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Article

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Staying idle or investing in prevention: the short-term and long-term impact of cost stickiness on firm value

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ABSTRACT

Current theories about cost stickiness explain the phenomenon from the perspectives of adjustment cost, optimistic management expectations, and agency costs. However, the economic implications implied by different theories are different. We find that, in general, cost stickiness will reduce firm value in the short-term, but increase it in the long-term. That is, cost stickiness has an intertemporal heterogeneous impact on firm value. Furthermore, we found that the intertemporal heterogeneous effect of cost stickiness on firm value is mainly manifested in enterprises with higher adjustment cost, more optimistic manager's expectations, and lower agent costs. The above findings suggest that cost stickiness is a rational choice made after weighing its short-term costs and long-term benefits. The results of the threshold regression model show that rapid adjustment of costs (anti-stickiness) in the short-term will reduce the firm value, while maintaining a modest cost stickiness can increase the firm value in the long run.

KEYWORDS

Cost stickiness; firm value; short-term and long-term impact; cost and benefit trade-off

1. Introduction

The traditional theory of cost behaviour holds that costs change proportionately with change in activity, that is, costs only increase or decrease in proportion with sales revenue. However, Anderson et al. (2003) found that costs increase more when activity rises than they decrease when activity falls by an equivalent amount, that is, costs are 'sticky'. Existing literature explains cost stickiness from the perspectives of adjustment costs, optimistic management expectations, and agency costs, but the economic implications of different theories are quite different (Banker & Byzalov, 2014; R. Banker et al., 2011; Jiang & Hu, 2011). The 'adjustment cost' view is that cost stickiness is a rational choice made by management based on the adjustment costs of various resources (Banker et al., 2013), therefore, cost stickiness is economically reasonable. The 'agency cost' view states that cost stickiness is a reflection of the management's 'empire building' behaviour (C. X. Chen et al., 2012), and should be curbed by changing management incentives or strengthening corporate governance. The 'optimistic management expectations' view has two possibilities. On the one hand, if the management's optimistic expectations are based

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on rational expectations of the economy, industries, and the performance of the firm (Anderson et al., 2003), cost stickiness is conducive to the enhancement of firm value. On the other hand, if the management's optimistic expectations are caused by overconfidence, cost stickiness is unfavourable to the firm and should be curbed (Liang, 2015). It can be seen that cost stickiness can have varying economic significance according to different theoretical explanations.

However, although there are three viewpoints in theory that can explain cost stickiness, the existing literature mostly studies cost stickiness in China from the perspective of 'agency cost' alone. Sun and Liu (2004) found that China's listed companies are slower to adjust costs downwards than US listed companies, and the impact of capital intensity and macroeconomic growth on cost stickiness is not significant. Therefore, they conclude that the cost stickiness of Chinese companies is caused by a lower management capacity of these companies and higher agency cost of the management. Since then, many researchers have explored ways to reduce the cost stickiness of firms from the perspective of internal and external governance mechanisms. These include board independence, institutional investors, equity incentives, media governance, external auditors, overseas listings, and industry competition. It is found that these internal and external governance mechanisms could inhibit the cost stickiness of firms (Cui & Xu, 2013; Fang, 2009; Liang, 2016, 2017; Liang et al., 2015; Xiao et al., 2016; Zhang & Jiang, 2010). Almost all of these studies inherently assume that cost stickiness is a reflection of the management's 'staying idle', and hold that only by strengthening internal and external governance mechanisms can these problems be inhabited effectively.

However, as Chen, Song, et al. (2012) pointed out, cost stickiness is a neutral word without any positive or negative connotation. We cannot judge the efficiency of resource allocation, the quality of internal governance, and the level of agency cost based on the level of cost stickiness. Under normal circumstances, firms with different natures should have different degrees of cost stickiness. For example, firms with higher adjustment costs should also have a higher degree of optimal cost stickiness.

When the management rationally judges that future expectations are more optimistic based on objective facts, costs should not be cut quickly in response to falling demand. Otherwise, it is difficult for us to explain why cost stickiness that seems to reduce firm value is widespread in different countries (Calleja et al., 2006; Sun & Liu, 2004), different industries (Kong et al., 2007; Liu, 2006), and different cost products (Anderson et al., 2003; Fang, 2009; Sun & Liu, 2004). Moreover, in the context of the relatively concentrated ownership of listed firms in China, there are fewer agency problems between large shareholders and management (G. Jiang et al., 2010), hence, the cost stickiness caused by the management's agency costs should be weak. Therefore, this raises the question: Is cost stickiness really only the consequence of management 'staying idle', or is it possible that it is a consequence of management 'investing in prevention'?

This paper argues that existing literature has focused more on the costs arising from cost stickiness in the short-term while ignoring its possible long-term benefits. For example, the 'eight-point austerity rules' issued at the end of 2012 made first-class branded liquors subject to plunging demands and poor sales, and the plasticiser incident made liquor industry sales even worse. In this context, Jiugui Liquor and Kweichow Moutai resorted to different cost control strategies. Jiugui Liquor shrunk its market outside the Hunan Province and focused on the local market in Hunan. Although this

resource reduction behaviour lowered Jiugui Liquor's short-term costs to a certain extent, it caused the company to turn into a marginalised and regional business, which resulted in them losing a huge out-of-province market. On the other hand, Kweichow Moutai did not shrink its market to reduce the cost burden but significantly increased its advertising investment (its advertising fees in 2012 and 2013 increased by 69% and 58%, respectively, much higher than the 5.7% in 2011) to attract new consumer groups. This approach undoubtedly increased the costs of Kweichow Moutai in the short-term, but helped it get rid of external unfavourable factors during the market downturn. Kweichow Moutai has been performing better year by year, and its stock market share became the first A share with a unit price of more than CNY 600 in 2017. The above case shows that when sales revenue declines, increased firm costs are not necessarily a reflection of poor management, they may be a strategic choice based on long-term consideration by the management.

In this paper, we take Shanghai and Shenzhen A-share non-financial listed companies from 2003 to 2016 as a sample to test the short and long-term impacts of corporate cost stickiness on firm value. We found that cost stickiness does have a negative impact on firm value in the short-term, but it can help increase firm value in the long-term. This conclusion is still valid after considering possible omitted variables, sample self-selection issues, seasonal fluctuations in business, and management's 'big bath' behaviour. Additionally, this paper finds that the intertemporal heterogeneous impact of cost stickiness on firm value is mainly reflected in firms with higher adjustment costs (measured using their fixed assets intensity and personnel intensity), firms with optimistic management expectations (measured using industry prosperity and whether their revenue declined for two consecutive years or not), and firms with lower agency costs (measured using their management shareholding ratio and free cash flow). Furthermore, we find that compared with state-owned enterprises, the cost stickiness of private enterprises has a more significant intertemporal heterogeneous impact on firm value.

The above findings indicate that cost stickiness of firms is not only a result of the management 'staying idle' but also a reflection of the management 'investing in prevention'. That is, maintaining cost stickiness is a rational choice made by the management after weighing its short-term costs and long-term benefits. The mechanism analysis indicates that firms with a higher degree of cost stickiness also have a higher actual sales growth rate and higher analyst earnings forecast. Finally, according to the results of the panel threshold regression model, rapid adjustment of costs (anti-stickiness) in the short-term will reduce firm value, while maintaining a moderate degree of cost stickiness can increase firm value in the long-term.

The theoretical contribution of this paper is as follows: First, this paper helps to understand the economic implication of cost stickiness among Chinese firms. Although the theory of 'adjustment cost', 'optimistic management expectation', and 'agency cost' can explain cost stickiness, their respective economic implications are not the same. Many studies on cost stickiness of Chinese firms inherently assume that cost stickiness is unfavourable to firms, and most of these studies ignore the management's initiative in cost control decisions. In this paper, we discover that although the cost stickiness of Chinese firms will reduce the firm value in the short-term, it will increase the firm value in the long run, thus indicating that it may be a result of the management weighing the short-term costs and long-run benefits of cost stickiness. The conclusion of this study

makes up for the shortcomings of existing literature, which only pays attention to the short-term costs of cost stickiness. Further, it confirms the economic rationality of cost stickiness to a certain extent, thus expanding the perception of existing literature on the economic implications of cost stickiness.

Secondly, this paper adds an important supplement to the existing literature on the economic consequences of cost stickiness from the perspective of the intertemporal heterogeneous impact of cost stickiness on firm value. Existing research on economic consequences of cost stickiness only examines its impact on the accuracy of earnings forecasts (Banker & Chen, 2006; Weiss, 2010) and accounting conservatism (Banker et al., 2016; Bu et al., 2016). This paper forms an important supplement to the literature by examining the relationship between cost stickiness and firm value.

The conclusions of this paper also have important practical value. In a setting of 'low economic growth and high cost level', firms are advancing the reform of 'de-capacity and cost reduction'. However, the conclusions of this paper show that blindly cutting costs may not be conducive to firm value, as it may only offer short-term benefits by sacrificing long-term benefits. Therefore, to advance the reform of 'de-capacity and cost reduction', firms should also formulate appropriate cost control measures according to their own needs to maximise the firm value.

The remainder of the paper is organised as follows. In section 2, we develop our hypotheses based on the literature review and theoretical analysis. In section 3, we discuss the sample, measures, and models used in the analysis. Section 4 presents the empirical results, section 5 makes further analysis, and section 6 concludes.

2. Literature review and hypothesis development

2.1. Literature review

Cost stickiness is a phenomenon that causes costs to increase more when activity rises than decrease when activity falls by an equivalent amount (Anderson et al., 2003; Noreen & Soderstrom, 1997). There are three main viewpoints in the existing research about the causes of this phenomenon: 'adjustment cost', 'optimistic management expectation', and 'agency cost' (Banker & Byzalov, 2014; R. Banker et al., 2011; Jiang & Hu, 2011).

Firstly, the 'adjustment cost' view holds that firms will incur additional costs when adjusting resource allocation, such as disposal costs and re-purchase costs of fixed assets, employee severance costs, and retraining costs, among others. Therefore, the management is unwilling to reduce costs proportionately when the business volume declines, which results in cost stickiness. Anderson et al. (2003) and Kong et al. (2007) found that capital-intensive and labour-intensive firms have higher adjustment costs and a higher degree of cost stickiness. Balakrishnan and Gruca (2008) take hospitals as the sample and find that the cost stickiness of core departments such as diagnosis and treatment was higher than that of non-core departments such as auxiliary medical treatment and logistics administration because the adjustment cost of core resources was higher than that of non-core resources. Banker et al. (2013) found that in countries with better labour law protection there was more cost stickiness. One reason for this is higher the severance cost of employees, the greater the cost stickiness. Liu and Liu (2014) found that the *Labour Contract Law* implemented in 2008 strengthened the protection of employees' interests

and ultimately led to an increase in corporate cost stickiness. However, Jiang et al. (2016) showed that cost stickiness has weakened after the implementation of the *Minimum Wages Regulations*. Further, Jiang et al. (2015) found that firms subject to greater financing constraints have a lower degree of cost stickiness. Zhou et al. (2016) demonstrated that the cost stickiness of firms using the differentiation strategy is higher than that of firms using the low-cost strategy because firms using the former have more firm-specific assets and therefore higher adjustment costs.

Secondly, the 'optimistic management expectation' view holds that if the management expects that the firm's business volume has only declined temporarily, it will not easily reduce idle capacity, thus resulting in cost stickiness. Anderson et al. (2003) found that a higher degree of cost stickiness exists during macroeconomic growth, and when sales declined for two consecutive years, cost stickiness also declined. Lu and Chen (2015) found that tight monetary policies will exacerbate the firms' pessimistic expectations for future economic growth, thus weakening the labour cost stickiness of non-state-owned enterprises. In particular, when corporate managers are too optimistic and overconfident, they tend to overestimate future market needs and their abilities to cope with adverse situations, and underestimate the potential risks, leading to a higher degree of cost stickiness (Liang, 2015).

Finally, the 'agency cost' view holds that the management may harm the company's interests for personal benefits, resulting in a deviation of resource allocation from its optimal level. The agency cost between management and shareholders may either strengthen or weaken cost stickiness. Chen, Lu, et al. (2012) found that the management's 'empire building' would increase the cost stickiness of firms. Based on a cross-country sample, Calleja et al. (2006) found that firms in common law countries (UK and US) face more stringent external regulations than firms in civil law countries (Germany and France), and thus the cost stickiness of UK and US firms is lower than that of the firms in Germany and France. Dierynck et al. (2012) and Kama and Weiss (2013) found that in order to avoid losses and decline in profits or to meet analysts' earnings forecasts, firms will not increase costs significantly when the business volume increases, but will instead quickly reduce business costs when the business volume decreases, that is, the agency cost could also lead to anti-stickiness.

Although the three theories mentioned above can explain cost stickiness, they contain different economic implications. The view of 'adjustment cost' and the view of 'optimistic management expectations' based on rational expectations suggest that the cost stickiness is a rational decision made by the management based on objective facts and should be encouraged, while the view of 'agency cost' holds that the cost stickiness is caused by agency problems between management and shareholders and should be curbed. However, most of the literature explains the cost stickiness of Chinese firms from the perspective of 'agency cost'. Sun and Liu (2004) found that Chinese listed companies are slower to adjust their costs downwards than US listed companies, and the capital intensity and macroeconomic growth cannot explain the cost stickiness of Chinese companies. Therefore, they believe that the cost stickiness of Chinese companies was caused by lower management capacities and higher agency costs of the management. Since then, a large literature has explored ways to reduce cost stickiness from the perspective of internal and external governance mechanisms. For the internal governance mechanism, the existing research has found that enhancement of board independence (Chen, Lu, et al., 2012;

Fang, 2009), appropriate board size, a staggered board, separation of CEO and chairman, lack of anti-takeover provisions (Chen, Lu, et al., 2012), and equity incentive (Liang, 2016) can reduce the cost stickiness of firms. For the external governance mechanism, existing research has found that shareholding ratio of institutional investors (Chen, Lu, et al., 2012; Zhang & Jiang, 2010), national legal systems (Calleja et al., 2006), overseas listings (Cui & Xu, 2013), external audits (Liang et al., 2015), media coverage (Liang, 2017), and a more intense industry competition environment (Xiao et al., 2016) can also inhibit the cost stickiness of firms. It becomes clear that these studies almost all inherently assume that cost stickiness is a reflection of a management-based weakness, 'staying idle', and hold that only strengthening internal and external governance mechanisms can effectively constrain non-optimal decision-making behaviour.

However, as Chen, Song, et al. (2012) pointed out, cost stickiness is a neutral word without any positive or negative connotation. The optimal degree of cost stickiness of a firm should be determined by the specific situation of the firm itself. Therefore, this paper states that the shortcoming of the existing research is two-fold, first, the existing research pays more attention to the costs arising from cost stickiness in the short-term, while ignoring its possible long-term benefits. Second, most of the existing research emphasises the management's agency problems in cost control decisions while ignoring the management's initiative in cost control decisions. To this end, this paper studies the economic essence of cost stickiness by examining the short-term and long-term impacts of cost stickiness on firm value.

2.2. Theoretical analysis and hypothesis development

The impact of cost stickiness on firm value may have two theoretical possibilities. From the perspective of 'adjustment cost', if there are rational management expectations, the firm's cost stickiness is actually a rational choice made by the firm after weighing its short-term costs and long-term benefits. For example, when the business volume of a firm decreases, the firm may cut costs by disposing idle assets or dismissing employees. In the short-term, this will reduce current production and operating costs of the firm, but in the long-term, especially if production rises again, firm would have to pay a large number of adjustment costs, such as disposal costs when assets are sold, purchase, transportation, and installation costs when repurchasing assets, severance costs for dismissed employees, and employment and training costs for new employees (Anderson et al., 2003). Therefore, firms with higher adjustment costs can maintain a certain degree of cost stickiness if the business volume declines. Although they would have to bear more operating costs in the short-term, it would help them save a lot of adjustment costs in the long-term. Therefore, the cost stickiness can reduce the firm value in the short-term, but increase the firm value in the long-term.

Similarly, firms retaining too many resources may create idle costs, while holding fewer resources may lead to loss of potential markets. Therefore, when the management is optimistic about the future economic situation, even if the firm's current business volume declines, the management will still maintain a certain degree of cost stickiness to meet the possible future demand increase. They can do this by maintaining moderately flexible

employees and retaining necessary inventories to avoid losing market shares and missing development opportunities (Banker & Byzalov, 2014). Of course, maintaining a certain degree of cost stickiness will inevitably increase the firm's operating costs in the short-term, which will have a negative impact on firm value. However, as this is the result of the management's considerations based on the firm's long-term interests, it is likely to enhance the firm value in the long run.

The 'agency cost' view holds that due to the existence of agency costs, management will be reluctant to adjust the costs downward if the market demands decline, and there will be cost stickiness (Chen, Lu, et al., 2012). Specifically, due to the separation of ownership and controls, the management may sacrifice shareholders' interests for personal gains, such as the behaviour of 'empire building', continuous expansion of firm size to expand power and influence, and construction of luxury office for personal enjoyment, etc. (Jensen, 1986; Stulz, 1990) The self-serving behaviour of the management for personal power, prestige, or high salaries causes a sharp rise in the costs of the firm when the business volume increases, but makes it difficult to reduce costs when the business volume declines, thus resulting in cost stickiness. In short, the existence of agency problems makes management more likely to take resource allocation decisions for the purpose of maximising their own interests rather than maximising the interests of shareholders. Therefore, the allocation of firm resources deviates from its optimal level, thereby eroding the interests of firms and reducing the firm value. Therefore, cost stickiness caused by agency problems will not have any positive impact on firm value in both the short-term and long-term.

The above analysis indicates that from the view of 'adjustment cost' and 'optimistic management expectations', maintaining cost stickiness is actually a rational choice made by management after weighing the short-term costs and long-term benefits of cost stickiness. In this context, cost stickiness will lower firm value in the short-term and increase it in the long-term. However, from the 'agency cost' view, cost stickiness will not have any positive impact on firm value in both the short-term and long-term. Therefore, when the first two views more accurately explain the actual situation, cost stickiness will have an intertemporal heterogeneous impact on the firm value, but when the 'agency costs' view is more accurate, cost stickiness will not have any intertemporal heterogeneous impact on the firm value.

It should be noted that if the capital market is highly efficient and the management's behavioural decision making can be accurately informed by investors or even pre-judged, then the intrinsic value of the firm's cost stickiness behaviour can be immediately reflected in the stock price. However, relevant research shows that the capital market in China is still weak and inefficient (Y. F. Zhang et al., 2006; He & Cheng, 2005; Lei et al., 2016). In an inefficient capital market, the interpretation of new information by investors is slower, and the economic behaviours of the firm to maintain cost stickiness also take time to be gradually reflected in the stock price. Therefore, this paper argues that cost stickiness may have an intertemporal heterogeneous impact on firm value.

Since the theoretical analysis in this paper does not form a definite empirical expectation, this paper only proposes the following alternative hypothesis for empirical tests:

H1: Cost stickiness has an intertemporal heterogeneous impact on firm value, that is, in the short-term, cost stickiness will reduce the firm value, while in the long-term, cost stickiness will increase the firm value.

3. Research designs

3.1. Measurement of cost stickiness

The existing research mainly adopts two methods to measure the cost stickiness of a firm. The first is the change regression model proposed by Anderson et al. (2003). The regression coefficient of this model can only represent the average cost stickiness of all samples, and it is impossible to generate the degree of cost stickiness for each firm in each year. The second is the direct measurement model constructed by Weiss (2010), which can obtain the degree of cost stickiness for each sample firm in each year. In view of the different characteristics of these two methods, the existing research on the factors affecting cost stickiness mostly adopts the model constructed by Anderson et al. (2003), while the research on the economic consequences of cost stickiness uses the model constructed by Weiss (2010). Since this paper studies the impact of cost stickiness on firm value, we refer to Weiss (2010) to calculate the annual degree of cost stickiness for each firm. We measure the cost stickiness of a firm by the difference between the logarithm of the ratio of the increase in cost for each unit of increase in sales revenue and the decrease in cost for each unit of decrease in sales revenue. The larger the value, the greater the cost stickiness is. The specific model is as follows:

$$STICKY_{i,t} = \log\left(\frac{\Delta COST}{\Delta SALE}\right)_{i,\bar{t}} - \log\left(\frac{\Delta COST}{\Delta SALE}\right)_{i,t} \quad (1)$$

In model (1), *STICKY* is a firm's degree of cost stickiness, subscript *i* represents the firm, *t* represents the year, \bar{t} is the quarter of the year subject to revenue rises that is closest to the end of the year, \underline{t} is the quarter of the year subject to revenue falls that is closest to the end of the year; $\Delta SALE$ is the difference between the sales revenue of the quarter and the sales revenue of the previous quarter, $\Delta COST$ is the difference between the operating cost of the quarter and the operating cost of the previous quarter. Operating costs refer to all costs including the cost of goods sold, business tax and surcharges, selling expenses, administrative expenses, and financial expenses.

In model (1), when *STICKY* is higher than 0, it means that the increase in cost when the sales revenue rises is greater than the decrease in cost when sales revenue declines, that is, the firm is subject to cost stickiness. When *STICKY* is lower than 0, it means the increase in cost when sales revenue rises is less than the decrease in cost when sales revenue declines, that is, the firm is subject to cost anti-stickiness. In other words, the higher the *STICKY*, the greater the cost stickiness is.

3.2. Model specification

In order to examine the short-term and long-term impacts of cost stickiness on firm value, this paper uses the following regression model to test:

$$\text{Tobin's } Q_{i,T} = \alpha + \beta STICKY_{i,t} + \text{Control Variables} + \sum \text{Year} + \sum \text{Industry} + \varepsilon \quad (2)$$

In model (2), the dependent variable is firm value (*Tobin's Q*), which is defined as the ratio of the sum of a firm's stock market value and its book value of debts to the book value of its total assets (Bai et al., 2005; Fauver et al., 2017). The subscript *i* represents the firm,

t represents the year, and T represents $t, t + 1, t + 2$. Since the research question examined in this paper is the 'short-term and long-term impacts of cost stickiness on firm value', this paper focuses on the regression coefficient and significance of cost stickiness ($STICKY_{i,t}$). If hypothesis 1 in this paper is established, that is, cost stickiness has a negative impact on firm value in the short-term, but has a positive impact on firm value in the long-term, then we expect that the coefficient β in model (2) is monotonic increasing from t to $t + 2$, and is significantly negative in the period t , and significantly positive in the period $t + 2$.

Referring to the practices of Bai et al. (2005) and Fauver et al. (2017), this paper controls other variables affecting firm value (*Tobin's Q*) in model (2), including nature of ownership (*SOE*), shareholding ratio of the largest shareholder (*TOP1*), proportion of independent directors (*INDEP*), separation of ownership and controlling right (*SEPARATION*), duality (*DUAL*), management shareholding ratio (*MANA*), cash holding ratio (*CASH*), financial leverage (*LEV*), return on equity (*ROE*), operating margin (*PM*), accrual earnings management (*EM*), degree of provincial marketisation (*MARKET*), previous firm value (*Tobin's Q* _{$t-1$}), year (*Year*), and industry (*Industry*) dummy variables. Refer to Table 1 for variable definitions in more detail.

3.3. Data

For this paper we selected all A-share non-financial listed companies from 2003 to 2016 as the research sample. The sample selection is based on the following: the direct measurement method proposed by Weiss (2010) requires quarterly data to calculate cost stickiness, and Chinese listed companies are required to disclose quarterly reports since 2002. The corporate governance variables such as the shareholding ratio of the largest shareholder, proportion of independent directors have only been disclosed since 2003, so we choose the year 2003 as the start date of this study. We deleted 16,310 observations because of missing data. The direct measurement model proposed by Weiss (2010) necessitates the exclusion of 13,350 more observations to calculate cost stickiness, including the observations with continuous increases or decreases in revenue or cost within the four quarters of the year, the samples subject to changes in revenue and cost in different directions, and the samples with revenue or cost less than 0. In the end, 11,320 observations are used as the sample for this paper.

It is likely that the deleted observations may cause self-selection problems, and these are dealt with later using the Heckman two-stage model. In addition, in order to avoid the influence of outliers, we perform 1% winsorisation for all continuous variables. Robust standard errors are used to calculate the significance of the coefficient in the regression. The data required for this study comes from the CSMAR database, with the exception of the marketisation index which comes from Wang et al. (2016).

Table 2 shows the annual distribution statistics of the samples. It can be seen that the sample size from 2003 to 2016 is generally increasing but fluctuating slightly. This is because the number of listed companies in China is increasing year by year. However, the economic development and environmental uncertainty in different years are also quite different. Table 3 reports the descriptive statistics of variables.

Table 1. Variables definition.

Variables	Definition
<i>Tobin's Q</i>	Firm value = (market value of total shares + book value of debt) / book value of total assets
<i>STICKY</i>	Cost stickiness, as shown in the model (1), which is referred to Weiss (2010).
<i>SOE</i>	Corporate ownership: State-owned enterprises take as 1, otherwise take as 0
<i>TOP1</i>	The shareholding ratio of the large shareholder = the share owned by the largest shareholder / total shares
<i>INDEP</i>	The percentage of independent directors = the number of independent directors / the total number of board of directors
<i>SEPARATION</i>	The difference between cash flow rights and control rights of the controller of the firm.
<i>DUAL</i>	Duality: equal to one if the CEO and the chairman of the board are the same person and zero otherwise.
<i>MANA</i>	Management shareholding ratio = the total shares owned by management / total shares of the firm
<i>CASH</i>	Cash holding ratio = (cash + financial assets held for trading) / total assets
<i>LEV</i>	Leverage = total debt / total assets
<i>ROE</i>	Return on equity = net profit / total equity
<i>PM</i>	Operating margin adjusted by industry annually = operating profit ratio – the median of annual industry operating margin. Note: before the implementation of new accounting standards in 2007, operating profit ratio = operating profit / sales; after the implementation, operating profit ratio = (operating profit – gain or loss from changes in fair values – investment income) / sales
<i>EM</i>	Accrual earnings management: adjusted Jones model matched by ROA (Kothari et al., 2005).
<i>MARKET</i>	Regional marketisation index, the higher the value, the higher the degree of marketisation. The data comes from Wang et al. (2016).
<i>VOL</i>	Stock returns volatility, defined as the standard deviation of stock returns over all trading days in one year.
<i>SDGDP</i>	The standard deviation of GDP growth for 4 quarters in 1 year.
<i>SDROA</i>	The standard deviation of net profit on total assets for 4 quarters in 1 year
<i>DTL</i>	Degree of total leverage = rate of change in Pre-tax Profit / rate of change in EPS
<i>Salesvolatility</i>	Seasonal volatility in sales: The standard deviation of the firm's sales in four quarters.
<i>RETURN</i>	Returns of individual stock = (Year-end closing price – Year-beginning opening price) / Year-beginning opening price
<i>DEGREE</i>	Executives' education background: secondary school and below is taken as 1, junior college is taken as 2, undergraduate is taken as 3, graduate is taken as 4, Ph. D. is taken as 5.
<i>PC</i>	Executives' political background: the central level is taken as 5, the provincial level is taken as 4, the city level is taken as 3, the county and district level is taken as 2, the other levels are 1, and without political background is taken as 0.
<i>FIN</i>	Executives' financial background: Executives with financial background are taken as 1 (including regulatory authorities, policy banks, commercial Banks, insurance companies, securities companies, fund management companies, securities registration and settlement companies, futures companies, investment Banks, trust companies, investment management companies, exchanges, and others), without financial background are taken as 0.
<i>FixIntensity</i>	Fixed assets intensity, defined as 1 when the ratio of fixed assets to total assets greater than the median, otherwise defined as 0.
<i>EmplIntensity</i>	Employee intensity, defined as 1 when the ratio of number of employees to sales greater than the median, otherwise defined as 0.
<i>Prospect1</i>	Dummy variable of industry prosperity: derived from the "industry prosperity index" regularly released by the development research centre of the state council industry prosperity monitoring platform. If the index is larger than the median, it is defined as 1, indicating that the managers have optimistic expectations. Otherwise, it is defined as 0, indicating that the manager has pessimistic expectations.
<i>Prospect2</i>	Whether the sales have declined for two consecutive years: it is defined as 1 if the sales declines for two consecutive years, representing that the manager has pessimistic expectations. Otherwise, it is defined as 0, representing that managers have optimistic expectations.
<i>Mshare</i>	Dummy variable of management shareholding ratio: If the ratio of the total number of shares owned by management to the total number of shares is greater than the median, then it equals 1. Otherwise, it equals 0.
<i>FCF</i>	Free cash flow = (net profit + interest expenses + non-cash charges) – additional working capital – capital expenditure
<i>Growth</i>	Defined as the sales growth rate of the firm = (sales in the current period – sales in the previous period) / sales in the previous period
<i>FEPS</i>	The growth of earnings per share forecasted by analysts = Average earnings per share forecasted by analysts of this year – actual earnings per share of the last year

Table 2. Sample descriptive statistics.

Year	N	Year	N
2003	423	2010	940
2004	559	2011	1,147
2005	634	2012	1,175
2006	559	2013	1,094
2007	702	2014	1,065
2008	602	2015	1,115
2009	711	2016	1,180
<i>Total</i>	11,320		

Table 3. Variables descriptive statistics.

Variables	N	mean	min	1/4 quantile	median	3/4 quantile	max	sd
<i>Tobin's Q</i>	11,320	2.37	0.90	1.32	1.81	2.76	13.09	1.72
<i>STICKY</i>	11,320	0.28	-2.58	-0.09	0.15	0.58	3.75	0.92
<i>SOE</i>	11,320	0.52	0	0	1	1	1	0.50
<i>TOP1</i>	11,320	0.37	0.09	0.24	0.35	0.48	0.75	0.15
<i>INDEP</i>	11,320	0.36	0.18	0.33	0.33	0.38	0.57	0.05
<i>SEPARATION</i>	11,320	5.57	0	0	0	10.72	29.18	8.02
<i>DUAL</i>	11,320	0.19	0	0	0	0	1	0.40
<i>MANA</i>	11,320	0.08	0	0	0	0.02	0.68	0.17
<i>CASH</i>	11,320	0.18	0.01	0.09	0.14	0.23	0.71	0.13
<i>LEV</i>	11,320	0.48	0.05	0.32	0.48	0.63	1.49	0.21
<i>ROE</i>	11,320	0.07	-0.95	0.03	0.07	0.12	0.52	0.13
<i>PM</i>	11,320	-0.01	-2.27	-0.05	-0.01	0.05	0.38	0.17
<i>EM</i>	11,320	0.00	-0.30	-0.04	-0.00	0.04	0.36	0.09
<i>MARKET</i>	11,320	6.21	1.27	4.74	6.87	7.45	11.93	1.80

4. Empirical results

4.1. Regression results for short-term and long-term impacts of cost stickiness on firm value

Table 4 reports the regression results for short-term and long-term impacts of cost stickiness on firm value. Columns (1) – (3) show the impact of cost stickiness ($STICKY_t$) on current firm value ($Tobin's Q_t$), the firm value in the next period ($Tobin's Q_{t+1}$) and the firm value in the next two periods ($Tobin's Q_{t+2}$). In columns (1) – (3), the coefficients of cost stickiness ($STICKY_t$) are -0.0225 , -0.0011 , and 0.0396 respectively, subject to monotonically increasing. The coefficient of $STICKY_t$ in column (1) is significantly negative at a significance level of 5%, and the coefficient of $STICKY_t$ in column (3) is significantly positive at a significance level of 1%. These results show that cost stickiness has an intertemporal heterogeneous impact on firm value, as it has a negative impact on firm value in the short-term and a positive impact in the long-term. This confirms to some extent the opinion of G. Jiang et al. (2010) that 'in the context of relatively concentrated ownership of listed companies in China, there are relatively few agency problems between large shareholders and the management'. To sum up, management will often make cost stickiness decisions that benefit the long-term firm value based on reasonable expectations of adjustment costs and future economic conditions, although these decisions may reduce their firm's value in the short-term. In other words, a firm maintaining cost stickiness is actually the result of a rational choice made by the management after weighing the short-term costs and long-term benefits of cost stickiness.

Table 4. The long-term and short-term impact of cost stickiness on firm value.

Variables	(1)	(2)	(3)
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
<i>STICKY_t</i>	-0.022** (-2.07)	-0.001 (-0.10)	0.040*** (3.33)
<i>SOE</i>	-0.129*** (-5.11)	-0.169*** (-6.57)	-0.136*** (-5.00)
<i>TOP1</i>	-0.032 (-0.46)	-0.087 (-1.22)	-0.043 (-0.56)
<i>INDEP</i>	0.433** (2.23)	0.244 (1.23)	0.288 (1.36)
<i>SEPARATION</i>	-0.002* (-1.73)	-0.004*** (-2.80)	-0.001 (-0.97)
<i>DUAL</i>	0.036 (1.38)	0.028 (1.02)	0.023 (0.79)
<i>MANA</i>	0.092 (1.21)	-0.023 (-0.28)	0.309*** (3.27)
<i>CASH</i>	0.214** (2.37)	0.279*** (2.91)	0.469*** (4.48)
<i>LEV</i>	-0.443*** (-7.81)	-0.399*** (-6.93)	-0.590*** (-9.76)
<i>ROE</i>	0.673*** (7.71)	0.524*** (6.43)	0.397*** (4.72)
<i>PM</i>	-0.842*** (-12.29)	-0.821*** (-13.84)	-0.853*** (-14.59)
<i>EM</i>	-0.759*** (-6.68)	-0.672*** (-5.76)	-0.779*** (-6.39)
<i>MARKET</i>	0.004 (0.70)	0.004 (0.73)	0.004 (0.66)
<i>TobinsQ_{t-1}</i>	0.710*** (102.84)	0.715*** (99.24)	0.695*** (88.57)
<i>Intercept</i>	0.429*** (3.59)	0.501*** (4.08)	0.521*** (4.08)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>N</i>	11,320	10,791	9,616
<i>Adj. R²</i>	0.636	0.627	0.616

Note: Robust standard errors are in parentheses. ***, **, * represents significance level at 1%, 5%, and 10% respectively, the same as below.

4.2. Robustness tests

4.2.1. Endogenous problems caused by self-selection

This paper adopts the direct measurement model proposed by Weiss (2010) to calculate cost stickiness. This model requires excluding samples subject to rising cost along with falling revenue, excluding samples subject to falling cost along with rising revenue, and excluding samples subject to continuous increase or decrease in revenue within the four quarters of the year. As many samples are not excluded randomly but on the basis of a concerned variable, the regression results in Table 4 may be affected by the sample self-selection problems. To this end, this paper uses the Heckman two-stage model to solve the sample self-selection problems. The dependent variable of the first-stage regression model is whether we can calculate the cost stickiness (*NotNULL*) via the model of Weiss (2010). If the answer is yes, *NotNULL* equals 1. Since this variable is mainly affected by risk factors such as the fluctuations in business volume, we select stock returns volatility in 1 year (*VOL*), standard deviation of net profit on total assets for 4 quarters in 1 year (*SDROA*), degree of total leverage (*DTL*) and

standard deviation of GDP growth for 4 quarters in 1 year (*SDGDP*) as explanatory variables and for control variables we use year and industry fixed effects.

Table 5 shows the regression results of the Heckman two-stage model. The coefficients of *mills lambda* are all significant at the significance level of 1%, which indicates that the Heckman two-stage regression can better solve the sample self-selection problems caused by the calculation of the cost stickiness via the direct measurement method. According to the second-stage regression results, after controlling the sample self-selection problems, the coefficient of *STICKY_t* monotonically increases from *t* to *t + 2*, and is significantly negative in the period *t*, and positive in the period *t + 2*, indicating the empirical results of our paper are robust.

4.2.2. Endogeneity concerns caused by omitted variables

When examining the impact of cost stickiness on firm value, this paper may have omitted some factors affecting firm value, such as the capabilities of firm founders. In order to alleviate the endogenous problems caused by such time-independent omitted variables, we differentiate all variables in the model (2) and re-regress it. The regression results are shown in Table 6. The results indicate that the coefficient of $\Delta STICKY_t$ monotonically increases in columns (1) – (3), the coefficient of $\Delta STICKY_t$ in column (1) is significantly negative at the significance level of 5%, and the coefficient of $\Delta STICKY_t$ in column (3) is significantly positive at the significance level of 5%. This finding remains consistent with the above conclusion, that cost stickiness has a negative impact on firm value in the short-term and will have a positive impact on firm value in the long-term.

4.2.3. Endogeneity concerns caused by measurement errors of cost stickiness

Chen, Song, et al. (2012) found that loss-making firms often carried out the ‘big bath’ process to manage earnings. When this happens, the business cost does decrease when business volume declines, that is, the business cost decreases less when business volume declines than the business cost increases when the business volume rises. In this case, the measured cost stickiness would be overestimated due to the ‘big bath’ behaviour of the management. Given this, this paper excludes the observations of loss-making firms and re-estimates the regression model (2). It is found that after excluding the loss-making firms, the conclusion does not change significantly, indicating that the results are robust.

4.2.4. Consider the seasonal sales fluctuations

This paper uses the direct measurement method proposed by Weiss (2010) to measure cost stickiness. Since this method uses quarterly data for calculation, the results are affected by seasonal fluctuations of sales. In order to alleviate the influence from seasonal sales fluctuations on the regression results, we exclude the samples subject to large fluctuations in sales revenue for 4 quarters in 1 year and re-examine the intertemporal heterogeneous impact of cost stickiness. Specifically, one by one we exclude the top 10%, 20%, and 30% of samples subject to fluctuations in sales revenue, and then carry out regression analysis on the new sample each time. The results are shown in Table 7.¹ It is found that the conclusion

¹In order to present the regression results better and more concisely, only the regression coefficients and standard errors of explanatory variables are shown here, excluding the regression results of control variables. If necessary, please contact us.

Table 5. Sample self-selection problem – Heckman two-stage regression.

	(1)	(2)	(3)
<i>First stage</i>	<i>NotNULL</i>	<i>NotNULL</i>	<i>NotNULL</i>
<i>VOL</i>	-0.102* (-1.91)	-0.094* (-1.75)	-0.055 (-0.95)
<i>SDROA</i>	4.997*** (3.27)	1.706 (1.13)	2.103 (1.23)
<i>DTL</i>	-2.312*** (-11.15)	-2.999*** (-11.80)	-3.397*** (-10.78)
<i>SDGDP</i>	0.001* (1.76)	0.001 (1.50)	0.002* (1.93)
<i>Intercept</i>	-1.523*** (-2.74)	-0.504 (-0.91)	-0.409 (-0.74)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>N</i>	18,896	18,346	15,934
<i>Rho</i>	1.000	0.764	0.459
<i>sigma</i>	2.556	1.267	1.109
<i>Second stage</i>	<i>Tobin's Q_t</i>	<i>Tobin's Q_{t+1}</i>	<i>Tobin's Q_{t+2}</i>
<i>mills</i>			
<i>lambda</i>	2.556*** (8.92)	0.968*** (6.35)	0.509*** (3.01)
<i>STICKY_t</i>	-0.032* (-1.82)	-0.009 (-0.74)	0.027** (2.17)
<i>SOE</i>	-0.107*** (-2.58)	-0.167*** (-6.37)	-0.108*** (-3.83)
<i>TOP1</i>	-0.066 (-0.59)	-0.076 (-1.04)	-0.040 (-0.50)
<i>INDEP</i>	0.358 (1.12)	0.350* (1.71)	0.359 (1.63)
<i>SEPARATION</i>	-0.002 (-0.68)	-0.003** (-2.22)	-0.000 (-0.28)
<i>DUAL</i>	0.031 (0.71)	0.022 (0.81)	0.028 (0.91)
<i>MANA</i>	0.208* (1.65)	-0.007 (-0.09)	0.367*** (3.67)
<i>CASH</i>	0.036 (0.24)	0.315*** (3.18)	0.437*** (4.00)
<i>LEV</i>	-0.510*** (-5.53)	-0.429*** (-7.28)	-0.689*** (-10.89)
<i>ROE</i>	0.595*** (4.39)	0.501*** (6.00)	0.359*** (4.13)
<i>PM</i>	-0.476*** (-4.11)	-0.806*** (-13.12)	-0.885*** (-14.25)
<i>EM</i>	-0.595*** (-3.20)	-0.636*** (-5.28)	-0.840*** (-6.57)
<i>MARKET</i>	0.005 (0.49)	0.005 (0.88)	0.004 (0.62)
<i>Tobin's Q_{t-1}</i>	0.733*** (58.58)	0.708*** (91.07)	0.685*** (80.11)
<i>Intercept</i>	-1.557*** (-4.94)	-0.155 (-0.96)	0.310* (1.83)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Censored N</i>	8,767	8,398	7,272
<i>Uncensored N</i>	10,129	9,948	8,662
<i>Wald chi2</i>	5,477.86	15,151.94	13,262.07

Table 6. Using difference method to alleviate the endogenous problems caused by omitted variables.

Variables	(1)	(2)	(3)
	Δ Tobin's Q_t	Δ Tobin's Q_{t+1}	Δ Tobin's Q_{t+2}
Δ STICKY _t	-0.039** (-2.20)	-0.023 (-1.62)	0.042** (2.53)
Δ TOP1	-0.926** (-2.09)	-1.004*** (-3.00)	-0.590 (-1.61)
Δ INDEP	-0.542 (-1.02)	-0.629 (-1.47)	-0.288 (-0.58)
Δ SEPARATION	-0.000 (-0.04)	-0.001 (-0.20)	0.000 (0.08)
Δ MANA	0.303 (0.56)	-0.088 (-0.20)	-0.898 (-1.51)
Δ CASH	1.882*** (6.92)	0.803*** (3.54)	0.608** (2.25)
Δ LEV	2.626*** (16.47)	1.143*** (8.49)	-0.363 (-1.62)
Δ ROE	-0.000 (-0.30)	0.153*** (5.46)	-0.016 (-1.01)
Δ PM	-1.288*** (-11.16)	-0.032*** (-5.52)	-0.003*** (-7.75)
Δ EM	0.909*** (4.88)	0.302** (2.09)	0.324* (1.95)
Δ MARKET	0.010 (0.23)	0.015 (0.41)	0.035 (0.93)
Δ Tobin's Q_{t-1}	-0.157*** (-13.20)	-0.308*** (-30.25)	-0.293*** (-20.22)
Intercept	-0.344* (-1.94)	-0.455*** (-3.17)	-0.162 (-1.05)
Year	Control	Control	Control
Industry	Control	Control	Control
N	6,063	5,770	5,071
Adj. R ²	0.275	0.373	0.316

Table 7. Delete samples with seasonal fluctuation.

Sample	(1)	(2)	(3)
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
(STICKY _t) _{-10%} ^a	-0.028** (-2.40)	-0.007 (-0.55)	0.0403*** (3.17)
(STICKY _t) _{-20%}	-0.0257** (-2.09)	-0.0093 (-0.72)	0.0383*** (2.76)
(STICKY _t) _{-30%}	-0.0273** (2.07)	0.0033 (0.23)	0.0391** (2.57)

^a(STICKY_t)_{-10%}: The subscript -10% represents the remaining samples after excluding the samples whose sales revenue fluctuation ranking in the top 10% of the total sample, and the rest and so on.

of this paper remains unchanged after excluding samples subject to seasonal fluctuations in sales revenue. This indicates that the conclusion is robust.

4.2.5. Change the measurement of the dependent variable

The main test of this paper uses Tobin's Q to measure the firm value. In this section, the firm value is measured by the annual returns of individual stocks (*RETURN*). The result is robust to this alternative measure.

4.2.6. Further control the manager characteristic variables

The main test of this paper controls manager characteristic variables such as duality of Chairman of the Board and General Manager, and management shareholding ratio. In order to further control the influence of the management's characteristics, three more manager characteristic variables are controlled, the manager's educational background, the manager's political background, and the manager's financial background. The empirical results are consistent with the above conclusion, which further indicates that the research conclusion is robust.

4.3. Cross-sectional tests for the heterogeneous impact of cost stickiness on firm value

The above results show that cost stickiness will reduce firm value in the short-term, but will increase firm value in the long-term, that is, cost stickiness has an intertemporal heterogeneous impact on firm value. However, Chen, Song, et al. (2012) pointed out that under normal circumstances, firms with different natures should have different degrees of cost stickiness. In other words, the impact of cost stickiness on firm value should vary among firms. To address this, this paper identifies three key factors that may influence the relationship between cost stickiness and firm value: adjustment costs, management expectations, and agency costs, and examines the differences in the intertemporal heterogeneous impact of cost stickiness on firm value under different conditions.

4.3.1. Impact of adjustment cost on the relationship between cost stickiness and firm value

Adjustment cost of firms affects the relationship between cost stickiness and firm value. Firms with higher adjustment costs should have a higher degree of optimal cost stickiness than firms with lower adjustment costs (Anderson et al., 2003). Specifically, for firms with high fixed assets density, if they cut costs through asset sales during the market downturn, they will not only incur costs for asset disposal but also incur additional acquisition costs in the future when market demands rise. More importantly, these firms may also lose potential growth opportunities in the future. Similarly, if labour-intensive firms dismiss their employees during the market downturn, they will not only incur severance costs for dismissed employees and employment and training costs for new employees in the future, there would also be a lack of security and morale among employees, which would affect their work efficiency. Given this, we argue that maintaining cost stickiness by firms with higher adjustment costs is more likely to be a rational choice made by the management after weighing its short-term costs and long-term benefits. It can be inferred that the intertemporal heterogeneous impact of cost stickiness on firm value is more significant among firms with higher adjustment costs than those with lower adjustment costs.

In order to verify the above inference, we measure the adjustment costs by fixed asset intensity and employee intensity (see Table 1 for a detailed definition of variables) and carry out tests based on groups according to the medians of these two indicators. Tables 8 and 9 show the regression results grouped by fixed asset intensity and employee intensity respectively. Results in Table 8 show that in the group with higher fixed asset intensity in columns (1) – (3), the regression coefficient of cost stickiness ($STICKY_t$) monotonically

Table 8. The impact of fixed assets intensity on the relationship between cost stickiness and firm value.

Variables	Fixed assets intensity is high (FixIntensity = 1)			Fixed assets intensity is low (FixIntensity = 0)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
<i>STICKY_t</i>	-0.051*** (-3.74)	0.021 (1.51)	0.040*** (2.78)	0.009 (0.51)	-0.026 (-1.41)	0.031 (1.56)
<i>SOE</i>	-0.189*** (-5.54)	-0.185*** (-5.47)	-0.170*** (-4.78)	-0.060 (-1.61)	-0.138*** (-3.51)	-0.085** (-2.06)
<i>TOP1</i>	0.028 (0.31)	-0.138 (-1.50)	-0.062 (-0.63)	-0.043 (-0.41)	0.014 (0.13)	0.047 (0.39)
<i>INDEP</i>	0.232 (0.89)	0.337 (1.29)	-0.124 (-0.44)	0.639** (2.25)	0.181 (0.60)	0.655** (2.07)
<i>SEPARATION</i>	-0.005*** (-2.98)	-0.005*** (-2.87)	-0.004** (-2.16)	0.001 (0.59)	-0.002 (-0.78)	0.002 (0.82)
<i>DUAL</i>	0.005 (0.14)	0.017 (0.47)	-0.015 (-0.41)	0.061 (1.58)	0.036 (0.86)	0.071 (1.55)
<i>MANA</i>	-0.102 (-0.98)	-0.080 (-0.75)	0.196 (1.60)	0.222** (1.98)	0.012 (0.10)	0.423*** (2.90)
<i>CASH</i>	0.267* (1.78)	0.471*** (3.02)	0.489*** (2.97)	0.108 (0.86)	0.130 (0.96)	0.281* (1.89)
<i>LEV</i>	-0.500*** (-6.60)	-0.399*** (-5.28)	-0.402*** (-5.10)	-0.360*** (-4.23)	-0.403*** (-4.58)	-0.796*** (-8.49)
<i>ROE</i>	0.768*** (6.83)	0.487*** (4.80)	0.561*** (5.48)	0.573*** (4.24)	0.504*** (3.83)	0.126 (0.90)
<i>PM</i>	-1.087*** (-11.78)	-0.892*** (-11.92)	-0.907*** (-11.83)	-0.626*** (-6.21)	-0.715*** (-7.56)	-0.765*** (-8.55)
<i>EM</i>	-0.717*** (-4.09)	-0.664*** (-3.74)	-0.826*** (-4.42)	-0.748*** (-4.89)	-0.653*** (-4.10)	-0.713*** (-4.28)
<i>MARKET</i>	0.008 (1.06)	0.013* (1.68)	0.021** (2.57)	0.002 (0.19)	-0.005 (-0.60)	-0.014 (-1.45)
<i>Tobin's Q_{t-1}</i>	0.723*** (74.25)	0.742*** (75.81)	0.706*** (67.85)	0.701*** (71.52)	0.691*** (64.89)	0.680*** (57.49)
<i>Intercept</i>	0.535*** (3.37)	0.409** (2.55)	0.460*** (2.75)	0.296* (1.66)	0.557*** (2.98)	0.624*** (3.21)
<i>Year</i>	Control	Control	Control	Control	Control	Control
<i>Industry</i>	Control	Control	Control	Control	Control	Control
<i>N</i>	5,773	5,555	4,978	5,547	5,236	4,638
<i>Adj. R²</i>	0.634	0.649	0.626	0.645	0.611	0.611

increases, and is significantly negative in column (1) and significantly positive in column (3). While in the group with lower fixed asset intensity in columns (4) – (6), the regression coefficient of cost stickiness ($STICKY_t$) is not significant. The above results indicate that the intertemporal heterogeneous impact of cost stickiness on firm value exists only among firms with higher fixed asset intensity, which confirms the above inference.

Similarly, the results in Table 9 indicate that in the group with higher employee intensity, the regression coefficient of cost stickiness ($STICKY_t$) monotonically increases from t to $t + 2$, and is significantly negative in the period t and significantly positive in the period $t + 2$. While in the group with lower employee intensity, the regression coefficient of cost stickiness ($STICKY_t$) is not significant. This shows that the intertemporal heterogeneous impact of cost stickiness on firm value exists only among firms with higher employee intensity, thereby confirming the above inference.

To sum up the above results, the intertemporal heterogeneous impact of cost stickiness on firm value is more significant among firms with higher adjustment costs than those with lower adjustment costs, indicating that when the adjustment cost is high, cost

Table 9. The impact of employee intensity on the relationship between cost stickiness and firm value.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Employee intensity is high (Emplintensity = 1)</i>			<i>Employee intensity is low (Emplintensity = 0)</i>		
	<i>Tobin's Q_t</i>	<i>Tobin's Q_{t+1}</i>	<i>Tobin's Q_{t+2}</i>	<i>Tobin's Q_t</i>	<i>Tobin's Q_{t+1}</i>	<i>Tobin's Q_{t+2}</i>
<i>STICKY_t</i>	-0.033*** (-2.89)	-0.002 (-0.07)	0.038* (1.99)	-0.016 (-1.17)	-0.014 (-1.44)	0.039 (1.63)
<i>SOE</i>	-0.114** (-2.19)	-0.197*** (-4.27)	-0.143** (-2.11)	-0.141*** (-5.22)	-0.143*** (-7.86)	-0.126*** (-3.46)
<i>TOP1</i>	0.194* (1.77)	0.015 (0.13)	0.152 (1.22)	-0.179 (-1.26)	-0.089 (-1.14)	-0.140 (-1.25)
<i>INDEP</i>	0.485** (2.20)	0.655** (2.76)	0.634 (1.44)	0.399* (2.07)	-0.121 (-0.77)	0.022 (0.09)
<i>SEPARATION</i>	-0.003* (-1.95)	-0.008*** (-5.99)	-0.003 (-1.11)	-0.002 (-1.04)	-0.001 (-1.36)	-0.000 (-0.31)
<i>DUAL</i>	0.051** (2.38)	-0.038 (-1.22)	-0.015 (-0.33)	0.029 (0.65)	0.081** (2.61)	0.050 (1.25)
<i>MANA</i>	0.064 (0.70)	-0.142 (-1.24)	0.204** (2.23)	0.049 (0.41)	-0.046 (-0.33)	0.360* (1.77)
<i>CASH</i>	0.278** (2.56)	0.447*** (4.07)	0.297 (1.48)	0.206 (1.36)	0.177 (0.85)	0.634** (2.47)
<i>LEV</i>	-0.220* (-1.89)	-0.117 (-1.30)	-0.350*** (-3.26)	-0.555*** (-3.90)	-0.547*** (-5.63)	-0.762*** (-7.56)
<i>ROE</i>	0.578** (2.59)	0.545*** (3.70)	0.425 (1.48)	0.713*** (3.78)	0.491** (2.44)	0.277 (1.13)
<i>PM</i>	-0.856*** (-4.74)	-0.840*** (-4.76)	-0.874*** (-4.00)	-0.402*** (-3.41)	-0.413*** (-3.26)	-0.291 (-1.68)
<i>EM</i>	-1.008*** (-4.28)	-1.016*** (-3.41)	-1.085*** (-4.00)	-0.615*** (-3.30)	-0.489*** (-3.73)	-0.532*** (-3.93)
<i>MARKET</i>	0.001 (0.23)	0.013 (1.55)	0.011 (1.53)	0.009 (0.97)	0.002 (0.18)	0.001 (0.08)
<i>Tobin's Q_{t-1}</i>	0.717*** (30.73)	0.728*** (27.42)	0.730*** (31.04)	0.689*** (12.61)	0.687*** (25.39)	0.643*** (13.28)
<i>Intercept</i>	0.085 (0.78)	-0.015 (-0.10)	-0.025 (-0.18)	0.711*** (3.21)	0.923*** (8.68)	0.998*** (5.72)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>N</i>	5,161	4,920	4,323	6,159	5,871	5,293
<i>Adj. R²</i>	0.648	0.633	0.632	0.621	0.623	0.592

stickiness has a negative impact on firm value in the short-term, but a positive impact on firm value in the long-term.

4.3.2. Impact of management expectations on the relationship between cost stickiness and firm value

Management expectations also affect the relationship between cost stickiness and firm value. Retaining too many resources may incur idle costs, while holding fewer resources may lose potential markets. Therefore, the management should correctly anticipate future business prospects, and then determine optimal resource allocation based on idle costs and shortage costs of resources (Banker & Byzalov, 2014). When management is optimistic about the future, even if the firm's current business volume declines, they should still maintain a certain degree of cost stickiness to meet a possible increase in demand in the future. They can do this by maintaining flexible staffing and retaining necessary inventories to avoid losing market share and to avoid missing potential opportunities. Of course, maintaining cost stickiness will inevitably increase operating costs in the short-term and may have a negative impact on firm value. It can be inferred that the

intertemporal heterogeneous impact of cost stickiness on firm value is more significant among firms with optimistic management expectations than those with pessimistic management expectations.

Specifically, we measure management expectations based on the industry prosperity and whether the sales revenue of a firm has declined for two consecutive years (see Table 1 for a detailed definition of variables). In reference to Dai et al. (2017), we set the industry prosperity dummy variable (*Prosperity1*) using the industry prosperity index published by Development Research Centre of the State Council (*DRC*). In addition, according to Anderson et al. (2003), in this paper we define pessimism about the future as taking place when the sales revenue declines for two consecutive years (*Prosperity2*). Tables 10 and 11 respectively show the regression results grouped by the industry prosperity and whether the sales revenue of a firm has declined for two consecutive years.

The results in Table 10 show that in the group subject to industry prosperity in columns (1) – (3), the regression coefficient of cost stickiness ($STICKY_t$) monotonically increases, and is significantly negative in column (1) and significantly positive in column (3), while in the group subject to industry recession in columns (4) – (6), the regression coefficient of cost

Table 10. The impact of industry prosperity on the relationship between cost stickiness and firm value.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Prosperity (<i>Prospect1</i> = 1)			Depression (<i>Prospect1</i> = 0)		
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
<i>STICKY</i> _{<i>t</i>}	-0.042** (-2.24)	0.007 (0.38)	0.055*** (2.75)	-0.028 (-1.58)	0.014 (0.78)	0.009 (0.46)
<i>SOE</i>	-0.149*** (-3.23)	-0.131*** (-2.77)	-0.087* (-1.77)	-0.160*** (-3.94)	-0.175*** (-4.39)	-0.182*** (-4.13)
<i>TOP1</i>	0.110 (0.87)	-0.075 (-0.57)	0.004 (0.03)	-0.121 (-1.08)	-0.169 (-1.52)	-0.282** (-2.23)
<i>INDEP</i>	0.316 (0.87)	0.003 (0.01)	0.122 (0.31)	0.573* (1.84)	0.529* (1.72)	0.203 (0.59)
<i>SEPARATION</i>	-0.006*** (-2.59)	-0.005* (-1.94)	-0.001 (-0.38)	-0.001 (-0.26)	-0.004* (-1.88)	-0.003 (-1.33)
<i>DUAL</i>	0.027 (0.59)	0.031 (0.65)	-0.015 (-0.29)	-0.003 (-0.08)	-0.039 (-0.93)	-0.005 (-0.10)
<i>MANA</i>	0.114 (0.88)	0.136 (0.97)	0.485*** (3.00)	-0.079 (-0.67)	-0.089 (-0.75)	0.060 (0.42)
<i>CASH</i>	0.492*** (2.95)	0.623*** (3.49)	0.678*** (3.49)	0.063 (0.43)	0.147 (0.98)	0.419** (2.42)
<i>LEV</i>	-0.454*** (-4.39)	-0.440*** (-4.17)	-0.474*** (-4.37)	-0.346*** (-3.83)	-0.372*** (-4.20)	-0.567*** (-5.75)
<i>ROE</i>	0.862*** (5.31)	0.695*** (4.68)	0.502*** (3.31)	0.505*** (3.67)	0.491*** (3.89)	0.344** (2.49)
<i>PM</i>	-1.099*** (-8.91)	-1.019*** (-9.53)	-1.148*** (-10.62)	-0.543*** (-4.50)	-0.801*** (-8.34)	-0.645*** (-6.26)
<i>EM</i>	-0.280 (-1.26)	-0.563** (-2.45)	0.197 (0.84)	-0.991*** (-4.85)	-0.998*** (-4.99)	-1.326*** (-5.95)
<i>MARKET</i>	0.009 (0.86)	-0.007 (-0.66)	-0.004 (-0.34)	0.006 (0.64)	0.015 (1.63)	0.007 (0.71)
Tobin's Q_{t-1}	0.721*** (60.13)	0.705*** (57.43)	0.714*** (53.71)	0.774*** (69.86)	0.752*** (67.37)	0.760*** (58.38)
Intercept	0.354 (0.95)	0.597* (1.67)	0.498 (1.42)	0.344* (1.81)	0.418** (2.25)	0.566*** (2.75)
Year	Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control	Control
<i>N</i>	3,668	3,411	3,009	4,454	4,289	3,802
Adj. R^2	0.643	0.634	0.635	0.642	0.638	0.616

stickiness ($STICKY_t$) is not significant. This indicates that the intertemporal heterogeneous impact of cost stickiness on firm value exists only in the group subject to industry prosperity. The results in Table 11 show that in the samples with decreases in sales revenue for two consecutive years (when the management generally has pessimistic expectations for the future), the regression coefficient of cost stickiness ($STICKY_t$) is not significant; while in the samples without decreases in sales revenue for two consecutive years (when the management generally has optimistic expectations for the future), the regression coefficient of cost stickiness ($STICKY_t$) monotonically increases, and is significantly negative in column (1) and significantly positive in column (3). This shows that the intertemporal heterogeneous impact of cost stickiness on firm value exists only among samples with optimistic management expectations. In summation, when the management is optimistic about the future, the firm's maintaining cost stickiness is more conducive to the long-term benefits of firm value than when they are pessimistic about the future. This confirms the above inference.

Table 11. The impact of sales declines for two consecutive years on the relationship between cost stickiness and firm value.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Optimism (Prospect2 = 0)			Pessimism (Prospect2 = 1)		
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
$STICKY_t$	-0.021* (-1.79)	-0.001 (-0.11)	0.043*** (3.51)	-0.045 (-1.40)	-0.004 (-0.12)	-0.002 (-0.06)
SOE	-0.114*** (-4.32)	-0.162*** (-6.00)	-0.125*** (-4.43)	-0.187** (-2.36)	-0.176** (-2.18)	-0.171** (-1.98)
TOP1	-0.003 (-0.04)	-0.059 (-0.80)	-0.034 (-0.42)	0.009 (0.04)	-0.111 (-0.46)	-0.042 (-0.17)
INDEP	0.355* (1.75)	0.183 (0.88)	-0.059 (-0.27)	1.290** (2.16)	0.895 (1.44)	2.407*** (3.80)
SEPARATION	-0.002 (-1.45)	-0.004** (-2.54)	-0.002 (-0.98)	-0.002 (-0.46)	-0.001 (-0.19)	0.001 (0.14)
DUAL	0.018 (0.68)	0.020 (0.73)	0.004 (0.14)	0.239*** (2.76)	0.153* (1.70)	0.201** (2.09)
MANA	0.103 (1.30)	-0.007 (-0.08)	0.275*** (2.84)	0.340 (1.16)	0.400 (1.35)	0.795** (2.29)
CASH	0.187** (1.99)	0.231** (2.27)	0.414*** (3.76)	0.176 (0.60)	0.217 (0.77)	0.634** (2.02)
LEV	-0.497*** (-8.14)	-0.464*** (-7.43)	-0.701*** (-10.70)	0.026 (0.17)	0.062 (0.41)	-0.000 (-0.00)
ROE	0.525*** (5.39)	0.511*** (5.44)	0.161 (1.63)	1.047*** (5.14)	0.473*** (2.70)	0.606*** (3.41)
PM	-0.517*** (-6.07)	-0.673*** (-8.94)	-0.382*** (-4.60)	-0.967*** (-7.73)	-0.690*** (-6.06)	-1.019*** (-9.94)
EM	-0.660*** (-5.64)	-0.703*** (-5.76)	-0.762*** (-6.00)	-1.637*** (-3.91)	-0.575 (-1.55)	-0.435 (-1.12)
MARKET	0.003 (0.49)	0.003 (0.47)	-0.001 (-0.09)	0.018 (0.87)	0.023 (1.16)	0.044** (2.15)
Tobin's Q_{t-1}	0.684*** (95.56)	0.685*** (90.55)	0.667*** (81.34)	0.965*** (40.66)	0.941*** (40.94)	0.864*** (34.92)
Intercept	0.549*** (4.46)	0.658*** (5.22)	0.827*** (6.24)	-0.523 (-1.28)	-0.836* (-1.90)	-1.375*** (-3.19)
Year	Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control	Control
N	10,252	9,583	8,435	1,068	1,208	1,181
Adj. R^2	0.634	0.621	0.616	0.716	0.697	0.661

4.3.3. *Impact of agency problems on the relationship between cost stickiness and firm value*

Agency problems also affect the relationship between cost stickiness and firm value. Separation of ownership and control rights leads to agency problems between shareholders and management (Jensen & Meckling, 1976). When agency problems are more serious, management is more likely to make cost control decisions for the purpose of maximising its own interests rather than the shareholders' interests, thus resulting in non-optimal cost stickiness decisions (Chen, Lu, et al., 2012). It can be inferred that the intertemporal heterogeneous impact of cost stickiness on firm value is more significant among firms with lower agency costs than those with higher agency costs.

Specifically, this paper identifies two factors related to agency problems of the management. Firstly, when the management shareholding ratio is high, the interests of the management and shareholders tend to be consistent, and the agency problems are relatively weak, thereby making the management more likely to make business decisions favourable to the firm's long-term interests. The opposite is true when the management shareholding ratio is low. Secondly, when the firm has sufficient free cash flows, the management is more likely to carry out opportunistic behaviours, and the agency problems are more serious. When the firm has insufficient free cash flows, the management's opportunistic behaviours are restricted (Jensen, 1986; Shen et al., 2013).

In order to verify the above inference, we carry out regression analysis by groups based on the medians of management shareholding ratio and free cash flows (see Table 1 for a detailed definition of variables). The corresponding regression results are shown in Tables 12 and 13. Results in Table 12 show that in the group with higher management shareholding ratio in columns (1) – (3), the regression coefficient of cost stickiness ($STICKY_t$) monotonically increases and is significantly negative in column (1) and significantly positive in column (3). In the group with lower management shareholding ratio in columns (4) – (6), the regression coefficient of cost stickiness ($STICKY_t$) is not significant. These results indicate that the intertemporal heterogeneous impact of cost stickiness on firm value exists only among firms with a higher management shareholding ratio. The results in Table 13 show that in the group with low free cash flow (columns (4) – (6)), the regression coefficient of cost stickiness ($STICKY_t$) monotonically increases and is significantly negative in column (4) and significantly positive in column (6), while in the group with high free cash flow (columns (1) – (3)), the regression coefficient of cost stickiness ($STICKY_t$) is not significant, indicating that the intertemporal heterogeneous impact of cost stickiness on firm value exists only among firms with low free cash flow.

Based on the above empirical results, this paper finds that, compared with firms with large agency problems, the management's maintaining cost stickiness is more conducive to firm's long-term value than among firms with fewer agency problems. These results confirm the above inference.

4.3.4. *Impact of corporate ownership on the relationship between cost stickiness and firm value*

There are clear differences in resource endowment and operating efficiency among firms with different ownership structures. Corporate ownership may also affect the relationship between cost stickiness and firm value. On the one hand, the state ownership of state-owned enterprises leads to the problem of 'absence of owners' among state-owned

Table 12. The impact of management ownership on the relationship between cost stickiness and firm value.

Variables	High proportion of management ownership (<i>Mshare</i> = 1)			Low proportion of management ownership (<i>Mshare</i> = 0)		
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
<i>STICKY_t</i>	-0.027* (-1.65)	0.005 (0.29)	0.093*** (4.87)	-0.011 (-0.79)	-0.011 (-0.75)	-0.008 (-0.55)
<i>SOE</i>	-0.071* (-1.70)	-0.113*** (-2.61)	-0.074 (-1.57)	-0.158*** (-4.94)	-0.200*** (-6.17)	-0.173*** (-5.22)
<i>TOP1</i>	0.166 (1.52)	-0.044 (-0.39)	0.134 (1.02)	-0.153* (-1.73)	-0.108 (-1.21)	-0.129 (-1.41)
<i>INDEP</i>	0.977*** (3.44)	0.728** (2.41)	0.873*** (2.55)	0.008 (0.03)	0.011 (0.04)	-0.041 (-0.16)
<i>SEPARATION</i>	-0.001 (-0.52)	-0.001 (-0.56)	-0.001 (-0.22)	-0.003* (-1.83)	-0.005*** (-3.04)	-0.002 (-1.22)
<i>DUAL</i>	0.033 (0.96)	0.052 (1.43)	0.006 (0.14)	0.018 (0.46)	0.008 (0.21)	0.046 (1.13)
<i>MANA</i>	0.018 (0.19)	0.018 (0.17)	0.233* (1.85)	-23.081 (-1.27)	-63.234*** (-3.39)	-28.428 (-1.57)
<i>CASH</i>	0.384*** (2.87)	0.433*** (2.94)	0.874*** (5.05)	0.007 (0.06)	0.145 (1.18)	0.135 (1.07)
<i>LEV</i>	-0.836*** (-9.12)	-0.719*** (-7.63)	-0.709*** (-6.91)	-0.146** (-2.10)	-0.160** (-2.29)	-0.432*** (-6.03)
<i>ROE</i>	0.929*** (5.82)	0.990*** (6.56)	0.577*** (3.71)	0.550*** (5.55)	0.324*** (3.52)	0.254*** (2.68)
<i>PM</i>	-0.507*** (-4.12)	-0.785*** (-7.26)	-0.703*** (-6.18)	-0.957*** (-12.07)	-0.772*** (-11.35)	-0.883*** (-13.70)
<i>EM</i>	-0.730*** (-4.19)	-0.650*** (-3.56)	-0.536*** (-2.65)	-0.772*** (-5.37)	-0.749*** (-5.14)	-0.945*** (-6.49)
<i>MARKET</i>	-0.005 (-0.62)	0.004 (0.45)	0.001 (0.07)	0.009 (1.25)	0.004 (0.59)	0.004 (0.58)
Tobin's Q_{t-1}	0.652*** (61.16)	0.634*** (56.34)	0.659*** (53.14)	0.753*** (83.31)	0.783*** (84.38)	0.730*** (73.11)
Intercept	0.336* (1.94)	0.500*** (2.78)	0.195 (0.97)	0.503*** (3.11)	0.401** (2.43)	0.646*** (4.00)
Year	Control	Control	Control	Control	Control	Control
Industry	Control	Control	Control	Control	Control	Control
N	5,551	5,159	4,393	5,769	5,632	5,223
Adj. R^2	0.648	0.621	0.619	0.648	0.658	0.633

enterprises, and the management of state-owned enterprises may sacrifice the long-term interests of shareholders for their own short-term interests. Moreover, state ownership will also cause state-owned enterprises to undertake more social responsibilities. For example, in the case of economic downturn, state-owned enterprises should help the government to achieve the goal of 'stabilising finance' (D. Chen et al., 2016). Lin and Li (2004) and Lin et al. (2004) stated that the essential problem of state-owned enterprises was that state-owned enterprises undertook too many policy burdens, and once state-owned enterprises suffered losses, the government often needed to increase investments and loans, reduce taxes, and provide financial subsidies. In other words, the 'policy burden' and 'soft budget constraint' of state-owned enterprises cause them to often not make optimal operating decisions. On the other hand, the management of state-owned enterprises has the feature of 'quasi-officials'. Whether they are promoted or not depends largely on whether their political goals are met rather than on the improvement of business performance (Yang et al., 2013). L. L. Zhang et al. (2015) found that the promotion of executives in local state-owned enterprises often relied on their political

Table 13. The impact of free cash flow on the relationship between cost stickiness and firm value.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	High levels of free cash flow (FCF = 1)			Low levels of free cash flow (FCF = 0)		
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
<i>STICKY_t</i>	-0.013 (-0.87)	-0.014 (-0.75)	0.028 (1.58)	-0.036* (-1.95)	0.015 (0.75)	0.056*** (2.70)
<i>SOE</i>	-0.123*** (-3.32)	-0.136*** (-3.67)	-0.125*** (-3.22)	-0.143*** (-3.89)	-0.212*** (-5.22)	-0.144*** (-3.53)
<i>TOP1</i>	-0.030 (-0.31)	-0.237** (-2.50)	-0.095 (-0.89)	-0.023 (-0.23)	0.052 (0.52)	-0.007 (-0.07)
<i>INDEP</i>	0.207 (0.72)	-0.072 (-0.25)	-0.071 (-0.24)	0.673** (2.52)	0.488 (1.62)	0.659** (2.00)
<i>SEPARATION</i>	-0.003* (-1.88)	-0.005*** (-3.05)	-0.003 (-1.56)	-0.002 (-0.82)	-0.003 (-1.56)	0.000 (0.02)
<i>DUAL</i>	0.028 (0.72)	0.051 (1.29)	0.013 (0.29)	0.045 (1.11)	0.014 (0.34)	0.040 (0.88)
<i>MANA</i>	0.180 (1.43)	0.062 (0.48)	0.402** (2.56)	-0.108 (-0.76)	-0.224 (-1.52)	0.169 (0.98)
<i>CASH</i>	0.413*** (2.70)	0.541*** (3.03)	0.710*** (2.88)	0.112 (0.71)	0.147 (0.98)	0.338* (1.79)
<i>LEV</i>	-0.462*** (-4.55)	-0.379*** (-2.93)	-0.563*** (-4.89)	-0.375*** (-3.22)	-0.379*** (-3.05)	-0.585*** (-4.52)
<i>ROE</i>	0.831*** (3.83)	0.776*** (3.68)	0.517** (1.96)	0.485** (2.31)	0.255 (1.53)	0.242 (1.17)
<i>PM</i>	-0.947*** (-3.70)	-0.867*** (-4.18)	-0.630*** (-3.04)	-0.778*** (-4.85)	-0.779*** (-5.43)	-1.038*** (-5.71)
<i>EM</i>	-0.169 (-0.64)	-0.373 (-1.42)	-0.842*** (-3.15)	-1.046*** (-4.83)	-0.713*** (-3.35)	-0.531** (-2.17)
<i>MARKET</i>	0.000 (0.06)	0.000 (0.04)	0.001 (0.10)	0.008 (1.03)	0.007 (0.94)	0.007 (0.80)
<i>Tobin's Q_{t-1}</i>	0.755*** (27.08)	0.760*** (26.73)	0.742*** (25.42)	0.677*** (27.94)	0.680*** (27.24)	0.653*** (24.63)
<i>Intercept</i>	0.345** (1.98)	0.573*** (3.20)	0.499*** (2.82)	0.482*** (2.78)	0.469*** (2.59)	0.539*** (2.72)
<i>Year</i>	Control	Control	Control	Control	Control	Control
<i>Industry</i>	Control	Control	Control	Control	Control	Control
<i>N</i>	5,684	5,375	4,800	5,636	5,416	4,816
<i>Adj. R²</i>	0.658	0.648	0.630	0.619	0.614	0.608

relationship resources or on the assumption of policy burdens rather than performance-based factors. This unique feature of state-owned enterprises often causes their management to not make optimal decisions for resource allocation. On the contrary, private enterprises are solely responsible for their own profits and losses, undertake fewer social responsibilities, and are rarely subject to 'soft budget constraints'. Therefore, private enterprises are more likely to make appropriate cost control decisions for the purpose of maximising long-term interests. Based on the above analysis, this paper holds that the cost control decisions of state-owned enterprises are easily affected by many factors such as government goals, social responsibilities, 'soft budget constraints', and the promotion incentive of executives, while private enterprises are more likely to make optimal cost control decisions for the purpose of maximising corporate interests. It can be inferred that the intertemporal heterogeneous impact of cost stickiness on firm value is more significant among private enterprises than state-owned enterprises.

Table 14 shows the results of regressions with grouping based on corporate ownership. The results show that: in the group of state-owned enterprises in columns (1) – (3), the coefficients of cost stickiness (*STICKY_t*) is not significant. Meanwhile, in the group of

Table 14. The impact of corporate ownership on the relationship between cost stickiness and firm value.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	State-owned enterprise (SOE = 1)			Private enterprise (SOE = 0)		
	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}	Tobin's Q_t	Tobin's Q_{t+1}	Tobin's Q_{t+2}
<i>STICKY_t</i>	0.013 (1.10)	0.017 (1.42)	0.020 (1.54)	-0.057*** (-3.18)	-0.028 (-1.48)	0.060*** (2.98)
<i>TOP1</i>	-0.083 (-1.13)	-0.066 (-0.90)	-0.013 (-0.15)	0.033 (0.26)	-0.118 (-0.89)	-0.035 (-0.24)
<i>INDEP</i>	-0.013 (-0.06)	-0.120 (-0.56)	-0.331 (-1.42)	0.868*** (2.68)	0.565* (1.67)	0.972*** (2.69)
<i>SEPARATION</i>	-0.002 (-1.16)	-0.002 (-1.61)	0.000 (0.27)	-0.001 (-0.52)	-0.005* (-1.77)	-0.001 (-0.41)
<i>DUAL</i>	0.017 (0.50)	0.013 (0.36)	0.012 (0.30)	0.036 (0.96)	0.022 (0.54)	0.022 (0.49)
<i>MANA</i>	0.755 (1.21)	1.384** (2.09)	2.115*** (2.95)	0.022 (0.23)	-0.092 (-0.86)	0.209* (1.72)
<i>CASH</i>	0.034 (0.32)	0.146 (1.35)	0.340*** (2.87)	0.381*** (2.68)	0.458*** (2.90)	0.613*** (3.51)
<i>LEV</i>	-0.356*** (-5.73)	-0.428*** (-6.76)	-0.510*** (-7.47)	-0.525*** (-5.49)	-0.289*** (-2.96)	-0.581*** (-5.67)
<i>ROE</i>	0.558*** (6.03)	0.513*** (5.96)	0.319*** (3.42)	0.756*** (5.03)	0.476*** (3.32)	0.386*** (2.69)
<i>PM</i>	-0.820*** (-10.36)	-0.713*** (-10.01)	-0.701*** (-10.28)	-0.894*** (-8.26)	-0.899*** (-9.74)	-0.964*** (-10.20)
<i>EM</i>	-0.705*** (-5.55)	-0.438*** (-3.40)	-0.550*** (-3.94)	-0.800*** (-4.34)	-0.901*** (-4.66)	-0.961*** (-4.83)
<i>MARKET</i>	0.009 (1.64)	0.006 (1.02)	0.008 (1.25)	-0.007 (-0.61)	-0.001 (-0.09)	-0.011 (-0.91)
<i>Tobin's Q_{t-1}</i>	0.709*** (76.06)	0.727*** (74.44)	0.720*** (67.34)	0.717*** (70.92)	0.715*** (66.94)	0.689*** (59.29)
<i>Intercept</i>	0.472*** (3.78)	0.506*** (4.01)	0.559*** (4.12)	0.152 (0.68)	0.039 (0.17)	0.190 (0.81)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>N</i>	5,850	5,719	5,210	5,470	5,072	4,406
<i>Adj. R²</i>	0.628	0.620	0.617	0.632	0.617	0.603

private enterprises in columns (4) – (6), the coefficient of cost stickiness ($STICKY_t$) monotonically increases, and the coefficient of $STICKY_t$ in column (4) is significantly negative at the significance level of 1%, the coefficient of $STICKY_t$ in column (6) is significantly positive at the significance level of 1%. This shows that the intertemporal heterogeneous impact of cost stickiness on firm value exists only among private enterprises. The results show that compared with state-owned enterprises, private enterprises are more likely to consider the long-term interests of enterprises during resource allocation.

5. Further analysis

5.1. Mechanism tests for the intertemporal heterogeneous impact of cost stickiness on firm value

The above results show that cost stickiness has an intertemporal heterogeneous impact on firm value. We have examined under what conditions the firm's maintaining cost stickiness is more conducive to the firm's long-term value from the perspectives of adjustment costs, management expectations, agency costs, and nature of ownership.

This section further examines the mechanisms for the intertemporal heterogeneous impact of cost viscosities on firm value. Specially, we take the actual growth rate of firm's sales revenue (*Growth*) and the growth of earnings per share forecasted by analysts (*FEPS*) as dependent variables and the cost stickiness (*STICKY_t*) as an independent variable, and use model (3) to test the impact of cost stickiness on the increases in actual growth rate of firm's sales revenue and growth of earnings per share forecasted by analysts, where the control variables are consistent with those of model (2). Detailed variables definitions are shown in Table 1.

$$Growth_{i,T}/FEPS_{i,T} = a + \beta STICKY_{i,t} + Control\ Variables + \Sigma Year + \Sigma Industry + \varepsilon \quad (3)$$

Table 15 shows the impact of cost stickiness on the actual sales growth rate of the firm (*Growth*). The results show that regardless of whether the growth rate of firm's sales revenue (*Growth*) is adjusted by industry mean, the coefficient of cost stickiness (*STICKY_t*) monotonically increases from t to $t + 1$ and is significantly negative in the period t and significantly positive in the period $t + 2$. This shows that firms with higher cost stickiness

Table 15. The mechanisms of the short-term and long-term influence of cost stickiness on firm value – the sales growth rate.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Without adjusted by annual industry mean			Adjusted by annual industry mean		
	<i>Growth_t</i>	<i>Growth_{t+1}</i>	<i>Growth_{t+2}</i>	<i>ADGrowth_t</i>	<i>ADGrowth_{t+1}</i>	<i>ADGrowth_{t+2}</i>
<i>STICKY_t</i>	-0.029*** (-5.25)	0.008 (1.52)	0.015*** (2.60)	-0.030*** (-5.44)	0.009 (1.63)	0.014** (2.43)
<i>SOE</i>	-0.041*** (-3.15)	-0.047*** (-3.82)	-0.069*** (-5.14)	-0.042*** (-3.31)	-0.048*** (-3.93)	-0.071*** (-5.34)
<i>SEPARATION</i>	0.119*** (3.35)	0.130*** (3.79)	0.169*** (4.46)	0.115*** (3.29)	0.137*** (4.02)	0.165*** (4.40)
<i>DUAL</i>	0.115 (1.17)	0.062 (0.65)	0.053 (0.50)	0.118 (1.21)	0.066 (0.70)	0.083 (0.81)
<i>MANA</i>	-0.001 (-1.42)	-0.001 (-0.87)	0.000 (0.05)	-0.001 (-1.30)	-0.001 (-0.96)	-0.000 (-0.10)
<i>TOP1</i>	-0.002 (-0.16)	0.006 (0.49)	-0.004 (-0.29)	-0.003 (-0.25)	0.004 (0.35)	-0.005 (-0.31)
<i>INDEP</i>	0.011 (0.27)	0.040 (1.02)	0.127*** (2.73)	0.016 (0.41)	0.034 (0.88)	0.123*** (2.66)
<i>CASH</i>	0.047 (1.01)	0.038 (0.81)	-0.012 (-0.23)	0.036 (0.79)	0.018 (0.40)	-0.028 (-0.55)
<i>LEV</i>	0.413*** (14.33)	0.366*** (13.21)	0.398*** (13.36)	0.411*** (14.42)	0.358*** (13.07)	0.394*** (13.33)
<i>ROE</i>	0.447*** (10.06)	0.452*** (11.50)	0.426*** (10.27)	0.430*** (9.82)	0.438*** (11.28)	0.418*** (10.14)
<i>PM</i>	0.381*** (10.95)	0.334*** (11.67)	0.370*** (12.85)	0.388*** (11.29)	0.335*** (11.84)	0.368*** (12.87)
<i>EM</i>	0.215*** (3.73)	0.341*** (6.08)	0.317*** (5.27)	0.235*** (4.12)	0.359*** (6.46)	0.333*** (5.60)
<i>MARKET</i>	-0.009*** (-3.20)	-0.008*** (-2.96)	-0.012*** (-4.01)	-0.009*** (-3.26)	-0.008*** (-2.86)	-0.012*** (-3.88)
<i>Tobin's Q_{t-1}</i>	0.064*** (18.33)	0.050*** (14.46)	0.063*** (16.19)	0.062*** (17.89)	0.048*** (14.02)	0.059*** (15.40)
<i>Intercept</i>	-0.120** (-1.96)	-0.139** (-2.35)	-0.074 (-1.18)	-0.332*** (-5.52)	-0.359*** (-6.13)	-0.342*** (-5.47)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>N</i>	11,320	10,791	9,616	11,320	10,791	9,616
<i>Adj. R²</i>	0.103	0.096	0.111	0.081	0.079	0.090

do have a higher growth rate of the firm's sales revenue. Similarly, Table 16 shows the impact of cost stickiness on the growth of earnings per share forecasted by analysts. The results show that regardless of whether the growth of analyst earnings forecasted for EPS is adjusted by industry mean, the coefficient of cost stickiness ($STICKY_t$) monotonically increases from t to $t + 1$ and is significantly positive in the period $t + 2$. This shows that firms with higher cost stickiness do have a higher growth of earnings per share forecasted by analysts, indicating that the management's maintaining cost stickiness is actually the rational choice made based on the optimistic expectations for future earnings.

5.2. Intertemporal heterogeneous impact of cost stickiness at different degrees on firm value

The overall regression results above show that cost stickiness will reduce the firm value in the short-term but will increase the firm value in the long-term. However, different degrees of cost stickiness may have different impacts on firm value. Sun and Liu (2004)

Table 16. The mechanisms of the short-term and long-term influence of cost stickiness on firm value – The growth of EPS forecast by analysts.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Without adjusted by annual industry mean			Adjusted by annual industry mean		
	$FEPS_t$	$FEPS_{t+1}$	$FEPS_{t+2}$	$ADFEPS_t$	$ADFEPS_{t+1}$	$ADFEPS_{t+2}$
$STICKY_t$	-0.053 (-0.82)	0.011 (0.16)	0.295** (2.46)	-0.063 (-0.96)	0.023 (0.32)	0.267** (2.26)
SOE	-0.092 (-0.60)	0.125 (0.78)	-0.081 (-0.30)	-0.084 (-0.54)	0.136 (0.84)	-0.083 (-0.31)
$SEPARATION$	-1.042** (-2.50)	-1.034** (-2.36)	-1.215 (-1.61)	-0.954** (-2.27)	-0.905** (-2.06)	-1.172 (-1.58)
$DUAL$	2.101* (1.89)	2.412** (2.05)	1.596 (0.80)	2.185* (1.95)	2.602** (2.20)	1.867 (0.95)
$MANA$	0.004 (0.50)	0.001 (0.14)	-0.003 (-0.19)	0.003 (0.38)	0.001 (0.13)	-0.003 (-0.22)
$TOP1$	0.060 (0.42)	0.080 (0.52)	-0.269 (-0.99)	0.034 (0.23)	0.079 (0.51)	-0.253 (-0.95)
$INDEP$	-0.746* (-1.87)	-0.204 (-0.47)	0.514 (0.63)	-0.728* (-1.81)	-0.236 (-0.54)	0.361 (0.45)
$CASH$	0.529 (1.02)	-0.073 (-0.13)	-0.811 (-0.80)	0.811 (1.55)	0.201 (0.35)	-0.510 (-0.51)
LEV	1.775*** (4.57)	1.574*** (3.93)	0.910 (1.33)	1.700*** (4.35)	1.473*** (3.66)	0.807 (1.19)
ROE	-0.566 (-0.80)	-0.026 (-0.04)	6.815*** (5.84)	-0.622 (-0.88)	-0.178 (-0.24)	6.693*** (5.81)
PM	0.388 (0.74)	-0.545 (-0.93)	-0.174 (-0.19)	0.468 (0.89)	-0.440 (-0.75)	-0.230 (-0.25)
EM	0.893 (1.25)	0.015 (0.02)	-2.981** (-2.33)	1.187* (1.65)	0.374 (0.49)	-2.531** (-2.00)
$MARKET$	-0.094** (-2.08)	0.017 (0.35)	-0.112 (-1.39)	-0.087* (-1.91)	0.022 (0.46)	-0.097 (-1.22)
$Tobin's Q_{t-1}$	0.191*** (4.47)	0.138*** (3.14)	-0.098 (-1.28)	0.146*** (3.41)	0.097** (2.20)	-0.130* (-1.71)
<i>Intercept</i>	-0.148 (-0.20)	-0.079 (-0.10)	0.919 (0.71)	-1.199 (-1.59)	-1.240 (-1.58)	-0.487 (-0.38)
<i>Year</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>Industry</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>	<i>Control</i>
<i>N</i>	5,939	5,627	5,097	5,939	5,627	5,097
<i>Adj. R²</i>	0.008	0.004	0.016	0.009	0.004	0.006

pointed out that a lower degree of cost stickiness will result in lower long-term performance, while a higher degree of cost stickiness indicates that firms respond slowly to changes in business environment and therefore reduce the long-term performance of firms. So they believe that a moderate level of cost stickiness will improve long-term performance. However, they only carried out theoretical analysis and did not conduct any empirical test. To this end, this paper examines the above proposition using the *threshold model* of Hansen (1999). Specifically, assuming there are two thresholds, the threshold model is set as follows:

$$\begin{aligned}
 \text{Tobin's } Q_{i,T} = & a_0 + a_1 \text{STICKY}_{i,t} (\text{STICKY}_{i,t} \leq X_1) + a_2 \text{STICKY}_{i,t} (X_1 < \text{STICKY}_{i,t} \leq X_2) \\
 & + a_3 \text{STICKY}_{i,t} (\text{STICKY}_{i,t} > X_2) + \text{Control Variables} + \sum \text{Year} + \sum \text{Industry} + \varepsilon
 \end{aligned}
 \tag{4}$$

$\text{STICKY}_{i,t}$ in the model (4) is a threshold variable, X_1 and X_2 are the threshold values, and the remaining variables are consistent with those of model (2). The model parameters are estimated based on the balanced panel data. Table 17 shows that in the period t , the single threshold, double threshold, and triple threshold do not pass the significance tests, while in the period $t + 1$ and period $t + 2$, the double threshold passes the significance tests at the significance level of 1% and 5% respectively. Therefore, we hold that there is no threshold effect on the regression of period t , but that there is a double threshold effect on the regression of period $t + 1$ and period $t + 2$.

According to the results of the threshold model, the impact of cost stickiness on firm value in the period $t + 1$ and period $t + 2$ is subject to a double threshold effect. The threshold values corresponding to the period $t + 1$ are -0.1474 and -0.1690 respectively and the threshold values corresponding to the period $t + 2$ are 0.5053 and 0.4282 respectively. Based on this, we divide the cost stickiness level of period $t + 1$ into three ranges, including $\text{STICKY} \leq -0.1690$, $-0.1690 < \text{STICKY} \leq -0.1474$ and $\text{STICKY} > -0.1474$, corresponding to the three variables STICKY_1_t , STICKY_2_t , and STICKY_3_t . Similarly, the cost stickiness level of period $t + 2$ is divided into three ranges, including $\text{STICKY} \leq 0.4282$, $0.4282 < \text{STICKY} \leq 0.5053$, $\text{STICKY} > 0.5053$, corresponding to three variables such as

Table 17. The threshold effect of the impact of cost stickiness on firm value.

Model	F-value	P-value	Threshold value			Critical value		
			I	II	III	1%	5%	10%
<i>t</i>								
A single threshold	1.30	0.53	-1.158			5.540	4.522	3.491
Double threshold	4.24	0.47	0.477	0.746		25.324	12.829	10.495
Triple threshold	1.49	0.88	0.477	0.746	-1.158	12.916	8.734	6.830
<i>t + 1</i>								
A single threshold	2.44	0.330	0.746			6.983	5.260	4.161
Double threshold	18.94***	0.007	-0.147	-0.169		15.670	11.505	8.962
Triple threshold	5.17	0.780	-0.147	-0.169	0.659	30.335	22.707	19.797
<i>t + 2</i>								
A single threshold	2.03	0.563	0.505			11.728	6.761	5.688
Double threshold	14.23**	0.043	0.505	0.428		19.516	13.408	11.747
Triple threshold	2.03	0.813	0.505	0.428	0.306	16.165	10.167	8.226

Note: (1)***, **, * indicates that the significance level is less than 1%, 5%, and 10%, respectively, and the p-value is obtained from 300 times repeated sampling using the bootstrap method.

(2) In each threshold test, the previous threshold value will be revised when a new threshold value is identified.

Table 18. The impact of cost stickiness on firm value – The threshold regression results.

Variables	(1)	(2)
	Tobin's Q_{t+1}	Tobin's Q_{t+2}
$STICKY_1_t$	-0.004 (-0.02)	0.030 (0.18)
$STICKY_2_t$	-14.817*** (-4.62)	3.367*** (3.78)
$STICKY_3_t$	0.052 (0.38)	-0.21 (1.40)
Intercept	1.767*** (27.06)	1.860*** (30.95)
Controls	Control	Control
Year	Control	Control
Industry	Control	Control
N	156	156
Within R^2	0.132	0.106

$STICKY_1_t$, $STICKY_2_t$, and $STICKY_3_t$. Then, we estimate the model regression coefficients for each range during period $t + 1$ and period $t + 2$.

Empirical results are shown in Table 18. The results in column (1) show that in the period $t + 1$, the coefficients of $STICKY_1_t$ and $STICKY_3_t$ are not significant, while the coefficient of $STICKY_2_t$ is significantly negative at the significance level of 1%. The cost stickiness range corresponding to $STICKY_2_t$ is $(-0.1690, -0.1474]$, that is, the cost stickiness is in the 'anti-stickiness' range. Results show that in the short-term, a firm's rapid adjustment of costs (anti-stickiness) will reduce the firm value. The results in column (2) show that in the period $t + 2$, the coefficients of $STICKY_1_t$ and $STICKY_3_t$ are not significant, while the coefficient of $STICKY_2_t$ is significantly positive at the significance level of 1%. The cost stickiness range corresponding to $STICKY_2_t$ is $(0.4282, 0.5053]$. This indicates that in the long-term, only maintaining a moderate level of cost stickiness can increase the firm value. The above results suggest that in the short-term, a firm's rapid adjustment of resource allocation to reduce costs (anti-stickiness) will instead lower the firm value when the business volume declines, while in the long-term, maintaining a moderate level of cost stickiness can increase the firm value.

6. Conclusions

Cost stickiness is a core aspect for cost control decisions among firms. Existing research explains cost stickiness from the perspectives of adjustment costs, optimistic management expectations, and agency costs, but the economic implications implied by different theories are quite different. To this end, this paper examines the impact of cost stickiness on firm value, so as to examine the economic consequences of cost stickiness from the perspective of its net real effect, thereby providing clear policy implications for cost control decisions among firms.

It is found that cost stickiness has an intertemporal heterogeneous impact on firm value, that is, cost stickiness will reduce firm value in the short-term, but increase firm value in the long-term. Moreover, such an impact mainly exists among firms with higher adjustment costs, more optimistic management expectations, and smaller agency costs. Moreover, the intertemporal heterogeneous impact of cost stickiness on firm value exists only among

private enterprises. The above findings indicate that, to a certain extent, cost stickiness of a firm is not merely a reflection of management 'staying idle', but also a reflection of management 'investing in prevention'. That is, maintaining cost stickiness is a rational choice made by management after weighing its short-term costs and long-term benefits. The mechanism analysis also indicates that firms with higher levels of cost stickiness also have a significant actual sales growth rate and growth of earnings per share forecasted by analysts. Finally, the results of the panel threshold regression model show that the rapid adjustment of costs (anti-stickiness) in the short-term will reduce the firm value while maintaining a moderate level of cost stickiness can increase the firm value in the long-term.

The conclusion of this paper explains the high level of cost stickiness among listed companies in China from the perspective of economic rationality. First of all, although the economic growth rate in China has slowed down in recent years, it has remained the fastest growth rate in the world. The short-term decreases in business volume may only be temporary. At this time, maintaining a certain amount of idle resources is more favourable to firms to grasp potential opportunities when the business volume rises. Secondly, compared with developed countries, the level of economic development in China and the marketisation level are relatively low, thus leading to higher adjustment costs for firms in resource allocation. When the adjustment costs get higher, firms should also maintain a certain level of cost stickiness.

The conclusions of this paper have the following policy implications: Firstly, effective cost management does not mean that 'the lower the cost, the better the performance'. The management should reasonably determine the level of cost based on the future needs of the firm, expectations for future economic growth, the trend of the industry, and the competitive advantages of the firm. Such a practice requires the management to balance between current costs and future benefits in order to maximise the efficiency of resource allocation. This implication provides the necessary theoretical reference for the ongoing reform of 'de-capacity and cost reduction'. Secondly, the conclusion of this paper also reminds external investors to correctly understand the nature of the cost stickiness of firms. External investors should not only evaluate the economic consequences of cost stickiness from a short-term perspective but also evaluate the advantages and disadvantages of cost stickiness from a long-term perspective.

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