# Mandatory vs. Voluntary Disclosure of Management Forecast in China

Xiaobai Zhang
Nagoya University

Hu Dan Semba†
Nagoya University
kotan@soec.nagoya-u.ac.jp

Hong Xu
Nagoya University

† Corresponding author

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This study examines the difference in management forecast quality under mandatory vs. voluntary disclosure in China's stock markets in terms of management forecasting error (MFE) and value relevance. The results of MFE tests reveal that the disclosure approach is significantly associated with forecast accuracy, and voluntarily disclosed forecasts are more accurate than mandatorily disclosed forecasts. In terms of value relevance, the results are also consistent with the belief that in China's stock markets, management forecast quality under voluntary disclosure is higher than that under mandatory disclosure.

Keywords: mandatorily disclosed forecasts, voluntarily disclosed forecasts, management forecast quality, management forecast error, value relevance

## 1. Introduction

Management forecasts are critical information sources for both individual and institutional investors. According to previous literature, corporate managers issue management forecasts to inform the market regarding their predictions of companies' future performance, thereby reducing information asymmetry (Diamond and Verrecchia 1991). However, its effectiveness depends on whether management forecasts provide correct information; thus pointing to the quality of forecasts. This study examines the quality of management forecasts in China's stock markets from two perspectives: management forecasting error (MFE) and value relevance.

In some mature stock markets (e.g., the United States) managers disclose their forecasts voluntarily at any time before making financial announcements. In China, disclosures of management forecasts are required only under certain conditions; thus, they are only partially mandatory. If not required, firms are encouraged to provide voluntary disclosures or take a non-disclosure option. As such, China's system regarding disclosures is characterized as being half mandatory and half voluntary.

Research on the quality of management forecasts under forecast reporting regulations has attracted substantial attention from accounting researchers, with the consequences of mandatory disclosure a constant topic for debate (Burton 1973; Gonedes, Dopuch, and Penman 1976; Till 1980; Yamada 2016). With regard to voluntary management earnings forecasts in the capital market, related literature can be traced back to as early as 1968. Ball and Brown (1968) found preliminary evidence of the usefulness of voluntary earnings announcements in the U.S. market, while several other studies have discussed the pros and cons of voluntary disclosure (Penman 1980; Waymire 1985; Pownall and Waymire 1989; Lev and Penman 1990; Skinner 1994; Kasznik 1999; Baginski, Hassell, and Kimbrough 2002; Cao et al. 2017). Meanwhile, this study focuses on the difference in management forecast quality under mandatory vs. voluntary disclosure in China.

The results show that the disclosure approach influences the quality of management forecasts and is significantly associated with forecast accuracy. Specifically, voluntarily disclosed forecasts are likely to be more accurate than mandatorily disclosed forecasts. The results are consistent when considering value relevance and management forecasting error (MFE).

This study contributes to the literature on management forecast information quality, specifically regarding mandatory vs. voluntary disclosure. It examines management forecast quality using replenished data and applies Heckman's two-stage model to address the natural selection problem of samples, as well as the issue of endogeneity. This study also applies propensity score matching (PSM) to test the robustness of the main results. Furthermore, the value relevance of management forecast information is examined using Ohlson's model.

In a previous study, Huang et al. (2018, p.320) examined four economic effects of China's half mandatory, half voluntary disclosure system with regard to "(1) the usefulness of mandatory forecasts to market participants, (2) the effect of forced forecast experience on subsequent-period voluntary forecast behavior, referred to as the managerial learning effect, (3) insider trading, and (4) earnings management." In contrast to Huang et al. (2018), this study does not examine the economic impacts of the "(2) managerial learning effect, (3) insider trading, and (4) earnings management."Meanwhile, as Huang et al. (2018, note 4, p.320) noted, they "do not examine the relative usefulness of mandatory vs. voluntary forecasts;" rather, they apply the event study method to focus on the firm's cumulative market-adjusted stock return and examine "(1) the usefulness of mandatory forecasts to market participants." To fill the gap in the literature left by Huang et al. (2018), our study applies a value relevance perspective to "examine the relative usefulness of mandatory vs. voluntary forecasts." Considering the large number of studies on value relevance, this study supplements not only Huang et al. (2018), but also contributes to the value relevance literature on the economic effects of China's half mandatory, half voluntary disclosure system. Furthermore, this study also examines management forecasts under mandatory vs. voluntary disclosure systems using the Heckman model, which was not applied in Huang et al. (2018). Note that regarding"(1) the usefulness of mandatory forecasts to market participants," Huang et al. (2018, p.321) found that in the short term, "stock prices react significantly to mandatory forecasts and are in a direction consistent with the forecast news." However, the result of our study regarding "the relative usefulness of mandatory vs. voluntary forecasts" suggests that voluntary forecasts tend to be more accurate than mandatory forecasts. Further research is expected on the usefulness of China's half mandatory, half voluntary disclosure system.

Han and Yang (2012) argued that in the context of China's stock market, voluntary disclosure provides higher quality information compared with mandatory disclosure. They evaluated forecast quality from four perspectives: (1) error of earnings forecast, (2) the precision of forecast, whether provided in terms of ranges or specific numbers, (3) timeliness, that is, the time difference between the forecast date and actual announcement date, and (4) the number of analysts that follow the firm. The study used multi-linear regression models, and the control variables included the nature of the news, increase of main business, positive or negative forecasts, earnings management accruals using Kasznik's model, leverage, changes in earnings, market-to-book value, and dummy variables (size and industry). The authors found that from all four perspectives, voluntary disclosure performs better than mandatory disclosure. For their robustness test, the authors used the Heckman model to support the main results. Gao and Wang (2014) used a similar method (linear regression) and dependent variables as Han and Yang (2012), but they arrived at different conclusions. The major difference between our study and the previous two studies (Han and Yang 2012 and Gao and Wang 2014) is that we evaluate the quality of forecast from the perspective of value relevance by adopting the Ohlson model.

The remainder of this paper is organized as follows. Section 2 provides background information on China's stock market disclosure regulations, reviews previous literature, and presents our hypothesis. Sections 3 and 4 discuss the methodology and data collection, respectively, while Section 5 presents the results of the analysis and robustness tests to reexamine the results.

## 2. Literature review and hypothesis development

### *2.1. Disclosure regulations in China's stock markets*

The disclosure policy regarding management earnings forecasts in China was developed just before the 21st century. The China Securities Regulatory Commission (CSRC) made an announcement concerning listed companies' annual reports on December 9, 1998, stipulating that a "pre-loss" announcement should be issued prior to the annual report. This was a prelude to the earnings forecast system that governs listed Chinese companies. Since then, regulators have constantly changed policies to promote and perfect the management forecast system.

Prior to 2001, management earnings forecasts were required to be released at any date after the end of fiscal year, but before the annual disclosure.. Since 2002, the Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) have required listed companies to provide forecasts of their annual results in the third quarterly report. Eventually, the earnings forecast of listed companies had to be made in advance.

The CSRC specializes in step-by-step regulations. Until 2008, new regulations were published almost every other year. To date, a mandatory disclosure system has been established, and voluntary disclosure has supplemented the system. The current disclosure system requires A-share and B-share stocks to make earnings announcements mandatorily if certain conditions, such as large losses in the coming reporting season, apply. Table 1 summarizes the regulation changes regarding management forecasts in China.

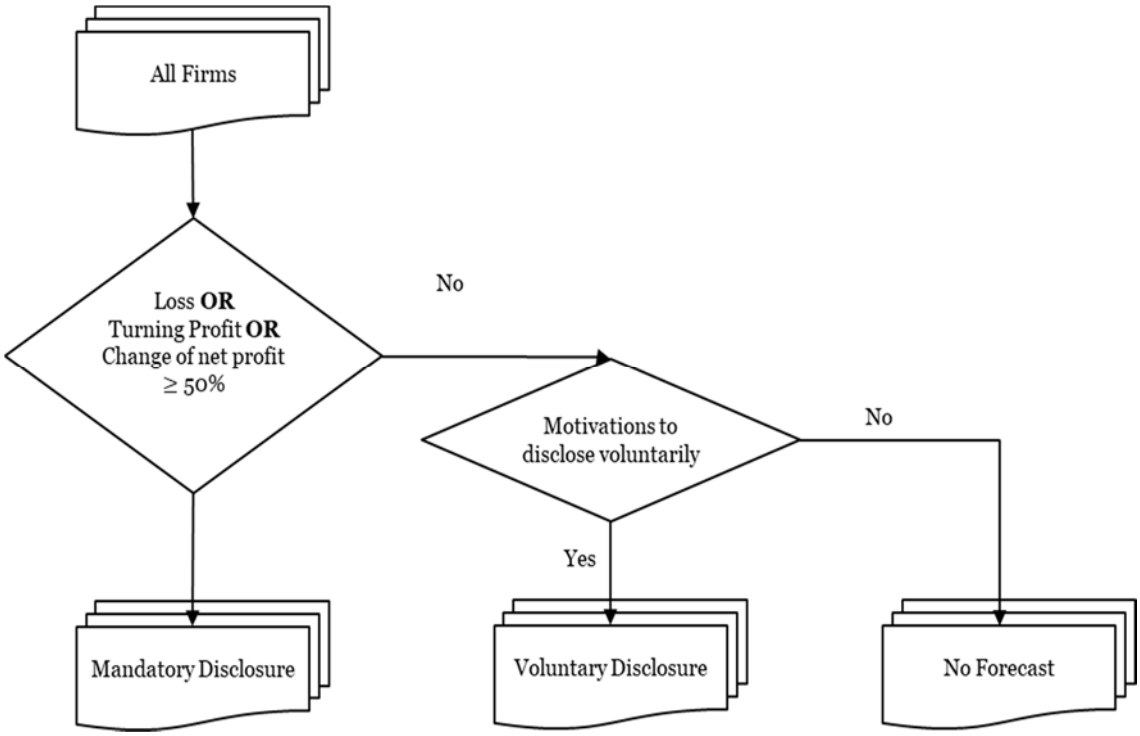
Table 1. Disclosure regulation in China.

| Year | Management forecast disclosure regulations for SSE and SZSE |
|---|---|
| 1998 | A pre-loss announcement should be issued prior to the annual report if the listed company expects an annual loss. |
| 2000 | A pre-loss announcement should be issued within two months after a |

| Year | Management forecast disclosure regulations for SSE and SZSE |
|---|---|
| | fiscal year if the listed company expects an annual loss. |
| 2001 | A pre-loss announcement should be issued within 30 working days after a fiscal year if the listed company expects a loss or changes of more than 50% compared with the previous year's annual profit. |
| 2002 | If the listed company expects losses or changes of more than 50% compared with the previous year's annual or semi-annual profit, the management forecast should be disclosed in the preceding quarterly report or separately. |
| 2004 | If the listed company expects profits and meets any of the following conditions—(1) loss in the previous year, (2) changes of more than 50% compared with the previous year, or (3) loss in the previous fiscal year but turning into profit in the current year—annual and semi-annual management forecasts should be disclosed in the preceding quarterly report or separately, no later than January 31st for annual forecasts and July 15th for semi-annual forecasts. |
| 2005 | If the listed company expects profits and meets any of the following conditions—(1) loss in the previous year, (2) changes of more than 50% compared with the previous year, or (3) loss in the previous fiscal year but turning into profit in the current year—annual and semi-annual management forecasts should be disclosed in the preceding quarterly report or separately, no later than January 25th for annual forecasts and July 15th for semi-annual forecasts. |
| 2006 | If the listed company expects profits and meets any of the following conditions—(1)loss in the previous year, (2) changes of more than 50% compared with the previous year, or (3) loss in the previous fiscal year but turning into profit in the current year—annual, semi-annual, and third quarterly management forecasts should be disclosed in the preceding quarterly report or separately, no later than January 31st for annual forecasts, July 15th for semi-annual forecasts, and October 15th for third quarterly forecasts. |
| 2008 ~ 2018 | SZSE: If the listed company expects profits and meets any of the following conditions—(1)loss in the previous year, (2) changes of more than 50% compared with the previous year, or (3) loss in the previous fiscal year but turning into profit in the current year—annual, semi-annual, and third quarterly management forecasts should be disclosed in the preceding quarterly report or separately, no later than January 31st for annual forecasts, July 15th for semi-annual forecasts, and October 15th for third quarterly forecasts.<br>SSE: Requirements are only for annual forecasts. |

Source: Summarized by the authors with reference to information on the homepage of CSRC (see http://www.csrc.gov.cn/pub/newsite/).

The regulation changes summarized above shows that disclosures of management forecasts in China were shaped step-by-step in consideration of the timing, forecast objects, and mandatory disclosure conditions. Regarding the timing of the disclosure in 1998, the CSRC only required disclosures before publication of annual reports. However, detailed deadlines were then shifted to earlier dates. The forecast periods were made more frequent from annual to semiannual and third quarter periods. Similarly, the conditions that require mandatory disclosure were expanded. The flowchart in Figure 1 describes how mandatory disclosure/voluntary disclosure/non-disclosure approaches are determined based on current regulations (i.e., 2004–2018). For any firm that expects profits and meets any of the following conditions—(1) loss in the previous year, (2) changes of more than 50% compared with the previous year, or (3) loss in the previous fiscal year but turning into profit in the current year—the disclosure of management forecast is mandatory. For companies that do not meet any of the conditions outlined above, voluntary disclosure is allowed if there are strong incentives for disclosure, such as enhancing investor relations. Firms may also choose not to make disclosures in other circumstances.




Source: Summarized by the authors with reference to the information on the homepage of CSRC (see http://www.csrc.gov.cn/pub/newsite/).

Figure 1. Decision-making process of the disclosure.

### *2.2. Previous Literature and hypothesis development*

Previous studies have discussed that in the case of information asymmetry and market failure, mandatory disclosure is conducive to promoting information transparency, reducing market value deviation, and enhancing the efficiency of capital market allocation (Coffee 1984). Easterbrook and Fischel (1984) argued that the market creates effective incentives for companies to disclose information that investors need and that mandatory disclosures can achieve this goal. Bonaimé's research showed that mandatory disclosure enhances companies' information disclosure level, thereby improving the open market completion rate and reducing capital costs (Bonaimé 2015). Meanwhile, Liao and Chen (2009) believed that unlike entrepreneurs, regulators are not bound by competition and private property rights when making mandatory disclosure

regulations. Furthermore, there is no incentive for them to measure carefully the costs and benefits of disclosure, which is more likely to lead to excessive or inadequate disclosure. However, the theory of voluntary disclosure argues that management can disclose information voluntarily for a variety of reasons, for instance, to reduce market transaction costs, maintain control over competitive positions, implement stock compensation plans, evade litigation risks, and project good corporate image to the market (Healy and Palepu 2001). Under these circumstances, management considers multiple-contract fulfillment and cost–benefit principles when disclosing private information, and chooses the disclosure method that maximizes its own interests (Gao and Wang 2013). Wang (2010) pointed out that for observable verifiable information, mandatory disclosure rules are valid, but not for unobservable verifiable information and unobservable unverifiable information. Moreover, it is apparent that different motivation theories exist regarding mandatory and voluntary disclosures, and the findings remain inconclusive.

As a result of this unique half mandatory, half voluntary disclosure system, a special situation has developed in China's stock markets, where there are now two types of management forecasts. Differing from mature capital markets (e.g., the United States and Japan), in China, disclosures of forecast information are neither completely mandatory nor voluntary. According to previous literature, managers' motivations to release forecast information vary under different disclosure environments. Thus, this study conjectures that there might be differences in the management forecast quality for different disclosure types. If this is true, investors need to recognize the existence of quality differences.

There is limited literature on management forecasting under China's special disclosure system. Han and Yang (2012) found that the accuracy, specificity, and

timeliness of voluntarily disclosed forecasts are significantly higher than those that are mandatorily disclosed. Gao and Wang (2013) argued that the reliability of management forecasting under the mandatory disclosure policy is significantly higher than that under the voluntary disclosure policy. Further testing revealed that different types of mandatory disclosures are of significantly better quality than voluntary disclosures. Moreover, mandatory disclosures of bad news have significantly lower quality than those made voluntarily (Gao and Wang2014). Ma, Zhou, and Zhang (2015) used management forecasting as a proxy for transparency and found that firms making voluntary disclosures have higher transparency. In short, despite differences in research design and focus, previous studies have shown the superiority of voluntary vs. mandatory disclosures. However, existing studies are limited in the strength of their findings, methodologies, varieties of evidence, and number.

This study hypothesizes that under the context of China's stock market, voluntarily disclosed management forecasts have better quality than those that are mandatorily disclosed. Specifically, this study proposes the following hypotheses:

H1. Forecasting accuracy under voluntary disclosure is higher than that under mandatory disclosure because of better information quality.

H2. Voluntary forecasting provides higher-quality information than mandatory forecasting in terms of value relevance by contributing to better performance estimation.

## 3. Methodology

### *3.1. Research Design*

This study investigates management forecast quality under different disclosure approaches from two perspectives as follows.

*3.1.1 Management forecast error*

In this study, Heckman's two-step model is adopted to address sample selection bias for unobservable firms that do not release management forecasts and for endogenous issues relating to mandatory and voluntary disclosures. This is done by controlling for firms' financial characteristics. The first step involves a probit model with the following function:

$$\text{Probit(Guidance)} = \alpha_0 + \alpha_1 * SelectVar + \varepsilon (1)$$

where Guidance is a dummy variable equal to1 if management forecast information exists and 0 otherwise. *SelectVar* denotes the variables selected to explain whether a firm has chosen to disclose management forecasts. The selection variables, *SelectVar*, are chosen carefully based on China's disclosure regulations (see details provided in the last section). Two variables (Loss Dummy and ROA) are selected to represent the three current mandatory disclosure conditions: loss, turning into profit, and large changes in profit. Three variables (size, LANA, and MTB) are selected to represent voluntary disclosure motivations. Similar variables can be found in various studies (e.g., Penman 1980; Waymire 1985; Pownall and Waymire 1989; Skinner 1994; Kasznik 1999; Cao et al. 2017).

The second step involves a correction factor, the inverse Mills ratio, which is inserted into the management forecast regression model as in equation (2). Nawata (1993) and Nawata and Nagase (1996) pointed out that having a considerable overlap of variables used in steps 1 (selection model) and 2 is not desirable due to the issues of multicollinearity; therefore, we limit overlapping variables in equations (1) and (2) as follows:

$$\text{MFE} = \alpha_0 + \alpha_1 * ExpVar + \alpha_2 * Contr + Invmills + \varepsilon \quad (2)$$

where MFE denotes management forecast error; *ExpVar* means explanatory variable

(i.e., disclosure dummy); and *Contr* means control variable.

Management forecast error is defined as

$$MFE = Actual\ value - Forecast\ value \quad (3)$$

or the inverse.

To achieve comparability among firms, MFEs are usually divided by proxy variables such as assets, market value of shares, book value of earnings, and so on. This study focuses on a specific MFE: $MFE_{Accuracy}$, defined as =|actual net profit- net profit in management forecast |/actual net profit, to show the level of accuracy of management's forecast of net profit (see Table 2 for details).

The explanatory variable used here is a disclosure dummy that measures mandatory or voluntary disclosure. Referring to the disclosure measurement methodology used in Guo and Qi (2010), in this study the disclosure dummy equals 1 if a firm is under mandatory disclosure and0 otherwise. For control variables, this study takes the most commonly tested determinants that influence MFE and other variables concerning basic company properties, financial condition proxies, environmental factors, and forecast information features. Table 2provides a list of the variables.

Table 2. Variables definition.

| Variables | Definition |
|---|---|
| $MFE_{Accuracy}$ | Accuracy of management forecast of net profit; calculated by the following equation: $MFE_{\mathrm{ACC}} = \frac{\lvert Actual\ Net\ Profit\ -\ Net\ Profit\ in\ Management\ Forecaqs}{Actual\ Net\ Profit}$ The average is calculated for forecasts expressed in ranges. Internal forecasts are excluded. |
| $MFE_{Accuracy}$_Pre | $MFE_{Accuracy}$ for the previous year |
| Guidance | Equal to 1 if management forecast information exists and 0 |

| Variables | Definition |
|---|---|
| | otherwise |
| Disclosure | Equal to 1 if mandatory |
| Dummy | Equal to 0 if voluntary |
| Horizon | Elapsed days since the last accounting period, using 365days as a deflator; calculated by the following equation: $\frac{(Public\ Date\ -\ End\ of\ Account\ Period)}{365}$ |
| Size | Size of the company; calculated by the following equation (companies with negative net asset are not considered): $ln(Net\ Asset)$ |
| Age | History of a company; calculated by the following equation: $End\ of\ Account\ Period\ -\ Established\ Date$ |
| ROA | $\frac{Net\ Profit}{Total\ Assetof\ Year\ End}$ |
| STDROA | Denotes standard deviation of ROA |
| MTB | $Ratio\ of\ Market\ Value\ to\ Book\ Value$ |
| Loss Dummy | Equal to 0 if net profit > 0,<br>Equal to 1 if net profit < 0 |
| Leverage | Denotes capital in the form of debt (loans); assesses the ability of a company to meet its financial obligations; calculated by the following equation: $Total\ Asset\ of\ Year\ End\ /\ Net\ Asset$ |
| Macroeconomics | Rate of GDP increase |
| Audit Dummy | Equal to 0 if not Big4,<br>1 if Big4 |
| Year | Year of Accounting period. |
| $L_{ANA}$ | Analyst followers' number |

*3.1.2. Value relevance*

In this study, referring to Ota (2014), we adjust the linear information dynamics of the Ohlson model. Linear information dynamics is a model with high discretion, that is, in specifying the variable, $v_t$, we can estimate future residual income by adding forecasted accounting information. The variable $v_t$denotes information other than abnormal earnings yet to be captured in the current financial statements. However, it affects future abnormal earnings. This study considers forecast information of expected earnings as

variable $v_t$. The basic formulation is as follows:

$$\boldsymbol{V_{Ohlson,t} = \gamma_0 b_t + \gamma_1 x_t + \gamma_2 d_t + \gamma_3 F_t[x_{t+1}]} \quad (4)$$

Here, we use data from 2005 on a rolling basis to calculate the coefficients of the above-mentioned model. Then, we apply the coefficients to the variables from 2007 to 2017 to obtain the theoretical firm value, $P_t$.

The calculation of the theoretical firm value is as follows:

$$\boldsymbol{V_{Ohlson(v=0),2005\sim t-1} = \alpha_0 b_{2005\sim t-1} + \alpha_1 x_{2005\sim t-1} + \alpha_2 d_{2005\sim t-1} + \alpha_3 F_{2005\sim t-1}[x_{t+1}]} \quad (5)$$

From the regression, we obtain$\boldsymbol{\alpha_0, \alpha_1, \alpha_2, \alpha_3}$, and by inserting them into the following equation, we obtain the theoretical firm value $P_t$.

$$\boldsymbol{P_{Ohlson(v=0),t} = \alpha_0 b_t + \alpha_1 x_t + \alpha_2 d_t + \alpha_3 F_t[x_{t+1}]} \quad (6)$$

To examine the explanatory power of the contemporaneous firm value, we calculate the accuracy of the firm value estimation. Specifically, this study compares the estimated firm value and real firm value to determine the validity of the valuation models. Here, it is defined as:

Accuracy of Estimation = $|V_t - P_t|/V_t$

Therefore, the closer the values are to zero, the more accurate the estimation is. The definitions of the variables used above are shown in Table 3.

Table 3. Variables definition.

| Variables | Meaning | Definition |
|---|---|---|
| $t$ | Time period | Year t |
| $V_t$ | Firm value | Market capitalization at the end of March in year t+1 |
| $P_t$ | Theoretical firm value | Firm value estimated based on the valuation model (Ohlson model in this study) |
| $b_t$ | Net asset | Book value of equity |

| Variables | Meaning | Definition |
|---|---|---|
| $x_t$ | Net income | Book value of net income |
| $d_t$ | Dividend | Annual dividend |
| $F_t[x_{t+1}]$ | Expected net income 1 year ahead | Expected net income for year t+1 from management forecast |

Note: This study uses firms whose accounting periods end in December as samples. To wait for the financial information to be released and reflected in the stock price, data of the month of March subsequent to the fiscal year are used.

## 4. Data

The sample must meet the following requirements:

(1) A shares and B shares of firms listed on the SSE and SZSE,

(2) Accounting period ending in December,

(3) Accounting period consisting of 12 months,

(4) Exclude firms in the financial industry (e.g., banks, securities firms, insurance firms),

(5) Year ranging from 2005 to 2017,

(6) Sample data with management forecast reported, and

(7) Exclude stocks marked by China Securities' Supervision and Management Committee (CSSMC) as being under financial distress—the so called "Special treatment (ST)"stocks.

The data used in this study are available to the public. After excluding the outliers at a 0.05 interval, this study has a total of 21,920 firm-year observations.

Table 4. Sample Selection.

| Sample Selection | Number |
|---|---|
| Total samples | 31,454 |
| Excluding financial industry | 30,655 |
| Excluding "special treatment" stocks | 29,986 |
| Excluding missing values | 23,090 |

| | |
|---|---|
| 5%–95% of the samples | 21,920 |
| Samples with unobservable management forecast | 15,280 |
| Observable samples | 6,640 |
| Observable samples, excluding those with missing values for $MFE_{Accuracy}$_Pre | 4,584 |

Note: The results of this study are robust when using 1%–99% of the samples.

## 5. Results

### *5.1. Management Forecast Error*

Table 5 provides the descriptive statistics of the variables used in the Heckman model and the comparison test results for mandatory vs. voluntary samples. The descriptive information reveals some distributional properties. The percentage of mandatorily disclosed forecasts is around 65%, meaning that most of the forecast information in the market is mandatorily disclosed. Moreover, most of the means or medians of the variables significantly differ from each other.

Table 5. Descriptive statistics of "management forecast error" variables.

| | Mandatory | | | | | | Voluntary | | | | | | All Samples | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | firm-years | mean | sd | min | median | max | firm-years | mean | sd | min | median | max | firm-years | mean | sd | min | median | max | t-value | chi-square value |
| (Independent Variable) | | | | | | | | | | | | | | | | | | | | |
| $MFE_{Accuracy}$ | 3001 | 0.099 | 0.093 | 0.004 | 0.068 | 0.470 | 1583 | 0.100 | 0.089 | 0.004 | 0.074 | 0.460 | 4584 | 0.099 | 0.092 | 0.004 | 0.070 | 0.470 | 0.001 | 4.864** |
| (Dummy Varible) | | | | | | | | | | | | | | | | | | | | |
| Disclosure Dummy | 3001 | 1.000 | 0.000 | 1.000 | 1.000 | 1.000 | 1583 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4584 | 0.655 | 0.476 | 0.000 | 1.000 | 1.000 | | |
| Loss Dummy | 3001 | 0.227 | 0.419 | 0.000 | 0.000 | 1.000 | 1583 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 4584 | 0.149 | 0.356 | 0.000 | 0.000 | 1.000 | -0.227*** | 422.626*** |
| Audit Dummy | 3001 | 0.038 | 0.192 | 0.000 | 0.000 | 1.000 | 1583 | 0.025 | 0.157 | 0.000 | 0.000 | 1.000 | 4584 | 0.034 | 0.181 | 0.000 | 0.000 | 1.000 | -0.013** | 5.404** |
| (Explanatory Variable) | | | | | | | | | | | | | | | | | | | | |
| $MFE_{Accuracy}$_Pre | 3001 | 3.266 | 161.294 | 0.000 | 0.089 | 8835.926 | 1583 | 11.475 | 322.826 | 0.000 | 0.071 | 10458.220 | 4584 | 6.101 | 230.259 | 0.000 | 0.081 | 10458.220 | 8.210 | 23.183*** |
| Horizon | 3001 | -0.015 | 0.121 | -0.227 | 0.052 | 0.329 | 1583 | -0.139 | 0.095 | -0.468 | -0.175 | 0.310 | 4584 | -0.058 | 0.127 | -0.468 | -0.167 | 0.329 | -0.124*** | 1043.622*** |
| Size | 3001 | 9.709 | 0.419 | 7.955 | 9.709 | 11.994 | 1583 | 9.822 | 0.369 | 8.095 | 9.810 | 11.298 | 4584 | 9.748 | 0.406 | 7.955 | 9.744 | 11.994 | 0.113*** | 57.920*** |
| Age | 3001 | 16.305 | 5.099 | 4.299 | 16.019 | 41.532 | 1583 | 13.923 | 5.427 | 3.929 | 13.449 | 49.729 | 4584 | 15.483 | 5.335 | 3.929 | 15.145 | 49.729 | -2.382*** | 214.062*** |
| ROA | 3001 | 0.019 | 0.290 | -2.746 | 0.015 | 10.397 | 1583 | 0.052 | 0.039 | 0.001 | 0.043 | 0.301 | 4584 | 0.030 | 0.236 | -2.746 | 0.026 | 10.397 | 0.033*** | 431.867*** |
| STDROA | 3001 | 0.124 | 1.534 | 0.000 | 0.029 | 63.155 | 1583 | 0.056 | 1.572 | 0.000 | 0.010 | 62.535 | 4584 | 0.101 | 1.547 | 0.000 | 0.020 | 63.155 | -0.069 | 797.307*** |
| MTB | 3001 | 12.300 | 97.633 | 0.044 | 3.952 | 4031.016 | 1583 | 4.309 | 3.131 | 0.186 | 3.640 | 55.835 | 4584 | 9.540 | 79.105 | 0.044 | 3.807 | 4031.016 | -7.991*** | 13.209*** |
| Leverage | 3001 | 4.524 | 26.851 | 1.017 | 2.264 | 1304.809 | 1583 | 2.005 | 1.489 | 1.008 | 1.621 | 32.102 | 4584 | 3.654 | 21.775 | 1.008 | 1.976 | 1304.809 | -2.519*** | 367.340*** |
| Macroeconomics | 3001 | 0.082 | 0.020 | 0.065 | 0.073 | 0.143 | 1583 | 0.074 | 0.010 | 0.065 | 0.073 | 0.143 | 4584 | 0.079 | 0.018 | 0.065 | 0.073 | 0.143 | -0.008*** | 84.073*** |
| Year | 3001 | 12.686 | 2.957 | 6.000 | 14.000 | 16.000 | 1583 | 13.915 | 1.945 | 7.000 | 14.000 | 16.000 | 4584 | 13.110 | 2.715 | 6.000 | 14.000 | 16.000 | 1.229*** | 19.426*** |
| LANA | 3001 | 0.956 | 1.084 | 0.000 | 0.693 | 3.970 | 1583 | 1.639 | 1.129 | 0.000 | 1.792 | 3.871 | 4584 | 1.192 | 1.147 | 0.000 | 1.099 | 3.970 | 0.683*** | 282.723*** |

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

The results of the Pearson's correlation test for all variables are shown in Table 6. Because the control variables, MTB and Leverage, are closely related, Leverage is

dropped in the test. Furthermore, it is not surprising to find that the variable Year has a −0.9 coefficient with Macroeconomics. Thus, Macroeconomics is dropped as well. The regression results of MFE in the Heckman model show a positive significant association between $MFE_{Accuracy}$ and Disclosure (dummy variable; see Table 7). In other words, management forecast information under mandatory disclosure tends to be less accurate than that under voluntary disclosure. The Heckman model is used to control for selection variables for all 19,869 samples (including companies that do not disclose management forecasts) and to calculate the inverse Mills ratio (in Table 7, "Lambda"). Lambda (the inverse Mills ratio) is then used in the regression model of the second step (4,584 samples) as an "omitted variable" that can estimate the probability of "Guidance."The findings support H1, which states that voluntary disclosures have better quality in terms of forecast accuracy. Also, not shown in Table 7, the results are consistent after controlling for firm- and year-fixed effects.

Table 6.Correlation coefficient.

| | MFE Accuracy | MFE Accuracy Pre | Dis closure | Horizon | Size | Age | ROA | STD ROA | MTB | *Loss Dummy* | Leve rage | Macro econom ics | *Audit Dummy* | *Year* | $L_{ANA}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $MFE_{Accuracy}$ | 1 | -0.017 | -0.004 | -0.106 | -0.127 | -0.086 | -0.041 | -0.010 | -0.009 | -0.031 | -0.011 | 0.066 | -0.027 | -0.081 | -0.102 |
| $MFE_{Accuracy}$ $P$ | -0.017 | 1 | -0.017 | -0.024 | 0.006 | -0.015 | 0.001 | -0.001 | -0.002 | -0.010 | -0.001 | -0.009 | -0.005 | 0.008 | 0.009 |
| Disclosure | -0.004 | -0.017 | 1 | 0.464 | -0.132 | 0.212 | -0.066 | 0.021 | 0.048 | 0.304 | 0.055 | 0.220 | 0.034 | -0.215 | -0.283 |
| Horizon | -0.106 | -0.024 | 0.464 | 1 | -0.105 | 0.333 | -0.066 | 0.029 | 0.058 | 0.265 | 0.069 | 0.119 | 0.043 | -0.148 | -0.267 |
| Size | -0.127 | 0.006 | -0.132 | -0.105 | 1 | 0.005 | 0.035 | -0.007 | -0.035 | -0.208 | -0.053 | -0.243 | 0.163 | 0.372 | 0.524 |
| Age | -0.086 | -0.015 | 0.212 | 0.333 | 0.005 | 1 | -0.006 | 0.042 | 0.053 | 0.106 | 0.035 | -0.217 | 0.004 | 0.243 | -0.202 |
| ROA | -0.041 | 0.001 | -0.066 | -0.066 | 0.035 | -0.006 | 1 | 0.079 | -0.001 | -0.218 | -0.018 | 0.015 | -0.001 | -0.006 | 0.090 |
| STDROA | -0.010 | -0.001 | 0.021 | 0.029 | -0.007 | 0.042 | 0.079 | 1 | 0.014 | -0.005 | 0.002 | 0.000 | -0.008 | -0.002 | -0.024 |
| MTB | -0.009 | -0.002 | 0.048 | 0.058 | -0.035 | 0.053 | -0.001 | 0.014 | 1 | 0.099 | 0.838 | -0.001 | -0.015 | 0.008 | -0.062 |
| Loss Dummy | -0.031 | -0.010 | 0.304 | 0.265 | -0.208 | 0.106 | -0.218 | -0.005 | 0.099 | 1 | 0.116 | 0.005 | -0.007 | -0.036 | -0.270 |
| Leverage | -0.011 | -0.001 | 0.055 | 0.069 | -0.053 | 0.035 | -0.018 | 0.002 | 0.838 | 0.116 | 1 | 0.022 | -0.001 | -0.024 | -0.059 |
| Macroeconomics | 0.066 | -0.009 | 0.220 | 0.119 | -0.243 | -0.217 | 0.015 | 0.000 | -0.001 | 0.005 | 0.022 | 1 | 0.053 | -0.908 | -0.089 |
| Audit Dummy | -0.027 | -0.005 | 0.034 | 0.043 | 0.163 | 0.004 | -0.001 | -0.008 | -0.015 | -0.007 | -0.001 | 0.053 | 1 | -0.051 | 0.098 |
| Year | -0.081 | 0.008 | -0.215 | -0.148 | 0.372 | 0.243 | -0.006 | -0.002 | 0.008 | -0.036 | -0.024 | -0.908 | -0.051 | 1 | 0.094 |
| $L_{ANA}$ | -0.102 | 0.009 | -0.283 | -0.267 | 0.524 | -0.202 | 0.090 | -0.024 | -0.062 | -0.270 | -0.059 | -0.089 | 0.098 | 0.094 | 1 |

Table 7.Heckman model.

| **Model:** | **Selection** | | **Outcome** | |
|---|---|---|---|---|
| Dep Var: | Guidance | | $MFE_{Accuracy}$ | |
| | Coefffcient | z-stat. | Coefffcient | z-stat. |
| $MFE_{Accuracy}$ | | | | |
| Disclosure | | | 0.007** | (2.056) |
| Horizon | | | -0.097*** | (-7.676) |
| Size | 0.532*** | (20.540) | -0.004 | (-0.746) |
| Age | | | -0.001*** | (-3.216) |
| $L_{ANA}$ | 0.047*** | (4.321) | -0.008*** | (-5.250) |
| Audit Dummy | | | -0.001 | (-0.159) |
| Year | | | -0.001*** | (-2.579) |
| STDROA | | | -0.000 | (-0.484) |
| MTB | 0.002*** | (5.413) | -0.000 | (0.569) |
| $MFE_{Accuracy}$_Pre | | | -0.000 | (-1.340) |
| Select | | | | |
| Loss Dummy | 0.680*** | (18.938) | | |
| ROA | 0.262*** | (2.698) | | |
| Mills | | | | |
| Lambda | | | 0.032*** | (3.805) |
| Constant | -5.997*** | (-24.562) | 0.129** | (2.352) |
| Observations | 19,867 | | 4,584 | |

Notes: Z-statistics are in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

### *5.2. Value relevance*

Table 8 presents the descriptive statistics of the "value relevance" variables. The data are separated into two groups: mandatory and voluntary. This study applies the data from the Ohlson model with mixed information to calculate the accuracy of firm value estimation. Table 9 shows that both the mean(0.936) and median(0.429) of the mandatory group are significantly higher (t-values at 8.84 and 2.14) than the mean(0.481) and median(0.319) of the voluntary group, and the results for all of the sample groups are in the middle of the two groups. Table 10 presents the regression analysis results using accuracy of estimation as the dependent variable and Disclosure as the test variable, and controlling for other factors that

explain the accuracy of management forecasts and the predictability of the Ohlson model. The results of the accuracy of estimation together indicate that voluntarily disclosed forecasts contribute to higher accuracy of firm value estimations. Thus, voluntarily disclosed forecasts, which have better quality, are more value-relevant than those that are mandatorily disclosed. Therefore, H2 is supported.

Table 8. Descriptive statistics of "value relevance" variables.

| | N | Mean | Median | Min | Max | Std_Deviation |
|---|---|---|---|---|---|---|
| $V_t$ | 6,640 | 8,689,483,505.855 | 5,102,533,605 | 71,069,380.800 | 985,200,289,600 | 18,527,479,924.002 |
| $b_t$ | 6,640 | 2,742,937,923.608 | 1,408,102,783 | 322,995.530 | 377,182,000,000 | 7,752,824,581.823 |
| $x_t$ | 6,640 | 169,733,557.080 | 69,495,560.020 | -16,216,880,000.000 | 61,290,000,000 | 1,096,246,484.063 |
| $d_t$ | 6,640 | 5,903,244.622 | 0 | 0 | 1,377,556,741 | 38,569,470.211 |
| $F_t[x_{t+1}]$ | 6,640 | 170,467,696.374 | 70,500,000 | -16,300,000,000 | 44,533,500,000 | 951,804,462.775 |

Table 9. Accuracy of estimation.

| **Accuracy_mean** | | | |
|---|---|---|---|
| Accounting Period | Accuracy_Mandatory | Accuracy_Voluntary | Accuracy_All Samples |
| 2008/12/31 | 2.830 | 2.466 | 2.764 |
| 2009/12/31 | 0.645 | 0.336 | 0.591 |
| 2010/12/31 | 0.543 | 0.395 | 0.497 |
| 2011/12/31 | 2.044 | 0.466 | 1.834 |
| 2012/12/31 | 1.397 | 1.188 | 1.355 |
| 2013/12/31 | 2.023 | 0.741 | 1.285 |
| 2014/12/31 | 0.407 | 0.314 | 0.369 |
| 2015/12/31 | 0.472 | 0.421 | 0.441 |
| 2016/12/31 | 0.378 | 0.261 | 0.333 |
| Total | 0.936 | 0.481 | 0.762 |
| Standard deviation | 2.726 | 2.538 | 2.193 |

**Accuracy_median**

| Accounting Period | Accuracy_Mandatory | Accuracy_Voluntary | Accuracy_All Samples |
|---|---|---|---|
| 2008/12/31 | 2.278 | 2.051 | 2.276 |
| 2009/12/31 | 0.426 | 0.295 | 0.386 |
| 2010/12/31 | 0.398 | 0.277 | 0.376 |
| 2011/12/31 | 0.931 | 0.399 | 0.911 |
| 2012/12/31 | 0.899 | 0.648 | 0.797 |
| 2013/12/31 | 0.771 | 0.356 | 0.579 |
| 2014/12/31 | 0.319 | 0.273 | 0.297 |
| 2015/12/31 | 0.419 | 0.430 | 0.412 |
| 2016/12/31 | 0.268 | 0.233 | 0.254 |
| Total | 0.429 | 0.319 | 0.397 |
| Standard deviation | 2.726 | 2.538 | 2.193 |

Table 10.Regression on accuracy of estimation.

| **Model:** | **$MFE_{Accuracy}$(OLS)** | |
|---|---|---|
| | **Coefficient** | **t-stat.** |
| Disclosure | 0.190** | -2.497 |
| $x_t$ | 0 | -1.319 |
| $d_t$ | 0 | -0.973 |
| $b_t$ | 0.000*** | -9.022 |
| $V_t$ | -0.000*** | (-9.520) |
| Horizon | 0.831*** | -2.781 |
| Age | 0 | (-0.018) |
| $L_{ANA}$ | -0.193*** | (-6.404) |
| STD ROA | 0.075*** | -3.769 |
| MTB | 0 | (-0.851) |
| ROA | 2.290*** | -17.228 |
| Constant | 0.928*** | -7.093 |
| Observations | 4,373 | |
| Adj R-squared | 0.1054 | |

Notes: t-statistics are in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

## 6. Robustness tests

For the management forecast accuracy, a general OLS is performed to test the robustness of the Heckman two-stage model (see results in Table 11). The test reveals that Disclosure is

significant at the 90% confidence interval. Moreover, an alternative set of sample data, randomly abstracted from the original data, is applied to the Heckman selection model. Data comprising90% of the original data volume (i.e., 18,798 firm-year samples) show similar results for forecast accuracy, as shown in Table 12.Furthermore, the robustness of the results is checked by replacing $MFE_{Accuracy}$_Pre in Table 9 with Dpre and Dpre* $MFE_{Accuracy}$_Pre, where Dpre equals 1if a firm discloses management's forecast in the previous year and 0 otherwise. Not shown in the table, we found the results are robust.

Furthermore, PSM is applied on the mandatory and voluntary samples to control for the systematic difference between mandatory disclosure and voluntary disclosure and to mitigate the limitation of the selection process in the Heckman two-stage model. The PSM results shown in Tables 13 to 16 are robust to the main results. The PSM model's first equation is as follows:

$$Disclosure = 1 + Horizon + Size + Age + L_{ana} + Audit\ Dummy + Year + STDROA + MTB + MFE_{Accuracy}\_Pre + Loss\ Dummy + ROA$$

Table 11. Management forecast error accuracy (Linear model).

$$MFE_{Accuracy} = 1 + Disclosure + Horizon + Size + Age + L_{ANA} + Audit\ Dummy + Year + STDROA + MTB + MFE_{Accuracy}\_Pre + LossDummy + ROA$$

| | Estimate | SE | t-value | p-value |
|---|---|---|---|---|
| (Intercept) | 0.297 | 0.038 | 7.73 | 0.000 |
| Disclosure | 0.006 | 0.003 | 1.92 | 0.055 |
| Horizon | -0.098 | 0.013 | -7.79 | 0.000 |
| Size | -0.016 | 0.004 | -3.86 | 0.000 |
| Age | -0.001 | 0.000 | -3.14 | 0.002 |
| $L_{ANA}$ | 0.009 | 0.001 | -5.93 | 0.000 |
| Audit Dummy | -0.001 | 0.007 | -0.14 | 0.000 |
| Year | -0.002 | 0.001 | -2.70 | 0.888 |
| STDROA | 0.000 | 0.001 | -0.29 | 0.007 |
| MTB | 0.000 | 0.000 | -0.25 | 0.774 |
| $MFE_{Accuracy}$_Pre | 0.000 | 0.000 | -1.34 | 0.180 |

| | | | | |
|---|---|---|---|---|
| Loss Dummy | -0.015 | 0.004 | -3.59 | 0.000 |
| ROA | -0.019 | 0.006 | -3.27 | 0.001 |
| Observations: | 4,584 | | | |
| DOF: | 4,583 | | | |
| Adjusted R-Squared: | 0.045 | | | |

Table 12. Heckman Model with alternative data set.

| **Model:** | **Selection** | | **Outcome** | |
|---|---|---|---|---|
| Dep Var: | Guidance | | $MFE_{Accuracy}$ | |
| | Coefffcient | z-stat. | Coefffcient | z-stat. |
| $MFE_{Accuracy}$ | | | | |
| Disclosure | | | 0.007** | (2.154) |
| Horizon | | | -0.098*** | (-7.497) |
| Size | 0.535*** | (20.089) | -0.002 | (-0.440) |
| Age | | | -0.001*** | (-3.374) |
| $L_{ANA}$ | 0.046*** | (4.093) | -0.008*** | (-5.265) |
| Audit Dummy | | | 0.000 | (-0.050) |
| Year | | | -0.002*** | (-2.806) |
| STDROA | | | 0.000 | (-0.345) |
| MTB | 0.001*** | (5.281) | 0.000 | (0.845) |
| $MFE_{Accuracy}$_Pre | | | 0.000 | (-1.346) |
| Select | | | | |
| Loss Dummy | 0.682*** | (18.496) | | |
| ROA | 0.264*** | (2.690) | | |
| Mills | | | | |
| Lambda | | | 0.036*** | (4.123) |
| Constant | -6.026*** | (-24.001) | 0.114** | (1.998) |
| Observations | 18,798 | | 4,333 | |

Notes: t-statistics are in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 13. Propensity score matching model (using mandatory vs. voluntary samples).

| ***Variable*** | ***Coefficient*** | ***t-stat.*** |
|---|---|---|
| Disclosure | 0.007** | -2.139 |
| Horizon | -0.091*** | -6.530 |
| Size | -0.016*** | -3.528 |
| Age | -0.001*** | -3.114 |
| $L_{ANA}$ | -0.010*** | -6.191 |
| Audit Dummy | -0.009 | -1.188 |

| | | |
|---|---|---|
| STDORA | -0.001 | -0.597 |
| MTB | 0 | -0.726 |
| $MFE_{Accuracy}$_Pre | 0 | -0.684 |
| Loss Dummy | - | |
| ROA | -0.020*** | -3.268 |
| Year | -0.002*** | -3.448 |
| Constant | 0.296*** | -7.364 |
| Observations | 3,857 | |
| Adj R-squared | 0.061 | |

Note: ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 14. Mean for accuracy of estimation (using propensity score matching samples).

| Accounting Period | Accuracy_Mandatory | Accuracy_Voluntary | Accuracy_All Samples |
|---|---|---|---|
| 2008/12/31 | 2.578 | 2.466 | 2.528 |
| 2009/12/31 | 0.460 | 0.336 | 0.429 |
| 2010/12/31 | 0.468 | 0.395 | 0.427 |
| 2011/12/31 | 2.037 | 0.466 | 1.777 |
| 2012/12/31 | 1.216 | 1.188 | 1.188 |
| 2013/12/31 | 2.250 | 0.741 | 1.219 |
| 2014/12/31 | 0.310 | 0.314 | 0.305 |
| 2015/12/31 | 0.436 | 0.421 | 0.419 |
| 2016/12/31 | 0.326 | 0.261 | 0.302 |
| Total | 0.847 | 0.481 | 0.671 |
| Standard deviation | 2.949 | 2.538 | 2.264 |

Table 15.Median for accuracy of estimation (using propensity score matching samples).

| Accounting Period | Accuracy_Mandatory | Accuracy_Voluntary | Accuracy_All Samples |
|---|---|---|---|
| 2008/12/31 | 2.060 | 2.051 | 2.060 |
| 2009/12/31 | 0.370 | 0.295 | 0.332 |
| 2010/12/31 | 0.329 | 0.277 | 0.293 |
| 2011/12/31 | 0.999 | 0.399 | 0.839 |
| 2012/12/31 | 0.811 | 0.648 | 0.693 |
| 2013/12/31 | 0.695 | 0.356 | 0.507 |
| 2014/12/31 | 0.257 | 0.273 | 0.264 |
| 2015/12/31 | 0.436 | 0.430 | 0.426 |
| 2016/12/31 | 0.235 | 0.233 | 0.225 |
| Total | 0.396 | 0.319 | 0.358 |
| Standard deviation | 2.949 | 2.538 | 2.264 |

Table 16. Regression on accuracy of estimation (using propensity score matching samples).

| Model: | $MFE_{Accuracy}$(PSM) | |
|---|---|---|
| | Coefficient | t-stat. |
| Disclosure | 0.157*** | -2.032 |
| $x_t$ | 0.000*** | -5.788 |
| $d_t$ | 0 | -1.318 |
| $b_t$ | 0.000*** | -5.095 |
| $V_t$ | -0.000*** | (-10.334) |
| Horizon | 0.578* | -1.779 |
| Age | 0.009 | -1.274 |
| $L_{ANA}$ | -0.154*** | (-4.900) |
| STDROA | 0.068*** | -3.445 |
| MTB | -0.004*** | (-3.015) |
| ROA | 3.404*** | -24.637 |
| Constant | 0.678*** | -4.888 |
| Observations | 3,706 | |
| Adj R-squared | 0.1864 | |

Notes: t-statistics are in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Regarding cross-validation, this study adopts 100 sets of randomly abstracted alternative samples for the robustness test. The mean and median of the estimation accuracy are shown in Figures 2 and 3. The results fluctuate within a range of 5%. The random change of the sample set rarely has an effect on the conclusion. The detailed validation results are shown in Appendix B.

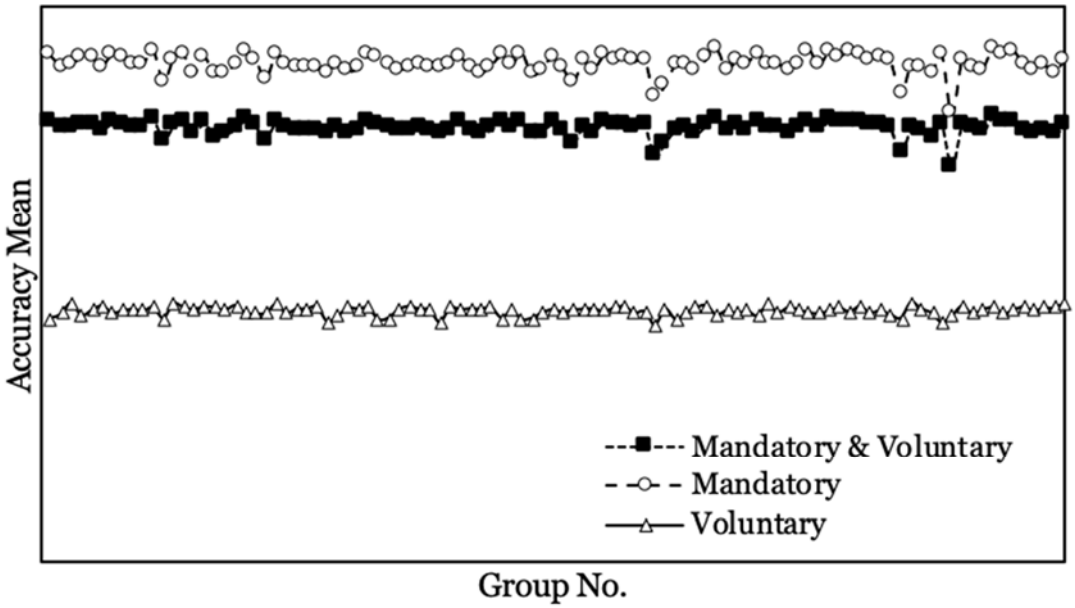



Figure 2. Simulation of the accuracy of the means from 100 sets of randomly abstracted samples: Mandatory vs. voluntary samples

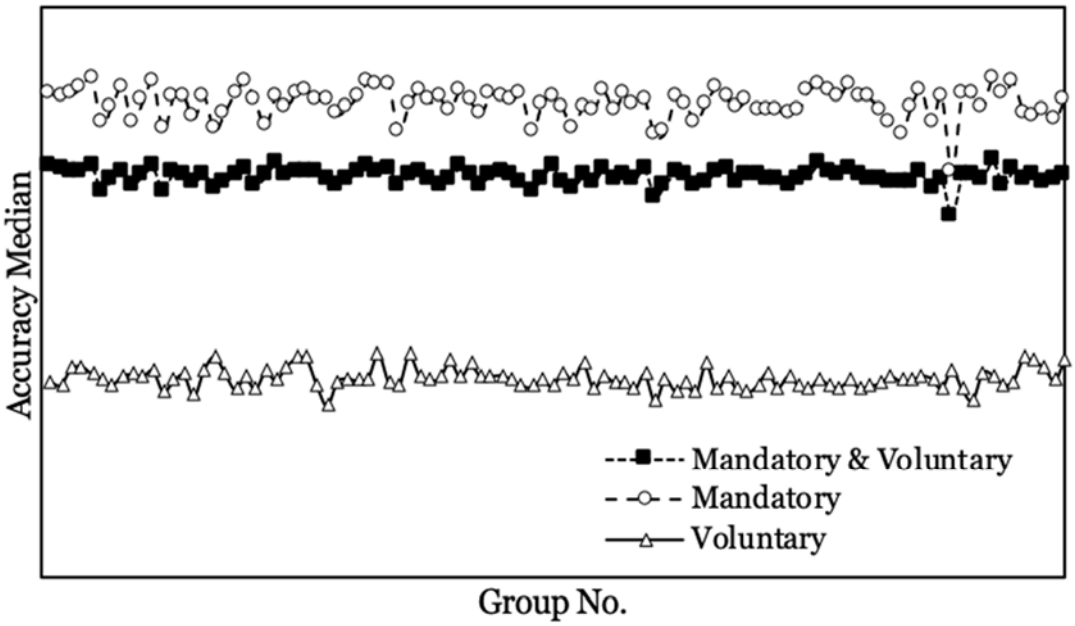



Figure 3. Simulation of the accuracy of the medians from 100 sets of randomly abstracted samples: Mandatory vs. voluntary samples

## 7. Conclusion

The results of this study show a difference in management forecast quality between the two disclosure approaches, which significantly influence forecast accuracy. Mandatorily disclosed forecasts tend to be less accurate, while voluntarily disclosed forecasts are more likely to have smaller forecast errors (i.e., higher accuracy). The results in terms of value relevance are consistent with the belief that management forecast quality (under the context of China's stock market) is better under voluntary versus mandatory disclosure conditions.

This study complements existing literature by providing additional evidence as follows. The findings suggest that investors should be aware of, and consider in their decision-making, the difference in information quality between mandatory and voluntary forecasts.

Additionally, this study examined management forecast quality using replenished data. The Heckman two-stage model used in this study has been adopted by previous studies to address the natural selection problem of samples, as well as endogeneity issues arising from a firm's financial features. Moreover, this study used various robustness tests, including the PSM model, to confirm robustness of the results.

Regarding the study's implications, the findings provide meaningful reference to regulators concerning the effect of a disclosure mandate. The unique setting in China's markets allows a comparison between mandatory and voluntary regimes under the same legal, cultural, and macroeconomic environment.

However, this study has its limitations, specifically in relation to data accessibility and research design. First, the Heckman two-stage model was used to control for the natural selection and endogeneity problems, but it did not explain how a firm decides to disclose

mandatorily, voluntarily, or not disclose at all. In addition, as Lennox, Francis, and Wang (2012) pointed out, the selection of variables in the Heckman selection model is important. We must point out that the results from this study's Heckman selection model could be affected by selection bias. Lastly, regarding the various forecast data types (i.e., point, range, interval, etc.), the analysis results and findings are based on a general integration of all data types. These limitations may provide opportunities for future research.

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***Appendix B***

| | Mean | | | Median | | |
|---|---|---|---|---|---|---|
| | Mandatory & Voluntary | Mandatory | Voluntary | Mandatory & Voluntary | Mandatory | Voluntary |
| group1 | 0.793 | 0.912 | 0.439 | 0.431 | 0.463 | 0.337 |
| group2 | 0.783 | 0.895 | 0.447 | 0.429 | 0.461 | 0.335 |
| group3 | 0.782 | 0.899 | 0.467 | 0.429 | 0.462 | 0.343 |
| group4 | 0.788 | 0.907 | 0.444 | 0.428 | 0.465 | 0.344 |
| group5 | 0.787 | 0.908 | 0.454 | 0.431 | 0.469 | 0.340 |
| group6 | 0.779 | 0.895 | 0.462 | 0.420 | 0.449 | 0.338 |
| group7 | 0.794 | 0.914 | 0.450 | 0.425 | 0.457 | 0.335 |
| group8 | 0.790 | 0.912 | 0.452 | 0.427 | 0.465 | 0.339 |
| group9 | 0.783 | 0.897 | 0.456 | 0.423 | 0.450 | 0.340 |
| group10 | 0.782 | 0.897 | 0.452 | 0.427 | 0.459 | 0.339 |
| group11 | 0.802 | 0.922 | 0.459 | 0.430 | 0.467 | 0.342 |
| group12 | 0.762 | 0.867 | 0.440 | 0.420 | 0.447 | 0.332 |
| group13 | 0.787 | 0.905 | 0.466 | 0.428 | 0.461 | 0.337 |
| group14 | 0.796 | 0.913 | 0.459 | 0.427 | 0.462 | 0.340 |
| group15 | 0.772 | 0.882 | 0.456 | 0.424 | 0.452 | 0.330 |
| group16 | 0.794 | 0.910 | 0.461 | 0.427 | 0.461 | 0.342 |
| group17 | 0.769 | 0.879 | 0.459 | 0.422 | 0.447 | 0.348 |
| group18 | 0.771 | 0.884 | 0.454 | 0.424 | 0.454 | 0.341 |
| group19 | 0.782 | 0.897 | 0.463 | 0.427 | 0.463 | 0.333 |
| group20 | 0.797 | 0.919 | 0.448 | 0.430 | 0.468 | 0.338 |
| group21 | 0.788 | 0.905 | 0.447 | 0.423 | 0.459 | 0.333 |
| group22 | 0.764 | 0.871 | 0.449 | 0.426 | 0.448 | 0.341 |
| group23 | 0.794 | 0.914 | 0.465 | 0.432 | 0.461 | 0.337 |
| group24 | 0.783 | 0.898 | 0.449 | 0.426 | 0.457 | 0.343 |
| group25 | 0.780 | 0.891 | 0.456 | 0.428 | 0.462 | 0.347 |
| group26 | 0.780 | 0.895 | 0.457 | 0.427 | 0.464 | 0.347 |
| group27 | 0.779 | 0.890 | 0.460 | 0.428 | 0.460 | 0.335 |
| group28 | 0.771 | 0.883 | 0.433 | 0.426 | 0.460 | 0.326 |
| group29 | 0.781 | 0.897 | 0.443 | 0.423 | 0.454 | 0.337 |
| group30 | 0.772 | 0.885 | 0.458 | 0.426 | 0.456 | 0.338 |
| group31 | 0.777 | 0.890 | 0.456 | 0.428 | 0.462 | 0.337 |
| group32 | 0.792 | 0.913 | 0.459 | 0.430 | 0.467 | 0.338 |
| group33 | 0.789 | 0.911 | 0.437 | 0.428 | 0.467 | 0.349 |
| group34 | 0.781 | 0.897 | 0.440 | 0.430 | 0.466 | 0.337 |
| group35 | 0.775 | 0.888 | 0.456 | 0.423 | 0.446 | 0.335 |
| group36 | 0.778 | 0.892 | 0.461 | 0.426 | 0.458 | 0.348 |
| group37 | 0.783 | 0.899 | 0.456 | 0.428 | 0.464 | 0.340 |
| group38 | 0.778 | 0.894 | 0.455 | 0.426 | 0.459 | 0.337 |
| group39 | 0.772 | 0.891 | 0.432 | 0.423 | 0.460 | 0.338 |
| group40 | 0.779 | 0.896 | 0.458 | 0.425 | 0.456 | 0.346 |
| group41 | 0.793 | 0.910 | 0.456 | 0.430 | 0.463 | 0.339 |
| group42 | 0.778 | 0.890 | 0.457 | 0.426 | 0.459 | 0.344 |
| group43 | 0.771 | 0.882 | 0.456 | 0.423 | 0.454 | 0.339 |
| group44 | 0.782 | 0.895 | 0.459 | 0.427 | 0.462 | 0.339 |
| group45 | 0.792 | 0.912 | 0.440 | 0.428 | 0.460 | 0.340 |
| group46 | 0.782 | 0.896 | 0.452 | 0.427 | 0.459 | 0.338 |

| | Mean | | | Median | | |
|---|---|---|---|---|---|---|
| | Mandatory & Voluntary | Mandatory | Voluntary | Mandatory & Voluntary | Mandatory | Voluntary |
| group47 | 0.794 | 0.916 | 0.437 | 0.424 | 0.462 | 0.335 |
| group48 | 0.773 | 0.879 | 0.440 | 0.420 | 0.446 | 0.334 |
| group49 | 0.775 | 0.889 | 0.450 | 0.426 | 0.458 | 0.338 |
| group50 | 0.793 | 0.912 | 0.455 | 0.430 | 0.461 | 0.334 |
| group51 | 0.777 | 0.891 | 0.451 | 0.424 | 0.456 | 0.341 |
| group52 | 0.756 | 0.866 | 0.455 | 0.422 | 0.447 | 0.338 |
| group53 | 0.785 | 0.902 | 0.456 | 0.426 | 0.457 | 0.345 |
| group54 | 0.775 | 0.888 | 0.457 | 0.424 | 0.456 | 0.334 |
| group55 | 0.795 | 0.912 | 0.452 | 0.429 | 0.463 | 0.339 |
| group56 | 0.788 | 0.905 | 0.458 | 0.426 | 0.456 | 0.337 |
| group57 | 0.791 | 0.908 | 0.461 | 0.426 | 0.462 | 0.336 |
| group58 | 0.785 | 0.902 | 0.449 | 0.425 | 0.458 | 0.333 |
| group59 | 0.789 | 0.906 | 0.452 | 0.430 | 0.460 | 0.340 |
| group60 | 0.732 | 0.839 | 0.427 | 0.417 | 0.444 | 0.328 |
| group61 | 0.757 | 0.861 | 0.456 | 0.423 | 0.446 | 0.338 |
| group62 | 0.780 | 0.896 | 0.438 | 0.428 | 0.460 | 0.333 |
| group63 | 0.782 | 0.896 | 0.448 | 0.427 | 0.458 | 0.336 |
| group64 | 0.773 | 0.886 | 0.459 | 0.423 | 0.451 | 0.332 |
| group65 | 0.788 | 0.907 | 0.463 | 0.424 | 0.458 | 0.344 |
| group66 | 0.801 | 0.925 | 0.445 | 0.428 | 0.465 | 0.333 |
| group67 | 0.777 | 0.888 | 0.453 | 0.429 | 0.461 | 0.339 |
| group68 | 0.791 | 0.904 | 0.448 | 0.424 | 0.456 | 0.333 |
| group69 | 0.780 | 0.900 | 0.452 | 0.427 | 0.460 | 0.332 |
| group70 | 0.797 | 0.917 | 0.444 | 0.426 | 0.455 | 0.335 |
| group71 | 0.781 | 0.896 | 0.464 | 0.426 | 0.455 | 0.341 |
| group72 | 0.782 | 0.898 | 0.449 | 0.425 | 0.455 | 0.334 |
| group73 | 0.774 | 0.887 | 0.459 | 0.423 | 0.454 | 0.339 |
| group74 | 0.783 | 0.896 | 0.455 | 0.425 | 0.455 | 0.335 |
| group75 | 0.796 | 0.922 | 0.449 | 0.426 | 0.464 | 0.333 |
| group76 | 0.782 | 0.896 | 0.448 | 0.432 | 0.466 | 0.338 |
| group77 | 0.797 | 0.919 | 0.453 | 0.428 | 0.463 | 0.335 |
| group78 | 0.793 | 0.912 | 0.458 | 0.427 | 0.461 | 0.334 |
| group79 | 0.795 | 0.918 | 0.451 | 0.430 | 0.467 | 0.337 |
| group80 | 0.793 | 0.912 | 0.461 | 0.427 | 0.461 | 0.334 |
| group81 | 0.788 | 0.906 | 0.450 | 0.426 | 0.460 | 0.335 |
| group82 | 0.791 | 0.907 | 0.453 | 0.425 | 0.456 | 0.336 |
| group83 | 0.784 | 0.902 | 0.446 | 0.423 | 0.451 | 0.339 |
| group84 | 0.737 | 0.846 | 0.440 | 0.424 | 0.444 | 0.337 |
| group85 | 0.781 | 0.894 | 0.468 | 0.424 | 0.456 | 0.337 |
| group86 | 0.780 | 0.895 | 0.457 | 0.428 | 0.464 | 0.339 |
| group87 | 0.767 | 0.880 | 0.449 | 0.421 | 0.450 | 0.338 |
| group88 | 0.790 | 0.914 | 0.432 | 0.425 | 0.461 | 0.334 |
| group89 | 0.712 | 0.808 | 0.444 | 0.409 | 0.429 | 0.342 |
| group90 | 0.789 | 0.905 | 0.461 | 0.427 | 0.462 | 0.333 |
| group91 | 0.781 | 0.895 | 0.447 | 0.426 | 0.462 | 0.328 |
| group92 | 0.775 | 0.890 | 0.455 | 0.425 | 0.456 | 0.341 |
| group93 | 0.804 | 0.925 | 0.459 | 0.433 | 0.469 | 0.340 |
| group94 | 0.794 | 0.915 | 0.447 | 0.422 | 0.462 | 0.336 |
| group95 | 0.795 | 0.921 | 0.454 | 0.429 | 0.467 | 0.337 |

| | Mean | | | Median | | |
|---|---|---|---|---|---|---|
| | Mandatory & Voluntary | Mandatory | Voluntary | Mandatory & Voluntary | Mandatory | Voluntary |
| group96 | 0.779 | 0.896 | 0.460 | 0.426 | 0.455 | 0.347 |
| group97 | 0.773 | 0.887 | 0.453 | 0.426 | 0.453 | 0.345 |
| group98 | 0.780 | 0.896 | 0.458 | 0.424 | 0.455 | 0.343 |
| group99 | 0.772 | 0.883 | 0.458 | 0.425 | 0.451 | 0.337 |
| group100 | 0.788 | 0.906 | 0.468 | 0.427 | 0.460 | 0.346 |
| All Data | 0.782 | 0.897 | 0.450 | 0.427 | 0.461 | 0.338 |

| | **Accuracy (Standard Deviation)** | | |
|---|---|---|---|
| | Mandatory & Voluntary | Mandatory | Voluntary |
| group1 | 2.108 | 2.547 | 0.621 |
| group2 | 2.038 | 2.439 | 0.658 |
| group3 | 2.103 | 2.540 | 0.914 |
| group4 | 2.091 | 2.522 | 0.625 |
| group5 | 2.079 | 2.512 | 0.845 |
| group6 | 2.102 | 2.533 | 0.899 |
| group7 | 2.118 | 2.562 | 0.808 |
| group8 | 2.128 | 2.568 | 0.748 |
| group9 | 2.120 | 2.557 | 0.825 |
| group10 | 2.094 | 2.532 | 0.852 |
| group11 | 2.144 | 2.584 | 0.834 |
| group12 | 2.003 | 2.411 | 0.778 |
| group13 | 2.107 | 2.542 | 0.948 |
| group14 | 2.134 | 2.573 | 0.881 |
| group15 | 2.041 | 2.445 | 0.888 |
| group16 | 2.111 | 2.539 | 0.837 |
| group17 | 2.093 | 2.523 | 0.884 |
| group18 | 2.030 | 2.446 | 0.745 |
| group19 | 2.063 | 2.479 | 0.842 |
| group20 | 2.116 | 2.551 | 0.799 |
| group21 | 2.112 | 2.537 | 0.880 |
| group22 | 1.983 | 2.390 | 0.760 |
| group23 | 2.128 | 2.577 | 0.941 |
| group24 | 2.057 | 2.473 | 0.747 |
| group25 | 1.908 | 2.289 | 0.805 |
| group26 | 2.074 | 2.504 | 0.830 |
| group27 | 2.024 | 2.442 | 0.834 |
| group28 | 1.953 | 2.355 | 0.752 |
| group29 | 2.119 | 2.565 | 0.679 |
| group30 | 1.993 | 2.400 | 0.828 |
| group31 | 2.001 | 2.415 | 0.847 |
| group32 | 2.126 | 2.567 | 0.917 |
| group33 | 2.105 | 2.547 | 0.547 |
| group34 | 2.002 | 2.427 | 0.774 |
| group35 | 2.059 | 2.467 | 0.824 |
| group36 | 2.107 | 2.534 | 0.856 |
| group37 | 2.092 | 2.525 | 0.833 |
| group38 | 2.038 | 2.454 | 0.881 |

| | Accuracy (Standard Deviation) | | |
|---|---|---|---|
| | Mandatory & Voluntary | Mandatory | Voluntary |
| group39 | 2.081 | 2.530 | 0.589 |
| group40 | 2.088 | 2.519 | 0.820 |
| group41 | 2.128 | 2.569 | 0.880 |
| group42 | 2.017 | 2.436 | 0.828 |
| group43 | 2.058 | 2.478 | 0.822 |
| group44 | 2.091 | 2.516 | 0.895 |
| group45 | 2.119 | 2.556 | 0.619 |
| group46 | 2.080 | 2.510 | 0.828 |
| group47 | 2.143 | 2.603 | 0.739 |
| group48 | 2.028 | 2.415 | 0.657 |
| group49 | 2.092 | 2.525 | 0.846 |
| group50 | 2.132 | 2.558 | 0.849 |
| group51 | 2.105 | 2.536 | 0.824 |
| group52 | 1.923 | 2.328 | 0.823 |
| group53 | 2.111 | 2.545 | 0.839 |
| group54 | 1.998 | 2.411 | 0.914 |
| group55 | 2.125 | 2.559 | 0.754 |
| group56 | 2.069 | 2.487 | 0.873 |
| group57 | 2.056 | 2.463 | 0.878 |
| group58 | 2.121 | 2.549 | 0.803 |
| group59 | 2.114 | 2.548 | 0.809 |
| group60 | 1.875 | 2.244 | 0.741 |
| group61 | 2.014 | 2.421 | 0.882 |
| group62 | 2.011 | 2.420 | 0.738 |
| group63 | 2.099 | 2.525 | 0.793 |
| group64 | 2.055 | 2.479 | 0.867 |
| group65 | 2.102 | 2.530 | 0.832 |
| group66 | 2.149 | 2.593 | 0.731 |
| group67 | 2.038 | 2.448 | 0.825 |
| group68 | 2.142 | 2.540 | 0.787 |
| group69 | 2.113 | 2.546 | 0.877 |
| group70 | 2.144 | 2.593 | 0.675 |
| group71 | 2.111 | 2.540 | 0.906 |
| group72 | 2.104 | 2.541 | 0.811 |
| group73 | 2.039 | 2.445 | 0.887 |
| group74 | 2.096 | 2.522 | 0.843 |
| group75 | 2.139 | 2.597 | 0.823 |
| group76 | 1.991 | 2.404 | 0.814 |
| group77 | 2.141 | 2.583 | 0.857 |
| group78 | 2.139 | 2.568 | 0.893 |
| group79 | 2.166 | 2.618 | 0.792 |
| group80 | 2.044 | 2.461 | 0.896 |
| group81 | 2.111 | 2.547 | 0.824 |
| group82 | 2.132 | 2.567 | 0.823 |
| group83 | 2.117 | 2.560 | 0.641 |
| group84 | 1.978 | 2.362 | 0.767 |
| group85 | 2.112 | 2.540 | 0.943 |
| group86 | 1.997 | 2.414 | 0.830 |
| group87 | 2.006 | 2.425 | 0.760 |
| group88 | 2.131 | 2.584 | 0.591 |

| | Accuracy (Standard Deviation) | | |
|---|---|---|---|
| | Mandatory & Voluntary | Mandatory | Voluntary |
| group89 | 1.874 | 2.252 | 0.633 |
| group90 | 2.087 | 2.515 | 0.828 |
| group91 | 2.046 | 2.444 | 0.831 |
| group92 | 2.064 | 2.484 | 0.819 |
| group93 | 2.130 | 2.560 | 0.843 |
| group94 | 2.066 | 2.485 | 0.739 |
| group95 | 2.151 | 2.610 | 0.930 |
| group96 | 2.064 | 2.481 | 0.862 |
| group97 | 2.045 | 2.460 | 0.815 |
| group98 | 2.047 | 2.458 | 0.785 |
| group99 | 2.039 | 2.455 | 0.843 |
| group100 | 2.112 | 2.543 | 0.922 |
| All Data | 2.071 | 2.494 | 0.807 |