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Research Article

Big Data Analysis on the Effect of Cost Stickiness on Digital Transformation

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The A-share listed companies in Shanghai and Shenzhen from 2012 to 2020 were taken as the research sample to study the impact of digital transformation on enterprise cost stickiness. Overall, digital transformation has a restraining effect on enterprise cost stickiness. This kind of inhibitory effect is more significant in the samples with strong asset specificity, high-environmental uncertainty, and high-management cost rate, indicating that enterprises have reduced adjustment costs through digital transformation, weakened the optimistic expectations of management, and reduced agency costs, thus curbing cost stickiness. Our research results provided a new understanding of how the implementation of digital transformation affects the cost stickiness of enterprises and can help to provide policy suggestions for promoting the supply side structural reform from the perspective of "cost reduction."

1. Introduction

Compared with traditional economy, digital economy breaks the restriction of physical factors on economic development and fundamentally changes the organizational operation logic and value creation mode of business society [1]. By the end of 2020, the proportion of digital economy in the total GDP had reached 38.6%, becoming an important driving force leading China's high-quality economic development. With the rapid growth of digital economy, the industrial pattern has undergone a violent shock in the past decade [2]. Both digital industrialization and industrial digitization make the enterprises face unprecedented opportunities and challenges [3]. For enterprises, digitization is a trend of technological change with subversive innovation characteristics, which have changed the direction of enterprise strategic planning and the logic of value creation, and innovated the way of enterprise market expansion. Especially for enterprises that do not have the characteristics of "natural digitization," the success of digital transformation is the crux of whether enterprises can seek innovation breakthrough [4].

Digital transformation means that enterprises use digital technology to identify market opportunities and environmental changes and promote the internal integration and external expansion of old and new resources and capabilities through the combined application of specific technologies, for instance, information, computing, communication, and connection, and trigger the transformation of business activities, process design, capability change, and business model. A set of digitally oriented activities in which products and businesses (portfolios) are upgraded and transformed to improve competitiveness [5, 6]. Digital transformation promoted the deep integration of digital technology and the existing production system of enterprises [7], which is a strategic priority for contemporary enterprises [8]. On the one hand, the information technology, which is indispensable for digitization, can help enterprises make accurate judgment on the future trend, and lead managers can make reasonable business decisions and avoid the high cost stickiness caused by blind optimistic expectations. On the other hand, the digital big data storage function records the transaction activities of various stakeholders in a large amount, which can inhibit the agency behavior of the management to a great extent, so as to reduce the cost stickiness. Therefore, the digital transformation is very vital for our daily life. In other word, we cannot leave digital transformation.

However, the view that digital transformation can directly promote the economic consequences of enterprises has been questioned by some researchers [9]. In the early stage of digital transformation, the cost stickiness of enterprises will be increased and aggravated by the agency cost. At the initial stage of digital introduction into traditional enterprises, the organization and business models will often meet great changes [10, 11], and the business process risk points. Meanwhile, control methods of enterprises will also have systematic changes. We cannot get the matching systems of risk management and internal control overnight. Enterprises need a lot of time to explore and practice. It is easy to induce opportunistic behavior of the management, and even may increase the agency cost and aggravate the cost stickiness. Consequently, whether digital transformation enhances or suppresses cost stickiness needs to be further explored.

In our work, the mechanism that digital transformation affects the cost stickiness of enterprises was revealed. We took digital transformation as the starting point to explore the impact of digital transformation on cost stickiness in the context of the digital economy era. However, the previous research on the relationship between digital transformation and cost stickiness has rarely studied its path mechanism. The research on the impact of digital transformation is mainly carried out from the perspectives of enterprise innovation [12, 13], strategic choice [14], value creation [15], and total factor productivity [16]. Based on the analysis of enterprise cost stickiness, we supplement the existing research literature. Through the empirical test research of this paper, scholars are stimulated to think about the digital transformation and consider the diversity of research methods, and then a digital theoretical system gradually is formed, which provides some reference for broader and more comprehensive research and promote scholars to think about the new opportunities and risks of digital transformation in the digital era.

Our work also provided new empirical evidence on how to curb cost stickiness. The research work of existing scholars mainly studies the influencing factors of cost stickiness from the perspective of corporate governance [17, 18], corporate strategy [19], and stakeholder relations [20]. This paper studies how to reduce cost stickiness from the perspective of digital transformation. Therefore, to some extent, the content of this paper enriches the literature on cost stickiness.

In 2020, the COVID-19 swept the globe, and the world economy was seriously affected. Therefore, there is an urgent need to support the new dynamic energy of sustainable economic development, and digital transformation is the core of the sustainable development of the economy. The digitization of real economy has become a hot issue of great concern to all sectors of society. Here, we have some interesting questions to know. What role has digital transformation play? What is the mechanism of action? With these questions, our work gave us the answers from the perspective of enterprise cost stickiness. This will help us promote the effective implementation of digitization and its deep integration with the real economy.

Our work mainly focuses on the relationship between digital transformation and enterprise cost stickiness and tries to uncover the "black box" of digital transformation inhibiting cost stickiness. Through the establishment of OLS model for empirical research, combined with previous studies, this paper established a theoretical model and collects a large amount of data. Finally, Stata software was used for data analysis. The rest of this paper is as follows: theoretical analysis and hypothesis development are carried out in Section 2. Our research design and samples are described in Section 3. The empirical results are discussed in Section 4. The robustness was tested in Section 5. Further analysis is expounded in Section 6. Conclusions are given in Section 7.

2. Theoretical Analysis and Hypothesis Development

2.1. Digital Transformation. Digital transformation is a strategic problem that enterprises of all organizational forms and sizes need to face. It is not limited to any kind of enterprises such as innovative enterprises, digital start-ups, or high-tech enterprises. The transformation path of digitization enables enterprises to go beyond the growth mode of single dimension and win more development space in value creation and acquisition by changing value proposition and business logic [21, 22]. With the popularization and application of digital technology, the way of interaction between enterprises and consumers has fundamentally changed [23]. Thus, it is necessary to make a new evaluation of the previous value proposition. Enterprises can accurately collect huge amounts of data and meet the requirements of timely identifying consumers' diversified needs and continuous tracking by digital technologies, such as Internet of Things, blockchain, and cloud computing. In order to deeply respond to these feedback information, enterprises also need the opportunity to use the digital transformation to innovate the external interaction mode, communication mode, and link channel [24] to realize the collaborative evolution with upstream and downstream subjects.

2.2. Cost Stickiness. The traditional cost behavior model assumes that the variable cost will change in the same proportion with the change of the current business volume of the enterprise. Noreen and Soderstrom [25] questioned that in the practice of enterprise cost management, the increase of cost when the business volume increases is often greater than the decrease when the business volume decreases. Anderson et al. [26] called this phenomenon "Cost Stickiness." Banker and Byzalov [27] summarized the causes of cost stickiness into three aspects: adjusting costs, optimistic expectations of management, and agency problems. The view of adjustment cost holds that the costs and expenses of enterprises are the resource input promised by managers, and the adjustment cost will be generated when the resource input increases or decreases. Since the cost of downward adjustment is often higher than that of upward adjustment, enterprises are unwilling to reduce resource

investment year-on-year when income decreases, resulting in cost stickiness [26]. The optimistic expectation of the management believes that the business volume of enterprises tends to increase year by year. When the sales revenue decreases, the management usually believes that this is only temporary, and the sales revenue will generally show an upward trend in the future. Even if the current business volume has declined, the management is often reluctant to reduce resource investment out of optimistic expectations for the future. The optimistic expectation of the management led to the asymmetry of the change range of costs with the increase and decrease of business volume, resulting in cost stickiness [28, 29]. From the perspective of agency problem, executives as the entrusted party will have self-interest behavior when adjusting resource investment, making the cost decision deviate from the optimal resource allocation. Under the analysis framework of agency problem, the management tends to increase resource investment excessively when the business volume increases and refuse to reduce resource investment when the business volume decreases, resulting in cost stickiness [30].

2.3. Inhibitory Effect of Digital Transformation on Enterprise Cost Stickiness

2.3.1. Digital Transformation Helps Reduce Adjustment Costs

(1) Digital transformation reduced the marginal cost of enterprises [31]. When the business volume increases, reducing the increased cost investment of the enterprise can adjust the cost reduction. This is because the search cost, matching cost, and signature cost of producers and consumers have been reduced by digital platforms. The decline of transaction cost will change the sales layout in the long tail theory. In the past, due to the limits of time and space, 20% of the best-selling products in the market created 80% of the profits, and the remaining 80% of the unsalable products only created 20% of the profits. With the implementation of digital technology, the sales scale of 20% of head products in the past has further expanded due to the increase in the number of consumers, and the consumer group of 80% of long tail products will also be expanded. Enterprises can not only realize personalized customization but also carry out mass production [32], having the scale effect of production. When the business volume increases, the increased cost investment is greatly reduced due to the scale effect of production.

(2) Digital transformation has changed the value creation mode of enterprises, making enterprises pay more attention to the "use" rather than "ownership" of resources to reduce the adjustment cost. When the business volume decreases, enterprises can realize effective cost management by transferring their excess capacity. Collaboration and sharing are the main spiritual embodiment of digital thinking. Digital technology promoted the development and improvement of sharing economy [33]. Under the cooperative consumption theory of sharing economy, consumers prefer to use the way of "renting" rather than "buying" to meet production or living needs with as little expenditure as possible [34]. In the traditional mode, enterprises need to purchase a lot of resources to expand reproduction. When the business volume decreases, the enterprise may have some idle resources. If it is not disposed in time, the cost will be increased, and the profit space and aggravate the cost stickiness will be compressed. In the digital mode, when the business volume increases, enterprises can meet the business needs of expanding reproduction through sharing. When the business volume decreases, enterprises can temporarily transfer the right to use resources, and then reasonably control the cost based on the digital platform, to increase the willingness of enterprises to dispose of idle or inefficient resources, and finally reduce the adjustment cost.

2.3.2. Digital Transformation Helps to Curb the Optimistic Expectations of Management. Network externalities comply with Metcalfe's law. The law holds that the growth multiple of network value is approximately equal to the square of the growth multiple of the number of network nodes, which means that the more network members, the more sufficient information dissemination, information exchange, and information sharing, and the greater the network value. Under the influence of network externalities, on the one hand, enterprises can establish customers' consumption information database through digital platform, which will be gradually improved with the increase of network members. Based on this, enterprises can establish sales forecasting models based on macro factors such as economic fluctuations, interest rate changes, and inflation, as well as individual factors such as consumers' personal characteristics, consumption preferences, and consumption habits. On the other hand, enterprises can realize intelligent management and effective cost control through technical means such as big data, artificial intelligence, and cloud computing. With the development of digitalization, the management can timely obtain market information, analyze the information with the help of prediction models and analysis tools, accurately predict future sales and demand according to the market information, and make accurate decisions on the investment, disposal, and retention of enterprise resources, which undoubtedly reduce the optimistic expectations of the management [20]. The subjective optimistic expectation can be avoided, leading to the deviation of cost decision from the optimal resource allocation state [35].

2.3.3. Digital Transformation Helps Reduce Agency Costs. With the popularization of information technologies, big data, artificial intelligence, cloud computing, the information disclosure, corporate governance mechanism, and supervision and balance system of enterprises more and more tend to be scientific and accurate. All links of corporate governance improve the management efficiency through data mining and analysis. Digital transformation can not

only help to improve the quality of information disclosure and the efficiency of information transmission but also help to gradually form a corporate governance system based on data mining, analysis, and application. In the process of cost control and investment decision-making, the management is more based on quantitative analysis of data rather than subjective judgment to reduce its discretion and alleviate the principal-agent problem [36, 37].

To sum up, the digital transformation of enterprises can help to reduce the adjustment cost, restrain the optimistic expectation of the management, alleviate the principal–agent problem, and thus curb the cost stickiness. In view of this, this paper puts forward the following assumptions:

H1a: enterprise digital transformation suppresses enterprise cost stickiness.

2.4. Intensifying Effect of Digital Transformation on Enterprise Cost Stickiness

2.4.1. Digital Transformation Is Easy to Cause Opportunistic Behavior of Major Shareholders and Management due to the Complexity and Diversity of Enterprise Operation. Digital transformation makes the investment decision-making and corporate governance of enterprises more digital and scientific, but it will also subvert their value creation mode and business model [10]. Zhao [11] believes that the introduction of digital technology will creatively destroy the original industrial and market foundation of enterprises and bring them new products, new services, and new business models. Guo and Luo [38] also stressed that in the early stage of introducing traditional industries, digital transformation may bring a destructive innovation. Therefore, digital transformation will extend the business scope of enterprises and become complex and diverse [39]. Demsetz and Lehn [40] consider that the increase of business complexity will make it more difficult for major shareholders to supervise managers and easily induce moral hazard of managers. Bushman et al. [41] also found that the higher the business complexity of an enterprise, the more likely to trigger opportunistic behavior of major shareholders and management.

2.4.2. Digital Transformation Is Easy to Aggravate Agency Conflict due to the Untimely Updating and Improvement of Relevant Enterprise Systems. Digital transformation will bring new business models to enterprises. The new business model requires enterprises to constantly improve risk management and internal control to meet the new needs of development. However, the construction and improvement of relevant systems are difficult to achieve overnight, and it often takes lots of time and energies to constantly explore and practice. Doyle et al. [42] found that fast-growing enterprises are more likely to have internal control defects. The imperfection of enterprise system is easy to induce moral hazard of managers and aggravate agency conflict [43].

In general, in the early stages of digital transformation, due to the great changes in organizational structure and business model, and the relevant systems such as governance model, risk control, and internal control matching, the new business model needs to be improved, the opportunistic behavior of major shareholders and management may be more serious, which exacerbates the cost stickiness of enterprises. Although China has made positive progress in digital technology, industry, application, and cross-border integration, the integrated development of traditional enterprises and digitization is still in its infancy. Hence, the following assumptions was put forward:

H1b: digital transformation intensifies the cost stickiness of enterprises.

3. Research Design

3.1. Samples and Data Sources. From 2012 to 2020, A-share listed companies in Shanghai and Shenzhen stock exchanges were selected as research samples. Before 2012, digital technology was rarely used by traditional Chinese enterprises. Before 2012, although digital technology developed rapidly, such as cloud computing, in fact, the deep and direct integration of digital and real economy mainly occurred after 2012 [44, 45].

This paper excludes the following samples: (1) listed companies in information technology industry and communication and cultural industry; (2) listed companies whose main business involves software development; (3) GEM companies; (4) financial listed companies; (5) listed companies with missing main variables. Finally, 3122 sample enterprises and 12,655 sample observations were obtained. The relevant data of digital transformation and other relevant data in this paper are from CSMAR database. In our work, all continuous variables are winterized up and down by 1%.

3.2. Variable Design and Model. Based on the research of Anderson et al. [26] and Liang [37], a model (1) is established to test the research hypothesis. The explanatory variable is the change of operating cost (lncost). Explanatory variables include the change of operating income (lnincome), the virtual variable of income decline (D), and the intersection of the change of operating income and the virtual variable of income decline ($\text{lnincome} \times D$). If $\alpha 2$ is significantly negative, indicating that the increase of cost when the business volume increases is higher than the decrease of cost when the business volume decreases, that is cost stickiness. Based on the previous content, the intersection term ($\text{lnincome} \times D \times N$) of digital transformation degree (N), operating income change (lnincome), and income decline dummy variable (D) are introduced. If $\alpha 3$ is significantly positive, H1a is assumed to be true. On the contrary, H1b is assumed to be true:

$$\begin{aligned}\text{Lncost} = {} & \alpha_0 + \alpha_1 \text{lnincome} + \alpha_2 \text{lnincome} \times D + \alpha_3 \text{lnincome} \\ & \times D \times N + \alpha_4 N + \sum \text{lnincome} \times D \times \text{EconVariables} \\ & + \sum \text{EconVariables} + \sum \text{Cont.rolVariables} + \varepsilon.\end{aligned} \tag{1}$$

Table 1: Definition of main variables.

Variable	Measurement
Lncost	The log-change in total operating costs
Lnincome	The log-change in total operating revenue
N	Logarithm of disclosure times of keywords related to digital transformation
D	Dummy variable that equals one if sales decreased in the current year and zero otherwise
DD	Dummy variable that equals one if the operating income decreases for two consecutive years and zero otherwise
Gdpgrowth	GDP growth rate of provinces where listed companies are located
Eintensity	Ratio of the number of employees to the operating income of the current year
Aintensity	Ratio of total assets to operating income of the current year
Lnsize	Logarithm of total assets
os	Ratio of total liabilities to total assets
IDRZ	Proportion of independent directors in the board of directors
Mshare	Proportion of the number of shares held by the management in the total number of shares
Dual	Dummy variable that equals one if the chairman and general manager are in one position and zero otherwise
Lnage	Ln (year of the current year − year of listing + 1)

Table 2: Descriptive statistics of main variables.

Variable	Mean	STD	Min	Max
Lncost	0.106	0.272	−0.796	1.18
Lnincome	0.101	0.287	−0.81	1.253
N	1.615	1.227	0	5.004
D	0.267	0.443	0	1
DD	0.113	0.317	0	1
GDP growth	0.071	0.05	−0.112	0.184
Eintensity	1.332	0.995	0.079	5.648
Aintensity	2.867	3.962	0.42	38.331
Lnsize	22.335	1.391	19.902	27.859
Os	0.426	0.203	0.056	0.935
IDRZ	37.78	5.43	33.33	57.14
Mshare	14.875	20.458	0	70.382
Dual	0.307	0.461	0	1
Lnage	2.048	0.91	0	3.296

Among them, economic variables include income decline (DD), economic growth (GDPgrowth), human capital density, and fixed-capital intensity for two consecutive years. Control variables mainly include enterprise size (lnsize), management shareholding ratio (mshare), current ratio (OS), and enterprise listing age (lnage). The industry and year dummy variables also need to be controlled. Table 1 shows the definitions of main variables.

4. Analysis of Empirical Results

4.1. Descriptive Statistics. The descriptive statistical results of the main variables are reported in Table 2 of this paper. The average value of changes in operating costs (lncost) is 0.106, and the average value of changes in operating income (lnincome) is 0.101. The average number of digital transformation disclosures (*N*) is 1.615 (about 5.03 times), the minimum value is 0, and the maximum value is 5.004 (about 149 times). There are great differences between the study samples. The values of other variables are within a reasonable range.

4.2. Correlation Analysis. If there is multicollinearity between the independent variables of the model, which may affect the effect of regression and affect the research conclusion. The correlation analysis of variables therefore is particularly important. The correlation analysis of the main variables is shown in Table 3 of this study.

Based on Table 3, there is a significant positive correlation between the change rate of operating revenue and the change rate of operating cost at the level of 1%, and the correlation coefficient is 0.91, indicating that the correlation between the two is high. With the increase of operating revenue, the operating cost also increases, which is consistent with the actual situation of the enterprise. At the same time, there is a positive correlation between the change rate of enterprise operating costs and the degree of digital transformation, which is significant at the level of 1%. From the perspective of control variables, the change rate of operating cost has a negative correlation with fixed capital intensity, human capital intensity, and the decline of revenue for two consecutive years, which is significant at the level of 1%, and has a significant positive correlation with the shareholding ratio of management and enterprise scale. It can be seen that the change of enterprise cost is not only affected by business volume but also by economic factors and enterprise characteristics, which will affect cost stickiness to a certain extent. Generally speaking, when the correlation coefficient between variables is greater than 0.8, there is likely to be a multicollinearity problem, which will interfere with the regression results. According to the output results in the above table, we can see that the correlation coefficient between the explanatory variables is less than 0.5, and it is considered thus that there is no obvious multicollinearity and further regression analysis can be made.

4.3. Regression Analysis. The regression results between the degree of digital transformation and enterprise cost stickiness are reported in Table 4. The goodness of fit of each column regression is high, indicating that the model setting is good. The results of column (1) showed that the regression coefficient of lnincome is 0.897, and the regression coefficient of lnincome × *D* is −0.143, which is significant at the level of 1%. This shows that for every 1% increase in operating revenue, the operating cost increases by 0.897%,

Table 3: Correlation coefficient matrix of each variable.

	Lncost	Lnincome	*N*	*D*	DD	Einten~y	Ainten~y	Gdpgro~h	Lnsize	os	IDRZ	Mshare	Dual	Lnage
Lncost	1													
Lnincome	0.906***	1												
N	0.056***	0.051***	1											
D	−0.551***	−0.619***	−0.022**	1										
DD	−0.358***	−0.395***	−0.022**	0.592***	1									
Eintensity	−0.085***	−0.129***	−0.022**	0.088***	0.109***	1								
Aintensity	−0.080***	−0.107***	−0.0130	0.120***	0.131***	0.125***	1							
GDPgrowth	0.108***	0.113***	0.00700	−0.0130	−0.0130	0.00800	−0.00500	1						
Lnsize	0.070***	0.078***	0.015*	−0.0130	−0.035***	−0.367***	0.245***	0.056***	1					
os	0.038***	0.037***	−0.026***	0.038***	0.0130	−0.240***	0.140***	0.050***	0.564***	1				
IDRZ	−0.0120	−0.00800	0.034***	0.0140	0.0100	0.027***	−0.0110	0.0140	−0.016*	−0.019**	1			
Mshare	0.083***	0.063***	0.050***	−0.114***	−0.079***	0.156***	−0.120***	−0.044***	−0.398***	−0.315***	0.075***	1		
Dual	0.024***	0.0130	0.059***	−0.037***	−0.020**	0.103***	−0.046***	−0.039***	−0.207***	−0.142***	0.132***	0.249***	1	
Lnage	−0.058***	−0.034***	−0.021**	0.170***	0.071***	−0.186***	0.051**	0.152**	0.424***	0.366***	−0.029***	−0.524***	−0.246**	1

Note: this table reports the correlation matrix comprising all dependent and independent variables. * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$. The upper triangle shows Spearman correlation coefficients and the lower triangle shows Pearson correlation coefficients.

Table 4: Digital transformation degree and enterprise cost stickiness.

Variables	(1) Lncost	(2) Lncost	(3) Lncost	(4) Lncost
Lnincome	0.897***	0.892***	0.896***	0.891***
	(187.856)	(183.176)	(187.351)	(182.769)
Lnincome × D	−0.143***	−0.029*	−0.166***	−0.044**
	(−14.060)	(−1.662)	(−11.854)	(−2.228)
Lnincome × D × N			0.015**	0.010*
			(2.409)	(1.656)
LnN			0.003***	0.002**
			(3.202)	(2.221)
Lnincome × D × DD		−0.003		−0.003
		(−0.159)		(−0.195)
Lnincome × D × GDPgrowth		0.549***		0.540***
		(3.953)		(3.888)
Lnincome × D × eintensity		−0.067***		−0.067***
		(−11.399)		(−11.355)
Lnincome × D × aintensity		−0.008***		−0.008***
		(−8.222)		(−8.198)
GDPgrowth		0.076***		0.074***
		(3.032)		(2.961)
DD		−0.010**		−0.010**
		(−2.215)		(−2.212)
Eintensity		0.002		0.002
		(1.534)		(1.493)
Aintensity		−0.001***		−0.001***
		(−3.262)		(−3.224)
Mshare		0.000***		0.000***
		(4.463)		(4.402)
Lnage		−0.012***		−0.012***
		(−8.358)		(−8.331)
Lnsize		0.007***		0.007***
		(7.217)		(7.088)
os		0.009		0.009
		(1.464)		(1.476)
IDRZ		−0.000**		−0.000**
		(−2.229)		(−2.266)
Dual		0.003		0.003
		(1.345)		(1.268)
Constant	0.011	−0.129***	0.007	−0.129***
	(1.351)	(−4.984)	(0.842)	(−4.984)
Observations	12,655	12,655	12,655	12,655
R-squared	0.830	0.837	0.830	0.837
Control	No	Yes	No	Yes
Industry and year FE	Yes	Yes	Yes	Yes

The symbols ***, **, or * indicate that the coefficient estimate is significant at the 1%, 5%, or 10% level, respectively.

while for every 1% decrease in operating revenue, the operating cost only decreases by 0.143%, that is, there is a certain stickiness in the cost of listed companies. Column (2) added economic factor variables and control variables, the regression coefficient of lnincome × D is −0.159, which is significant at the level of 1%. These results showed that after considering economic factors and other control variables, the cost of listed companies in China still has a certain stickiness. The results from columns (3) to (4) show that the degree of digital transformation and cost stickiness (lnincome × D). The cross multiplication coefficient is significantly positive at the levels of 5% and 10%, indicating that the digital transformation of traditional enterprises suppresses the cost stickiness. Hypothesis H1 is verified.

5. Robustness Analysis

(1) Control individual fixation effect. In view of the possible impact of some individual effects that do not change with time and are not easy to quantify, we choose to control the individual fixed effect for regression again. The results showed that the coefficient of the three intersection terms is positive and significant, indicating that the research conclusion is also robust.

(2) DID test. Considering that there may be endogenous problems caused by missing variables, this paper selects double difference test: first, determining the experimental group and control group according to

Table 5: The results of robustness analysis.

	FE	DID	Replacing the core variable
Lnincome × D × N	**0.0490** **		0.0258***
	(0.0202)		(4.532)
Lnincome × D × treat × post		0.0592***	
		(3.940)	
Observations	12655	16444	12655
R-squared	0.8190	0.7947	0.8856
Control	Yes	Yes	Yes
Industry and year FE	Yes	Yes	Yes

whether the enterprise has digital transformation. If the enterprise does not have digital transformation in the previous year and has transformed in the current year, it is defined as the experimental group (treat = 1). If the enterprise has no digital transformation in the previous year, and the current year, it is defined as the control group (treat = 0). Second, it is defined whether the digital transformation is "from scratch" (post). If the manufacturing enterprise is undergoing digital transformation in a year, the definition of post is 1, otherwise, it is 0. The regression results show that the cross-multiplication term lnincome × D × Treat × Post is positive, it indicates that the research conclusion is still robust.

$$\begin{aligned} \text{Lncost} = {} & \alpha_0 + \alpha_1 \text{lnincome} + \alpha_2 \text{lnincome} \times D \\ & + \alpha_3 \text{lnincome} \times D \times \text{Treat} \times \text{Post} + \alpha_4 \text{Treat} \times \text{Post} \\ & + \sum \text{lnincome} \times D \times \text{EconVariables} \\ & + \sum \text{EconVariables} + \sum \text{ControlVariables} + \varepsilon. \end{aligned} \tag{2}$$

(3) Replace the core variable. In order to investigate the impact of digital transformation on different types of cost stickiness of enterprises, this paper replaced "total operating cost" with "operating cost" and "total operating revenue" with "operating revenue" in model (1) for regression. The results showed that the coefficient of the three intersection terms is positive and significant, indicating that the research conclusion is still robust. Table 5 shows the results of robustness analysis.

6. Channel Impact Analysis

The above theoretical analysis pointed out that the digital transformation of enterprises helps to reduce the adjustment cost, restrain the optimistic expectation of the management, alleviate the principal–agent problem, and thus curb the cost stickiness. This paper mainly tested the three channels of reducing adjustment cost, restraining management's optimistic expectation, and reducing agency cost. According to the research ideas of Chen et al. [30], this paper used the method of grouping regression to test. If the inhibitory effect of digital transformation on cost stickiness is more obvious in the samples with high adjustment cost, strong management optimistic expectation, and high-agency cost, which showed that the channel to reduce adjustment cost, restrain management optimistic expectation, and reduce agency cost is established.

Table 6: Impact channel inspection.

Panel A: channel tests to reduce adjustment costs		
	High ASI	Low ASI
Lnincome	0.900***	0.881***
	(148.109)	(109.732)
Lnincome × D	−0.044*	−0.047
	(−1.898)	(−1.256)
Lnincome × D × N	**0.028** ***	**−0.020** *
	(3.867)	**(−1.844)**
Constant	−0.200***	−0.092**
	(−6.193)	(−2.009)
Observations	7,641	5,014
R-squared	0.851	0.823
Control	Yes	Yes
Industry and year FE	Yes	Yes

Panel B: channel tests to curb optimistic expectations from management		
	High EU	Low EU
Lnincome	0.874***	0.920***
	(116.435)	(156.857)
Lnincome × D	−0.036	0.027
	(−1.258)	(0.867)
Lincome × D × N	**0.017** **	**0.009**
	(1.962)	**(1.024)**
Constant	−0.142***	−0.037
	(−3.115)	(−1.467)
Observations	6,328	6,327
R-squared	0.831	0.868
Control	Yes	Yes
Industry and year FE	Yes	Yes

Panel C: channel tests to reduce agency costs		
	High MF	Low MF
Lnincome	0.865***	0.922***
	(115.995)	(172.155)
Lnincome × D	−0.052**	−0.058*
	(−1.982)	(−1.705)
Lnincome × D × N	**0.018** **	**−0.005**
	(2.334)	**(−0.469)**
Constant	−0.188***	−0.052*
	(−4.872)	(−1.682)
Observations	7,726	4,929
R-squared	0.800	0.906
Control	Yes	Yes
Industry and year FE	Yes	Yes

Williamson [46] pointed out that assets with strong specificity have few uses, large value loss during realization, and high adjustment cost. Therefore, referring to the research of Wang et al. [47], this paper divided the samples into two groups according to the median of asset specificity (ASI).

Theoretically, when the degree of uncertainty is high, it is difficult for the management to make an accurate judgment on the future business situation, and it is easier to have optimistic expectations. In view of this, referring to the research of Shen and Wu [48], this paper separated the samples into two groups according to the median of environmental uncertainty (EU). EU is an indicator of environmental uncertainty. This paper used the ordinary least squares (OLS) operation model (3) to estimate the abnormal sales revenue in the past five years, respectively, to eliminate the impact of the stable growth part of the sales revenue and more accurately measure the environmental uncertainty.

$$\text{Sale} = \varnothing_0 + \varnothing_1 \text{Year} + \varepsilon. \quad (3)$$

Sales refers to sales revenue, year is an annual variable, with values of 1–5 from the past fourth year to the current year. The residual of model (3) is abnormal sales revenue; calculate the standard deviation of the company's abnormal sales revenue in the past five years, and then divide it by the average value of the sales revenue in the past five years to obtain the environmental uncertainty without industry adjustment. The value is obtained by dividing the environmental uncertainty of each company without industry adjustment by the industry median. The environmental uncertainty of all companies is arranged and grouped according to the year. The group with high-environmental uncertainty (EU) is 1, and the group with low-environmental uncertainty (EU) is 0.

Agency cost reflected the principal–agent problem of shareholders and managers. The higher the rate of management expenses, the more serious the agency problem is. In view of this, this paper divided the sample into two groups based on the median of management expense rate (MF). See Table 6 for the inspection results of affected channels.

Panel A results show that among the samples with strong asset specificity, the regression coefficient of $\text{lnincome} \times D \times N$ is 0.028, which was significant at the level of 1%. In the sample with weak asset specificity, the regression coefficient of $\text{lnincome} \times D \times N$ is −0.020, which was significant at the level of 10%. These results show that the inhibitory effect of digital transformation on cost-stickiness is more obvious in the samples with high-adjustment cost. Therefore, digital transformation can restrain the cost stickiness of enterprises by reducing the adjustment cost.

The panel B results showed the regression coefficient is 0.017, significant at the 5% level, in the sample with high levels of environmental uncertainty; however, in the sample with less uncertainty about the environment, the regression coefficient is 0.009 (not significant), which suggested that the suppressing effect of digital transformation on cost stickiness is more pronounced in samples with high levels of environmental uncertainty. Thus, digital transformation restrains channels of influence from optimistic expectations of management from being established.

The panel C results showed that the regression coefficient of the three multiplicative terms, 0.018, is significant at the 5% level in the sample with a high rate of overhead costs; however, in the sample with the low overhead ratio, the regression coefficient of the three multiplicative terms was −0.005, which was not significant, which suggested that the suppressing effect of digital transformation on cost stickiness is even more pronounced in samples with large administrative expense rates. Thus, the channel was founded where digital transformation suppressed cost stickiness by reducing agency costs.

7. Research Conclusion

We treated the A-share listed companies in Shanghai and Shenzhen from 2012 to 2020 as the research sample, used the panel fixed effect model to investigate the profound impact of digital transformation on enterprise cost stickiness and explored its impact mechanism. The conclusions are as follows: (1) digital transformation has an inhibitory effect on enterprise cost stickiness, and the results are robust by controlling individual fixed effect, constructing double difference model, and replacing core variables. (2) The inhibitory effect of digital transformation on enterprise cost stickiness is more significant in the samples with strong asset specificity, high-environmental uncertainty, and high-management expense rate. These results show that the implementation of digital transformation reduces the adjustment cost, weakens the optimistic expectation of the management, and reduces the agency cost, and even can curb the cost stickiness.

In order to further improve the digital level of traditional manufacturing enterprises and reduce the cost stickiness of enterprises, this paper puts forward the following suggestions: (1) traditional manufacturing enterprises should actively do a good job in the overall planning of digital transformation, consolidate the construction of transformation basic conditions, and promote the digital renewal and iteration of products and businesses from products, production management and other links to promote digital transformation in an orderly manner. (2) Enterprises upstream and downstream of the industrial chain should cooperate to promote digital transformation, build a digital manufacturing ecosystem, provide IT infrastructure and digital technology to traditional manufacturing enterprises, form a collaborative innovation mode of the whole industrial chain, and drive the digital transformation of traditional manufacturing enterprises by creating an interconnected, symbiotic, and win-win whole industrial chain collaboration platform. (3) The government should create a development environment conducive to the digital transformation of traditional manufacturing enterprises, support and encourage traditional manufacturing enterprises to carry out digital transformation and promote the process of digital transformation by issuing special support policies, accelerating the construction of new infrastructure, increasing data security legislation and other measures.

Data Availability

The datasets used and analyzed during the current study are available from the author upon reasonable request.

Conflicts of Interest

The author declares no conflicts of interest.

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