombie enterprises has become an urgent task. They squeeze resources, hinder the emergence of new innovative enterprises and seriously affect improvements to social productivity. In addition, zombie enterprises have the ability to bear higher losses than general enterprises. In the context of a macroeconomic downturn, this may lead to a situation of "the bad wins the best," exacerbating economic problems. As zombie enterprises have such a large negative impact on China's economy, how do they continue to exist? What is the underlying logic behind this phenomenon? This study examines the problem theoretically and provides possible explanations, supported by empirical evidence.

The conditions necessary for the survival of enterprises are good production, strong management and the ability to produce outstanding technological innovations. Enterprises need to accomplish three tasks: produce quality products to sell; turn their inventory into cash flow for further production and innovation; and continually create profits. Zombie enterprises have low operational efficiency and bear long-term losses; to "stay alive," they often accept support from external resources. From the perspective of resource allocation, these are direct salvage operations undertaken by the government. Why do government departments spend huge amounts of resources keeping zombie companies alive? Social exchange theory's view of behavior as an exchange of tangible or intangible commodities or services (Hou, 2006) provides a useful lens for analyzing this process. That is, the act itself is the social interaction process: an actor trades a "resource" for some kind of "reward" (Chen and Qu, 2012). Social exchange activities can be divided into market exchange, redistribution exchange and reciprocal exchange (Homans, 1958). Reciprocal exchange between enterprises and governments is commonplace (Antia et al., 2013). China's current political system is characterized by political centralization and fiscal decentralization (Yao and Zhang, 2013). In this system, a local government official's promotion is entirely in the hands of the central government, and standards for promotion depend on the needs of the government. China has a large population, and employment problems are an important concern for the government. Solving citizens' employment difficulties has become a major task for the Chinese government and its officials. This has also become one of the main indicators for evaluating local government officials' promotion prospects (Zhang et al., 2013). To perform well on these assessments, local officials, under the pressure of a political promotion system, require the help of enterprises that can maintain employment volume and social stability. Although zombie enterprises are inefficient, they can still offer jobs. Within the framework of social exchange theory, local officials are incentivized to allocate government resources to zombie enterprises that have lost their ability to operate efficiently.

Based on the preceding analysis, we chose Chinese Shanghai and Shenzhen A-share listed companies as our research sample to examine the mystery of zombie enterprises and uncover the underlying logic of continuing to breathe life into these "stiff but deathless" entities. Our conclusions reveal that zombie enterprises obtain the direct support and credit endorsement of the government, and that these "blood transfusions" in the form of government subsidies and bank loans are the direct reasons that zombie enterprises persist. However, the distribution strength of government subsidies has heterogeneous characteristics. Specifically, a zombie enterprise with more jobs to offer receives more government subsidies, but an enterprise's property rights have little to no influence. Furthermore, this kind of blood transfusion seldom boosts the enterprise's operating efficiency or value. This study considers the direct cause of these stiff but deathless zombie enterprises from the perspective of resource rationing. The potential logic behind this phenomenon is further explored in the context of the incentives provided to local government officials to maintain employment stability to secure their own paths to promotion. Our research conclusions highlight the necessity and urgency of cleaning up zombie enterprises.

The remainder of this paper is organized as follows. Section 2 outlines the institutional background and hypothesis. Section 3 describes the research design. Section 4 provides the empirical results. Section 5 discusses further analysis and the robustness test, and Section 6 concludes the paper.

2. Institutional background and hypothesis

Zombie enterprises first emerged in the late 1980s, when the US Federal Deposit Insurance Corporation set an unrealistically low credit criterion (Kane, 1987; Zhu and He, 2016). The literature on Japan's economic development shows that from 1995 to 2002 the proportion of zombie enterprises in Japan increased, and this is considered the main reason for Japan's long-term economic decline (Fukuda and Nakamura, 2011; Kawai and Morgan, 2013). According to current research, zombie enterprises are formed by various factors. Zombie enterprises can be the result of poor production quality, low or no technological innovation or a lack of entrepreneurial spirit (Cheng and Hu, 2016). Some studies suggest that the root cause of zombie enterprises is the support they receive from external resources. For example, Liu and Mao (2016) argue that economic agents (banks and governments) and institutional and cultural elements play an important role.

This raises interesting questions about the survival of Chinese zombie enterprises in China's institutional context. In the Chinese government's top-down approach to governance, realizing a national-level goal depends on the performance of local government officials. Compared with local governments, the central government has a structural power advantage. In the early days of liberation, the central government controlled the key powers, such as the cadres, the military and important economic resources (Sun, 2011). China is now in a period of economic reform and transformation. As military control can no longer be used as a common means for managing the states, the present system is economically decentralized, but politically centralized, which means that many economic resources are transferred to local governments, but the central government harnesses its power by tightly controlling the tenure length and promotion opportunities of the local personnel (Zhang et al., 2012). Hence, local government officials, under the pressure of the political promotion system, have strong incentives to achieve the central government's objectives.

The central government's performance evaluations of local government officials is becoming more diversified, but employment stability continues to be the main criterion for assessment (Xue and Bai, 2008). Improvements to social welfare are an important embodiment of government and an important way to maintain social stability. They also depend on optimized social employment (Zheng and Li, 2015). The Outline of the 10th Five-year Plan for Economic and Social Development defines "full employment, price stability, economic growth and international balance of payments" as the overall requirements of macro-control for the People's Republic of China. The Recommendations for the 13th Five-Year Plan for Economic and Social Development advocated "persisting in employment priority strategies, implementing more active employment policies, creating more jobs and tackling structural employment contradictions," further confirming the employment issue as a strategic consideration. The overall economic development plan at the national level emphasizes the importance of stabilizing employment, and the performance criteria of government departments and their officials are aligned to support these goals. The State Council's Notice on promoting employment in 2008 required that employment should "be regarded as an important criteria of government performance appraisal." Liaoning Province began to emphasize employment and re-employment as a primary indicator of local government assessment in 2003 (Zheng and Luo, 2015). Influenced by the complex economic situation at home and abroad, China's rapid economic growth has gradually slowed, and economic development has entered a new state of normalcy (Lu and Zheng, 2016). Guaranteeing employment and maintaining social stability under this "new normal" has become the central government's biggest concern. Therefore, under this top-down approach to policy and the pressure of the promotion system, local government officials are motivated to advocate employment policies and maintain employment stability. As district enterprises are typically a region's main employers, they are an important starting point for local officials seeking to achieve employment stability, and government officials will often help these enterprises create more jobs to maintain social stability (Li et al., 2012).

Social exchange theory holds that an excellent paradigm for analyzing and understanding organizational and interpersonal behavior is to treat behavior as an exchange in the form of tangible or intangible commodities or services (Hou, Jun 2006). An actor exchanges some kind of remuneration with another actor at the

expense of their own resources (Chen and Qu, 2012). Social exchange activities can be divided into market exchange, redistribution exchange and reciprocal exchange (Homans, 1958). Reciprocal exchanges commonly exist between enterprises and governments (Antia et al., 2013). For enterprise organizations in pursuit of maximum economic benefit, non-economic decisions made by local government officials for political reasons will inevitably have an impact on their business operations, but local governments will find ways to support those enterprises in return. Many detailed studies support the government's use of promotions to motivate local government officials (Rosenstein-Rodan, 1943; Liu and Lin, 2013; Han et al., 2016; Zhang and Wu, 2017). Studies also show that government subsidies are both an important and a common method for providing reciprocal exchange (Du et al., 2015; Wang et al., 2015; Chen and Li, 2001). Although unable to turn a profit, zombie enterprises can still provide jobs and help maintain social stability. As this increases their likelihood of a favorable promotion assessment, local officials in exchange provide the enterprises with government subsidies that ensure their survival. As such, the immediate reason for the continued existence of zombie enterprises is the availability of government subsidies. Based on the principle of reciprocity, the more jobs they offer, the greater the government subsidy support a zombie enterprise will receive.

Based on the preceding analysis, the following hypotheses are put forward.

H1. Zombie enterprises are "stiff but deathless" due to their access to government resources in the form of government subsidies.

H2. Zombie enterprises that assume greater job placement responsibilities will receive greater government subsidies.

3. Research design

3.1. Sample selection and data source

For our empirical analysis of the causes of the "stiff but deathless" zombie enterprises and the government motives behind this phenomenon, we select data from Shanghai and Shenzhen A-share listed companies from 2009 to 2016. Following previous studies, the raw data are processed according to the following rules: financial enterprises are excluded from the sample; enterprises with missing data are eliminated; and the top and bottom 1% of the continuous variables are winsorized. Government subsidy data are sourced from the WIND database; the other financial data are collected from the CSMAR database.

3.2. Test model and variable definitions

We construct the following model to ascertain whether zombie enterprises obtain more government resources.

$$Sub = \beta_0 + \beta_1 Zombie + \beta Control + \sum Ind + \sum YEAR + \varepsilon \quad (1)$$

Sub represents the government resources, defined as the proportion of government subsidies in operating income, and *Zombie* is a dummy variable that identifies whether the enterprise is a zombie enterprise. Two methods have been used in other studies to identify zombie enterprises.

The first method, CHK, is proposed by Caballero et al. (2008). In this method, the basic characteristic of zombie enterprises is that the interest charges paid to banks are too low. There are two steps to the judgment process. First, the following formula is used to calculate the minimum required interest payment:

$$R^*_{i,t} = rs_{t-1} \times BS_{i,t-1} + \left(\frac{1}{5}\sum_{j=1}^{5} rl_{t-j}\right) \times BL_{i,t-1} + rcb_{\min overlast5years,t} \times Bonds_{i,t-1},$$

where rs_{t-1} is the average short-term prime rate for the year t − 1, $\left(\frac{1}{5}\sum_{j=1}^{5} rl_{t-j}\right)$ is the average long-term prime rate for the years t − 1 to t − 5 and $rcb_{\min overlast5years,t}$ is the lowest coupon rate for convertible bonds in the

years t − 5 to t − 1. $BS_{i,t-1}$ are short-term bank loans, $BL_{i,t-1}$ are long-term bank loans and $Bonds_{i,t-1}$ are the amount of bonds outstanding for company i in the year t − 1. A zombie enterprise judgment index is then calculated using

$$X_{i,t} = \frac{R_{i,t} - R^*_{i,t}}{BS_{i,t-1} + BL_{i,t-1} + Bonds_{i,t-1} + CP_{i,t-1}},$$

where $CP_{i,t-1}$ is the amount of commercial paper outstanding for company i in the year t − 1. If the value of $X_{i,t}$ is less than 0, the enterprise is judged to be a zombie enterprise.

The second method relies on the official definition of the State Council as the standard for judgment: "Enterprises that [are] not in line with the national energy consumption, environmental protection, quality or safety standards, sustained loss for more than three consecutive years and does not conform to the restructuring direction."

We use both methods in our analysis. The CHK method is widely used in the literature (Giannetti and Simonov, 2013; Lin et al., 2015) and is denoted by the *Zombie1* variable. Based on the official definition, we eliminate the non-recurring gains and losses of each enterprise and denote the result as the *Zombie2* variable. Specifically, by deducting the non-recurring profit and loss earnings as the standard measure, if the earnings per share have been negative for three consecutive years, *Zombie2* is defined as 1; otherwise, it is defined as 0. *Control* is a placeholder for the control variables, including the enterprise management, the type of corporate governance and the industry and year.

To examine the deep-seated reasons why zombie enterprises receive more government subsidies, we construct the following model, based on social exchange theory, from the perspective of the policy burdens borne by enterprises:

$$Sub = \beta_0 + \beta_1 Zombie + \beta_2 Zombie \times Burden + \beta Control + \sum Ind + \sum YEAR + \varepsilon \quad (2)$$

Here, *Burden* is the number of employment placements provided by the enterprise, as measured by *Burden1* and *Burden2*. *Burden1* is the number of excess employees expressed as the residual of the regression of the company's employees after controlling for the factors that may affect the number of current employees (Zheng and

Table 1
Variable definitions.

Variable	Definition
Sub	Government subsidy/income
Zombie1	Calculated according to the CHK method
Zombie2	1 if earnings per share, after deducting abnormal profit and loss, is negative for three consecutive years, equals 0 otherwise years, and 0 otherwise
Burden1	Actual number of employees minus theoretical number of employees
Burden2	10,000 × number of employees/income
Size	Natural logarithm of a firm's total assets
Cash	Cash over total assets
ROA	Net profit over total assets
Lev	Total debt over total assets
Growth	Percentage growth in operating income
First	Percentage of shares held by the largest shareholder
Rela	1 if the chairman has political connections with the government, and 0 otherwise
Dual	1 if the chairman and CEO are the same person, and 0 otherwise
Fa_r	Fixed assets over total assets
State	1 if the company is state-owned, and 0 otherwise
Stime	Years elapsed since the firm was listed
Ind_r	Percentage of independent directors on the board
Shrz	Shareholdings of the first largest shareholder over shareholdings of the second largest shareholder
GDP	GDP growth rate of the province in which the firm is located
YEAR	Year dummy variables
IND	Industry dummy variables

Luo, 2015). *Burden2* is calculated as 10,000 × employee number/operating income (Zeng and Chen, 2006). The control variables are the same as mentioned previously. The definitions for the variables are provided in Table 1.

4. Empirical results

4.1. Descriptive statistics of variables

The descriptive statistics of the variables are shown in Table 2. During the sample period, government subsidies accounted for 1% of operating income, but the maximum value was 9.1%. Whether zombie companies received a greater share of government subsidies is worth examining. The mean value of *Zombie1*, the CHK measure, is 21.5%, and the mean value of *Zombie2*, measured by earnings per share after deducting abnormal profit and loss for three consecutive years, is 6.7%, given a preliminary indication of the number of zombie enterprises in China's listed companies. The mean value of *Burden1* is 0, which reflects a 0 mean value property of the regression residuals, and the mean value of *Burden2* is 0.016, indicating that a company income of RMB10000 is able to provide 0.016 jobs. According to the statistical analysis of control variables, the standard deviation in enterprise size is 1.211, indicating that the size difference between the sample enterprises is large. The average cash holding is 0.179, indicating that the average enterprise holds 17.9% of its total assets as cash. The average corporate profitability (ROA) is 0.036, and the average financial leverage (*Lev*) is 0.456, suggesting that the sample firms use debt financing moderately. The average shareholding of the first largest shareholder is 35.4%, which means that it is a common phenomenon in China for the large shareholders in listed companies to hold an absolute advantage.

4.2. Regression analysis

4.2.1. Are zombie companies receiving more government resources?

Theoretical analyses have shown that China's zombie enterprises are still "standing up" despite losing their vitality, due to the intentional support of the government in the form of government subsidies. We validate this through Model (1) and list the regression results in Table 3. The dependent variable, *Sub*, is the subsidies obtained from the government. The coefficient for *Zombie1* is positively correlated with *Sub* at a significance level of 10%; *Zombie2* is positively correlated at 1%, suggesting that, among Chinese listed companies, zombie

Table 2
Descriptive statistics.

Variable	N	Mean	Std. dev	Min.	Max.
Sub	13,566	0.010	0.014	0.000	0.091
Zombie1	13,566	0.215	0.411	0.000	1.000
Zombie2	13,566	0.067	0.250	0.000	1.000
Burden1	13,566	0.000	0.017	−0.110	1.153
Burden2	13,566	0.016	0.013	0.001	0.071
Size	13,566	22.138	1.211	19.231	25.504
Cash	13,566	0.179	0.126	0.013	0.671
ROA	13,566	0.036	0.056	−0.239	0.220
Lev	13,566	0.456	0.206	0.056	0.900
Growth	13,566	0.431	1.283	−0.814	10.248
Frist	13,566	0.354	0.149	0.090	0.750
Rela	13,566	0.343	0.475	0.000	1.000
Dual	13,566	0.219	0.414	0.000	1.000
Fa_r	13,566	0.239	0.168	0.002	0.751
State	13,566	0.462	0.499	0.000	1.000
Stime	13,566	10.854	6.014	2.003	26.077
Ind_r	13,566	0.371	0.055	0.091	0.800
Shrz	13,566	12.776	21.430	1.007	135.783
GDP	13,566	0.099	0.059	−0.233	0.238

Table 3
Zombie enterprises and government subsidies.

Variable	(1) Sub	(2) Sub
Zombie1	0.001*	
	(1.85)	
Zombie2		0.010***
		(6.98)
Size	−0.001***	−0.001***
	(−5.96)	(−4.85)
Cash	0.001	−0.000
	(0.43)	(−0.10)
ROA	−0.014***	−0.005
	(−3.72)	(−1.09)
Lev	−0.003*	−0.005***
	(−1.92)	(−3.00)
Growth	0.000**	0.000**
	(2.06)	(2.04)
Frist	−0.006***	−0.006***
	(−4.22)	(−3.88)
Rela	0.000	0.000
	(1.00)	(0.88)
Dual	0.000	0.000
	(0.64)	(0.81)
Fa_r	0.007***	0.006***
	(4.47)	(4.18)
State	0.001	0.000
	(1.31)	(0.86)
Stime	−0.000	−0.000**
	(−1.15)	(−2.56)
Ind_r	0.006*	0.006*
	(1.79)	(1.74)
Shrz	−0.000	−0.000
	(−1.02)	(−1.10)
GDP	−0.002	0.000
	(−0.40)	(0.10)
Cons	0.046***	0.040***
	(8.92)	(7.89)
YEAR	Controlled	Controlled
IND	Controlled	Controlled
N	13,566	13,566
R^2	0.041	0.052
F	28.455	28.914
P	0.000	0.000

* Represents significance at the 10% level.
** Represents significance at the 5% level.
*** Represents significance at the 1% level.

enterprises have received more government subsidies. This result provides direct support for the existence of zombie enterprises in China and for Hypothesis 1.

4.2.2. Why do zombie enterprises receive government support?

The logical follow-up question is as follows: why are these zombie companies able to secure a steady stream of government resources without being eliminated by the market? Hypothesis 2 suggests the underlying reason is an exchange of interests between these enterprises and the local government. Despite their poor profitability, these companies can still provide jobs to the region, and thus they meet the needs of the local government. By this measure, zombie companies that offer more jobs should receive more government subsidies. Table 4 shows

Table 4
Zombie enterprises – Employee scales and government subsidies.

Variable	(1) Sub	(2) Sub	(3) Sub	(4) Sub
Zombie1	0.001**	−0.002		
	(2.16)	(−1.10)		
Burden1 × Zombie1	0.179***			
	(4.84)			
Burden2 × Zombie1		0.166*		
		(1.65)		
Zombie2			0.009***	0.008***
			(11.57)	(5.58)
Burden1 × Zombie2			0.130***	
			(5.00)	
Burden2 × Zombie2				0.091*
				(1.68)
Burden1	0.108***		0.088***	
	(9.39)		(7.09)	
Burden2		0.116***		0.098***
		(3.35)		(2.89)
Size	−0.001***	−0.001***	−0.001***	−0.001***
	(−7.09)	(−3.93)	(−5.50)	(−3.28)
Cash	0.001	0.001	0.000	−0.000
	(0.54)	(0.39)	(0.05)	(−0.01)
ROA	−0.015***	−0.009**	−0.005	−0.001
	(−3.93)	(−2.53)	(−1.17)	(−0.23)
Lev	−0.003**	−0.002	−0.004***	−0.004**
	(−2.24)	(−1.17)	(−3.44)	(−2.31)
Growth	0.000**	0.000**	0.000**	0.000**
	(2.16)	(2.50)	(2.26)	(2.36)
Frist	−0.005***	−0.005***	−0.005***	−0.005***
	(−3.54)	(−3.83)	(−3.40)	(−3.57)
Rela	0.000	0.000	0.000	0.000
	(0.94)	(0.99)	(0.83)	(0.78)
Dual	0.000	0.000	0.000	0.000
	(0.71)	(0.75)	(0.87)	(0.90)
Fa_r	0.007***	0.006***	0.007***	0.006***
	(4.65)	(3.59)	(4.57)	(3.66)
State	0.001	0.001	0.000	0.000
	(1.62)	(1.41)	(1.00)	(0.89)
Stime	−0.000	−0.000	−0.000***	−0.000***
	(−1.60)	(−1.45)	(−3.03)	(−2.77)
Ind_r	0.005	0.005*	0.006	0.006*
	(1.58)	(1.71)	(1.64)	(1.78)
Shrz	−0.000	−0.000	−0.000	−0.000
	(−0.79)	(−1.00)	(−0.71)	(−1.01)
GDP	−0.003	−0.003	−0.001	−0.001
	(−0.63)	(−0.72)	(−0.20)	(−0.22)
Cons	0.047***	0.033***	0.040***	0.030***
	(10.51)	(5.47)	(8.96)	(5.15)
YEAR	Controlled	Controlled	Controlled	Controlled
IND	Controlled	Controlled	Controlled	Controlled
N	13,566	13,566	13,566	13,566
R^2	0.052	0.054	0.062	0.063
F	17.360	28.450	20.812	28.797
p	0.000	0.000	0.000	0.000

* Represent significance at the 10% level.
** Represent significance at the 5% level.
*** Represent significance at the 1% level.

the regression results of this analysis. The results in columns (1) and (3) consider excess employees the independent variable, where excess employees are calculated as the difference between the actual number of employees and the theoretical number according to Zheng and Luo (2015). These authors calculate the regression as the residual of the size of the enterprise, total asset yield, corporate asset liability ratio, capital density, main business income growth rate, industry and year on the actual enterprise employee scale. The regression results in columns (2) and (4) consider the number of employees per million RMB of operating income as the independent variable (Zeng and Chen, 2006). Table 4 shows that the regression coefficients for *Zombie1* and *Zombie2* are positive in regressions (1), (3) and (4) (significance levels of 5%, 1% and 1%, respectively), which confirms the reliability of the preceding conclusions. In addition, the regression coefficients for *Burden1* and *Burden2* are both positive in all of the regressions, each with a 1% significance level, suggesting that companies that take on more employees are indeed rewarded with policy-driven government resources. The interaction of the zombie and burden variables paints a similar picture, with all of them showing significantly positive results in our regressions (1% in columns (1) and (3) and 10% in columns (2) and (4)). These results imply that the government is making a purposeful choice when allocating resources to zombie enterprises, and that zombie enterprises that assume a greater policy burden are likely to receive more government subsidies, in accordance with the reciprocity principle of social exchange theory. This partly reflects non-economic interventions by local government officials, who are seeking to secure better chances of promotion by exploiting zombie enterprises. The results of this analysis support Hypothesis 2.

Research holds that under the current property rights system, state-owned enterprises have significant advantages in resource acquisition because of their political connections with the government (Sheng, 2015). Scholars generally believe that, relative to non-state-owned enterprises, China's state-owned enterprises receive more government subsidies because they bear more of the policy burden (Kong et al., 2013; Xu et al., 2014). It is therefore worthwhile to investigate whether there is any difference between state-owned enterprises and non-state-owned enterprises in terms of the government subsidies allocated to the zombie enterprises. Based on the preceding findings, government officials are motivated to distribute subsidies to zombie enterprises that can maintain employment stability, and in so doing further their own career prospects. As both state-owned and non-state-owned enterprises have jobs to offer, we can infer that when a business is in trouble and needs an external blood transfusion to survive, the government is just as likely to support either type of enterprise in the belief that "no matter whether white or black, it is a good cat as long as it can catch mice." Therefore, there should be no significant differences in the level of government subsidies received by state-owned and non-state-owned zombie enterprises. The results of this analysis, provided in Table 5, show that the coefficients for both zombie variables are positive at a significance level of 10% in column (1) and 1% in column (2), offering further proof of the soundness of the preceding conclusions. In addition, the interaction terms between the zombie enterprises (*Zombie1* and *Zombie2*) and property rights (*State*) are not statistically significant in either regression. This suggests that there is no significant difference between the ability of state-owned and non-state-owned zombie enterprises to obtain government subsidies, and reflects that local governments allocate subsidies to zombie enterprises for the purpose of maintaining local stability, regardless of their property rights. As long as they can help local governments achieve the goal of stable employment, zombie enterprises will be granted subsidies.

5. Further analysis and robustness tests

5.1. Zombie enterprises and credit acquisition: Institutional resources versus market resources

One of the main reasons why zombie companies persist in their stiff, arthritic, but deathless existence is that they continue to survive on external resources. Government subsidies are an important aspect of these resources, but bank credit and commercial credit are two other important lifelines zombie enterprises can obtain. Bank credit consists of bank loans an enterprise obtains; commercial credit is based on the business transactions between enterprises in the industry supply chain, either upstream or downstream, including accounts payable and accounts receivable. Although both forms of credit are corporate debt, their natures are different. In the context of the Chinese institutional setting, acquiring a bank loan often requires implicit government guarantees, especially for zombie enterprises. Prior studies indicate that government intervention

Table 5
Zombie enterprises – Property rights and government subsidies.

Variable	(1) Sub	(2) Sub
Zombie1	0.001*	
	(1.78)	
State × Zombie1	−0.001	
	(−0.76)	
Zombie2		0.009***
		(5.94)
State × Zombie2		−0.001
		(−0.74)
State	0.000	0.000
	(0.48)	(0.04)
Size	−0.001***	−0.001***
	(−5.60)	(−4.58)
Cash	0.001	0.001
	(0.79)	(0.47)
ROA	−0.015***	−0.008*
	(−3.62)	(−1.95)
Lev	−0.003**	−0.005***
	(−2.37)	(−3.17)
Growth	−0.000	−0.000
	(−0.87)	(−0.83)
Frist	−0.007***	−0.006***
	(−4.04)	(−3.73)
Rela	0.000	0.000
	(0.28)	(0.16)
Dual	0.000	0.001
	(0.87)	(0.96)
Fa_r	0.006***	0.006***
	(3.68)	(3.46)
Stime	−0.000	−0.000*
	(−0.59)	(−1.71)
Ind_r	0.006	0.006
	(1.48)	(1.48)
Shrz	−0.000	−0.000
	(−0.49)	(−0.59)
GDP	0.002	0.003
	(0.37)	(0.56)
Edu	−0.001*	−0.001*
	(−1.90)	(−1.68)
Age	0.000	0.000
	(1.00)	(0.81)
Cons	0.043***	0.039***
	(7.59)	(6.83)
YEAR	Controlled	Controlled
IND	Controlled	Controlled
N	11,188	11,188
R^2	0.040	0.046
F	10.787	12.453
P	0.000	0.000

* Represents significance at the 10% level.
** Represents significance at the 5% level.
*** Represents significance at the 1% level.

in the banking credit system is actually a part of the system of government, which helps the government to provide directional support to enterprises (Porta et al., 2002; Lian et al., 2011). Although the use and acquisition of commercial credit need to be based on the enterprise's operating capacity and profitability, institu-

tional intervention is irrelevant, and the market characteristics are more obvious. Only future-assured enterprises can gain the trust of upstream or downstream enterprises in the industry chain and are thus able to increase their access to more commercial credit. What are the characteristics of credit use for zombie enterprises? The results of the analysis are shown in Tables 6 and 7.

Table 6 displays the results for the analysis of whether zombie enterprises obtain more institutional credit. In columns (1) and (3), long-term loans from banks are the dependent variable, expressed as the proportion of long-term loans against operating income. In columns (2) and (4), short-term loans are the dependent variable. Our analysis shows that the *Zombie1* variable is positively correlated with both the long- and short-term loan variables at a significance level of 1%. The *Zombie2* variable is also positively correlated with both the loan

Table 6
Zombie enterprises and bank credit.

Variable	(1) Long-term loan	(2) Short-term loan	(3) Long-term loan	(4) Short-term loan
Zombie1	8.112***	9.187***		
	(10.84)	(17.85)		
Zombie2			0.989*	0.474***
			(1.78)	(5.07)
Size	0.081	0.327	−0.137	0.512**
	(0.16)	(1.12)	(−0.68)	(1.97)
Cash	4.772**	2.343*	4.933***	2.574
	(2.23)	(1.66)	(4.38)	(1.33)
ROA	2.266	1.005	0.868	1.011
	(0.62)	(0.45)	(0.63)	(0.66)
Lev	3.977**	1.469	2.619**	1.282**
	(2.27)	(1.20)	(2.41)	(2.09)
Growth	−0.006	−0.169**	0.040	−0.181***
	(−0.09)	(−1.96)	(0.44)	(−6.27)
Frist	−0.188	−1.330	−0.999	−2.812***
	(−0.07)	(−0.61)	(−0.58)	(−2.65)
Rela	−0.453	−0.092	−0.613	−0.239
	(−0.95)	(−0.28)	(−1.35)	(−0.77)
Dual	−0.383	0.093	−0.634***	−0.003
	(−0.72)	(0.25)	(−3.13)	(−0.01)
Fa_r	1.613	3.821***	0.993	1.816*
	(0.62)	(2.61)	(0.45)	(1.69)
State	1.355	3.365***	1.471*	2.492***
	(0.89)	(2.79)	(1.77)	(2.85)
Stime	0.879***	0.940***	−0.066	−0.099**
	(4.57)	(6.93)	(−0.64)	(−2.10)
Ind_r	−4.030	−4.338	−2.234	−7.477***
	(−0.88)	(−1.34)	(−0.61)	(−3.52)
Shrz	0.009	−0.000	0.014***	0.002
	(1.17)	(−0.08)	(3.12)	(0.70)
GDP	−0.000	−0.000	0.000	0.000***
	(−1.58)	(−0.99)	(0.31)	(3.07)
Cons	2.279	−3.728	19.120***	5.566
	(0.21)	(−0.59)	(3.08)	(0.98)
YEAR	Controlled	Controlled	Controlled	Controlled
IND	Controlled	Controlled	Controlled	Controlled
N	2224	3719	2224	3719
R^2	0.214	0.316	0.020	0.022
F	6.428	17.555	116.708	43.604
p	0.000	0.000	0.000	0.000

* Represents significance at the 10% level.
** Represents significance at the 5% level.
*** Represents significance at the 1% level.

Table 7
Zombie enterprises and commercial credit.

Variable	(1) Credit	(2) Credit	(3) AP	(4) AP	(5) DR	(6) DR
Zombie1	−0.003***		−0.001**		−0.001***	
	(−4.70)		(−2.25)		(−4.90)	
Zombie2		−0.008***		−0.006***		−0.002**
		(−3.38)		(−6.76)		(−1.97)
Size	−0.010***	−0.011***	−0.007***	−0.008***	−0.003***	−0.004***
	(−9.73)	(−8.78)	(−8.20)	(−8.07)	(−12.40)	(−12.01)
Cash	−0.030***	−0.029***	−0.038***	−0.037***	0.008***	0.008***
	(−6.81)	(−6.26)	(−28.10)	(−25.55)	(3.42)	(3.38)
ROA	0.081***	0.077***	0.032***	0.029***	0.044***	0.043***
	(6.79)	(7.31)	(6.09)	(6.20)	(12.14)	(13.58)
Lev	0.177***	0.178***	0.101***	0.103***	0.070***	0.070***
	(26.21)	(24.41)	(83.34)	(68.12)	(14.59)	(14.23)
Growth	0.002***	0.002***	0.001***	0.001***	0.001**	0.001**
	(2.87)	(2.93)	(4.17)	(4.31)	(2.44)	(2.48)
Frist	0.023***	0.022***	0.010**	0.010**	0.013***	0.013***
	(3.43)	(3.39)	(2.24)	(2.14)	(8.44)	(8.56)
Rela	−0.003***	−0.003***	−0.001	−0.001	−0.001**	−0.001**
	(−3.06)	(−3.09)	(−0.83)	(−0.82)	(−2.35)	(−2.37)
Dual	−0.005***	−0.005***	−0.003***	−0.003***	−0.001**	−0.001**
	(−6.64)	(−6.62)	(−5.40)	(−5.44)	(−2.49)	(−2.49)
Fa_r	−0.029***	−0.028***	0.005	0.005	−0.032***	−0.032***
	(−4.44)	(−4.50)	(1.13)	(1.28)	(−18.29)	(−19.27)
State	0.001	0.001	−0.003	−0.003	0.004***	0.004***
	(0.49)	(0.54)	(−1.17)	(−1.21)	(2.87)	(2.89)
Stime	0.001***	0.001***	0.001***	0.002***	−0.001***	−0.001***
	(3.52)	(3.75)	(9.14)	(9.08)	(−18.55)	(−15.19)
Ind_r	−0.002	−0.002	−0.013**	−0.013**	0.007**	0.007**
	(−0.37)	(−0.36)	(−2.08)	(−2.08)	(1.99)	(1.99)
Shrz	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***	−0.000***
	(−3.62)	(−3.76)	(−3.93)	(−4.18)	(−3.11)	(−3.13)
GDP	0.016**	0.014*	−0.003	−0.004	0.016**	0.016**
	(1.97)	(1.86)	(−0.59)	(−0.88)	(2.57)	(2.48)
Cons	0.277***	0.293***	0.190***	0.202***	0.090***	0.094***
	(14.14)	(12.51)	(11.26)	(10.81)	(17.06)	(17.97)
YEAR	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
IND	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
N	13,552	13,552	13,564	13,564	13,553	13,553
R^2	0.140	0.141	0.117	0.118	0.066	0.066
F	6785.127	4859.073	3516.099	2651.799	3676.668	4087.028
p	0.000	0.000	0.000	0.000	0.000	0.000

* Represents significance at the 10% level.
** Represents significance at the 5% level.
*** Represents significance at the 1% level.

variable at 10% in column (3) and 1% in column (4). This demonstrates that zombie enterprises have acquired relatively more long- and short-term bank loans than non-zombie loans. As a result of government endorsements of credit, companies that cannot even achieve normal operating profits have been able to obtain a greater amount of long- and short-term financing. In this light, it is not difficult to understand why zombie enterprises are "stiff but deathless" in China. The force behind this phenomenon is the purposeful support of government through direct government subsidies and indirect credit endorsements.

It is clear that zombie enterprises use more bank credit. However, do they also use more commercial credit? Table 7 shows the regression results. Here, we use three indicators as measures: *AP* is measured as the accounts payable over the total assets, *DR* is measured as the accounts receivable over the total assets and

Credit is measured as the sum of accounts payable and accounts receivable over the total assets. As we can see, the *Zombie1* and *Zombie2* variables are negatively correlated with all of the dependent variables, showing that the total amount of business credit, accounts payable and accounts receivable used in zombie enterprises is significantly less than that used in non-zombie enterprises. Commercial credit is based on one's ability to guar-

Table 8
Government subsidies and the productivity of zombie enterprises.

Variable	(1) TE	(2) TE
Zombie1	−0.001	
	(−1.24)	
Sub × Zombie1	0.038	
	(0.96)	
Zombie2		−0.004***
		(−2.78)
Sub × Zombie2		0.004
		(0.10)
Sub	−0.106***	−0.090***
	(−5.75)	(−4.12)
Size	−0.008***	−0.008***
	(−24.00)	(−24.24)
Cash	0.001	0.001
	(0.27)	(0.41)
ROA	0.043***	0.039***
	(6.63)	(6.05)
Lev	0.020***	0.020***
	(8.39)	(8.59)
Growth	0.001**	0.001**
	(2.38)	(2.37)
Frist	0.012***	0.012***
	(5.42)	(5.36)
Rela	−0.001**	−0.001**
	(−2.33)	(−2.33)
Dual	−0.000	−0.000
	(−0.31)	(−0.39)
Fa_r	−0.124***	−0.124***
	(−46.91)	(−46.76)
State	−0.001	−0.001
	(−1.24)	(−1.14)
Stime	0.000***	0.000***
	(3.82)	(4.25)
Ind_r	0.009*	0.009*
	(1.71)	(1.73)
Shrz	−0.000	−0.000
	(−0.10)	(−0.09)
GDP	−0.016**	−0.017**
	(−2.33)	(−2.45)
Cons	0.924***	0.926***
	(128.08)	(128.41)
YEAR	Controlled	Controlled
IND	Controlled	Controlled
N	13,524	13,524
LL	27241.834	27245.948
F	1261.130	1257.488
p	0.000	0.000

* Represents significance at the 10% level.
** Represents significance at the 5% level.
*** Represents significance at the 1% level.

antee a debt will be repaid, and zombie operations are in a difficult position. Zombie enterprises are seldom in a position to gain the trust of a transaction partner, and thus they can seldom take advantage of commercial credit. This reflects the counterclaim that the resources that support zombie companies' survival originate more from institutional support.

Table 9
Government subsidies and the value of zombie enterprises.

Variable	(1) L1. Roe	(2) L1. Roe	(3) L1. EVA	(4) L1. EVA
Zombie1	−0.000		0.001	
	(−0.04)		(0.23)	
Sub × Zombie1	−0.219***		−0.258***	
	(−2.99)		(−3.37)	
Zombie2		−0.052***		−0.097***
		(−14.24)		(−25.98)
Sub × Zombie2		−0.212***		−0.330***
		(−2.64)		(−4.03)
Sub	−0.176***	−0.136***	−0.392***	−0.278***
	(−4.02)	(−3.33)	(−8.48)	(−6.62)
Size	0.015***	0.014***	0.023***	0.020***
	(17.55)	(15.64)	(24.69)	(21.87)
Cash	−0.019***	−0.016**	−0.036***	−0.028***
	(−2.83)	(−2.30)	(−5.03)	(−4.03)
ROA	0.679***	0.628***	0.794***	0.699***
	(42.35)	(38.76)	(47.02)	(41.98)
Lev	−0.063***	−0.053***	−0.113***	−0.093***
	(−11.76)	(−9.88)	(−20.00)	(−16.92)
Growth	−0.003***	−0.003***	−0.001	−0.001
	(−4.14)	(−4.13)	(−1.38)	(−1.32)
Frist	0.013**	0.011*	0.015**	0.010
	(2.10)	(1.81)	(2.19)	(1.62)
Rela	0.002	0.002	−0.000	−0.000
	(0.90)	(0.99)	(−0.22)	(−0.15)
Dual	0.002	0.001	0.003	0.002
	(0.85)	(0.66)	(1.52)	(1.20)
Fa_r	−0.037***	−0.035***	−0.077***	−0.072***
	(−6.16)	(−5.79)	(−12.03)	(−11.66)
State	−0.008***	−0.007***	−0.013***	−0.010***
	(−4.15)	(−3.32)	(−6.04)	(−4.75)
Stime	−0.000***	−0.000	−0.001***	−0.000
	(−2.66)	(−0.69)	(−4.25)	(−0.82)
Ind_r	−0.019	−0.019	−0.018	−0.017
	(−1.34)	(−1.31)	(−1.19)	(−1.14)
Shrz	−0.000***	−0.000***	−0.000***	−0.000***
	(−3.57)	(−3.62)	(−5.11)	(−5.23)
GDP	0.069***	0.053**	0.187***	0.159***
	(3.05)	(2.37)	(7.89)	(6.92)
Cons	−0.293***	−0.255***	−0.497***	−0.429***
	(−14.97)	(−13.09)	(−24.15)	(−21.43)
YEAR	Controlled	Controlled	Controlled	Controlled
IND	Controlled	Controlled	Controlled	Controlled
N	12,419	12,419	12,472	12,472
R^2	0.257	0.273	0.344	0.389
F	101.799	110.486	155.493	83.862
P	0.000	0.000	0.000	0.000

* Represents significance at the 10% level.
** Represents significance at the 5% level.
*** Represents significance at the 1% level.

5.2. Government subsidies and the productivity of zombie enterprises

Under normal circumstances, government subsidies significantly enhance an enterprise's growth and ability to innovate (Wei et al., 2015) because they improve productivity. However, in the case of zombie enterprises, operating conditions are poor. As such, do government subsidies effectively enhancing the productivity of these enterprises? We explore this issue here. In Table 8, *TE* is an alternative variable for enterprise productivity, computed using the data envelopment analysis (DEA) method. Research shows that the DEA method is a good way of measuring the relative efficiency of decision-making units with multiple inputs and outputs. It is a nonparametric estimation method, suitable for the efficient estimation of multiple output indices (Chu et al., 2015). Following previous studies, we choose fixed asset investments and intangible asset investments as the increments for the input index of the DEA model. The total asset growth rate, the net asset yield and Tobin's Q values are selected for the output index to measure the productive efficiency of the enterprises (Wang and Yang, 2010). In the calculation process, the following formula is used to nondimensionalize the input and output indices.

$$X_i = 0.1 + 0.9\frac{x_i - xMin}{xMax - xMin},$$

where x_i is the original input or output data and $xMin$ and $xMax$ are the minimum and maximum values of the original data. As according to the DEA method, the enterprise productivity index ranges from 0 to 1, which is truncated data, we use a TOBIT regression to investigate the effect of government subsidies on the productivity of zombie enterprises. The regression results given in Table 8 shows that both the *Zombie1* and *Zombie2* variables are negatively correlated with enterprise productivity performance, and the significance level in column (2) is 1%. This shows that the overall productivity of zombie enterprises is relatively lower than that of non-zombie enterprises. The interaction terms for the zombie variables (*Zombie1* and *Zombie2*) and the government subsidy variable (*Sub*) in columns (1) and (2) are statistically insignificant. This indicates that the government subsidies obtained by zombie enterprises do not play a role in improving their productivity.

5.3. Government subsidies and the value of zombie enterprises

The reason and logic underlying the tenacity of zombie enterprises is revealed above, including their overt acceptance of government subsidies. Yet, the supply of external resources does not improve productivity. Given the lack of a zombie enterprise's capacity to sustain healthy operations, we further expect that government subsidies serve only to sustain the survival of the enterprise, not improve its value. To test this assertion, we follow previous studies (Li et al., 2015) and select *ROE* as the measure of enterprise value. *ROE* takes into account that economic value added (*EVA*) is an important standard for assessing the value of an enterprise (Guo and Cui, 2004). It has been recognized by State-owned Assets Supervision and Administration Commission and is widely promoted in the enterprise (Li, 2016). We further choose the proportion of EVA in assets as the measure of enterprise value in our analysis of the impact of government subsidies on the value of zombie enterprises. As the transformation of government subsidies into enterprise value may take some time, we use a data lag of one year as the dependent variable. The regression results are shown in Table 9. The data in columns (2) and (4) show that *Zombie2* is negatively correlated with both one year of lagged *ROE* and one year of lagged *EVA* at a significance level of 1%, which suggests that the future value of zombie enterprises is significantly lower than that of non-zombie enterprises. Further analysis of the interaction terms in the table demonstrates that all of the interaction terms are negative at a significance level of 1%. This suggests that, compared with non-zombie companies, government subsidies to zombie companies reduce their future value, proving the preceding inference. Timely "blood transfusions" by the government to ensure the survival of zombie enterprises are useless for boosting their corporate value.

6. Conclusions

With the end of China's 30-year period of rapid economic growth, the call for economic restructuring and industrial upgrading is becoming louder. The reality of the decline in economic growth provides an opportu-

nity to adjust the capacity of enterprises and to promote a clearing out of the market. In this process, dealing with zombie enterprises has become a focus for government action. At the opening ceremony of the fourth session of the 12th National People's Congress, Premier, Li Keqiang presented a government work report, highlighting the need for the "active and safe disposal of zombie enterprises." The persistence of zombie enterprises not only occupies precious resources, but also causes financing problems for other enterprises and lowers the production efficiency of the whole industry. Perhaps more importantly, zombie enterprises are highly resistant to losses, and their voracious appetite for resources may endanger enterprises that are highly efficient but have a poor ability to withstand lean times. Any prescription for dealing with the zombie enterprise disease that can produce good results requires a clear understanding of the reasons behind their stiff but deathless existence.

In this study, we use data from China's Shanghai and Shenzhen A-share listed companies to examine why zombie enterprises are "stiff but deathless." The results of our analysis show that zombie enterprises exist as a direct result of the resources and credit endorsements they receive from the government. Government subsidies and bank loans serve as the main forms of sustenance for these enterprises, and the companies that offer a greater number of jobs receive more government subsidies. Further research shows that the property rights of the enterprise do not affect the level of these "blood transfusions"; whether an enterprise is state-owned or non-state-owned has no influence on the level of subsidies they receive. Additionally, government support fails to increase the enterprise's operating efficiency or value. This study frames the persistence of these "stiff but deathless" zombie enterprises from the perspective of resource rationing. The potential logic behind this phenomenon is further explored through the eyes of local government officials seeking to maintain employment stability as a means of meeting job performance criteria that will ensure their future promotion. Our research demonstrates that cleaning up zombie enterprises is a necessary and urgent task.

References

Antia, M., Kim, I., Pantzalis, C., 2013. Political geography and corporate political strategy. J. Corpor. Financ. 22 (3), 361–374.

Caballero, R.J., Hoshi, T., Kashyap, A.K., 2008. Zombie lending and depressed restructuring in Japan. Am. Econ. Rev. 98 (5), 1943–1977.

Chen, Q., 2015. Where is the way out for zombie enterprise? New Financ. 12, 32–35 (in Chinese).

Chen, X., Li, J., 2001. Exploring the role of local government fiscal support in accounting performance of listed companies. Acc. Res. 12, 20–28 (in Chinese).

Chen, X.Q., Qu, Z.X., 2012. An analysis of the current situation and strategies on philanthropy of the rich in China: Based on the perspective of social exchange theory. Comparat. Econ. Soc. Syst. 1, 154–164 (in Chinese).

Cheng, H., Hu, D.Z., 2016. The mystery of zombies: An empirical study from a microscopic perspective: Evidence from China employer employee survey (CEES). J. Macro-quality Res. 4 (1), 7–25 (in Chinese).

Chu, D.Y., Han, Y.D., Zhang, T.B., 2015. Fiscal decentralization, public sector efficiency and the supply of medical and health services. J. Financ. Econ. 41 (5), 28–41 (in Chinese).

Du, Y., Yan, B., Zhang, H., Bu, D.L., 2015. Charitable donations, government grants and performance of loss reversal: Based on empirical evidence from loss listed corporations in China. Econ. Sci. 4, 81–94 (in Chinese).

Fukuda, S., Nakamura, J.I., 2011. Why did "zombie" firms recover in Japan? World Econ. 34 (7), 1124–1137.

Giannetti, M., Simonov, A., 2013. On the real effects of bank bailouts: Micro-evidence from Japan. Am. Econ. J.: Macroecon. 5 (1), 135–167.

Guo, J.H., Cui, W.J., 2004. The explanatory of EVA on firm value: A comparative study. Contemporary Financ. Econ. 5, 123–126 (in Chinese).

Han, W.L., Huang, C., Xie, L., 2016. Induced investment, forced competition and excess capacity. Soc. Sci. Res. 4, 25–33 (in Chinese).

Homans, G.C., 1958. Social behavior as exchange. Am. J. Sociol. 63 (6), 597–606.

Hou, J.S., 2006. A course in Western Sociology. Nankai University Press, Tianjin (in Chinese).

Kane, E.J., 1987. Dangers of capital forbearance: the case of the FSLIC and "zombie" S&Ls. Contemp. Econ. Policy 5 (1), 77–83.

Kawai, M., Morgan, P., 2013. Banking crises and 'Japanization': Origins and implications. SSRN Working Paper.

Kong, D.M., Liu, S.S., Wang, Y.N., 2013. Market competition, ownership and government subsidy. Econ. Res. J. 2, 55–67 (in Chinese).

Li, J.J., Wang, F.S., Xu, C., 2015. The impact of PE characteristics on the invested firm value: empirical evidence from 2008–2012 IPO companies. Nankai Bus. Rev. 18 (5), 151–160 (in Chinese).

Li, W.J., Cheng, M.Y., Huang, Q.Y., 2012. Local government competition, corporate listing approaches, interest transfer between governments and firms: evidence from family listed companies in China. J. Financ. Econ. 9, 27–36 (in Chinese).

Li, X.N., 2016. Research on enterprise value management system based on EVA. Manage. World 8, 182–183 (in Chinese).

Lian, J., Liu, X., Yang, J.Y., 2011. Political connections, bank loans and firm value. Nankai Bus. Rev. 14 (5), 48–57 (in Chinese).

Lin, Y., Srinivasan, A., Yamada, T., 2015. The effect of government bank lending: Evidence from the financial crisis in Japan. SSRN Working Paper.

Liu, K.F., Mao, N., 2016. A foreign literature review of zombie companies research. Foreign Econ. Manage. 38 (10), 3–19 (in Chinese).
Liu, X.Y., Lin, S., 2013. Impact of local government behavior on technological innovation of start-up enterprises. R&D Manage. 25 (5), 12–25 (in Chinese).
Lu, Z.Y., Zheng, Z.W., 2016. Logical starting point, constraint and path selection about the new growth point of consumption under the New Normal of Economy. Inquiry into Econ. Issues 1, 1–6 (in Chinese).
Porta, R.L., Lopez-De-Silanes, F., Shleifer, A., 2002. Government ownership of banks. J. Financ. 57 (1), 265–301.
Rosenstein-Rodan, P.N., 1943. The problems of industrialization of eastern and south-eastern Europe. Econ. J. 53 (210–211), 202–211.
Sheng, X.H., 2015. An empirical test on government subsidy, property characteristic and the effect of debt financing. Econ. Survey 2, 138–143 (in Chinese).
Sun, D.C., 2011. Fiscal decentralization, political centralization and economic growth in China: The role of local extra-budget funds expansion. J. Soc. Sci. 4, 34–42 (in Chinese).
Wang, H.J., Li, Q.Y., Liu, F., 2015. Government subsidies: Relief for the emergency or the poor? An empirical evidence from loss-making firms. Nankai Bus. Rev. 5, 42–53 (in Chinese).
Wang, J.Q., Yang, J.J., 2010. Investment efficiency evaluation based on DEA model. Sci. Res. Manage. 4, 73–80 (in Chinese).
Wei, Z.H., Wu, Y.H., Zeng, A.M., 2015. Rent-seeking, fiscal subsidies and corporate growth. Econ. Manage. J. 37 (1), 1–11 (in Chinese).
Xu, G.Y., Shi, Y., Yang, D.W., 2014. Research on the incentive effect of the government R&D subsidy policy. Soft Sci. 9, 30–34 (in Chinese).
Xue, Y.K., Bai, Y.X., 2008. State ownership, excess employees and companies' performance. Manage. World 10, 96–105 (in Chinese).
Yao, Y., Zhang, M.Y., 2013. Performance of officials and the promotion tournament. Econ. Res. J. 1, 137–150 (in Chinese).
Zeng, Q.S., Chen, X.Y., 2006. State stockholder, excessive employment and labor cost. Econ. Res. J. 5, 74–86 (in Chinese).
Zhang, M., Wang, C.F., Liu, H.L., 2013. Redundancy burden and executive incentive of state-owned enterprises. J. Financ. Res. 5, 140–151 (in Chinese).
Zhang, P., Wu, J.N., 2017. Government intervention, resource curse and regional innovation: An empirical research based on the provincial panel data from Mainland China. Sci. Res. Manage. 38 (1), 62–69 (in Chinese).
Zhang, P., Zhao, G.C., Luo, Z., 2012. Sources of central officials and local economic growth. China Econ. Quart. 2, 613–634 (in Chinese).
Zheng, A.M., Li, Z., 2015. Social burden of private listed corporation, financial constraints and cash holding ability. Syst. Eng. 8, 117–122 (in Chinese).
Zheng, J., 2016. Environmental regulation competition and industrial structure adjustment from the perspective of decentralization. Modern Econ. Sci. 1, 77–85 (in Chinese).
Zheng, W., Luo, D.L., 2015. Employment, social objectives and capital resource allocation. Quart. J. Financ. 9 (1), 51–81 (in Chinese).
Zhu, H., He, F., 2016. Quantity and characteristics of zombie firms in China. J. Beijing Technol. Bus. Univ. 31 (4), 116–126 (in Chinese).

China Journal of Accounting Research 10 (2017) 359–378

HOSTED BY

Contents lists available at ScienceDirect

China Journal of Accounting Research

journal homepage: www.elsevier.com/locate/cjar

How does smog affect firms' investment behavior? A natural experiment based on a sudden surge in the PM2.5 index

Jingbo Luo

School of Accountancy, Jiangxi University of Finance and Economics, China

ARTICLE INFO

Article history:
Received 31 May 2015
Accepted 30 September 2017
Available online 2 November 2017

Keywords:
Smog
Investment expenditure
Investment opportunity sensitivity
Environment supervision
Property right

ABSTRACT

This study examines the effect of environmental regulations on the investment behavior of high-polluting enterprises. Our data are from A-share listed firms in China from 2006 to 2014. We use a sudden surge in the PM2.5 index as an exogenous event to conduct a natural experiment. We find that after the event with a series of regulatory policies introduced, investment expenditure declines significantly in local state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs), whereas investment opportunity declines significantly in non-SOEs compared with SOEs. However, there are no significant changes in central SOEs' investment expenditure and investment opportunity. Further analysis shows that investment expenditure and investment opportunity decline for high-polluting enterprises located in East China but increase for those located in West China. Our study is the first to investigate the effect of smog on enterprises' investment behavior. Our findings reveal that environmental regulation has influence on the investment behavior of enterprises with different property rights and regional differences.

1. Introduction

The relationship between economic growth and environmental quality has been a major discussion topic for both scholars and the public. China's rapid economic growth has given rise to many environmental pollution problems, and the resulting environmental degradation has become a threat to the Chinese economy. Recent increases in smog and PM2.5 concentrations have also drawn the attention of the Chinese scholars on

E-mail address: gaintheend@163.com

https://doi.org/10.1016/j.cjar.2017.09.001
1755-3091/

environment and corporate behaviors. As the sudden surge in the PM2.5 index at the end of 2011 is of particular importance, we hereafter use the term "2011 event" to refer to it.

Ecological environment and environmental pollution are the most important factors that influence China's sustainable economic development and living environment (Tian and Cheng, 2014). China's Ministry of Environmental Protection and provinces with severe smog problems adopted strict environmental regulations after the 2011 event. The new National Ambient Air Quality Standard and the relevant governance regulations put the operational and investment behavior of high-polluting enterprises under close monitoring. The State Council of China released the "Action plan on air pollution control on 12 September 2013" with the implication that air pollution governance has ushered in new demand and a source of external pressure on the transformation of economic development pattern. The plan sets out the specific responsibilities of the government, enterprises and society and has caused the approval of key projects in underdeveloped regions to be suspended. However, there is no evidence that the strengthening of environmental regulations after the 2011 event has had any effect on enterprises' financial behavior.

China is the world's largest developing country. In the course of its modernization and industrialization, it has inevitably faced tension between economic growth and environmental quality. Pollution abatement may impose additional pollution treatment costs, thus reducing the productivity and market competitiveness of enterprises (Jorgenson and Wilcoxen, 1990). Gray (1987) finds that U.S. Occupational Safety and Health Administration and Environmental Protection Agency regulations reduced productivity growth in the manufacturing industry by an average of 0.44 percentage point per year, accounting for over 30 percent of the slowdown in the 1970s. Consistent with Gray (1987), other studies draw similar conclusions based on sub-manufacturing industries such as paper-making, mining, oil and steel (Gollop and Roberts, 1983; Barbera and McConnell, 1990; Gray and Shadbegian, 1995). Grimaud and Rouge (2008) argue that environmental regulation is similar to an environmental tax on non-renewable resources. Although it can slow the emission of pollutants and improve resource allocation, it has no effect on R&D or innovations in abatement technology. In contrast, Porter and Van Der Linde (1995) find that properly designed environmental standards can trigger innovation that may partially or more than fully offset the costs of complying with them and that strict environmental regulations can actually enhance competitiveness. Palmer et al. (1995), however, hold an opposing view that strict environmental regulations can bring much more cost less than the benefit. Berman and Bui (2011) examine the effect of air quality regulations on productivity in some of the most heavily regulated manufacturing plants in the United States. They study the oil refineries of the Los Angeles (South Coast) Air Basin and find that despite the high costs associated with the local regulations, productivity rose sharply between 1987 and 1992. As the years between 1987 and 1992 were a period of decreased refinery productivity in other regions, the authors conclude that abatement cost measures may grossly overstate the economic cost of environmental regulations because such measures can increase productivity. This paper uses different data, such as Mexican offshore oil and gas industry, Japanese manufacturing, Quebec (Canada) manufacturing and Taiwan industry data, and draws similar conclusions. Obviously, the literature has not yet reached a consensus about the effects of environmental regulations on enterprises, and neither does it provide evidence of or an explanation for the micro mechanism of air pollution and enterprises' investment behavior.

With improving living standards and increasing environmental awareness, protection of the environment is now widely considered a stable and influential social norm (Green, 2006). The 3rd plenary session of the 18th Communist Party of China Central Committee proposed the establishment of a comprehensive ecological civilization system to protect the ecological environment. This provides us with an opportunity to analyze the effect of strict environmental regulations on enterprises' investment behavior and the underlying mechanism that brings about this effect; thus, this study has strong theoretical value and policy implications.

We use the difference-in-differences method to investigate the effect of government environmental regulations on high-polluting enterprises' investment behavior (investment expenditure and investment opportunity sensitivity) based on Chinese A-share listed firms from 2006 to 2014 and examine whether the effect varies across property rights, enterprise locations and high-polluting enterprises. We find that after the 2011 event, investment expenditure declined significantly in both local SOEs and non-SOEs, whereas investment opportunity sensitivity declined more significantly in non-SOEs than in SOEs. There are no significant changes in central SOEs in terms of investment expenditure and investment opportunity sensitivity. Further analysis shows that investment expenditure and investment opportunity sensitivity decline for high-polluting

enterprises located in East China but increase for those located in West China. Findings reveal that there exist SOE/non-SOE discrimination and regional differences in the implementation of environmental regulations. The findings also demonstrate that environmental supervision in China has caused polluting enterprises to move to "lower pressure" areas.

This study contributes to the literature in the following ways. First, we take the 2011 event as a natural experiment and use the difference-in-differences method to investigate the effect of government environment regulations on high-polluting enterprises' investment behavior. This effectively reduces the interference of endogenous problems. Second, it analyzes the effect of environmental regulations on specific firms from the perspective of the institutional environment and reveals that heavy polluting corporations located in areas with strict supervision have moved to areas with looser supervision. Third, unlike the previous studies, this study reveals the dynamic effects of environmental regulation on the investment behavior of enterprises with different property rights. The findings can be used to design future regulations on high-polluting enterprises to reduce the chance of another surge in the PM2.5 index. Finally, this study complements the literature on the effects of government environmental regulations on micro-enterprises' financial decisions.

The remainder of this paper is organized as follows. In the next section, we provide an overview of the related literature and propose the hypotheses. Section 3 describes the research design, and Section 4 presents the analysis of the empirical results. Sections 5 and 6 provide further analyses and robustness tests, and Section 7 concludes the paper.

2. Literature review and hypothesis development

2.1. Surge in the PM2.5 index and enterprises' investment expenditure

After inspecting Beijing's air pollution governance performance in February 2014, the President of the People's Republic of China, Xi Jinping, proposed that controlling PM2.5 was the primary task for dealing with smog and improving air quality. Severe smog had appeared around Beijing and North China in autumn 2011. The resulting air pollution and low visibility had caused the closures of many highways and the cancellations of many flights. This caused a great deal of public concern and many complaints. As the air pollution became more severe, attention turned to PM2.5, the key index of smog severity. When PM2.5 suddenly exceeded the threshold of the detecting instrument, 500 $\mu g/m^3$, the public panicked. China's environmental pollution problem, especially the severe pollution in Beijing–Tianjin–Hebei, then attracted worldwide attention. PM2.5 includes all particulate matter in the air with an aerodynamic diameter of 2.5 μm or smaller, including toxic heavy metals and hazardous organic pollutants that are not present in normal air. This particulate matter can be inhaled directly into the lungs, causing severe harm to human health. The main sources of PM2.5 include fuel combustion from automobiles, power plants, wood burning, industrial processes and diesel-powered vehicles. To reduce social panic, the government introduced a series of regulatory policies. For example, the State Council issued a new "National Ambient Air Quality Standard" in 2012, in which PM2.5 was officially added to the general evaluation items, and issued an "Action Plan on Prevention and Control of Air Pollution" that introduced 10 measures to improve air quality in September 2013. The plan required the establishment of a regional coordination mechanism and arrangements for regional environmental treatment. Beijing–Tianjin–Hebei and the Yangtze River Delta established a regional coordination mechanism for air pollution control. The State Council signed target responsibility letters with all the provincial governments, conducted annual examinations and strictly enforced the accountability system. On 25 April 2015, the Chinese Communist Party (CCP) Central Committee and the State Council formally announced the publication of "Opinions on Accelerating Ecological Civil Construction," which set out clear requirements and guidance to accelerate ecological civil construction and divided the relevant provinces into nine areas to synergize efforts toward healthy economic growth and sustainable environmental protection. This elevated governance strategies for pollution such as smog to the national level.

We believe that understanding how to guide the operational and investment behavior of high-polluting enterprises is key to the successful implementation of pollution regulations. Allen et al. (2005) show that the completeness of China's shareholder protection law falls between that of the English-origin countries and that of the French-origin countries. The former have the highest protection measures, whereas the latter

have the poorest. However, China's enforcement of the law is nearly as weak as in the world's poorest countries. Engau and Hoffmann (2011) show that in response to post-Kyoto regulatory uncertainty, firms have predominantly pursued reduction, and to a lesser extent adaptation, regardless of their investment strategies. While Xiong and Xu (2007) find that the relaxed environmental regulation has a positive effect on attracting foreign direct investment, the lack of regulation is likely to attract high-polluting industries. Heavy pollution has a significant crowding-out effect on foreign direct investment, but the effect is not significant in low-pollution areas. The recurrent protests against PX projects are related to the p-xylene chemical, a petroleum chemical. It is a colorless transparent liquid, the smell of which is similar to that of toluene. If heavy pollution projects cannot be effectively controlled, strong dissatisfaction with the government's environmental regulations will result. Strengthening environmental regulations may either have an inhibiting effect on the investment expenditure of high-polluting enterprises or increase these enterprises' uncertainty about their future, leading them to postpone their investments (Viscusi, 1983).

Heavy pollution also has significant implications for the capital market. Excessive emissions from high-polluting enterprises lead to PM2.5 surges and violate basic social norms and requirements. These enterprises are then at the center of public attention. Following the 2011 event, high-polluting enterprises have had to take action in response to queries from the media and the public. Hong and Kacperczyk (2009) provide evidence of the significant effects of social norms on markets by studying the investing environment of "sin" stocks—publicly traded companies involved in the production of alcohol, tobacco and gambling. They find that sin stocks are less likely to be held by norm-constrained institutions such as pension plans than by mutual or hedge funds that are natural arbitrageurs, and they receive less coverage from analysts than do other stocks with comparable characteristics. If high-polluting enterprises have low levels of compliance to social norms, institutional investors will withdraw their investments (Li and Yifeng, 2011). At the same time, institutional investors in high-polluting enterprises "vote with their feet" by reducing their investments in polluting projects to impose pressure on managers. Chava (2014) finds that investors demand significantly higher expected returns on stocks excluded by environmental pollution (such as hazardous chemicals, substantial emissions and climate change concern) than firms without such environmental concerns. Lenders also charge significantly higher interest rates on bank loans issued to firms with such environmental concerns. Meanwhile, firms' environmental risk exposure is associated with lower accuracy and higher dispersion in analysts' earnings forecasts, and analysts are more likely to revise their stock recommendations downward if firms experience an increase in their environmental risk exposure, and the inverse is also true (De Franco et al., 2013). These firms are charged higher audit fees (Simunic et al., 2014). Furthermore, firms that violate environmental protection regulations or have environmental accidents have lower market value (Lundgren and Olsson, 2010; Dasgupta et al., 2006). Darnall et al. (2007) find that strict environmental regulation is negatively correlated with firm performance. Firms that face strict regulation pay more when environmental accidents occur, and their operational costs increase, thus lowering investment incentives. With so many obstacles for high-polluting enterprises at the refinancing step and the strengthening of regulations following the 2011 event, high-polluting enterprises have to reduce their investment expenditure. We thus propose the following hypothesis:

H1a. Ceteris paribus, government environmental regulations have effectively restrained the investment expenditure of high-polluting enterprises following the 2011 event.

Although high-polluting enterprises have been influenced by the 2011 event, such influences vary across types of property rights. The operating environments and operating goals are quite different in SOEs and non-SOEs. In 2007, the China Banking Regulatory Commission issued a notification (No. 161) requiring financial institutions to supervise loan origination for high-polluting industries. This requirement seems to have had little effect on SOEs with bank loan advantages and loose budget constraints. Some SOEs may take a flexible or passive approach to environmental regulations by claiming that their products support the national security strategy. Despite resistance from institutional investors and medium and small investors, it is extremely difficult to prevent SOE managers from investing in projects that cause heavy pollution under the strong incentive of promotion championship. To maintain a competitive advantage, local governments typically lower environmental standards to attract foreign direct investment (Ljungwall and Linde-Rahr, 2005). Thus, as long as governments at all levels continue to prioritize GDP and given that environmental pollution is not a one-ballot veto, environmental protection cannot entirely reorganize the pollution industry.

In contrast, high-polluting non-SOEs will reduce their investments in projects that cause heavy pollution because these firms are under the implicit control of institutional investors who can "vote with their feet." This may help protect the environment and increase public satisfaction, and it may offset the temporary decline in economic performance. During the process of implementation, local governments might provide certain protection for SOEs out of vested interests because SOEs are important in achieving local GDP goals. For example, the Central Environmental Protection Inspectorate openly affirmed the supervision opinions of Hebei province on 3 May 2016: Tangshan Iron Company, a branch of the largest SOE in Hebei province (Hebei Steel Group), increased its steel production capacity, which violated the "Guidance on resolving contradiction severe overcapacity" issued by the State Council.[1] This case illustrates that continual environmental pollution is closely associated with the failure of some SOEs to meet their environmental responsibilities. The above analysis shows that the strengthening of environmental regulations as a result of the 2011 event implies that high-polluting non-SOE enterprises are the most influential. Thus, we propose the second hypothesis:

H1b. Ceteris paribus, non-SOEs' reduction in investment expenditure is greater than that of SOEs after the 2011 event.

2.2. The surge in the PM2.5 index and enterprises' investment opportunity sensitivity

Classic corporate governance theory assumes that agency conflict is the key factor that influences corporate investment efficiency, but the theory may not work in China during the transitional economy phase. If there is a close association between pollution governance and government officials' promotion, officials will focus their efforts on strengthening the supervision of high-polluting enterprises and adopt the carrot and stick policy to make polluting enterprises rely on them to prevent heavy pollution.

How the PM2.5 index can be decreased and how the occurrence frequency of the PM2.5 surge can be reduced are important environmental and social problems. First, as the Chinese government has tight control over enterprises and the economy, the government may simultaneously use the grabbing hand and the helping hand to ensure effective policy implementation. Chen et al. (2010) find that the Chinese government often intervenes in enterprises' investment decisions by way of property rights or political connections for political or social purposes, which distorts investment behavior and reduces investment opportunity sensitivity. As government intervention might distort enterprises' investment decisions, enterprises' high-polluting investment projects that caused the 2011 event must be strictly supervised. For instance, the government may approve fewer projects and reduce bank loan origination. This may further reduce the value of future profitable projects. However, if high-polluting enterprises make huge investments in governance to reduce PM2.5 emissions, it will reduce their profits and investment opportunities.

Xu and Xiao (2011) argue that environmental regulations enhance the environmental policy risk of high-polluting enterprises and that environmental regulations increase the information asymmetry between projects and the capital market and decrease investment efficiency. La Porta et al. (1999) find that a "game" exists between the government and enterprises—that is, a tacit exchange of interests between the government and enterprises: politicians use certain means (subsidies or bribes) to attract entrepreneurs to comply with political goals. Public subsidies are the key equilibrium between the government and enterprises when the government wants to exchange its resources with high-polluting enterprises to reduce PM2.5 emissions. The government often requires high-polluting enterprises to disclose more environmental information with the use of public subsidies (Lin et al., 2015). This increases the supervision of these specific firms' investment projects and further reduces the value of the projects. The government's aim is to guide high-polluting enterprises to implement industry upgrades and technology innovations and to gradually eliminate or close high PM2.5 emissions projects in the hope of significantly reducing investment in heavily polluting projects. In addition, although high-polluting enterprises play a key role in the PM2.5 index's sudden surge, they still pursue corporate value maximization like other industries do. As long as there is demand for the products, the optimal choice is to enlarge the operational scale and increase investment in projects. Environmental regulations

[1] http://finance.ifeng.com/a/20160503/14360248_0.shtml.

distort firms' optimal investment decisions, leading to inefficient investment, fewer future investment opportunities and a mismatch between intrinsic investment expectation and investment opportunity. Therefore, we propose the following hypothesis:

H2a. Ceteris paribus, governmental environmental regulations effectively reduced the investment opportunity sensitivity of high-polluting enterprises after the 2011 event.

To explore the underlying reasons for the sudden surge in the PM2.5 index, we should not only analyze the high-polluting enterprises but also the environmental regulation background and its effect on enterprises. The goal of emission reduction set out in the 11th Five-Year Plan period was achieved, and the central government extended the goal in the 12th Five-Year Plan, in which a strictly binding policy seems to be the key to reversing the deterioration of the ecological environment. However, these rules have had little effect on emission reduction. This shows that we need a deeper exploration of the underlying institutional factors to resolve PM2.5 pollution.

The central idea behind China's environmental governance is to control overall pollution and to allow specific entities to assume the corresponding responsibilities. In reality, administrative approval for investment in heavy-polluting industry is scarce because resource capacity is limited. This results in an interesting "game" between the government and the enterprises, where the distribution of emission-reducing tasks in a certain area is the key point. SOEs assume greater social responsibilities, and their investment behavior directly influences the performance of local officials, yet these SOEs are given fewer emission-reducing tasks and may even face competition for new investment projects. Consequently, SOEs may still have certain investment opportunities under the strict environment regulations. Using data from the Wind and CCER databases, we find that state-owned and state-holding enterprises account for 70 percent of A-share listed firms in China and that nearly half of state-owned-capital industries are high-polluting. The Ministry of Environmental Protection announced penalties for "environment-violating" enterprises on its website. The list includes some central SOEs, such as the State Electric Power Corporation, Petro China and Datang Power. This implies that SOEs' investment in heavy-polluting projects is less influenced by the government's PM2.5 environment regulations than is investment by local SOEs and non-SOEs. Bardhan and Mookherjee (2005, 2006) point out that local governments are more likely than the central government to be trapped by enterprises and that this exacerbates the degree of environmental pollution. Consistent with this argument, Wang et al. (2003) find that firms from the private sector appear to have less bargaining power than state-owned enterprises and that the greater the social impact of a firm's emissions, the less bargaining power the firm has with local environmental authorities. Under such circumstances, non-SOEs are under pressure from public opinion and credit rationing and will not spend their own money on heavy-polluting projects, leading to a lowering of investment opportunity sensitivity. Thomas and Brown (1995) hold the opinion that environmental regulation may prevent new entrants to the industry, and incumbents may thus become monopolists. Although social cost is increased by a monopoly, the scale of investment in high-polluting industries is decreased. The National Development and Reform Commission and the Ministry of Environmental Protection set more industry restrictions on non-SOEs (including heavy pollution industry) than on SOEs. This further reduces non-SOEs' chances of participating in heavy-polluting industry and projects. We propose the following hypothesis:

H2b. Ceteris paribus, non-SOEs' investment opportunity sensitivity reduction was greater than that of SOEs' after the 2011 event.

3. Research design

3.1. Sample selection

We select Chinese A-share listed firms from 2006 to 2014 as our initial sample. We then refine this initial sample by removing some irrelevant data from it. The irrelevant data that we removed from our initial sample are the firms that meet the following criteria: (1) Particular Transfer and Special Treatment firms; (2) financial industry firms; (3) firms with leverage greater than 1 or less than 0; (4) B share or H share firms; (5) delisted firms; (6) firms initially listed in the current year; and (7) firms with missing data. Property rights data are

taken from the CCER database. Financial and corporate governance data are from the CSMAR database, and the classification of high-polluting industries is taken from the Wind database and compared with the CSRC (2011) industry classification.

3.2. Variable definitions

3.2.1. Explanatory variables

High-polluting enterprises. Following Li and Yifeng (2011), we classify firms as high-polluting if they belong to one of the following 14 industries in the "Industry Classification of Environmental Protection Management in Listed Companies" published by the Ministry of Environmental Protection in 2008: thermal power, steel, cement, electrolytic aluminum, mining, metallurgy, building materials, coal, chemistry, petrochemical, pharmacy, light industry, spinning and leather. When the Ministry of Environmental Protection issued the "Emission Standard for Air Pollutants" in 2011, they considered thermal power, steel, petrochemical, nonferrous metals, chemistry industry and coal-fired boiler projects as the major monitoring areas. As the Ministry of Environmental Protection's list is more comprehensive, we classify firms that belong to one of the 14 industries as high-polluting; high-polluting firms belonging to these 14 industries are assigned a value of 1, and all other firms are assigned 0.

Investment opportunity. Following Chen et al. (2011), we use Tobin's Q to proxy investment opportunity, which reflects the growth and relative value-added potential. The greater the investment opportunity is, the higher the investment expenditure and investment efficiency are (Fazzaris et al., 1988). However, the use of Tobin's Q for China is questioned, mainly because of the capital market efficiency and the reform of non-tradable shares there. After the 2005 reform, the value relevance of stock improved and capital market efficiency increased (Liu et al., 2010). We therefore use the variable measure method in this paper.

3.2.2. Dependent variable

We measure investment expenditure as "cash paid to acquire fixed assets, intangible assets and other long-term assets" from firms' cash flow statements, scaled by total assets.

3.2.3. Control variables

Following Chen et al. (2011), Fazzaris et al. (1988), Akdogu and MacKay (2008) and Mclean et al. (2012), we control firm age (*Age*), sales growth (*Salgrow*), fixed asset proportion (*Fixas*), proportion of shares held by the largest shareholder (*Hold1*), firm size (*Size*), leverage (*Lev*) and profitability (*Roe*).

Table 1 presents the variables' definitions.

3.3. Regression model

We construct Model (1) to test hypotheses 1a and 1b. Following Mayer (1995), Bertrand and Mullainathan (2004), Liu and Liu (2015) and Yuan and Zuo (2011), the basic regression model is based on the difference-in-differences method, which is used to examine the net effect of policy implementation. We compare in detail the difference between the treatment group and control group before and after policy implementation. We divide the enterprises in our refined sample into two parts: high-polluting enterprises and non-high-polluting enterprises. We also use the 2011 event as a watershed event that defines the pre-2011 event period and the post-2011 event period. The treatment group includes the high-polluting enterprises from the 14 industries that we identified in the previous section (*Dumpollute*); these industries take a value of 1, whereas all other industries take a value of 0; observations before 2011 (Dum11) equal 1 and 0 otherwise.

$$Invest = \alpha_0 + \alpha_1 * Dumpollute + \alpha_2 * Dum11 + \alpha_3 * Dumpollute * Dum11 + \mu_{i,t} \quad (1)$$

In the control group ($Dumpollute = 0$), the investment expenditures before ($Dum11 = 0$) and after 2011 ($Dum11 = 1$) are denoted by $Invest = \alpha_0 + \mu_{i,t}$ and $Invest = \alpha_0 + \alpha_2 + \mu_{i,t}$, respectively, so the difference in the control group before and after 2011 is α_2. In the treatment group ($Dumpollute = 1$), the investment

Table 1
Variable definitions.

Variable	Definition
Invest	Investment expenditure. Measured as "cash paid to acquire fixed assets, intangible assets and other long-term assets" from firms' cash flow statements, scaled by total assets
Dumpollute	Dummy variable. Firms that are listed in the "Industry classification of environmental protection management in listed companies" as thermal power, steel, cement, electrolytic aluminum, mining, metallurgy, building materials, coal, chemistry, petrochemical, pharmacy, light industry, spinning and leather industries, or whose prime business matches the listed industry, take a value of 1 and 0 otherwise
Dum11	Dummy variable. If the observation belongs to 2011–2014, which is after the 2011 event, it takes a value of 1 and 0 otherwise[a]
Tobin	Investment opportunity. (Market value of circulation stock + book value of non-tradable shares + book value of liability)/book value of total assets
Salegrow	Sales growth. Sales growth/sales at the beginning of the year
Size	Firm size. The logarithm value of total assets
Age	Firm age. Number of years since the firm was established
Ebit	Earnings before interest and tax. (Net profit + income tax + interest)/total assets
Lev	Leverage. Total liability at the end of year/total assets at the end of year
Roa	Return on equity. Net profit at the end of year/total assets
Hold1	The largest shareholders. Percentage of outstanding shares held by the largest holders
Fixas	The proportion of fixed assets. Net value of fixed assets/total assets
S0	Marketization process. Marketization process index from Fan and Wang (2011)
Lloan	Loan. Long-term debt/total asset
Yszk	Accounts receivable. Accounts receivable/total assets
Yfzk	Accounts payable. Accounts payable/total assets
S4a	Marketization process of financial industry. Marketization process index of financial industry from Fan and Wang (2011)
Eqcash	Cash flow from operating activities. Net cash flow from operating activities in cash flow statement
S5b	The proportion of enterprises with local government intervention. Local government intervention index from Fan and Wang (2011)

[a] The American Embassy in China initially published air quality monitoring data for Beijing at the end of October 2011, after which PM2.5 became a hot topic in the media. However, as firms disclose their financial reports on 30 April, they still had almost half a year to modify the disclosed information. We therefore classify 2011 into the post-event period (Liu and Liu, 2015). Furthermore, this paper mainly focuses on high-polluting enterprises and industries, and the Ministry of Environmental Protection published the "Industry classification of environmental protection management in listed companies" in 2008. The 2011 Event drew public attention to PM2.5, and the provisions that were issued after 2011 were intended to solve the PM2.5 problem.

expenditures before ($Dum11 = 0$) and after 2011 ($Dum11 = 1$) are denoted by $Invest = \alpha_0 + \alpha_1 + \mu_{i,t}$ and $Invest = \alpha_0 + \alpha_1 + \alpha_2 + \alpha_3 + \mu_{i,t}$, respectively, so the difference in the treatment group before and after 2011 is $\alpha_2 + \alpha_3$. Thus, α_3 measures the difference in the effect of environment regulations on high-polluting enterprises' investment expenditure. Then, we control for other effects that could influence the inferences in Model (1). The main regression model is as follows.

$$Invest = \alpha_0 + \alpha_1 * Dumpollute + \alpha_2 * Dum11 + \alpha_3 * Dumpollute * Dum11 + \alpha_4 * Roa + \alpha_5 * Size + \alpha_6 * Lev + \alpha_7 * S0 + \alpha_8 * Hold1 + \alpha_9 * Fixas + \alpha_{10} * Lloan + \delta_{i,t} + \varphi_{i,t} + \mu_{i,t} \quad (2)$$

We use Model (3) to test Hypothesis 2. Fazzaris et al. (1988) and Vogt (1994) find that firms that have more investment opportunities invest more and have higher investment efficiency. However, when investment opportunities are few, investment expenditure declines accordingly—that is, investment expenditure is sensitive to investment opportunity. We add the variable *Tobin* to measure investment opportunity[2] and add the interactions with *Dumpollute* and *Dum1*. We also control industry, year and province effects.

[2] Following the literature, we use the sales growth rate to substitute Tobin's Q in the robustness test, and the results remain the same.

$$Invest = \beta_0 + \beta_1 * Dumpollute + \beta_2 * Dum11 + \beta_3 * Dumpollute * Dum11 + \beta_4 * Dumpollute * Dum11 * Tobin + \beta_5 * Dumpollute * Tobin + \beta_6 * Dum11 * Tobin + \beta_7 * Tobin + \beta_8 * Roa + \beta_9 * Size + \beta_{10} * Lev + \beta_{11} * S0 + \beta_{12} * Hold1 + \beta_{13} * Fixas + \beta_{14} * Lloan + \delta_{i,t} + \varphi_{i,t} + \mu_{i,t} \quad (3)$$

4. Empirical results

4.1. Descriptive statistics

Table 2 shows the descriptive statistics. The mean investment expenditure (*Invest*) is 0.059, with a minimum value of 0 and maximum of 0.5451, indicating that the distribution is reasonable, but left-skewed (median is 0.039). The mean of investment opportunity (Tobin) is 1.5832, with a standard deviation of 0.888, shows that the distribution is discrete. High-polluting enterprises account for 30% of the full sample (*Dumpollute*).

Table 3 reports the Pearson correlation coefficients. The correlation coefficient between *Invest* and *Dumpollute* is 0.2001 and significant at the 10% level. This means that high-polluting enterprises invest more than non-high-polluting enterprises do. The correlation coefficient between *Dum11* and *Invest* is −0.313 and significant at the 1% level, showing that strengthening environmental regulation reduces firms' investment expenditure. Although the coefficient between investment opportunity (*Tobin*) and investment expenditure (*Invest*) is small (0.022), it is significant at the 1% level. Sales growth (*Salgrow*) is significantly negatively correlated with investment expenditure (*Invest*), indicating that the higher the sales growth, the more cash is occupied, leaving the firm with little cash flow to invest. The correlation coefficients of the other variables are all below 50%, showing that there is no multicollinearity.

4.2. Univariate statistics

Table 4 shows the univariate statistics based on property rights and periods (pre-2011 event period and post-2011 event period). We find no significant difference in the (mean or median) investment expenditure (*Invest*) of SOEs after the strengthening of environmental regulations. However, there is a significant decline in the investment expenditure (*Invest*) of non-SOEs, and the mean (median) difference is significant at the 10% (5%) level. This shows that the investment expenditure of non-SOEs was influenced more by the 2011 event than by SOEs. The investment opportunity (*Tobin*) of SOEs does not significantly change after the 2011 event but significantly decreases in non-SOEs. Table 4 shows that the values of investment expenditure and investment opportunity are lower in the post-2011 event period than in the pre-2011 event period and that SOEs' values are larger than non-SOEs' values. These results show that environmental regulations have a negative effect on investment expenditure and opportunity, but the effect is more significant for non-SOEs.

Table 2
Descriptive statistics.

Variables	N	Mean	SD	Min	P50	Max
Invest	7308	0.0590	0.0570	0	0.0390	0.5451
Tobin	7308	1.5832	0.8880	0.7183	1.2563	5.8664
Lloan	7308	0.0760	0.0960	0	0.0290	0.7993
Dum11	7308	0.6583	0.2354	0	0	1
Fixas	7308	0.2582	0.191	0	0.2325	0.9602
Eqcash	7308	19.4126	1.5023	9.7321	19.7410	25.8725
Ebit	7308	0.0560	0.0610	0.0124	0.0500	0.6757
Dumpollute	7308	0.3032	0.4603	0	0	1
Age	7308	13.0829	3.262	1	14	30
Salgrow	7308	0.5413	0.1677	0.0070	0.5363	1.9902
Hold1	7308	36.5012	15.8903	0.8203	34.5002	100
Lev	7308	0.5407	0.1643	0.1128	0.5362	0.8547
Size	7308	22.2143	1.1876	18.1625	22.039	27.7521
Roa	7308	0.0370	0.0570	0.0023	0.0340	0.5172

Table 3
Pearson correlation coefficients.

Variables	*Invest*	*Tobin*	*Lloan*	*Dum11*	*Opcash*	*Ebit*
Invest	1					
Tobin	0.0221**	1				
Lloan	−0.0923***	−0.3063***	1			
Dum11	−0.3137***	−0.0381***	0.1702***	1		
Eqcash	0.2014***	−0.2518***	0.2153***	0.1427***	1	
Ebit	0.0971***	0.1512***	−0.0653***	−0.0756***	0.2040***	1
Dumpollut	0.2001*	0.2451*	0.0031	0.1202	–0.1003	–0.0182**
Age	−0.3454***	0.0150	0.1297***	−0.1628***	0.0300	–0.0442***
Salgrow	−0.033***	−0.4065***	0.4867***	−0.1382***	0.0694***	–0.1778***
Hold1	−0.1102	0.1001	0.0400	0.1003	0.0900	–0.0600
Lev	−0.0326***	−0.4135***	0.4932***	−0.1403***	0.0735***	–0.1463***
Size	0.4001	−0.4712***	0.4633***	−0.0702***	0.3224***	0.1853***
Roa	0.0357***	0.1218***	−0.1127***	−0.1602***	0.1952***	0.3748***
	Dumpollut	*Age*	*Salgrow*	*Lev*	*Size*	*Roa*
Dumpollut	1					
Age	−0.1003	1				
Salgrow	−0.1629*	0.0153*	1			
Hold1	0.4003***	0.0300	0.0600			
Lev	−0.1775*	0.0140	0.3953***	1		
Size	−0.1403	0.0598***	0.4632***	0.4745***	1	
Roa	−0.0178*	−0.0249***	−0.2341***	−0.2013***	0.1628***	1

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

Table 4
Univariate statistics.

	After the 2011 event		Before the 2011 event		Difference test	
	Mean	Median	Mean	Median	T-test	Wilcoxon-test
Invest-SOEs	0.0583	0.0538	0.0598	0.0476	1.4284	1.3546
Invest -Non-SOEs	0.0517	0.0429	0.0530	0.0327	1.9438*	2.1429**
Tobin-SOEs	1.5804	1.2086	1.5968	1.3843	1.0314	1.4732
Tobin - Non-SOEs	1.5335	1.2328	1.5923	1.1207	3.4718***	2.3519***

* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

Table 5
Investment expenditure in different industries and regions and intra-industry.

Item	*Invest*-Mean	*Invest*-Median
High-polluting enterprises	0.0595	0.0386
Non-high-polluting enterprises	0.0593	0.0391
Difference (significance)	0.0002 (T = 2.216)	0.0005 (Z = 1.8264)
High-polluting enterprises in west region	0.0661	0.0386
High-polluting enterprises in east region	0.0462	0.0113
Difference (significance)	−0.0199 (T = −18.57)	−0.0273 (Z = −26.155)
Three industries with the highest number of high-polluting enterprises	0.0579	0.0386
Three industries with the lowest number of high-polluting enterprises	0.0596	0.0425
Difference (significance)	0.0017 (T = 1.8326)	0.039 (Z = 1.926)

Table 5 shows the differences in investment expenditure by industry, region and intra-industry. We find that the investment expenditure difference between high-polluting enterprises and non-high-polluting enterprises is significant at the 5% (mean) and 10% (median) levels. The mean (median) investment expenditure of high-polluting enterprises in the western region is 0.0661 (0.0386), which is significantly higher than that in the eastern region, demonstrating that high-polluting enterprises have an incentive to move to other areas. Furthermore, the investment expenditure of the three industries with the lowest number of high-polluting enterprises is significantly higher than that of the three industries with the highest number of high-polluting enterprises, which is contrary to intuition. One possible explanation is that the industries with the lowest number of high-polluting enterprises are dispersed, the marginal supervision cost is large and there is a lack of regulation scale effect.

4.3. Regression results

Table 6 shows the results of the main regression. In column 1, the coefficient on the interaction of *Dumpollute* and *Dum11* is −0.0159, which is significant at the 10% level, showing that the environmental regulations after the 2011 event decreased the investment expenditure of high-polluting enterprises. Columns 2 and 3 report the results for SOEs and non-SOEs. The coefficient on the interaction of *Dumpollute* and *Dum11* of

Table 6
The 2011 event and investment expenditure.

Variables	(1) Full sample	(2) SOEs	(3) Non-SOEs
Dumpollute	0.032*	0.018**	0.0424*
	(1.83)	(2.15)	(1.97)
Dum11	−0.0402***	−0.0345***	−0.0168***
	(−3.43)	(−4.87)	(−2.91)
Dumpollute*Dum11	**−0.0159***	**−0.0124**	**−0.0246****
	(−1.778)	**(−1.34)**	**(−2.21)**
Lev	0.0225	−0.148**	0.0718
	(0.96)	(−1.95)	(1.47)
Size	0.0121***	0.0178***	−0.0518***
	(5.26)	(2.75)	(−4.22)
Hold1	−0.0014	−0.0012	0.0305
	(−1.28)	(−1.04)	(0.95)
Roa	0.0412***	0.0292***	0.0728***
	(2.48)	(2.77)	(3.15)
S0	0.0114**	−0.0943**	0.0276***
	(2.16)	(−2.54)	(3.09)
Fixas	0.0017***	0.0004***	0.0026***
	(5.27)	(2.76)	(2.36)
Lloan	−0.0406***	−0.0374***	−0.0219***
	(−2.45)	(−3.06)	(−2.87)
Constant	−0.217***	−0.0826**	−0.107**
	(−3.75)	(−2.11)	(−2.07)
Industry	*Controlled*	*Controlled*	*Controlled*
Year	*Controlled*	*Controlled*	*Controlled*
		$\chi(2) = 55.63$	
P value		0.000	
Observations	7308	4333	2975
Adj-R2	0.259	0.219	0.28
F	126.74	55.68	105.47

The robust t-statistics are reported in brackets.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

SOEs is −0.0124 but insignificant, while the coefficient on the interaction of non-SOEs is −0.0246 and significant at the 5% level. Further, the $\chi(2)$ of the coefficients of the two sub-samples is 55.63 and significant at the 1% level. This reveals that there is a selective and discriminatory phenomenon in the implementation of environmental regulations: SOEs are less affected by the regulations, but the investment expenditure of non-SOEs is significantly decreased.

Table 7 shows the effect of the 2011 event on investment opportunity sensitivity. In column 1, the interaction of *Dumpollute*, *Dum11* and *Tobin* is −0.0307, and is significant at the 10% level. This demonstrates that the strengthening of government environmental regulation decreases investment in heavy-polluting projects and reduces investment opportunity sensitivity. Columns 2 and 3 present the results for SOEs and non-SOEs; the coefficient on the interaction of SOEs is −0.0275 but insignificant, while the coefficient on the interaction of non-SOEs is −0.0437 and significant at the 5% level. The above results show that the decrease in investment opportunity sensitivity caused by the strengthening of environmental regulations is asymmetric

Table 7
The 2011 event and investment opportunity sensitivity.

Variables	(1) Full sample	(2) SOEs	(3) Non-SOEs
Dumpollute	0.0792*	0.0325**	0.0176**
	(1.79)	(2.19)	(2.14)
Dumpollute*Dum11*Tobin	**−0.0307***	**−0.0275**	**−0.0437****
	(−1.834)	**(−1.25)**	**(−2.25)**
Dum11	−0.0428***	−0.0375***	−0.0124*
	(−4.46)	(−2.45)	(−1.81)
*Dumpollute*Dum11*	−0.0711*	−0.0429	−0.0215***
	(−1.95)	(−1.08)	(−2.51)
*Dumpollute*Tobin*	0.0328**	0.0415*	0.0206***
	(2.03)	(1.95)	(2.37)
*Dum11*Tobin*	−0.0218*	−0.0207**	−0.0346***
	(−1.79)	(−2.16)	(−2.539)
Lev	0.0572	−0.0933	0.126
	(0.93)	(−1.36)	(1.57)
Tobin	0.0644***	0.0328***	0.0796***
	(2.84)	(3.25)	(2.45)
Size	0.0112***	0.0131***	−0.0258*
	(7.21)	(3.07)	(−1.76)
Hold	−0.0109	−0.0311	0.0262
	(−0.55)	(−0.96)	(0.41)
Roa	0.0315***	0.0292***	0.0703***
	(2.75)	(3.06)	(4.69)
S0	0.0125***	−0.0832**	0.0216***
	(2.78)	(−2.06)	(4.05)
Fixas	0.0021***	0.0013***	0.0039***
	(2.63)	(3.19)	(2.82)
Lloan	−0.0272***	−0.0315***	−0.0470***
	(−3.63)	(−4.58)	(−3.22)
Constant	−0.346***	−0.106***	−0.153***
	(−4.36)	(−3.15)	(−2.99)
Industry	*Controlled*	*Controlled*	*Controlled*
Year	*Controlled*	*Controlled*	*Controlled*
Observations	7308	4333	2975
Adj-R2	0.39	0.25	0.48
F	102.48	65.73	103.79

The robust t-statistics are reported in brackets.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

in SOEs and non-SOEs, further demonstrating the discrimination in the implementation of the environmental regulations.

5. Further analysis

5.1. Layers of government ownership

In general, central SOEs are large-scale enterprises in industries vital to national well-being and people's livelihoods. They are either monopolistic or oligopolistic, and hence their operational risk is low. Local SOEs are generally smaller than central SOEs and are in a disadvantaged situation in terms of the supply of capital, energy and raw materials. Thus, these local SOEs are subject to higher competitive pressure and greater

Table 8
Different layers of government ownership.

Variables	(1) Central SOEs	(2) Local SOEs	(3) Central SOEs	(4) Local SOEs
Dumpollute	0.0762*	0.0827***	0.0796*	0.01537*
	(2.14)	(2.58)	(1.77)	(1.86)
*Dumpollute*Dum11*Tobin*			−0.0430	−0.026**
			(−1.36)	(−2.18)
Dum11	−0.0326***	−0.0456***	−0.0468***	−0.0532***
	(−2.35)	(−3.72)	(−3.19)	(−4.251)
*Dumpollute*Dum11*	−0.0118	−0.0473*	−0.0215	−0.04721*
	(−1.083)	(−1.94)	(−0.79)	(−1.69)
*Dumpollute*Tobin*			0.002*	0.015**
			(1.78)	(2.13)
*Dum11*Tobin*		–	−0.031	−0.042**
			(−1.52)	(−2.13)
Lev	0.725***	0.0346	0.824***	0.0582
	(2.38	(1.35)	(2.62)	(1.06)
Tobin			0.0736***	0.0718***
			(2.88)	(3.72)
Size	0.0073***	0.0118***	0.0135***	0.0155***
	(2.36)	(3.25)	(3.62)	(4.27)
Hold	0.0256	0.0517	0.0294	0.0595
	(1.26)	(1.18)	(0.63)	(1.47)
Roa	0.0214	0.0633***	0.0279*	0.0225
	(1.32)	(2.45)	(1.77)	(1.57)
S0	0.0315	0.0328	0.0361	0.0418
	(1.35)	(1.43)	(1.38)	(1.12)
Fixas	0.0037***	0.0028***	0.0017***	0.003***
	(2.44)	(3.67)	(2.43)	(2.52)
Llaon	−0.0291***	−0.0314***	−0.0374**	−0.0329***
	(−2.75)	(−3.92)	(−2.02)	(−2.14)
Constant	−0.249***	−0.178***	−0.663**	−0.195***
	(−3.13)	(−3.16)	(−2.14)	(−3.48)
Industry	Controlled	Controlled	Controlled	Controlled
Year	Controlled	Controlled	Controlled	Controlled
	$\chi(2) = 43.86$		$\chi(2) = 58.62$	
P value	0.004		0.023	
Observations	1531	2802	1531	2802
Adj -R2	0.43	0.36	0.35	0.42
F	26.34	48.05	55.83	62.05

The robust t-statistics are reported in parentheses.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

operational risk. The literature suggests that the layers of government ownership in SOEs lead to diverse effects. Furthermore, local government policies on industry regulation, taxation and loan support have different effects on central SOEs and local SOEs (Yuan and Zuo, 2011). The Ministry of Environmental Protection is the highest-level organization responsible for environmental regulations. Most central SOEs still have a vice-ministerial or ministerial administrative level. Managers of these SOEs are assigned by the CCP Central Committee's Organization Department, which creates certain difficulties during the supervision process and has a negative influence on the effective implementation of PM2.5 regulation. The Ministry of Environmental Protection announced the handling of penalties for enterprises with environmental violations on its website in 2013. Some central SOEs, including the State Electric Power Corporation, Petro China and Datang Power, are on the list and account for 30% of firms to be punished. Twenty-six (23.21%) central SOEs are involved in the environmental protection inspection industry. Although central SOEs and local SOEs both belong to the same system, local SOEs are more involved in local economic development services.

The theory of political asylum assumes that local government officials can benefit from the operation of local SOEs and will therefore support these firms. Ljungwall and Linde-Rahr (2005) find that local governments always opt for lower environmental standards to attract direct foreign investment and keep their competitive advantages. When the central government incorporates environmental protection performance into the evaluation system for local officials, "solicitude" becomes "intervention" and "administrative order." From the perspective of political promotion, during the distribution of pollution reduction tasks, some high-polluting provinces might promise to achieve higher reduction standards set by the central government, and the corresponding municipal and prefecture governments may also require higher reduction levels to complete the central government's pollution reduction targets (Zhou et al., 2015). Central SOEs may then use the protection of the national economy and people's livelihoods as excuses for escaping emission tasks, and non-SOEs may be affected the most. Compared with central SOEs, local SOEs undertake more responsibility for reducing investment in heavy pollution projects, thus reducing the investment opportunity sensitivity. Considering the different effects of government environmental regulations on central and local SOEs (including differences in getting key investment projects and bank loans), we believe that the investment expenditure and investment opportunity sensitivity differs between central and local SOES.

Table 8 shows the results for the layers of government ownership. In column 1, the interaction of *Dum11* and *Dumpollute* is −0.0118 but insignificant. In column 2, the interaction of *Dum11* and *Dumpollute* is −0.0473 and significant at the 10% level. The difference between the interaction of *Dum11* and *Dumpollute* in columns 1 and 2 is 43.86 and significant at the 1% level. This shows that the environmental regulations have an inhibiting effect on local SOEs' investment, but not on that of central SOEs'. Columns 3 and 4 examine the effect of environmental regulations on investment opportunity sensitivity in central and local SOEs. In column 3, the interaction of *Dum11, Dumpollute* and *Tobin* is −0.0430 and insignificant, but it is significantly negative in column 4. The difference between the interactions of *Dum11, Dumpollute* and *Tobin* in columns 3 and 4 is 58.62 and significant at the 5% level. This shows that environmental regulations have a greater inhibiting effect on local SOEs' investment opportunity sensitivity.

5.2. Regional effect

Air pollution has a spillover effect and can cause transboundary pollution problems across various areas (Li et al., 2014). According to the Pollution Haven Hypothesis (Copeland and Taylor, 1994), a low environmental regulation area has an innate advantage in attracting high-polluting enterprises. The "marketization" method of resource allocation causes these areas to become popular locations for high-polluting enterprises. With recent improvements in the comprehensiveness of environmental protection requirements, the migration of polluting enterprises from their original locations to new places has become a noticeable new phenomenon. Zhou et al. (2015) find that China's pollution-intensive enterprises were mainly distributed in the Shandong peninsula, Yangtze River Delta and Pearl River Delta and in other economically developed regions before 1998 and were mostly located in the central and western regions until 2008. The eastern region has more restrictive environmental regulations and higher GDP; reducing the number of heavy polluting industries would have little effect on the economy and industrial structure. In the western region, labor costs are lower, and there are abundant low-cost energy and raw materials, which are intrinsic causes for the mushrooming of

Table 9
Investment expenditure in different regions.

Variables	(1) West	(2) East	(3) Middle
*Dumpollute*Dum11*	0.0495**	−0.0386*	0.0971
	(2.112)	(−1.929)	(1.161)
Dumpollute	−0.0101	0.0156	−0.0816
	(−0.110)	(0.814)	(−1.243)
Dum11	−0.0741	−0.0363***	−0.0142**
	(−0.696)	(−13.729)	(−2.109)
Lloan	0.0103**	0.0014	0.0206**
	(2.139)	(0.042)	(2.511)
Roa	0.0990**	0.0791***	0.0931***
	(2.267)	(7.658)	(3.116)
S0	−0.0234	0.0165***	0.0740
	(−1.558)	(31.689)	(0.644)
Hold1	−0.0687	−0.0429	0.0144
	(−0.375)	(−1.306)	(0.119)
Lev	0.0560***	0.0466***	−0.0821
	(2.930)	(9.159)	(−0.539)
Fixas	0.001**	0.014***	0.002
	(2.443)	(3.087)	(0.518)
Size	0.0131**	0.0269***	0.0108***
	(2.536)	(3.142)	(3.702)
Constant	−0.257**	−0.102***	−0.175***
	(−2.341)	(−5.213)	(−2.894)
Industry	*Controlled*	*Controlled*	*Controlled*
Year	*Controlled*	*Controlled*	*Controlled*
Observations	515	5669	1124
Adj-R2	0.116	0.598	0.207
F	2.673	256.6	7.911

The robust t-statistics are reported in parentheses.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

high-polluting enterprises in this region. Furthermore, as economic development is relatively primitive in the middle and western regions, local officials might be willing to relax the regulatory standards on environmental pollution to attract investment and meet political performance requirements. Shen et al. (2012) find that the spatial distribution trend of pollution-intensive industries in Guangdong province is ''disperse-concentrate-dis perse'': they were concentrated in the Pearl River Delta from 2002 to 2005 but dispersed to other places from 2006. This provides evidence of the migration of pollution-intensive industry from Guangdong province to other places to escape the environmental regulations of the polluted area. In fact, polluting enterprises are the main source of PM2.5. We further investigate whether there are regional differences in investment behavior in high-polluting enterprises and whether these enterprises moved to other places after the 2011 event.

Many listed high-polluting enterprises invest in correlative industries by way of capital operation at the national scale. For example, Zijin Mining, whose stock code is 601899, has subsidiaries in Xinjiang, Xizang, Qinghai and Fujian provinces; Zijin Mining established the Northwest Company of Zijin Mining Group, South Investment Company of Zijin Mining Group and Zijin International Mining Corporation to take advantage of differences in environmental regulations and the policy of attracting investment to underdeveloped areas. The intention was to move the polluting industries and realize profit maximization by reducing the pollution risk and cost, thus undermining the implementation of environmental regulations.[3] Due to the spillover effect of air pollution, implementation of strict environmental regulations in certain areas may not be

[3] Bao Steel (600019) is in a similar situation: it has subsidiaries in Shanghai, Xinjiang and Shaoguan and can distribute industry on a national scale.

able to prove that the environmental regulations can decrease pollution. Hence, local government and enterprises may have strong incentives to increase the scale of their investments and gain short-term benefits. Thus, we believe that the investment projects of high-polluting enterprises probably migrated to other places where regulatory pressure is less severe after the 2011 event.

Table 9 reports the results of investment expenditure in different regions. The interactions of *Dumpollute* and *Dum11* are 0.0495, −0.0386 and 0.0971 for enterprises in the western, eastern and central regions, respectively, but are only significant for those in the western and eastern regions.

Table 10 further examines the investment opportunity sensitivity under different regions. The interaction of *Dum11, Dumpollute* and *Tobin* is only significantly positive (0.0825) in western region enterprises (column 1), and is insignificantly negative (−0.0296) in eastern region enterprises. Although the interaction of *Dum11, Dumpollute* and *Tobin* is insignificant in central region enterprises, the positive value shows that this region possibly has some pollution transfer projects. The above results demonstrate that with the strengthening of environmental regulations, investment expenditure and investment opportunity sensitivity of high-polluting enterprises were reduced in the eastern region and increased in the western region.

Table 10
Investment opportunity sensitivity under different regions.

Variables	(1) West	(2) East	(3) Middle
*Dumpollute*Dum11*	0.0118***	−0.0306*	0.0159
	(2.342	(−1.837)	(1.325)
*Dumpollute*Dum11*Tobin*	0.0825**	−0.0296	0.0379
	(2.073)	(−1.429)	(0.827)
*Dumpollut*Tobin*	0.0133*	0.0379**	0.0206**
	(1.78)	(2.15)	(2.06)
*Dum11*Tobin*	−0.0135**	−0.0344	−0.0196*
	(−2.08)	(−0.792)	(−1.86)
Dumpollute	0.0108	0.0153*	0.0759
	(0.267)	(1.842)	(1.026)
Dum11	−0.0124	−0.0275***	−0.0149**
	(−0.882)	(−5.178)	(−2.126)
Tobin	0.018	0.0436***	0.0787
	(0.183)	(2.345)	(0.503)
Lloan	0.0012**	−0.011	0.0201**
	(2.092)	(−0.781)	(2.178)
Roa	0.0834**	0.0724***	0.0909**
	(2.136)	(5.029	(3.116
S0	−0.0104	0.0125***	0.0573
	(−1.256)	(3.716)	(0.782)
Hold1	−0.0517	−0.0427	0.0506
	(−0.346)	(−1.581)	(0.049)
Lev	0.0493***	0.0502***	−0.0792
	(2.725)	(4.406)	(−0.773)
Fixas	0.0285**	0.003***	0.0316
	(2.328)	(3.354)	(0.758)
Size	0.0133***	0.0482***	0.0116***
	(2.460)	(3.182)	(3.296)
Constant	−0.286**	−0.162***	−0.165***
	(−2.12)	(−3.039)	(−2.667)
Industry	*Controlled*	*Controlled*	*Controlled*
Year	*Controlled*	*Controlled*	*Controlled*
Observations	515	5669	1124
Adj-R2	0.235	0.307	0.196
F	52.07	33.89	78.52

The robust t-statistics are reported in parentheses.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

One possible explanation is that the "performance championships" of officials, the demands of polluting enterprises and environmental regulation cause high-polluting enterprises to transfer their investments.

6. Robustness tests

As there may be a missing value and external disturbance from macro policy to the micro mechanism, we further retest the investment opportunity sensitivity model using a "change model." According to Li (2010), change models have three advantages: (1) testing the effect of the incremental explanatory variable on the explained variable can mitigate the effects of informal institutions that do not change over time, such as the corporate culture and managers' preferences, on the explained variable; (2) the incremental part brings

Table 11
Robustness test.

Variables	Full sample	Non-SOEs	SOEs
ΔLev	0.5560***	0.0915	0.6324*
	(5.772)	(0.874)	(1.693)
ΔSize	0.0650***	0.0828	0.0265***
	(14.940)	(1.642)	(3.579)
ΔRoa	0.0516***	0.0459	0.679*
	(8.482)	(0.226)	(1.735)
ΔS0	−0.3117***	0.1314	−0.4796
	(−3.461)	(1.353)	(−1.437)
ΔAge	−0.0319***	−0.0282	−0.0406***
	(−7.326)	(−0.554)	(−5.987)
ΔTobin	0.1476***	0.0304	0.2379
	(2.485)	(0.231)	(1.046)
Dumpollute	−0.0128**	−0.0121*	−0.0858
	(−2.028)	(−1.669)	(−1.173)
Dum11	−0.0263**	−0.0318***	−0.0217*
	(−2.374)	(−3.061)	(−1.793)
Dum11 Dumpollute*	−0.1275*	−0.0206**	−0.1136
	(−1.777)	(−2.124)	(−1.286)
*ΔTobin1*Dumpollute*Dum11*	−0.0762**	−0.0623*	−0.0260
	(−2.265)	(−1.879)	(−0.753)
*Dumpollute*ΔTobin*	0.0341*	0.0276*	0.0484
	(1.675)	(1.974)	(1.528)
*Dum11*ΔTobin*	−0.2016**	−0.1803**	−0.1795
	(−2.013)	(−2.355)	(−1.036)
ΔFixas	0.0372*	0.0255**	0.0464**
	(1.695)	(2.124)	(2.017)
ΔHold1	0.553	0.175	0.710
	(0.885)	(0.243)	(0.590)
ΔLloan	−0.0429***	−0.0516***	−0.0471***
	(−2.962)	(−3.814)	(−2.963)
Constant	−0.1738***	−0.1447*	−0.6518***
	(−3.902)	(−1.983)	(−3.257)
Industry	*Controlled*	*Controlled*	*Controlled*
Year	*Controlled*	*Controlled*	*Controlled*
Province	*Controlled*	*Controlled*	*Controlled*
Observations	7215	4751	2464
Adj-R2	0.49	0.35	0.83
F	54.41	21.34	99.05

The robust t-statistics are reported in parenthesis.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

new information and can eliminate the influence of old information; and (3) the mitigation of endogenous problems. We generate the first-order difference for all continuous variables and re-regress model (3). Table 11 shows the results, which remain the same.

7. Conclusion

The third plenary session of the 18th session of the CCP proposed the establishment of a complete ecological civilization system to protect the ecological environment and to realize the grand blueprint of "beautiful China." Polluting enterprises are the main source of air pollution. This study examines the effects of government environmental regulations on high-polluting enterprises' investment behavior based on Chinese A-share listed firms from 2006 to 2014. The sudden surge in the PM2.5 index is used as a natural experimental exogenous event. We analyze the differences in investment expenditure and investment opportunity sensitivity between SOEs and non-SOEs, central SOEs and local SOEs and different regions.

We find that after the 2011 event, investment expenditure declines significantly in local SOEs and non-SOEs, whereas investment opportunity sensitivity declines significantly in non-SOEs compared with SOEs. However, there are no significant changes in central SOEs' investment expenditure and investment opportunity sensitivity. Further analysis shows that investment expenditure and investment opportunity sensitivity decline for high-polluting enterprises located in East China but increase for those located in West China.

This paper has some policy implications. Although the Ministry of Pollution Protection and governments at all levels introduced the strictest regulations after the 2011 event, the goal of realizing a "Wild China" is still some way off under the current regulations. Effective implementation of smog governance and environmental regulations is the key to reducing PM2.5 pollution. The Ministry of Pollution Protection should collaborate with the China Securities Regulatory Commission, China Banking Regulatory Commission and commercial banks to enforce the environmental governance of high-polluting enterprises. Such enforcement of environmental governance is achieved not only by reducing investment in polluting projects but also by cutting off their financial support. Local government should fully understand the connotation of "investment opportunity" and reduce excessive interventions for companies and commercial bank credit. Local officials should adopt correct attitudes toward political performance and lessen the excessive dependence on high-polluting enterprises to support local GDP. The governments and environmental management departments should propose appropriate solutions to resolve the lack of supervision and the pollution transfer phenomenon in China as soon as possible.

Acknowledgments

The authors gratefully acknowledge the helpful comments from two anonymous referees.

This study is funded by the Humanities and Social Science in Colleges and Universities in Jiang Xi Province Key Base Research Project (JD16052) and the Natural Foundation Science of China (71762014).

References

Akdogu, E., MacKay, P., 2008. Investment and competition. J. Financ. Quant. Anal. 43 (2), 299–330.

Allen, F., Qian, J., Qian, M., 2005. Law, finance, and economic growth in China. J. Financ. Econ. 77, 57–116.

Bardhan, P., Mookherjee, D., 2005. Decentralizing anti-poverty program delivery in developing countries. J. Public Econ. 89, 675–704.

Bardhan, P., Mookherjee, D., 2006. Corruption and decentralization of infrastructure delivery in developing countries. Econ. J. 116, 107–133.

Barbera, A.J., McConnell, V.D., 1990. The impact of environmental regulation on industry productivity: Direct and indirect effects. J. Environ. Econ. Manage. 18, 50–65.

Berman, E., Bui, L.T.M., 2011. Environmental regulation and productivity: Evidence from oil refineries. Rev. Econ. Stat. 83 (3), 498–519.

Bertrand, M., Mullainathan, S., 2004. Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination. Am. Econ. Rev. 94 (4), 991–1013.

Chava, S., 2014. Environmental externalities and cost of capital. Manage. Sci. 60 (9), 2223–2247.

Chen, S., Sun, Z., Tang, S., Dong Hui, Q., 2011. Government intervention and investment efficiency: Evidence from China. J. Corp. Financ. 17 (2), 259–271.
Copeland, B.R., Taylor, M.S., 1994. North-South trade and the environment. Q. J. Econ. 109 (3), 755–787.
Dasgupta, S., Hong, J.H., Laplante, B., Mamingi, N., 2006. Disclosure of environmental violations and stock market in the republic of Korea. Ecol. Econ. 58 (4), 759–777.
Darnall, N., Jolley, J., Ytterhus, B., 2007. Understanding the relationship between a facility's environmental and financial performance. Corp. Beha. Environ. Policy 5 (6), 213–259.
De Franco, G., Li., Y., Zhou, Y., 2013. Corporate Environmental Risk Exposure and Analyst Behavior. University of Toronto, University of Texas at Dallas, Working paper.
Engau, C., Hoffmann, V.H., 2011. Corporate response strategies to regulatory uncertainty: evidence from uncertainty about post-Kyoto regulation. Policy Sci. 44, 53–80.
Fan, G., Wang, X.L., 2009. Chinese Market Index: Regional Market Relative Processes Reported in 2009. Economic Science Press, Beijing (in Chinese).
Fazzaris, Hubbard, R.G., Petersen, B.C., 1988. Financing constraints and corporate investment. Brooking Pap. Econ. Activity 45 (1), 141–195.
Gollop, F.M., Roberts, M.J., 1983. Environmental regulation and productivity growth: The case of fossil-fueled electric power generation. J. Polit. Econ. 91 (4), 654–674.
Gray, W.B., 1987. The cost of regulation: OSHA, EPA and the productivity slowdown. Am. Econ. Rev. 77 (5), 998–1006.
Gray, W.B., Shadbegian, R.J., 1995. Pollution Abatement Costs, Regulation, and Plant-level Productivity. NBER Working Paper No. 4994.
Green, A., 2006. You can't pay them enough: Subsidies, environmental law, and social norms. Harvard Environ. Law Rev. 3, 407–426.
Grimaud, A., Rouge, L., 2008. Environment, directed technical change and economic policy. Environ. Resour. Econ. 41, 439–463.
Hong, H., Kacperczyk, M., 2009. The price of sin: The effects of social norms on markets. J. Financ. Econ. 93, 15–36.
Jorgenson, D.W., Wilcoxen, P.J., 1990. Environmental regulation and U.S. Economic Growth. Rand J. Econ. 21 (2), 314–340.
La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1999. The quality of government. J. Law Econ. Organ. 15, 222–279.
Li, F., 2010. Managers' Self-serving Attribution Bias and Corporate Financial Policies, Available at SSRN.
Li, P., Yifeng, S., 2011. Social norms, capital market and environmental governance: Evidence on the perspective of institutional investors. World Econ. 6, 126–146 (in Chinese).
Li, S., Chu, S., Shen, C., 2014. The local government competition, environmental regulation and regional ecological efficiency. World Econ. 4, 88–110 (in Chinese).
Liu, W., Niu, J., Zhang, X., 2010. Impact of split-share structure reform upon capital market validity: An empirical study based on the three-factor model. Account. Res. 3, 65–72 (in Chinese).
Liu, Y., Liu, M., 2015. Has smog affected the earnings management of heavy polluting enterprises? Based on the polluting-cost hypothesis. Account. Res. 3, 26–33 (in Chinese).
Lin, R., Xie, Z., Li, Y., Wang, C., 2015. Political connection, environmental disclosure and government subsidy: the perspective of resource dependence theory. J. Public Manage. 4, 30–43 (in Chinese).
Ljungwall, C., Linde-Rahr, M., 2005. Environmental Policy and the Location of FDI in China. CCER Working Paper, No. E2005009.
Lundgren, T., Olsson, R., 2010. Environmental incidents and firm value: International evidence using a multifactor event study framework. Appl. Financ. Econ. 20 (16), 1293–1307.
Mayer, B.D., 1995. Natural and quasi-experiments in economics. J. Bus. Econ. Stat. 13 (2), 151–161.
McLean, R.D., Zhang, T., Zhao, M., 2012. Why does the law matter? Investor protection and its effects on investment, finance and growth. J. Financ. 67 (1), 313–350.
Palmer, K.L., Oates, W.E., Portney, P.R., 1995. Tightening environmental standards: The benefit-cost or the no-cost paradigm? J. Econ. Perspect. 9 (4), 119–132.
Porter, M.E., Van Der Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. J. Econ. Perspect. 9 (4), 97–118.
Shen, J., Xiang, C., Liu, Y.Y., 2012. The mechanism of pollution-intensive industry relocation in Guangdong province, 2000–2009. Geogr. Res. 2, 357–368 (in Chinese).
Simunic, D., Ye, M., Li, Y., 2014. Do Auditors Care About Clients' Compliance with Environmental Regulations? SSRN.
Thomas, J., Brown, R.L., 1995. Pollution regulation as a barrier to new firm entry: Initial evidence and implications for future research. Acad. Manag. J. 38 (1), 288–303.
Tian, G., Cheng, X.D., 2014. Ecological Civilization System Reform and the Governance of Environmental Pollution. Report on the Policy Studies of Shanghai University of Finance and the Higher Institute (in Chinese).
Viscusi, W.K., 1983. Frameworks for analyzing the effects of risk and environmental regulation on productivity. American Economic Review 73 (4), 793–801.
Vogt, S.C., 1994. The cash flow/investment relationship: Evidence from U.S. manufacturing firms. Financ. Manage. 123 (2), 3–20.
Wang, H., Mamingi, N., Laplante, B., Dasgupta, S., 2003. Incomplete enforcement of pollution regulation: Bargaining power of Chinese factories. Environ. Resour. Econ. 24 (3), 245–262.
Xiong, Y., Xu, X., 2007. The influence of environmental regulation on China's foreign direct investment: evidence on the analysis of panel data. Econ. Rev. 2, 122–125 (in Chinese).
Xu, S., Xiao, X., 2011. Do environmental regulations reduce the investment efficiency of heavy pollution industries? J. Public Manage. 7, 102–116 (in Chinese).

Yuan, Y., Zuo, X., 2011. Strong county of expansion and economic growth: Microscopic evidence of industrial enterprises above designated size. World Econ. 3, 89–107 (in Chinese).

Zhou, Y., He, C.F., Liu, Y., 2015. An empirical study on the geographical distribution of pollution-intensive industries in China. J. Nat. Resour. 1, 1183–1196 (in Chinese).