

## Earnings Management, Internal Control and Cost Stickiness: Evidence from Chinese listed High-tech Enterprises

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### Abstract:

*The proposal of "cost reduction" task puts forward higher requirements for cost management in high-tech enterprises in China. This study aims to investigate the relationship among earnings management, internal control and cost stickiness, using the financial data of A-share listed high-tech enterprises in China from 2016 to 2020. The findings reveal a direct positive relationship among internal control, earnings management and cost stickiness, namely a high-tech company implements a high-quality internal control system, earnings management will be decreased and the cost stickiness will be lowered too.*

**Key words :** Earnings management, internal control, cost Stickiness, listed high-tech Enterprises

### 1. Introduction

High-tech enterprises have become a new driving force for China's economic development, and its contribution to GDP has risen to over 40%<sup>[1]</sup>. They play an irreplaceable promotion role for Chinese long-term, stable sustainable development economy<sup>[2]</sup>. High-tech enterprises have high core technology and innovation capabilities in R&D. Their characteristics are high investment, high risk, high profit and high science and technology content. China vigorously promoted the five major tasks of "cutting overcapacity, destocking, deleveraging, reducing costs and strengthening weak areas", in particular, the proposal of "cost reduction" task puts forward higher requirements for cost management in high-tech enterprises.

Cost refers to the consumption of resource allocated and asset utilization of an enterprise. The resource input of an enterprise should match the business volume of an enterprise<sup>[3]</sup>. However, fluctuations in the macro environment lead to corresponding changes in corporate behavior<sup>[4]</sup>. The change of business volume do not completely match with the consumption of resources<sup>[5]</sup>. Anderson et al. (hereinafter referred to as ABJ) borrowed the concept of price stickiness in economics in 2003, and called the phenomenon that the proportion of cost increasing when sales increased was greater than the proportion of cost decreasing when sales decreased by the same amount. ABJ took the selling and administrative expenses of American listed companies as the research objective, and found the existence of cost stickiness in American listed companies<sup>[6]</sup>. In the same year, Subramaniam and Weidenmier also confirmed the existence of cost stickiness<sup>[7]</sup>. In 2004, according to the ABJ research model, Chinese scholars Sun Zheng and Liu Hao did the first empirical research of the existence of cost stickiness using the panel data of Chinese listed companies, and revealed that when sales increased by 1%, expenses increased by 0.5597%; However sales was reduced by 1%, expense was only reduced by 0.0578%<sup>[8]</sup>. Since then, Chinese scholars began to pay attention to study the problem of cost stickiness.

Earnings management is the behavior of the management to adjust the financial statements by changing the accounting method or deliberately arranging real transactions so as to maximize their own or enterprise's interests, and mislead the users of accounting information to understand the company's benefits that is

different from the actual situation. Schipper (1989) found that the most important ways of earnings management include accrual and real earnings management<sup>[9]</sup>. Accrual earnings management refers to the earnings management activities in which the management utilizes accounting policy selection and accounting estimation changes to adjust accounting data to disguise or cover up the true accounting information. Real earnings management refers to earnings management activities in which the management conducts profit control through timely and deliberately structuring, adjusting or changing the actual sales, production, investment and financing activities of the company (Roy chowdhury, 2006)<sup>[10]</sup>. Due to the information asymmetry, the management can satisfy the self-interest motivation through earnings management by expanding resource control and scale through increasing cost during the period of increasing sales; However, when the volume of business declines, some resources will be reserved in order to reduce the impact on the performance of management tenure. In the face of different economic situations, management adopts the strategy of rapidly increasing or decreasing the resource input to reduce the cost, which leads to the asymmetry change between business volume and cost, and generates cost stickiness. Earnings management is an important internal source of enterprise cost stickiness. Therefore, more and more scholars began to study the relationship between earnings management and cost stickiness. First, earnings management motivation and cost stickiness (Ma Yongqiang and Zhang Zenan, 2013<sup>[11]</sup>; Jiang Wei et al., 2015<sup>[12]</sup>), then the relationship between real earnings management, cost stickiness and corporate performance (Yao Yongxi, 2018)<sup>[13]</sup>, and the impact of earnings management on cost stickiness from the perspective of enterprise life cycle (Peng Fei, 2019)<sup>[14]</sup> were studied. Suo Zhilin and Sui Jingjing (2020) empirically researched the impact of managerial incentives and earnings management on enterprise cost stickiness<sup>[15]</sup>.

Chinese scholars are also expanding their exploration on the correlation of cost stickiness between different industries. Liu Wu (2006)<sup>[16]</sup> and Liu Yanwen and Wang Yugang (2009)<sup>[17]</sup> found that manufacturing and information technology industries have strong cost stickiness, while real estate and other industries have relatively weak cost stickiness. Wan Shouyi and Wang Hongjun (2011) researched the relationship between managerial self-interest, board governance and expense stickiness<sup>[18]</sup> and Jiang Wei, Di Lulu and Yao Wentao (2017) studied the relationship between customer concentration and enterprise cost stickiness<sup>[19]</sup> and Xin Huiqin and Liang Jingjing (2018) mainly studied the impact of senior management change on cost stickiness<sup>[20]</sup> and Chen Lianghua, Hu Yufei and Chi Yingying (2019) studied the influence of supplier relationship on enterprise cost stickiness from the perspective of supply chain<sup>[21]</sup> and Chen Gen (2020) studied the impact of different forms of real earnings management behaviors on cost stickiness based on the empirical evidence of Chinese listed manufacturing companies<sup>[22]</sup>.

Internal control is a common way of cost control. Good internal control can effectively restrain earnings management, and avoid excessive cost stickiness and damage the interests of the company. The development time of Chinese high-tech enterprises is not too long and its related theories is relatively short too, there are few research on high-tech enterprises. Moreover, most of the existing researches explore the impact of earnings management on cost stickiness, and few research on the relationship among internal control, earnings management and cost stickiness. Then this paper study this question, can internal control restrain earnings management and alleviate cost stickiness on Chinese high-tech enterprises? In order to answer this question, this paper will do research the relationship among earnings management, internal control and cost stickiness using the financial data of A-share listed high-tech enterprises in China from 2016 to 2020. The findings reveal a direct positive relationship among earnings management, internal control and cost Stickiness, namely a high-tech company implements a high-quality internal control system, management's earnings management behavior will be reduced and the company's cost stickiness level will be lowered too.

## 2. Theoretical support and hypotheses development

Anderson et al. (2003) tested the hypothesis of the existence of cost stickiness for the first time<sup>[6]</sup>. Liu Wu (2006) found through empirical studies that management of enterprises in various industries obtained benefits by adjusting the cost of enterprises<sup>[16]</sup>. Kong Yusheng et al. (2007) also obtained similar results<sup>[23]</sup>. The separation of ownership and management rights is also bound to be asymmetric information between shareholders and management in listed high-tech enterprises. During the period of sales growth, the cost of good sold will increase at a slower rate than the sales, and financial statement will show better performance to information users, so it can bring employee higher remuneration and good reputation to management. When sales fall, management makes choices based on self-interest. On the one hand, when the management is optimistic about the future prospects of the enterprise, the management expects that business environment will be good in the future, and the current sales decline is only temporary. In order to save costs, the decline of costs and expenses will be lower than the decline of sales. Reducing production will inevitably lead to idle equipment and resources or reduce production efficiency, but some of the necessary expenditures that have been invested, such as depreciation expenses of fixed assets, are still occurring, and the costs are still increasing. On the other hand, if the management is faced with a deteriorating business environment, in order to maintain their own interests and prevent losses, the management will increase book income through earning management. They chose to reduce costs with reservation; If some products cannot be sold in time and sales decrease, the storage and management fees will increase. Therefore, the enterprise will maintain a high level of expenses to ensure that the management interest is not affected, cost stickiness then generates. Based on the cost stickiness caused by the incongruity between the total cost and operating income of Chinese A-share listed high-tech enterprises, hypothesis 1 is proposed.

**H1: Cost stickiness will generate during cost control in Chinese A-share listed high-tech enterprises.**

Ro sanmay (2017) found that earnings management generally does not violate accounting standards. In particular, most of the operating activities constructed by real earnings management are true and not easy to be detected with low risk. Therefore, enterprises are more willing to choose real earnings management<sup>[24]</sup>. However, when the real earnings management is carried out, the management will reduce the expenses required by daily operating activities of the enterprise in order to maintain higher performance. Different enterprises have different earnings management ways on costs control, which will lead to cost stickiness. Turetken et al. (2020) found that the cost of most accrued earnings management are less than that of the real earnings management, and basically, as long as the degree of earnings management is well grasped, the risks of accrual earnings management can be controlled<sup>[25]</sup>. So most of management will carry out accrual earnings management at the same time when implementing real earnings management. Based on the above analysis, hypothesis 2 is proposed:

**H2: There are both accruals and real earnings management during the cost control of Chinese A-share listed high-tech enterprises, and the management is more inclined to real earnings management.**

Different earnings management behaviors may have different effects on the cost stickiness of enterprises. Turetken et al. (2020) found that positively adjusted accrual earnings management increased earnings. Companies would take a series of measures to reduce their costs on books, but such adjustments would not affect the real transaction. Therefore, no matter how business sales change, the probability of cost reduction will be higher than that of cost increase so as to reduce the cost stickiness. In turn, negatively adjusted accrual earnings management tends to increase cost stickiness<sup>[25]</sup>. That's where the hypothesis comes in 3a:

**H3a: The positive accrual earnings management behavior reduces the cost stickiness in Chinese**

### **A-share listed high-tech enterprises, while the negative accrual earnings management behavior increases the cost stickiness.**

Roychowdury (2006) proposed the model, which divided real earnings management into three categories including abnormal operating cash flow, abnormal discretionary cost and abnormal production cost<sup>[10]</sup>. Gray and Premti (2020) believed that the managers increased the sales by providing cash discounts or credit sales in order to quickly increase the profit, but the profit growth did not bring a large amount of cash flow into the enterprise, but caused abnormal operating cash flow<sup>[26]</sup>. The increase of sales leads to a significant increase of short-term cost, which is higher than the decrease of cost when the sales decreases under normal operation, and then this will generally increase the cost stickiness. Liu Jing et al. (2019) believed that adjusting discretionary expenses was a common way for management to control expenses. If it was necessary to increase earnings, the discretionary expenses of the enterprise could be reduced, such as advertising expenses and staff training expenses, etc. However, the sales did not fluctuate significantly in a short time due to the reduction of discretionary expenses, thus the cost stickiness would reduce on the whole<sup>[27]</sup>. Kreilkamp et al. (2021) found that managers could increase the output of products to share the fixed cost, and cause overcapacity and abnormal production cost, At this time, the production cost did not exceed the normal level because of the increase of sales, so it reduced the cost stickiness on the whole because it would not aggravate the asymmetric change of cost and sales<sup>[28]</sup>. Based on this, hypothesis 3B is proposed:

### **H3b: Abnormal operating cash flow increases the cost stickiness, while abnormal discretionary expense and abnormal production cost reduce the cost stickiness in real earnings management of Chinese A-share listed high-tech enterprises.**

A-share listed high-tech enterprises are easy to obtain large amount of state support and investment because they are the support objective of Chinese government. However, the "Four High" characteristics of high-tech enterprises cause great difficulty in cost control, enterprises have to accept the supervision of government and pass qualification identification, their operating risk is very great. When an enterprise is faced with the risk of loss, the management may conduct earnings management based on the motivation of stopping loss or maintaining earnings. Song Yunling et al. (2019)<sup>[29]</sup>, Owusu et al. (2020)<sup>[30]</sup>, Silge and Wohrmann (2021)<sup>[31]</sup> found that when enterprises needed to increase performance and economic benefits, managers were more likely to adjust earnings by select accounting policies and estimates and adjust costs using their power, including reducing production costs, providing sales discounts, credit sales, cutting discretionary cost expenditures and other ways to reduce cost stickiness. Thus, hypothesis 4a is proposed as follows:

### **H4a: Based on the motivation of stopping loss or maintaining profits, Earnings management reduces the cost stickiness in Chinese A-share listed high-tech enterprises.**

Shen Yi and qing-song ruan (2017) found that the management would like to recognize overstated current period cost or loss through accounting for various asset losses or spending on current strategic in current period for one-time, thus **enterprises could** fill the loss incurred during the late period using the good year earnings or lay the foundation to achieve revenue growth for the future<sup>[32]</sup>. Making profit and loss adjustments for corporate and management's own performance is known as "taking a big bath" in the industry. Prabowo et al. (2018) found that the remuneration of managers was closely related to the business performance of enterprises<sup>[33]</sup>. Therefore, in order to enjoy considerable remuneration every year, the management would reserve part of the earnings in a good year and leave the surplus to be released in later bad years and then gave the impression of stable operation to information users. This earnings management

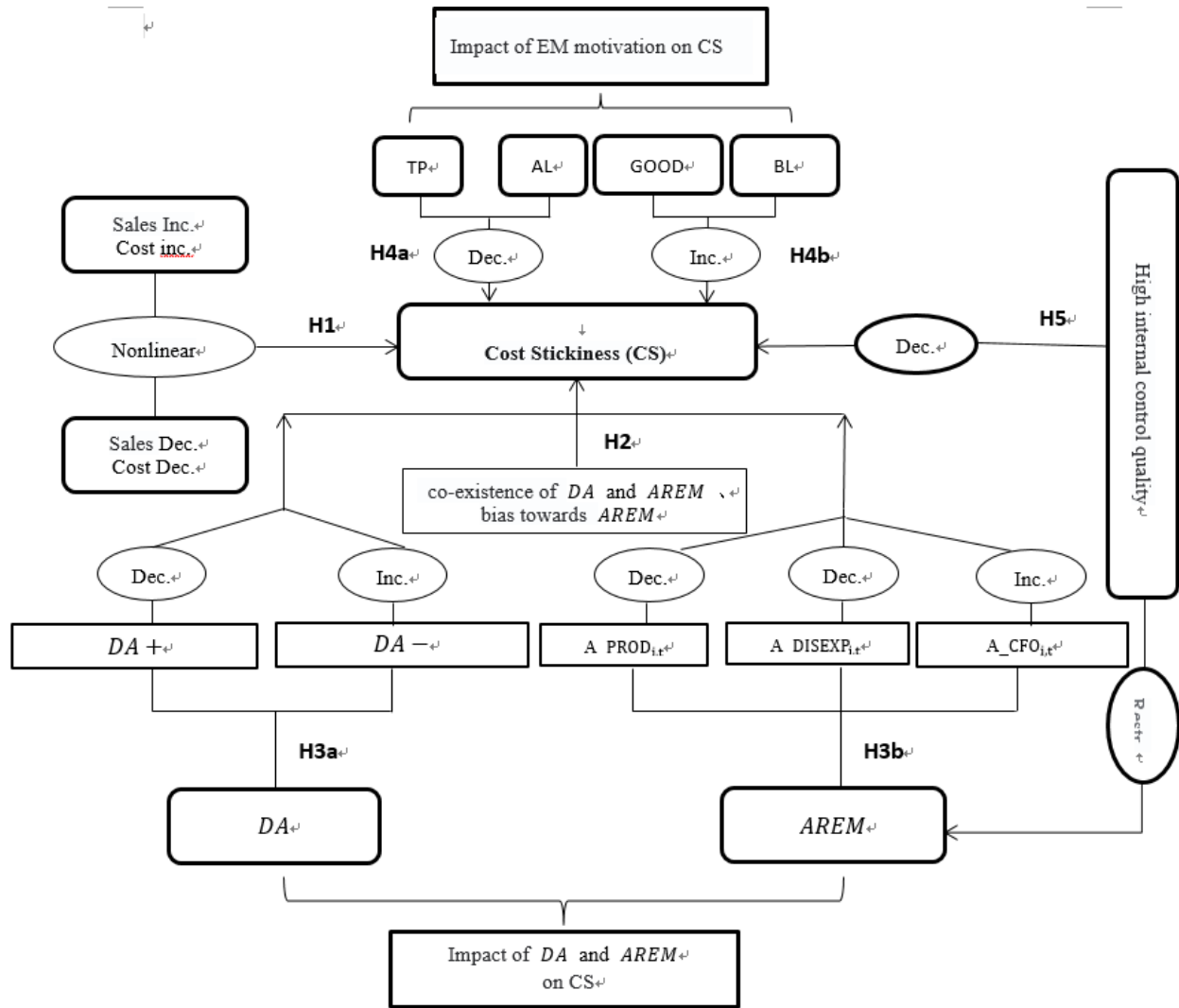
behavior is known as earning smoothing in the industry. However, He Yanan et al. (2020) found that "taking a big bath" and profit smoothing would inevitably increase costs for the accounting period requiring excessive recognition of losses or impairment, leading to a significant increase in the level of enterprise cost stickiness<sup>[34]</sup>. Put forward a hypothesis 4b based on the above discussion:

**H4b: Earnings management based on earning smoothing and "big bath" will improve cost stickiness in Chinese A-share listed high-tech enterprises.**

Internal control and supervision can effectively reduce earnings management with establishment of high-quality internal control system, and then reduce the cost stickiness. Studies have found that the high or low quality of internal control had a significant impact on cost stickiness, and the better the internal control, the better the inhibitory effect on cost stickiness (Chen Gen, Tan Haixia, 2021)<sup>[35]</sup>. Christensen et al. (2020) found that management was willing to solve the problems existing in the internal control and actively cooperate with the implementation of internal control, and reduce the earnings management and ensure the earnings quality<sup>[36]</sup>. High-quality internal control could effectively restrain the earnings management (Jin Yuna, Bai Xiaofeng, 2016)<sup>[37]</sup>. It can be seen that the implementation of a good internal control mechanism can significantly change the earnings management behavior, and make earnings management really to become a boost to improve the rationality of financial decision-making, financing ability and market competitiveness, and then effectively reduce cost stickiness. That is to say, high quality internal control can significantly weaken the promotion effect of earnings management on cost stickiness. Therefore, hypothesis 5 is put forward as follows:

**H5: A-share listed high-tech enterprises establish and implement high-quality internal control, which can reduce earnings management behavior and cost stickiness.**

The logical relationship between earnings management, internal control and cost stickiness is shown in Figure 1:



**Figure 1.** The logical relationship between earnings management, internal control and cost stickiness

### 3. Research design

#### 3.1 Sample selection and data sources

475 high-tech enterprises listed in Shanghai and Shenzhen A-shares from 2016 to 2020 were selected in this research, and total of 2375 samples observations were obtained. All the financial data of the sample companies are from the annual statement data published by each listed company. The internal control index is from the dibod database. The software uses Stata16.0.

#### 3.2 Variable definition

##### 3.2.1 Explained variable

To measure the cost stickiness of high-tech enterprises, this paper adopts the measurement model of Anderson et al. (2003) [6], which is widely recognized in the world, and defines the total cost including selling expense, administrative expense and operating cost. The total cost rate of change in the natural

logarithm of  $\ln(TC_{i,t}/TC_{i,t-1})$  is as explained variable.

### 3.2.2 Explanatory variables

(1) The natural log of the rate of change in operating income

$\ln(Sales_{i,t}/Sales_{i,t-1})$ , The study of cost stickiness needs to examine the change of the total cost rate when the operating revenue changes.

(2) Operating income decline dummy variable  $d$ . In order to prove the existence of cost stickiness, it is necessary to introduce a dummy variable  $d$  to compare the variation range when the revenue rises or falls. When the operating revenue rises,  $d$  takes 0, and when the operating revenue falls,  $d$  takes 1.

(3) Accrual earnings management level  $DA$ . According to the practice of most scholars, the Jones model modified by Dechow (1995) is used to measure the accrual earnings management level<sup>[38]</sup>.

$$\text{Model (1): } \frac{TA_{i,t}}{A_{i,t-1}} = \beta_0 \frac{1}{A_{i,t-1}} + \beta_1 \frac{\Delta REV_{i,t}}{A_{i,t-1}} + \beta_2 \left( \frac{PPE_{i,t}}{A_{i,t-1}} \right) + \varepsilon_{i,t} \quad (1)$$

$$\text{Model (2): } NDA_{i,t} = \hat{\beta}_0 \frac{1}{A_{i,t-1}} + \hat{\beta}_1 \frac{\Delta REV_{i,t} - \Delta REC_{i,t}}{A_{i,t-1}} + \hat{\beta}_2 \left( \frac{PPE_{i,t}}{A_{i,t-1}} \right) \quad (2)$$

$$\text{Model (3): } DA_{i,t} = \frac{TA_{i,t}}{A_{i,t-1}} - NDA_{i,t} \quad (3)$$

Where,  $TA_{i,t}$  represents the total accruals;  $NDA_{i,t}$  represents the non-manipulative accruals of enterprise  $i$  in year  $t$ , and  $DA_{i,t}$  represents the manipulative accruals of enterprise  $i$  in year  $t$ . The regression coefficient is obtained from the OLS regression of model (1) and then substituted into model (2) to obtain the non-manipulative accruals  $NDA_{i,t}$ . Finally, the revised discretionary accruals  $DA_{i,t}$  are obtained by substituting them into model (3).

(4) Real earnings management  $AREM$

$AREM_{i,t}$  is measured with reference to the model of Dechow (1995)<sup>[38]</sup> and Roy Chowdhury (2006)<sup>[10]</sup>. It is divided into abnormal operating cash flow ( $A\_CFO_{i,t}$ ), abnormal production cost ( $A\_PROD_{i,t}$ ) and abnormal discretionary expense ( $A\_DISEXP_{i,t}$ ). See Models 4, 5, and 6 for specific measurement:

$$\text{Model (4): } \frac{CFO_{i,t}}{A_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{A_{i,t-1}} + \alpha_2 \frac{REV_{i,t}}{A_{i,t-1}} + \alpha_3 \frac{\Delta REV_{i,t}}{A_{i,t-1}} + \varepsilon_{i,t} \quad (4)$$

$$\text{Model (5): } \frac{PROD_{i,t}}{A_{i,t-1}} = \gamma_0 + \gamma_1 \frac{1}{A_{i,t-1}} + \gamma_2 \frac{REV_{i,t}}{A_{i,t-1}} + \gamma_3 \frac{\Delta REV_{i,t}}{A_{i,t-1}} + \gamma_4 \frac{\Delta REV_{i,t-1}}{A_{i,t-1}} + \varepsilon_{i,t} \quad (5)$$

$$\text{Model (6): } \frac{DISEXP_{i,t}}{A_{i,t-1}} = \beta_0 + \beta_1 \frac{1}{A_{i,t-1}} + \beta_2 \frac{REV_{i,t-1}}{A_{i,t-1}} + \varepsilon_{i,t} \quad (6)$$

Where,  $CFO_{i,t}$  represents the net operating cash flow of enterprise  $i$  in year  $t$ ;  $PROD_{i,t}$  represents the production cost, which is equal to the sum of the current operating cost and inventory used;  $DISEXP_{i,t}$  represents the discretionary expense; The regression residuals of each model are obtained through OLS regression, and then  $AREM_{i,t}$  is calculated according to model (7) proposed by Li Zengfu et al. (2011)<sup>[37]</sup>.

$$\text{Model (7): } AREM_{i,t} = (-1)A\_CFO_{i,t} + A\_PROD_{i,t} + (-1)A\_DISEXP_{i,t} \quad (7)$$

(5) Dummy variable of stop-loss motive  $TP$ . In order to define whether the management has a stop-loss motive, if the ROA value changes from negative to positive during the year, the dummy variable  $TP$  is 1, otherwise  $TP$  is 0.

(6) Earnings protection motive dummy variable  $AL$ . In order to define whether the enterprise management has the profit protection motive, if ROA during the year is greater than 0 and less than or equal to 0.02, set the dummy variable  $AL$  as 1, otherwise  $AL$  is 0.

(7) "Big bath" motivation dummy variable  $BL$ . To define whether the enterprise management has the motivation of "taking a big bath", if the net earnings during the year  $t$  is less than 0, the dummy variable  $BL$  is 1, otherwise  $BL$  is 0.

(8) The profit smoothing motive dummy variable  $GOOD$ . In order to define whether the management has the profit smoothing motive, if the sum of ROE during year  $T-2$ , year  $T-1$  and year  $t$  is greater than 0.2, the variable  $GOOD$  is 1, otherwise  $GOOD$  is 0. Control variables are shown in Table 1.

**Table 1.** Summary table of variables

Variable design	Variable name		Variable code	Variable description
Explained variable	Total cost change rate		$\ln\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right)$	TC: The sum of selling expenses, administrative expenses and operating costs
	Sales	Increase	$\ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right)$	Sales: Prime operating revenue
Decline		d		Dummy variable: if business revenue is lower than T-1 period, it is 1; otherwise, it is 0
Explanatory variables	Earnings management motivation	Stop-loss motivation	$TP$	Dummy variable: ROA during year $t-1$ is negative while year $t$ becomes positive $TP = 1$ , otherwise $TP = 0$
		Earnings protection motivation	$AL$	Dummy variable: if ROA is between (0, 0.02), it is 1; otherwise, it is 0
		"Big bath" motivation	$BL$	Dummy variable: if the net profit during year $t$ is negative; Otherwise take 0
		Earnings smoothing motivation	$GOOD$	Dummy variable: if the sum of ROE during year $T-2$ , $T-1$ and $T$ is greater than 0.2, it is 1; Otherwise 0
	Earnings management behavior	Accrual earnings management	$DA$	Discretionary accruals
		Real earnings management	$AREM$	Real earnings management total
	AREM	Sales manipulation level	$A\_CFO_{i,t}$	Abnormal cash flows from operating activities
		Cost control level	$A\_DISEXP_{i,t}$	Abnormal discretionary expenses
		Production control	$A\_PROD_{i,t}$	Abnormal production cost



	level		
Control variable	Intensity of employees	EI	ln (employees / Current year income)
	Intensity of assets	ASSET	ln (total assets / Current year income)
	sustained losses	SD	Dummy variable: if net earnings of year t-1 and year t is less than that of year t-2 and year t-1, take 1; Otherwise, it's 0.

### 3.2.3 Model construction

To verify the hypothesis, model 8 is constructed to verify whether there is cost stickiness in A-share listed high-tech enterprises, if  $\beta_2 < 0$ , cost stickiness can be proved and the hypothesis H1 is true, and the greater  $|\beta_2|$ , the higher of cost stickiness in A-share listed high-tech enterprises.

$$\text{Model (8): } \ln\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right) = \beta_0 + \beta_1 \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \beta_2 d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \sum_{n=3}^5 \beta_n d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) \times \text{ContrVar}_{i,t,n} + \varepsilon_{i,t} \quad (8)$$

Construct models 9,10 to verify the impact of accruals and real earnings management on cost stickiness. if the coefficients  $\gamma_1$  and  $\gamma_2$  exist, it can be proved that accruals and real earnings management exist simultaneously. if the coefficients  $\gamma_1$  and  $\gamma_2$  are significantly positive, it indicates that accruals and real earnings management decrease cost stickiness. if the coefficients  $\gamma_1$  and  $\gamma_2$  are significantly negative, it indicates that the two kinds of earnings management increase cost stickiness. if  $|\gamma_1|$  less than  $|\gamma_2|$ , it can be proved that the A-share listed high-tech enterprises employ more real earnings management. By comparing significance and absolute size coefficient of  $\gamma_2$  of  $A\_CFO_{i,t}$ ,  $A\_PROD_{i,t}$  and  $\_DISEXP_{i,t}$ , We can further analyze whether the three methods of real earnings management have a significant impact on cost stickiness and the management's preference to select real earnings management.

$$\text{Model (9): } \ln\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right) = \beta_0 + \beta_1 \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \beta_2 d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \gamma_1 DA_{i,t} \times d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \sum_{n=3}^5 \beta_n d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) \times \text{ContrVar}_{i,t,n} + \varepsilon_{i,t} \quad (9)$$

$$\text{Model (10): } \ln\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right) = \beta_0 + \beta_1 \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \beta_2 d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \gamma_2 AREM_{i,t} \times d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \sum_{n=3}^5 \beta_n d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) \times \text{ContrVar}_{i,t,n} + \varepsilon_{i,t} \quad (10)$$

Model 11 is constructed to verify the impact of earnings management motivation on cost stickiness. ( $\beta_1 + \beta_2 + \gamma_3$ ) indicates earnings management reduces the degree of the total cost if the sales decrease. If  $\gamma_3$  is significantly positive, it can be proved that the earnings management motivation represented by  $\gamma_3$  is negatively correlated with cost stickiness. If  $\gamma_3$  is significantly negative, a positive correlation can be proved between earnings management motivation and cost stickiness.

$$\text{Model (11): } \ln\left(\frac{TC_{i,t}}{TC_{i,t-1}}\right) = \beta_0 + \beta_1 \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \beta_2 d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \gamma_3 BENCH_{i,t} \times d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) + \sum_{n=3}^5 \beta_n d_{i,t} \times \ln\left(\frac{Sales_{i,t}}{Sales_{i,t-1}}\right) \times \text{ContrVar}_{i,t,n} + \varepsilon_{i,t} \quad (11)$$

According to Model 10, the relationship among internal control and real earnings management and cost stickiness is verified. In order to study the influence of internal control on the relationship between real earnings management and cost stickiness, this study needs to classify the internal control into high and low quality. The mean value of internal control index is selected as the standard. Those above the mean value are classified into the high internal control quality group, and those below are classified into the low internal

control quality group. After grouping, according to model (10), if the high internal control quality group  $(\beta_1 + \beta_2 + \gamma_2)$  is smaller than  $(\beta_1 + \beta_2)$ , and  $\gamma_2$  is significantly less than 0; In the low internal control quality group  $(\beta_1 + \beta_2 + \gamma_2)$  is greater than  $(\beta_1 + \beta_2)$ , and  $\gamma_2$  is significantly greater than 0, then hypothesis H5 is valid.

## 4. Empirical analysis

### 4.1 Descriptive statistics

Table 2 reports the descriptive statistical results for all variables. In main variables, mean and median of the natural logarithm of the change rate of operating revenue (*lnSale*) and the change rate of total cost (*lnTC*) are both greater than 0, which indicates that the operating revenue and cost of A-share listed high-tech enterprises are rising. However, the mean and median of *lnTC*, 0.127 and 0.117, are larger than the mean and median of *lnSale*, 0.117 and 0.1, which indicates that the total cost change range is slightly larger than the operating revenue change range. It can be speculated that the sample enterprises may have cost sickness.

The average value of *d* is 0.248 when sales declines, which indicates that the revenue of about 24.8% sample enterprises declines. Observing the data of accrual and real earnings management, the mean value 0.016 and median value 0.003 of *DA* were smaller than the mean value 0.153 and median value 0.155 of *AREM*. It indicates that accrual and real earnings management behaviors exist simultaneously in Chinese A-share listed high-tech enterprises, and the real earnings management degree is greater than accrual earnings management. Observing the mean value of the four earnings management motives, it is found that about 6% of the 475 sample enterprises have the *TP* stop-loss motive, 19% have the *AL* earnings protection motive, 9% have the *BL* "big bath" motive, and nearly half (48%) have the *GOOD* earnings smoothing motive.

**Table 2.** Descriptive statistics of main variables

Variable	N	mean	Median	SD	Min.	Max.
<i>lnSale</i>	2375	0.117	0.100	0.256	-1.811	2.874
<i>lnTC</i>	2375	0.127	0.117	0.274	-1.744	3.270
<i>d</i>	2375	0.248	0	0.432	0	1
<i>DA</i>	2359	0.016	0.003	0.194	-3.641	0.609
<i>A-CFO</i>	2291	-0.075	-0.080	0.070	-0.359	0.468
<i>A-DISEXP</i>	2291	-0.063	-0.076	0.064	-0.307	0.432
<i>A-PROD</i>	2291	0.019	0.028	0.091	-0.443	0.540
<i>AREM</i>	2291	0.153	0.155	0.173	-0.973	0.668
<i>TP</i>	2375	0.061	0	0.239	0	1
<i>AL</i>	2375	0.193	0	0.395	0	1
<i>BL</i>	2375	0.091	0	0.288	0	1
<i>GOOD</i>	2375	0.483	0	0.500	0	1

## 4.2 Correlation analysis

Pearson correlation analysis of main variables is shown in Table 3. The correlation coefficient between  $\ln TC$  and  $\ln Sale$  is 0.94, which is greater than 0 and significant at the 1% level. The correlation coefficient between the dummy variable  $d$  of revenue decline and  $\ln TC$  is -0.552, which is less than 0 and significant at 1%, it shows that the change rate of total cost by revenue declining is unequal to those by revenue rising. It shows that the cost stickiness exists in sample enterprises. The correlation coefficient between dummy variable  $d$  and real earnings management  $AREM$  is 0.073, that is,  $\gamma_2$  is greater than 0 and significant at 1% level. It indicates that  $AREM$  is positively correlated with cost stickiness, i.e., when the revenue declines, the management will choose real earnings management to reduce cost stickiness. The natural logarithm of the change rate of total cost,  $\ln TC$ , is significantly correlated with the control variables  $ASSET$  intensity, employee intensity  $EI$ , and continuous loss dummy variable  $SD$  at the 1% level, and the coefficients are all less than 0.2, indicating that the control variables selected in this study are reliable.

**Table 3** Pearson correlation analysis of main variables

Variable	$\ln TC$	$\ln Sale$	$d$	$AREM$	$ASSET$	$EI$	$SD$
$\ln TC$	1.0000						
$\ln Sale$	0.940***	1.0000					
$d$	-0.552***	-0.609***	1.0000				
$AREM$	0.050**	0.008	0.073***	1.0000			
$ASSET$	-0.116***	-0.121***	0.180***	0.190***	1.0000		
$EI$	-0.125***	-0.129***	0.081***	-0.079***	0.437***	1.0000	
$SD$	-0.161***	-0.233***	0.273***	0.086**	0.120***	0.061***	1.0000

Note: \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10% levels, respectively

## 4.3 Regression results and analysis

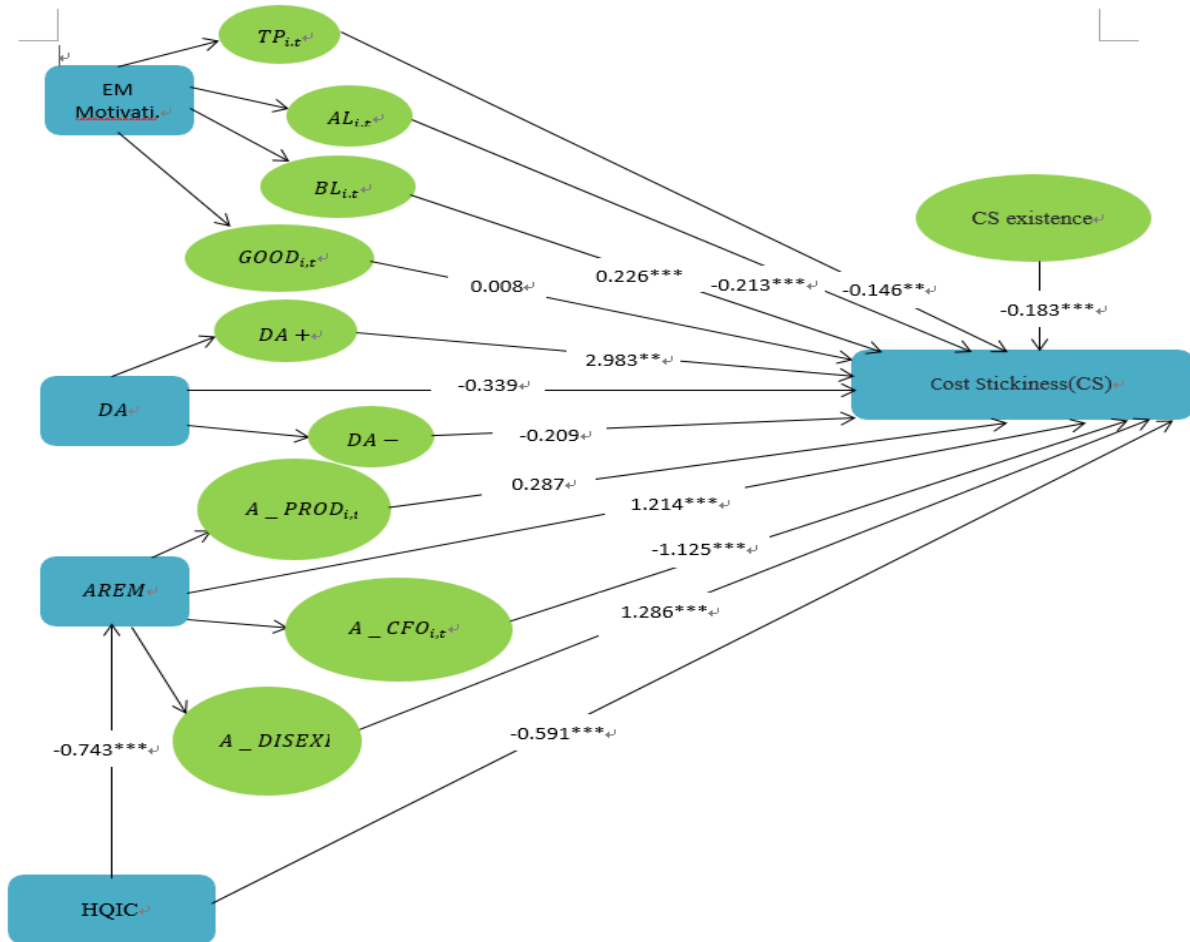
To verify the existence of cost stickiness and the impact of earnings management and internal control on cost stickiness, model (8), model (9), model (10) and model (11) were used for regression analysis. The results of regression analysis are summarized in table 4 and figure 2 for comparison.

**Table 4** Summary table of hypothesis test regression analysis

Hypothesis	Influence	Variable Coefficient	Regression Result	Conclusion
H1	Cost Stickiness(CS) existence	$\beta_2$	-0.183***	Accepted
H2	$DA \rightarrow CS$	$\gamma_1$	-0.339	Accepted
	$AREM \rightarrow CS$	$\gamma_2$	1.1214***	
H3a	$DA + \rightarrow CS$	$\gamma_1$	2.983**	Accepted
	$DA - \rightarrow CS$	$\gamma_1$	-0.209	
H3b	$A\_CFO_{i,t} \rightarrow CS$	$\gamma_2$	-1.125***	Accepted
	$A\_DISEXP_{i,t} \rightarrow CS$	$\gamma_2$	1.286***	
	$A\_PROD_{i,t} \rightarrow CS$	$\gamma_2$	0.287	

H4a	$TP_{i,t} \rightarrow CS$	$\gamma_3$	-0.146**	Accepted
	$AL_{i,t} \rightarrow CS \downarrow$	$\gamma_3$	-0.213***	
H4b	$GOOD_{i,t} \rightarrow CS \uparrow$	$\gamma_3$	0.008	Accepted
	$BL_{i,t} \rightarrow CS \uparrow$	$\gamma_3$	0.226***	
H5	$HQIC \rightarrow AREM \downarrow$	$\gamma_2$	-0.743***	Accepted
	$HQIC \rightarrow CS \downarrow$	$\gamma_2$	-0.591***	

Note: \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10% levels, respectively



Note: \*\*\*, \*\* and \* indicate significance at 1%, 5% and 10% levels, respectively

**Figure 2.** Verification results of main variables on cost stickiness

The regression coefficient  $\beta_2$  of model (8) to verify the existence of cost stickiness is -0.183, which is less than 0 and significant at 1% level, this shows that cost rising is greater than sales rising which cause management quality to decrease. In other words, the cost change with sales increasing satisfies the asymmetric condition. This indicates that sample enterprises studied in this paper generally have cost stickiness, hypothesis H1 is confirmed.

Analyzed the data results of multiple regression models (9) and (10) and compared the cost stickiness levels of accruals and real earnings management and found that the coefficient  $\gamma_1$  of accrual earnings management in the model (9) is -0.339, while the coefficient  $\gamma_2$  of real earnings management in the model (10) is 1.214. The coefficient  $\gamma_1$  and  $\gamma_2$  indicate that accrual and real earnings management exist at the same time in A-share listed high-tech enterprises.  $|\gamma_2|$  is greater than  $|\gamma_1|$ , it indicates real earnings management is more than accruals. The value of  $\gamma_1$  is negative 0.339, which also indicates that the management uses accrual earnings management to strengthen the cost stickiness but not significant. However,  $\gamma_2$  is greater than 0 and significant at 1% level, indicating that the real earnings management significantly weakens the cost

stickiness on the whole. Hypothesis H2 is proved.

This paper further studies the positive and negative aspects of accrual earnings management DA. The results show that DA in two different directions have obvious differences in the impact on cost stickiness. The coefficient  $\gamma_1$  of positive accrual earnings management  $DA +$  is 2.983, which is significant at 1% level, indicating that the management adopts positive accrual earnings management to increase earnings and reduce the cost stickiness. The coefficient  $\gamma_1$  of negative accrual earnings management  $DA -$  is -0.209, indicating that the use of negative accrual earnings management to reduce earnings to increase the cost stickiness, but the effect is not obvious. And the absolute value of  $DA +$  coefficient  $\gamma_1$  is much larger than that of  $DA -$ , which indicates that the management generally adopts more positive accrual earnings management to increase earnings. Thus, H3a is confirmed.

The results in table 4 and figure 2 show that the three different real earnings management methods have obvious differences in the impact on cost stickiness, and the impact of different methods may be offset. The correlation coefficient  $\gamma_2$  of abnormal operating cash flow  $A\_CFO_{i,t}$ , is -1.125, significantly negative, indicates that high-tech enterprises adopt adjusting operating cash flow to manage earnings, which significantly increases the cost stickiness. The correlation coefficient  $\gamma_2$  of discretionary expenses ( $A\_DISEXP_{i,t}$ ) and abnormal production cost ( $A\_PROD_{i,t}$ ) is 1.286 and 0.287, two are positive, it indicates that sample enterprises adopt adjustment of discretionary expenses and production cost to reduce the cost stickiness, but the effect of adjustment of discretionary expenses was more significant than production cost. Further analysis found that the absolute value of coefficient  $\gamma_2$  of three different means is different, it can be concluded that the management is more inclined to adjust the operating cash flow and discretionary expenses. So, H3b is accepted.

The regression test results of model (11) show that the  $\gamma_3$  coefficients of the  $TP_{i,t}$ ,  $AL_{i,t}$ ,  $GOOD_{i,t}$  and  $BL_{i,t}$  are -0.146 (significant at 5% level), -0.213 (significant at 1% level), 0.008 (insignificant) and 0.226 (significant at 1% level) respectively. The coefficient  $\gamma_3$  of the  $TP_{i,t}$  and  $AL_{i,t}$  is significantly negative, which indicates that the earnings adjustment can significantly reduce the cost stickiness based on  $TP_{i,t}$  and  $AL_{i,t}$ . So let's say we get H4a. This indicates that when the sales decline, the management will try to increase the earnings by reducing the cost if there is a profit protection motive, and thus to weaken the cost stickiness. The coefficient  $\gamma_3$  of  $GOOD_{i,t}$  and  $BL_{i,t}$  indicates that the earnings management based on  $BL_{i,t}$  leads to the improvement of the cost stickiness. Management's "big bath" motivation has the biggest impact on cost stickiness by earnings adjustments  $|0.226|$ . The effect of profit smoothing motive ( $GOOD_{i,t}$ ) is not obvious, which is proved by hypothesis H4b. It shows that when the sales

risks or falls, the management has the motivation of "taking a big bath", they adjust the earnings by adjusting the cost, so as to reduce the cost variation range when the sales changes, and thus increase the cost stickiness.

**Table 5** Regression analysis of real earnings management, internal control and cost stickiness

Variable	HQIC <i>lnTC</i>	LQIC <i>lnTC</i>
<u>Cons</u>	0.479*** (4.21)	0.797*** (8.60)
$\ln(\text{Sales}_{i,t}/\text{Sales}_{i,t-1})$	0.952*** (54.27)	0.837*** (34.57)
$d*\ln(\text{Sales}_{i,t}/\text{Sales}_{i,t-1})$	-0.591*** (-3.70)	-0.277*** (-3.52)

$d*\ln(\text{Sales}_{i,t}/\text{Sales}_{i,t-1})*AREM$	-0.743 <sup>***</sup>	0.549 <sup>**</sup>
	(-3.33)	(2.86)
$d*\ln(\text{Sales}_{i,t}/\text{Sales}_{i,t-1})*EI$	-0.099 <sup>**</sup>	-0.063
	(-1.96)	(-1.39)
$d*\ln(\text{Sales}_{i,t}/\text{Sales}_{i,t-1})*ASSET$	-0.155 <sup>**</sup>	-0.251 <sup>***</sup>
	(-2.21)	(-3.41)
$d*\ln(\text{Sales}_{i,t}/\text{Sales}_{i,t-1})*SD$	-0.144 <sup>**</sup>	-0.025
	(-2.09)	(-0.38)
N	1439	852
adj.R2	0.914	0.894
F	861.3	543.1

According to the internal control quality of the enterprise, the group is divided and the regression test of model (10) is shown in Table 5. When the quality of internal control is low (LQIC), the regression coefficient  $\gamma_2$  between real earnings management *AREM* and cost stickiness is 0.549, the coefficient is significantly positive. When the internal control quality is high (HQIC), the regression coefficient is -0.743, the coefficient is less than 0 and significant at 1% level. The results show that when the internal control quality is high, the motivation and opportunity of the management to implement real earnings management become smaller, and the cost stickiness decreases in the process of cost control. Based on the above discussion, hypothesis H5 is accepted. The research shows that the internal control quality has a significant impact on cost stickiness. The higher the internal control quality, the smaller the earnings management motivation or opportunity, the better the inhibition effect on cost stickiness, the closer the cost is to the model of formative state, and the more accurate the cost decision based on the model of formative state. On the contrary, the enterprise with poor internal control has larger error in cost decision-making; Compared with other forms of cost control, the cost of internal control is one of the lowest ways. In order to improve the effectiveness of cost decision-making, internal control should be strengthened.

#### 4.4 Robustness test

To further confirm the robustness of the study conclusions, the paper conducts tests as the following aspects: First, this study change the cost variable in cost stickiness index and replace it with the natural logarithm  $\ln O$  of the operating cost change rate according to the practice of Li Yuhui (2018)<sup>[40]</sup> and other scholars to conduct the above cost stickiness test. The results were not substantially different from those of this study. Second, in order to prevent the influence of multicollinearity on this study, this paper conducts variance inflation factor VIF test on several groups of key variables before data processing, and all VIF values are less than 10, indicating that there is no multicollinearity and ensuring the credibility of the study results. Under the above robustness test, the conclusion of this study is still valid.

#### 5. Conclusions and suggestions

Based on the financial data and internal control index of Chinese A-share listed high-tech enterprises from 2016 to 2020, this paper empirically verifies the impact of earnings management on cost stickiness and the moderating effect of internal control quality on this impact. This paper draws the following conclusions: First, there is cost stickiness in the cost control of Chinese A-share listed high-tech enterprises. Second, there are both accrual and real earnings management in Chinese A-share listed high-tech enterprises,

and the management is more inclined to real earnings management. Therefore, the management power to arrange transactions should be regulated to avoid the management to dispose of the company's products or services through a wide range of cash discounts and credit sales, which will damage the long-term interests of the enterprise.

Third, the positive accrual earnings management of Chinese A-share listed high-tech enterprises reduces the cost stickiness, while the negative accrual earnings management increases the cost stickiness. In real earnings management activities, abnormal operational cash flow will increase the cost stickiness, abnormal discretionary fees and abnormal production costs will reduce the cost stickiness. A-share listed high-tech enterprises are more inclined to achieve earnings target and reduce cost stickiness by adjusting operating cash flow and discretionary expenses, and these two means have more significant impact on cost stickiness. Therefore, the authority of the management to the discretionary expenses should be restricted, and the board of directors or professional evaluation institutions can help the management to decide the discretionary expenses.

Fourth, the stop-loss and earnings protection motivation of managers of Chinese A-share listed high-tech enterprises reduce the cost stickiness, while the profit smoothing and "taking a big bath" motivation increase the cost stickiness.

Finally, when A-share listed high-tech enterprises establish and implement high-quality internal control, the management will reduce earnings management, and then reduce the cost stickiness. The management should consider their own characteristics and the particularity of their industries, strengthen the construction of internal control. The design quality and implementation of the internal control system should be included in the management assessment to improve the quality of internal control, and finally help the enterprise to achieve the goal of "cost reduction" and healthy and sustainable development.

## 6. Declarations

### **Ethics approval and consent to participate**

Not applicable

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### **Competing interests**

The authors declare that they have no competing interests

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