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1 **Management Earnings Forecast and Technical Innovation: The Mediating Effects of Cost**
2 **of Debt**

3 **Abstract**

4 **Purpose** - This study examines whether a firm's management earnings forecasts affect its
5 technical innovation activities. Our study also examines whether the cost of debt plays a
6 mediating role between the management earnings forecasts and the innovation nexus.

7 **Design/methodology/approach** We obtained data from 1032 Chinese non-financial firms listed
8 on the Shanghai and Shenzhen stock markets from 2005 to 2022 (i.e., 18576 firm-year
9 observations). We used various econometrics techniques, such as Heckman's (1979) two-stage
10 selection method and two-stage least square, to examine the relationship between management
11 earnings forecasts and the firm's technical innovation activities.

12 **Findings** - We find a positive relationship between management earnings forecasts and the firms'
13 technical innovation. We also find that the cost of debt mediates the relationship between
14 management earnings forecast and technical innovation. Further analysis indicates that frequent
15 earnings forecasts provide incremental information regarding a firm's future value and cash
16 flows, thus reducing the volatility and uncertainty in cash flow calculations. Our findings are
17 robust to several tests.

18 **Research Implications** - Our study has implications for policymakers, practitioners, and high-
19 level management of Chinese firms, enabling them to understand the relationship between
20 management earnings forecasts and firms' innovation activities.

21 **Keywords:** Management Earnings Forecasts, Firm's Technical Innovation Activities, Cost of
22 Debt, Mediation Effect, Information Asymmetry implications for policymakers, practitioners,
23 and high-level management of Chinese firms,

24 **1. Introduction**

25 In recent years, intense competition has led to increased innovativeness among firms
26 (Bena & Li, 2014; S.-S. Chen, Huang, Hwang, Wang, & Accounting, 2019). Previous studies
27 highlight that innovation enables a firm to gain a competitive advantage by creating novel
28 products or services desired by customers (Jia, 2019; Ren, Huang, Liu, & Yan, 2023; Van de
29 Ven, 1986). Innovative-friendly firms are mindful of short-term outside pressure (Ederer &
30 Manso, 2011) and try to manage market participants' expectations through management earnings
31 forecasts (Choi, Myers, Zang, & Ziebart, 2011; H. J. Huang, Habib, Sun, Liu, & Guo, 2021).

32 Management earnings forecasts communicate comprehensive information about the firm's
33 essential features that control the value-generating process, particularly the firm's future cash
34 flows (Dutta & Gigler, 2002). The key motivation for disclosing firms' information is to reduce
35 asymmetric information (Gong, Xia, Xia, & Wang, 2023; Rakow, 2010) and provide
36 transparency in the innovative process (Brown & Martinsson, 2019; Zhong, 2018). Hence, a
37 firm's higher commitment toward frequent forward-looking earnings forecasts reflects the
38 managers' aptitude to close the information gap between managers and outsiders (Abdelazim,
39 Metwally, & Aly, 2023).

40 Extant literature suggests the need for firms to communicate with market participants and
41 maintain a transparent environment through frequent disclosure of information as it directly
42 impacts the cost of capital and is a key source of input into innovation activities (Alhaddad,
43 Whittington, & Gerged, 2021; Stephen P Baginski & Rakow, 2012; Cao, Myers, Tsang, & Yang,
44 2017; Rakow, 2010). Previous studies suggest that disclosing firm-specific information will
45 mitigate information asymmetry (R. Salem, Ezeani, & Song, 2023; R. I. A. Salem, Ezeani,
46 Gerged, Usman, & Alqatamin, 2021) and uncertainty among investors (Darrough & Stoughton,

47 1990). However, the proprietary cost (Jia, 2019), litigation costs (Yamada, 2016), and the
48 possibility of eroding firms' competitive advantage imply that it is not always beneficial for
49 managers to provide frequent earnings forecasts. This study examines whether frequent
50 management earnings forecasts affect the firm's research and development (R&D) expenditure
51 (i.e., technical innovation activities). It also investigates the mediating effects of the cost of debt
52 in the relationship between management earnings forecast and technical innovation. Our study is
53 important due to China's unique institutional environment (Komal, Ezeani, Shahzad, Usman, &
54 Sun, 2021; Komal, Ezeani, et al., 2023) and the mandatory earnings forecast requirements, which
55 deviate from the voluntary approach used in most developed countries.

56 We are motivated to undertake this study for the following reasons. Firstly, consistent with
57 the signaling and agency theory, studies suggest that management earnings forecasts will
58 mitigate information asymmetry (Dutta & Gigler, 2002; Hsieh, Song, Wang, & Wang, 2019;
59 Preussner & Aschauer, 2022). However, the existing studies have focused on voluntary forecasts
60 (Jog & McConomy, 2003; Waymire, 1986). Previous studies have ignored the impact of
61 management earnings forecasts on firm innovation. Also, no study have considered the
62 mediating effect of the cost of debt on the relationship between management earnings forecasts
63 and firm innovation.

64 Secondly, studies show that corporate innovation is generally costly (Bouncken & Kraus,
65 2013; Tian & Wang, 2014). However, it is well documented that management earnings forecasts
66 influence the cost of capital (Stephen P Baginski & Rakow, 2012; Cao et al., 2017; Rakow,
67 2010; K. T. Wang & Zhu, 2023), thereby reducing the cost of firms exploration. Hsieh et al.
68 (2019) proved that management earnings forecasts could help firms assess favourable bank loan

69 contract terms. However, no study to date has examined the mediating effect of the cost of debt
70 on the management earnings forecasts and the firm's technical innovation activities nexus.

71 Finally, China provides a unique context for examining the relationship between
72 management earnings forecasts and firm innovation. The country has the largest economy among
73 the world's emerging markets, and its capital market is rapidly improving. Also, the Chinese
74 government's growing efforts to increase investment probabilities (Ren et al., 2023) have led to
75 firms' innovative efforts. Previous studies overwhelmingly document voluntary disclosure's
76 relevance in reducing information asymmetry (Al-Bassam, Ntim, Opong, & Downs, 2018; Md
77 Zaini, Samkin, Sharma, & Davey, 2018; Ntim, Opong, Danbolt, & Thomas, 2012; R. Salem et
78 al., 2023; R. I. A. Salem et al., 2021; Tan, Komal, Ezeani, Usman, & Salem, 2022). However,
79 China has a mandatory approach to management earnings forecasts (Xiaobei Huang, Li, Tse, &
80 Tucker, 2018; Y. Wang, Chen, & Wang, 2015) and a unique institutional environment with type
81 two agency conflict (Komal, Bilal, et al., 2023; Komal et al., 2021; Tan et al., 2022). The
82 mandatory approach to earnings forecasts and the unique business environment makes it
83 interesting to examine the relationship between management earnings forecasts and corporate
84 innovation in China.

85 Therefore, using a sample of 1,032 non-financial firms listed on the Shanghai and
86 Shenzhen stock markets from 2005 to 2022, this study examines whether a firm's management
87 earnings forecasts affect its technical innovation activities. Our study also examines whether the
88 cost of debt plays a mediating role between the management earnings forecasts and the
89 innovation nexus. We find a positive relationship between frequent management earnings
90 forecasts and a firm's technical innovation activities, suggesting that frequent earnings forecasts
91 enable firms to invest in potential R&D projects. We show that management earnings forecasts

92 improve innovation by decreasing information asymmetry. Also, we find that the cost of debt
93 mediates the relationship between management earnings forecasts and technical innovation.

94 Our study contributes to previous literature in the following ways: firstly, previous studies
95 focused on the impact of voluntary management forecasts on various organisation outcomes
96 (Gramlich & Sørensen, 2004; Jog & McConomy, 2003; Kim, Shroff, Vyas, & Wittenberg-
97 Moerman, 2018), we contribute to this area of study by focusing on management earnings
98 forecasts in China, which is mainly mandatory. Secondly, we contribute to the literature by
99 documenting novel evidence on the mediating role of the cost of debt in the relationship between
100 management earnings forecast and technical innovation. Thirdly, the signaling theory suggests
101 the impact of disclosure in mitigating the information gap between insiders and firm outsiders
102 (Spence, 1978). Consistent with the signaling theory, we demonstrate that the frequency of
103 management earnings forecasts positively impacts corporate innovation.

104 The remaining study is arranged as follows. Section 2 includes the Institutional
105 background, Section 3 covers the literature review and hypothesis development, Section 4
106 describes the data sample, measurement of variables, experimental research design, and
107 empirical analysis, and Section 5 presents the empirical result of this study. Lastly, section 6
108 reveals the study's conclusions, limitations, and future directions.

109 **2. Institutional background**

110 In most Western countries, firms are expected to voluntarily provide earnings forecasts
111 (Gramlich & Sørensen, 2004; Jog & McConomy, 2003). Studies suggest that a voluntary
112 approach to earnings forecasts may result in bias and not fully reflect management information
113 (McConomy, 1998; McNichols, 1989).

114 As an emerging economy, China has not adopted the voluntary disclosure of earnings forecasts
115 prevalent in the West. Before 1998, it was not common for Chinese firms to forecast their
116 earnings before the required report date. However, Chinese regulators introduced mandatory
117 earnings forecasts in 2001 to reduce the information gap. According to the China Securities
118 Regulation Commission (CSRC), if a listed firm's financial efficiency and deviation reach a
119 specific threshold, they must publicly disclose their earnings forecasts (Xiaobei Huang et al.,
120 2018). Publicly listed firms in China must issue earnings forecasts for the fiscal year if the
121 manager anticipates their earnings will increase or reduce by at least 50% in the prior year. As all
122 the Chinese firms end their fiscal year on 31st December, the forecasts must be issued by 31st
123 January. An additional layer of mandatory earnings forecast was added in 2004 and required
124 firms to disclose the anticipated profit of the current year following a loss in the previous year.

125 From 1998 to 2006, management earnings forecast requirements passed through several
126 significant modifications and revisions, which suggest the vital influence in China. Also, the
127 stock exchange supported the mandatory approach to earnings forecasts advocated by the CSRC
128 by providing forms that enhance forecast release standardization. It also mandates an update on
129 the earnings forecast previously issued by firms if there are changes in circumstances. For
130 instance, the stock exchange demands another update if the new estimate shows a significant
131 difference (more than 50%) from the previous year's estimate. Also, firms are likely to be
132 publicly denounced for inaccurate earnings forecasts. In certain circumstances, the firm may be
133 required to restore the trust of investors by offering an apology through the national newspaper.

134 Previous studies in Chinese context highlight the benefits of the mandatory approach to earnings
135 forecast used in China (Xiaobei Huang et al., 2018; Y. Wang et al., 2015). For instance, Xiaobei
136 Huang et al. (2018) argue that mandatory forecasts' information content is superior to voluntary

137 earnings forecasts. They also suggest that mandating firms to forecast earnings will increase the
138 chances of future voluntary earnings forecasts since firms are accustomed to providing valuable
139 information. Similarly, Y. Wang et al. (2015) argue that forced earnings forecast increases the
140 likelihood of more timely information that mitigates asymmetric information in the capital
141 market. Dai, Parwada, and Zhang (2015) report that Chinese firms provide miscellaneous
142 information through management earnings forecasts, which help to decrease the information risk
143 between managers and market participants. Thus, market participants consider them an essential
144 document for the securities market in the country.

145 Prior studies have shown that a rigorous approach to management earnings forecasts encourages
146 managers to meet investor expectations regarding firms' performance, mitigate mispricing, and
147 reduce short-term behaviour (Choi et al., 2011; Kasznik & Lev, 1995). Mandatory earnings
148 forecasts also provide an incremental measure to the investor to assess how the managers
149 enhance the monitoring mechanism (Bens & Monahan, 2004; O. Z. LI & Zhuang, 2012). Hence,
150 examining the association between management earnings forecast and technical innovation in
151 Chinese firms would be interesting.

152 **3. Theoretical framework**

153

154 Studies suggest that firms managers and outsiders are at risk of information gaps due to
155 the complexity of innovative projects (March, 1991; Tian & Wang, 2014), making it difficult for
156 stakeholders to assess the benefits of innovation (Petkova, 2006; Zhong, 2018). Previous studies
157 suggest corporate transparency mitigates asymmetric information (Brown & Martinsson, 2019;
158 Elghuweel, Ntim, Opong, & Avison, 2017; D. Huang, Liu, Chan, & Chen, 2023). D. Huang et al.
159 (2023) argue that the mandatory and frequent disclosure of value-relevant firm-specific

160 information is the most effective way to reduce asymmetric information associated with
161 innovation.

162 Management earnings forecasts enable firms to open up credible communication
163 channels with market participants and maintain a good information environment, enabling firms
164 to mitigate asymmetric information (Preussner & Aschauer, 2022). In line with the signalling
165 theory (Spence, 1973), the credibility of disclosure and its relevance in reducing asymmetric
166 information may be influenced by the frequency of the signal sent (Ajinkya & Gift, 1984;
167 Gonedes, Dopuch, & Penman, 1976; Maslar, Serfling, & Shaikh, 2021). Extant literature
168 suggests numerous benefits of management earnings forecasts. For instance, Stephen P Baginski
169 and Rakow (2012) and Cao et al. (2017) suggest that management earnings forecasts will likely
170 reduce the cost of financing innovation projects, thereby boosting firms' technical innovation
171 activities. Verrecchia (2001) argues that minimising the information gap between firms and
172 investors will increase liquidity and enable firms to reduce the cost of external finance.

173 The literature highlights the consequences and costs of public disclosure of firm-specific
174 information (Berger & Hann, 2007; Leuz & Verrecchia, 2000; Yamada, 2016). Leuz and
175 Verrecchia (2000) highlight the proprietary cost of disclosing firms-specific information.
176 (Darrough & Stoughton, 1990) emphasize the importance of considering competition costs
177 relating to disclosure. Firms may erode their competitive edge by publicly disclosing the
178 estimation of future income relating to innovation efforts (Berger & Hann, 2007; Leuz &
179 Verrecchia, 2000; Yamada, 2016). Providing valuable firm-specific information may facilitate
180 competitors' exit or entry decisions (Jia, 2019). This view implies that managers of innovative
181 firms should conduct a cost-benefit analysis before disclosing firm-specific information.

182 From the agency theory perspective, studies suggest that improving firms' information
183 environment through frequent management earnings forecasts helps resolve agency conflicts. In
184 line with the agency theory of free cash flow (Jensen, 1986), the improved information
185 environment resulting from frequent forecasts will enhance board monitoring. Therefore, the
186 possibility of board monitoring may increase self-interested managers' reluctance to provide
187 frequent earnings forecasts.

188 **4. Empirical Literature Review and Hypothesis**

189 **4.1 Management Earnings Forecasts and the Firm's Technical Innovation**

190 The relationship between technical innovation and management earnings forecasts is still
191 unclear. On the one hand, previous studies suggest that proprietary and competition costs may
192 deter a firm from disclosing firm-specific information (D. Huang et al., 2023; Jia, 2019; Zhong,
193 2018). In this case, the public disclosure of the estimation of future income relating to innovation
194 efforts may reduce a firm's competitive advantage by facilitating competitors' exit or entry
195 decisions. Constant provision of management earnings forecasts is likely to increase the risk of
196 imitation and unwarranted competition (D. Huang et al., 2023). Y. Wang et al. (2015) and
197 (Yamada, 2016) suggest that earnings management forecast is associated with litigation risks. In
198 China, the regulator also closely monitors the format and content of the management forecasts
199 (Xiaobei Huang et al., 2018). Therefore, managers of innovative firms may show conservatism
200 towards providing earnings estimates, especially when the content of such disclosure matters to
201 the regulators. Ali, Klasa, and Yeung (2014) document an inverse relationship between
202 proprietary costs and voluntary disclosure.

203 On the other hand, due to the capital-intensive nature of technical innovation (D. Huang
204 et al., 2023) and the need to fund innovative projects over a longer period, managers are likely to
205 report frequent earnings estimates to reduce the cost of innovation. Also, since firms engaging in
206 technical innovation have a higher knowledge and information gap with their stakeholders
207 (Zhong, 2018), frequent management forecasts may be relevant to keep the investors on board
208 and reduce the information gap. D. Huang et al. (2023) suggest that outsiders are likely to benefit
209 from the credibility of the mandatory management earnings forecast. It is also the case that each
210 milestone in the innovative process represents 'a small win' for the firm. Penman (1980) argues
211 that firms with 'good news' are more likely to disclose private firm-level information. Therefore,
212 we expect that firms with technical innovation will increase their management earnings forecasts
213 and propose the following hypothesis.

214 H1: Management earnings forecasts have a positive effect on technical innovation activities

215 **4.2 Management Earnings Forecasts, the Firm's Technical Innovation and the Cost of** 216 **debt**

217 Prior studies have examined the increasing effects of disclosure practices on a firm's cost
218 of capital (Cao et al., 2017; Rakow, 2010). For instance, using overall corporate disclosure
219 measures, Lang and Lundholm (1996) showed that a higher level of disclosure was related to a
220 more significant analyst following enhanced market expectation accuracy and lower information
221 asymmetry. Their results suggested that high-quality disclosure led to a lower cost of capital.
222 Similarly, using a disclosure level self-constructed measure, Botosan (1997) found a negative
223 relationship between disclosure level and the firm's cost of capital. Stephen P. Baginski and
224 Hinson (2016) documented that the increase in management earnings forecast frequency,
225 followed by forecast initiation, was related to a decrease in the firm's cost of equity capital. Since

226 the management earnings forecasts provide a projection of the firm's future cash flow to repay its
227 debt obligations, they can assist creditors by communicating essential forward-looking details of
228 a firm that help reduce the cost of debt. The lower cost of debt could help firms manage their
229 expected free cash flows and increase investment in potential R&D innovation projects. Thus,
230 we conjecture an inverse relationship between the management earnings forecast and the cost of
231 debt.

232 In line with the agency theory, frequent management earnings forecasts will improve the
233 corporate governance of innovative firms. Consistent with the agency theory of free cash flow,
234 previous studies find that a good corporate governance environment will increase the monitoring
235 effect of debt (Elghuweel et al., 2017; Ezeani, Kwabi, et al., 2023; Ezeani et al., 2022; Morellec,
236 Nikolov, & Schürhoff, 2012). Also, Since innovative projects are capital-intensive and funded
237 over an extensive period, Hall and Lerner (2010) suggest that using debt for R&D projects may
238 be costly. They suggest lenders may be unwilling to finance firms with quality R&D projects due
239 to the information asymmetry problem. In contrast, Nanda and Nicholas (2014) showed that debt
240 is a vital financing choice for a firm's innovation activities. We suggest that self-interested
241 managers may refrain from frequent management earnings forecasts to evade the monitoring
242 effect of debt and formulate the following hypothesis.

243 H2: Cost of debt has a mediating impact between management earnings forecasts and firm's
244 technical innovation activities.

245 **Insert Figure 1 here**

246

247 **5. Data and Research Design**

248 **5.1 Data**

249 We collected listed firm's management earnings forecasts data from Wind database, while
250 the related financial indicators data and corporate governance indicators data from China Stock
251 Market & Accounting Research Database (CSMAR) database over the period 2005-2022. Our
252 study sample includes different industry sectors based on the China classification of national
253 economy industries-GB/T4754-2002. Our initial sample consists of 1,223 firms (22,008 firm-
254 year observations) obtained from the China Stock Market & Accounting Research Database
255 (CSMAR) and Wind database between 2005-2022. Following the prior research (Zhong 2018;
256 Jiang, Habib, and Gong 2015; Pittman and Fortin 2004; Jia, 2019; Qin and Zhang 2019), we
257 removed 191 firms from regulated industries and those with missing data or incomplete
258 information. We exclude the financial services, real estate, and insurance-related industries. We
259 also excluded 38 firms for which we cannot obtain management earnings forecasts from the
260 Wind/CSMAR database. We remove 39 firms which have insufficient information to construct
261 the cost of debt proxy. We exclude 42 firms with insufficient information to construct innovation
262 activities variables. Finally, we remove 71 firms that lack sufficient data to compute the control
263 variables. Our final sample is 1032 firms (18,576 firm-year observation). Panel A of Table I
264 shows the sample selection process, while Panel B of Table I explains the deletion of insufficient
265 data from the selected sample size.

266 All the management earnings forecasts data are firm-yearly and all the R&D activities,
267 cost of debt, and other proxies are taken from annual report of the company. For the technical
268 innovation activities data, we removed implementation observations that have been discontinued.
269 Therefore, we eliminated financial firms' observations and observations of firms that have been
270 treated differently and other inaccurate observations (Ezeani, Salem, Usman, & Kwabi, 2023;

271 Komal et al., 2021). For the earnings forecasts and other variables data; this study filtered the
272 sample using the following conditions to attain the final selection set: (1) Special treated and
273 newly listed firms were removed from the dataset. (2) Missing value observations and abnormal
274 data were dropped from the dataset. (3) Real estate, financial, and insurance firms were removed
275 from the study dataset. (4) To control any impact of outliers, entire perpetual variables were
276 winsorized at 01 percent to 99th percent. 5) Focused on A-share firms because the effect of
277 realized cost of debt of these firms is more significant in the capital market settings, and the A-
278 share financial information environment is different from that of the Band H-share firm¹.
279 Additionally, we exclude ambiguous observations, financial firms' observations and special
280 treated firms' observations.

281 Our dependent variable is the firms' technical innovation activities (TIA), demonstrating
282 the firm's innovation intensity. Prior studies used different proxies to estimate the firm's
283 innovation (Griliches, 2007; Hall, Mairesse, & Mohnen, 2010). Knott and Vieregger (2019)
284 assessed three typical innovation proxies in recent times. They contended that the research
285 quotient is the only proxy that fulfils the condition for the R&D productivity construct in
286 Romer's Theory (Romer, 1990). However, the main focus of our study is on the innovation
287 intent; thus, we follow Zhong (2018) and measure innovation as the firms' R&D spending scaled
288 by the entire operating revenue during the year.

289 In this study, we used management earnings forecasts (MEFs) as the independent
290 variable of primary interest. MEFs are commonly provided through a variety of channels,
291 including media releases, analyst interviews, and telephone conferences (F. Li, 2010) and their
292 information is effectively communicated to end users (Chen, Huang, Hwang, & Wang, 2019).

¹Chen et al. (2007) document that A-shares are traded in Yuan (Renimbi) and owned by individual and legal persons of the China, whereas B- and H-shares are exchange in foreign money and offered to foreign nations including Hong Kong, Macau, and Taiwan citizens only.

293 Following Jiang, Habib, and Gong (2015), this study estimated management earnings forecasts
294 as the firm's earnings forecast quantity during a financial year. The MEFs were used to test the
295 study hypotheses that capture the firms' precise information on future incomes relating to
296 accounting basics used to hold the firm's value-generating practices, particularly the firm's free
297 cash flow.

298 Our study used one mediating variable, namely the Cost of Debt (COD), to investigate
299 the firm's COD effect on the association between management earnings forecasts and TIA (see
300 Figure I). Following previous studies, including Pittman and Fortin (2004), this study estimated
301 COD as the interest cost of a firm divided by total debt (non-current obligations due during one
302 year, short- and long-run debts, bond payables, and accounts payable) of the firm "i" and year
303 "t." Our study expects that the firms' MEFs and COD are negatively associated.

304 Following previous studies (Jia, 2019; Qin and Zhang, 2019 (Owusu, Kwabi, Ezeani, &
305 Owusu-Mensah, 2022), the present study used control variables that might confound the
306 relationship among MEFs, TIA, and the COD. The control variables included bank loan access
307 (ABL), leverage (LEV), firm size (FS), firm's age (FA), profitability (ROA), state-owned
308 enterprise (SOE), cash flow from operations (CFO), the book value to market (BTM), big four
309 auditors (B4A), growth opportunity (GRO), Tobin's Q (TQ), loss in net income (LOSS), industry
310 and year effects. Also, following previous studies (Kwabi, Owusu, Ezeani, & Boateng, 2024;
311 Obenpong Kwabi, Owusu-Manu, Boateng, Ezeani, & Du, 2022) politically connected firm
312 (PCF).

313 The ABL was calculated as equivalent to "1" when firms access bank loans and "0" for
314 others. The LEV was calculated as the debt of the firms relating to the sum of debt in a year
315 scaled by assets in total (Usman et al., 2023). The FS is determined as the natural logarithm of

316 assets in total (Usman, Ezeani, Salem, & Song, 2022). Extant literature documents that FA is an
317 essential variable influencing innovation activity. The FA was estimated as the years between the
318 firm's annual financial reports and initial public offerings.

319 The ROA is the firm's profitability, estimated as the net earnings scaled by the total firm
320 assets. The SOE was calculated as if a non-financial firm was controlled by the state or
321 government, with one and zero values. The BTM was determined by the equity market worth
322 plus the sum of the asset book worthless, the equity book value, and deferred taxes (adjusted to
323 "0" when lost) scaled by the firm's entire asset book value. The B4A equaled one if an audit
324 report was issued in a year and zero otherwise. The PCF was equivalent to "1" if firms' officials,
325 including the manager, general manager, or real controller, had a political link with government
326 officials linked with political consultative meetings or national people congress duties at a
327 country level or above "0" otherwise. The CFO was measured as cash flow scaled by assets in
328 total in a year. The GRO was sales growth estimated as the disparity with the existing year's
329 sales plus the preceding year's sales divided by the prior sales. The TQ was calculated as the
330 equity market worth plus the firm's obligations book worth divided by the firm's total assets. A
331 firm's earnings are less substantial for the firm's loss, and the financial expectation of achieving
332 or striking the goals is less vital for the said firms. Thus, following a study like Jia (2019), this
333 study included LOSS estimated as one for the firms whose net income was negative and zeroed
334 otherwise to report a substantial loss in the previous period. Finally, this study includes year and
335 sector dummy variables to identify the invariable period, industry heterogeneity, and period
336 trends. The descriptive information of the sample selection procedure is presented in Table I.

337 **Insert Table I here**

338 5.2 Research Design

339 We first examined the effects of a firm's management earnings forecasts on technical
340 innovation activities (in model 1). Secondly, we examined whether the cost of debt plays a
341 mediating role in the relationship between management earnings forecasts and innovation (see
342 models 2 and 3). We used fixed effects regression to test the effect of management earnings
343 forecasts on technical innovation activities and the mediating effect of the cost of debt. We also
344 controlled for self-selection and endogeneity problems using Heckman's (1979) two-step
345 selection method and two-stage least square analysis. In the first step, we use a probit regression
346 model containing instrumental variable(s) that predict the independent variable but do not
347 directly expect the dependent variable. We computed the inverse Mills ratio in the first stage and
348 incorporated it in the second step to avoid self-selection bias. Following Caramanis and Lennox
349 (2008), we also used a two-stage least square technique to address the endogeneity problem. In
350 the first stage of regression, we regress the endogenous variable on their lagged values (lagged
351 variable used as instrumental variable). We used these variables to predict the endogenous
352 variable in the next-stage. In the second stage, we incorporate the endogenous variable's
353 predicted value along with the exogenous variable in the regression equation. Then, we used
354 ordinary least squares (OLS) regression to determine the variables that are vital (coefficient) in
355 the equation. The coefficient obtained from the second stage regression have similar results to
356 the regression models of the study. Finally, Following Liu, Cullinan, Zhang, and Wang (2016);
357 Gul, Zhou, and Zhu (2013), we used a robustness test i.e., regression (fixed effect) as a strategic
358 approach in which the dependent variable proxy was replaced with an alternative proxy along
359 with lagged variables. The industry and year fixed effects are controlled for in all the regressions.

360 **5.1.1 Management Earnings Forecasts and Firms' Technical Innovation Activities**

361 H1 states that MEFs have a positive effect on TIA. It postulates that frequent MEFs
362 increase a firm's innovation activities to mitigate information asymmetry's innate issue in firms
363 involved in additional innovation activities. Hence, we estimated the following basic model
364 equation (1):

$$\begin{aligned} 365 \text{TIA}_{it} = & \alpha_0 + \beta_1 \text{MEF}_{it} + \beta_2 \text{ABL}_{it} + \beta_3 \text{LEV}_{it} + \beta_4 \text{FS}_{it} + \beta_5 \text{FA}_{it} + \beta_6 \text{ROA}_{i,t} + \beta_7 \text{SOE}_{i,t} + \\ 366 & \beta_8 \text{BTM}_{i,t} + \beta_9 \text{B4A}_{i,t} + \beta_{10} \text{PCF}_{i,t} + \beta_{11} \text{GRO}_{i,t} + \beta_{12} \text{CFO}_{i,t} + \beta_{13} \text{TQ}_{i,t} + \beta_{14} \text{LOSS}_{i,t} + \text{Ind. FE} + \\ 367 & \text{Yr. FE} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

368 The TIA was the dependent variable, measuring its innovation intensity, and the subscript
369 denotes the industry and year. The independent variable, MEFs, referred to earnings forecasts'
370 quantity for the firm in a particular year t. The remaining are the control variables described.

371 **5.1.2 Cost of Debt Mediation Effect between Management Earnings Forecasts and Firm's** 372 **Technical Innovation Activities.**

373 Next, we investigated how the lower (higher) COD alleviated (aggravated) the issue of
374 the cash flow of a firm because of the MEFs; in turn, the MEFs facilitate (impede) the TIA. We
375 used path analysis to examine the presence of an indirect direction and assess the significance of
376 the direct and indirect connection through MEFs to the TIA. The path study presents the
377 conclusive descriptions of correlation structures, as it decomposes or breaks down a correlation
378 between the variable of the source (causal) that is MEFs, and the outcome that is the TIA, into
379 paths such as a simple, direct, indirect, or compound path that contains a mediating variable
380 (COD). The decomposition suggests the occurrence and proportional significance of both direct
381 and indirect pathways between MEFs and the TIA. This study considered that the primary path
382 analysis was repeated, e.g., all paths' flows are in one direction and include observable variables.

383 The path study's main output was the route coefficient connecting the path coefficient signified
384 the correlation part decomposed to the pathway matching.

385 This study used the path coefficient ratio to estimate the mediation effect or direct
386 pathway's significance, i.e., the mediation pathway with additional parts to the entire association
387 between the MEFs and TIA. The importance of the direct and indirect paths increases due to the
388 rise of the ratio, and, within the background of this research, the mediation effect between MEFs
389 and the TIA was the path coefficient product between the MEFs and COD and the path
390 coefficient between the COD and the TIA. To examine the COD mediation effect on the
391 relationship between MEFs and TIA, this study used the three steps of performing the mediation
392 effect described by Baron and Kenny (1986) are as follows;

393 The study's mediator regressed on the independent variable in the first step. Then, the
394 dependent variable regressed on the independent variable. Lastly, the dependent variable was
395 regressed on the mediator and independent variable. These authors explained that the
396 independent variable was expected to exhibit statistical significance in the first two steps. The
397 mediator variable was supposed to show statistical significance in the third step, and the
398 independent variables were unimportant. However, Zhao, Lynch, and Chen (2010) showed that
399 the association linking an independent and dependent variable is insignificant because it can be
400 confusing. An indirect effect establishes the mediation effect because it is the indirect and direct
401 impacts (along with the mediator). Thus, the indirect effect should be significant. We used the
402 following model's equations, i.e., (2) and (3), to check the COD mediation effect.

$$403 \text{ } COD_{it} = \alpha_0 + \beta_1 MEF_{it} + \beta_2 ABL_{it} + \beta_3 LEV_{it} + \beta_4 FS_{it} + \beta_5 FA_{it} + \beta_6 ROA_{it} + \beta_7 SOE_{it} + \beta_8 BTM_{it} + \beta_9 B4A_{it} + \\ 404 \beta_{10} PCF_{it} + \beta_{11} GRO_{it} + \beta_{12} CFO_{it} + \beta_{13} TQ_{it} + \beta_{14} LOSS_{it} + Ind. FE + Yr. FE + \varepsilon_{i,t} \quad (2)$$

405

$$\begin{aligned}
406 \quad TIA_{it} = & \alpha_0 + \beta_1 MEF_{it} + \beta_2 COD_{it} + \beta_3 ABL_{it} + \beta_4 LEV_{it} + \beta_5 FS_{it} + \beta_6 FA_{it} + \beta_7 ROA_{it} + \beta_8 SOE_{it} + \beta_9 BTM_{it} + \\
407 \quad & \beta_{10} B4A_{it} + \beta_{11} PCF_{it} + \beta_{12} GRO_{it} + \beta_{13} CFO_{it} + \beta_{14} TQ_{it} + \beta_{15} LOSS_{it} + Ind. FE + Yr. FE + \varepsilon_{i,t} \quad (3)
\end{aligned}$$

408 The TIA was the dependent variable, measuring the firm's innovation intensity. The
409 MEFs were the independent variable measured as earnings forecast quantity in an "i" firm for a
410 "t" year. A firm's COD measure was used to mediate between the study's dependent and
411 independent variables. All the variables are labeled.

412 Considering the possible endogenous association of MEFs with the TIA, we used the
413 Two-Steps Selection Method (TSSM) and Two-Stage Least Square (TSLS) to manage self-
414 selection and endogeneity. TSSM is used to avoid possible self-selection bias arising from
415 endogenous earnings forecasts. In the first step of TSSM, a Probit Regression Model (PRM) was
416 used to foresee that firms involved in innovation intent would issue more MEFs to obtain more
417 external debt financing. When employing the continuous variable, a dummy dependent variable
418 was required to run in the PRM. Thus, we included a dummy variable during the first step of the
419 PRM. Also, the 1st step model of TSSM must consist of the instrumental variable(s) that predict
420 the independent variable (MEFs) but do not directly expect the dependent variable (TIA);
421 therefore, this study included instrumental variables in the PRM². Finally, the inverse Mills ratio
422 (IMR) was produced following the PRM³. The IMR was incorporated into the next step to avoid
423 self-selection bias from the empirical analysis. This study used the TSLS method to control
424 endogeneity and recognise the instrumental variables that realise the elimination constraint
425 related to the MEFs but not correlated with TIA. Hence, we used a lagged instrument approach

²Following O. Z. LI and Zhuang (2012), this study includes industry guidance as an instrumental variable obtained as the proportion of the issuing MEF of a firm in the same sector.

³The IMR is calculated by $\phi(z)/\Phi(z)$, whereas z present the proper index feature of PRM; ϕ present the function of density; and Φ is the regular normal distribution total density.

426 in the TSLS method⁴. Finally, to verify the study's robustness, our results employed the
427 alternative proxy of innovation⁵.

428 **6. Empirical Findings and Discussion**

429 **6.1 Descriptive Summary**

430 Table II represents the descriptive statistics of the management earnings forecasts' effects
431 on innovation activities and the mediating effect of the cost of debt in the relationship between
432 management earnings forecast and technical innovation. Similar to the findings of Zeng and Lin
433 (2011), we find that on average, each firm spends about 4% of the R&D expenditure per year on
434 its technical innovation activities. The mean (median) value of the MEF frequency was 0.68
435 (0.000), whereas the Chinese firms had an average COD of 7%. The control variables, for
436 example ROA, CFO, and LEV mean (median) values were 4% (0.04), 6% (0.06), and 43%
437 (0.43), respectively. However, the dataset also showed that 67% of the Chinese firms were
438 SOEs, suggesting that SOEs were the principal shareholders and played an essential role in
439 domestic firms (Khan, Kayani, Saleem, & Aysan, 2024; Zeng & Lin, 2011).

440 **Insert Table II here**

441 Pearson's correlation matrix results are shown in Table III among all study variables. The
442 primary variable of interest, MEF, was positive and significantly correlated to TIA. The

⁴ Due to a few causes, the second stage estimate provided important findings (Caramanis & Lennox, 2008). Primarily, the lagged values of TIA in the first stage was strongly related to the MEFs (p-value <0.001), suggesting that lagged MEFs could act as a robust instrument. Similarly, the next stage estimates were consistent when the instrumental variables were uncorrelated to residual error.

⁵ The patent (INNO) was used as the dependent variable to further verify the study robustness. This study followed recent studies Qin and Zhang (2019), the present study selected patent data rather than the citations of patents as the firm's innovation proxy. For various reasons, the patent citation data is unavailable in China. Hence, this study calculated innovation output measures, i.e., total patent, as the sum of the inventory, utility, and design patent. These three measures were used to compute the total patent as the natural logarithm and the inventory patents, plus the natural logarithm and utility patents, plus the natural logarithm and design patents. The intellectual property market the patents actively traded by firms to guarantee safe lending.

443 correlation between MEF and TIA was 0.246, suggesting that MEF positively affected its
444 technical innovation activities. The relationship between the MEFs and COD was also significant
445 and negatively correlated. The correlation between MEFs and COD was -0.1053, indicating that
446 MEFs were useful in decreasing the firm's COD. Furthermore, in this study, many variables were
447 significantly correlated in the expected direction; therefore, all variables captured a distributed
448 underlying construct. Most pair-wise variables connected considerably at the one percent mark in
449 the predicted order.

450 **Insert Table III here**

451 **6.2 Management earnings forecasts, technical innovation activities: mediated by the firm's** 452 **cost of debt**

453 Table IV presents the baseline regression results of the H1 and H2 tests. In Model (1), the
454 finding shows that the coefficient of MEFs has a positive relationship with TIA. This
455 relationship is significant in both models 1 and 3 suggesting that frequent MEFs positively affect
456 the firm's TIA. Thus, this finding supports our first hypothesis, H1. Consistent with the signaling
457 theory and previous literature, MEFs provide valuable information about a firm's necessary
458 records that capture the value-generating process, particularly future cash flow (Bhattacharya,
459 Ecker, Olsson, & Schipper, 2012). Besides, these frequent MEFs are also associated with
460 improved reporting quality and transparency and a better internal control system (Feng, Li, &
461 McVay, 2009) that provides decision-makers a better precision about possible returns from
462 uncertain endeavors (Bushman & Smith, 2001), which helps decision-makers to understand the
463 future innovation prospects with fewer errors to achieve higher technical innovation success. Our
464 results are economically significant as a unit increase in MEFs corresponds to a 1.28 increase in
465 TIA.

466 In Table IV, the findings of Model (2) and (3) shows that the coefficient between (MEFs
467 and COD) and (TIA and COD) were negatively significant ($\beta = -0.00183$ significant at 01
468 percent) and ($\beta = -0.0619$ significant at 01 percent) suggesting that creditors offer lower interest
469 rate loans to frequent and precise MEFs due to fewer information asymmetry problems. This
470 study estimated that the overall correlation between MEFs and TIA was 0.0011 ($p < 0.10$). The
471 direct and mediated pathways decomposed this association into the section featuring the direct
472 relationship between MEFs and TIA and the COD mediated as an indirect relationship. For both
473 parts, the path coefficient (i.e., MEF path to COD and COD path to TIA) was statistically
474 significant at 1%, suggesting a robust mediation effect of COD on the MEFs and TIA nexus.

475 Besides, the impact of the path coefficient between COD and TIA was negatively
476 significant, suggesting that creditors include MEFs to lower information asymmetry and would
477 likely charge a lower interest rate when the firms provide frequent MEFs (Hsieh et al., 2019).
478 Sequentially, the firm's COD alleviates free cash flow problems, which are used to spur the
479 firm's innovation activities. Overall, these findings support the H2 predictions.

480 Furthermore, the control variables result revealed that the firm's ABL, LEV, FA, PCF,
481 GRO, CFO, TQ, and B4A were positively related to TIA. While the FS, ROA, SOE, BTM, and
482 LOSS were negatively associated with TIA. We also found that higher innovation activities are
483 related to a firm's LEV, which was identical to a previous study, suggesting that the credit
484 market was reluctant to encourage innovation activities because innovative firms have an
485 unstable and inadequate amount of inside-generated cash flows to facilitate debt (Hsu, Tian, &
486 Xu, 2014). Furthermore, a big-size firm's growth potential shows more significant innovation
487 activities (Tian & Wang, 2014).

488

Insert Table IV here

489 **6.3 Two-Steps Selection Method (TSSM)**

490 A key issue related to the findings from this research was the possibility of self-selection
491 bias. Thus, we conducted TSSM to process this possible self-selection bias concern. In Table V,
492 the 1st step employed a PRM to predict MEF decision but did not relate to TIA. We used a
493 continuous independent variable, i.e., MEF frequency, to calculate the significance of MEFs on a
494 firm's innovation intensity; therefore, it followed Xuerong Huang and Sun (2017) to construct a
495 dummy variable (MEFD) to run the PRM. Our study also followed O. Z. LI and Zhuang (2012)
496 and included instrumental variable industry guidance (ING). It was estimated as the proportion
497 of earnings forecasts released by firms in the identical industry and selected control variables.
498 This study produced the IMR following the self-selection PRM, adding IMR to avoid possible
499 endogeneity in selecting MEFs. The findings of the TSSM suggested that IMR had a significant
500 coefficient in all models, i.e., models (1, 2, and 3), which captured TIA in model 1, the
501 dependent variable, and model 3 and the mediator variable as the dependent variable in model 2.
502 The coefficient of ING was favorable and significant in the 1st step (i.e., presented in Table V).
503 MEFs coefficient was positive and significantly related to the TIA. In contrast, the MEFs were
504 negative and significantly associated with the mediator variable COD, suggesting that this
505 study's conclusion still holds after correction for self-selection bias. Therefore, the results did not
506 have selection bias by the MEFs decision.

507

Insert Table V here

508 **6.4 Endogeneity**

509 To address endogeneity, we used the TSLS technique to control endogeneity. We
510 performed a TSLS instrument variable method following (Caramanis & Lennox, 2008). Our
511 study conducted a 1st stage model that determined the observed level of TIA with the MEFs lags
512 as an instrumental variable and all formerly employed controls as exogenous variables. The
513 expected value through the 1st stage then replaced the MEFs in the model of the 2nd stage. The
514 findings for the 2nd stage generated the same results, indicating that the MEFs facilitated the TIA
515 (See Table VI).

516 **Insert Table VI here**

517 **6.5 Robustness Test**

518 During our research, we extensively analyzed the study data using various sophisticated
519 statistical techniques. In particular, our analytical framework incorporated a baseline regression
520 (fixed effect) analysis used to control for unobserved heterogeneity and time-invariant factors.
521 We also used Heckman's (1979) two-stage selection model to analyze any potential bias in
522 sample selection thoroughly. Additionally, endogeneity issues were addressed using the two-
523 stage least square approach, assuring the accuracy and consistency of our findings.

524 For robustness, this study used an alternative method for estimating the quality of
525 innovation is to study the association between effort and efficiency. We used a strategic
526 approach by replacing the technical innovation activities with proxy innovation patent proxy and
527 lagged variables. Using this technique, our research can evaluate the generality and consistency
528 of our findings beyond the particular measurement used in the initial models. We increase the
529 study's robustness by ensuring that our conclusions are independent of any metric by examining

530 how sensitive our conclusions are to changes in the selected dependent variable. This analytical
531 method provides a more thorough grasp of the phenomenon being studied, strengthening the
532 validity of our research and adding to the general dependability of the study's findings. In
533 general, using these many statistical methods demonstrates the care with which our study design
534 was executed since they all work together to produce a solid and well-supported analysis. Our
535 detailed methodology strengthens the validity and reliability of the results, supporting the
536 strength of the study's empirical findings. In this context, our study included a total patent as a
537 substitute for invention. This research followed previous studies by Qin and Zhang (2019) and
538 took a firm's entire patent (INNO) as the dependent variable for robustness tests. This study
539 estimated INNO as the natural logarithm and total patents (including inventory, utility, and
540 design). The finding shows that the coefficient of MEFs was also a positively significant
541 relationship with INNO. This relationship is significant in both models 1 and 3 with innovation
542 activities measured i.e., TIA ($\beta = 0.0385$ significant at 01 percent and ($\beta = 0.0378$ significant at 01
543 percent). Additionally, the findings of Model (2) and (3) shows that the coefficient between
544 (MEFs and COD) and (INNO and COD) were negatively significant ($\beta = -0.00180$ significant at
545 01 percent) and ($\beta = -0.0677$ significant at 10 percent), suggesting that creditors offer lower
546 interest rate loans to frequent and precise MEFs due to fewer information asymmetry problems.
547 This study estimated that the overall correlation between MEFs and TIA was 0.00378 ($p < 0.01$).
548 Overall, the robust test resembled the results of the baseline analysis (see Table VII).

549

Insert Table VII

550 7. Conclusion

551 We examine the relationship between management earnings forecasts and corporate
552 innovation. Our study also examines whether the cost of debt plays a mediating role between the
553 management earnings forecasts and the innovation nexus. Our independent variable is corporate
554 innovation, measured as the firms' R&D spending scaled by the entire operating revenue during
555 the year. The key independent variable used in this study is the management earnings forecast,
556 estimated as the firm's earnings forecast quantity during a financial year. We also examined the
557 mediating effect of the cost of debt (COD), defined as the interest cost of a firm divided by its
558 total debt.

559 Using data from 1032 non-financial firms listed on the Shanghai and Shenzhen stock
560 markets from 2005 to 2022, we document a positive relationship between management earnings
561 forecasts and the firms' technical innovation. Our findings also show that the cost of debt
562 mediates the relationship between management earnings forecast and technical innovation.
563 Further analysis indicates that frequent earnings forecasts provide incremental information
564 regarding a firm's future value and cash flows, thus reducing the volatility and uncertainty in
565 cash flow calculations.

566 Our study has implications for Chinese regulators, enabling them to promote frequent
567 management earnings forecasts through targeted incentives. The findings of this study are also
568 relevant to Chinese firms, allowing them to understand the relationship between management
569 earnings forecasts and firms' innovation activities. Our study will also help academics appreciate
570 the merits of mandatory disclosure in a weak institutional environment.

571 Our study has some limitations. One key limitation of this study is that the data used is
572 limited to Chinese firms. China has a unique disclosure environment, so our findings may not be

573 generalizable to different capital market settings. Future research would benefit from including
574 samples from both developed and emerging economies. This approach will help researchers to
575 compare the relationship between mandatory and voluntary MEFs disclosure on firm innovation.

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579 **Availability of data and materials**

580 The datasets used and analysed during the current study are available from the corresponding
581 author upon reasonable request.

582 **Competing interests**

583 The authors declare that they have no competing interests.

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Table I Descriptive information of sample selection procedure

Panel A		
Selection of Firms	Nos. of Firms	%
Agriculture	18	1.744
Telecommunication	10	0.969
Conglomerate	30	2.907
Information Technology	166	16.085
Manufacturing	582	56.395
Metals & Minerals	67	6.492
Business Service Sector	52	5.039
Transportation	20	1.938
Power Utilities	39	3.779
Whole Sales	48	4.651
Total Firms	1,032	100
Panel B		
Description	No of Firm Years	No of Firms
Availability of total firm-year observations on the CSMAR and Wind database from 2005 to 2022	22,008	1,223
Less:		
Observations with missing earning management forecasts	680	38
Observations with insufficient data to construct cost of debt proxy	710	39
Observations with insufficient data to construct innovation activities proxy	759	42
Observations with insufficient data construct control variables	1,283	71
Final sample	18,576	1,032

Source(s): Created by Author(s)

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811 **Table II Descriptive Summary**

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Variables	Observation	Mean	Median	Min.	Max.	S.D
Dependent Variable						
TIA	18,576	0.04	0.00	0.00	0.05	0.08
Independent Variable						
MEFs	18,576	0.68	1.00	0.00	1.00	0.85
Mediator						
COD	18,576	0.07	0.05	0.03	0.08	0.07
Control Variables						
ABL	18,576	0.47	0.00	0.00	1.00	0.50
LEV	18,576	0.43	0.43	0.27	0.59	0.20
FS	18,576	21.89	21.78	21.03	22.63	1.23
FA	18,576	10.91	11.00	6.00	14.00	6.24
ROA	18,576	0.04	0.04	0.01	0.07	0.05
SOE	18,576	0.67	1.00	0.00	1.00	0.47
BTM	18,576	0.54	0.51	0.32	0.74	0.27
B4A	18,576	0.04	0.00	0.00	1.00	0.18
PCF	18,576	0.60	1.00	0.00	1.00	0.49
GRO	18,576	0.14	0.07	0.00	0.26	0.28
CFO	18,576	0.06	0.05	0.01	0.09	0.11
TQ	18,576	1.84	1.42	0.73	2.56	1.51
LOSS	18,576	0.12	0.00	0.00	1.00	0.32
ING	18,576	0.06	0.00	-0.16	0.08	0.45

Notes: General information: TIA, the firms' R&D spending scaled by the entire operating revenue during the year; MEF, the firm's earnings forecast quantity during a financial year; COD, the interest cost of a firm divided by debt in total (non-current obligations due during one year, short- and long-run debts, bond payables, and accounts payable) of the firm "i" and year "t."; ABL, equivalent to "1" when firms access bank loans and "0" for others; LEV, the debt of the firms relating to the sum of debt in a year divided by assets in total; FS, the natural log of total assets; FA, the total years between the firm's financial reports per year and initial public offerings; ROA, the firm's profitability, and it was estimated as the net earnings scaled by the total firm assets; SOE, if a non-financial firm was controlled through the state or government, and the value is one and zero; BTM, the market worth of equity add the sum of asset book worthless, the equity book value, and deferred taxes (adjusted to "0" when lost) scaled by the firm's entire asset book value; B4A, equaled one if an audit report was issued in a year and zero otherwise; PCF, equivalent to "1" if firms' officials, including the manager, general manager, or real controller, had a political link with Government officials linked with political consultative meetings or national congress duties at a country level or above and "0" for others; GRO, sales growth estimated as the disparity with the existing year sale plus preceding year sales divided by the prior sales; CFO, CF divided by assets in total in a year; TQ, the equity market worth plus the firm's obligations book worth divided by the firm's total assets; LOSS, one for the firms whose net income was negative and zeroed otherwise; ING, the proportion of earnings forecasts released by firms in the identical industry.

813 Source(s): Created by Author(s)

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817 Table III Correlation Matrix

Variable	TIA	MEFs	COD	ABL	LEV	FS	FA	ROA	SOE	BTM	B4A	PCF	GRO	CFO	TQ	LOSS
TIA	1															
MEFs	0.2462*	1														
COD	-0.0455*	-0.1182*	1													
ABL	0.1821*	0.2503*	-0.2271*	1												
LEV	-0.1097*	0.0313*	-0.5019*	0.2192*	1											
FS	0.0753*	0.0988*	-0.2251*	0.3008*	0.3912*	1										
FA	0.1106*	0.1122*	-0.2828*	0.3501*	0.3215*	0.4711*	1									
ROA	0.0688*	-0.0622*	0.2740*	-0.1142*	-0.2851*	-0.0163*	-0.1314*	1								
SOE	-0.0790*	-0.1764*	-0.0431*	-0.0331*	0.1014*	0.1906*	0.1322*	-0.1121*	1							
BTM	-0.2230*	-0.1297*	-0.1142*	0.0730*	0.2445*	0.3384*	0.1364*	-0.2685*	0.2098*	1						
B4A	0.0309*	-0.0234*	0.005	0.0314*	0.0694*	0.2262*	0.1020*	0.0380*	0.0187*	0.0963*	1					
PCF	0.2094*	0.3100*	-0.0927*	0.2341*	0.0734*	0.1148*	0.2158*	0.0741*	-0.2963*	-0.1418*	0.0304*	1				
GRO	0.0800*	0.1117*	-0.0922*	0.1265*	0.0744*	0.1616*	0.0795*	0.1673*	-0.0549*	-0.0728*	-0.003	0.0996*	1			
CFO	-0.0431*	-0.1443*	0.2273*	-0.1801*	-0.1603*	-0.1358*	-0.2050*	0.2028*	0.1146*	0.0375*	0.0147*	-0.1706*	-0.0063	1		
TQ	0.2709*	0.1210*	0.1608*	-0.0344*	-0.3654*	-0.3949*	-0.1086*	0.2692*	-0.2315*	-0.7551*	-0.0729*	0.1720*	0.0419*	0.0037	1	
LOSS	-0.0574*	0.0370*	-0.0789*	0.014	0.1438*	-0.0768*	0.0226*	-0.6723*	0.0839*	0.0917*	-0.0210*	-0.0812*	-0.1713*	-0.0452*	-0.0868*	1

818 Source(s): Created by Author(s)

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831 **Table IV Testing mediation effect of cost of debt on the relationship between management earnings**
832 **forecasts and the firm's technical innovation activities**

VARIABLES	Exp. Sign	Model 1	Model2	Model 3
		DV	Mediator	DV
		TIA	COD	TIA
MEFs	+/-	0.00122** (0.000609)	-0.00183*** (0.000580)	0.00110* (0.000608)
COD	-	-	-	-0.0619*** (0.00792)
ABL	+/-	0.00267** (0.00108)	-0.00301*** (0.00102)	0.00248** (0.00107)
LEV	+/-	0.0195*** (0.00353)	-0.141*** (0.00336)	0.0108*** (0.00370)
FS	+/-	-0.00139 (0.000866)	-0.00362*** (0.000825)	-0.00162* (0.000865)
FA	+/-	-0.0655*** (0.00260)	0.00616** (0.00248)	-0.0651*** (0.00260)
ROA	+/-	-0.0133 (0.0125)	0.144*** (0.0119)	-0.00434 (0.0125)
SOE	+/-	-0.00151 (0.00128)	0.000961 (0.00122)	-0.00145 (0.00128)
BTM	+/-	0.00190 (0.00348)	-0.0101*** (0.00332)	0.00127 (0.00348)
B4A	+	0.0124*** (0.00382)	0.00258 (0.00364)	0.0125*** (0.00382)
PCF	+/-	0.000783 (0.00145)	-0.000801 (0.00138)	0.000733 (0.00145)
GRO	+/-	0.00423*** (0.00152)	-0.0111*** (0.00144)	0.00355** (0.00152)
CFO	+	0.00594 (0.00438)	0.0364*** (0.00417)	0.00820* (0.00438)
TQ	+/-	0.00613*** (0.000590)	-0.00350*** (0.000562)	0.00592*** (0.000590)
LOSS	+/-	-0.00345* (0.000590)	0.0153*** (0.000562)	-0.00250 (0.000590)

	(0.00178)	(0.00169)	(0.00178)
Cons.	1.094***	0.113***	1.101***
	(0.0458)	(0.0437)	(0.0458)
Industry F-E	Yes	Yes	Yes
Year F-E	Yes	Yes	Yes
Observations	18,576	18,576	18,576
R-squared	0.359	0.220	0.361

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

833 Source(s): Created by Authors

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836 **Table V Findings of Heckman's (1979) Selection Procedure**

VARIABLES	1stStep	2nd Step	2nd Step	2nd Step
	DV	Model 1	Model 2	Model 3
	MEFD	TIA	COD	TIA
		DV	Mediator	DV
MEFs	-	0.00130**	-0.00200***	0.00119**
	-	(0.000607)	(0.000577)	(0.000606)
COD	-	-	-	-0.0555***
	-	-	-	(0.00770)
ABL	-0.319***	0.0205***	-0.00529***	0.0202***
	(0.0327)	(0.00181)	(0.00173)	(0.00181)
LEV	2.110***	-0.102***	-0.133***	-0.110***
	(0.0797)	(0.00989)	(0.00944)	(0.00993)
FS	-0.287***	0.0138***	-0.00264*	0.0137***
	(0.0158)	(0.00148)	(0.00141)	(0.00148)
FA	-0.0489***	0.000515	-0.000828**	0.000467
	(0.00303)	(0.000337)	(0.000325)	(0.000336)
ROA	1.889***	-0.107***	0.177***	-0.0973***
	(0.395)	(0.0147)	(0.0140)	(0.0147)
SOE	-0.325***	0.0161***	-0.00126	0.0160***
	(0.0312)	(0.00194)	(0.00185)	(0.00194)
BTM	0.393***	-0.0162***	-0.00846**	-0.0167***
	(0.0869)	(0.00365)	(0.00349)	(0.00365)
B4A	0.582***	-0.0172***	0.00967**	-0.0166***
	(0.0751)	(0.00435)	(0.00416)	(0.00434)
PCF	0.0520	-0.00236	7.16e-05	-0.00236
	(0.0324)	(0.00145)	(0.00138)	(0.00145)
GRO	0.152***	-0.00330**	-0.0113***	-0.00393**

	(0.0544)	(0.00166)	(0.00158)	(0.00166)
CFO	-0.694***	0.0449***	0.0381***	0.0471***
	(0.134)	(0.00539)	(0.00514)	(0.00539)
TQ	0.0746***	0.00334***	-0.00256***	0.00319***
	(0.0155)	(0.000654)	(0.000624)	(0.000653)
LOSS	0.182***	-0.0121***	0.0184***	-0.0111***
	(0.0586)	(0.00192)	(0.00183)	(0.00192)
Instrumental Variable				
ING	-0.256***	-	-	-
	(0.0387)	-	-	-
IMR		-0.0658***	0.0098*	-0.0654***
		(0.00557)	(0.00532)	(0.00556)
Cons.	4.267***	-0.117***	0.185***	-0.107***
	(0.335)	(0.0225)	(0.0215)	(0.0225)
Industry F-E	Yes	Yes	Yes	Yes
Year F-E	Yes	Yes	Yes	Yes
Pseudo R ²	0.1731	-	-	-
R-Square	-	0.2978	0.3211	0.2981

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source(s): Created by Authors

837 **Table VI Findings of Two-Stage Least Square (TSLS)**

VARIABLES	Model 1	Model 2	Model 3
	DV	Mediator	DV
	TIA	COD	TIA
MEFs	0.0341***	-0.0151*	0.0346***
	-0.00645	-0.00883	-0.00646
COD	-	-	-0.114***
	-	-	-0.0107
ABL	0.0290***	-0.00542**	0.0282***
	-0.0022	-0.00232	-0.00217
LEV	-0.0575***	-0.141***	-0.0744***
	-0.00362	-0.00318	-0.00419
FS	0.0135***	0.00242***	0.0136***
	-0.000822	-0.000858	-0.000824
FA	0.000282**	-0.00104***	0.000164
	-0.000114	-0.000117	-0.000115
ROA	-0.165***	0.268***	-0.132***
	-0.0196	-0.0215	-0.019
SOE	-0.00598***	-0.00531***	-0.00619***
	-0.00175	-0.00175	-0.00176
BTM	-0.0383***	0.00222	-0.0381***
	-0.00397	-0.00386	-0.00396
B4A	0.0016	0.00558**	0.00293
	-0.00336	-0.00272	-0.00334
PCF	0.0303***	0.00439	0.0304***
	-0.00274	-0.00295	-0.00274

GRO	0.0124*** -0.00244	-0.0126*** -0.00235	0.0108*** -0.00241
CFO	0.00762 -0.00597	0.0640*** -0.00628	0.0144** -0.00591
TQ	0.0119*** -0.00064	-0.00075 -0.000512	0.0117*** -0.000638
LOSS	-0.00599** -0.00248	0.0278*** -0.00194	-0.00274 -0.00252
Cons.	-0.237*** -0.0149	0.0890*** -0.0127	-0.223*** -0.0147
Sargan Statistic	0.001	0.005	0.001
Cragg-Donald Wald F statistic	245.616	60.033	244.613
LM statistic	242.604	59.87	241.639
Observations	18,576	18,576	18,576
R-squared	0.055	0.306	0.052

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Source(s): Created by Authors

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840 **Table VII Findings of the Robustness Test**

VARIABLES	Model 1	Model 2	Model 3
	DV	Mediator	DV
	INNO	COD	INNO
MEFs	0.0385*** (0.00307)	-0.00180*** (0.000581)	0.0378*** (0.00310)
COD	- -	- -	-0.0677* (0.0404)
ABL	0.0168*** (0.00542)	-0.00286*** (0.00102)	0.0162*** (0.00551)
LEV	0.103*** (0.0178)	-0.141*** (0.00336)	0.0958*** (0.0191)
FSLN	0.0803 (0.0929)	-0.101*** (0.0176)	0.0738 (0.0988)
FALN	-0.0893*** (0.0241)	0.00374 (0.00455)	-0.121*** (0.0289)
ROA	-0.297*** (0.0628)	0.144*** (0.0119)	-0.267*** (0.0658)
SOE	-0.0620*** (0.00646)	0.00112 (0.00122)	-0.0580*** (0.00674)
BTM	-0.134*** (0.0175)	-0.00953*** (0.00331)	-0.145*** (0.0184)
B4A	0.0409**	0.00273	0.0501**

	(0.0193)	(0.00364)	(0.0204)
PCF	0.0684***	-0.000716	0.0662***
	(0.00732)	(0.00138)	(0.00748)
GRO	-0.00519	-0.0107***	-0.00747
	(0.00765)	(0.00145)	(0.00779)
CFO	-0.0390*	0.0354***	-0.0337
	(0.0221)	(0.00418)	(0.0237)
TQ	-0.0112***	-0.00359***	-0.01000***
	(0.00298)	(0.000562)	(0.00306)
LOSS	-0.0275***	0.0152***	-0.0275***
	(0.00896)	(0.00169)	(0.00923)
Constant	-0.134	0.445***	-0.0813
	(0.287)	(0.0542)	(0.299)
Industry F-E	Yes	Yes	Yes
Year F-E	Yes	Yes	Yes
Observations	18,576	18,576	18,576
R-squared	0.917	0.221	0.915

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source(s): Created by Authors

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