China Journal of Accounting Research

Volume 12, 2 (2019)

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

12 | 2 China Journal of Accounting Research Vol. 12/2 (2019) 135–230

ELSEVIER

Volume 12 • Issue 2 • June 2019

China Journal *of* Accounting Research

HOSTED BY
ELSEVIER

Available online at www.sciencedirect.com
ScienceDirect

ISSN 1755-3091

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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.

http://www.elsevier.com/journals/china-journal-of-accounting-research/1755-3091/guide-for-authors

CHINA JOURNAL OF ACCOUNTING RESEARCH

Volume 12/2 (2019)

China Journal of Accounting Research 12 (2019) 135–155

HOSTED BY

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Contents lists available at ScienceDirect

China Journal of Accounting Research

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

Facebook posting activity and the selective amplification of earnings disclosures

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ARTICLE INFO

Article history:
Received 30 April 2018
Accepted 20 February 2019
Available online 18 March 2019

Keywords:
Social media
Disclosures
Earnings announcements

ABSTRACT

This study examines the determinants of Facebook activity levels with a particular focus on Facebook activity around earnings announcements. Facebook activity is generally higher for firms with higher levels of analyst following, individual ownership, and trading volume, indicating that it is responsive to investor demand effects. Facebook activity also increases around earnings announcements, with the increase being largely attributable to posts containing earnings news. In general, therefore, firms use Facebook posts to amplify earnings news. Such activity is selective, however; it is lower for firms with high levels of information asymmetry, for firms reporting earnings that exactly meet the consensus analyst forecast amount, and when the earnings news is negative but the accompanying price movement is positive. Hence, firms appear to use Facebook to manage the level of attention paid to earnings news.

1. Introduction

The rise of network-based dissemination of information over the past 20 years has given rise to fundamental changes in how firms communicate with the public. In this study, we examine companies' use of one such network channel: Facebook. Corporate Facebook pages allow interested parties to obtain a wide variety of information about the companies they follow on Facebook. Hence, Facebook should serve as a mechanism for reducing information asymmetry among market participants and leveling the playing field for investors seeking relevant information. We examine the role of Facebook as a financial information disclosure channel for businesses. In particular, we take the perspective that Facebook posting activity falls within the realm of

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https://doi.org/10.1016/j.cjar.2019.02.001
1755-3091/

voluntary disclosure choices. Furthermore, in the context of mandated reports such as earnings announcements, Facebook posting decisions reflect a firm's voluntary choice as to whether to amplify mandated disclosure information.

Over the 2009 to 2012 period covered by our data, we find that for the subset of firms involved in Facebook posting, the intensity of their posting increased substantially. In the first months of 2009, posting levels averaged fewer than three posts per month, or less than one post a week. By the end of 2012, posting intensity levels averaged around 25 posts per month, or nearly one post per day. In general, posting activity increases with analyst following and individual ownership level, consistent with posting serving primarily as an information conduit to individual investors. Posting activity is also positively related to the volume of trading activity of a firm's stock, thereby connecting corporate Facebook activity levels with equity market information flow as captured by trading activity.

Facebook posting activity is generally higher during earnings announcement periods than during non-announcement periods. When subdividing posting activity into posts that do and do not mention earnings, we find that the heightened level of posting during announcement periods is largely attributable to the subset of posts that explicitly mention earnings. Hence, in general, firms use Facebook posting as a means of amplifying reported earnings news. The likelihood of a firm engaging in such earnings posting activity, however, decreases with analyst following. As analysts are also a channel for conveying earnings news to market participants, this inverse relation is consistent with the notion that firms use Facebook posts when other dissemination channels are limited.

Announcement-period posting activity, however, is also negatively associated with pre-existent bid-ask spread levels. Hence, firms avoid posting about their earnings when existent pre-disclosure information environments are poor and information asymmetry is high. Interestingly, while most firms display similar levels of non-earnings posts (i.e., posts that do not mention earnings) during the announcement and non-announcement periods, high bid-ask spread firms also display lower levels of non-earnings posts during earnings disclosure periods, presumably to avoid bringing any sort of attention to themselves via Facebook.

As spread is our primary measure of pre-disclosure information asymmetry, the finding of a negative relation between spread and posting activity is related to the evidence of a negative relation between announcement period change in spread and announcement-related tweeting activity documented in Blankespoor et al. (2014). We, however, do not find any reliable evidence of a negative relation between change in announcement period spread and announcement-period posting activity. Hence, information asymmetry seems better understood as a determinant of Facebook posting than as something affected by Facebook posting, at least with respect to earnings news.

Facebook posting activity during the announcement period is also a means for firms to manage the level of attention paid to the content of the earnings announcement. Engaging in posting activity during the announcement period can bring attention to the firm, while not doing so can reduce attention. We consider how such Facebook posting activity differs conditional on the news conveyed by the market as well as how the market responds to such news, as reflected in contemporaneous market returns. We find little evidence of any sort of relation between posting activity and seasonal random walk forecast error in earnings. Under certain conditions, however, posting activity does appear to be affected by news related to analyst forecast errors. Specifically, while posting activity generally increases during announcement periods, these increases are severely attenuated when reported earnings exactly equal forecasted earnings (i.e., earnings "just meet" analyst expectations) or when the forecast error news is unfavorable but the accompanying market price movement is favorable (that is, when the market is seemingly discounting the unfavorable earnings news).

The finding that managers avoid bringing attention to negative earnings performances when the market is valuing the firm favorably is, to our knowledge, the first evidence suggesting that firms condition their disclosure amplification decisions on how the market is responding to news. Similarly, by not posting about earnings results that just meet analyst forecasts, firms avoid bringing potentially unwelcome attention to just how close they came to not meeting the earnings target. Such behavior in managing the attention given to their disclosures is consistent with broader literature on managers employing disclosure strategies aimed at hiding or minimizing mandated disclosures of bad news by, for instance, reporting earnings outside of trading hours,

disclosing on Fridays, and disclosing when large numbers of other firms are disclosing.[3] In those settings, however, firms seek to exploit exogenous structural variation in market attention, while in our study firms are much more proactive: they decide to bring attention by posting or avoid attention by not posting.

Our evidence is also broadly consistent with the notion that firms favor the dissemination of favorable news over unfavorable news, a general relation documented in Kothari et al. (2009) that Jung et al. (2018) show for the dissemination of earnings news via Twitter.[4] Specifically, the two settings where our analysis indicates that firms are less likely to post on Facebook both involve unfavorable news. In one case, the earnings news is explicitly unfavorable (the firm did not meet the forecast, even though the market does not seem to be taking it as such), and in the other case, the news is implicitly unfavorable (results that just meet forecasts) given that firms generally are more likely to beat forecasts than to meet or fall short of them. However, the evidence uniquely identifies another important exception: when the market is responding negatively to negative news, firms do disclose on Facebook, likely in response to the negative market feedback.

Finally, we also investigate whether firms alter their non-earnings posting activity in the announcement period as a possible way to further manage the level of attention paid to their earnings disclosures. That is, firms might ramp up their non-earnings posts in the announcement period as a means of distracting attention from unfavorable earnings news or of drawing attention to favorable news. In fact, we find no evidence of increased non-earnings posting activity in the announcement period conditional on earnings news per se. We do find that, relative to other firms, firms with earnings that "just meet" the analyst forecast consensus and those with negative earnings news but positive associated price movements display lower non-earnings posting activity. That is, firms appear to unconditionally avoid bringing attention to themselves via Facebook posts when the earnings news is nominally ambiguous or when it is contrary to current market sentiment on the firm.

The rest of the paper is organized as follows. Section 2 provides background and reviews the relevant literature. Section 3 explains the research questions and design. Section 4 describes the data and variables. Section 5 presents the results, and we offer conclusions in Section 6.

2. Background

Companies have long used traditional media along with certain Internet-based disclosure channels, such as corporate websites, message boards, and RSS feeds. Internet-based disclosure channels increase the speed of dissemination but are not much different from traditional media; both generally allow communication from companies to investors, and investors still need to perform searches to get information from these sources. Social media is distinct from traditional media mainly because it allows the creation and exchange of user-generated content, and it delivers information directly to users. Moreover, companies can collect user-related metadata (user location, age, network, etc.) based on user interactions. Companies are increasingly using social media with the help of professional public relations (PR) practitioners to enhance customer-firm interaction. Existing literature has highlighted the benefits of corporate social media usage. Eyrich, Padman, and Sweetser (2008) find that social media has moved from "buzz word" status to being a strategic tool. Successful use of social media for business depends on building an online community and absorbing the dynamics of the community. Rishika et al. (2013) find that high levels of social media activity increase participation by customers, who exhibit a strong patronage of the firm, thus increasing firm profitability. Tirunillai and Tellis (2012) show that online reviews and chatter are leading indicators of stock-market performance. The importance of social media in business is also highlighted by Luo et al. (2013), who show that social media-based metrics are significant leading indicators of firm equity value and stronger predictors than online behavioral metrics like Google searches and web traffic.

Companies use many social media platforms, including Facebook, Twitter, YouTube, and Google Plus. Among them, Facebook and Twitter are the most frequently used. One of the benefits of using social media for information dissemination is that it pushes the information directly to users (using so-called "push

[3] See deHaan et al. (2015) for a comprehensive discussion and analysis.

[4] Crowley et al. (2018), however, find that tweet propensities increase for both good and bad news announcements. Interestingly, they use market sentiment-based measures to determine the direction of the news. Hence, their findings align to some degree with our evidence that firms with poor earnings news post when the market sentiment about the firm, as reflected in contemporaneous returns, is negative.

technology"). Once a user subscribes to a page, all new information made available on that page is also immediately available to the user, saving the user effort and time that would otherwise be expended searching for relevant information from multiple sources. Facebook and Twitter are the most popular social media platforms for corporate disclosures. This study focuses on Facebook disclosures because most of the disclosures on Twitter (tweets) and other similar platforms are generally also available on Facebook concurrently, either through simultaneous disclosures or through Facebook-link applications. Moreover, Facebook has a much broader reach, with 2.23 billion monthly active users, compared to 335 million for Twitter.[5] In addition, Twitter has a character limit (140 per tweet till late 2017, 280 now), whereas Facebook does not; this gives the latter more flexibility for disclosures.

As company Facebook pages generally disclose public news, they rarely serve as an original source of new information to external parties. Hence, as a disclosure mechanism, Facebook primarily serves as a means for firms to broaden the level of attention paid to what is being disclosed. In other words, it is a device for amplifying disclosures. Such amplification can play an important role in the overall information dissemination process. Broad dissemination can reduce informational friction even in the absence of genuine news (Fang and Peress, 2009). There is evidence of investors trading in response to stale news and stale disclosures (Tetlock, 2011; Drake et al., 2012), suggesting that they find such information useful even though it may already be fully impounded into prices.

In August 2008, the Securities and Exchange Commission (SEC) provided guidance on using corporate websites to disclose information to the market. With a view to increasing market transparency, the SEC also encouraged the use of internet "push" technologies. The SEC became serious about companies' use of Facebook for disclosure purposes only after the huge market movement following Netflix CEO Reed Hastings' announcement on his Facebook page that Netflix's monthly viewing exceeded 1 billion hours for the first time in June 2012. On April 2, 2013, the SEC recognized the use of social media for disclosure purposes and issued a report that stated *"companies can use social media outlets like Facebook and Twitter to announce key information in compliance with Regulation Fair Disclosure (Regulation FD) so long as investors have been alerted about which social media will be used to disseminate such information."* Companies had already been using Facebook and other social media platforms for disclosure purposes. General Electric made the following statement on its quarterly earnings report (April 19, 2013): *"GE's Facebook page and Twitter accounts contain a significant amount of information about GE, including financial and other information for investors. GE encourages investors to visit these websites from time to time, as information is updated and new information is posted."* The increasing popularity of social media as a communications tool led the SEC to provide additional specific guidance on the dissemination of genuine third-party commentary that could be useful to consumers (on March 2014) and issue new compliance and disclosure interpretations (on April 21, 2014).

The literature on social media disseminations, however, is still at an early stage. Blankespoor et al. (2014) show that dissemination of firm-initiated news via Twitter is associated with lower bid-ask spreads and greater depths, consistent with reduction in information asymmetry. Analyzing companies' Facebook data, Lee, Hutton, and Shu (2015) find that social media disclosures related to recall announcements attenuate the negative price reactions. Chawla et al. (2016) find that news tweets help diffuse stale news and lower bid-ask spread. Cade (2018) shows that when faced with valid criticisms, companies can benefit from addressing the criticisms directly on social media or from redirecting attention to positive information (relative to not responding). There is evidence that social media is changing the public relations (Eyrich et al. 2008), marketing (Tirunillai and Tellis, 2012), and information systems landscapes (Luo et al., 2013). However, corporate use of social media for disclosure purposes remains largely unexplored.

Jung et al. (2018) examines Twitter usage for corporate disclosures. They find that firms are less likely to disseminate via Twitter when they have bad earnings news to report, consistent with prior voluntary disclosure findings such as Kothari et al. (2009). Social media is a unique channel for disclosure. Another concurrent working paper by Crowley et al. (2018) show that firms engage in discretionary disclosure on Twitter, but they do not find differential disclosure behavior based on news direction. Our study highlights this unique aspect of

[5] http://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/ (last accessed: December 2018) lists monthly active users at 2.234 billion for Facebook, 335 million for Twitter, and 303 million for LinkedIn, etc.

social media disclosure and shows how firms opportunistically adjust their disclosure behavior in response to market reaction to reported news.

3. Research questions

In the empirical analyses that follow, we examine factors underlying cross-sectional variation in firm posting activity levels. Among the subset of firms engaging in posting activity, we first identify what factors are associated with higher or lower levels of posting. More specifically, we examine what factors lead firms to post about their earnings news. We examine both general firm-level factors (e.g., information asymmetry) and news-specific factors (e.g., good news vs. bad news).

In developing our research questions, we draw extensively on the voluntary disclosure literature. Facebook posts (of financial performance information in particular) typically only re-post items that have already been disclosed through more conventional disclosure channels and so do not strictly fit into the voluntary disclosure (of news) framework. However, many of the same factors that the literature argues influence firms' decisions to engage in voluntary disclosure seem likely to be similarly salient for their decisions about whether to re-disclose or amplify a prior disclosure.

The voluntary disclosure literature indicates that disclosure activity generally increases with firm size (e.g., Cox, 1985; Waymire, 1985; Lang and Lundholm, 1993). In the research on disclosure choices more aligned with amplification, such as the amount of financial information provided on corporate websites (Ettredge et al., 2002) and the provision of earnings conference calls (Frankel et al., 1999), there is also support for a positive relation between the choice to amplify disclosure and firm size. Hence, we expect a positive relation between size and posting frequency.

Investor demand for information also seems likely to influence firm decisions to engage in posting activity. Hence, firms with higher analyst following and higher trading activity levels would be expected to face greater investor demand for information, as these measures reflect investor interest in the firm. Additionally, Facebook seems to be a much more relevant communication medium for individual rather than institutional investors. Hence, we expect posting activity to increase with the level of individual ownership in the firm (measured inversely by the percentage of institutional ownership). Finally, incentives for a firm to engage in voluntary disclosure are expected to increase with information asymmetry (Lang and Lundholm, 1993). Consistent with this notion, Ettredge et al. (2002) document a positive relation between information asymmetry and the amount of financial information that firms voluntarily post on their websites.

Our evaluation of the underlying factors affecting Facebook posting activity during earnings announcement periods considers two distinct perspectives of what drives such activity. The first factor stems from the firm desiring to disseminate relevant information regarding its financial performance to interested investors. That is, Facebook postings are a mechanism for amplifying earnings disclosures. Such earnings news amplification would be evidenced by higher levels of Facebook disclosure activity during announcement periods relative to non-announcement periods. Hence, we examine whether Facebook posting activity is higher during earnings announcement periods relative to non-announcement periods.

If, indeed, firms use Facebook posts to amplify earnings news, then it is possible that they do so opportunistically. In particular, conventional voluntary disclosure and attention theory suggests that firms may be more interested in disclosing/amplifying good news than bad news. Recent evidence in deHaan et al. (2015) indicates that when the news is unfavorable, managers time their earnings disclosures to occur when they believe market attention is lower (e.g., on Fridays or after hours). (Conversely, they avoid disclosing during low-attention times when the news is favorable.) Hence, we investigate whether managers are more prone to engage in attention-drawing Facebook posting activity when the earnings news is favorable than when it is not favorable. Similarly, within the subset of firms reporting unfavorable earnings news, we investigate whether those firms experiencing contemporaneous positive price movements are more disinclined to post to avoid calling attention to an unfavorable earnings performance that the market is seemingly discounting.

Finally, it is also possible that firms use Facebook posts as a mechanism for distracting attention from unfavorable earnings news. That is, they may intentionally raise the level of their non-earnings-related posting activity during announcement periods as a means not of amplifying earnings news but of diluting or burying it. We investigate this possibility by examining the level of non-earnings posts by firms reporting unfavorable

earnings news. If, in fact, such non-earnings posting activity is higher for these firms relative to other firms, it would suggest that some announcement-period posting is aimed more at distraction than at amplification.

4. Facebook data

Facebook's platform allows information to quickly reach many users who are connected through this network. While there are no restrictions on which companies can use Facebook for disclosures, larger companies are more likely to take advantage of the broad and dynamic reach of social media. In this study, we focus our analyses on large companies. Our initial sample consists of all firms included in the S&P 500 index in 2012. We examined the corporate websites of each of these firms as of November 2012 for the presence of a Facebook link. We also searched for these firms by name on Facebook itself. We identified 301 Facebook-active firms. We obtained posting records for these firms based on posting activity reported on their Facebook pages. As we limit our analysis to the 2009–2012 period, however, we did not collect detailed information on pre-2009 posting activity. Moreover, as our interest is in Facebook posting activity for those firms with Facebook pages, each of these firms enters our sample based on the date of its first Facebook post—its Facebook start date. Hence, a firm with a start date prior to 2009 enters at the start of 2009, while a firm with a start date in 2011 only appears after this date. Some companies have multiple Facebook pages, including a page for corporate news and different pages for different products. We collected information from Facebook pages for corporate news; for companies with more than one Facebook page, we only collected information from the corporate news-related pages.

The final sample includes 172,221 firm-days over the sample period. We extract all posts on these company Facebook pages for each day in our sample period. Next, we calculate the total number of posts on a day (posts per day) as the sum of posts by a company on that day. Companies do not post on their Facebook pages every day; the mean (median) number of posts per day is 0.967 (1.00), the maximum number of posts on a day in our sample is six, and the average length of posts in our sample is 178 characters.

The period examined is formative for Facebook involvement by firms. At the beginning of 2009, only 11 firms from the 2012 S&P 500 had Facebook pages. By 2012, this number had risen to 301 based on our sample identification strategy. Fig. 1 shows the evolution of Facebook usage for corporate disclosures over the sample period, as represented by monthly average posts per firm with a Facebook page from 2009 to 2012. The sharp increase in Facebook activity is conspicuous. At the beginning of our sample period, Facebook-active firms on average posted fewer than five posts per month. By the end of our sample period, firms on average made almost 25 posts per month. This upward trend in posting indicates that companies rapidly became more active on their Facebook pages over the time period under examination.

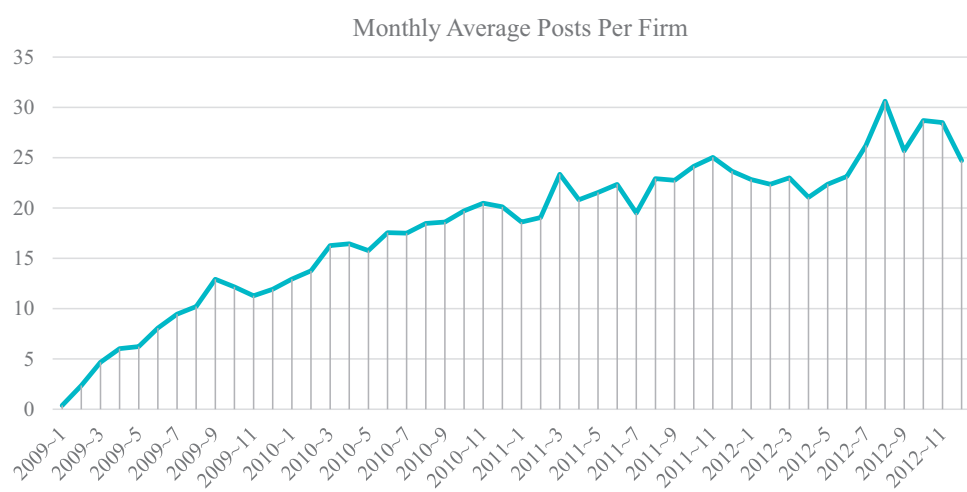


Fig. 1. The monthly average posts per firm over the sample period, 2009 to 2012. Monthly average posts per firm is the average posts per firm with a Facebook page during that month.

5. Empirical analyses

Our empirical analysis consists of two parts. In the initial section, we examine factors influencing the general level of Facebook activity by companies. In the second section, we focus on Facebook posting during earnings announcement periods.

5.1. Factors associated with Facebook posting

We examine factors associated with Facebook posting activity at the quarterly level for firms with (active) Facebook accounts by estimating the following equation:

$$\begin{aligned}\text{AvgNumPost}_{i,q} = {} & \text{Quarter Fixed Effects} + b1 * \text{Size}_{i,q-1} + b2 * \text{Analysts}_{i,q-1} \\ & + b3 * \text{InstOwnership}_{i,q-1} + b4 * \text{Book-to-Market}_{i,q-1} + b5 * \text{AbsReturn}_{i,q} \\ & + b6 * \text{Turnover}_{i,q} + b7 * \text{Spread}_{i,q} + e_{i,q,} \end{aligned} \quad (1)$$

where:

$\text{AvgNumPost}_{i,q}$ is the average of NumPost per trading day by firm i in quarter q and NumPost is calculated as log(1 + Posts per day by a firm).

$\text{Size}_{i,q-1}$ is the decile rank of size (log of total assets) for firm i in quarter q−1, scaled to vary from 0.1 to 1.0.

$\text{Analysts}_{i,q-1}$ is the log of analyst following for firm i in quarter q−1.

$\text{InstOwnerhsip}_{i,q-1}$ is shares owned by institutional investors scaled by shares outstanding for firm i in quarter q−1.

$\text{Book-to-Market}_{i,q-1}$ is the decile rank of book value of equity scaled by market value of shares outstanding for firm i in quarter q−1.

$\text{AbsReturn}_{i,q}$ is the average absolute return for firm i in quarter q.

$\text{Turnover}_{i,q}$ is the average trading volume scaled by average number of shares outstanding for firm i in quarter q.

$\text{Spread}_{i,q}$ is the difference between offer and bid, scaled by the average of offer and bid for firm i in quarter q.

As discussed in the development of our research questions, we expect posting activity to increase with firm size, analyst following, trading activity (i.e., turnover), and non-institutional ownership levels (measured inversely by InstOwnership). We apply one-quarter lags of these variables, as we also expect them to be predictive of future Facebook activity levels. We also expect posting activity to be more common as information asymmetry, measured by AbsReturn and Spread, increases. Growing companies, as measured by Book-to-Market, tend to have more information to disclose. Hence, we expect them to use Facebook to amplify their disclosures.

We estimate Eq. (1) using firm-quarter observations from our sample of identified posting firms, subject to the constraint that at least one Facebook post must have been made by the firm over the quarter. Additionally, data must be available for purposes of estimating all of the right-hand side variables in Eq. (1) for a firm-quarter to be included in the analysis. Panel A of Table 1 provides descriptive information on all of Eq. (1) variables for the 2990 firm-quarter observations that meet this constraint. Though firms average just under one Facebook post per trading day, at 0.967 posts per day, posting activity ranges as high as six posts per trading day in a quarter. Firms in our sample have an average size (total assets) of $13.55 billion and on average have 15 analysts following them. Technology firms tend to have higher analyst followings; in our sample, Broadcom, Texas Instrument, Intel, Google, and Cisco have multiple quarters with 38 or more analysts. Every firm in our sample has at least one analyst following it over the sample period. Institutional ownership averages 73.2% of outstanding shares but ranges between 0% and 100%. Panel B of Table 1 provides pairwise correlation information. In general, correlations among the variables are modest, with a notable exception being correlation involving firm size. Size is highly positively correlated with analyst following (0.601 correlation) and highly negatively correlated with spread (−0.402 correlation). Size also exhibits somewhat less pronounced negative correlations with institutional ownership (−0.304), book-to-market (−0.287) and turnover (−0.283).

Table 1

Variable	N	Mean	Std Dev	Min	P10	P25	P50	P75	P90	Max
Panel A: descriptive statistics										
Posts Per Day	172,221	0.967	1.246	0.000	0.000	0.000	1.000	1.000	3.000	6.000
Quarterly NumPost Per Day	2990	0.516	0.412	0.000	0.051	0.188	0.442	0.741	1.093	2.981
$Size_{q-1}$	2990	0.570	0.278	0.100	0.200	0.300	0.600	0.800	1.000	1.000
Number of Analysts	2990	15.378	7.505	1.000	6.000	10.000	15.000	20.000	26.000	40.000
$Analysts_{q-1}$	2990	2.668	0.526	0.693	1.946	2.398	2.708	3.045	3.296	3.689
$InstOwnership_{q-1}$	2990	0.732	0.216	0.000	0.510	0.657	0.779	0.871	0.949	1.000
$Book\text{-}to\text{-}Market_{q-1}$	2990	0.534	0.285	0.100	0.200	0.300	0.500	0.800	0.900	1.000
$AbsReturn_{q-1}$	2990	0.008	0.004	0.001	0.005	0.005	0.007	0.009	0.015	0.025
$Spread_{q-1}$	2990	0.026	0.012	0.006	0.015	0.018	0.024	0.033	0.040	0.118
$Turnover_{q-1}$	2990	0.271	0.154	0.048	0.126	0.174	0.230	0.332	0.458	1.238
$AbsAbnReturn_q$	2990	0.033	0.035	0.000	0.004	0.009	0.021	0.043	0.078	0.183
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Panel B: Correlations: Pearson (below diagonal), spearman (above diagonal)													
[1]	Posts Per Day	1	**0.617**	−0.010	**0.216**	**0.076**	0.033	**0.092**	**−0.072**	−0.009	**−0.080**	−0.022	0.017	0.038
[2]	Quarterly NumPost Per Day	**0.694**	1	**−0.080**	**−0.390**	**0.040**	0.022	**0.139**	**−0.060**	0.021	**−0.081**	−0.011	**0.067**	0.031
[3]	AbnPost[−5, −1]	0.013	**−0.081**	1	**0.123**	**0.101**	−0.002	−0.023	0.014	−0.005	0.030	−0.006	−0.033	−0.022
[4]	AbnPost[0, +1]	**0.289**	**−0.257**	**0.151**	1	**0.121**	−0.004	**−0.055**	−0.001	−0.020	−0.005	−0.008	**−0.034**	−0.021
[5]	AbnPost[+2, +5]	**0.073**	0.027	**0.099**	**0.181**	1	−0.028	**−0.040**	−0.011	0.011	−0.019	−0.006	−0.008	−0.013
[6]	$Size_{q-1}$	0.034	0.035	0.000	0.000	−0.020	1	**0.601**	**−0.304**	**−0.287**	0.007	**−0.402**	**−0.283**	**−0.196**
[7]	$Analysts_{q-1}$	**0.044**	**0.084**	−0.031	**−0.048**	−0.034	**0.592**	1	**−0.038**	**−0.139**	−0.026	**−0.084**	**0.140**	**−0.077**
[8]	$InstOwnership_{q-1}$	**−0.067**	**−0.066**	0.009	0.002	−0.019	**−0.140**	**0.091**	1	0.033	0.018	**0.267**	**0.363**	**0.114**
[9]	$Book\text{-}to\text{-}Market_{q-1}$	0.002	0.031	−0.014	−0.035	0.010	**−0.295**	**−0.154**	0.033	1	−0.013	**0.224**	**0.066**	**0.095**
[10]	$AbsReturn_{q-1}$	**−0.048**	**−0.050**	0.011	−0.011	−0.022	0.007	−0.021	0.023	−0.010	1	**0.423**	0.022	**0.114**
[11]	$Spread_{q-1}$	−0.017	−0.023	−0.017	−0.006	−0.019	**−0.412**	**−0.155**	**0.107**	**0.237**	**0.446**	1	**0.561**	**0.331**
[12]	$Turnover_{q-1}$	−0.002	0.022	−0.035	−0.011	−0.011	**−0.261**	**0.095**	**0.180**	**0.082**	−0.015	**0.512**	1	**0.191**
[13]	$AbsAbnReturn_q$	0.011	0.008	−0.005	−0.013	−0.018	**−0.256**	**−0.129**	**0.058**	**0.116**	**0.115**	**0.384**	**0.185**	1

Notes: Size and book-to-market are rank variables; scaled to vary from 0.1 to 1.0. Bold coefficients are significant at less than 5%.

Table 2
This table shows the regression results based on Firm-Year-Quarter average values from 2009 to 2012. The dependent variable is AvgNumPost, which is the quarterly average of the daily log (1 + posts per day) for each firm and year-quarter.

	AvgNumPost			
Variable	Estimate		Estimate	
$Size_{q-1}$	0.043		0.054	
	(0.038)		(0.039)	
$Analysts_{q-1}$	0.041	**	0.041	**
	(0.019)		(0.019)	
$InstOwnership_{q-1}$	−0.102	***	−0.101	***
	(0.035)		(0.035)	
$Book\text{-}to\text{-}Market_{q-1}$	0.049	*	0.044	
	(0.027)		(0.027)	
$AbsReturn_q$	−1.576		−2.521	
	(11.892)		(11.933)	
$Turnover_q$	0.198	***	0.168	***
	(0.053)		(0.061)	
$Spread_q$			1.015	
			(1.062)	
N	2990		2990	
Adjusted R^2	7.6%		7.5%	
Fixed effects	Yr-Qtr		Yr-Qtr	

Notes: Quarterly beginning values are used for size, analyst following, institutional ownership, and book-to-market. Quarterly decile ranks are used for size and book-to-market. Quarterly averages are used for absolute return, spread, and turnover. Standard errors are shown in parenthesis. Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Table 2 reports our estimates of Eq. (1). We find that analyst following is positively associated with average posting behavior. This implies that firms with higher analyst following, i.e., firms that have higher demand for information, tend to disclose more information through their Facebook pages. The negative association between institutional ownership and average number of posts implies that companies disclose more on their Facebook pages as the percent of individual ownership increases, or, equally, as the percent of institutional ownership decreases.[6] The positive association between quarterly average turnover and average number of posts indicates that companies disclose more on their Facebook pages when their trading volume levels are high.[7]

5.2. Announcement-period posting

We examine announcement-period posting behavior for 2314 of the previous section's 2990 firm-quarter observations for which we could locate quarterly earnings announcement information. We primarily use quarterly earnings announcement days (RDQ) as reported in IBES. For quarterly earnings announcement dates not available on IBES, we use earnings announcement dates from Capital IQ's Key Development database. We measure the level of abnormal announcement-period posting activity based on differences between firm announcement-period posting levels and firm non-announcement-period posting levels. We measure daily abnormal posting activity as:

[6] Family-run firms are also argued to influence firm disclosure choices (e.g., Ali et al., 2007). In a further robustness analysis, we also controlled for whether a firm was family-owned by including an indicator variable for those firms where family members hold>5% of the firm's shares based on data available from Professor Ron Anderson, Temple University. (http://www.ronandersonprofessionalpage.net/data-sets.html). While this variable itself is positive and significant (mirroring the association found for non-institutional ownership level) in this analysis, its inclusion has little impact on the results we report. (In the Table 4 analysis of announcement level activity, it lacks statistical significance.).

[7] In further robustness analysis, available upon request, we find that similar results (arguably weak for analyst following) when we replace the one-quarter lags of analyst following and institutional ownership with their values in the quarter prior to the firm becoming Facebook active. This robustness is consistent with a causal interpretation of the impact of these two variables, as the pre-Facebook levels are, as a matter of structure, not determined by actual Facebook posting activity levels.

$AbnPost_t$ = Log(1 + number of posts on day t) – average of prior and post ten week same weekday as announcement day t log(1 + number of posts).

Multi-day values for *AbnPost* are constructed as averages of these daily values.

Fig. 2 presents daily values of *AbnPost* for the 61-trading-day period centered on the announcement date (day 0). As expected, there is a noticeable spike in posting activity on the earnings announcement day. This spike is consistent with firms using Facebook posting to amplify their earnings disclosures.

Table 3 reports mean values for *AbnPost* in the immediate pre-announcement (days −5 to −1), announcement (days 0 to +1), and post-announcement (days +2 to +5) periods. There is no evidence of any sort of change in firm posting activity in the pre-announcement period, as average *AbnPost* is indistinguishable from 0 in this period. As expected, the average value for *AbnPost* increases substantially in the immediate announcement period. In days 0 to +1, the observed mean of *AbnPost* is 0.033, which is significant at the 0.001 level. Finally, in the post-announcement period, abnormal posting levels are positive and marginally significant (p value of 0.092), indicating the presence of some lingering posting activity from earnings announcements.

The second line of the table evaluates the abnormal level of non-earnings-related posting activity taking place during the announcement period. We measure this activity by removing announcement-related posts, i.e., posts that explicitly mention earnings news, from our daily posting measure as follows:

$Non\text{-}EarnAbnPost_t$ = Log(1 + number of posts without EarnPost on day t) – average of prior and post ten week same weekday as announcement day t log(1 + number of posts without EarnPost).

EarnPost in this expression is the number of "earnings posts" by a firm on day t, which we identify by means of a text search of around 110 earnings- and performance-related text strings. We identified these text

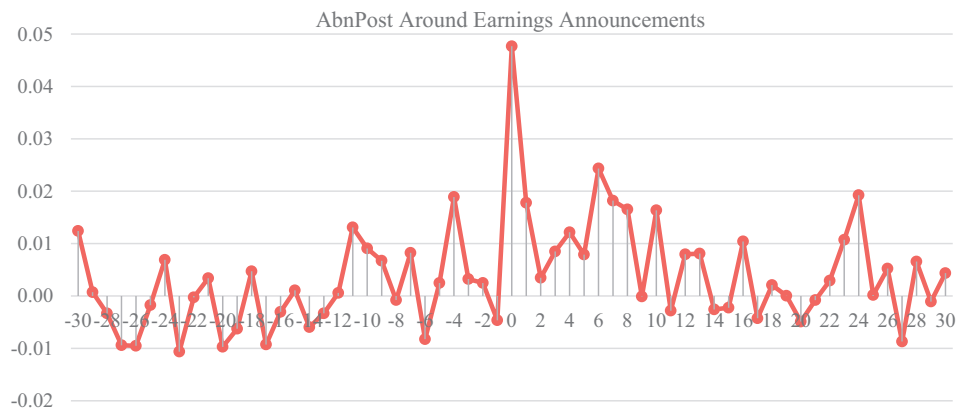


Fig. 2. The average abnormal posting behavior of sample firms around earnings announcements. Day 0 is the earnings announcement day. Abnormal post captures the idiosyncratic posting behavior of companies. AbnPost = Log (1 + Number of posts on a day by a firm) – (Average of prior and post 10-week same weekday Log (1 + number of posts)).

Table 3
Announcement-period abnormal posting activity.

Measure of posting activity	Days relative to announcement		
	Days −5 to −1	Days 0 to + 1	Days + 2 to + 5
	Mean	Mean	Mean
AbnPost	0.003	0.033***	0.007*
	(0.004)	(0.006)	(0.004)
Non-EarnAbnPost	NA	0.007	0.008*
		(0.007)	(0.004)

Notes: Non-earnings abnormal posts per day is calculated based only on the number of posts that do not include any earnings- or performance-related texts. Non-EarnAbnPost = Log (1 + non-earnings posts on a day by a firm) – (Average of prior and post 10 week same weekday Log (1 + number of non-earnings posts)). Non-EarnAbnPost[t, t + n] = Average Non-EarnAbnPost from day t to day t + n. Standard errors are shown in parenthesis. Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

Table 4
Firm characteristics and announcement-period posting activity.

Firm variable	Overall abnormal posting Days relative to announcement		Decomposition of announcement period (Days 0 to +1) Posts	
	Days −5 to −1	Days 0 to +1	Non-earnings	Earnings[a]
$Size_{q-1}$	0.030	0.044	0.028	−0.318
	(0.027)	(0.027)	(0.028)	(0.375)
$Analysts_{q-1}$	−0.017	−0.043***	−0.044***	−0.264*
	(0.012)	(0.013)	(0.013)	(0.139)
$InstOwnership_{q-1}$	−0.035	0.014	0.019	−0.140
	(0.025)	(0.026)	(0.026)	(0.367)
$Book\text{-}to\text{-}Market_{q-1}$	−0.020	0.003	0.007	0.425
	(0.019)	(0.021)	(0.021)	(0.265)
$AbsReturn_{q-1}$	37.952	−4.656	−3.923	192.618
	(27.072)	(17.638)	(17.547)	(313.432)
$Spread_{q-1}$	0.298	−1.773*	−1.930**	−2.694
	(0.828)	(0.912)	(0.889)	(10.398)
$Turnover_{q-1}$	−0.053	0.047	0.036	0.245
	(0.046)	(0.053)	(0.052)	(0.510)
FourthQtr	0.000	0.025	0.025	0.107
	(0.016)	(0.017)	(0.017)	(0.246)
N	2312	2312	2312	2312
Adjusted R^2 or Psuedo R^2	0.73%	0.81%	0.94%	2.18%

Notes: All regressions include fixed effects for year-quarter. Cluster-adjusted (by firm) standard errors are in parentheses except for final column, where logistic standard errors are reported. Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

[a]Earnings posts are measured as the presence or absence of any post mentioning earnings-related keywords in the day 0 to +1 window. Hence, the linear equation is estimated using logit regression rather than OLS regression.

strings by reading the Facebook posts of our sample firms around earnings announcements. Illustrative text strings so identified include earnings, exceeded target, financial performance, quarterly revenues, and record progress.[8] *Non-EarnAbnPost* is indistinguishable from 0 in the immediate announcement period (days 0 to +1) and marginally significant (p value of 0.073) in the post-announcement period (days +2 to +5). Hence, there is no indication in our data that firms, on average, engage in additional non-earnings posting activity as a means of distracting from earnings news.

5.2.1. Announcement-period posting and firm characteristics

We examine how firm characteristics affect announcement-period posting activity by estimating equations of the form:

$$\begin{aligned}\text{AbnPost Measure}_{i,t} = {} & c0 + c1 * \text{Size}_{i,q-1} + c2 * \text{Analysts}_{i,q-1} + c3 * \text{InstOwnership}_{i,q-1} \\ & + c4 * \text{Book-to-Market}_{i,q-1} + c5 * \text{AbsReturn}_{i,q-1} + c6 * \text{Spread}_{i,q-1} \\ & + c7 * \text{Turnover}_{i,q-1} + c8 * \text{FourthQtr} + \text{Fixed Year/Qtr.Effects} + e_{i,t,} \end{aligned} \quad (2)$$

Abnormal Post Measures examined are *AbnPost*, *Non-EarnAbnPost,* and an indicator variable, *Earnings*, for firms that make at least one earnings post. We do not consider the post-announcement (days +2 to +5) period in this portion of our analysis, as the Table 3 results suggest that posting activity during this period is largely unaffected by the earnings event. All independent variables in this analysis are lagged, consistent with our objective of assessing the degree to which they predict heightened announcement-period trading levels.

Table 4 reports our estimations of Eq. (2). In the pre-announcement period, we observe no statistically significant evidence of relations between abnormal posting activity levels and any of the variables considered in

[8] We identified 766 posts, for 283 different firm earnings announcements, in the day 0 to +5 period that contain earnings-related information. These posts are highly concentrated in the day 0 to +1 period with<1% of them falling in the day +2 to +5 period.

Table 5

Abnormal post means	AFE surprise				SRWFE surprise			
News	N	All posts	Non-earn posts	Mean abnormal return	N	All posts	Non-earn posts	Mean abnormal return
Panel A: announcement-period posting activity conditional on earnings news								
Good	1603	**0.040*****	0.011	0.002*	1513	**0.039*****	0.011	0.004***
(Std. Error)		(0.007)	(0.007)	(0.001)		(0.007)	(0.008)	(0.001)
Bad	536	**0.028****	0.005	−0.004*	728	**0.021****	−0.001	−0.008***
(Std. Error)		(0.012)	(0.012)	(0.0023)		(0.010)	(0.011)	(0.002)
"Neutral" News	175	−0.016	−0.032	−0.005*	73	0.026	−0.001	0.004
(Std. Error)		(0.020)	(0.020)	(0.003)		(0.019)	(0.035)	(0.004)

Abnormal post means	AFE surprise			SRWFE surprise		
News-return	N	All posts	Non-earn posts	N	All posts	Non-earn posts
Panel B: Announcement-period posting conditional on market response						
Mean abnormal posting conditional on news and market return direction						
Good News, Pos. Ret.	862	**0.038*****	0.012	808	**0.035*****	0.009
(Std. Error)		(0.010)	(0.010)		(0.010)	(0.010)
Good News, Neg. Ret.	741	**0.042*****	0.011	705	**0.043*****	0.013
(Std. Error)		(0.011)	(0.011)		(0.011)	(0.011)
Bad News, Pos. Ret.	241	0.001	−0.012	330	0.018	0.001
(Std. Error)		(0.018)	(0.018)		(0.016)	(0.016)
Bad News, Neg. Ret.	295	**0.050*****	0.019	398	0.023	−0.003
(Std. Error)		(0.016)	(0.016)		(0.014)	(0.014)

Notes: Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. For all posts and non-earnings posts, the t-statistic is for the hypothesis that the mean is less than or equal to zero. Mean abnormal return shows size-adjusted abnormal return for each category.

Eq. (2). In the announcement period itself, however, both analyst following and average pre-announcement period spread are negatively related to overall posting levels. The analyst relation is consistent with the idea that firms view analyst following as a substitute channel for distributing earnings news to interested external parties.[9] The spread relation is inconsistent with the notion that firms respond to high pre-existent information asymmetry levels by raising their posting activity levels during announcement periods.

5.2.2. Posting activity and earnings news

We examine the relation between the directional nature of the earnings news being disclosed and announcement-period posting based on analyst consensus forecast error (AFE) and seasonal random walk forecast error (SRWFE). We classify a forecast error greater (less) than zero, i.e., actual earnings are greater (less) than the consensus forecast or seasonal random walk expectation, as good news (bad news). We identify forecast errors that equal zero, i.e., firms have exactly met earnings expectations, as (nominally) "neutral" news.

Table 5 (Panel A) shows that firms post more frequently during earnings announcements periods when the earnings news is either good or bad. This finding is true for surprises based on both analyst forecast error and seasonal random walk forecast error. However, when we take out earnings-related posts and keep only non-earnings posts, we do not find any evidence of firms increasing their non-earnings posting activity around earnings announcements. These findings suggest that, on average, companies amplify disclosure of both good news and bad news, and there is no evidence that they attempt to distract the market with unrelated information around earnings announcements.

[9] In further robustness analysis, available upon request, when we replace the one-quarter lags of analyst following and institutional ownership with their values in the quarter prior to the firm becoming Facebook active, we continue to find negative relations between analyst following and Facebook earnings posting activity and positive relations between such activity and institutional ownership levels.

In the case of AFE-based neutral news, however, mean abnormal posting levels are negative, albeit not statistically significantly so (at conventional levels). One possible explanation for such lower posting levels is that the earnings news is not surprising. That is, earnings that simply meet expectations are not news, and so the firm opts not to post about it. However, this perspective is inconsistent with the market response evidence provided in the table. The mean abnormal return for the "just meeting the forecast" news group is −0.005, which, in terms of absolute magnitude, is larger than the estimated mean abnormal returns observed for either the goods news (+0.002) or bad news (−0.004) groups. That is, there is little indication that earnings announcements just meeting forecasts are somehow less informative relative to other announcement types.

Panel B of Table 5 reports how posting behavior varies conditional on the direction of earnings news in conjunction with contemporaneous stock price movements.[10] The categories are as follows:

Good News Positive Return (GNPR); unexpected earnings > 0 and stock return > 0,

Good News Negative Return (GNNR); unexpected earnings > 0 and stock return < 0,

Bad News Positive Return (BNPR); unexpected earnings < 0 and stock return > 0, and

Bad News Negative Return (BNNR); unexpected earnings < 0 and stock return < 0.

The results in Panel B indicate that posting activity increases significantly (at the 0.01 level) for all of the AFE-based surprise categories, except BNPR. Moreover, the highest level of increase occurs for the BNNR category. Not surprisingly, firms reporting good news increase their posting activity irrespective of contemporaneous price movements, but firms experiencing bad (AFE-based) news avoid amplifying such news via posting activity when the contemporaneous market price movement is favorable. These implications are further confirmed in (untabulated) analyses of group mean difference, where we find that the posting activity for BNPR announcements is significantly lower (0.10 level or better) relative to each of the other three announcement categories. These results are consistent with firms avoiding amplifying unfavorable news when it is contrary to the market's contemporaneous valuation assessments of the firm.

It is less clear, however, that SRWFE-based news is a salient factor in this price movement-conditioned setting. Abnormal posting levels for the GNPR and GNNR categories are positive and significant (at the 0.01 level) and of similar magnitudes, while the BNPR and BNNR categories both lack significance but also are of similar magnitudes. Hence, there is little indication that posting behavior is being conditioned on price. This inference is confirmed in (untabulated) analyses of mean differences between BNPR posting levels and posting levels for the other three categories of announcements. Specifically, there is no indication of any significant differences in SRWFE-based BNPR posting levels and the posting levels for any of the other three categories.

The evidence in Table 5 suggests that AFE-based earnings surprises are a possible determinant of announcement-period posting activity. We formally examine this possibility by incorporating new direction indicator variables into Eq. (2) as follows:

$$\begin{aligned}\text{AbnPost Measure}_{i,t} = {} & c0 + c1 * \text{GoodNews} + c2 * \text{BadNews} + c3 * \text{Size}_{i,q-1} + c4 * \text{Analysts}_{i,q-1} \\ & + c5 * \text{InstOwnership}_{i,q-1} + c6 * \text{Book-to-Market}_{i,q-1} + c7 * \text{AbsReturn}_{i,q-1} \\ & + c8 * \text{Spread}_{i,q-1} + c9 * \text{Turnover}_{i,q-1} + c10 * \text{AbsEarnSurprise}_{i,q} \\ & + c11 * \text{AbsDiscAccruals}_{i,q} + c12 * \text{AbsAbnReturn}_{i,q} \\ & + c13 * \text{Announcements}_{i,q} + c14 * \text{FourthQtr} + \text{Fixed Year/Qtr. Effects} + e_{i,t,}\end{aligned} \tag{3}$$

The reference category in this specification is neutral (AFE-based) news announcements. Hence, the GoodNews and BadNews coefficients reflect differences in posting levels for these categories relative to the neutral

[10] In additional supplemental analyses, available upon request, we use the signs of unexpected market model and Carhart four factor adjusted returns to classify announcements. These results are substantively identical to the direction of raw returns approach used in our reported analyses.

news category. In terms of overall posting, the GoodNews and BadNews coefficients are each positive and highly significant (at the 0.01 level). Hence, consistent with Table 5, firms are more likely to post about earnings when the news differs from the analyst forecast expectation. When we restrict the examination to non-earnings posting activity, we again observe positive coefficients for both good and bad news. In this case, however, only the GoodNews coefficient is statistically significant at conventional levels. The final rows of the table report our findings of whether there is any difference between the increases in posting behavior for good vs. bad news for each of the models. The results show that increases in posting behavior for earnings announcements are not different between GoodNews and BadNews at conventional levels of significance. Hence, we do not find reliable evidence of differences in announcement-period posting activity conditional on the nominal direction of news.

We next examine posting activity conditional on earnings news and stock return directions. For this analysis, we insert the news-return categories as defined in Table 5, Panel B into Eq. (2) as follows:

$$\begin{aligned}\text{AbnPost Measure}_{i,t} = {} & c0 + c1 * \text{GoodNews\_PosRet} + c2 * \text{GoodNews\_NegRet} \\ & + c3 * \text{BadNews\_PosRet} + c4 * \text{BadNews\_NegRet} + c5 * \text{Size}_{i,q-1} \\ & + c6 * \text{Analysts}_{i,q-1} + c7 * \text{InstOwnership}_{i,q-1} + c8 * \text{Book-to-Market}_{i,q-1} \\ & + c9 * \text{AbsReturn}_{i,q-1} + c10 * \text{Spread}_{i,q-1} + c11 * \text{Turnover}_{i,q-1} \\ & + c12 * \text{AbsEarnSurprise}_{i,q} + c13 * \text{AbsDiscAccruals}_{i,q} \\ & + c14 * \text{AbsAbnReturn}_{i,q} + c15 * \text{Announcements}_{i,q} \\ & + c16 * \text{FourthQtr} + \text{Fixed Year/Qtr.Effects} + e_{i,t,} \end{aligned} \quad (4)$$

The results from this analysis are consistent with the Table 5 evidence. Firms that miss analyst forecasts but see positive associated price movements are less likely to post on Facebook relative to other announcing firms, with the exception of firms that exactly meet forecasts (which, as seen in Table 6, are also less likely than other firms to post during announcement periods). As the reported coefficient test statistics measure relative differences with the "just meet the forecast" baseline group, the relevant statistical test of the BadNews_x_Pos.Ret. group is based on an F-test that the BadNews_x_Pos.Ret. coefficient differs from the (weighted) average of the other three coefficients. We combine the other three news-return categories (GoodNews-Pos.Ret, GoodNews-Neg.Ret., and BadNews-Neg.Ret.) into one indicator variable, which takes a value of 1 whenever any of these three news-return categories takes a value of 1, and 0 otherwise; in this way, we create a weighted average category for these three groups. Next, we perform tests of coefficient difference between the combined group and the BadNews_x_Pos.Ret group. Our results support our previous finding that firms amplify their earnings news with disclosures on Facebook, except when they miss the consensus forecast but the price reaction stays positive.

We also examine corporate Facebook posting behavior for earnings-related posts around earnings announcements conditional on news-return relations. We use logistic regression to estimate a version of Eq. (4) where the dependent variable is simply an indicator as to whether the firm made an earnings post during the day −1 to +1 announcement period. The results for this estimation are reported in Table 8, and they largely parallel Table 7 findings. In particular, the estimated coefficients for the BadNews_x_Pos.Ret. category are smaller than those for the other three non-neutral news categories, and the overall difference between each of them and the collective weighted average across the other three categories is significant at the 0.05 level.

5.3. Supplemental analyses

5.3.1. Earnings quality and announcement period posting

Earnings quality has been shown to be related to voluntary disclosures (Francis et al., 2008). For instance, firms with high-quality earnings may be more inclined to post about them. In an untabulated analysis, we explore this possibility by dividing the sample into two separate subsamples based on abnormal accrual-based earnings quality. We then estimate Eq. (4) for each sub-sample. We follow Kothari et al. (2005) to calculate performance-matched discretionary accruals. Observations with absolute discretionary accruals less than the median are grouped into the high-earnings-quality subsample, while the rest are grouped into the

Table 6
Announcement-period abnormal posting activity by news direction.

	All posts		Non-earnings posts	
	(1)	(2)	(3)	(4)
GoodNews	0.074***	0.072***	0.052**	0.054**
	(0.019)	(0.019)	(0.021)	(0.022)
BadNews	0.070***	0.069***	0.038	0.039
	(0.021)	(0.022)	(0.023)	(0.024)
$Size_{q-1}$		0.040		−0.023
		(0.030)		(0.033)
$Analysts_{q-1}$		−0.048***		−0.009
		(0.014)		(0.016)
$InstOwnership_{q-1}$		0.030		−0.011
		(0.027)		(0.029)
$Book\text{-}to\text{-}Market_{q-1}$		0.010		−0.010
		(0.022)		(0.025)
$AbsReturn_{q-1}$		−1.627		23.233
		(17.446)		(31.914)
$Spread_{q-1}$		−3.110***		−2.642***
		(0.892)		(1.009)
$Turnover_{q-1}$		0.059		0.073
		(0.053)		(0.051)
$AbsEarnSurprise_q$		0.273		0.222
		(0.216)		(0.279)
$AbsDiscAccruals_q$		0.029		0.035
		(0.043)		(0.034)
$AbsAbnReturn_q$		−0.014		−0.124
		(0.171)		(0.191)
$Announcements_q$		0.005**		−0.000
		(0.002)		(0.002)
FourthQtr		0.018		−0.023
		(0.017)		(0.021)
N	2108	2108	2108	2108
Adjusted R^2	0.8%	2.08%	1.71%	1.82%
p-value for F-Test of GoodNews vs. BadNews[1]	0.400	0.414	0.165	0.147

Notes: All regressions include fixed effects for year-quarter. Cluster-adjusted (by firm) standard errors are reported in parentheses. Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

[1] We perform coefficient difference tests to check whether good news earnings announcements affect companies' posting behavior on Facebook differently than bad news earnings announcements. We report the probabilities (Prob. > F) for tests with a null hypothesis that these coefficients are not different.

low-earnings-quality subsample. While the estimated likelihoods that firms engage in posting activity are higher (generally around 40%) for the higher-quality subsample, these differences lack statistical significance.

5.3.2. Announcement-period spread effects

Blankespoor et al. (2014) show that tweeting activities around information events (earnings and non-earnings press releases) reduce information asymmetry for low-visibility technology firms. In an untabulated analysis, we explore whether Facebook posts are related to earnings announcement asymmetry by estimating the following model to examine this relationship:

$$\begin{aligned} AbnSpread_{i,[-1,+1]} = {} & c0 + c1 * Posting\ Measure + c2 * Size_{i,q} + c3 * Analysts_{i,q-1} \\ & + c4 * InstOwnership_{i,q-1} + c5 * Book\text{-}to\text{-}Market_{i,q-1} + c6 * AbsReturn_{i,q-1} \\ & + c7 * Turnover_{i,q-1} + c8 * Spread_{i,q-1} + Fixed\ Year/Qtr.Effects + e_{i,t,} \end{aligned} \quad (5)$$

Table 7
Announcement-period abnormal posting activity by news and return direction.

	All posts		Non-earnings posts	
	(1)	(2)	(3)	(4)
GoodNews_x_Pos.Ret.	0.066***	0.063***	0.037*	0.037*
	(0.019)	(0.020)	(0.021)	(0.022)
GoodNews_x_Neg.Ret.	0.081***	0.082***	0.051**	0.060***
	(0.020)	(0.020)	(0.022)	(0.022)
BadNews_x_Pos.Ret.	0.041*	0.036	0.013	0.015
	(0.024)	(0.025)	(0.026)	(0.027)
BadNews_x_Neg.Ret.	0.090***	0.092***	0.042*	0.044*
	(0.024)	(0.024)	(0.025)	(0.026)
$Size_{q-1}$		0.037		−0.025
		(0.030)		(0.033)
$Analysts_{q-1}$		−0.047***		−0.008
		(0.014)		(0.016)
$InstOwnership_{q-1}$		0.028		−0.011
		(0.027)		(0.029)
$Book\text{-}to\text{-}Market_{q-1}$		0.009		−0.011
		(0.022)		(0.025)
$AbsReturn_{q-1}$		−1.433		23.547
		(17.371)		(31.981)
$Spread_{q-1}$		−3.049***		−2.609***
		(0.890)		(1.006)
$Turnover_{q-1}$		0.058		0.071
		(0.053)		(0.051)
$AbsEarnSurprise_q$		0.261		0.213
		(0.214)		(0.277)
$AbsDiscAccruals_q$		0.030		0.036
		(0.044)		(0.034)
$AbsAbnReturn_q$		−0.014		−0.121
		(0.170)		(0.190)
$Announcements_q$		0.005***		−0.000
		(0.002)		(0.002)
FourthQtr		0.019		−0.023
		(0.017)		(0.021)
N	2108	2108	2108	2108
Adjusted R^2	0.98%	2.37%	1.67%	1.84%
p-value for F-test for difference of Avg.(GoodxPos., GoodxNeg. & BadxNeg.) vs. BadxPos. Ret.[2]	0.025	0.007	0.059	0.053

Notes: All regressions include fixed effects for year-quarter. Cluster-adjusted (by firm) standard errors are reported in parentheses. Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

[2] We perform coefficient difference tests to check whether companies' posting behavior on Facebook is different between bad-news-positive-return earnings announcements and a combined group of the other three news-return categories. We report the probabilities (Prob. > F) for tests with a null hypothesis that these coefficients are not different.

We use the announcement-period [−1, +1] abnormal spread, *AbnSpread*, as the measure for information asymmetry, closely following Blankespoor et al. (2014). We construct *AbnSpread[−1,+1]* as the event-period three-day average spread minus the pre-event-period average spread, where the pre-event-period includes the three-week period, two weeks prior to the earnings announcement date. We examine the influence of Facebook posting activity on information asymmetry with three different posting measures: (i) *AbnPost [−1, +1],* which is abnormal posting for the three-day period around the earnings announcement, (ii) *AbnPost[0, +1],* which is abnormal posting on the day of the earnings announcement and the day after, and (iii) *EarningsPost[0, +1],* which takes a value of 1 if there was at least one post that contained earnings- or performance-related content on the announcement day or the day after.

Table 8
Announcement-period abnormal posting activity by news and return direction.

	Earnings posts (logit regression)	
	(1)	(2)
GoodNews_x_Pos.Ret.	0.660*	0.575*
	(0.347)	(0.348)
GoodNews_x_Neg.Ret.	0.876**	0.790**
	(0.344)	(0.347)
BadNews_x_Pos.Ret.	0.380	0.218
	(0.410)	(0.414)
BadNews_x_Neg.Ret.	0.717*	0.532
	(0.380)	(0.383)
$Size_{q-1}$		−0.173
		(0.388)
$Analysts_{q-1}$		−0.241
		(0.152)
$InstOwnership_{q-1}$		0.211
		(0.430)
$Book\text{-}to\text{-}Market_{q-1}$		0.927***
		(0.275)
$AbsReturn_{q-1}$		360.455
		(349.889)
$Spread_{q-1}$		−25.814**
		(10.530)
$Turnover_{q-1}$		0.037
		(0.575)
$AbsEarnSurprise_q$		0.615
		(2.242)
$AbsDiscAccruals_q$		−0.239
		(0.319)
$AbsAbnReturn_q$		4.043**
		(1.955)
$Announcements_q$		0.050**
		(0.025)
FourthQtr		0.101
		(0.259)
N	2108	2108
Pseudo R^2	1.8%	4.2%
P-value for χ^2 test of Avg. (GoodxPos., GoodxNeg. & BadxNeg.) − BadxPos.Ret.[3]	0.046	0.030

Notes: All regressions include fixed effects for year-quarter. Cluster-adjusted (by firm) standard errors are reported in parentheses. Statistical significance is represented by *, **, and *** for $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively.

[3] We perform coefficient difference tests to check whether companies' posting behavior on Facebook is different between bad-news-positive-return earnings announcements and a combined group of the other three news-return categories. We report the probabilities (Prob. > Chi^2) for tests with a null hypothesis that these coefficients are not different.

We do not find any statistically significant evidence of event-period Facebook posting activities *(AbnPost [−1, +1], AbnPost[0, +1], and EarningsPost[0, +1])* having any significant association with event-period information asymmetry, *AbnSpread[−1, +1]*.

6. Conclusion

Along with the advent of network-based information dissemination mechanisms, there has arisen a need to understand how such mechanisms are used by corporations to convey information to the public. Facebook is one such rapidly expanding mechanism. In our sample, monthly posts by Facebook-active firms rose from fewer than five per month in early 2009 to over 25 per month by the end of 2012. Moreover, a firm's level of Facebook activity is directly connected to factors associated with equity investor demand for firm-specific information, i.e., trading volume and analyst following. It is also directly connected to individual

investor ownership levels, suggesting that such posting activity is particularly valued by individual investors interested in obtaining firm-specific information.

We also find that firms use Facebook to amplify the disclosure of earnings news. Facebook posting activity increases markedly around earnings announcements, with much of the increase attributable to posts containing earnings news. There are, however, three notable exceptions to this general finding regarding the disclosure-amplifying use of Facebook. First, firms that have high levels of pre-disclosure information asymmetry as reflected by their bid-ask spreads avoid making posts of any type during earnings announcement periods. Arguably, their silence in these periods is an underlying driver of their high asymmetry state. Second, firms reporting unfavorable earnings news avoid posting about earnings on Facebook when the contemporaneous price movement is positive. That is, they avoid calling attention to unfavorable price-contrarian information. Third, firms reporting earnings that precisely equal the analyst forecast consensus also avoid posting about earnings on Facebook. A possible explanation here is that they wish to avoid calling attention to just how close they came to falling short of the forecast. Such attention might be particularly unwelcome if the firm used earnings management to just meet the forecast number, a practice widely documented in the literature.

The latter two exceptions to the general finding that firms use Facebook to amplify earnings news have important implications for the voluntary disclosure literature. This literature, in assessing factors affecting voluntary disclosure choices by firms, generally focuses on rather straightforward motivations such as whether the news that is available for disclosure is unconditionally good or bad. Our findings, however, suggest that factors guiding disclosure choices are more complex. Firms do not avoid amplifying all bad news announcements, only those that are price-contrarian. Consequently, we find little evidence of a general relation between news direction and the disclosure amplification decision. Similarly, just meeting the consensus forecast, which is nominally a good outcome, actually drives firms to actively avoid voluntary actions to bring attention to it.

Appendix A.

Variable definitions

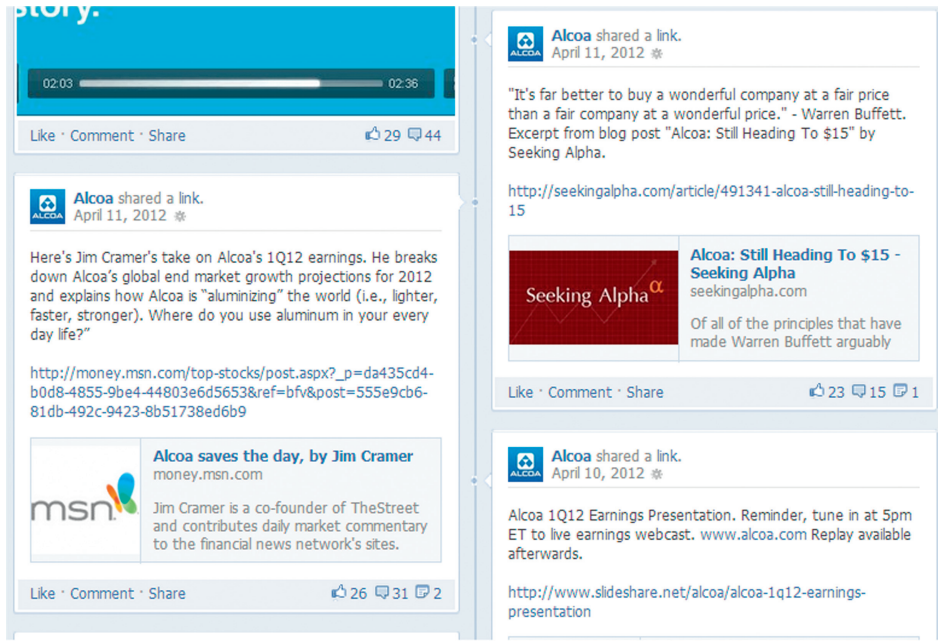
Variable	Description	Source
Posts Per Day	Total number of posts on a day by a firm	Facebook pages
NumPost	Log (1 + Posts Per day by a firm)	Facebook pages
AbnPost	[(NumPost on a day) − (Average of prior and post 10 week same weekday NumPost)]	Facebook pages
AbnPost[t, t + n]	Average AbnPost for the window t to t + n	
EarningsPost	1, if the Facebook post contains earnings- or performance-related texts; 0 otherwise	Facebook pages
Non-Earn Posts	Number of Facebook posts that do not contain earnings-related texts on a day by a firm	Facebook pages
AFE	Analyst consensus forecast error. Calculated as (Actual EPS – Median consensus earnings forecast)/Price	IBES
SRWFE	Seasonal random walk forecast error. Calculated as (Actual EPS – Prior year same quarter actual EPS)/Price	IBES
Good News	1, if earnings surprise > 0; 0 otherwise	IBES
Bad News	1, if earnings surprise < 0; 0 otherwise	IBES
Neutral News	1, if earnings surprise = 0; 0 otherwise	IBES
Good News, Pos. Ret.	1, if earnings surprise > 0 and return > 0; 0 otherwise	IBES & CRSP
Good News, Neg. Ret.	1, if earnings surprise > 0 and return < 0; 0 otherwise	IBES & CRSP

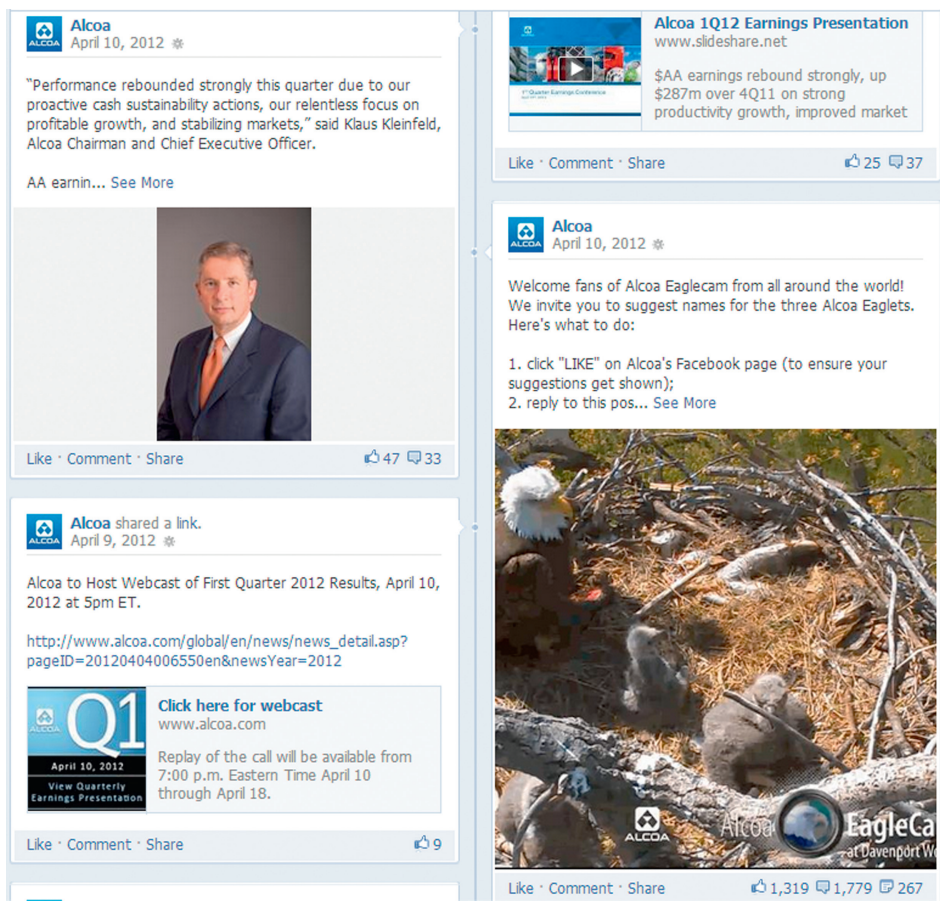
Bad News, Pos. Ret.	1, if earnings surprise < 0 and return > 0; 0 otherwise	IBES & CRSP
Bad News, Neg. Ret.	1, if earnings surprise < 0 and return < 0; 0 otherwise	IBES & CRSP
$AbsAbnReturn_q$	Absolute value of the difference between the actual stock return (RET) on the earnings announcement day of quarter q for a firm, minus the size-adjusted return, calculated as the average return within each size decile for each quarter	CRSP
$AbsEarnSurprise_q$	Absolute value of actual earnings minus the analyst median consensus scaled by price	IBES & CRSP
$AbsDiscAccruals_q$	Absolute value of performance matched discretionary accruals as suggested by Kothari et al. (2005)	Compustat
$AbsReturn_q$	Quarterly average of the absolute return, where the return is the absolute value of daily return (RET)	CRSP
$AbsReturn_{q-1}$	Previous quarter's average absolute return	
$Analysts_q$	Log (1 + number of analysts)	IBES
$Analysts_{q-1}$	Previous quarter's analysts	IBES
$Announcements_q$	Quarterly decile rank of number of announcements made by the company on day t	Capital IQ
$Book\text{-}to\text{-}Market_q$	Quarterly decile rank of the book-to-market ratio, scaled to vary from 0.1 to 1. Where Book-to-Market is the book value of equity divided by the market value of shares outstanding; [CEQQ/(PRCCQ*CSHOQ)]	CRSP-Compustat
$Book\text{-}to\text{-}Market_{q-1}$	Previous quarter's book-to-market	CRSP-Compustat
FourthQtr	Indicator variable taking the value of 1 for the 4th fiscal quarter	CRSP
$InstOwnership_q$	Shares owned by institutional investors scaled by shares outstanding	Thomson Reuters
$InstOwnership_{q-1}$	Previous quarter's InstOwnership	Thomson Reuters
$Size_q$	Quarterly decile rank of size for each firm, scaled to vary from 0.1 to 1.0. Where size is Log of Total Assets (ATQ)	CRSP-Compustat
$Size_{q-1}$	Previous quarter's size	CRSP-Compustat
$Spread_q$	Quarterly average value of spread. Where spread is (Offer – Bid)/((Offer + Bid)/2)	CRSP
$Spread_{q-1}$	Previous quarter's average spread	CRSP
$Turnover_q$	Quarterly average trading volume, scaled by average number of shares outstanding	CRSP
$Turnover_{q-1}$	Previous quarter's average turnover	CRSP

Example of disclosures around earnings announcements

Exhibit 1: ALCOA

Joined Facebook in July 2008. Posts around April 10, 2012 earnings announcement.


02:03
02:36
Like · Comment · Share
29 44
Alcoa shared a link.
April 11, 2012
Here's Jim Cramer's take on Alcoa's 1Q12 earnings. He breaks down Alcoa's global end market growth projections for 2012 and explains how Alcoa is "aluminizing" the world (i.e., lighter, faster, stronger). Where do you use aluminum in your every day life?"
http://money.msn.com/top-stocks/post.aspx?_p=da435cd4-b0d8-4855-9be4-44803e6d5653&ref=bfv&post=555e9cb6-81db-492c-9423-8b51738ed6b9
Alcoa saves the day, by Jim Cramer
money.msn.com
Jim Cramer is a co-founder of TheStreet and contributes daily market commentary to the financial news network's sites.
Like · Comment · Share
26 31 2
Alcoa shared a link.
April 11, 2012
"It's far better to buy a wonderful company at a fair price than a fair company at a wonderful price." - Warren Buffett. Excerpt from blog post "Alcoa: Still Heading To $15" by Seeking Alpha.
http://seekingalpha.com/article/491341-alcoa-still-heading-to-15
Seeking Alpha
Alcoa: Still Heading To $15 - Seeking Alpha
seekingalpha.com
Of all of the principles that have made Warren Buffett arguably
Like · Comment · Share
23 15 1
Alcoa shared a link.
April 10, 2012
Alcoa 1Q12 Earnings Presentation. Reminder, tune in at 5pm ET to live earnings webcast. www.alcoa.com Replay available afterwards.
http://www.slideshare.net/alcoa/alcoa-1q12-earnings-presentation


Alcoa
April 10, 2012
"Performance rebounded strongly this quarter due to our proactive cash sustainability actions, our relentless focus on profitable growth, and stabilizing markets," said Klaus Kleinfeld, Alcoa Chairman and Chief Executive Officer.
AA earnin... See More
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47 33
Alcoa shared a link.
April 9, 2012
Alcoa to Host Webcast of First Quarter 2012 Results, April 10, 2012 at 5pm ET.
http://www.alcoa.com/global/en/news/news_detail.asp?pageID=20120404006550en&newsYear=2012
Q1
April 10, 2012
View Quarterly Earnings Presentation
Click here for webcast
www.alcoa.com
Replay of the call will be available from 7:00 p.m. Eastern Time April 10 through April 18.
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9
Alcoa 1Q12 Earnings Presentation
www.slideshare.net
$AA earnings rebound strongly, up $287m over 4Q11 on strong productivity growth, improved market
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25 37
Alcoa
April 10, 2012
Welcome fans of Alcoa Eaglecam from all around the world! We invite you to suggest names for the three Alcoa Eaglets. Here's what to do:
1. click "LIKE" on Alcoa's Facebook page (to ensure your suggestions get shown);
2. reply to this pos... See More
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1,319 1,779 267

Appendix B. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.cjar.2019.02.001.

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China Journal of Accounting Research 12 (2019) 157–176

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China Journal of Accounting Research

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

Enhancing the competitiveness and sustainability of social enterprises in Hong Kong: A three-dimensional analysis

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ARTICLE INFO

Article history:
Received 14 February 2019
Accepted 29 March 2019
Available online 30 April 2019

Keywords:
Social enterprises
Corporate governance
Sustainability
Social mission
Advisory committee
Social enterprise performance

ABSTRACT

Running a social enterprise (SE) is more difficult than running a small or medium-sized enterprise because SEs have to achieve both economic sustainability as business enterprises and their social mission for the benefit of society. After a few years of operation, many SEs fail or struggle for survival. In this study, we examine some of the factors that affect an SE's profitability, financial management, and business planning and management. Based on in-depth interviews with 22 social enterprises in Hong Kong, we find that SEs with the dual investment objectives of social mission and financial return are more sustainable and competitive than SEs with social impact as their sole objective. Furthermore, SEs managed by non-owner managers have better financial planning and performance than those managed by owner managers. In addition, SEs with an oversight/advisory committee are more competitive and have better management practices than those without such a committee. Our findings have policy implications for government, SEs, funding bodies, and non-profit organizations to enhance and promote the development of the social enterprise sector.

1. Introduction

A "social enterprise" (SE) is usually defined as "an organization that addresses a basic unmet need or solve a social or environmental problem through a market-driven approach" (Social Enterprise Alliance, 2018). SEs

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https://doi.org/10.1016/j.cjar.2019.03.002
1755-3091/

are characterized as hybrid organizations that mix non-profit and for-profit elements with a social mission, ranging from creating employment for disadvantaged groups in the community to protecting the environment. SEs use entrepreneurial spirit and strategy to achieve their social objectives for the benefit of society and reinvest any surplus towards their social impact objective. The growth of SEs has been a key feature of economic activity in both developed and developing countries. However, SEs are confronted with high levels of complexity in their operations and threats to their long-term sustainability because they have both social and commercial objectives (Moizer and Tracey, 2010). SE practitioners, governments, impact investors, academia, and other stakeholders are increasingly becoming concerned about how SEs should be governed and operated to achieve their desired dual social and financial objectives. However, to the best of our knowledge, there has been little research into what drives the sustainability and competitiveness of SEs.

It has been documented in the literature that corporate governance and ownership control affect corporate decisions and firm performance. For example, a good corporate governance structure can improve firm performance (Leung and Horwitz, 2010), reduce earnings management (Jaggi et al., 2009), and improve corporate disclosure (Gul and Leung, 2004). Studies have also shown that family ownership control and owners holding key management positions are associated with poorer firm performance (e.g., Leung et al., 2014). However, how governance structures and funding sources affect SE performance is unclear given that social enterprises, unlike for-profit enterprises, have to balance the dual objectives of social impact and financial goals. This study is motivated by the need to better understand what contributes to the sustainability and competitiveness of SE operations. We therefore examine how three key dimensions of social entrepreneurship (i.e., investment objectives, funding sources, and governance structure) affect the profitability, business planning, and financial management of SEs in Hong Kong.

There are several reasons for choosing SEs in Hong Kong as the focus of our study. First, Hong Kong has a strong philanthropic tradition.[1] In particular, SEs in Hong Kong have played an important role in helping disadvantaged groups in the community.[2] Second, the government and social service sector in Hong Kong have been actively promoting the development of SEs with entrepreneurial thinking and innovative approaches in the hope of meeting the needs of various community groups and enabling the socially disadvantaged to become self-reliant through employment. The SE sector in Hong Kong has grown rapidly over the past 10 years, and according to the Social Enterprise Business Centre of the Hong Kong Council of Social Services, the number of SEs has increased significantly from 222 in 2008[3] to 654 in 2017.[4] This relatively high concentration of SEs in Hong Kong makes it easier for us to find a valid sample for our in-depth interviews. Third, managing SEs and achieving their social objectives require resolving culture-specific issues. Because Hong Kong is a society that best blends West and East, not only economically and culturally but also politically, a study of SEs in this setting will have more generalizability.

Based on in-depth interviews with 22 social enterprises in Hong Kong, we find that SEs with dual objectives, compared with those with only a social impact objective, are more likely to have an oversight/advisory committee, better business planning, and managers with business management skills. SEs funded by non-profit organizations (NGOs) are mainly managed by non-owner managers, whereas privately funded SEs are more likely to be managed by owner-managers. SEs with non-owner managers tend to use their budget as a benchmark to measure their business performance. Furthermore, SEs with an oversight/advisory committee tend to be more competitive and have better business planning, particularly for the start-up stage, compared with SEs lacking an oversight/advisory committee.

In summary, our findings suggest that SEs that embrace dual objectives create a better governance structure (e.g., an oversight/advisory committee), and those funded by NGOs tend to be more sustainable and compet-

[1] Donations from both individuals and business corporations have increased significantly from HK$2.9 billion in 2000/2001 to HK$11.7 billion in 2014/2015. Over the same period, the ratio of these donations to GDP more than doubled from 0.22% to 0.52%. (https://www.legco.gov.hk/research-publications/english/1718issh03-donations-to-charities-in-hong-kong-20171117-e.pdf).

[2] For instance, the Senior Citizen Home Safety Association (SCHSA), an SE that offers 24-h personal care and emergency assistance to the elderly and others in need, provides care or support through Safe & Well services to over 40,000 senior citizens monthly and has served over 9.8 million people since it was established in 1996. Its contribution has been recognized locally and worldwide.

[3] http://www.hkcss.org.hk/uploadfileMgnt/0_2014116151119.pdf.

[4] https://socialenterprise.org.hk/zh-hant/content/%E3%80%8A%E7%A4%BE%E4%BC%81%E6%8C%87%E5%8D%972018%E3%80%8B%E7%B6%93%E5%B7%B2%E6%8E%A8%E5%87%BA.

itive than their counterparts. However, there is a caveat for interpreting our results—this is an exploratory study based on a small sample. In addition, while our objectives are to analyze the differences in profitability, financial management, and business practices among SEs with different investment objectives, governance structure, and funding sources, we do not attempt to identify the causes of these differences.

This study makes several contributions. First, as emphasized by the Chief Executive of the HKSAR Government, Mrs. Carrie Lam, at the opening ceremony of the 2017 Social Enterprise Summit, "the business-for-good culture in social enterprise operation always keeps a close tab on the pulse of the community, and the sustainable growth of the social enterprise sector can help promote social innovation and address the needs of socially disadvantaged groups.",[5] given that SEs generate social and economic value that benefits local communities, society, and economic development, leveraging SEs and their social impact is in the interests of social development and society as a whole. Consequently, our findings provide insights and policy implications to policymakers (i.e., relevant government departments and units), funding decision makers, and other stakeholders who wish to enhance the sustainability of SEs and thus further promote and support their development.

Second, Spear et al. (2007) indicate that good governance is essential for SEs to thrive and be sustainable. In this paper, we show that the establishment of an oversight/advisory committee improves the competitiveness of SEs in business planning and financial management. This finding is consistent with the corporate governance literature, which generally shows that board committees are useful in providing monitoring and advisory functions to business corporations. This suggests that although the primary objective of social enterprises is to provide social value, sustainable SEs are no different to for-profit businesses and, therefore, need to adopt the best practices of for-profit enterprises (as suggested in the accounting and business literature).

Third, our findings provide insights for SEs who wish to develop better business plans, budgets, and forecasts in pursuit of sustainability and competitiveness. Fourth, in 2014, the Audit Commission reported a need for an overall governmental strategy and policy to support the development of SEs in Hong Kong (Audit Commission, 2014). The Commission also stressed that "the Hong Kong Government paid less attention to treating SEs as businesses with social objectives. On the contrary, the government has focused more on the aspect of providing jobs for the socially disadvantaged." Our findings show that SEs which pursue dual objectives are more sustainable and better managed than SEs with social impact as their sole objective, which is consistent with the Audit Commission's view and echoes the need to treat SEs more as business enterprises.

Finally, the findings of this study may be relevant to the SE sector in China. In the past 10 years, SEs in China have grown rapidly due to the state's effort to privatize public services, the third sector's efforts to play a greater role in solving socioeconomic problems, the growth of the private sector's interest in corporate social responsibility, and the activities of philanthropists to foster social entrepreneurship in China (Yu, 2011, 2013). Consequently, our findings provide insights into how to enhance the sustainability of SEs in China.

The rest of this paper is organized as follows. Section 2 reviews the related literature and describes the research questions. Section 3 presents the research method. Section 4 summarizes the empirical results, and the final section concludes the paper and makes recommendations.

2. Literature review and research questions

SEs have shown rapid growth recently and have become a global social, economic, and cultural phenomenon (Pless, 2012; Terjesen et al., 2011). While there is no unified definition of an SE, it is generally accepted as "an organization that addresses a basic unmet need or solves a social or environmental problem through a market-driven approach" (Social Enterprise Alliance, 2018). In other words, SEs are hybrid organizations established for a social purpose, which use a for-profit business model to generate the financial resources needed to support their social mission (Reis, 1999; Thompson, 2002).

In practice, SEs differ in the extent to which they adhere to their social and economic missions, resulting in a continuum (Stevens et al., 2015). For example, in the United States, SEs are non-profit organizations that prioritize revenue generation and the exploitation of business opportunities (Kerlin, 2006), while European SEs focus on creating social value (Defourny and Nyssens, 2010). Along the spectrum of social enterprises (Dees,

[5] https://www.info.gov.hk/gia/general/201711/07/P2017110700644.htm5Indeed.

1998), SEs are expected to balance their mission to create social value with the achievement of financial sustainability (e.g., Battilana et al., 2015; Dacin et al., 2010). While it is in the interests of any society for SEs to successfully address community needs such as providing employment and serving disadvantaged groups, there is much concern about their risk of financial failure. Past studies indicate that it is difficult for SEs to balance these dual but often competing objectives, which may result in mission drift if an SE over-focuses on its economic objectives to the neglect of its social objectives (Battilana et al., 2012; Mair et al., 2012). Although several studies have addressed how SEs can deal with these challenges by adopting strategies and managerial tools to prevent mission drift and improve competitiveness (e.g., Battilana et al., 2015; Grimes, 2010; Smith et al., 2013; Ramus and Vaccaro, 2017; Matthias et al., 2018), none has examined how the extent of their commitment to social and economic objectives affects their performance and sustainability in Hong Kong. Therefore, this study aims to fill this gap by answering the following research question:

RQ1: *Are there any differences in business and financial management practices and profitability in SEs with mainly social objectives vs. those with dual objectives?*

SEs have tended to depend heavily on government grants and donor funding, particularly in the early start-up stage (Czischke et al., 2012; Luke, 2016). In Hong Kong, there are three major government-funding schemes for SEs, namely the *Enhancing Self-Reliance through District Partnership Programme* funded by the Home Affairs Department, *Enhancing Employment of People with Disabilities through Small Enterprise* funded by the Social Welfare Department, and the *Social Innovation and Entrepreneurship Development Fund* funded by the Efficiency Office, Innovation and Technology Bureau. These government funds aim to support SEs to achieve specific missions, such as enabling self-reliance among the socially disadvantaged through employment. In addition, some Hong Kong-based SEs are funded by non-profit organizations and private funds. NGOs undertake SEs for many different reasons (Dees, 1998). For example, SEs with a specific social mission can help NGOs to achieve their social goals directly. In addition, NGOs may need to generate more sustainable sources of funding through the creation of a business rather than relying solely on charitable donations, which can be negatively affected during an economic downturn (Smith et al., 2012). However, NGOs may not have the skills, capabilities, and resources to develop for-profit SEs (Smith et al., 2012). In addition, the introduction of an SE may negatively affect the likelihood of donation and donor intentions. Smith et al. (2012) found that donors are only likely to continue supporting NGOs that engage in SEs when they perceive the SE to have a consistent mission and be entrepreneurially competent.

SEs with different funding sources are likely to meet different missions with varying monitoring systems and management practices, in turn affecting their performance. Thus, our second research question is as follows:

RQ2: *Are there any differences in business and financial management practices and profitability among SEs with different funding sources?*

Many studies address how corporate governance affects firm performance, earnings quality, and related corporate disclosure in the for-profit sector. For example, a good corporate governance structure has been shown to improve firm performance (e.g., Leung and Horwitz, 2010), reduce earnings management (e.g., Jaggi et al., 2009), and improve corporate disclosure (Gul and Leung, 2004). However, very few studies address governance issues in the SE sector. For example, Low (2006) assesses the appropriateness for SEs of two contrasting models of governance (stewardship vs. democratic) and suggests that despite being located within the non-profit sector, SE may be more likely to exhibit for-profit forms of governance. Based on a case study in the United Kingdom, Mason and Royce (2007) also find that a stewardship governance approach is better able to align board members and managers to deliver on social objectives. Similarly, applying governance theories such as the corporate agency, stakeholder, and stewardship theories, Kuan et al. (2011) compare governance structure and function, board composition, and CEOs in Taiwan and Hong Kong. Supplemented by interviews with four SEs in each region, they find that the boards of directors of SEs in Taiwan play a limited role in supervising the internal financial and administrative matters, while professional-level CEOs and manager experience in business management or in sales and distribution are closely related to SE development. In addition, they find that the governance structure of Hong Kong SEs is diversified and that

most NGOs operating SEs lack a business background. Like CEOs in Taiwan, those in Hong Kong have a strong impact on decision making. In summary, the prevailing governance theories (e.g., corporate and democratic models) fail to fully explain the governance dynamics of SEs (Kuan et al., 2011).

These studies on SE governance focus mainly on building a theoretical framework without linking governance structure to SE performance. For example, Spear et al. (2007) report that good governance is essential for SEs to thrive and be sustainable. Therefore, our third research question relates to the impact of governance structure on SE profitability. Past studies show that family ownership control and an owner holding a key management position are associated with poorer firm performance in business organizations (e.g., Leung et al., 2014). Therefore, we compare owner-managed and non-owner-managed SEs and SEs with and without an oversight committee. Thus, our final research questions are:

RQ3a: *Are there any differences in business and financial management practices and profitability between owner-managed and non-owner-managed SEs?*
RQ3b: *Are there any differences in business and financial management practices and profitability between SEs with and without an oversight committee?*

3. Research method and sample selection

Because no data on the governance structure and management of SEs in Hong Kong are available in the public domain, we used an in-depth interview approach for data collection. We first reviewed the SE literature and held discussions with key players in the SE sector to gain their input on potential key factors for running sustainable and competitive SEs. This formed the core of our list of questions in the interview questionnaire. We then consolidated this input into a questionnaire with 43 questions covering four major sections, namely, (i) ownership, funding and governance structure, and profitability; (ii) financial management practices; (iii) business planning and operations; and (iv) employment. We conducted a pilot interview with an SE to improve the design and wording of the questionnaire. An English-language copy of the interview questionnaire is provided in the Appendix.

For sample selection, we obtained a full list of SEs registered in the Social Enterprise Directory administrated by the Social Enterprise Business Centre, which was established by the Hong Kong Council of Social Services in 2007 to advance social entrepreneurship and mobilize social innovation. We consider only SEs registered in the Social Enterprise Directory for not less than 5 years to ensure sufficient data to classify them as high- or low-profit SEs. Accordingly, 445 SEs were included in the initial population. To minimize sampling bias, SEs listed in the categories of home, personal care, and transportation were eliminated as they had fewer than 15 SEs in each category. Thus, 417 SEs were included in the final SE population.

Two rounds of letters were sent out to invite SEs to participate in our interviews. In the first round, 80 SEs were selected from the population by proportional allocation of stratified random sampling. We sent them invitation letters by both post and email in November 2017, followed by telephone calls and/or emails, and received 15 positive replies. To increase the number of participants, a second round of invitations was sent out in February 2018 to another 50 SEs by stratified random sampling, and eight more SE participants were gained. However, as one later declined to be interviewed because the key manager was too busy, the study sample consists of 22 SEs. In-depth interviews based on the questionnaire were conducted with the owner/-founder or key manager of each SE between December 2017 and April 2018, each lasting 1–1.5 h.

4. Main results

4.1. Descriptive statistics of the sample SEs

The sample SEs operated mainly in retail (45%), catering (23%), and workshops (14%), and their main sources of funding were private (41%), NGOs (32%), and government (27%). Over half (55%) of the SEs held dual investment objectives (i.e., both social impact and financial return), while the remaining 45% had social impact as their sole objective. In terms of financial goals, less than one third of the SE sample (32%) rated

profitability (i.e., business revenue should exceed expenses) as their financial target. Nearly half of the SEs (45%) held self-sufficiency (i.e., business revenue should cover expenses) as their financial goal, while the remaining 23% accepted losses, and their financial goal was contribution (i.e., business revenue covered part of costs). In terms of profitability, 27% of the SEs had made no profit in any of the past 5 years (no profitability), 41% had generated a profit for 1–3 of the past 5 years (moderate profitability), and one third (32%) recorded a profit for at least 4 of the past 5 years (high profitability). The majority (64%) of SEs were run by a non-owner manager, while the owner served as the key manager in the remaining 36%. An oversight/advisory committee was present in 45% of the SEs and absent in 55%.

These results show that our sample of Hong Kong SEs had not yet embraced the importance of financial sustainability or the notion of social enterprise as a for-profit business (i.e., working primarily to generate profit to be reinvested in nonprofit activities) (see Table 1).

4.2. Financial goals and profitability

We compare the financial goals and profitability of SEs from the three dimensions, as mentioned in our research questions. As shown in Table 2, there is a significant difference in investment objectives between SEs with and without an oversight/advisory committee at the 10% level (Mann–Whitney *U* test). Specifically, SEs with such a committee are more likely to have dual investment objectives. Regarding financial goals, despite no statistically significant difference between the different types of SEs, it is interesting that government-funded SEs did not consider contribution as their financial goal and most considered self-sufficiency as their goal. For profitability over the past 5 years, SEs with dual objectives, NGO funding, and non-owner management were more profitable than their counterparts, although this was not statistically significant. For example, the dual-objective SEs averaged 2.75 profitable years over the past 5, whereas the sole-objective SEs averaged 2.1 profitable years. In terms of funding source, NGO-funded SEs averaged 3.29 profitable years, while privately funded SEs had only 1.67 profitable years.

4.3. Financial and business planning

Table 3 shows the differences in financial and business planning among different SEs. Overall, most SEs had an annual budget including capital and operating expenditure. However, SEs with an oversight/advisory committee prepared more detailed budgets and had a greater tendency to adopt an updated business plan than

Table 1
Descriptive statistics of sample social enterprises.

Industry	Retail	Catering	Workshop	Eco Tour	Health Care
	45%	23%	14%	9%	9%
Funding Source	Private Funding	Non-Governmental Organization		Government Funding	
	41%	32%		27%	
Investment Objectives	Mixture of social impact and financial returns		Social impact only		
	55%		45%		
Financial Goal	Self-sufficiency	Profitability		Contribution	
	45%	32%		23%	
Number of Profitable Years	Low profitability[1]	Moderate profitability[2]		High profitability[3]	
	27%	41%		32%	
Management	Non-owner manager		Owner manager		
	46%		36%		
Governance	Without oversight/advisory committee		With oversight/advisory committee		
	55%		45%		

[1] Low profitability SE: no profit at all in the past 5 years.
[2] Moderate profitability SE: 1–3 years of profits in the past 5 years.
[3] High profitability SE: at least 4 profitable years in the past 5 years.

Table 2
Differences in financial goals and profitability among social enterprises.

		Investment Objectives Mean (Std. Dev.)		Funding Sources Mean (Std. Dev.)			Top Management Mean (Std. Dev.)		Oversight/Advisory Committee Mean (Std. Dev.)	
	Total (n = 22)	Social impact only (n = 10)	Dual objectives (n = 12)	NGO (n = 7)	Govt. (n = 6)	Private (n = 9)	Owner managed (n = 8)	Non-owner managed (n = 14)	With (n = 10)	Without (n = 12)
Investment objectives[1]	0.55 (0.510)			0.86 (0.378)	0.33 (0.516)	0.44 (0.527)	0.50 (0.535)	0.57 (0.514)	**0.80*** **(0.422)**	**0.33*** **(0.492)**
Financial goal is Self-sufficiency[2]	0.45 (0.510)	0.50 (0.527)	0.42 (0.515)	0.43 (0.535)	0.67 (0.516)	0.33 (0.500)	0.38 (0.518)	0.50 (0.519)	0.50 (0.527)	0.42 (0.515)
Financial goal is Profitability[2]	0.32 (0.477)	0.30 (0.483)	0.33 (0.492)	0.14 (0.378)	0.33 (0.516)	0.44 (0.527)	0.50 (0.535)	0.21 (0.426)	0.30 (0.483)	0.33 (0.492)
Financial goal is Contribution[2]	0.23 (0.429)	0.20 (0.422)	0.25 (0.452)	0.43 (0.535)	0.00 (0.000)	0.22 (0.441)	0.13 (0.354)	0.29 (0.469)	0.20 (0.422)	0.25 (0.452)
Number of profitable years in the past 5 years	2.45 (1.993)	2.10 (1.792)	2.75 (2.179)	3.29 (2.360)	2.67 (1.506)	1.67 (1.871)	2.00 (1.690)	2.71 (2.164)	2.30 (1.767)	2.58 (2.234)

Notes:
[1] Dual objectives = 1, sole objective = 0.
[2] Yes = 1, no = 0.
* Indicates a significant difference in means between SEs with and without an oversight/advisory committee at the 10% level (Mann–Whitney *U* test).

Table 3
Differences in financial and business planning among different social enterprises.

		Investment Objectives Mean (Std. Dev.)		Funding Sources Mean (Std. Dev.)			Top Management Mean (Std. Dev.)		Oversight/Advisory Committee Mean (Std. Dev.)	
	Total (n = 22)	Social impact only (n = 10)	Dual objectives (n = 12)	NGO (n = 7)	Govt. (n = 6)	Private (n = 9)	Owner manager (n = 8)	Non-owner manager (n = 14)	With (n = 10)	Without (n = 12)
Detailed budget including capital expenditure and operating expenditure of start-up costs[1]	0.95 (0.722)	0.70 (0.483)	1.17 (0.835)	1.00 (0.816)	1.17 (0.408)	0.78 (0.833)	0.75 (0.886)	1.07 (0.616)	**1.30* (0.675)**	**0.67* (0.651)**
Supply chain for products and services in business start-up plan[2]	0.45 (0.510)	0.30 (0.483)	0.58 (0.515)	0.71 (0.488)	0.33 (0.516)	0.33 (0.500)	0.38 (0.518)	0.50 (0.519)	**0.70* (0.483)**	**0.25* (0.452)**
Innovative concept (new business idea/model with market potential)[2]	0.59 (0.503)	0.50 (0.527)	0.67 (0.492)	0.71 (0.488)	0.50 (0.548)	0.56 (0.527)	0.63 (0.518)	0.57 (0.514)	0.70 (0.483)	0.50 (0.522)
Competitor profiling in business plan[2]	0.50 (0.512)	0.50 (0.527)	0.50 (0.522)	0.71 (0.488)	0.50 (0.548)	0.33 (0.500)	0.25 (0.463)	0.64 (0.497)	0.50 (0.527)	0.50 (0.522)
Current business plan[2]	0.64 (0.492)	**0.40* (0.516)**	**0.83* (0.389)**	0.86 (0.378)	0.67 (0.516)	0.44 (0.527)	0.50 (0.535)	0.71 (0.469)	**0.90* (0.316)**	**0.42* (0.515)**
Profit and loss forecast frequency[1]	1.27 (0.550)	1.30 (0.675)	1.25 (0.452)	1.29 (0.488)	1.00 (0.632)	1.44 (0.527)	1.25 (0.463)	1.29 (0.611)	1.30 (0.483)	1.25 (0.622)
Cash flow forecast frequency[1]	1.00 (0.873)	1.00 (0.816)	1.00 (0.953)	1.00 (1.000)	0.67 (0.816)	1.22 (0.833)	0.75 (0.886)	1.14 (0.864)	1.10 (0.876)	0.92 (0.900)
Budget used to measure business performance[3]	1.36 (0.581)	1.30 (0.675)	1.42 (0.515)	1.57 (0.535)	1.33 (0.516)	1.22 (0.667)	**1.00* (0.535)**	**1.57* (0.514)**	1.20 (0.422)	1.50 (0.674)

[1] No budget = 0, yearly budget = 1, quarterly/monthly budget = 2.
[2] Yes = 1, no = 0.
[3] No use of budget = 0, use of yearly budget = 1, use of quarterly/monthly budget = 2.
* Indicates a significant difference in means between different social enterprises at the 10% level (Mann–Whitney *U* test).

SEs without such a committee. Similarly, SEs with dual objectives were also more likely to have a current business plan than SEs with only a social impact objective. In addition, SEs with an oversight/advisory committee also developed more comprehensive and thoughtful business start-up plans. For instance, compared to SEs without such a committee, SEs with an oversight/advisory committee were more likely to set up a supply chain for their products/services. Finally, SEs managed by non-owners were more likely than owner-managed SEs to use quarterly or monthly budgets to measure business performance.

4.4. Management and governance structure

We also analyze the differences in the management and corporate governance of SEs categorized by different perspectives. Table 4 shows significant differences in top management among SEs funded by different sources. NGO-funded SEs were all managed by non-owners whereas privately funded SEs were more likely to be owner-managed. Consistent with the findings in Table 2, SEs with dual investment objectives were more likely to have a committee to guide or advise on their business operations. While overall, SEs considered business review and sales performance to be the most important items for discussion in management meetings, privately funded SEs gave significantly less importance to business review but viewed sales performance and profit and loss as more important. In addition, SEs without an oversight/advisory committee were more concerned about employee issues than those with such a committee. When actual performance was lower than planned performance, the most preferred options were to boost sales (mean = 3.23), revise business strategies (mean = 2.82), and cut costs (mean = 2.41). The only significant difference in preferred options between SEs with different investment objectives, funding sources, and governance structures was the cost-cutting option, where SEs with non-owner managers were more likely than owner-managed SEs to cut costs when performance was below expectations.

We further examine the key operating risks perceived by the management of different types of SEs. Table 5 shows that the highest risk rated by SEs was "lack of manpower," followed by "earnings lower than expected," "surging productions costs," "resignation of key managers," "increase in competitors," and "changes in regulation." However, the mean ratings differed between types of SE. Specifically, SEs with only a social impact objective rated "lack of manpower" as less risky than did SEs with dual objectives, and also rated "surging production costs" and "earnings lower than expected" as riskier than "lack of manpower." Meanwhile, privately funded SEs considered the risk of "earnings lower than expected" (mean = 4.00) significantly lower than did NGO-funded (mean = 5.14) and government-funded SEs (mean = 6.00).

Finally, we evaluate the skill set gaps of key managers by analyzing the skills that they already had ("possessed") and those that they believed to be essential for managing their SE ("desirable"). Table 6, Panel A shows that most key SE managers possessed staff management, business management, and sales and marketing skills. However, those whose SE had a sole objective possessed significantly fewer management skills than did SEs with dual objectives, business management being one of the weakest skills among SEs with a sole objective. Among government-funded SEs, the key managers had less expertise in sales and marketing but more in social impact assessment, while key managers of SEs with an oversight/advisory committee had significantly greater expertise in product/service knowledge than SEs without such a committee.

As shown in Table 6, Panel B, the most desirable skills for key managers were sales and marketing, followed by business management, with financial planning and management, product/service knowledge, and staff management rated equally, and NGO management rated least necessary. While the ratings did not vary significantly among SEs with different investment objectives, there was significant variance among SEs with different funding sources and governance structures. Specifically, among SEs with different funding sources, privately funded SEs rated product/service knowledge as more desirable compared with SEs funded by NGOs or the government. Owner-managed SEs rated sales and marketing and product/service knowledge as the most desirable skills, whereas non-owner-managed SEs rated business management skills most desirable. Interestingly, SEs with an oversight/advisory committee rated financial planning and management skills much more desirable than staff management skills, while SEs without an oversight/advisory committee took the opposite view.

We compare the skills of key managers in Panel A with their ratings of desirable skills in Panel B, and observe gaps in sales and marketing, financial planning and management, and staff management skills. Although sales and marketing was rated the most desirable skill by government-funded and owner-

Table 4
Differences in management and corporate governance among different social enterprises.

		Investment Objectives Mean (Std. Dev.)		Funding Source Mean (Std. Dev.)			Top Management Mean (Std. Dev.)		Oversight/Advisory Committee Mean (Std. Dev.)	
	Total (n = 22)	Social impact only (n = 10)	Dual objectives (n = 12)	NGO (n = 7)	Govt. (n = 6)	Private (n = 9)	Owner manager (n = 8)	Non-owner manager (n = 14)	With (n = 10)	Without (n = 12)
Major owner is a key manager[1]	0.36 (0.492)	0.40 (0.516)	0.33 (0.492)	**0.00** (0.000)**	**0.33** (0.516)**	**0.67** (0.500)**			0.40 (0.516)	0.33 (0.492)
A committee oversees day-to-day operations[1]	0.45 (0.510)	**0.20** (0.422)*	**0.67** (0.492)*	0.57 (0.535)	0.50 (0.548)	0.33 (0.500)	0.50 (0.535)	0.43 (0.514)		
Most important items discussed in management meetings										
Business Review[2]	0.73 (0.456)	0.60 (0.516)	0.83 (0.389)	**1.00** (0.000)*	**0.83** (0.408)*	**0.44** (0.527)*	0.63 (0.518)	0.79 (0.426)	0.90 (0.316)	0.58 (0.515)
Sales performance[2]	0.55 (0.510)	0.60 (0.516)	0.50 (0.522)	0.43 (0.535)	0.67 (0.516)	0.56 (0.527)	0.63 (0.518)	0.50 (0.519)	0.70 (0.483)	0.42 (0.515)
Employee issues[2]	0.41 (0.503)	0.60 (0.516)	0.25 (0.452)	0.43 (0.535)	0.33 (0.516)	0.44 (0.527)	0.38 (0.518)	0.43 (0.514)	**0.10** (0.316)**	**0.67** (0.492)**
Profit and loss[2]	0.32 (0.477)	0.20 (0.422)	0.42 (0.515)	0.14 (0.378)	0.17 (0.408)	0.56 (0.527)	0.38 (0.518)	0.29 (0.469)	0.30 (0.483)	0.33 (0.492)
Preferred option when performance is lower than planned										
Boost sales[3]	3.23 (0.752)	3.20 (0.789)	3.25 (0.754)	3.29 (0.488)	3.00 (0.894)	3.33 (0.866)	3.25 (0.886)	3.21 (0.699)	3.00 (0.816)	3.42 (0.669)
Revise business strategies[3]	2.82 (1.140)	2.60 (1.174)	3.00 (1.128)	3.14 (1.215)	2.50 (1.378)	2.78 (0.972)	3.25 (0.707)	2.57 (1.284)	3.20 (1.033)	2.50 (1.168)
Cut costs[3]	2.41 (1.098)	2.70 (1.160)	2.17 (1.030)	2.14 (0.900)	2.83 (1.169)	2.33 (1.225)	**1.75** (1.035)**	**2.79** (0.975)**	2.10 (1.197)	2.67 (0.985)
Seek more funding[3]	1.55 (0.739)	1.50 (0.707)	1.58 (0.793)	1.43 (0.787)	1.67 (0.816)	1.56 (0.726)	1.75 (0.886)	1.43 (0.646)	1.70 (0.823)	1.42 (0.669)

Note:
[1] Yes = 1, no = 0.
[2] Important = 1, not important = 0.
[3] Most preferred = −4, least preferred = 1.
** Indicates significant differences in means between different SEs at the 5% level (Mann–Whitney *U* test/ANOVA).
* Indicates significant differences in means between different SEs at the 10% level (Mann–Whitney *U* test/ANOVA).

Table 5
Key Operating Risks Perceived by Social Enterprises.

Key operating risks	Full sample (n = 22)	Investment Objective Mean (Std. Dev.)		Funding Source Mean (Std. Dev.)			Top Management Mean (Std. Dev.)		Oversight/Advisory Committee Mean (Std. Dev.)	
		Social impact only (n = 10)	Dual objectives (n = 12)	NGO (n = 7)	Government (n = 6)	Private (n = 9)	Owner manager (n = 8)	Non-owner manager (n = 14)	With committee (n = 10)	Without committee (n = 12)
Lack of manpower[1]	5.14 (1.424)	**4.50[*] (1.354)**	**5.67[*] (1.303)**	5.57 (1.512)	4.67 (1.033)	5.11 (1.616)	5.13 (1.642)	5.14 (1.351)	5.00 (1.414)	5.25 (1.485)
Earnings lower than expected[1]	4.91 (1.509)	4.90 (1.101)	4.92 (1.832)	**5.14[*] (1.345)**	**6.00[*] (1.265)**	**4.00[*] (1.323)**	4.75 (1.753)	5.00 (1.414)	4.90 (1.729)	4.92 (1.379)
Surging production costs[1]	4.73 (1.751)	5.10 (1.792)	4.42 (1.730)	4.43 (1.618)	4.67 (2.066)	5.00 (1.803)	4.00 (1.773)	5.14 (1.657)	4.50 (1.841)	4.92 (1.730)
Lack of capital[1]	4.05 (1.838)	4.00 (2.261)	4.08 (1.505)	4.14 (1.574)	3.17 (1.835)	4.56 (2.007)	4.50 (2.070)	3.79 (1.718)	4.30 (1.703)	3.83 (1.992)
Resignation of key managers[1]	3.95 (2.554)	4.80 (2.486)	3.25 (2.491)	2.71 (2.928)	5.00 (2.191)	4.22 (2.333)	5.25 (1.581)	3.21 (2.751)	4.20 (2.394)	3.75 (2.768)
Increase in competitors[1]	3.23 (1.541)	3.20 (1.398)	3.25 (1.712)	4.00 (1.732)	3.00 (1.095)	2.78 (1.563)	3.00 (1.414)	3.36 (1.646)	3.10 (1.663)	3.33 (1.497)
Changes in regulation[1]	2.00 (1.447)	1.50 (0.850)	2.42 (1.730)	2.00 (0.816)	1.50 (0.837)	2.33 (2.062)	**1.38[**] (1.061)**	**2.36[**] (1.550)**	2.00 (1.886)	2.00 (1.044)

Note:
[1] Highest risk = 7, lowest risk = 1.
[**] Indicates significant differences in means between different SEs at the 5% level (Mann–Whitney *U* test/ANOVA).
[*] Indicates significant differences in means between different SEs at the 10% level (Mann–Whitney *U* test/ANOVA).

Table 6
Skills key managers possess vs. desirable skills.

Panel A: Skills Key Managers Possess

Skills Key Managers Possess	Full sample (n = 22)	Investment Objective Mean (Std. Dev.)		Funding Source Mean (Std. Dev.)			Top Management Mean (Std. Dev.)		Oversight/Advisory Committee Mean (Std. Dev.)	
		Social Impact only (n = 10)	Dual objectives (n = 12)	NGO (n = 7)	Government (n = 6)	Private (n = 9)	Owner manager (n = 8)	Non-owner manager (n = 14)	With committee	Without committee
Staff management	0.82 (0.395)	0.80 (0.422)	0.83 (0.389)	0.86 (0.378)	0.83 (0.408)	0.78 (0.441)	0.75 (0.463)	0.86 (0.363)	0.90 (0.316)	0.75 (0.452)
Business management	0.64 (0.492)	**0.40* (0.516)**	**0.83* (0.389)**	0.86 (0.378)	0.50 (0.548)	0.56 (0.527)	0.63 (0.518)	0.64 (0.497)	0.80 (0.422)	0.50 (0.522)
Sales and marketing	0.64 (0.492)	0.50 (0.527)	0.75 (0.452)	0.86 (0.378)	0.33 (0.516)	0.67 (0.500)	0.50 (0.535)	0.71 (0.469)	0.70 (0.483)	0.58 (0.515)
Product/service knowledge	0.59 (0.503)	0.40 (0.516)	0.75 (0.452)	0.71 (0.488)	0.50 (0.548)	0.56 (0.527)	0.75 (0.463)	0.50 (0.519)	**0.90** (0.316)**	**0.33** (0.492)**
Financial planning and management	0.59 (0.503)	0.50 (0.527)	0.67 (0.492)	0.57 (0.535)	0.50 (0.548)	0.67 (0.500)	0.75 (0.463)	0.50 (0.519)	0.80 (0.422)	0.42 (0.515)
Social impact Assessment	0.41 (0.503)	0.50 (0.527)	0.33 (0.492)	0.29 (0.488)	0.67 (0.516)	0.33 (0.500)	0.38 (0.518)	0.43 (0.514)	0.40 (0.516)	0.42 (0.515)
NGO management	0.41 (0.503)	0.50 (0.527)	0.33 (0.492)	0.29 (0.488)	0.50 (0.548)	0.44 (0.527)	0.50 (0.535)	0.36 (0.497)	0.40 (0.516)	0.42 (0.515)

Note: 1 = possess, 0 = do not possess.
** and * indicate significant differences in means between different SEs at the 5% and 10% levels, respectively (Mann–Whitney *U* test).

Panel B: Desirable Key Manager Skills

Desirable Skills	Full sample (n=22)	Investment Objective Mean (Std. Dev.)		Funding Source Mean (Std. Dev.)			Top Management Mean (Std. Dev.)		Oversight/Advisory Committee Mean (Std. Dev.)	
		Social impact only (n=10)	Dual objectives (n=12)	NGO (n=7)	Government (n=6)	Private (n=9)	Owner manager (n=8)	Non-owner manager (n=14)	With committee (n=10)	Without committee (n=12)
Sales and marketing	5.36 (1.432)	5.40 (1.350)	5.33 (1.557)	4.86 (1.676)	5.17 (1.329)	5.89 (1.269)	**6.13* (1.126)**	**4.93* (1.439)**	5.60 (1.578)	5.17 (1.337)
Business management	4.77 (2.159)	4.40 (2.066)	5.08 (2.275)	5.57 (1.988)	4.50 (2.739)	4.33 (1.936)	**3.75* (2.053)**	**5.36* (2.061)**	4.70 (2.452)	4.83 (1.992)
Financial planning and management	4.36 (1.916)	4.50 (1.958)	4.25 (1.960)	5.00 (2.236)	4.00 (1.789)	4.11 (1.833)	3.88 (1.727)	4.64 (2.023)	**5.20* (1.619)**	**3.67* (1.923)**

Product/service knowledge	4.36 (1.620)	3.90 (1.969)	4.75 (1.215)	**3.57* (1.512)**	**4.00* (1.789)**	**5.22* (1.302)**	**5.50* (1.069)**	**3.71* (1.541)**	4.50 (0.850)	4.25 (2.094)
Staff management	4.36 (1.677)	4.60 (1.897)	4.17 (1.528)	4.00 (1.826)	4.50 (2.074)	4.56 (1.424)	4.75 (0.886)	4.14 (1.994)	**3.60** (1.350)**	**5.00** (1.706)**
Social impact assessment	3.14 (1.424)	3.30 (1.252)	3.00 (1.595)	3.29 (1.704)	3.33 (1.633)	2.89 (1.167)	2.88 (1.458)	3.29 (1.437)	3.10 (1.595)	3.17 (1.337)
NGO management	1.64 (1.364)	1.90 (1.912)	1.42 (0.669)	**1.71** (0.756)**	**2.50** (2.345)**	**1.00** (0.000)**	1.13 (0.354)	1.93 (1.639)	1.30 (0.675)	1.92 (1.730)

Note: 7 = highly desirable, 1 = least desirable.

** and * indicates significant differences in mean ratings between different SEs at the 5% and 10% levels, respectively (Mann–Whitney *U* test/ANOVA).

managed SEs, fewer than 50% of their key managers possessed this skill. Similarly, NGO-funded SEs considered financial planning and management the second most desirable skill, but only 57% of their key managers had this skill. Finally, 90% of the key managers of SEs with an oversight/advisory committee possessed staff management skills, yet they considered this skill not very desirable.

5. Recommendations and conclusion

SEs are characterized by the application of commercial strategies to achieve improvements in financial, social, and environmental well-being, which may include maximizing social impact alongside profit generation for external shareholders. Therefore, it is important for SEs to be competitive, sustainable, and profitable. Consequently, SEs need to adopt good practices in their operations, such as good business planning and reviews, accounting and financial management, and operations management. While the sustainability of SEs has been a concern for government, the third sector, and commercial enterprises, there has been little research on what drives SEs to adopt competitive business management practices. Our study fills this gap and provides insights into how to enhance SE competitiveness.

Our study examines the effects of investment objectives, funding sources, and enterprise governance on profitability and business planning and management. We find that SEs that do not seek to balance the objectives of both a social mission and profit generation to finance their mission are less sustainable and competitive. NGO-funded SEs are more profitable and better managed than government-funded and privately funded SEs. We also find that owner-managed SEs underperform in terms of profitability and financial planning and business management than non-owner-managed SEs. In addition, our findings clearly indicate that SEs with an oversight/advisory committee are more competitive and adopt better management practices than SEs without such a committee.

In summary, this study shows that investment objectives, funding sources, and governance structure matter to the competitiveness and sustainability of SEs in Hong Kong. Based on our findings, we are able to make the following recommendations to further support and promote the development of the SE sector in Hong Kong. First, we recommend that SEs establish an oversight/advisory committee with at least three members, one from each expert area: sales and marketing, accounting and finance, and related industries. As it is difficult for SEs themselves to find suitable advisors to serve on the committee, the government should expand its existing efforts to consolidate a pool of experts, particularly in sales and marketing, business management, and financial planning and management, and make them available to all SEs in Hong Kong, including privately funded SEs.

Second, the current SE practice of preparing annual budgets and forecasts is inadequate, and should be replaced with quarterly or monthly cash flow and profit and loss forecasts, against which actual business performance is evaluated and forecasts revised accordingly.

Third, government-funded SEs receive financial support for both their operating budgets and start-up capital expenditure. NGO-funded SEs usually have access to resources from parent NGOs at the start-up stage. Start-up capital expenditure typically requires a large sum of money and can thus be a major hurdle for many privately funded SEs, who often have good social innovations and business models. Therefore, the government should consider a new funding scheme or the expansion of an existing scheme to provide competitive private SEs with one-off funding support for start-up capital expenditure.

Finally, we strongly encourage SEs to embrace realistic and sustainable dual investment objectives with an extended operating horizon beyond 3–5 years, because this will enhance their sustainability and competitiveness and ultimately maximize their social impact.

Our study is limited by the small sample size, which constrained our ability to perform statistical regression analysis. We recommend that future research examines the determinants of starting or scaling up SEs. Another avenue for future research is to examine the determinants and consequences of establishing oversight/advisory committees for SEs.

Acknowledgement

The work described in this paper was fully supported by a grant from UGC Knowledge Transfer Earmarked Fund.

Appendix A. Interview questionnaire in english

Survey on Operation of Social Enterprise

A. Ownership and funding structure

Q1a. What is your major funding source?

☐ Non-profit organization ☐ Government funding ☐ Private funding (commercial or individuals)
☐ Individual or family philanthropic investors ☐ Charity foundation ☐ Matching fund (government or others)
☐ Other: _____

Q1b. Are there any changes in your major funding source from the beginning (start-up stage) until now?

☐ Yes, please specify: _____
☐ No

Q2. What are your investment objectives?

☐ Only social impact ☐ Social impact and financial return

Q3. What expected financial returns are specified by the owners/investors?

☐ Not specified ☐ Not required ☐ Break-even ☐ >10%
☐ <2% ☐ ≥2%–<5% ☐ 5%–10%

Q4. How many years were profitable in the past 5 years?

☐ 0 ☐ 1 year ☐ 2 years
☐ 3 years ☐ 4 years ☐ 5 years

Q5. Is the key manager a major owner(s)?

☐ Yes ☐ No

Q6. Is there any committee oversight of the day-to-day operations?

☐ Yes ☐ No
☐ Board ☐ Committee

Q7. Is your social enterprise a subsidiary/project of another organization?

☐ Yes ☐ No
Parent organization is ☐ commercial entity ☐ NPO entity

Q8. Did you form an NPO to receive public donations to support your social enterprise?

☐ Yes ☐ No

Q9. Is there still a funding gap since start up?

☐ Yes ☐ No
☐ The funding gap remains the same
☐ The funding gap has reduced
☐ The funding gap has increased

B. Financial Management

Q10. Did you have a detailed budget including capital expenditure and operating expenditure for start-up costs?

☐ Yes ☐ No
☐ Monthly
☐ Quarterly
☐ Yearly

Q11. Is there a profit and loss forecast?

☐ Yes ☐ No
☐ Monthly
☐ Quarterly
☐ Yearly
☐ 0.5 year
☐ 1 year

☐ 2 years
☐ 3 years or above

Q12. Is there a cash flow forecast?

☐ Yes
- ☐ Monthly
- ☐ Quarterly
- ☐ Yearly
  - ☐ 0.5 year
  - ☐ 1 year
  - ☐ 2 years
  - ☐ 3 years or above

☐ No

Q13a. Do you use a budget to measure business performance?

☐ Yes
- ☐ Monthly
- ☐ Quarterly
- ☐ Yearly
  - ☐ 0.5 year
  - ☐ 1 year
  - ☐ 2 years
  - ☐ 3 years or above

☐ No

Q13b. What do you do when performance is lower than budgeted/planned? Please rank the following items (4 = most important, 1 = least important).

☐ Boost sales
☐ Cut costs
☐ Seek more funding
☐ Revise business strategies

Q14a. What are the two main financial risks of your SE? _____

Q14b. Based on the two financial risks mentioned above, how do you manage these risks? _____

Q15. In what ways does your SE have expert financial advice? _____

☐ Outsourcing system

☐ In-house system
- ☐ Excel
- ☐ Self-developed system (Including sales and inventory, etc.)

Q16. What is your financial management system?

Q17. What is the background of your staff member responsible for accounting and financial performance? _____

Q18. What key performance indicators do you use to measure the achievement of your SE? _____

Q19. What is your financial goal?

☐ Self-sufficiency: business revenues will cover all expenses.
☐ Profitability: business revenues will exceed expenses.
☐ Contribution: business revenues will contribute to costs (e.g. business revenues may cover business expenses, but not the social costs associated with our mission). The remainder is covered by other revenue sources such as a recurring grant.

Q20. What main key indicators do you use to measure financial performance? (Multiple answers allowed, but choose the most important.)

☐ Returns on sales ☐ Returns on assets (ROA) ☐ Returns on equity (ROE)
☐ Gross profits ☐ Net profits ☐ Others: _____

C. Business Planning and Operations

Q21. Does your business plan (start-up) contain the following?

A.	Established stated objectives or business goals.	☐ Yes What are the two most important goals? 1._____ 2._____	☐ No
B.	Set supply chain for products and services	☐ Yes	☐ No
C.	Clearly identified revenue targets	☐ Yes	☐ No
D.	Clearly identified targeted customers	☐ Yes	☐ No
E.	An innovative concept (a new business idea/model with market potential)	☐ Yes	☐ No
F.	Statement of what makes the business different	☐ Yes	☐ No
G.	Established sales and marketing strategies	☐ Yes	☐ No
H.	Market research done	☐ Yes	☐ No
I.	Customer profile	☐ Yes	☐ No
J.	Competitor profile	☐ Yes	☐ No
K.	Pricing and promotion plan	☐ Yes	☐ No
L.	Growth plan	☐ Yes What are the two most important plans? 1._____ 2._____	☐ No

Q22a. Do you currently have a business plan?

☐ Yes ☐ No (Skip to Q23)

Q22b. [Only for those who answered "Yes" in Q22a.] How regularly will the business plan be reviewed and updated?

_____

Q23. Which two of the following are the most important items to be discussed in a management meeting?

☐ Profit and loss ☐ Sales performance
☐ Business review ☐ Employee issues

Q24. For how long have you been the key manager(s) leading and coordinating the enterprise? (to check commitment and continuity for sustainable involvement over the long term)_____

Q25. How do you manage the partnership/relationship with

1. Funders:_____
2. Supply chain:_____
3. Employees:_____
4. Customers:_____

Q26a. Prior to your appointment as key manager of this SE, did you have expertise in:

A.	Business management	☐ Yes	☐ No
B.	Financial planning and management	☐ Yes	☐ No
C.	Sales and marketing	☐ Yes	☐ No
D.	Product/service knowledge	☐ Yes	☐ No
E.	Social impact assessment	☐ Yes	☐ No
F.	NPO management	☐ Yes	☐ No
G.	Staff management	☐ Yes	☐ No

Q26b. As key manager of the SE, please rank the importance of these 7 skills to you from 1 to 7 (1 = least important, 7 = most important).

☐ Business management ☐ Financial planning and management ☐ Sales and marketing
☐ Product/service knowledge ☐ Social impact assessment ☐ NPO management
☐ Staff management

Q27. Has your SE scaled up in the past 5 years?

☐ Yes

☐ 1 year ago ☐ 2 years ago ☐ 3 years ago ☐ 4 years ago ☐ 5 years ago

Why?

☐ Sales growth ☐ Increased funding

☐ Other: _____

How?

☐ Established new sales outlets ☐ Expanded product categories

☐ Corporate [Should this be cooperation?] with other organizations ☐ Other: _____

☐ No

Does your SE have any plans to scale up in the future?

☐ Yes Reason: _____

☐ No

Managers: ☐ <5% ☐ 5%–10% ☐ 11%–20% ☐ 21%–30% ☐ >30%

General employees: ☐ <5% ☐ 5%–10% ☐ 11%–20% ☐ 21%–30% ☐ >30%

Q28. What was the employee turnover rate last year?

Q29a. Please rate your staff morale from 1 to 7 ◦ (1 = very bad, 4 = neutral, 7 = very good)

7 6 5 4 3 2 1

Q29b. Please explain: _____

Q30a. Please rank anticipated operating risks in managing the business from 1 to 7 (7 = very high risk, 1 = no risk)

☐ Lack of manpower ☐ Lack of capital ☐ Resignation of key manager(s)

☐ Lower earnings than expected ☐ Changes in regulation ☐ Surging production costs

☐ Increase in competitors

Q30b. How do you prevent these operating risks? Please explain using the 2 greatest operating risks identified in (a).

1 _____ 2._____

D. Employment

Q31. How many part-time and full-time staff work in your organization? Part-time: _____ Full-time:_____

Q32. To what percentage of employees does your SE intentionally provide in-service training and job opportunities to enhance their employment skills? _____

Q33. Do you view employees leaving your organization as a positive or a negative sign? Why?

☐ Positive Reason:_____

☐ Negative Reason:_____

☐ Neutral Reason:_____

Q34. Do the majority of employees leaving your organization remain in the same type of job afterwards?

☐ Yes ☐ No

Q35. In the past two years, how many employees left your SE to take up similar jobs in the job market? _____

Q36. How active is your SE at recruiting staff from marginalized groups? (1 = not active, 4 = neutral, 7 = very active)

7 6 5 4 3 2 1

☐ In-service training ☐ Internal pre-service training ☐ External pre-service training

☐ Mentorship program ☐ Job rotation ☐ Other: _____

Q37. How do you provide staff training to your staff? (Multiple answers allowed)

Q38. How many partnerships have you developed?

Funding partnerships: _____
Business partnerships: _____
Employment partnerships: _____

Q39. How successful is your SE at improving the working skills of your staff? (7 = most successful, 4 = neutral, 1 = least successful)

7 6 5 4 3 2 1

Q40. How successful is your SE in enhancing the future job opportunities of your staff?

7 6 5 4 3 2 1

Q41. How successful is your SE in increasing the social exposure (e.g., making new friends, interaction, and mutual understanding with others) of your staff?

7 6 5 4 3 2 1

Q42a. How many donors have you had until now? _____

Q42b. ☐ One-off donation ☐ Regular donation Other: _____

Mainly [Something is missing here.]

Q43. How many volunteers do your SE have until now? _____

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China Journal of Accounting Research 12 (2019) 177–189

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Contents lists available at ScienceDirect

China Journal of Accounting Research

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

West meets east: Understanding managerial incentives in Chinese SOEs

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ARTICLE INFO

Article history:
Received 5 October 2018
Accepted 24 April 2019
Available online 22 May 2019

Keywords:
SOE
Managerial incentives
Bureaucratic hierarchy
Political promotion

ABSTRACT

State-owned enterprises (SOE) are essentially extensions of the government and are therefore responsible for multi-task objectives. The incentive system for SOE managers consists of both monetary compensation and promotion within the bureaucratic system. Political promotion is key to understanding the incentives of SOE managers. In the reform and opening up era, SOEs have been reformed and exposed to political and market forces. The design of incentive systems for SOE managers has thus become complicated and challenging. Our study provides important implications for this key issue of SOE reform.

SOEs play a vital role in China's economic and political system and serve as an important material and political foundation for the development of the Communist Party of China and the country. Improving SOEs' operating performance and strengthening party control over them are always important aspects of the government's economic work. This article discusses the nature of SOEs and then uses the incentive theory for firms developed in Western literature to analyze and summarize the basic characteristics of the managerial incentive system in Chinese SOEs. Specifically, we discuss the strengths and weaknesses of this incentive system by combining empirical findings on CEO incentives in Chinese SOEs. Finally, this article discusses potential improvements to SOE managerial incentives in the future.

1. Multi-tasks of SOEs and top-down administration

Before the reform and opening up, China's economic system consisted entirely of a state-owned economy. The reform and opening up led to increased market power and diversified property rights. SOEs, private enter-

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https://doi.org/10.1016/j.cjar.2019.04.001
1755-3091/

prises, and foreign-funded enterprises coexist in the market and compete with each other. In contrast to non-state-owned enterprises, SOEs typically have multiple goals beyond profitability—that is, obvious multi-tasking characteristics. Early discussions of the objectives of Chinese SOEs focused on their social stability function (Bai et al., 2000; 2006).

Views of SOEs suggest that during this transition period, because the security system to maintain social stability is still underdeveloped, the state needs enterprises to provide employment to maintain social stability, which will adversely affect business efficiency. Because non-state-owned enterprises do not have incentives to provide social stability, the state needs to maintain a certain number of SOEs to hire more employees and promote social stability, which places a policy burden on SOEs (Lin et al., 1998).

In the past 40 years since the implementation of market-oriented reforms in China, the national economy has grown rapidly, and underground market institutions have been established. Given the social stability objectives of SOEs, the importance of SOEs should gradually decline. However, based on the declarations of the Central Committee of the Communist Party of China and the State Council, the role and status of SOEs have not been diminished. Within China's socialist economic system, SOEs are responsible not only for strengthening social stability but also for promoting social development. In 2016, at the National Conference on the Construction of State-Owned Enterprises, President Xi Jinping stated:

State-owned enterprises are an important material and political foundation for socialism with Chinese characteristics, and an important pillar and power for our party to govern and rejuvenate the country. Since the founding of the People's Republic, especially since the reform and opening up, the development of SOEs has made great achievements. China's SOEs have made historic contributions to economic and social development, scientific and technological progress, national defense construction, and improvement of people's livelihood. It is of great merits and dedication.

Moreover, if SOEs only undertake social stability functions (such as employing a large number of excess employees), their business performance will undoubtedly be negatively affected. However, since the beginning of this century, the operating performance of SOEs has improved significantly. For example, according to the "Statistical Communiqué of the National Economic and Social Development of the People's Republic of China in 2017," state-owned holding companies had an income of 1,665.1 billion yuan in 2017, an increase of 45.1% over the previous year, and their growth rate ranked first among various economic activities. Thus, SOEs not only undertake the policy burden of social stability but also the functions of policy implementation and innovation to promote social development. In other words, SOEs are an important force for the government to promote economic and social development. They are "the vanguard of the implementation of the new development concept, the vanguard of innovation-driven development, and the vanguard of the implementation of the national major strategy."[1] With the development of society and the economic aggregate, SOEs themselves have also made considerable progress.[2] In undertaking the policy burden of promoting social stability and social development, Chinese SOEs also enjoy policy dividends. As organizations controlled by different levels of government, SOEs need to enforce and implement various government economic and social policies, such as taking on leadership roles in industrial or economic affairs, addressing income inequality, and building the community environment. Such undertakings make up the social mission of SOEs.

But why must SOEs undertake such missions? Cannot the functions of social security and social development be realized through other mechanisms such as public finance and market transactions? The factors underlying this problem are complex and beyond the scope of this article. A preliminary answer in this article is that China has delegated some decision rights to government officials at all levels to encourage them to adopt discretionary and flexible measures to promote economic and social development within their jurisdictions. However, governments at all levels must strictly comply with policies and laws (such as the Budget Law), which limits the ability of government officials at all levels to use public finances to promote local economic and social policies. In addition, governments at all levels can put little pressure on non-state-owned enterprises to pursue social goals. Non-state-owned enterprises that exclusively pursue profitability are not

[1] When Xi Jinping visited China Aluminum Corporation in 2017, he proposed that SOEs should be the vanguards of implementing new development concepts, of innovation-driven development, and of implementing major national strategy.

[2] According to the 2017 China Statistical Yearbook, the total profit of SOEs in 1998 was 52.514 billion yuan. In 2016, it reached 12,324.34 billion yuan, an increase of 23.46 times, and the GDP growth during the same period increased 8.73 times.

motivated to undertake unprofitable or highly uncertain projects. If the government forces non-state enterprises to undertake government policy tasks, it will lead to high transaction costs between governments and market players, and would be inconsistent with the trend of market-oriented reforms. By letting SOEs implement the economic and social policies of all levels of government, the transaction costs are internalized to some extent, which is conducive to the implementation of the ideas and policies of government officials. In this sense, SOEs can be regarded as extensions of government that manifest as downstream organizations in the bureaucratic hierarchy. SOEs are accountable and report to higher-level governments, and SOE managers are responsible to officers in charge, which contrasts sharply with the typical "shareholders meeting–board of directors–manager team" Anglo-American corporate governance structure. Thus, in terms of corporate governance mechanisms and characteristics, SOEs and non-state-owned enterprises are inevitably very different.

Importantly, the multi-task characteristics of SOEs that are accountable to higher levels of government also require their pursuit of profit targets. Only profitable companies can survive in the market, and SOEs that cannot achieve profitability will increase the serious financial burden on high-level government and therefore fail to fulfill to carry out the economic and social policies assigned to them. Once an SOE has suffered losses, high-level government may restructure it (Wang et al., 2001). SOE managers may also face hard budget constraints. However, because SOEs have government support, they have certain competitive advantages when competing with non-state-owned enterprises, especially when undertaking government-issued business (such as infrastructure construction projects). Thus, in theory, SOEs should try to avoid losses, but they cannot purely emphasize profit maximization. This is a dilemma that non-state-owned enterprises do not face.

2. Careers of SOE managers in a locked market

Because SOEs are government affiliates, SOEs and government administrative agencies are integrated as units within the system, which shapes the careers of SOE managers within a locked market. Changes in administrative levels and work units are the two main factors that of the careers of SOE managers. The work units of SOE managers can only switch between SOEs, or between SOEs and government administrative agencies (see Fig. 1). In addition, similar to government officials, in most cases, SOE managers also have administrative levels. To a large extent, the career ceiling of an SOE manager is determined by his administrative level and the size of the unit in which he served.

China's bureaucracy has been exposed to relatively less market risk because it resists brutal shocks from external markets and enhances utility for risk-averse individuals. In addition, the bureaucracy requires individuals to follow discipline in their work (Weber, 1968). This system has a special self-selection pattern:

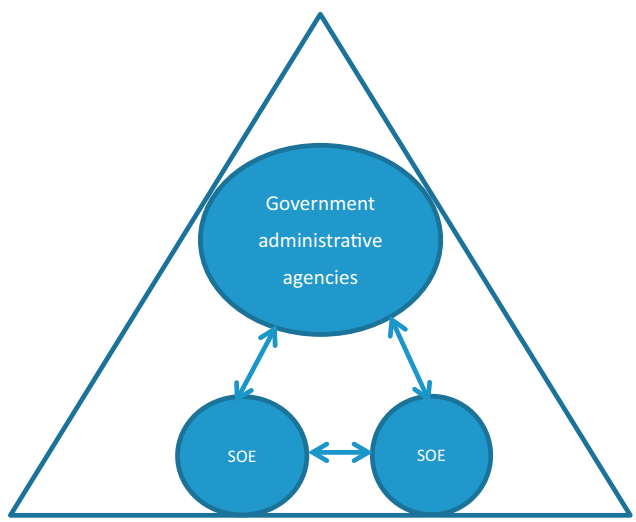

Fig. 1. Career of an SOE manager in a closed system.

individuals who are more risk-averse and more disciplined are more likely to choose the path of development within the system.

If an SOE manager wants to leave the system and seek professional development outside it (commonly known as "xia hai"), he will face high switching costs, including the abandonment of a series of hidden benefits attached to the system. In addition, the higher the administrative level of SOE managers, the higher the switching costs (Chen et al., 2018). This high cost of switching job markets leads most SOE managers to spend their entire careers in the locked market.

3. Performance evaluation of SOE managers

Generally speaking, there are two kinds of performance evaluations for managers, objective and subjective. Objective evaluation seeks an objective indicator of sufficient information to reflect talents and efforts (Holmstrom, 1979). If this objective and effective indicator cannot be found or the objective indicator selected is too noisy, the objective evaluation should not be emphasized too heavily, and subjective evaluation should be used.

When a manager faces multiple tasks with different performance indicators for evaluation, it is easy to induce managers to act discretionarily to maximize their own interests, as these different dimensions of indicators may conflict with each other, or the objective performance measures may not be consistent (Holmstrom and Milgrom, 1990; Baker, 1992). It is clearly not what the principal expects. In this case, the manager's performance evaluation should be more subjective.

It should be pointed out that the multi-tasks of SOE managers do not necessarily conflict with the use of objective evaluation indicators. For example, the complexity and diversity of the tasks of a company's CEO cannot be denied, but there are still objective evaluation indicators, such as stock returns and accounting performance in the CEO's incentive contracts. Indeed, the company's stock returns and accounting performance indicators can better summarize the CEO's efforts on multiple tasks. In other words, although the CEO undertakes multiple tasks, these tasks are linked to the company's market value and economic performance, which are evaluated using objective criteria (Prendergast, 1999).

However, the characteristics of the tasks faced by SOE managers are highly complex, which makes the performance evaluation of SOE managers difficult. Because SOEs promote social security and social development, they are an important force for governments at all levels in implementing economic and social policies. The tasks faced by SOE managers are diversified and heterogeneous, and include government project investment, counterpart poverty alleviation, and projects on the State-owned Assets Supervision and Administration Commission (SASAC) reform task list. These tasks cannot be aggregated simply through stock returns or accounting performance indicators. As a result, performance evaluations of the SOE managers must be based on the weighted average of multi-dimensional indicators and then subjectively rated based on the weighted average. Table 1 provides an example of the assessment of a major SOE of a province.

Du et al. (2012) explain in detail how the SASAC assesses the central SOEs. Specifically, the SASAC works with subordinate SOEs to determine the target operating results for the next year in the fourth quarter of each year. In general, SOEs first propose their own business performance targets, and then the two parties

Table 1
Assessment plans of a major SOE by the SASAC of a province in 2017.

Indicator	Score	Assessment items	Weight	Target value
Fundamental	70	Completion of Government project investment (unit: 100 million yuan)	20%	X1
		Net profit attributable to the parent company (unit: 10,000 yuan)	30%	X2
		Economic value added (unit: 10,000 yuan)	30%	X3
		Financial performance evaluation	20%	
Comprehensive	30	Provincial State Assets reform task list	50%	
		Provincial State Assets innovation task list	30%	
		Provincial SASAC risk control checklist	20%	

Note: Financial performance is evaluated by the provincial SASAC at the end of the year, and the comprehensive industry annual standard is benchmarked.

determine the final business performance target and sign a business responsibility contract through consultation and negotiation at the end of March in the second year. Each April, the CFO of the SOE prepares relevant statements on the completion of the operational indicators based on the reviewed financial report of the previous year and compares them with the previously determined business performance targets, and then submits them to the SASAC for review and evaluation. The SASAC uses the SOEs' performance reports to calculate their performance scores and then independently adjusts them according to the specific conditions of the SOEs (such as whether there are security incidents, etc.). Finally, the SASAC assigns a five-level rating (A-E) to SOEs based on the final performance scores of each SOE and score interval. Generally, SOE managers at and above C are qualified, while D and E mean that SOE managers are incompetent. Fig. 2 shows the evaluation ratings of 152 central SOEs from 2005 to 2007.

The literature shows that when managers face multi-tasking, subjective performance evaluation is more comprehensive than objective performance evaluation. However, subjective evaluation has a number of shortcomings. First, subjective evaluation results are difficult to verify externally, so they are susceptible to various non-performance factors, which mitigates their credibility. For example, subordinates may waste resources to maintain good relationships with their superiors to obtain good evaluation results (e.g., Milgrom, 1988). Du et al. (2012) find that the political relevance of SOE CFOs and the geographic proximity of SOEs and SASAC are positively correlated with the level of subjective evaluation. Thus, SASAC's evaluations of SOEs may be affected by non-performance factors.

Second, subjective evaluation is prone to problems such as centralization bias and benevolent bias, and often does not distinguish well between good performance and poor performance (e.g., Landy and Farr, 1980). In addition, the results of subjective performance evaluations should not be weighted too heavily for high-power manager incentive contracts. Because the results of subjective performance evaluation cannot be verified, if the economic consequences of a subjective evaluation are particularly important, it is highly likely to distort the agent's actions (Milkovich and Wigdor, 1983). The results of the subjective evaluation should be mainly used to examine the manager's talents and efforts over the long term and to help the manager develop his or her career rather than immediately link subjective evaluation results with explicit incentive contracts.

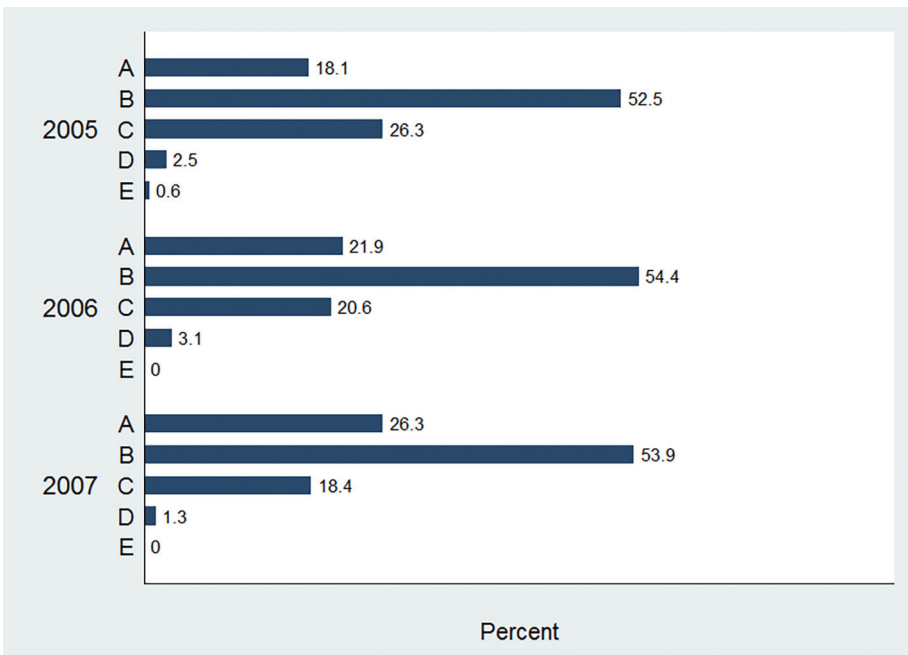

Fig. 2. Evaluation ratings of 152 central SOEs from 2005 to 2007 (Source: Du et al. (2012)).

Table 2
Descriptive statistics of the cash compensation of central SOEs' chairmen (deputy ministerial level) in 2016.

Statistics	Chairman's cash compensation (unit: yuan)
Mean	738,300
Median	751,200
Min.	535,000
Max.	125,7,500
Std.	132,000

Note: The data come from the website of the SASAC of the State Council. In 2016, 104 central SOEs disclosed the compensation data for their chairmen. We excluded 23 samples for which the chairman had not yet been appointed or for which the chairman did not serve for the whole year in 2016, resulting in 81 samples.

4. Features of the incentive system for SOE managers

SOEs are subject to the government, and SOEs managers undertake multi-tasks and are accountable to high levels of governments. As their careers are in a locked system, the incentive system for SOE managers has unique features, including bureaucratic monetary compensation, promotion within the system, incentives for control, and delayed payments.

4.1. Bureaucratic monetary compensation

Compared with managers of non-state-owned enterprises, the monetary compensation of SOE managers is rather low. The salary differential among SOE managers is small, which reflects bureaucratic salary characteristics. Table 2 shows the salaries of 81 central SOEs in 2016 (administrative level: deputy ministerial level). The annual average monetary salary of the chairman of the central SOEs is 738,300 yuan, the median is 751,200 yuan, the minimum is 535,500 yuan, the maximum is 1,257,500 yuan, and the standard deviation is 132,000 yuan. Given that most of the central SOEs are large-scale firms, the monetary compensation of their managers is quite low compared to managers of non-state-owned enterprises of similar size.[3] The standard deviation of the monetary compensation of SOE managers is also very small,[4] which indicates that the monetary compensation contract is unlikely to be effective in providing incentives.

Why do SOE managers' salaries have bureaucratized monetary compensation characteristics? The reasons are complex. First, as mentioned earlier, an SOE manager is a quasi-official officer who is both the enterprise manager and an administrative official. This duality is determined by the party's organizational department according to work needs. For a manager registered with the party's organizational department—a "bureaucratic manager" or "official manager"—monetary compensation is naturally determined with reference to the administrative bureaucratic compensation system.

Second, SOEs undertake multiple tasks beyond profitability, which lack comprehensive indicators to evaluate the talents and efforts of managers, which makes it difficult to implement pay-for-performance compensation contracts. In theory, it is possible to aggregate multiple task performance indicators into one comprehensive indicator and then link this comprehensive indicator with manager compensation. However, because of the complexity of the performance indicators of multiple tasks and the variation in information content and the noise of performance indicators of different tasks, a manager may miss certain tasks. Therefore, in a multi-tasking situation, manager monetary compensation should not exclusively rely on strict performance indicators.

[3] Taking Longhu Real Estate, a large private real estate enterprise, as an example, the cash compensation of Wu Yajun, the chairman of the company, was 10.09 million yuan in 2016, and the cash compensation of CEO Shao Mingxiao was 15.10 million yuan (excluding an equity incentive of 12.55 million yuan).

[4] According to the information disclosed by the SASAC, if the head of the central SOE needs to work overseas, an additional RMB 350,000 in monetary subsidies will be issued each year. After this addition, the salary gaps between the central SOEs will be smaller.

SOEs' non-profit tasks will affect their accounting performance because they have access to the preferential policies and investment opportunities brought by government support. Accounting performance is thus less applicable for measuring managerial talent and effort. Therefore, accounting performance alone is not suitable for determining managerial compensation.

Based on data from Chinese listed companies, Firth et al. (2006) find that there is no statistically positive association between managerial compensation and corporate performance in a listed company with a state agency as the major shareholder. Liu et al. (2007) find that the more the government intervenes in enterprises, the less accounting performance is used in compensation contracts for SOE manager, and the weaker the relationship is between manager compensation and accounting performance.[5] The empirical evidence documented is consistent with the above theoretical predictions.

The degree of managers' risk aversion also affects the design of compensation contracts. Holmstrom and Milgrom (1987) point out that the higher the agent's risk aversion, the less explicit the incentive level should be. If a manager who chooses to spend his or her career in the system has a higher degree of risk aversion, his or her compensation contract will be characterized by bureaucratization.

4.2. Political promotion

Political promotion is key to understanding the incentive mechanism of SOE managers. Promotion has always played an important role in organizational incentives. Lazear and Rosen (1981) and subsequent studies use tournament theory to analyze the incentive effects of position promotion in organizations. In an organization, many employees (agents) compete for the same position, and employees' compensation is linked to the positions. For positions at the same level, the salary is relatively fixed and the gap is not large. The higher the position level, the greater the corresponding return, and thus it provides agents with incentives for upward promotion. Only winners can qualify for the next round (higher level) of competition, and this option effect provides further incentives for agents. When selecting candidates to participate in the competition, the principal pays attention to their talents and efforts. Because only one candidate can win in a position, the principal only needs to select the best of the limited candidates, which reduces the cost of assessment for candidates. Moreover, the cost of negotiation between the principal and the agent in the compensation contract is reduced because of the specific position and fixed salary. In addition, the principal is unlikely to pick the winner based on the agents' short-term performance, which also eases the agents' short-termism. Because only one of the candidates wins, this also eliminates problems of kindness deviation and center deviation that are common in subjective evaluation. Moreover, once a candidate is successfully promoted to a higher position, he has more resources to control, and thus the consequences of decision-making are more serious. Therefore, if an incompetent candidate is promoted, the interests of the superior (principal) will be damaged. This potentially constrains the rent-seeking issue in position promotion. For the above reasons, position-based promotion incentives play a highly important role in organization governance.

However, once an agent is promoted to the highest position in the enterprise, the incentive effect of promotion will be significantly weakened because there is no further room for improvement. Therefore, monetary compensation and equity incentives are the main incentives for CEOs of non-state-owned enterprises. Correspondingly, foreign literature on CEO incentives rarely discusses the incentive mechanism for promotion. Unlike non-state-owned enterprises, SOE managers seek political promotion in the government system. Table 3 lists the administrative rankings of Chinese officials, from the lowest level (Quasi Town/Section) to the highest (Full State), a total of 10 levels. Among them, officials at the Quasi Department level and above belong to the ranks of "senior cadres." The persons responsible for central and local SOEs are managed by the party's various organizational departments with reference to the corresponding administrative ranking. For example, the administrative ranking of the heads of central SOEs (the chairman and general manager) is generally Quasi Province/Ministry, the administrative level of the heads of provincial SOEs is generally Department, the

[5] In theory, if there is a positive correlation between the political indicators undertaken by SOEs and economic performance, the existence of political tasks does not necessarily weaken (or even strengthen) the sensitivity of managerial compensation to accounting performance. We thank Professor Ye Kangtao for pointing this out.

Table 3
Administrative levels of Chinese officials.

Rank order	Political rank	Multi-level SOEs
1	Full State	
2	Quasi State	
3	Province/Ministry	
4	Quasi Province/Ministry	Central SOEs
5	Department	Provincial SOEs
6	Quasi Department	
7	County/Division	City SOEs
8	Quasi County/Division	
9	Town/Section	County SOEs
10	Quasi Town/Section	

administrative level of the heads of SOEs in prefecture-level cities is generally County/Division, and so on. Therefore, SOE managers have a great deal of room for future promotion, which can motivate their actions.

In addition, as shown in Fig. 1, because SOE managers can move between different units within the system and the social status and influence of different units vary, the rotation of managers between different units can also be seen as a form of reward or punishment even if their administrative level is unchanged. For example, when a small SOE manager is transferred to a large SOE unit, it can be considered a political promotion.

In general, SOE administrators (State Council SASAC or local SASAC) are responsible for the assessment of SOE managers, and organizational departments at all levels of the CPC (such as the Organization Department of the CPC Central Committee) are responsible for the selection and promotion of SOE managers. Thus, the appraisal organization and selection institution are separate, which ensures a certain degree of independence in the manager selection process. In the selection of a specific manager (cadre), the organization department needs to conduct surveys and vote to ensure fair evaluations (opinion poll) of the candidates. The results of the evaluations by surveys and voting are important reference indicators for choosing a manager. Candidates with poor public opinion responses are not competitive. To a certain extent, the assessment of candidates brings together private information about candidates' conduct and abilities. It has functions similar to market (decentralized) decision-making, which enhances objectivity in the selection process.

4.3. Control as an incentive mechanism

For business managers, control of the position is an important source of incentives. In reality, the social and political influence of individuals often depends on the resources that they control, not the resources that they own (Morck et al., 2005). The psychological achievement, respect, and social status that accompany the control rights enhance the individual's utility.

In China, the government plays an important role in economic and social life. A large number of economic and social resources (such as education, medical care, etc.) are allocated by public power rather than market mechanisms, which further enhances the return of power within the system. SOE managers can obtain not only useful information from closed networks, but also the attention of other members of the network when dealing with personal matters such as personal and family friends (such as children's education, job opportunities, medical resources, etc.). Managers can also inject information and resources into a closed network, which are important bargaining chips in their relationship networks. The ability of an individual to obtain returns from the system is closely related to his or her position (control), which contributes to the incentive to "preserve a seat" and thus provides a source of motivation for actions.[6]

[6] Professor Kangtao Ye provided a wonderful exposition of the incentives and effects of resource control on SOE managers when discussing this article in the 10th Anniversary Symposium of *China Journal of Accounting Research*. Incentives include the retention of SOEs' profits, the provision of more capital, and appointments to positions that control more resources. For the government, compared with administrative promotion, the resources granted to SOE managers are considerable, so managers' enthusiasm can be more fully mobilized.

4.4. Deferred compensation

SOE managers, especially high-level cadre managers, typically have deferred compensation. Deferred compensation is the redistribution of employee compensation across the career life cycle. The employee receives low compensation when young, but high compensation when old. A number of literatures have discussed the role of deferred compensation organizational incentives (Salop and Salop, 1976; Lazear, 1981). Under the deferred payment system, older employees are more motivated to work harder (because they receive more than the market compensation), while younger employees work hard based on future compensation expectations. Moreover, if it takes long time to observe the agent's talents and efforts, the deferred compensation is better than the instant compensation. In addition, deferred compensations are also more helpful in retaining employees.

SOE cadre managers' deferred compensation is mainly reflected in post-retirement benefits, including higher retirement wages and better medical conditions than general employees receive. The post-retirement benefits of cadre managers are also closely related to their administrative level, which further strengthens the incentive effect of administrative promotion.

5. Consequences of the incentive system for SOE managers

From the previous discussion, the incentives for SOE cadre managers have the obvious characteristics of low monetary compensation and strong administrative promotion incentives. What are the economic and political consequences of these managerial incentives? We discuss the positive and negative effects.

5.1. Positive effects of the incentive system for SOE managers

As mentioned, SOEs are an extension of the government, safeguarding social stability and promoting social development. For them to effectively achieve these goals, the government must ensure that its economic and social policies can be implemented in SOEs, and thus the government must maintain control of SOEs. An important way that the government ensures this control is by appointing and dismissing heads (party management cadres) of SOEs. Further, SOE managers' motivation to work hard with less monetary compensation can be strengthened by establishing multiple levels of executive positions and allowing SOE managers to move within the system. Thus, the government can use fewer management resources to control a large number of SOEs, which is key to the implementation of party and government economic and social policies.[7]

This incentive system also helps to reduce the inclination of SOE managers to take excessive risks. Chen et al. (2018) believe that SOE managers in a closed system enjoy non-transferable benefits: the higher the administrative level of the manager, the greater the non-transferable interest, so the cost of getting out of the system is high. Therefore, for career and benefit considerations, cadre managers tend to be conservative and avoid risks when running a business. Using data for state-owned listed companies from 2005 to 2012, Chen et al. (2018) find that the administrative level of SOE managers is negatively correlated with the company's stock price crash risk. Because SOEs operate using resources owned by the people, the risk of agent asset abuse is particularly serious. It is essential to reduce the excessive risk exposure of managers through various means, such as the administrative level system.

[7] The literature on the promotion of SOE managers finds that the poor performance of SOEs is likely to lead to the demotion of managers, but that good performance has a weak relationship with manager promotion (Liu and Xiao, 2015). The social responsibility and policy burden of SOEs can help managers obtain promotions (Liu and Xiao, 2015; Zhang et al., 2015). This shows that adopting an incentive mechanism for administrative promotion will help SOEs implement the government' economic and social policies. First, if the company's performance is sufficiently bad, the company will not be able to implement the government's economic and social policies and will place a heavy financial burden on the government (such as the consumption of a large amount of government subsidies). Managers of poorly performing companies will be punished. Second, the company assumes more social responsibility and policy tasks, and it helps implement the government's economic and social policies, so company managers are more likely to receive government rewards. Third, if the government pays too much attention to the profitability of SOEs, it is likely to lead to suspicions of "competing with the people" and will weaken the incentives for SOEs to assume social and policy burdens (because doing so will weaken the performance of enterprises). Therefore, SOE managers will not be promoted just because of their excellent performance. In terms of the evidence observed above, the administrative promotion of SOE managers generally matches the tasks and missions undertaken by SOEs.

The incentive system for SOE managers also helps to avoid over-emphasizing "pay for performance" earnings management (e.g., Cheng and Warfield, 2005; Bergstresser and Philippon, 2006), managerial myopia (Edmans et al., 2017), and other opportunistic behaviors. However, an incentive system with administrative promotion as the core will experience a series of serious problems, which we discuss below.

5.2. Problems caused by the incentive system of SOE managers

Cadre managers face extremely fierce competition for administrative promotion. The higher the administrative level, the more intense the competition. Moreover, there is usually a limit on the age of a candidate promoted. For example, most candidates promoted to the County/Division level for the first time are less than 50 years old, while those promoted to the Department level for the first time are typically no more than 55 years old. The brutal competition and age limits require cadre managers to assess their future promotion prospects during their tenure. When a manager feels no hope of promotion, the incentive effect of administrative promotion is greatly weakened. With meager cash compensation, such a cadre manager may have the incentive to chase wealth, which can lead to corruption.[8]

Second, a long-standing problem in China's cadre management system is that cadre managers can be promoted but rarely dismissed. That is, there is no specific stipulation on the terms of cadre managers. Many have worked in fixed positions for a long time, which has lowered the promotion prospects of middle and lower managers. It also reduces incentives for incumbent cadre managers, especially when their promotion prospects are slim. The literature suggests that incompetent managers retained in their positions are among the most serious agency problems (Jensen, 1993; Shleifer and Vishny, 1989). When a group of mediocre cadre managers occupy important positions, organizational efficiency and even the entire state-owned economic system may be seriously damaged.[9]

In addition, because superior officials decide whether to promote a cadre manager, SOE managers prefer to take actions that can attract the attention of their superiors. Zheng et al. (2012) conduct a case study of a large provincial SOE and find that SOE executives have a strong incentive to build image projects to achieve political promotion, including public welfare donations and media promotion reports to enhance the personal image of a company or executive in the short term. SOE managers are often too eager to pursue actions that are observable by their superiors, which frequently leads to resource mismatches and reduces resource allocation efficiency.

As mentioned, SOE managers seek career development throughout the system (rather than within a company). SOE managers are often transferred to other units within the system because of the arrangement of the superior organization, which results in a large degree of uncertainty in their term within a particular enterprise. This uncertainty disincentivizes managers from acting in the interests of the long-term development of the company, which leads to short-termism issues.[10]

6. Evolution of the incentive system for SOE managers

In the 40 years of reform and opening up, market forces have played an increasingly important role in resource allocation and have profoundly affected the governance of SOEs. The growing numbers of private enterprises, foreign-owned enterprises and multinational corporations present SOEs with more intense market competition. Companies with continuous losses cannot survive in the market; in a competitive market, SOEs must establish governance systems that adapt to market forces and market signals. SOEs must simultaneously

[8] Chen et al. (2009) conduct a study of local state-owned listed companies and find that the existence of executive compensation regulation is positively related to the probability of executive corruption; Xu and Liu (2013) further support this finding. Wan and Chen (2010) document that when SOE executives face retirement, they are more likely to suffer occupational occupation.

[9] In the market competition environment, the empirical shows (Liu and Xiao, 2015) that the performance of SOEs is negatively correlated with the executives turnover, that is, the executives is demoted due to poor performances. This means that SOE cadre managers face hard constraints on performance to a certain extent, and stronger market forces will tighten such constraints.

[10] Professor Ye Kangtao believes that administrative promotion is a high-cost incentive mechanism. High-level positions are scarce and therefore prone to insufficient incentives. According to the Peter Principle, executive promotion can easily lead to entrepreneurial mismatches. We agree that more theoretical and empirical research is needed on the interpretation and consequences of the promotion incentives for state-owned enterprise managers.

promote social stability and development; thus, they have mixed market and administration goals. From the market perspective, SOEs must improve operational efficiency and enhance their vitality. From a political point of view, the government needs to strengthen control over SOEs so that they implement relevant government policies. Strengthening control and improving efficiency are the dual goals to be achieved in SOE reform. Mixed incentives have been developed to meet these goals.

First, the management of SOE managers has been reformed. Not all managers are treated as cadres, and non-cadre managers are allowed to adopt market-oriented incentives, such as higher monetary compensation, stronger pay for performance, and equity incentives. Through the establishment of a multi-layer ownership structure (equity pyramid), market forces can play a greater role in SOE operation and governance. Generally, SASAC is at the top of the equity pyramid of SOEs. When there are two or more layers in the equity relationship between an SOE and SASAC, the SOE manager (if the manager does not serve in the upper-level enterprise) is generally not managed as a cadre. This manager's assessment and compensation are mainly determined internally by the SOE. At this point, the selection and incentives of these managers will be more market-oriented. For example, Fan et al. (2013) provide theoretical explanations and evidence that the pyramid structure can isolate administrative interventions from the government, reduce political costs, and improve the efficiency of SOEs and the level of management specialization. Zhou and Xin (2017) document that when state-owned listed companies are at the bottom of the pyramid structure, the stronger the correlation is between manager compensation and accounting performance, the more likely managers are to be replaced because of poor accounting performance. Other studies find that the stronger the market power faced by SOEs, the more market-oriented managers' incentives are Ke et al. (2012), Hu et al. (2013).

Second, different SOEs have different responsibilities, roles, and goals in economic and social development. Therefore, different management and evaluation models are needed. For example, SOEs in competitive industries should allow market forces to play a leading role in business management and governance, while SOEs related to people's livelihoods and public services should emphasize administrative power. In 2015, SOEs began to implement classified reform and supervision policies, and SOEs were classified as public welfare or commercial. The evaluation indicators and incentive contracts differ for different types of SOE.

Third, the Chinese government increased promotion incentives and discipline on cadre managers to decrease manager shirking. Age thresholds for managerial promotion are no longer emphasized, and a clear cadre manager tenure system is being implemented. For example, in general, if the chairman and general manager have served in the same positions for 9 years and can still serve for at least 3 more years, they should change posts. An exit mechanism is being put in place to solve the problem of mediocre cadre managers who "can go up but can't go down."[11]

The locked market of SOE cadre managers may open in the future. First, promoting SOE cadre managers will emphasize the market-based selection and employment mechanism, which may not promote candidates completely in accordance with the current administrative level. Second, the administrative ranking of cadre managers may no longer be a lifelong system, and cadre managers will be able to explore channels to become professional managers. Managers will be able to give up the cadre identity to follow the principles of marketization and to receive market-based compensation within the company or in joint ventures established by the company.

In short, with the mixed organization of the government and market, the design of incentive contracts for SOE managers is complex. Such design must focus on the dual goals of enhancing control and improving managerial efficiency. The government needs to develop effective operational plans through the exploration and summarization of the reform of SOEs. It is also necessary to further promote the ongoing reform of the SOE incentive system. Most importantly, it is necessary to further promote the change in the incentive system of the government (including officials) itself so that it truly fulfills the role of qualified supervisor.

7. Conclusion

When examining the governance characteristics of Chinese SOEs, we must first understand the nature of SOEs and the logic of their existence. We must answer the question of why China needs SOEs. We believe

[11] Refer to the "Regulations on the Management of Central Enterprises Leaders" revised in 2018.

that in the process of state governance, because of historical factors, ideology, transaction costs, and other factors, some businesses cannot be managed in a completely market-oriented manner, nor can they be completely managed through administrative orders. The form of organization must adapt to the specific institutional environment (Williamson, 1985). As hybrid organizations that combine government and market forces, SOEs may have adapted to the Chinese political and economic institutional environment. This article summarizes and comments on the main characteristics, economic consequences, and evolution of the incentive system of SOE managers.

SOEs serve as extensions of the government, which profoundly affects the selection, evaluation, and remuneration of SOE managers. The incentive system for SOE cadre managers features bureaucratic monetary compensation, political promotion within the system, and incentives for control and delayed compensation. Administrative promotion is key to understanding the incentives for SOE cadre managers. This kind of incentive system with political promotion at the core enables the government to control the SOEs with minimal management resources and to promote social stability and social development. However, it often impairs the efficiency and innovation of SOEs. The reform of SOEs further strengthens the government's control over SOEs and stimulates the growth of business operations. Although this poses a great challenge to the design and implementation of incentive contracts for SOE managers, it is promising for finding an effective manager incentive system suitable for the Chinese institutional environment through continuous reform and exploration, which may include increasing the number of SOEs listed in the stock market, setting up a multilevel pyramid structure, reforming SOEs, and managing managerial markets.

The introduction of the system in this paper has implications for academic research in the field of SOE governance. A large number of studies directly compare SOEs with non-state-owned enterprises to provide policy implications. However, if the nature and mission of SOEs are significantly different from those of non-state-owned enterprises, comparisons based on certain indicators (such as operation performance, investment efficiency, innovation activities, etc.) do not make sense. Second, as mixed administration and market organizations, SOEs are highly heterogeneous. Some SOEs play political leadership roles in the local economy, while others are more market-oriented. An in-depth study of the governance of SOEs by exploring their features is necessary. Third, in exploring the incentive mechanism for SOE managers, researchers need to explore the nature of SOEs given their institutional environment instead of replicating the approach of Western literature using Chinese data.

Acknowledgments

We thank Zengquan Li, Lijun Xia, Feng Liu, Yu Xin, and Kangtao Ye for their helpful comments at the 10th Anniversary symposium of *China Journal of Accounting Research*. Qingquan Xin acknowledges financial support from a China National Social Science Foundation Key Research Project (Project No.: 17ZDA086): Research on Reforms and Innovations of Monitoring System in State-Owned Enterprises.

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China Journal of Accounting Research 12 (2019) 191–208

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China Journal of Accounting Research

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Do significant risk warnings in annual reports increase corporate bond credit spreads? Evidence from China

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ARTICLE INFO

Article history:
Received 30 September 2016
Accepted 15 April 2019
Available online 23 May 2019

Keywords:
Risk disclosure
Risk warning
Credit spreads

ABSTRACT

Based on listed companies issuing bonds on the Shanghai and Shenzhen Stock Exchanges from 2007 to 2017, this study analyzes the relationship between significant risk warnings in Chinese companies' annual reports and corporate bond credit spreads. The main findings are as follows. First, in the Chinese market, "substantial warnings of significant risks" can significantly improve corporate bond credit spreads, reflecting the risk-warning effect; second, state-owned property rights weaken this effect, which only pertains to listed companies with poor risk management and low information quality; third, significant risk warnings increase investors' heterogeneous beliefs, also affecting credit spreads; and fourth, through textual analysis, it is found that the corporate bond credit spread is greater when the disclosed risk factors are more pessimistic and less similar to those of the previous year. The findings of this paper help to enrich the literature on credit spreads and risk disclosure.

1. Introduction

The scale of the issuance of corporate bonds in China has grown rapidly since their pilot issuance in 2007. Issuing corporate bonds has become one of the most vital financing methods for listed companies and plays an increasingly important role in the Chinese financial system. "Credit spread" refers to the cost of corporate bond financing. How to reduce credit spreads to decrease financing costs is the core concern in the corporate bond market. Therefore, the factors thought to affect credit spreads have attracted the attention of scholars and the market. Studies have found that when determining bond credit spreads, in addition to credit risk

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☆ We thank the NSFC (71472188, 71672191) and Humanities and Social Science Foundation (19YJC630040) for its support.

https://doi.org/10.1016/j.cjar.2019.04.002
1755-3091/

compensation (Kidwell et al., 1984), incomplete and asymmetric information compensation (Duffie and Lando, 2001; Yu, 2005) plays an important role. Thus far, research on asymmetric information compensation has largely used financial information (Callen et al., 2009; Zhou et al., 2014). Few scholars have considered non-financial information, especially that found in the risk disclosure of annual reports. Non-financial information can enhance users' confidence in the reliability and authenticity of earnings information, thus improving the information environment and the efficiency of investment decisions (Li, 2010). However, as of yet there is no evidence that non-financial information affects corporate bond credit spreads. This study analyzes the effect of disclosed risk information, as found in companies' annual reports, on corporate bond credit spreads, filling an important research gap.

Sufficient, timely, and effective information disclosure is a necessary prerequisite for mature capital markets. In 2005, the U.S. first asked listed companies to discuss their significant risk factors on the start page (Item 1A) of their annual reports (10-K filings). In 2007, according to the guidance of the "The Content and Format Standards of Information Disclosure for Companies That Offer Securities to the Public No. 2-Annual Report," the China Securities Regulatory Commission (CSRC) required Chinese public companies to disclose as much information on their risk factors as possible in the "Management Analysis and Discussion" (MD&A) section of their annual reports to be in accordance with the principle of relevance. However, from the perspective of management, risk disclosure also represents a kind of risk because the consequences of that disclosure cannot be anticipated. Companies tend to adopt the strategy of "the less trouble the better" by disclosing a small degree of risk to hide a more significant degree of risk. In addition, the disclosure of risk information in annual reports has long been regarded as a formality involving filling out a template without including much real content (Fanning, 2015). In this light, the CSRC placed further demands on risk disclosure in 2012, requiring listed companies to make their disclosure information more prominent by positioning this section at the beginning of their annual reports and by structuring the "significant risk warnings" according to the principle of importance. This standard was proposed on the basis of a company's having already disclosed risk information, and attempted to address the complications and obfuscations common to the previous template. Therefore, compared with those in the United States, the requirements for risk disclosure in China's annual reports take the process one step further. In the wake of the CSRC's guidelines, the listed company's substantial risk factors are now more visible, making it easier to ascertain the disclosure's market effect. That is the unique advantage of Chinese data.

Do significant risk warnings in annual reports play a role? What is their effect on the corporate bond market? Without direct empirical evidence, research has mainly resorted to stock market data; evidence from the bond market is still rare. The effect of risk disclosure on the stock market, as gleaned from the results of empirical research, cannot be simply applied the bond market, for the following three reasons. First, the bond market has a relatively fixed income, and so to minimize losses, bondholders tend to be sensitive to risk, focusing on more negative news than positive news, unlike stock investors, who tend to purse "high-risk, high-yield" investments and are more concerned with positive news or upside risks. Defond and Zhang (2014) find that bond prices react much more quickly to "bad new" than to "good news," and that the "bad news" contained in bond prices is greater than that in stock prices. Theoretically, therefore, the effect of annual reports' risk disclosure on bond prices should be greater than on stock prices. Second, as different types of investors pay attention to different risk factors and interpret them differently, investors in the stock market and bond market may reach different conclusions about the disclosed information. Third, bond investors' demand for risk information is much higher than that of their counterparts in the stock market. Bond investors tend to exert greater effort in gathering and analyzing negative news. Institutional investors, which account for the vast majority of the Chinese bond market, have an advantage over individual investors in terms of the ability to acquire and process private information. Here, institutional investors seeking risk information are not limited to that which is commonly revealed in company announcements and reports. Meantime, whether and how individual bond investors can use such information remain unknown. This situation differs from the stock market, where individual investors dominate. For the reasons stated above, research findings about the stock market, despite its advances, cannot be directly applied to the bond market. The effect of the annual risk disclosure on the corporate bond market remains a topic for further study.

In addition, the corporate bond market provides a good information environment for us to study corporate bond credit spreads. Since the CSRC promulgated its "Guide to Piloting Corporate Bond Issuance" in 2007, China's corporate bond market has achieved rapid and stable development. The growing demand for bond investment has intensified bond trading more than ever, and the liquidity of the bond market has also increased, which is important because only in a liquid market can information be efficiently integrated. Previous research on the bond market has come into question because of the lack of market liquidity. In contrast with other bond markets, the booming development of the corporate bond market provides a relatively good environment for the study of credit spreads.

This research was based on companies listed on the Shanghai and Shenzhen Stock Exchanges that issued bonds from 2007 to 2017, and it examined the relationship between the significant risk warnings of Chinese companies' annual reports and the credit spread of their corporate bonds. We made four important findings. First, "substantial warnings of significant risks" can significantly narrow (improve) corporate bond credit spreads, which reflect the risk-warning effect, and this relationship remains after excluding the company's fundamental risk, controlling sample self-selection, and conducting other robustness tests. Second, state-owned property rights weaken this effect, and "substantial warnings of significant risks" only affect companies with poor risk management capabilities and poor information quality. Third, the warnings affect credit spread by increasing the heterogeneity of investors' beliefs, which is the incomplete intermediary effect of risk disclosure on credit spread. Fourth, through textual analysis, it is found that bond credit spreads are greater when the risk factors are more pessimistic and less similar to those of the previous year.

Our study contributes to the literature in several ways. First, we find that the substantial warnings of significant risks has increased investors' heterogeneous beliefs and thus increased corporate bond credit spreads, which plays a risk-warning role. This contradicts the findings of Chiu et al., (2017) in the U.S. stock market, concluding that risk factors in Item 1A improve the transparency of financial reporting and therefore reduce credit default swap (CDS) spreads. Our findings supplement the literature on the economic consequences of risk disclosure. Second, we advance research on how non-financial information affects corporate bond credit spreads. There is little research evidence regarding how risk information disclosure affects credit spreads, and we fill that research gap. Third, in response to poor disclosure practices, the newly issued "The Content and Format Standards of Information Disclosure for Companies That Offer Securities to the Public No. 2-Annual Report" of 2015 relaxed companies' mandatory disclosure of significant risk warnings, but our research emphasizes the usefulness of such warnings in providing a decision-making basis for China's regulatory authorities as they develop more effective disclosure measures, strengthen their supervision over risk disclosure, and promote the healthy growth of capital markets.

2. Literature review and hypothesis development

2.1. Research on risk information disclosure

Research on risk information disclosure in annual reports has been based mostly based on company cases, special industries (Beattie, 2004), or small samples (Rajgopal, 1999). With the development of data mining technology over the past decade, more and more research has used the content analysis method to undertake textual analysis of disclosure content, often excavating information that had been buried deeply in the text and exposing it to the light of day.

In recent years, the use of textual analysis of risk information disclosure has focused on the stock market, addressing on the value relevance of disclosure content, the ability to predict a company's risk level, and the effects of risk disclosure on investors' risk perception. Li (2006) finds that the number of risk keywords is negatively correlated with future earnings and future market returns. Kravet and Muslu (2013) examine investors' perceptions of the risk disclosure of annual reports, finding a relative positive correlation between change in the frequency of risk statements and the volatility of future stock returns, the abnormal trading volume of the 3-day window period, and bias corrected analyst forecasts are relatively positively correlated. When the risk disclosed by the enterprise exceeds the industry average, the correlation is weakened, indicating that most of the information disclosed by the enterprise belongs to the template type, with a lack of the company's own special information disclosure. Campbell et al. (2014) and Hope et al. (2016) suggest that the types and traits

of risk factors are related to the company's risk and affect market performance, showing that the level of a company's disclosed risk can reflect and predict its actual risk. Investors incorporate disclosed risk information into the stock price, causing it to react accordingly. Fanning (2015) tests whether lowering the threshold of risk disclosure can affect investors' risk perception in an experimental way. The study concludes that the risk perception of people with targeted performance goals is less likely to be lowered by disclosed risk information or by the lengthy disclosure of generally unimportant risks. Also, that study finds that short-term investors are the ones most vulnerable to management's disclosure strategies because shorter-term investors need to consider risk to a greater extent. Filzen and Peterson (2015) finds that management may adjust policy in the face of risk disclosure and has a "wait and see" attitude in the face of uncertainty disclosure. Companies that are small or non-profit, along with high-risk companies running on credit, are more sensitive to factors of risk and uncertainty, and increases in those factors exert stronger effects on company policy than their decreases. Chiu et al. (2017) suggest that annual risk disclosure improves the transparency of financial reporting and reduces CDSs. In addition, for companies with greater information uncertainty and default probability, risk disclosure can help investors evaluate potential risks and make forecasts of future performance. Elliott et al. (2015) provide evidence on the correlation between disclosed risk information and company policy. Studies have shown that increased risk disclosure can explain changes in the company's financial policies such as those relating to debt ratios, investment, R&D, employees, dividend policy, cash holdings, and stock purchases. Moreover, these changes in financial policies are sensitive to changes in company size, profitability, and credit ratings.

Research has found that incremental change of disclosed risk information is negatively correlated with future earnings and positively correlated with market volatility and bias corrected analyst forecasts. That is, disclosed risk information can be used to predict a company's future risk, enhance the ability of capital market investors to identify risk, and reduce information asymmetry. Such research has mostly addressed the U.S. stock market, and Chiu et al.'s (2017) research also involves the U.S. CDS market. However, regarding the Chinese market, CDSs have just recently been launched and their development has been marked by instability. In addition, research findings about the American market cannot be applied to the Chinese market. Therefore, studies are needed to test the effects of Chinese companies' risk information disclosure, as found in their annual reports, on the corporate bond market.

2.2. Research on risk information and corporate bond credit spreads

With the rapid development of the corporate bond market in recent years, bond credit spread has become a focal point of research in macroeconomics and microfinance. Duffie and Lando (2001) propose that credit spreads can be influenced by the following two factors: corporate default risk and information asymmetry between investors and listed companies. Those two factors have also been the focus of numerous studies on corporate bond credit spreads.

"Default risk" refers to the risk of bond repayment resulting from uncertainty over the company's future cash flow. Here, the literature shows great interest in the role of "uncertainty." Jiang et al. (2005) and Zhou et al. (2014) show that information uncertainty affects corporate bond credit spreads. Leng et al. (2015) discover that role of loan guarantees in default risk affects corporate bond credit spreads. Wu and Wang (2016) investigate the disclosure of environmental information by heavy-polluting industries, and find that the level of such disclosure was significantly positively correlated with credit spreads for the listed companies showing poor environmental performance. Wang and Gao (2017) explore the effect of customer concentration risk on the credit spreads of secondary market bonds, concluding that the greater the company's fundamental risk, the greater the bond default and the greater the bond credit spread.

Regarding information risk, Duffie and Lando (2001) argue that information asymmetry can lead investors to different understandings of company value, such that they have different expectations of the term structure of corporate credit spreads. Yu (2005) finds that the quality of accounting information is negatively correlated with bond credit spreads: the higher the information quality, the smaller the credit spread. Zhou et al. (2010) review the literature on corporate bond credit risk from the perspective of information asymmetry. Zhou et al. (2014) empirically test how information asymmetry between corporate bond issuers and investors affects corporate bond credit spread via the ratio of intangible assets to the book value of total assets. Zhou et al. (2016)

confirm that the disclosure of social responsibility can reduce information asymmetry and thus reduce corporate bond credit spreads.

2.3. Hypothesis development

According to the above research, risk disclosure tends to have two effects on the stock market: improving investors' perception of corporate risk (Kothari et al. (2009); Kravet and Muslu, 2013) and reducing information asymmetry between investors and companies (Campbell et al., 2014; Chiu et al., 2017). This conclusion also applies to the bond market. The regulators' original intention in establishing criteria for risk disclosure was to provide investors with more valuable information for use in risk assessment and investment decisions, thus reducing information asymmetry between listed companies and investors and promoting price discovery in the bond market. The more the information disclosed in significant risk warnings elaborates on the risk factors, the less the information asymmetry and the smaller the corporate bond spread. However, the disclosure criteria for issuing a "Significant Risk Warning" were formulated with precisely that intention: warning investors about risk. Sometimes a company faces significant risk but fails in its obligation to disclose it. However, if that risk is somehow revealed, or if its underlying elements erupt into real crisis, then the market punishes the company, and soon afterwards, the CSRC punishes the company's management.[1] Once a company has disclosed its significant risk factors, the greater the indicated risk, the greater the investors' risk perception, which is a condition inevitably requiring a higher risk premium and one that can be expected to increase the bond credit spread.

The main effect of significant risk warnings on the corporate bond market—that is, its intended effect—is to reduce information asymmetry, thereby reducing the bond credit spread, and to improve the investor's risk perception, thereby also improving the bond credit spread. Each of these causal links needs further testing. Considering the poor quality of risk disclosure in China, most warnings contain little information and do not function as warnings of substantial risk, despite their wordiness.

Based on this, we propose the following hypotheses under H1.

H1a. Substantial warnings of significant risks narrow (improve) corporate bond credit spreads (the information effect hypothesis).

H1b. Substantial warnings of significant risks widen (worsen) corporate bond credit spreads (the pre-warning effect hypothesis).

The state-owned property rights and their implicit guarantees to a company may weaken both the information effect and pre-warning effect of risk disclosure in the corporate bond market. An explanation can be found in the political and financial support of the state, and state-owned property rights enables state-owned enterprises (SOEs) have a particular reputational effect. Even the company's financial statements are inaccurate, or even if the bond is unpayable due to poor management, the government is likely to take responsibility and inject state funds, representing what some have called a governmental "blood transfusion." This governmental role offsets the auditor's role in verifying the authenticity of financial statements and internal control quality (Fang and Chen, 2015). The implicit guarantees behind SOEs, which lower risk perception, reduce investors' concerns, and, in turn, weaken the pre-warning effect. However, in the absence of the government's implicit guarantees, non-SOEs are subject to the pressure to disclose risk, and the majority of bond investors may raise their risk awareness to avoid risking their investment. For them, solvency and the reliability of financial information reliability are concerns. Therefore, for non-SOEs, the effect of risk disclosure on narrowing (improving) corporate bond credit spreads is enhanced. On the contrary, implicit guarantees of SOEs highlight the value of risk information in reducing information asymmetry and investor risk compensation, which lead to a narrowing of corporate credit spreads. To this end, this paper proposes hypothesis H2:

[1] There are not a few companies that have been punished for failing to fully disclose risk. Dayou Energy (code 600403) and its controlling shareholder did not disclose significant risks in 2017. The chairman of the controlling shareholder was fined 600,000 yuan and imposed a 10-year market ban by the CSRC.

H2. State-owned property rights reinforce the effect of "substantial warnings of significant risks" on narrowing corporate bond credit spreads, and weaken the effect of such warnings on widening credit spreads.

3. Research design

3.1. Data and sample

For China, risk disclosure in annual reports began in 2007, the same year as the pilot issuance of the corporate bond. Therefore, this paper is based on all A-share listed companies from 2007 to 2016. We use computer programs to extract the "Significant Risk Warnings" segment from the annual reports, and eliminate the samples that cannot be extracted due to the disclosure format or to extraction standards, and finally obtain 21224 items for risk information disclosure. We retain the listed companies in the Shanghai and Shenzhen Stock Exchanges that issued bonds from 2007 to 2017, and eliminate duplicate bonds and bonds with missing data. After merging the risk disclosure sample, the final study sample includes observations on 2516 items consisting of 947 bonds issued by 568 listed companies. The other variables in this paper are taken from the CSMAR and WIND databases. To avoid the influence of extreme values, this research winsorizes all continuous variables at the 1% level, controls the industry and annual effects for all regressions, and conducts cluster processing in the company dimension.

3.2. Definitions of variables

3.2.1. Credit spread

In our research, Spread equals the yield of the bond at the end of the year minus the yield of the Treasury bond that has the same remaining maturity at the end of the year. The missing yield of a certain year's Treasury bond is calculated by interpolation.[2]

3.2.2. Risk information disclosure in annual reports

The Disclosure Rule of Significant Risk in 2012 was developed to avoid a company disclosing just enough information to meet the requirements of the standard form and the content is template. The requirement of including "Significant Risk Warnings" in annual reports was designed to offer more information to investors than the previous "Possible Risk Factors" mandated in 2007. This paper focuses on the effect of substantial risk disclosure on the bond market.

This study uses content analysis to measure significant risk indicators. First, we extract the "Possible Risk Factors" segment from the MD&A section with Python. Then, through reading and analysis, the significant risk prompts are divided into two groups: "substantial warnings of significant risk" and "non-substantial warnings of significant risks," according to whether the risks are the same as in "Possible Risk Factors" of the MD&A section. The basis of the classification is as follows: substantial warnings of significant risks are long, detailed, and not entirely consistent with or different from the risk factors in the MD&A; meantime, non-substantial warnings of significant risks are those warnings that simply remind investors to refer to information in the MD&A, or whose risk factors are exactly the same as those in the MD&A, or whose level of risk seems insignificant. According to this classification, we set our variable as "substantial warning of significant risks" (*SubstanTip*). When the warning is substantive, the value is 1; otherwise, the value is 0.[3]

[2] Treasury yields are obtained through the website of China Central Depository & Clearing Co., Ltd., or constructed by the linear interpolation method to get the interest rate of the same remaining maturity.

[3] The disclosure of significant risk warnings began in 2012, so the values of SubstanTip that take 1 happen after 2012, but the sample period of this paper runs from the beginning of the risk disclosure policy in 2007. In this way, the samples that reveal substantial significant risks can be compared not only with the un-sampled sample, but also with samples that disclose the risk factor only to the board of directors without warning of significant risk, making the conclusion more reliable. In the following robustness test, the pre-2012 samples are also excluded.

3.2.3. Control variables

Referring to Griffin et al. (2014), we control the influencing factors of the credit spread structure model, debt ratio (*Lev*), risk-free interest rate (*Spot*), return on total assets (*ROA*), credit rating (*Rate*), and company size (*Size*), with reference to Callen et al. (2009). According to Zhou (2014), we control the bond term (*Term*) and the bond issuance scale (*Lnum*). Stock liquidity (*Illiq*) is controlled, and the bankruptcy index (*Zscore*) is controlled to control the risk facing the company, considering that bond liquidity has a greater effect on change in bond prices.

3.3. Empirical model

To test the research hypothesis, this paper constructs an empirical model:

$$Spread_{i,t+1} = a_0 + b_1 RiskDisclosure_{i,t} + Controls_{i,t} + \varepsilon. \quad (1)$$

Of these variables, $Spread_{i,t+1}$ in model (1) is the explanatory variable in this paper, which is the debt credit spread of the company in t + 1 years. Also, $RiskDisclosure_{i,t}$ is the current indicator of risk disclosure used to examine its effect on corporate credit spreads. Finally, $Controls_{i,t}$ is the current control variable, as defined above.

4. Empirical test and analysis

4.1. Descriptive statistics

Table 1 provides descriptive statistics for the main variables. The variables are grouped according to whether the company has a significant risk, and the mean and variance of the two groups of samples are counted separately. The statistical results show that the average value of the bond credit spread is significantly larger for the companies that announced substantial warnings than for the companies that did not, which is basically consistent with the pre-warning effect hypothesis in H1b. The sample of substantive prompts is much smaller than the sample without substantive prompts, indicating that the company has a lower willingness to issue substantive risk warnings. In addition, companies that disclose significant risk warnings tend to be smaller, have lower debt ratios, lower credit ratings, and higher liquidity, which are characteristics not unlike companies that do not issue substantial risk warnings. In summary, in the descriptive statistics of two groups, it is impossible to see any obvious difference in their companies' fundamental risk.

Table 1
Descriptive statistics.

Variable	Without substantial warnings			With substantial warnings			Difference
	N	mean	Sd	N	mean	sd	diff
Spread	324	2.590	1.597	2174	1.957	1.607	0.632***
Size	324	22.88	1.124	2174	23.10	1.184	−0.225***
Lev	324	0.539	0.156	2174	0.568	0.150	−0.028***
ROA	324	0.111	0.197	2174	0.118	0.156	−0.007
Rate	324	6.939	0.564	2174	7.024	0.580	−0.085**
Term	324	6.087	0.824	2174	6.208	1.369	−0.121
Spot	324	5.435	1.365	2174	5.503	1.256	−0.068
Lnum	324	2.529	0.598	2174	2.548	0.635	−0.019
Illiqd	324	1.659	2.275	2174	2.182	2.470	−0.523***

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

4.2. Correlation analysis

The results of the regression of the Pearson correlation coefficient are listed in Table 2. It can be seen from Table 3 that *SubstanTip* is positively correlated with the *Spread* of the next issue, with a coefficient of 0.133, and it is significant at the 1% level. This suggests that corporate bonds have higher credit spreads when there is a substantial warning of significant risks. This finding is consistent with the pre-warning effect hypothesis H1b, further validating the hypothesis inference. The company size *Size*, profitability *ROA*, credit rating *Rate*, bond maturity *Term*, issue size *Lnum*, and liquidity deficiency *Illiqd* are all significantly negatively correlated with credit spreads, and the interest rate of Treasury bond is significantly positively correlated with spreads.

4.3. Analysis of results

4.3.1. Test on Hypothesis 1: substantial warnings of significant risks and corporate bond credit spreads

Columns (1) and (2) of Table 3 list the results of the regression of substantial warnings of significant risks and bond credit spreads. The results show that whether or not the control variables are added, they are significantly positively correlated at the 1% level. The coefficient decreases from 0.469 to 0.426 after adding the control variables, but the significance remains unchanged. One of the original intentions of risk information disclosure is to induce a pre-warning effect, and the second is to alleviate the information asymmetry between investors and companies and thus reduce capital costs. According to the results, after revealing the substantial warnings of significant risks, the credit spread of corporate bonds widened significantly, thus supporting the pre-warning effect of hypothesis H1b, and negating the information effect hypothesis H1a, due to the weaker rationale for mitigating information asymmetry. One explanation of the findings of this study is that management that does not deliberately disclose significant risks becomes subject to severe punishment from the CSRC, and perhaps even criminal prosecution. Therefore, as soon as the company faces significant risk, management is placed in a position in which the risk from the authorities is greater than the risk from the market, and thus they become more inclined to disclose. Substantial warning of significant risks, being mandatory, is valued by bond investors, who regard the disclosure as revealing the most important risk factors in the company's future business development. Another explanation is that *SubstanTip*, the explanatory variable used in China, refers to the reports that are significantly different than the risk disclosure of the "Significant Risk Warning" section of the MD&A. Compared with the frequency of words and sentences relating to "risk" in previous studies, this measurement method pays more attention to the information content of risk disclosure, and it also better reflects more recently added risk factors. Investors are likely demand a higher risk premium of companies that have made substantial risk warnings, which suggests that substantial warning of significant risks can enhance bond investors' risk perception. This may explain why the findings of this paper are inconsistent with those of foreign studies.

Table 2
Pearson Correlation Coefficient.

	Spread	SubstanTip	Size	Lev	ROA	Rate	Term	Spot	Lnum	Illiqd
Spread	1.000									
SubstanTip	0.133***	1.000								
Size	−0.436***	−0.064***	1.000							
Lev	0.013	−0.059***	0.128***	1.000						
ROA	−0.113***	−0.023	0.052***	−0.571***	1.000					
Rate	−0.278***	−0.045**	0.479***	−0.001	0.067***	1.000				
Term	−0.099***	−0.036*	0.316***	0.126***	−0.065***	0.238***	1.000			
Spot	0.204***	−0.018	−0.338***	0.042**	−0.095***	−0.502***	−0.046**	1.000		
Lnum	−0.158***	−0.011	0.557***	0.117***	0.015	0.559***	0.257***	−0.474***	1.000	
Illiqd	−0.300***	−0.070***	0.234***	0.048**	−0.109***	−0.003	0.164***	0.103***	−0.064***	1.000

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

Table 3
Substantial warnings of significant risks and bond credit spreads.

	Spread				
	OLS	Add control variables	Differential regression	Control risk level	Remove the sample with risk announcement
Variable	(1)	(2)	(3)	(4)	(5)
SubstanTip	0.496***	0.426***	0.495***	0.435***	0.361***
	(3.75)	(3.41)	(4.19)	(3.49)	(2.83)
Size		−0.340***	−0.333***	−0.344***	−0.324***
		(−8.97)	(−4.56)	(−9.25)	(−8.40)
Lev		0.419	0.58	0.468	0.243
		(1.39)	(1.21)	(1.54)	(0.82)
ROA		0.086	−0.36	0.157	−0.048
		(0.41)	(−1.53)	(0.74)	(−0.24)
Rate		−0.194**	−0.07	−0.197**	−0.216**
		(−2.13)	(−0.67)	(−2.16)	(−2.33)
Term		−0.009	0.04	−0.01	0.005
		(−0.35)	(1.17)	(−0.41)	(0.22)
Spot		0.117***	−0.02	0.115***	0.107***
		(3.14)	(−0.47)	(3.09)	(2.79)
Lnum		0.066	0.217**	0.092	0.046
		(0.83)	(2.22)	(1.11)	(0.56)
Illiqd		0.112	0.055***	0.097	0.117
		(0.6)	(3.28)	(0.53)	(0.62)
SdRet				2.688***	
				(3.9)	
EDR				1.37	
				(1.08)	
Zscore				−0.002*	
				(−1.67)	
Constant	2.471***	10.321***	−0.376*	10.245***	10.134***
	(6.44)	(9.94)	(−1.76)	(9.89)	(9.53)
Obs	2516	2516	2041	2516	2476
AdjR−sq	0.095	0.184	0.02	0.19	0.177
F	10.94	14.58	2.998	13.3	13.61

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

4.3.2. Robustness test

To ensure the reliability of the results, this paper carries out the following robustness test.

(1) Perform differential regression. Compared with the disclosed risk factors, the changes of disclosure often contain more abundant information. For this reason, the differential regression model is used to test the effect of the substantial warnings of significant risks on changes in bond credit spreads. Column (3) of Table 3 shows the results of differential regression. The results show that when the company makes substantial disclosures of significant risks, the increase in the credit spread of corporate bonds is improved, further testing the findings of this paper.
(2) Exclude the effect of the company's risk level

The company's risk level has a direct effect on the credit spread of bond. The article above also points out that companies that disclose substantial prompts of significant risks may also be those with relatively high risk, that is, those for which risk level affects risk disclosure. To this end, it is necessary to rule out

the effect of the company's fundamental risk level on the research findings. We mainly use the following two methods.

First, we control the company's risk level. Column (4) of Table 3 adds the company's stock price volatility (*SdRet*), performance downside risk (*EDR*), and bankruptcy index (*Z-score*)[4] on the basis of column (2). These three indicators represent the company's market risk, operational risk, and credit risk. The regression results show that the explanatory variables are significant as always; that is, in the case of controlling the company's risk level, the disclosure of substantial hints of significant risks can still significantly widen the bond credit spread. Creditors are more concerned about the substantive warnings of significant risks, enhancing risk perception and requiring a higher risk premium through the substantive warnings.

Second, we remove the samples of risk warning announcements. For some extreme risk factors in significant risk warnings, such as delisting risks, major losses, and other serious risks, companies normally admit that their risk levels are relatively high. Such cases inevitably lead to increasing market volatility and bond credit spreads. The influence of such extreme situations on the findings here needs to be eliminated. The listing rules of the Shenzhen Stock Exchange require listed companies to separately disclose their risk warning notice and identify significant risk situations, such as those resulting from breaking the law, mergers and acquisitions, and large losses. The failure to do so can lead to being punished by both the law and the market. Therefore, companies that have issued previous risk warning announcements are likely to have higher risk levels. This study obtains the risk warning announcements of all listed companies during the sample period from the "Juchao Information" website and deletes these samples before regression. The regression results are shown in column (5) of Table 3. The results remain unaffected even after removing a company's extreme risk status. The explanatory variables are significant at the 1% level, indicating that the extreme risk status has no significant effect on the findings of this study.

(3) Replace the dependent variable

The dependent variable credit spread is obtained by using the value calculated at the end of each year. This examines the long-term effects of risk information disclosure on the corporate bond market. It is not known whether information disclosed in annual reports in the bond market has the same effect in the short run. Therefore, we calculate the bond credit spread *Spread_d* from the bond yield on the first trading day after the annual report is disclosed, and then conduct a regression. The test results are shown in column (1) of Table 4. The coefficients of the explanatory variables are significant at the 5% level and the signs are consistent with the above test. The results show that investors in the bond market pay close attention to significant risk warnings in annual reports. After the first day of the annual report disclosure, the significant risk warning information is integrated into the bond market price.

(4) Propensity score matching (PSM)

Companies having made substantial warnings may show wide bond credit spreads because of other traits, so there is a problem of sample self-selection. We therefore try to reduce the effect of the problem by PSM. For companies that did not announce substantial warnings, we conduct one-to-one neighbor matching to identify the sample company closest to the experimental group company in the aspects of the control group. The resulting samples are combined with the control group before regression. The results are shown in columns (2) and (3) of Table 4 below: the regression coefficient of the explanatory variables is significantly positive regardless of whether the control variable is added, indicating that sample self-selection has a minimal influence on our conclusion.

[4] *SdRet*, the standard deviation of stock price fluctuations in one year; *EDR*, downside risk of performance, according to the model of Konchichki et al. (2016), is obtained by calculating the difference between the actual accounting earning and the expected accounting earning, measuring the possibility of declining company's performance and reflecting the downside risk of performance better than other past indicators of operational risk. *Zscore*, the bankruptcy index, measures the risk of bankruptcy. The greater the value, the greater the risk.

Table 4
Other robustness tests.

Variable	Replace the dependent variable Spread_p (1)	PSM Spread (2)	IV stage 1 SubstanTip (3)	IV stage 2 Spread (4)	Exclude samples before 2012 Spread (5)
SubstanTip (IV_SubTip)	0.207**	0.451***		1.514***	0.353***
	(2.23)	(3.72)		(4.38)	(4.52)
Ind_SubTip			0.587***		
			(10.97)		
Top1RiskDisc			0.041**		
			(2.27)		
Size	−0.469***	−0.267***	−0.005	−0.500***	−0.412***
	(−5.42)	(−8.71)	(−0.64)	(−15.44)	(−11.18)
Lev	−0.337	0.128	−0.202***	0.258	0.451*
	(−0.35)	−0.45	(−3.74)	(1.04)	(1.71)
ROA	−1.681***	−0.411*	−0.088*	−0.812***	−0.549**
	(−2.72)	(−1.83)	(−1.75)	(−3.66)	(−2.53)
Rate	−0.694**	−0.345***	−0.016	−0.379***	−0.214***
	(−2.01)	(−4.04)	(−1.06)	(−5.91)	(−2.63)
Term	−0.047	−0.011	−0.004	0.019	0.025
	(−0.83)	(−0.47)	(−0.68)	(0.8)	(0.99)
Spot	0.126*	0.113***	−0.001	0.135***	0.201***
	(1.84)	(3.28)	(−0.18)	(4.91)	(5.29)
Lnum	0.133	0.022	0.01	0.482***	0.243***
	(1.37)	(0.3)	(0.65)	(7.57)	(3.12)
Illiqd	0.097	0.017	−0.003	−0.137***	0.067
	(1.01)	(1.33)	(−1.12)	(−11.23)	(0.72)
Constant	15.689***	9.848***	0.401**	14.193***	10.301***
	(3.52)	(12.24)	(2.33)	(18.41)	(8.95)
Obs	2516	648	2516	2516	1999
AdjR−sq	0.058	0.091	0.076	0.219	0.399
F(IV F)	14.58	36.01	20.48	78.4	49.67

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

(5) Instrumental variable (IV)

To avoid any potential endogeneity problems in the above research findings, this paper uses the instrumental variable to control. To ensure the exogenous nature of the instrumental variables, we use two instrumental variables to test: first, we take the mean value of whether the significant risks warnings are disclosed by other companies in the same industry (*Ind_SubTip*) as a tool variable; second, we do the same for whether to disclose substantial warnings of significant risk for the leading company in the same industry (*Top1RiskDisc*). On the one hand, studies have found that a company's information disclosure level is affected by the overall disclosure level of that industry (Campbell et al., 2014), but those levels appear to have no direct effect on the company's credit spread. On the other hand, due to the learning effect, the disclosure behavior of the leading companies in the same industry affect other companies' risk disclosure but not directly affect other companies' credit spreads. Therefore, both variables satisfy the selection condition of the tool variable.[5] Columns (3) and (4) of Table 4 show the test results of the instrumental variable: column (3) is the first-stage regression, which regresses the instrumental variables and other exogenous variables on the explanatory variables, to find that the industry's disclosure level for substantial risk warnings *Ind_SubTip* is significantly positively correlated with the companies' substantive disclosure of significant risk; column (4) is the second-stage regression,

[5] The selection of instrumental variables is checked by over-identification, and the instrumental variables are related to the independent variables.

regressing the first-stage regression fitting value *IV_SubTip* on credit spread, and the results are still significantly positive. The test results of the instrumental variables show that the findings of this paper are stable.

(6) Exclude samples before 2012

The CSRC's disclosure requirements for significant risk warnings began to be implemented in 2012, so we exclude the samples before 2012. We also consider the different effects on spreads from companies' substantial warnings and from companies' non- substantial warnings. The regression results are listed in column (5) of Table 4 and show that even if the samples before 2012 are excluded, the findings remain unaffected.

4.3.3. Test of Hypothesis 2: the effect of property rights

The effect of property rights on risk disclosure is mainly reflected in the implicit guarantees of state-owned enterprises. According to the research findings for Hypothesis 1, it is known that the substantial risk warnings entail the pre-warning effect, and whether state-owned property rights weaken that effect remains to be tested. Columns (1) and (2) of Table 5 show the results of group regression according to the nature of property rights. The effect of risk disclosure on credit spreads is mainly found in non-SOE enterprises, and hardly at all in SOE enterprises, even if there are some signs of the opposite. The table shows that state-owned property rights weaken the pre-warning effect, and that such risk-warning effect exists only in non-SOE enterprises, suggesting that in non-SOE enterprises, significant risk information has more relevance for corporate bond investors, being easier to integrate into bond prices with resulting effects on credit spreads. Thus, Hypothesis 2 is verified.

Table 5
Risk disclosure in annual reports, property rights, and bond credit spreads.

	Spread Property rights	
Variable	SOE (1)	Non-SOE (2)
SubstanTip	−0.053	0.535***
	(−0.59)	−4.27
Size	−0.255***	−0.292***
	(−6.18)	(−4.03)
Lev	0.217	0.624
	−0.63	−1.36
ROA	−0.373	−0.046
	(−1.40)	(−0.14)
Rate	−0.249**	−0.087
	(−2.35)	(−0.56)
Term	0.019	−0.015
	−0.72	(−0.16)
Spot	0.045	0.181***
	−1.14	−2.74
Lnum	−0.018	−0.101
	(−0.23)	(−0.56)
Illiqd	0.01	0.012
	−0.41	−0.8
Constant	9.027***	8.319***
	−9.03	−3.89
Obs	1169	1347
AdjR−sq	0.103	0.041
F	17.68	8.216

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

Table 6
The adjustment effects of risk management capability.

	Spread					
	Internal control level		Whether CEOs have risk management experience		Whether company has a risk management committee	
Variable	High (1)	Low (2)	Yes (3)	No (4)	Yes (5)	No (6)
SubstanTip	0.001	0.572***	0.101	0.201**	−0.294	0.230***
	(0.01)	(4.12)	(0.50)	(2.54)	(−1.15)	(3.00)
Size	−0.279***	−0.413***	−0.429***	−0.270***	−0.207**	−0.299***
	(−6.62)	(−5.80)	(−4.88)	(−7.03)	(−1.97)	(−7.96)
Lev	−0.188	−0.159	−0.233	0.131	−0.095	0.064
	(−0.56)	(−0.32)	(−0.34)	(0.43)	(−0.09)	(0.22)
ROA	−0.802***	0.151	−0.212	−0.378	−0.817	−0.381*
	(−2.96)	(0.44)	(−0.36)	(−1.64)	(−0.74)	(−1.75)
Rate	−0.451***	−0.061	−0.400**	−0.341***	−0.660**	−0.325***
	(−4.54)	(−0.36)	(−2.01)	(−3.58)	(−2.26)	(−3.63)
Term	0.017	−0.103*	0.095**	−0.083**	0.090	−0.015
	(0.61)	(−1.68)	(2.44)	(−2.33)	(1.38)	(−0.51)
Spot	0.083**	0.203**	−0.030	0.152***	−0.058	0.128***
	(2.16)	(2.44)	(−0.40)	(3.82)	(−0.66)	(3.33)
Lnum	0.027	0.089	0.074	0.082	−0.311	0.053
	(0.32)	(0.51)	(0.45)	(0.97)	(−1.25)	(0.68)
Illiqd	0.029	0.055***	−0.005	0.069***	0.033	0.072**
	(0.59)	(2.87)	(−0.11)	(3.46)	(1.51)	(2.34)
Constant	11.202***	10.941***	14.165***	9.927***	12.132***	10.311***
	(11.04)	(5.98)	(7.07)	(10.09)	(4.52)	(11.04)
Obs	1302	1214	348	2168	219	2297
AdjR−sq	0.135	0.044	0.129	0.087	0.093	0.087
F	26.37	7.951	7.401	26.74	3.788	28.42

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

4.3.4. Examination of adjustment effects

(1) Corporate's risk management capabilities

The purpose of risk management is to help a company better control risk and reduce risk levels. Therefore, the stronger the company's risk management capability, the lower the probability of significant risk events, and the smaller the effect on bond credit spread.

This paper uses the internal control levels of whether company executives have risk management experience, and whether the company has a risk management committee as an alternative to the company's risk management capabilities.[6] According to the median of the above three variables, the samples are divided into high and low groups, and the group regression is also conducted separately to test the difference between the coefficients of the explanatory variables between the groups.

Table 6 lists the results of the three combinations of regression, and the results show the following: For a company with low internal control levels, low CEO risk management experience, and no risk management committee, the effect of significant risk warnings on bond credit spreads is stronger. The conclusion of the study shows that when a company's level of risk management is higher, the effect of significant risk warnings on credit spreads is weaker.

[6] For the values of the following variables: internal control level, we use the Dibo internal control index; whether the company CEOs have risk management experience, we read the executive experience in the annual report by the textual analysis method, if CEOs have served in risk-related positions indicates risk experience; whether the company has a risk management committee, we search for a similar institution of the "risk management committee" in the full text of the annual report through textual analysis, and if it is found, it is considered to have a risk management committee.

(2) Influence of information quality

Information quality influences the relationship between risk disclosure and bond credit spreads. Investors estimate and judge the company's risk status accordingly. When the company's information quality is good and the information transparency is high, investors' estimates of the company's risk level are more accurate, and the disclosed information has less of an effect on investors. When the company has poor information quality and large information asymmetry, investors cannot accurately estimate the company's risk level. After disclosing a significant risk warning, there is the possibility of a difference between the actual situation and the bond investor's expectations, so the effect on bond credit spread is greater. We measure the quality of corporate information based on the degree of earnings management and the transparency of internal control information disclosure.

The degree of earnings management, as a measure of the quality of accounting information, indicates the degree of management's manipulation of accounting earnings. The more serious the earnings management, the lower the reliability of accounting information, and vice versa. The disclosure quality of internal control is obtained from the Dibo database in a separate process. The score can be used to objectively evaluate the disclosure quality of the company's internal control information. The higher it is, the better the quality.

Columns (1) and (2) of Table 7 show the results of group regression according to the degree of earnings management. Columns (3) and (4) of Table 7 are the results of group regression according to the disclosure quality of internal control information. The regression results for the two groups indicate that in the group with a high degree of earnings management and poor quality internal control information disclosure, substantial risk warnings have a more significant effect on the bond credit spread, while in the lower group there is no

Table 7
The adjustment effects of information quality.

	Spread			
	Degree of earnings management		Quality of internal control disclosure	
Variable	High (1)	Low (2)	High (3)	Low (4)
SubstanTip	0.312***	−0.044	−0.014	0.324***
	(−0.42)	(2.92)	(−0.14)	(2.88)
Size	−0.291***	−0.338***	−0.338***	−0.267***
	(−5.98)	(−6.47)	(−7.18)	(−5.03)
Lev	−0.092	0.062	−0.361	0.276
	(−0.23)	(0.16)	(−1.02)	(0.65)
ROA	−0.398	−0.514	−0.773***	−0.042
	(−1.45)	(−1.47)	(−2.69)	(−0.14)
Rate	−0.226*	−0.485***	−0.527***	−0.109
	(−1.91)	(−3.79)	(−5.09)	(−0.75)
Term	−0.080*	0.037	0.051*	−0.113**
	(−1.69)	(1.18)	(1.71)	(−2.25)
Spot	0.167***	0.046	0.030	0.216***
	(3.45)	(0.91)	(0.72)	(3.64)
Lnum	−0.037	0.123	0.086	−0.026
	(−0.33)	(1.20)	(0.93)	(−0.22)
Illiqd	0.048**	0.006	0.059***	−0.000
	(2.21)	(0.34)	(2.80)	(−0.02)
Constant	10.158***	12.179***	13.126***	8.170***
	(7.74)	(10.20)	(11.65)	(5.79)
Obs	976	1540	1069	1447
AdjR−sq	0.106	0.084	0.159	0.051
F	15.39	18.61	26.17	10.70

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

correlation between the two. The findings of this study explain that the effect of such warnings are only found in companies with poor information quality.

4.3.5. Testing the effect mechanism

Economic theory maintains that risk disclosure increases the bond credit spread because it raises the investor's estimate of the company's risk level, leading the investor to demand a higher rate of return. Research shows that investors' heterogeneous beliefs influence risk asset prices Zhang and Zhang (2006), and risk information may also increase investors' heterogeneous beliefs. Therefore, we examine whether risk information disclosure improves credit spreads by improving investors' heterogeneity beliefs.

First, we set a model for regressing risk information disclosure *SubstanTip* on mediator variable heterogeneous beliefs. The regression results, listed in columns (1) and (2) of Table 8, show that the substantial warnings of significant risk in China increases the bid-ask spread and leads to stock price volatility. This suggests that the material risk warning provides the information that causes a "panic," raises the investor's risk awareness, and increases heterogeneous beliefs.

We further tests whether heterogeneous beliefs act as mediators of risk information disclosure affecting credit spreads. Columns (3) to (4) of Table 8 list the tests for adding mediator variables to the main regression (see Table 3), that is, controlling the degree of significant risk prompts and heterogeneous beliefs in the same regression. The results show that the indicators of the two heterogeneous beliefs are significantly positively correlated, but while the significant risk warnings *SubstanTip* are still significantly positively correlated, the

Table 8
Testing the effect mechanism.

	Regression on mediator		Add mediator to main regression	
	SdRet	Sprd	Spread	
Variable	(1)	(2)	(3)	(4)
Sd_Ret			0.199***	
			(2.87)	
spread				0.012*
				(1.96)
SubstanTip	0.002***	3.987***	0.430***	0.421***
	(15.37)	(24.29)	(3.38)	(3.32)
Size	−0.001***	0.687***	−0.319***	−0.342***
	(−28.36)	(11.97)	(−7.59)	(−8.81)
Lev	−0.002***	−2.412***	0.335	0.384
	(−7.97)	(−7.77)	(1.07)	(1.26)
ROA	−0.000	3.622***	−0.153	−0.002
	(−1.49)	(20.28)	(−0.66)	(−0.01)
Rate	0.000	−0.035	−0.226**	−0.204**
	(0.71)	(−0.11)	(−2.30)	(−2.19)
Term	−0.000	−0.407***	−0.001	−0.005
	(−1.00)	(−3.73)	(−0.02)	(−0.22)
Spot	0.000	−0.053	0.161***	0.119***
	(0.64)	(−0.36)	(3.55)	(3.19)
Lnum	−0.000	−0.796**	0.080	0.068
	(−1.56)	(−2.54)	(0.86)	(0.83)
Illiqd	0.003	−0.502***	0.109***	0.090***
	(1.18)	(−10.28)	(2.76)	(2.59)
Constant	0.059***	−2.012	9.701***	10.331***
	(20.28)	(−0.72)	(8.35)	(9.97)
Obs	22,421	22,526	2516	2516
AdjR−sq	0.361	0.190	0.182	0.185
F	289.0	139.6	13.77	13.91
Sobel Z	–	–	4.45 (0.002)	2.21 (0.023)

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

Table 9
Tone, similarity, and credit spread.

Variable	Spread			
	OLS	Add control variables	OLS	Add control variables
	(1)	(2)	(3)	(4)
Tone_neg	0.187*	0.260***		
	(1.68)	(2.76)		
similarity			−0.248***	−0.404***
			(−3.00)	(−5.86)
Size		−0.521***		−0.514***
		(−16.32)		(−15.65)
Lev		−0.203		−0.296
		(−0.90)		(−1.34)
ROA		−0.891***		−0.954***
		(−4.72)		(−4.95)
Rate		−0.392***		−0.387***
		(−5.77)		(−5.74)
Term		0.036*		0.034
		(1.70)		(1.64)
Spot		0.121***		0.130***
		(4.27)		(4.63)
Lnum		0.428***		0.429***
		(7.32)		(7.26)
Illiqd		−0.156***		−0.160***
		(−12.88)		(−13.15)
Constant	1.915***	15.268***	2.194***	15.513***
	(34.97)	(20.70)	(32.44)	(20.67)
Obs	2358	2358	2328	2328
AdjR-sq	0.001	0.303	0.003	0.309
F	2.815	115.9	9.004	118.6

* indicate that the estimated coefficient is statistically significant at the 10% levels, respectively.
** indicate that the estimated coefficient is statistically significant at the 5% levels, respectively.
*** indicate that the estimated coefficient is statistically significant at the 1% levels, respectively.

regression coefficient and significance are lower than prior to the inclusion of the mediator variable (Table 3), and they all pass Sobel Z test. This indicates that in cases of substantial warnings of risk, the bid-ask spread and stock price volatility partially affect corporate bond credit spreads.

4.4. Further analysis: tone, similarity, and credit spread

As an indicator of substantial warnings of significant risks, *SubstanTip* considers the information content of the prompt to a certain extent but does not explore the content of the risk information. There are fewer samples of disclosure in significant risk hints, and their length is usually very short, making in-depth textual analysis inconvenient. Also, the risk description paragraph in the MD&A involves a large number of companies with many more risk factors, more information content, and greater length. In this regard, we attempt to examine the content of risk factors in the MD&A from the perspectives of tone and considering the degree of similarity with the previous year's disclosure

The risk description paragraph is extracted by Python, and the negative tone of the risk factor segment (*Tone_neg*)[7] and the similarity to the previous year's disclosure (*Similarity*)[8] are constructed. Table 9 shows the regression results. The negative tone of the risk factor is partly correlated with credit spread, indicating

[7] The negative tone of the risk factor passage in the "Significant Risk Warning" (*Riskneg*) is calculated as the number of negative vocabulary/total words.

[8] With reference to Brown and Tucker (2011), the similarity between the risk factor segment this year and that of the previous year (*Similarity*), is measured by constructing a vector cosine. The greater the similarity, the lower the information content, and vice versa.

that the more negative the tone, the higher the credit spread. The lower the similarity between the risk descriptions of the two years, the greater the credit spread, with similarity being significantly negatively correlated with credit spread. That is, the richer the information content of the risk paragraph in the current year, the greater the bond spread. It can be seen that the more new information that is included in the risk disclosure, and the more negative the management's attitude, the greater the unforeseen risk factors, resulting in bond investors requiring higher risk compensation.

5. Conclusion

In 2012, the CSRC requested that listed companies should increase the disclosure of "significant risk warnings" in their annual reports. However, there have been no studies on whether this new requirement has produced meaningful information or whether such content affects bond investors. This paper takes listed companies in the Shanghai and Shenzhen Stock Exchanges that issued bonds from 2007 to 2017 as samples, and analyzes, for the first time in this research field, the relationship between the significant risk warnings in these Chinese companies' annual reports and corporate bond credit spreads. The main findings of this paper are as follows. First, the substantial warnings of significant risks can significantly improve corporate bond credit spreads, reflecting the risk-warning effect. Second, state-owned property rights weaken this effect, which only pertains to listed companies with poor risk management and low information quality. Third, significant risk warnings increase investors' heterogeneous beliefs, also affecting credit spreads. Fourth, through textual analysis, it is found that the corporate bond credit spread is greater when the disclosed risk factors are more pessimistic and less similar to those of the previous year.

The findings of this paper indicate that investors incorporate the risk information of annual reports into bond prices. We approach risk information disclosure indicators differently from previous researchers, as seen in our focused content analysis, which provides unique evidence for research into risk correlation. In addition, this study provides empirical evidence for the effect of non-accounting information on the bond market. The requirements found in "The Content and Format Standards of Information Disclosure for Companies That Offer Securities to the Public No. 2-Annual Report," issued in 2015, relaxed companies' mandatory disclosure of significant risk warnings, but our research highlights the importance of significant risk warnings for bond investors evaluating corporate risk for China's regulatory authorities attempting to strengthen their supervision of risk disclosure and significant risk warnings.

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China Journal of Accounting Research 12 (2019) 209–229

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China Journal of Accounting Research

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

Do major customers promote firms' innovation?☆

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ARTICLE INFO

Article history:
Received 31 May 2018
Accepted 4 January 2019
Available online 26 February 2019

Keywords:
Supply chain
Innovation
Customer concentration
Financial constraint

ABSTRACT

This study examines whether and how a concentrated supply chain relationship affects a firm's innovation decisions. Using data from Chinese listed firms in the manufacturing industry, we find that a concentrated customer base constrains a firm's R&D investment, where a 1% increase in customer concentration is associated with a 0.011% decrease in R&D investment. To establish causality, we use the instrumental variable method, the reverse causality model, and the Granger causality test to re-examine the relationship and arrive at a consistent conclusion. Results from mechanism analysis suggest that a concentrated customer base constrains the internal fund availability and that the negative relationship between customer concentration and firms' innovation is less pronounced for firms with more external financial support. Additional analysis reveals that the negative effect of customer concentration mainly affects R&D investment expenditure and that customer concentration also constrains innovation output in China. Overall, our paper reveals the dark side of close customer-supplier relationships and provides new insights into how supply chain relationships affect firms' innovation decisions.

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☆ We appreciate the valuable comments from Shunlin Song, Jingxin Zhang, Weihang Xu, Laiqiang Feng, and the anonymous referees. The work was supported by funds from the National Natural Science Foundation of China (General Program 71572206, 71272196 and Major Program 71790603), Guangdong Key Research Institute of Humanities and Social Sciences (Major Project 2012JDXM-0002), China Ministry of Finance's Project to Support Accounting Masters, Natural Science Foundation of Guangdong Province (2018A0303130328), Guangdong Planning Office of Philosophy and Social Science (GD18CYJ09) and Sun Yat-sen University (16wkpy04).

https://doi.org/10.1016/j.cjar.2019.01.003
1755-3091/

1. Introduction

An economy's long-term growth prospects reflect its potential for innovation (Kung and Schmid, 2015). Innovation is especially critical in emerging countries. China is a large manufacturing country and is known as the "world's factory." However, China is still at the lower end of the value chain. In many cases, only the labor-intensive parts of production, such as processing and packaging, are done in China. For example, with a retail price of US$1149, the total manufacturing cost of the iPhone X (256G) is US$412.75. China (excluding Taiwan) mainly provides low-cost components, such as wireless charging receivers, acoustics, RF antennas, and accessories, all of which amount to about US$75, a price that also includes the artificial remuneration of Chinese workers, estimated at about US$3.[1] Innovation is thus the guideline for transforming China's manufacturing industry from large to powerful. The promotion of manufacturing innovation thus becomes an important issue, both in practice and in academic research. A growing literature links various factors to innovation, such as the effect of property protection (Long, 2010), financial development (Acharya and Xu, 2017), and industrial policies or corporate governance mechanisms (Manso, 2011; Aghion et al., 2013). However, in a context where the scale of the manufacturing industry is constantly increasing, little is known about whether and how supply chain relationships affect a firm's innovation-related decisions.

In this paper, we focus on the key ingredient of supply chain relationships: the concentration. In a concentrated supply chain relationship, firms often need to meet customized requirements of large customers through specific R&D investments to reap the benefits of supply chain integration, reduce costs, and enhance product competitiveness (Chu et al., forthcoming; Dou et al., 2013; Nunn, 2007). For example, manufacturers of automotive parts must always develop dedicated production lines to provide customized parts, while software companies require dedicated software or operating systems for different platforms, such as Apple iOS and Google Android.

However, like other relationship-specific investments, R&D costs can trigger a classic "hold-up problem." Firms in countries with inadequate legal protections typically underinvest, as contracts cannot be enforced (Grossman and Hart, 1986; Nunn, 2007; Williamson, 1979). More importantly, financing innovation is a challenge for most firms, because innovation activities are risky, unpredictable, long-term, and multi-stage, all of which leads to severe information asymmetry and high agency costs (Holmstrom, 1989). Hence, R&D activities generally lead to difficulty in obtaining external funding. Previous evidence shows that internal funds are a primary resource for R&D activities (Czarnitzki and Hottenrott, 2011; Hall, 2002). However, having major customers can also limit a firm's internal cash flow. Major customers use their bargaining power to obtain favorable terms, such as lower product pricing or more trade credit, resulting in lower profitability and higher earnings and cash flow volatility (Fabbri and Klapper, 2016; Huang et al., 2016; Itzkowitz, 2013). In short, a concentrated customer base can lead to internal financial constraints and therefore underinvestment in R&D.

We test the above two competing hypotheses by examining whether customer concentration encourages or hinders firms' R&D investment. Using data from Chinese listed firms in the manufacturing industry, we document that a concentrated customer base constrains a firm's R&D investment. A 1% increase in customer concentration is associated with a 0.011% decrease in R&D investment. To establish causality, we use the instrumental variable method, the reverse causality model, and the Granger causality test to re-examine the relationship, and we arrive at a consistent conclusion. However, the relationship is less pronounced for firms with more external financial support. Furthermore, the negative effect of customer concentration mainly affects R&D investment expenditure. We also provide evidence that customer concentration limits R&D output.

This paper contributes to three strands of literature. First, it relates to research examining the real effects of supplier-customer relationships on R&D investment. Most studies focus on how supply chain relationships affect financial decisions, including capital structure (Banerjee et al., 2008), dividend policy (Wang, 2012), equity financing (Dhaliwal et al., 2016), debt financing (Campello and Gao, 2017), and so on. However, there is a literature gap on how supplier-customer relationship affects corporate investment behavior. Chu et al. (forthcoming) and our paper are both related to this topic. Chu et al. (forthcoming) examines the effect of

[1] See the website http://www.sohu.com/a/200592527_100030976.

supplier-customer geographic proximity on R&D output. Proceeding from the notion that being closer to customers makes communication more efficient, they document that the timely feedback and the demand to decrease production costs from the geographically closer customers can motivate suppliers to innovate. Compared to Chu et al. (forthcoming), our paper focuses on a different dimension of supplier-customer relationships and applies a different theoretical framework to examine how supplier-customer relationship affects corporate innovation. We document that concentrated customer bases constrain the availability of internal funds and impede suppliers' R&D input, an outcome that has traditionally been understood to be the product of a poorly functioning legal system where contracts cannot be enforced (Grossman and Hart, 1986; Nunn, 2007; Williamson, 1979).

Second, our paper contributes to the emerging literature on finance and innovation. R&D investment activity is generally associated with high agency costs. Innovation projects are usually risky, unpredictable, long-term, labor-intensive, and idiosyncratic (Holmstrom, 1989). Agency problems associated with separate ownership and management may undermine firm incentives to innovate (Bernstein, 2015). Therefore, determining appropriate mechanisms to motivate or incentivize innovation is an important research topic. Manso (2011) proposes an optimal innovation incentive scheme that favors tolerance for early failure and rewards long-term success. Indeed, analysts often exert too much pressure on managers to meet short-term performance goals, which hinders managers' incentives to create long-term value for the firm (He and Tian, 2013). Instead, institutional owners motivate managers by reducing career risk (Aghion et al., 2013). However, while motivation is important, it is not enough. Being heavily dependent on financing, an adequate financial resource is essential for R&D investment. Firms with innovation opportunities often lack capital (Acharya and Xu, 2017). Therefore, the roles of internal financing, external financing, and in particular, equity and debt financing are also discussed. Our paper supports the hypothesis that internal cash flow plays a leading role in R&D investment.

Third, our paper contributes to research on the consequences of customer-concentration risk. Our study identifies the exact mechanism by which a concentrated customer base influences firm's innovation, thereby helping both firms and investors optimize their strategies by understanding how downstream enterprises influence firm's investment decisions.

The rest of the paper is organized as follows. Section 2 reviews the literature and develops our hypothesis. Section 3 describes the sample and model construction. Section 4 presents the baseline results and various tests to address endogeneity problems, and examines the possible underlying mechanisms. Finally, Section 5 concludes the paper.

2. Theory and hypothesis

In this section, we develop arguments for how downstream businesses influence a firm's R&D investment decisions. We propose two hypotheses: the relationship-specific investment hypothesis and the financial-pressure hypothesis. However, weak legal environments may impede firms' ability to make relationship-specific investments. We therefore predict that in China, the financial-pressure hypothesis dominates and concentrated customers restrict firms' R&D investment. This restricting effect will diminish if the firm has access to external financial resources.

2.1. The positive relationship between customer concentration and R&D input: the relationship-specific investment hypothesis

In a close supply chain relationship, a firm's dealings with its major customers often entails relationship-specific investments, including R&D (Bowen et al., 1995; Chu et al., forthcoming; Raman and Shahrur, 2008). Relationship-specific investments support transactions between the firm and its stakeholders. These investments are relationship-specific because the value derived from their use outside the relationship is less than within the relationship (Bowen et al., 1995). Such specialized investments are usually customized to meet customers' proprietary needs. Relationship-specific investments also contribute to products' uniqueness, which makes it difficult for downstream enterprises to obtain substitute products from the market (Holmstrolm and Roberts, 1998). Close cooperation along the supply chain increases the customer's

stickiness. Further, the stable customer-base will improve efficiency and create more value for the firm (Patatoukas, 2012; Irvine et al., 2015).

R&D investment is necessary to meet customers' proprietary needs, increase products' uniqueness, and improve market competitiveness (Chu et al., forthcoming; Dou et al., 2013; Nunn, 2007). Indeed, the intensity of R&D expenditure is often used in the empirical literature as a proxy for asset specificity (Kale and Shahrur, 2007). Bowen et al. (1995) use R&D expenses to measure this kind of investment. Raman and Shahrur (2008) use R&D intensity of a firm's suppliers and customers to measure the importance of relationship-specific investments. In the automotive industry, auto part suppliers often customize production lines to supply specific car parts, depending on their customers' requirements, and in the mobile phone industry, Foxconn announced plans to invest US$270 million in R&D for specialized optical lens, glass, and metal processing equipment to complete Apple's orders of iPhone 8 and iPhone X.

To maintain stable and integrated relationships with major customers, firms have an incentive to produce customized products and improve product uniqueness, and R&D investment is essential to achieving these outcomes. This is what we refer to as the **relationship-specific investment hypothesis**. Under this hypothesis, having a concentrated customer base motivates firms to invest more in R&D.

2.2. The negative relationship between customer concentration and R&D input: the financial-pressure hypothesis

By the same token, a concentrated customer base also constrains firms' internal finances. First, faced with major customers, the firm has weak bargaining power. Hence, the firm is more likely to make a series of concessions during business negotiations, such as providing a lower product price and extending trade credit (Fabbri and Klapper, 2016; Porter, 1989). Second, the firm risks losing anticipated cash flows if the customer goes bankrupt (Dhaliwal et al., 2016). If one customer represents a large portion of a firm's sales, then the loss of that customer will result in a large adverse cash flow shock and cause severe financial distress (Itzkowitz, 2013). Third, firms with concentrated customer base also face contagion risk along the supply chain, when downstream distress "spills over" and transmits real costs to upstream businesses (Jorion et al., 2009; Kolay et al., 2016; Pandit et al., 2011). For instance, Kolay et al. (2016) find that firms with economically distressed customers experience large losses in market value and increased sales, general, and administrative expenses. Jorion et al. (2009) further provide evidence of credit contagion from counterparty risk. After a counterparty goes bankrupt, the credit rating of the firm also declines at the same time, and the probability of bankruptcy increases. As a result, firms in such relationships are likely to hold onto additional cash as a precautionary measure (Itzkowitz, 2013; Huang et al., 2016), rather than make risky R&D investments.

R&D investment depends on abundant financial support. Compared with general investment, the external financing costs associated with R&D are higher (Czarnitzki and Hottenrott, 2011; Hall, 2002; Holmstrom, 1989). First, the R&D process is long and has uncertain outputs. Considerable input does not necessary lead to equal advantageous outcomes. Establishing an R&D program may involve significant sunk costs and trigger additional adjustment spending. Second, the collateral value of R&D investment is low, as most input consists of wages for R&D employees rather than tangible assets. Third, to protect asset specificity, the R&D process must be kept secret. Information asymmetries between investors and managers create additional uncertainties. Moreover, high external financing costs lead to financing gaps and underinvestment. As a result, internal financing becomes the principal determinant of R&D investment (Himmelberg and Petersen, 1994), with cash flow volatility resulting in decreased R&D expenditure (Minton and Schrand, 1999).

From the discussion above, financial pressure from a concentrated customer base limits firms' R&D investment. This is the **financial-pressure hypothesis**.

2.3. China: the financial-pressure hypothesis dominates

Relationship-specific investment can trigger a "hold-up problem" for firms in countries with inadequate legal protections. Given that the value of specialized investment decreases outside of the supplier-customer relationship (Dou et al., 2013), if that relationship breaks down, then the investment becomes a sunk cost. When a contract is incomplete in a context where contract enforceability is weak, customers are likely to have more bargaining power. To protect and maintain the relationship, supplier firms must accept more oppressive

clauses. In the economics literature, this is commonly referred to as the hold-up problem, as underinvestment occurs when contracts cannot be enforced (Grossman and Hart, 1986; Nunn, 2007; Williamson, 1979). Nunn (2007) finds that the intensity of relationship-specific investment is positively associated with judicial quality and contract enforcement. In the case of China, legal institutions are weak. In fact, until recently, many important economic laws were missing or incomplete. More importantly, current laws are rarely enforced effectively. The absence of judicial independence and a lack of qualified legal professionals are the major causes. In 2005, there was one lawyer for every 9000 people, while this ratio is 1:300 in the United States. According to the World Bank's 2001 Investment Climate Survey on 1500 Chinese firms, most disputes with customers are settled through negotiations between firms rather than through the formal court system (Long, 2010). In such a legal environment, Chinese firms have little incentive to engage in relationship-specific R&D investment because of the hold-up problem.

In summary, a well-functioning legal system and abundant financial resources are both prerequisites for R&D investment. In China, legal institutions are still weak. Moreover, in a close supply chain, the financial resources necessary for investing in R&D activities are restricted both by the pressure from downstream businesses and by the precautionary incentive to hold onto more cash. The above discussion leads to our baseline hypothesis.

Hypothesis 1. There is a negative relationship between customer concentration and firm's R&D investment.

3. Data and methodology

3.1. Data and sample

Our sample consists of manufacturing industry firms listed on the main board of the Chinese A-share market during the period from 2011 to 2015. We limit our sample to the manufacturing industry because the characteristic of the supply chain is more evident than service industries. To measure innovation activities, we collect firm-year R&D investment data from the Wind database. In addition, financial data are obtained from the China Security Market and Accounting Research (CSMAR) database.

We implement the following process for sample selection. First, we exclude firms that suffer from financial losses in two consecutive fiscal years (ST firms). Second, we drop firms listed in the current year. Finally, we eliminate samples with missing values in the model estimation. Our final sample includes 1984 firm-year observations. All continuous variables are winsorized at the 1st and 99th percentile.

3.2. Model and variable definition

We construct model (1) to assess whether customer concentration affects R&D investment.

$$RD_{i,t} = \alpha_0 + \alpha_1 Concentration_{i,t} + \sum \alpha_j Control_{i,t} + \theta_{i,t} \quad (1)$$

where i indexes firm and t indexes year. *RD* is the R&D input deflated by the total assets. *Concentration* is the sales fraction of a firm's top 5 customers. *Control* variables include finance- and governance-related variables that influence both the firm's R&D investment and customer concentration. The set of control variables includes firm size (*Size*), debt levels (*Lev*), operating performance (*ROA*), cash holding (*Cash*), revenue growth (*Growth*), growth prospect (*TobinQ*), listed years (*Age*), analyst following (*Analyst*), and institutional ownership (*Ins*). We also control the industry and year-fixed effect in the model. Our key variable of interest is *Concentration*. Based on Hypothesis 1, we expect the coefficient of *Concentration* in model (1), α_1, to be negative. The definitions of all variables are presented in Appendix A.

3.3. Descriptive statistics

Panel A of Table 1 presents the summary statistics. The average sales to top-five customers account for 25.440% of firms' total revenue. The ratio of R&D spending over the total assets is 1.722%. Panel B shows

Table 1
Descriptive statistics of main variables.

Variables	N	Mean	Median	P25	P50	P75
Panel A: Total sample						
RD (%)	1984	1.722	1.419	0.598	1.442	2.483
Concentration (%)	1984	25.440	17.830	12.640	20.380	32.660
AR (%)	1984	10.810	9.504	3.627	8.261	15.120
TurnPeriod	1984	62.970	66.630	18.450	45.090	82.860
PM	1984	0.232	0.162	0.128	0.194	0.289
OCF (%)	1984	4.984	6.458	0.988	4.560	8.874
Size	1984	22.530	1.161	21.740	22.350	23.220
Lev (%)	1984	48.820	18.100	35.960	49.180	62.720
ROA (%)	1984	4.200	5.449	0.897	2.975	6.676
Age	1984	2.455	0.642	2.398	2.639	2.833
Cash (%)	1984	14.410	10.260	7.185	11.980	18.860
Growth (%)	1984	9.510	26.950	−4.943	6.149	18.480
Analyst	1984	1.633	1.181	0.693	1.609	2.639
Ins (%)	1984	46.020	20.420	31.450	46.380	61.530
TobinQ	1984	1.996	1.114	1.250	1.653	2.343
	Low concentration		High concentration		Difference	
	N	Mean	N	Mean		
Panel B: Comparison of firms with different level of customer concentration						
RD (%)	990	1.845	994	1.601	0.244***	
Concentration (%)	990	13.062	994	37.766	−24.705***	
AR (%)	990	10.312	994	11.305	−0.993**	
TurnPeriod	990	58.372	994	67.555	−9.183***	
PM	990	0.242	994	0.221	0.021***	
OCF (%)	990	5.411	994	4.560	0.852***	
Size	990	22.828	994	22.232	0.597***	
Lev (%)	990	50.265	994	47.380	2.885***	
ROA (%)	990	4.718	994	3.683	1.035***	
Age	990	2.446	994	2.463	−0.017	
Cash (%)	990	14.258	994	14.566	−0.309	
Growth (%)	990	9.152	994	9.867	−0.715	
Analyst	990	1.834	994	1.432	0.403***	
Ins (%)	990	48.019	994	44.032	3.987***	
TobinQ	990	1.847	994	2.145	−0.298***	

This table presents summary statistics for variables. Panels A and B present summary statistics for the total sample and subsample. The *Low concentration* and *High concentration* subsamples are determined by whether the ratio of sales to top-five customers over the total sales (which is the definition of *Concentration*) is higher the median value in the same 2-digit CSRC industry in the same year. If the ratio is higher, then the firm-year observation belongs to the *High concentration* subsample; otherwise, it belongs to the *Low concentration* subsample. Continuous variables are winsorized at their 1st and 99th percentiles. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

that firms with more concentrated customer bases invest less in R&D. However, these firms provide about 0.993% more trade credit (*AR*) to their downstream enterprises and have a longer collection period (*TurnPeriod*), around 9 days on average. The average profit margin (*PM*) decreases from 24.200% to 22.100% as customer concentration increases. *ROA* and the ratio of operating cash flow over the total assets (*OCF*) are also significantly reduced by 1.035% and 0.852%, respectively. Overall, firms with more concentrated customers have lower operating profits. To reduce concentrated customers' operating risk, firms prefer to maintain lower leverage (Banerjee et al., 2008). In our sample, the average leverage (*Lev*) for high-customer-concentration firms is 47.380%, while this ratio is 50.265% for low-customer-concentration firms.

Fig. 1 shows the evident relationship between customer concentration and R&D investment. In Fig. 1, the horizontal axis represents the decile of customer concentration. A higher value means a more concentrated

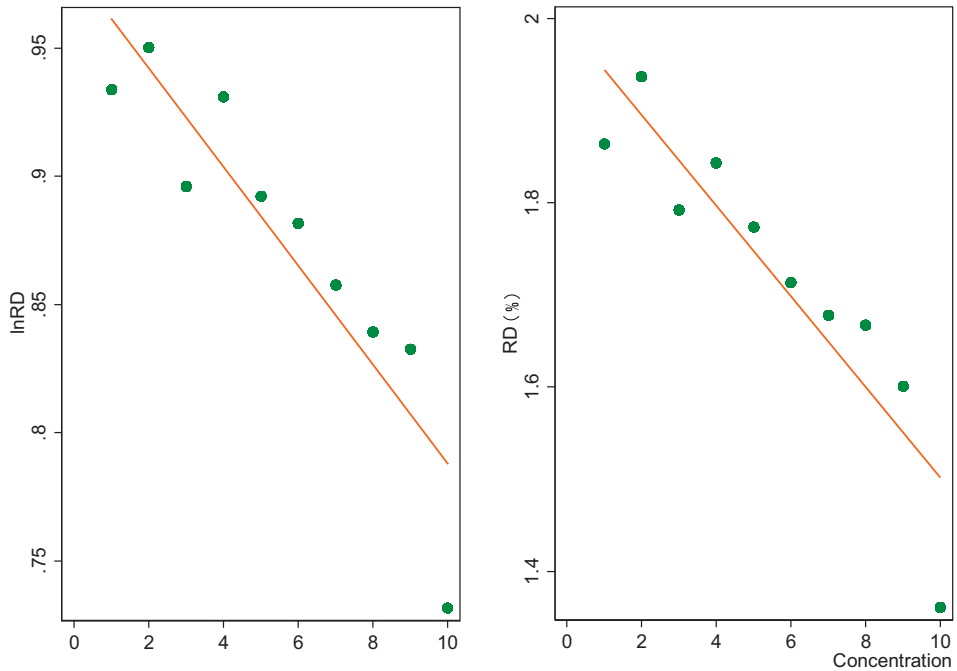

Fig. 1. Customer concentration and R&D investment.

customer base. The vertical axis represents absolute R&D spending and asset-adjusted R&D spending. With an increase in customer concentration, R&D investment shows a significant downward trend. When customer concentration reaches its highest level, R&D spending is at its lowest. This provides preliminary statistical evidence to support Hypothesis 1.

Fig. 2 reveals the mechanism by which a concentrated customer base negatively influences firms' R&D investment; this represents the internal financial pressure exerted by a concentrated customer base. Fig. 2 illustrates that several aspects closely related to the customer base, such as profit margin (*PM*), credit policies (*AR* and *TurnPeriod*), and operating cash flow (*OCF*), exert a negative influence on R&D expenditure. First, lower product prices for major customers directly reduce firms' profits and potential cash flow. As customer concentration increases, the profit margin decreases. Moreover, major customers not only benefit from preferential product prices, but also from a flexible credit policy, further affecting firms' current cash flow. The higher the customer concentration, the more trade credit for customers and the longer the collection period. When concentration is at its highest, corporate accounts receivable accounts for up to 11.5% of total assets. Firms not only provide major customers a large amount of commercial credit, but also extend their credit collection period. For major customers, the collection period can last up to 75 days at the highest level. Finally, both preferential prices and flexible credit policies lead to limited operating cash flow. Fig. 2 shows that the higher the customer concentration, the less cash flow from operating activities. In summary, Fig. 2 indicates that the presence of major customers constrains firms' internal financing ability, thereby limiting R&D investment.

Table 2 provides the correlations between variables. The negative correlation between *Concentration* and *RD* shows that firms with high customer concentration make less R&D investment, as hypothesized earlier. In addition, consistent with prior research findings, customer concentration is negatively correlated with liability level (Banerjee et al., 2008) and positively correlated with trade credit (Fabbri and Klapper, 2016). The correlation coefficients of explanatory variables in the regression model remain below 0.5, which suggests that our regression model presents no serious multicollinearity problem.

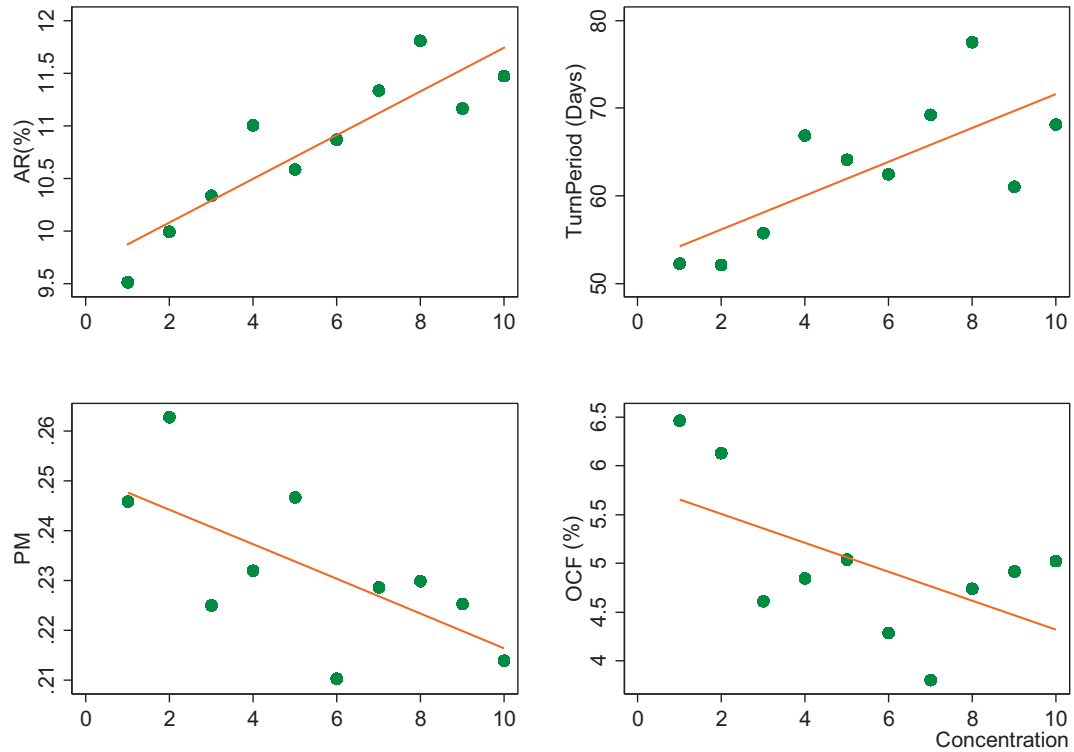

Fig. 2. Customer concentration and internal finance of firm.

4. Empirical results

4.1. Baseline empirical results: customer concentration and R&D investment

We begin our empirical analysis by examining whether a concentrated customer base affects a firm's R&D investment. Table 3 presents the results of this analysis.

Column (1) shows that there is a negative and statistically significant relationship between customer concentration and R&D investment. Column (2) considers all of the control variables in model (1). The relationship remains significantly negative. In terms of economic significance, the coefficient estimate of *Concentration* in Column (2) implies that a 1% increase in customer concentration is associated with a 0.011% decrease in R&D investment.

Regarding control variables, firms that are smaller, institutionally owned, more profitable, and have more analysts following them are more innovative. Consistent with previous findings, analyst coverage decreases information asymmetry and thus increases the firm's R&D investment (Derrien and Kecskes, 2013). Institutions are sophisticated investors that play a monitoring role in reducing pressure for myopic performance (Bushee, 1998; Aghion et al., 2013).

4.2. Test of causality

We argue that the direction of causality is from the customer concentration to the firm's decision to invest in R&D. Nevertheless, it is possible that the lack of market competitiveness due to less R&D investment leads to a more concentrated customer base. Also, there may be some unobservable variables that affect both customer concentration and corporate R&D investment. To establish the causal relation between customer concentration and R&D investment, we use three methods to re-examine the relation: the instrumental variable method, the reverse causality test, and the Granger test.

Table 2
Correlation matrix.

	RD	*Concentration*	*AR*	*TurnPeriod*	*PM*	*OCF*	*Size*	*Lev*	*ROA*	*Age*	*Cash*	*Growth*	*Analyst*	*Ins*
RD	1.000													
Concentration	−0.033	1.000												
AR	0.297***	0.063***	1.000											
TurnPeriod	0.099***	0.083***	0.787***	1.000										
PM	0.083***	−0.062***	0.005	0.057**	1.000									
OCF	0.121***	−0.066***	−0.200***	−0.273***	0.289***	1.000								
Size	−0.058***	−0.283***	−0.120***	−0.104***	−0.118***	0.060***	1.000							
Lev	−0.140***	−0.087***	0.083***	0.028	−0.398***	−0.185***	0.408***	1.000						
ROA	0.192***	−0.090***	0.001	−0.151***	0.618***	0.469***	0.027	−0.433***	1.000					
Age	−0.058***	0.004	−0.075***	−0.128***	−0.007	0.021	0.012	0.155***	−0.072***	1.000				
Cash	0.098***	0.028	−0.059***	−0.051**	0.164***	0.174***	−0.047**	−0.273***	0.258***	−0.105***	1.000			
Growth	0.015	0.015	0.045**	−0.102***	0.144***	0.042*	0.051**	0.028	0.295***	0.002	−0.003	1.000		
Analyst	0.146***	−0.190***	−0.065***	−0.153***	0.288***	0.258***	0.483***	−0.045**	0.508***	−0.097***	0.080***	0.180***	1.000	
Ins	0.057**	−0.101***	−0.072***	−0.134***	0.125***	0.150***	0.301***	0.088***	0.230***	0.157***	0.062***	0.059***	0.351***	1.000
TobinQ	0.109***	0.163***	0.050**	0.036	0.462***	0.182***	−0.390***	−0.409***	0.385***	0.030	0.189***	0.072***	0.060***	0.088***

This table reports the Pearson correlations between variables. Continuous variables are winsorized at their 1st and 99th percentiles. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 3
Customer concentration and R&D investment.

	$RD_{i,t}$	
	(1)	(2)
$Concentration_{i,t}$	−0.010***	−0.011***
	(−5.624)	(−6.600)
$Size_{i,t}$		−0.310***
		(−8.118)
$Lev_{i,t}$		−0.001
		(−0.640)
$ROA_{i,t}$		0.038***
		(5.041)
$Age_{i,t}$		−0.056
		(−1.199)
$Cash_{i,t}$		−0.003
		(−1.003)
$Growth_{i,t}$		−0.000
		(−0.318)
$Analyst_{i,t}$		0.235***
		(6.837)
$Ins_{i,t}$		0.005***
		(2.820)
$TobinQ_{i,t}$		−0.057
		(−1.325)
Constant	1.785***	8.400***
	(8.930)	(9.495)
Observations	1984	1984
Adjusted R2	0.154	0.235
F	37.34	33.53

This table reports results from OLS regressions relating R&D investment to customer concentration and control variables. *Concentration* is the ratio of sales to top-five customers over the total sales. *RD* is R&D investment scaled by total assets at the end of the year. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.2.1. Instrumental variable method

Specifically, instrumental variables must satisfy two conditions to be considered valid instruments (Larcker and Rusticus, 2010). First, the relevance condition requires instrumental variables to be correlated with customer concentration measures. Second, the exclusion restriction stipulates that these variables should be uncorrelated with the error term after controlling for the set of control variables in our main model specification. As a result, instruments are correlated with a firm's R&D investment only through their correlations with customer concentration measures.

We select two-year ($Concentration_{i,t-2}$) and three-year ($Concentration_{i,t-3}$) lagged variables as our instrumental variables. First, customer concentration remains relatively stable, to some extent. Therefore, there is a correlation between current customer concentration and previous levels. Furthermore, the two-year and three-year lagged customer concentration maybe irrelevant to the current R&D investment. Therefore, $Concentration_{i,t-2}$ and $Concentration_{t-3}$ are uncorrelated with $\theta_{i,t}$ in model (1).

Column (1) in Table 4 presents the first-stage results obtained by regressing customer concentration measures on our selected instrumental variables and the set of control variables used in model (1). We perform various tests that demonstrate that our selected instrumental variables are valid. First, the high Shea's partial R^2 of our instruments implies that our results do not suffer from the weak instrument problem. Then, the Hansen J test shows that the null hypothesis that our selected instruments are uncorrelated with the error term cannot be rejected, which implies that the instruments meet the exclusion restriction requirement. The second-stage results in Column (2) show a negative relation between customer concentration and firm's

Table 4
Instrumental variables regression.

Dependent Variable=	First stage $Concentration_{i,t}$ (1)	Second stage $RD_{i,t}$ (2)
$Concentration_{i,t-2}$	0.712***	
	(17.778)	
$Concentration_{i,t-3}$	0.152***	
	(3.939)	
$Fit\_Concentration_{i,t}$		−0.014***
		(−5.831)
$Size_{i,t}$	−1.020***	−0.333***
	(−2.922)	(−7.056)
$Lev_{i,t}$	0.039**	−0.003
	(2.044)	(−1.222)
$ROA_{i,t}$	−0.105	0.043***
	(−1.456)	(4.692)
$Age_{i,t}$	0.196	−0.373***
	(0.252)	(−3.135)
$Cash_{i,t}$	0.001	−0.008**
	(0.044)	(−2.044)
$Growth_{i,t}$	−0.013	0.000
	(−0.907)	(0.147)
$Analyst_{i,t}$	0.235	0.199***
	(0.663)	(4.485)
$Ins_{i,t}$	0.038**	0.004*
	(2.399)	(1.831)
$TobinQ_{i,t}$	0.134	−0.010
	(0.392)	(−0.176)
Constant	17.008**	9.313***
	(2.185)	(8.208)
Observations	1286	1286
Adjusted R2	0.736	0.247
F	107.2	22.86
Weak identification test		
Shea's partial R2	0.690	
Hansen J Test		
Chi-sq(1) P-value	0.117	
Wu-Hausman F-statistic	48.420 (p = 0.002)	

This table reports results from 2-Stage Least Squares regressions relating R&D investment to customer concentration using instrumental variables. The instrumental variables for $Concentration_{i,t}$ are the two-year ($Concentration_{i,t-2}$) and three-year ($Concentration_{i,t-3}$) lagged values of $Concentration_{i,t}$. The first-stage regression results are presented in column (1), ant the second-stage results are in column (2). Continuous variables are winsorized at their 1st and 99th percentiles. Robust z-statistics and t-statistics are in parentheses in column (1) and (2) respectively. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

R&D investment. Specifically, to the extent that our instruments are valid, the Wu-Hausman test rejects the null hypothesis that our customer concentration measures are exogenous. As a result, the instrumental variable method is required, and we obtain a consistent reference with previous OLS regressions. Thus, the results in Table 4 suggest that higher customer concentration causally decreases a firm's R&D investment.

4.2.2. Reverse causality test

Following Lennox and Park (2006), to further examine the robustness of the causal relationship between customer concentration and R&D investment, we construct model (2).

$$Concentration_{i,t} == \theta_0 + \theta_1 RD_{i,t-1} + \theta_2 RD_{i,t+1} + \sum \theta_j Control_{i,t} + \phi_{i,t} \quad (2)$$

where the explained variable is customer concentration. Control variables include *Size, Lev*, *ROA*, *Age*, *Cash*, *Growth*, and *TobinQ*. If there is a significant relation between $RD_{i,t+1}$ and $Concentration_{i,t,}$ (not vice versa), meaning that θ_2 (not θ_1) is significantly negative, then the results provide statistical evidence that customer concentration influences R&D investment, as hypothesized. Table 5 shows the regression results. As we predict, the coefficient $RD_{i,t+1}$ ($RD_{i,t-1}$) is significantly (not significantly) negative, which supports our conclusion.

4.2.3. Granger causality test

Following Lev et al. (2010), we use the Granger causality test (Granger, 1969) to establish temporal causality between customer concentration and R&D investment. If customer concentration is the "cause" of R&D investment, then previous customer concentration will be a significant predictor of R&D investment in the current period. Conversely, previous R&D investment should not predict customer concentration in the current period. Specially, we construct model (3a) and (3b). The control variables in model (3a) are the same as in model (1), while the controls in model (3b) are the same as in model (2). We use the first-order difference method to reduce the serial correlation problem.

$$\Delta RD_{i,t} = \gamma_0 + \gamma_1 \Delta RD_{i,t-1} + \gamma_2 \Delta RD_{i,t-2} + \gamma_3 \Delta Concentration_{i,t-1} + \gamma_4 \Delta Concentration_{i,t-2} + \sum \gamma_j Control_{i,t-1} + \pi_{i,t} \quad (3a)$$

$$\Delta Concentration_{i,t} = \psi_0 + \psi_1 \Delta RD_{i,t-1} + \psi_2 \Delta RD_{i,t-2} + \psi_3 \Delta Concentration_{i,t-1} + \psi_4 \Delta Concentration_{i,t-2} + \sum \psi_j Control_{i,t-1} + \eta_{i,t} \quad (3b)$$

Table 5
Reverse causality regression.

Dependent Variable=	$Concentration_{i,t}$	
	(1)	(2)
$RD_{i,t-1}$	−0.534	−0.560
	(−0.797)	(−0.867)
$RD_{i,t+1}$	−1.267**	−1.564***
	(−2.120)	(−2.732)
$Size_{i,t}$		−2.729***
		(−4.730)
$Lev_{i,t}$		−0.065
		(−1.607)
$ROA_{i,t}$		−0.251*
		(−1.664)
$Age_{i,t}$		0.004
		(0.004)
$Cash_{i,t}$		0.016
		(0.260)
$Growth_{i,t}$		0.035
		(1.440)
$TobinQ_{i,t}$		2.129***
		(2.810)
Constant	27.449***	90.467***
	(11.665)	(7.070)
Observations	982	982
Adjusted R2	0.101	0.160
F	10.44	12.09

This table reports the reverse causality test results from OLS regressions relating customer concentration to R&D investment. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6 presents the results. The explanatory variable in column (1) is R&D investment. The coefficients of lag-two and lag-three period customer concentration are −0.136 (robust t statistics = −2.178) and −0.258 (robust t statistics = −1.642), respectively. The results of model (3b) are shown in Column (2). Previous R&D investment ($\triangle RD_{i,t-1}$, $\triangle RD_{i,t-2}$) cannot predict customer concentration in the current period. Overall, our causality tests show that customer concentration limits firms' R&D investment, at least at the empirical level.

4.3. Mechanism analysis

Our evidence thus far is consistent with the financial-pressure hypothesis, which predicts customer concentrations to impede firm's R&D input. In this section, we provide evidence for the mechanism underlying this hypothesis. In Section 4.3.1, we show direct evidence that customer concentration is positively associated with

Table 6
Granger causality test.

Dependent Variable=	$\triangle RD_{i,t}$ (1)	$\triangle Concentration_{i,t}$ (2)
$\triangle RD_{i,t-1}$	−0.210**	0.026
	(−2.422)	(0.586)
$\triangle RD_{i,t-2}$	−0.071***	0.006
	(−2.915)	(0.690)
$\triangle Concentration_{i,t-1}$	−0.136**	−0.327***
	(−2.178)	(−4.192)
$\triangle Concentration_{i,t-2}$	−0.258	−0.133**
	(−1.642)	(−2.107)
$Size_{i,t-1}$	−0.005	−0.000
	(−0.235)	(−0.000)
$Lev_{i,t-1}$	0.002**	0.001*
	(2.119)	(1.725)
$ROA_{i,t-1}$	−0.006	−0.001
	(−1.238)	(−0.733)
$Age_{i,t-1}$	−0.004	−0.009
	(−0.170)	(−0.470)
$Cash_{i,t-1}$	0.004	0.000
	(1.402)	(0.220)
$Growth_{i,t-1}$	−0.000	−0.000
	(−1.263)	(−0.709)
$TobinQ_{i,t-1}$	−0.015	−0.006
	(−0.901)	(−0.596)
$Analyst_{i,t-1}$	−0.000	
	(−0.290)	
$Ins_{i,t-1}$	0.042	
	(1.542)	
Constant	0.987***	0.910***
	(2.821)	(2.816)
Observations	535	535
Adjusted R2	0.086	0.062
F	1.959	1.437

This table reports Granger causality test results. The dependent variable in column (1) is the change-value of R&D investment ($\triangle RD_{i,t}$). The dependent variable in column (2) is the change-value of customer concentration ($\triangle Concentration_{i,t}$). Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

weakened internal finance. Section 4.3.2 argues that if it is the financial pressure mechanism that drives our findings, then we should expect to observe significant cross-sectional heterogeneity in the results when financial pressure varies across firms.

4.3.1. Customer concentration and internal finance

When a customer's purchases account for a large share of a firm's profits, the firm's bargaining power is low (Porter, 1989), which has a negative effect on its internal financing. Customers can exert bargaining power on firms by acquiring extended trade credit or reducing the product price. First, firms with weak bargaining power are more likely to have a larger share of goods sold on credit and offer longer payment periods (Fabbri and Klapper, 2016). Extended trade credit policies can reduce the current operating cash flow. Second, product prices for major customers are relatively lower so that the firm's profit margins are lower.

Following Fabbri and Klapper (2016), we examine the direct effect that a concentrated customer base has on internal finances, including the turnover period of accounts receivable (*TurnPeriod*), the ratio of accounts receivable over assets (*AR*), the profit margin of products (*PM*) and the operating cash flow (*OCF*). Control variables include whether the firm is exporting (*Export*), the industry competition index (*Herfindal*), the firm's age and size (*Age, Size*), the percentage of the firm owned by foreign institutions (*Foreign*), and whether the firm is owned by state (*SOE*). Consistent with the intuitive and visual evidence shown in Fig. 1, the multiple regressions provide even stronger evidence. We report the results in Table 7. The regression results suggest that when a firm's customer base is more concentrated, it provides longer payment periods, more accounts receivable, lower product prices, and experiences a decrease in operating cash flow, all signs that its internal financing ability is weakened.

4.3.2. The moderating effect of external finance

We next conduct cross-sectional tests to examine whether the effect of having a concentrated customer base on R&D investment varies in (1) firms with different levels of external financing resources, including trade credit from upstream firms (*Credit*), equity financing cash flow (*Equity*), and debt financing cash flow (*Debt*),

Table 7
Customer concentration and internal financing.

Dependent Variable=	$TurnPeriod_{i,t}$	$AR_{i,t}$	$PM_{i,t}$	$OCF_{i,t}$
	(1)	(2)	(3)	(4)
$Concentration_{i,t}$	0.623***	0.093***	−0.002***	−0.019**
	(7.017)	(6.669)	(−8.533)	(−2.029)
$Age_{i,t}$	−12.026***	−0.775**	−0.003	0.363*
	(−4.048)	(−2.401)	(−0.655)	(1.653)
$Size_{i,t}$	−5.172***	−0.911***	−0.019***	0.291**
	(−3.953)	(−5.334)	(−6.428)	(2.395)
$Freign_{i,t}$	−6.459***	−0.042	0.063***	2.265***
	(−3.028)	(−0.094)	(6.354)	(6.394)
$SOE_{i,t}$	−3.537	−0.447	−0.034***	−1.394***
	(−1.191)	(−1.062)	(−4.632)	(−4.630)
$Export_{i,t}$	18.210***	3.803***	−0.098***	−1.061***
	(5.103)	(7.619)	(−9.306)	(−3.065)
$Herfindal_{i,t}$	−118.248***	−20.452***	−0.142***	5.751**
	(−7.234)	(−7.642)	(−4.555)	(2.408)
Constant	202.025***	30.558***	0.832***	−0.617
	(6.417)	(7.456)	(11.526)	(−0.214)
Observations	1984	1984	1984	1984
Adjusted R2	0.089	0.096	0.149	0.056
F	20.480	20.400	25.910	10.830

This table reports results of the relationship between customer concentration and firm's internal financing. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

and (2) firms in different external financing environments, such as those located in districts with more developed financial markets (*Market*),[2] operating in high-tech industries (*Tech*), and with higher levels of state ownership (*SOE*).

If internal finances are insufficient to promote innovation, then adequate external financing resources may serve as substitutes and alleviate the problem. Equity financing is a main source of external financing for R&D investment (Acharya and Xu, 2017; Brown et al., 2009; Hall, 2002; Hsu et al., 2014). Compared with equity financing, the credit market plays only a limited role (Brown et al., 2009; Hsu et al., 2014). Creditors are risk averse and only obtain fixed interest from borrowers. However, recent evidence shows the development of banking sectors contributes to innovation activity due to the stronger ability of banks to diversify credit risk (Amore et al., 2013). In the manufacturing industry, trade credit along the supply chain has gradually become a means for firms to ease financing constraints (Fisman and Love, 2003). As such, in addition to direct external financial resources, a developed external financing environment can play a key role in reducing the costs associated with external financing, such as evaluating innovative projects, managing risk, and monitoring managers (Khurana et al., 2006; Hsu et al., 2014). In China, the government plays an important role in allocating financial resources (Firth et al., 2008; Mukherjee et al., 2017). To accelerate technological upgrading, the Chinese government supports and subsidizes firms in various ways, for instance, through tax reductions and exemptions (Mukherjee et al., 2017). State-owned enterprises have more flexible financing channels and lower financing constraints (Firth et al., 2008).

To examine the moderating effect that external financing might have on innovation, we include *Financing* and its interaction with *Concentration* in model (1). Table 8 reports the regression results. Columns (1) and (2) show that when firms have more trade credit from suppliers or equity financing resources, the constraint effect of customer concentration on R&D investment is lower. However, debt financing seems to have no positive effect on R&D investment. This might be attributable to the high-risk nature of R&D investment, which is antithetical to creditors' risk-averseness (Hsu et al., 2014). Columns (4), (5), and (6) in Table 8 also support our predictions that the negative relationship between customer concentration and R&D input is less pronounced in firms with more external financing.

4.4. Further analysis

4.4.1. Expense R&D and capital R&D

According to Chinese accounting standards, the treatment of R&D input is based on the stage of R&D activities. Total R&D input consists of an expense at the research stage and a capitalization in the development stage. In the initial stage of R&D activity, output is uncertain and input can only be expensed. As the application value gradually develops and the R&D activity enters the development stage, uncertainty decreases and R&D expenditure is capitalized.

Research-stage R&D input is more sensitive to customer concentration, because a concentrated customer base leads to internal funds pressures, which directly affect whether the firm will invest in R&D. The capitalization part of R&D input is only transformed from the previous expense part when the certainty of the program increases. As a result, sensitivity to customer concentration decreases. We therefore predict that the negative impact of customer concentration on corporate R&D investment will mainly occur at the research stage of R&D input.

The results of the comparison are presented in Table 9. In Column (1), a 1% increase in customer concentration is associated with a 0.010% decrease in R&D expenditure, while the effect is only 0.001% in R&D capitalization. In other words, the constraint effect of customer concentration on R&D expenditure is almost 10 times higher than R&D capitalization.

[2] The financial market development index for Chinese provinces is calculated from Wang et al. (2017). This index is commonly used in Chinese research (Guan et al., 2016; Fang et al., 2017). The index is calculated based on authority statistics and survey data through the investigation of enterprises in China. Higher values indicate a more developed financial market.

Table 8
Customer concentration, external financing and R&D investment.

Dependent Variable=	$RD_{i,t}$					
	External financing resource			External financing environment		
$Financing_{i,t}$=	*Credit*	*Equity*	*Debt*	*Market*	*Tech*	*SOE*
	(1)	(2)	(3)	(4)	(5)	(6)
$Concentration_{i,t}$	−0.014***	−0.014***	−0.013***	−0.014***	−0.012***	−0.015***
	(−5.926)	(−6.511)	(−6.023)	(−6.545)	(−6.826)	(−5.614)
$Concentration_{i,t}$ * $Financing_{i,t}$	0.005*	0.006*	0.004	0.005*	0.016***	0.006*
	(1.706)	(1.831)	(1.441)	(1.682)	(2.729)	(1.814)
$Financing_{i,t}$	0.148	−0.197*	−0.166*	−0.080	−0.929***	−0.027
	(1.481)	(−1.928)	(−1.665)	(−0.789)	(−4.442)	(−0.266)
$Size_{i,t}$	−0.302***	−0.313***	−0.297***	−0.305***	−0.304***	−0.315***
	(−7.812)	(−8.201)	(−7.828)	(−7.970)	(−7.957)	(−8.213)
$Lev_{i,t}$	−0.001	−0.001	−0.003*	−0.002	−0.001	−0.001
	(−0.630)	(−0.354)	(−1.649)	(−0.739)	(−0.580)	(−0.578)
$ROA_{i,t}$	0.038***	0.037***	0.035***	0.037***	0.037***	0.041***
	(5.038)	(4.916)	(4.659)	(4.957)	(4.931)	(5.348)
$Age_{i,t}$	−0.060	−0.060	−0.070	−0.056	−0.052	−0.081*
	(−1.284)	(−1.279)	(−1.506)	(−1.218)	(−1.123)	(−1.677)
$Cash_{i,t}$	−0.003	−0.003	−0.003	−0.003	−0.003	−0.004
	(−1.044)	(−1.075)	(−1.086)	(−1.009)	(−1.096)	(−1.133)
$Growth_{i,t}$	−0.000	−0.000	−0.000	−0.000	0.000	−0.000
	(−0.370)	(−0.366)	(−0.087)	(−0.378)	(0.126)	(−0.298)
$Analyst_{i,t}$	0.005***	0.005***	0.004***	0.005***	0.005***	0.004**
	(2.715)	(2.735)	(2.579)	(2.762)	(3.003)	(2.324)
$Ins_{i,t}$	−0.056	−0.058	−0.042	−0.053	−0.054	−0.057
	(−1.307)	(−1.354)	(−0.993)	(−1.229)	(−1.257)	(−1.329)
$TobinQ_{i,t}$	0.238***	0.238***	0.229***	0.233***	0.233***	0.234***
	(6.879)	(6.874)	(6.657)	(6.743)	(6.806)	(6.820)
$Constant_{i,t}$	6.872***	7.069***	6.707***	6.873***	6.783***	7.108***
	(7.943)	(8.157)	(7.739)	(7.831)	(7.832)	(8.170)
Observations	1984	1984	1984	1984	1984	1984
Adjusted R2	0.235	0.235	0.245	0.235	0.241	0.237
F	31.150	31.670	33.300	31.270	31.390	32.470

This table reports results for the moderating effect of external financing. Columns (1)-(3) use direct external financing resources as the interaction term, $Financing_{i,t}$. Columns (4)-(6) use indirect external financing environment to measure $Financing_{i,t}$. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.4.2. Customer concentration and R&D output

Given that innovation correlates with levels of R&D investment, if customer concentration limits R&D input, then we can reasonably predict that R&D output will be negatively influenced.

We use a firm's total number of patent applications filed in a given year to gauge its R&D output. As previous studies show (He and Tian, 2013), using patent applications rather than patent grants captures the actual timeframe of innovation. There is an administrative approval process before patents are finally granted and this can involve factors that are not controlled by firms. Because innovation generally takes longer than a single year, we examine the effect of customer concentration on firms' patenting two or three years ahead (He and Tian, 2013). To assess how customer concentration affects innovation, we replace the dependent variable $RD_{i,t}$ in model (1) with $Patent_{i,t+2}$ and $Patent_{i,t+3}$. The value of *Patent* is the natural logarithm of one plus the number of patent applications.

Results in Table 10 support our predictions. Firms with a concentrated customer base have fewer patents in the following two and three years.

Table 9
Customer concentration and R&D investment in different stages.

Dependent Variable=	$RD\_FEE_{i,t}$ (1)	$RD\_CAPITAL_{i,t}$ (2)
$Concentration_{i,t}$	−0.010***	−0.001**
	(−5.981)	(−2.249)
$Size_{i,t}$	−0.305***	−0.014
	(−8.207)	(−1.340)
$Lev_{i,t}$	−0.001	0.000
	(−0.596)	(0.795)
$ROA_{i,t}$	0.045***	−0.007***
	(6.147)	(−3.297)
$Age_{i,t}$	−0.039	−0.024*
	(−0.838)	(−1.898)
$Cash_{i,t}$	−0.003	−0.000
	(−1.157)	(−0.036)
$Growth_{i,t}$	−0.001	0.001*
	(−0.758)	(1.733)
$Analyst_{i,t}$	0.210***	0.027**
	(6.262)	(2.484)
$Ins_{i,t}$	0.004**	0.001*
	(2.297)	(1.802)
$TobinQ_{i,t}$	−0.074*	0.006
	(−1.779)	(0.649)
Constant	8.340***	0.297
	(9.699)	(1.341)
Observations	1984	1984
Adjusted R2	0.215	0.040
F	29.060	8.193

This table reports results of the effect of customer concentration on R&D investment at different stages of the R&D process. Column (1) presents results for the research stage; column (2) presents results for the development stage. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.5. Robustness tests

To verify the robustness of our findings, we replace the measurement of key variables in our model and re-examine the relationship between customer concentration and R&D investment. The results are presented in Table 11.

First, we replace customer concentration measures. Following Patatoukas (2012), to reduce the potential measurement error of our proxy variables, we measure customer concentration (*HHIConcentration*) with the customer sales-based Herfindahl-Hirschman Index. The regression results are presented in Column (1) of Table 11. The results remain consistent. Next, rather than using the raw values of customer concentration measures (*Concentration*), we use their decile rank transformations (*DeConcentration*). Firms are ranked annually in different industries and assigned to deciles based on *Concentration*. Therefore, the raw values of *Concentration* are replaced by the corresponding annual decile ranks (*DeConcentration*).

We also replace the dependent variable R&D investment with *R_RD* or *RE_RD*. *R_RD* is the ratio of a firm's R&D investment over its sales, while *RE_RD* is the ratio of a firm's R&D investment over its equity. The regression results are presented in Columns (3) and (4). The results hold.

Table 10
Customer concentration and R&D output.

Dependent Variable=	$Patent_{t+2}$ (1)	$Patent_{t+3}$ (2)
$Concentration_{i,t}$	−0.009***	−0.009**
	(−3.169)	(−2.326)
$Size_{i,t}$	0.434***	0.342***
	(6.813)	(4.139)
$Lev_{i,t}$	0.003	0.003
	(0.964)	(0.609)
$ROA_{i,t}$	0.018	0.008
	(1.520)	(0.483)
$Age_{i,t}$	−0.032	−0.094
	(−0.423)	(−0.787)
$Cash_{i,t}$	−0.002	−0.002
	(−0.547)	(−0.309)
$Growth_{i,t}$	0.003	0.001
	(1.462)	(0.312)
$Analyst_{i,t}$	0.001	0.001
	(0.473)	(0.214)
$Ins_{i,t}$	0.016	−0.046
	(0.238)	(−0.486)
$TobinQ_{i,t}$	0.176***	0.234***
	(3.472)	(3.067)
Constant	−8.349***	−5.294***
	(−5.520)	(−2.920)
Observations	710	383
Adjusted R2	0.375	0.342
F	19.76	14.33

This table reports results of the effect of customer concentration on R&D output. We use the number of patent applications to measure R&D output. *Patent* is the natural logarithm of one plus the number of patent applications. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

5. Conclusion

We examine the effect of customer concentration on firms' R&D investment. We document that a concentrated customer base restricts firms' internal financing and thus constrains its R&D investment. A 1% increase in customer concentration is associated with a 0.011% decrease in R&D investment. To establish causality, we use the instrumental variable method, the reverse causality model, and the Granger causality test to re-examine the relationship and obtain consistent results. However, this relationship is less pronounced for firms with more external financial support. Furthermore, the negative effect of customer concentration is more pronounced for the early stages of R&D. We also provide evidence that customer concentration constrains R&D output. Overall, our paper reveals the dark side of close customer-supplier relationships from the perspective of innovation. We extend the traditional risk view of customer concentration (Banerjee et al., 2008; Campello and Gao, 2017; Dhaliwal et al., 2016) to the real effect view (Chu et al., forthcoming).

We focus on manufacturing enterprises' innovation behaviors. Based on the unique supply chain relationship in the manufacturing industry, we identify the mechanism that influences firms' innovation behaviors, thereby enriching the literature on customer concentration risk in the supply chain field. Moreover, we contribute to research on the determinants of innovation behavior. Overall, our findings should help firms and investors better understand the influence of downstream businesses and thus optimize their strategies.

Table 11
Robustness tests.

Dependent Variable=	$RD_{i,t}$		$R\_RD_{i,t}$	$RE\_RD_{i,t}$
	(1)	(2)	(3)	(4)
$HHIConcentration_{i,t}$	−0.0003***			
	(−5.336)			
$DeConcentration_{i,t}$		−0.054***		
		(−5.068)		
$Concentration_{i,t}$			−0.013***	−0.022***
			(−5.389)	(−4.844)
$Size_{i,t}$	−0.340***	−0.309***	−0.180***	−0.613***
	(−6.930)	(−8.068)	(−3.431)	(−6.062)
$Lev_{i,t}$	0.001	−0.001	−0.012***	0.080***
	(0.262)	(−0.611)	(−4.147)	(12.880)
$ROA_{i,t}$	0.034***	0.036***	−0.016	0.143***
	(3.451)	(4.783)	(−1.555)	(6.759)
$Age_{i,t}$	0.021	−0.055	−0.358***	−0.042
	(0.347)	(−1.170)	(−4.699)	(−0.394)
$Cash_{i,t}$	−0.005	−0.003	−0.005	−0.010
	(−1.355)	(−0.866)	(−1.316)	(−1.314)
$Growth_{i,t}$	−0.001	−0.000	−0.002	−0.002
	(−0.710)	(−0.450)	(−1.177)	(−0.845)
$Analyst_{i,t}$	0.304***	0.235***	0.222***	0.327***
	(6.771)	(6.778)	(4.574)	(3.653)
$Ins_{i,t}$	0.003	0.005***	−0.000	0.013***
	(1.343)	(2.745)	(−0.075)	(3.059)
$TobinQ_{i,t}$	−0.041	−0.058	0.081	−0.133
	(−0.769)	(−1.359)	(1.313)	(−1.487)
Constant	8.103***	8.360***	7.641***	13.556***
	(7.096)	(9.296)	(6.232)	(6.186)
Observations	1278	1984	1984	1984
Adjusted R2	0.212	0.228	0.299	0.241
F	21.290	32.770	41.920	29.930

This table reports results from OLS regressions relating R&D investment to customer concentration and control variables. We replace the previous customer concentration measure, $Concentration_{i,t}$, with $HHIConcentration_{i,t}$ and $DeConcentration_{i,t.}$ $HHIConcentration_{i,t}$ is the customer sales-based Herfindahl-Hirschman Index. $DeConcentration_{i,t}$ is the decile rank transformations of $Concentration_{i,t}$ in the same 2-digit CSRC industry and the same year. Continuous variables are winsorized at their 1st and 99th percentiles. Robust t-statistics are in parentheses. See Appendix A for definitions of all variables. The superscripts ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Appendix A. Variable definitions

Variable	Definition
RD	Ratio of R&D investment over the total assets at the end of the year
Concentration	Ratio of sales to top-five customers over total sales
Credit	An indicator variable equal to 1 if ratio of the difference between accounts payable and prepaid over the total assets in the previous year is higher than the median value in the same 2-digit CSRC industry and year; equal to 0 otherwise
Equity	An indicator variable equal to 1 if ratio of the equity financing cash flow over total assets in the previous year is higher than the median value in the same 2-digit CSRC industry and year; equal to 0 otherwise

Debt	An indicator variable equal to 1 if ratio of the debt financing cash flow over total assets in the previous year is higher than the median value in the same 2-digit CSRC industry and year; equal to 0 otherwise
Market	An indicator variable equal to 1 if the financial development index of place of incorporation is higher than the median value in the same year; equal to 0 otherwise. The financial development index is from Wang et al. (2017)
Tech	An indicator variable equal to 1 if the firm belongs to the high-tech industry classification in manufacturing industry; equal to 0 otherwise. The high-tech industry classification is prepared by the State Statistics Bureau, specifically including pharmaceutical manufacturing, aviation, spacecraft equipment manufacturing, electronics and communications equipment manufacturing, computer and office equipment manufacturing, medical equipment and instrumentation manufacturing and information chemicals manufacturing
SOE	An indicator variable equal to 1 if the firm is ultimately controlled by government and equal to 0 otherwise
AR	Ratio of accounts receivable over the total assets at the end of the year
TurnPeriod	365 days, scaled by turnover of accounts receivable
PM	The difference of sales and operating costs, scaled by sales
OCF	Net operating cash flow, scaled by total assets
Size	Natural logarithm of year-end total assets at the end of the year
Lev	Ratio of total liabilities over the total assets at the end of the year
Age	Natural logarithm of one plus the number of years a company has been listed
ROA	Ratio of net income over the total assets at the end of the year
Cash	Ratio of cash, short-term investment, and trading financial assets over the total assets at the end of the year
Growth	Annual percentage sales growth of the firm
Analyst	Natural logarithm of one plus the number of analysts following the company
TobinQ	The sum of the book value of total debts and market value of shareholder equity over the total assets at the end of the year
Ins	The institutional ownership in the firm
Export	An indicator variable equal to 1 if the firm is exporting and equal to 0 otherwise
Herfindal	Herfindal Index of revenues in the 2-digit CSRC industry
Foreign	The foreign institutional ownership of the firm

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