Corporate governance, information disclosure and investment - Cash flow sensitivity

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ARTICLE INFO

ABSTRACT

We investigate the impact of cash flow on investment spending under the scenarios of underinvestment and overinvestment and the moderating effect of corporate governance and information disclosure on the sensitivity of both. The empirical analysis is conducted by selecting listed companies in the manufacturing sector from 2013 to 2020. We find that companies investment is highly sensitive to cash flow under financing constraints and overinvestment due to agency costs. In the case of overinvestment, improving the level of disclosure significantly mitigates investment-cash flow sensitivity; in the case of underinvestment, improving corporate governance significantly reduces investment-cash flow sensitivity.

1. Introduction

Investment is the basis for business growth. Only by investing in projects with positive net cash flow can a company earn profits in order to expand. Internal cash flow is one of the channels of corporate financing, and there is an inseparable relationship between corporate investment activities and corporate cash flow. It is essential to understand the general dependence of investment activities on the cash flow of Chinese enterprises today and how to reduce this dependence. The manufacturing industry has always played an essential role in China's national economic system, and its development is a critical macroeconomic proposition for China. Only when the overall productivity of the manufacturing industry is improved can the allocation of resources be optimized and the sustainability of the real economy be ensured. This will ensure that the economy runs smoothly under low bubble conditions?

The development of the manufacturing industry is inseparable from the excellent investment of enterprises. At the same time, manufacturing companies in China generally have problems such as low profitability, tight cash flow, and inadequate internal management. A higher investment-cash flow sensitivity means that in the case of insufficient cash flow, companies will lack sufficient funds and give up good investment projects, or blindly increase investment in the case of sufficient cash flow, thus making the investment behavior of companies more volatile due to the influence of cash flow level. Furthermore, only when the enterprise's investment-cash flow sensitivity is weak the investment behavior decision can be relatively independent of the restriction on internal cash flow: when the enterprise finds good investment opportunities, it will not give up investment projects because of insufficient cash flow level, and can obtain funds to meet the project development needs through various financing channels; when the investment opportunities are not beneficial to the company, it will not invest blindly because of the cash flow; When the investment opportunity is not beneficial to the company, it will not impulsively invest because of the abundant cash flow, but can carefully analyze the net present value of the project before making a choice.

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Corporate investment is the fundamental basis and means by which it can achieve its objectives. An enterprise's competitiveness can be enhanced through corporate investment in good projects, which is a fundamental guarantee of strengthening and seeking development. Through the study on the sensitivity of corporate investment to cash flow, we can get the overall level of investment cash flow sensitivity of listed enterprises in China. We can also see whether this sensitivity is affected by information disclosure or agency problems. This will help enterprises make better investment decisions, formulate better investment management measures, and provide guidance for the country to improve the effectiveness of the capital market. It will also strengthen the supervision of internal corporate governance, and improve the construction of an information disclosure system. Theoretically, studies on the relationship between investment and cash flow are limited. There needs to be more literature on the motivation for sensitivity from the perspectives of both internal corporate governance mechanisms and external information disclosure. This paper builds on previous theoretical studies (Gupta et al., 2021) and continues to explore the impact of cash flow on investment in depth. Due to the limited effectiveness of the Chinese capital market and the specificity of Chinese companies in terms of ownership, the issue of the sensitivity of investment cash flows of Chinese companies should be analyzed with due regard to the Chinese context.

This paper investigates the impact of cash flow on investment spending. It also examines the moderating effect of corporate governance and information disclosure on the sensitivity of both underinvestment and overinvestment scenarios. It uses the manufacturing companies listed in Shenzhen City from 2013 to 2020 as the research sample. The conclusions of the study are as follows: on the whole, the problem of investment-cash flow sensitivity still exists in China's listed manufacturing companies, and this problem exists in both over-investment and under-investment scenarios; information disclosure can reduce the company's investment-cash flow sensitivity, and this inhibitory effect is more evident in the over-investment group; the effect of corporate governance on investment-cash flow is somewhat different in the over-investment and under-investment scenarios. Corporate governance's effect on investment-cash flow differs between over-investment and under-investment scenarios.

Previous studies on investment-cash flow sensitivity tend to use a simple Tobin's Q linear model with little consideration of relevant variables (Bukalska, 2020), and the research methods are mostly limited to group tests and static panel regressions (Khan et al., 2019), which are all contributed in this paper. A nonlinear Eulerian investment model with a series of control variables, including the nature of ownership, is used. The model design is consistent with the efficiency level of developing country securities markets with Chinese characteristics. Moreover, the paper contributions includes corporate governance and information disclosure in analyzing cash flow affecting investment. In addition, when calculating information disclosure, the paper abandons the traditional index of "probability of informed trading (PIN)" to measure information asymmetry (Kashefi-Pour et al., 2020) and uses the information assessment results of SZSE instead, which simplifies the calculation and enhances the results. In measuring the level of corporate governance, factors in shareholding structure, board governance, and management governance are considered, and factor analysis is used to calculate the corporate governance index.

2. Theoretical derivation and hypothesis formulation

The relationship between investment-cash flow sensitivity and financing constraints is not a single positive correlation but a more complex one; the agency problem is more severe in Chinese listed companies, which may have a particular preference for endogenous financing due to specific corporate governance issues, and this preference is also motivated by 'insider control,' making investment-cash flow sensitivity an ineffective proxy for the external financing constraints faced by companies. Under the assumption of imperfect capital markets, corporations need to spend more on external financing than internal financing (Machokoto et al., 2021). Considering the actual development of China's capital market, corporations with more or less imperfect external information disclosure and internal governance still prefer to use internal cash flow financing to meet investment expenditures. Thus corporate investment behavior will show a high correlation with the level of cash flow (Yang and Kim, 2020). Accordingly, the hypothesis of this paper is proposed.

H1. *: There is a significant investment-cash flow sensitivity in the sample as a whole, and cash flow significantly affects the level of investment.*

Although scholars define corporate governance differently, they all agree that a good level of corporate governance maximizes the firm's value and satisfies the interests of all stakeholders, including shareholders and operators, thereby increasing investment efficiency (Guizani and Ajmi, 2021). Further, this paper divides internal corporate governance into three dimensions: equity concentration, board and supervisory board governance, and management incentives. As an important factor affecting investment efficiency, there is a close relationship between corporate governance and firm operations (Jiang et al., 2019). Due to the separation of ownership and operation of the company, significant shareholders can seek private control benefits by secretly transferring company resources and forcing the company to invest in unprofitable but beneficial projects for the controlling shareholder by plundering control. In contrast, under suitable corporate governance mechanisms, these inefficient investments caused by agency problems are reduced, and thus the firm's investment-cash flow sensitivity is reduced (Khodamipour and Amiri, 2019).

In the case of overinvestment, corporate governance mechanisms, as an institutional norm, can reduce the interests of internal managers against external investors, thus effectively curbing inefficient investments due to agency problems. On the one hand, by reducing the concentration of equity and expanding the size of the board of directors and supervisory board, the agency behavior of managers can be effectively regulated and restrained. The misuse of free cash will be reduced so that the behavior of using sufficient internal cash flow to expand investment blindly will be effectively curbed (French and Li, 2022); on the other hand, an excellent managerial incentive system will managers' operating performance is linked to the value of the company, which makes managers make investment decisions with full consideration of the company's interests and reduces their behavior of using idle funds to invest blindly, thus reducing investment-cash flow sensitivity (El Ghoul and Karoui, 2021).

In addition to solving managers' agency problems, suitable corporate governance mechanisms imply increased information

exchange between company operators and owners (Guizani et al., 2021). In the case of underinvestment, by communicating positive information about internal management and decision-making to shareholders promptly, corporate managers can alleviate corporate constraints in equity financing and thus corporate underinvestment, thus ensuring that financing can be obtained promptly and at a reasonable cost to meet investment project needs (Beladi et al., 2021).

Based on the above analysis, this paper argues that as the quality of corporate governance improves, agency conflicts between managers and owners will decrease, and more information will be exchanged between owners and investors. Thus investment efficiency will increase, and the sensitivity of investment to cash flow will decrease. Accordingly, we propose the hypothesis that.

H2. *: Corporate governance effectively mitigates investment-cash flow sensitivity, the higher the level of corporate governance, the less sensitive investment is to cash flow.*

Further, we classify the inefficient investment behavior of firms into two scenarios of over-investment and under-investment and propose the following hypothesis.

H2.1. *: In the case of over-investment, corporate governance can effectively mitigate investment-cash flow sensitivity.*

H2.2. *: In the case of underinvestment, corporate governance can effectively mitigate investment-cash flow sensitivity.*

The effect of information disclosure on investment-cash flow sensitivity can be discussed in underinvestment and overinvestment, as it improves internal and external communication and reduces information asymmetry between the two sides of the transaction. In the case of underinvestment, information disclosure can mitigate the dependence of investment on cash flow by widening access to finance and expanding external financing, thus dampening investment-cash flow sensitivity (Tran, 2020a). First, with the improvement of information disclosure quality, investors will have a better understanding of the internal operation and profitability of the company and thus will be able to judge the good or bad investment projects of different companies based on the disclosed information before making decisions on investment behavior. By comparing the company's credit rating with the average credit level of the market, it is conducive for investors to have more reasonable pricing of investment projects and optimize the resource. Thus, companies facing financing difficulties can obtain external funds at a cost that matches their credit level, thus effectively avoiding the "old car market" dilemma (Bhardwaj and Kumar, 2020). Second, improved disclosure also reduces investors' risk-taking, reducing their required payoffs and thus reducing the external financing costs of firms. Finally, proactive information disclosure is also a sign of a company's increased competitive strength, which helps to enhance creditors' confidence and trust in the company and increase their willingness to invest. Therefore, the debt and equity financing costs will decrease as the information disclosure level increases. The narrowing of the gap between the cost of external financing and the cost of using internal funds will reduce the company's preference for cash flow, which will also make the company's investment behavior decisions relatively independent of the level of cash flow and depend on the goodness of investment projects and the needs of the company's development, thus making the company's investment less dependent on cash flow (Tran, 2020b).

In the case of over-investment, information disclosure can effectively curb the inefficient investment of the company, effectively play a regulatory role and reduce the investment-cash flow sensitivity. As the quality of information disclosure improves, the financial and non-financial charges of the company will be disclosed more often. The behavior and management performance of the company's managers will be more regulated by the market, thus forcing the company's managers to strive to improve the company's value, increase the efficiency of the use of capital, and use it for investment opportunities that can be profitable. Therefore, information disclosure has a dual role in financing and regulation, according to which the following hypothesis is made.

H3. *: Disclosure effectively mitigates the sensitivity of investment to cash flow, and the higher the level of disclosure, the less sensitive investment is to cash flow.*

Further, we classify the inefficient investment behavior of companies into two scenarios of over-investment and under-investment and make the following hypothesis.

H3.1. *: In the case of over-investment, information disclosure can effectively mitigate investment-cash flow sensitivity.*

H3.2. *: In the case of underinvestment, information disclosure can effectively mitigate investment-cash flow sensitivity.*

3. Study design

3.1. Model design

This paper uses the Euler equation investment model to investigate the investment-cash flow sensitivity. In addition, to avoid the endogeneity problem that arises when ordinary least squares and fixed or random effects models are estimated for dynamic panel data models, this paper will use the dynamic panel generalized method of moments (GMM) for estimation.

Combined with the previous description of the study and research hypotheses, this paper uses Eq. (1) to verify the impact of investment on cash flow.

$$INVEST_{it} = \beta_0 + \beta_1 INVEST_{it-1} + \beta_2 INVEST^2_{it-1} + \beta_3 CASH_i + \beta_4 DEBT + \beta_5 SIZE + \beta_6 AGE + \beta_7 OWNERSHIP + v_{it} \tag{1}$$

Where $INVEST_{it-1}$ and $INVEST^2_{it-1}$ denote the lagged first order of investment and its quadratic term, respectively, and if their

coefficients are significantly positive, it indicates that cash flow positively affects investment, i.e., investment is sensitive to cash flow.

To further verify the inhibitory effect of corporate governance on investment-cash flow sensitivity, the interaction term between corporate governance and cash flow is added to obtain Eq. (2).

$$INVEST_{it} = \beta_0 + \beta_1 INVEST_{it-1} + \beta_2 INVEST_{it-1}^2 + \beta_3 CASH_i + \beta_4 GOVERNANCE * CASH + \beta_5 DEBT + \beta_6 SIZE + \beta_7 AGE$$
$$+ \beta_8 OWNERSHIP + v_{it} \tag{2}$$

Where *GOVERNANCE*CASH* is the interaction term between corporate governance and cash flow, and if its coefficient is negative, it indicates that the level of corporate governance can inhibit the positive effect of cash flow on investment.

Similarly, the inhibitory effect of information disclosure on investment-cash flow sensitivity is further verified by adding the interaction term between information disclosure and cash flow to obtain Eq. (3).

$$INVEST_{it} = \beta_0 + \beta_1 INVEST_{it-1} + \beta_2 INVEST_{it-1}^2 + \beta_3 CASH_i + \beta_4 DISCLOSURE * CASH + \beta_5 DEBT + \beta_6 SIZE + \beta_7 AGE$$
$$+ \beta_8 OWNERSHIP + v_{it} \tag{3}$$

3.2. Variable definition

3.2.1. Investment - cash flow sensitivity metric

Cash flow sensitivity is reflected by the coefficient of the cash flow (CASH) term in Eqs. (1) – (2), and a significant positive coefficient indicates the existence of cash flow sensitivity. In order to avoid the bias caused by the difference in the size of the sample companies, this paper standardizes the investment expenditure by dividing the investment by the total assets at the beginning of the period, "cash paid for the purchase and construction of fixed assets, intangible assets and other long-term assets/total assets at the beginning of the period."

Since cash flow from operating activities can be obtained directly from the cash flow statement and reflects the adequacy of the company's internal funds, the paper uses "net cash flow from operating activities" in the cash flow statement for the measurement of cash flow, which also needs to be standardized by dividing the net cash flow from operating activities divided by total assets at the beginning of the period, "net cash flow from operating activities/total assets."

3.2.2. Information disclosure and corporate governance metrics

In order to regulate the information disclosure behavior of listed companies, Shenzhen Stock Exchange conducts an annual assessment according to the timeliness, accuracy, and impact of information disclosure of listed companies. The results are from low to high according to the quality of information disclosure: failing, passing, reasonable, and excellent, which will be assigned as 1, 2, 3, and 4 in this paper and expressed by the variable *DISCLOSURE*.

In this paper, we find the relevant eight indicators from three perspectives of equity structure, board governance, and management governors and then calculate the total evaluation value of corporate governance (*GOVERNANCE*) through factor analysis. The indicators are shown in Table 1.

In order to make the empirical results more consistent with the actual situation in China, several control variables are included in the study, including ownership nature (*OWNERSHIP*), corporate gearing ratio (*DEBT*), enterprise size (*SIZE*) and listing years on the market (*AGE*). A summary of all the variables involved in the paper is shown in Table 2.

3.3. Data sources

Therefore, in order to make the research time continuous and the research results reliable, it is necessary to make the sample include as many listed companies that have completed the share reform as possible, so the starting point of the sample period is determined as 2013 in this paper; and the results of annual financial reports and information disclosure assessments of listed companies are announced in April and June respectively, so the end point of the sample period is determined as 2020 in order to ensure the availability of data. Since the data involving several variables, such as cash flow, information disclosure, and corporate governance, are obtained annually, the sample interval is selected as the year in this paper. In terms of sample selection, the object selected in this paper is the data of manufacturing companies listed on the Shenzhen Stock Exchange, which is classified based on the industry

Table 1
Corporate governance variables.

Governance elements	Indicator name and calculation method
Shareholding Structure	Shareholding concentration (Herfindahl index of shares held by the five largest shareholders)
Board of Directors, Supervisory Board Governance	Size of the Board of Directors
	Proportion of sole directors to directors
	Two jobs and the situation (otherwise count 1 point)
	Size of the Supervisory Board
Management Governance	Management shareholding
	Executive shareholding
	Board of Directors' shareholding

Table 2
Summary of variables.

Variable symbols	Variable full name	Remarks	Meaning	Data source
INVEST	Enterprise investment level	Explained variables	Cash paid for the construction of fixed assets, intangible assets and other long-term assets	CSMAR
CASH	Cash Flow	Explanatory variables	Net cash flow from operating activities for the year	CSMAR
DISCLOSURE	Information Disclosure	Explanatory variables	Selection of disclosure assessment results given by the Shenzhen Stock Exchange	SZSE official website
GOVERNANCE	Corporate Governance	Explanatory variables	Shareholding structure; board of directors, supervisory board governance, management governance	CSMAR
DEBT	Liabilities of enterprises	Control variables	Total liabilities	CSMAR
SIZE	Company Size	Control variables	Logarithm of total assets for the year	CSMAR
AGE	Years on the market	Control variables	Year of a year minus the year the company went public	CSMAR
OWNERSHIP	Nature of ownership	Control variables	Dummy variable, private is 0, otherwise is 1	CSMAR

classification standard of the Securities and Futures Commission in 2012. Restricting the object to SZSE companies is to consider that only SZSE is currently evaluating the quality of information disclosure of listed companies. Moreover, the industry selected as the manufacturing industry is inseparable from the importance and investment characteristics of the manufacturing industry. This paper selects manufacturing companies on the SZSE as the research object and carries out the following screening: excluding stocks with less than three consecutive years of available data; excluding stocks marked with ST and *ST; excluding companies with missing or abnormal financial data; excluding stocks marked with S. After the above processing, the final sample contains a total of 2050 data records. The data used for the study were obtained from the official website of SZSE and the database of Guotaian (CSMAR).

4. Empirical analysis

4.1. Factor analysis and test results

Before dynamic panel estimation, each company's annual corporate governance indices were first obtained by factor analysis. The linear relationship between the individual factors and the original indexes was obtained by outputting the factor score coefficients through SPSS22.0, and the results are shown in Table 3.Based on the data in the table, the three individual factors of the coefficient matrix are expressed in the linear form of each original variable. The individual factor scores are calculated based on the factor score function of each factor. The score function of the public factor is a linear function of the three factors. The score of the public factor calculated using the score function is the total evaluation value of corporate governance.

In this paper, the maximum, minimum, mean and standard deviation of all variables were analysed with descriptive statistics and the results are shown in Table 4.

4.2. Regression results of the effect of cash flow on investment

The results generated using the one-step systematic GMM estimation are shown in Table 5. The regression results show that overall, the coefficients on the investment lag term and its quadratic and cash flow terms are significant, and the Euler equation model passes the significance test. In terms of investment-cash flow sensitivity, internal cash flow has a significant positive effect on the level of investment: for every 1 unit increase in the level of internal cash flow, other things being equal, the level of company investment subsequently increases by 0.110 units, which indicates that the problem of investment being susceptible to cash flow still exists in China's manufacturing industry, and hypothesis 1 holds. This sensitivity may be due to the lack of sufficient financing channels for manufacturing companies to meet their investment needs, or it may be due to the low level of corporate management, which leads companies to be too aggressive in their cash flow management activities and tend to over-invest. Both cases will be discussed further.

In addition, concerning the control variables, the level of debt, the age of the firm, and the nature of the firm's ownership all

Table 3
Factor score coefficient matrix.

	Factor 1	Factor 2	Factor 3
Shareholding Concentration	−0.037	−0.034	0.324
Two jobs at once	0.129	−0.140	0.729
Director Size	0.008	0.515	0.002
Supervisor Size	0.011	0.543	−0.093
Percentage of independent directors	0.060	0.091	0.410
Management shareholding	0.389	−0.015	0.122
Executive Shareholding	0.286	0.055	−0.132
Board of Directors' shareholding	0.387	−0.015	0.112

Table 4

Descriptive statistical analysis table.

	N	Max	Min	Mean	std
INVEST	2050	0.449	0.002	0.054	0.052
CASH	2050	0.762	−0.847	0.036	0.080
AGE	2050	24	0	6.438	5.868
DEBT	2050	0.939	0.003	0.023	0.068
OWNERSHIP	2050	1	0	0.754	0.430
DISCLOSURE	2050	4	1	3.045	0.585
GOVERNANCE	2050	16.260	1.110	0.026	0.496

Table 5

Investment-cash flow sensitivity regression results.

$INVEST_{t-1}$	$INVEST^2_{it-1}$	*Cash*	*Debt*	*Age*	*Ownership*
0.794***	−1.893*	0.110**	−0.010**	−0.002**	−0.002**
(4.06)	(−1.93)	(2.23)	(−2.03)	(−2.37)	(−2.31)

significantly affect the level of investment. The significant negative effect of debt level on investment level may be due to firms' preference for internal financing; the significant negative effect of firm age on investment level indicates that firms' investment level tends to be more robust as their establishment time increases; the nature of firm ownership also has a significant effect on investment level, with private firms tending to have a higher level of investment than state-owned firms.

In order to prove the reliability of the GMM estimation results, we discussed the residual autocorrelation problem separately using the AR test. From the AR test results, it can be seen that the p-value corresponding to AR (1) is less than 0.01, rejecting the original hypothesis that there is no residual autocorrelation, there is residual autocorrelation in the original equation; the p-value corresponding to AR (2) is 0.980, accepting the original hypothesis that there is no residual autocorrelation in the first-order difference equation, in line with the GMM estimation.

4.3. The role of corporate governance in moderating investment-cash flow sensitivity

Since investment-cash flow sensitivity may arise from either financing constraints due to information asymmetry or "empire building" due to agency problems, it is necessary to distinguish between the two cases and explore the moderating effect of information disclosure on investment-cash flow sensitivity in each case. We first divide the sample into the underinvested portfolio, overinvestment group and. The grouping method is based on the expected investment model of Richardson (2006). Unlike ordinary least squares regression, GMM dynamic panel estimation talks less about the residual term, so in this paper, we bring the regression coefficients in Table 6 into the equation. The calculated investment level represents the expected investment level, counted as Ie. The actual investment level of the firm is *I*. Then "*I- Ie*" indicates the difference between the actual investment level of the firm, and "*I- Ie*" represents the difference between the actual investment level and the expected investment level. If the difference is positive, *I-Ie>0*, the company is assigned to the over-investment group; if the difference is negative, I-Ie<0, the company is assigned to the under-investment group.

Table 6

Effect of corporate governance on investment-cash flow sensitivity.

	Underinvestment group		Overinvestment group	
	Model 2	Model 3	Model 2	Model 3
$INVEST_{t-1}$	0.699***	0.698***	0.305***	0.691***
	(6.07)	(6.06)	(6.09)	(5.44)
$(INVEST_{t-1})^2$	−0.319***	−0.319***	−0.3197***	−0.313***
	(−9.12)	(−9.11)	(−9.13)	(−8.69)
CASH	0.009*	0.009*	0.0259**	0.007*
	(1.86)	(1.93)	(2.03)	(1.90)
*CASH*GOVERNANCE*		0.004*		−6.19e+09*
		(1.96)		(−1.98)
DEBT	−0.013	−0.001	−0.008*	−0.002
	(−1.39)	(−1.32)	(−1.86)	(0.96)
AGE	0.007**	0.007**	0.007**	0.007**
	(2.12)	(2.12)	(2.07)	(2.21)
OWNERSHIP	0.029*	−0.000	0.017	−0.001
	(2.79)	(−0.32)	(1.86)	(−0.42)
AR (1)	$z = -14.29$	$z = -14.29$	$z = -14.27$	$z = -13.72$
	Pr > z = 0.000	Pr>z = 0.000	Pr>z = 0.000	Pr>z = 0.000
AR (2)	$z = 1.47$	$z = 1.36$	$z = 1.53$	$z = 0.57$
	Pr > z = 0.142	Pr>z = 0. 182	Pr>z = 0.127	Pr > z = 0.569

Then, the regressions of model 2 and model 3 are conducted in these two groups, respectively, and the results are shown in Table 6. In the overinvestment group, the interaction term coefficient between corporate governance and cash flow (GOVERNANCE*CASH) is significantly negative, and corporate governance has a significant negative moderating effect on cash flow, positively affecting investment. As the level of corporate governance improves, the sensitivity of investment to cash flow decreases, and H2.1 holds. This implies that in the case of over-investment, companies can improve their corporate governance mechanisms by reducing equity concentration, management equity incentives, and increasing the proportion of independent directors to decentralize the company's investment decisions so that managers' behaviors are more constrained and also link managers' income to their operating performance, prompting them to maximize the value of the company as the fundamental principle when making investment decisions, and try to prevent them from investing cash flow in projects that are not beneficial to the company in order to satisfy their utility, reducing the company's overinvestment and thus alleviating the sensitivity of investment to cash flow.

In the underinvestment group, the coefficient of the interaction term between corporate governance and cash flow (*GOVERNANCE*CASH*) is significantly positive. Corporate governance has a reinforcing effect on cash flow, positively affecting investment. Improving corporate governance cannot reduce investment dependence on internal cash flow, and H2.2 does not hold. The possible reason is that although the corporate governance mechanism can protect the interests of external investors from erosion by internal managers, a high level of corporate governance will also send positive signals to the outside world about the company's management and decision-making and reduce the information asymmetry between owners and operators, in the case of underinvestment, the firm is already facing a certain degree of financing constraints, and improving the level of corporate governance will cost more, leading to The problem of investment-to-cash-flow sensitivity is further exacerbated by the fact that the internal cash flow of the firm is further reduced. Thus the financing constraint is more severe.

4.4. The effect of information disclosure on investment-cash flow sensitivity regulation

Also, according to the previous method, after dividing the sample into two groups, the regressions of model 1 and model 3 were conducted in the two groups. The results are shown in Table 7 from the results of the table. It can be seen that the coefficient of cash flow (*CASH*) is significantly positive in both groups of the sample, indicating that the problem of investment-cash flow sensitivity exists regardless of whether it is in the case of over-investment or under-investment, and H1 is further verified. Moreover, the coefficient of cash flow in the underinvestment group is smaller than that in the overinvestment group, indicating that the problem of over-investment causes the investment-cash flow sensitivity problem in China's manufacturing industry. After adding an information disclosure and cash flow interaction term, we find that the moderating effect of information disclosure on investment cash flow sensitivity shows a difference between the two groups.

In the overinvestment group, the coefficient of the disclosure-cash flow interaction term (*DISCLOSURE*CASH*) is negative, indicating that disclosure has a significant negative moderating effect on cash flow, positively affecting investment, and H3.1 holds. This implies that in the case of overinvestment, the problem of sensitivity of investment to cash flow is mitigated as the level of information disclosure increases and management's private use of internal cash flow to expand investment blindly is significantly reduced under the effect of external monitoring.

In the underinvestment group, the coefficient of the disclosure and cash flow interaction term (*DISCLOSURE*CASH*) is negative but not significant, indicating that disclosure does not have a significant negative moderating effect on cash flow, positively affecting investment, and H3.2 does not hold. The possible reason is that the effect of information disclosure on investment-cash flow sensitivity has a threshold effect. When information disclosure is at a low level, improving certain information disclosure quality is beneficial to reduce information asymmetry between firms and external investors, thus alleviating firms' underinvestment due to financing constraints, but too high a level of information disclosure may lead firms to pass on internal information such as poor financial operating conditions of the firm to investors, thus causing them to face specific difficulties in raising external financing. They have to rely on internal cash flow for investment.

5. Conclusion

This paper selects a sample of manufacturing companies on the SZSE, collects data on their investment, cash flow, information disclosure, and corporate governance from 2013 to 2020, and combines factor analysis and dynamic panel analysis to explore the effects of cash flow on investment under the scenarios of underinvestment and overinvestment and the effects of information disclosure and corporate governance on investment-cash flow The effect of information disclosure and corporate governance on investment-cash flow regulation is explored. In general, China's listed manufacturing companies still have the problem of investment-cash flow sensitivity, which exists in both over-investment and under-investment scenarios; under-investment due to financing constraints and over-investment due to agency costs can cause high sensitivity to cash flow. Information disclosure can reduce the investment-cash flow sensitivity of firms, and this inhibitory effect is more pronounced in the overinvestment group. The effect of corporate governance on investment-cash flow differs somewhat between the overinvestment and underinvestment scenarios. In future studies, improvements are expected in the following aspects. Firstly, we will analyze other industries to compare whether there is a difference in the sensitivity of investment to cash flow under different industry characteristics and then explore whether there is a difference in the moderating effect of information disclosure and corporate governance on the sensitivity. Secondly, we will conduct a cluster analysis of the manufacturing industry to identify different sub-categories of companies in the industry and analyze the investment and cash flow for each sub-category of manufacturing companies; finally, we will explore in depth whether the moderating effect of information disclosure on investment-cash flow Whether there is a threshold effect on the moderating effect of information disclosure on the

Table 7
Impact of information disclosure on investment-cash flow sensitivity.

	Underinvestment group		Overinvestment group	
	Model 1	Model 3	Model 1	Model 3
$INVEST_{t-1}$	0.699***	0.530**	0.699***	0.689***
	(6.07)	(2.46)	(5.09)	(5.45)
$(INVEST_{t-1})^2$	−0.319***	−0.310**	−0.320***	−0.310***
	(−9.12)	(−8.61)	(−9.13)	(−8.61)
CASH	0.009*	0.129**	0.0260**	0.029**
	(1.86)	(2.41)	(2.03)	(2.37)
CASH*DISCLOSURE		−0.017		−0.002***
		(1.30)		(3.43)
DEBT	−0.013	−0.005	−0.008*	−0.001
	(−1.39)	(−0.86)	(−1.86)	(−1.05)
AGE	0.007**	−0.002**	0.007**	0.007**
	(2.12)	(−2.30)	(2.07)	(2.00)
OWNERSHIP	0.026***	−0.004	0.017	0.027***
	(3.79)	(−0.91)	(1.86)	(3.56)
AR (1)	z = −14.29	z = −8.53	z = −14.27	z = −14.21
	Pr > z = 0.000	Pr > z = 0.000	Pr>z = 0.000	Pr > z = 0.000
AR (2)	z = 1.47	z = −0.32	z = 1.53	z = 0.57
	Pr > z = 0.142	Pr > z = 0.751	Pr > z = 0.127	Pr > z = 0.569

sensitivity of cash flow.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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