Minority Shareholders' Activism and Corporate Digital Transformation

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Abstract: Promoting corporate digitalization is necessary to ensure the high-quality development of the digital economy, whose transformation is often decided by enterprise management. In the Internet age, network interactive platforms such as "e Interaction in Shanghai Stock Exchange" and "Easy Interaction in Shenzhen Stock Exchange" provide minority shareholders with the right to speak and functions including external supervision and governance that they do not have in traditional corporate governance. Based on the sample data of A-share and non-financial listed companies from 2011 to 2021, this paper adopts the panel data fixed effect model to investigate the influence and mechanism of minority shareholders' activism on corporate digital transformation. It is found that the attention paid to digitalization by minority shareholders significantly promotes corporate digital transformation, which is still valid after a series of robustness tests. Further research proves that minority shareholders' activism improves corporate digital transformation by alleviating the intermediary effect between managerial myopia and corporate financing constraints. According to the results of the adjustment effect test, compared with predictable economic policies, the increasing uncertainty of economic policies weakens the promotion of minority shareholders' activism. Besides, compared with the corporate decentralized power, the centralized management power stimulates the full play of minority shareholders' activism to perform the supervision and governance. This study provides inspires an in-depth understanding of how to play the role of minority shareholders in the digital transformation and corporate upgrading up against the digital economy.

Keywords: Corporate Digital Transformation; Minority Shareholders' Activism; Corporate Governance.

1. Research Background

With the rapid development of ABCD-related digital technologies such as Artificial Intelligence, Blockchain, Cloud Computing, and Big Data, the integration of data elements with other traditional fields is still on the advance. Meanwhile, the digital economy begins to emerge and prosper swiftly, which becomes a powerful engine leading industrial transformation in current economic and social development. According to the *20th National Congress of the Communist Party of China*, "accelerating the development of digital economy and promoting the deep integration of digital economy and the real economy" will drive the transformation in quality, efficiency, motivation, and production mode of the real economy, which can mitigate the serious problems that the supply structure and efficiency fail to meet the demand upgrading. New technologies, formats, and models can be promoted in the corporate digital fields. Besides, digitalization can be used to drive comprehensive optimization and upgrading of manufacturing, sub-sales, and other links. According to the *2022 Digital Transformation Index of Chinese Enterprises*, under the percentile system, the digital transformation in the whole sample increased from 37 in 2018 to 52 in 2022. After the outbreak of the COVID-19 pandemic in 2020, Chinese economic development and even the world has been severely impacted and challenged. The sluggish real economy and shrinking trade have forced enterprises to carry out digital transformation and upgrading. The resilient digital economy is imperative to the production resumption of real enterprises. As an individual from the perspective of the micro economy and society, corporate digital transformation is the only way to boost the macro digital economy. Under the changing global trade pattern with the increasing economic uncertainty and upgrading industrial structure, Chinese enterprises not only explore upgrading and optimization

paths, but also seek change and innovation, regarding "digital technology +" as the corporate primary strategy in adversity (Yang & Liu, 2018).

Corporate digital transformation is to reconstruct and transform business processes, operation modes, and organizational structures of enterprises by using the new generation of information technology (Liang et al., 2017). Acemoglu (2003) believes that digital technology is integrated with traditional production mode, and various production factors are reconfigured through technological innovation, which breaks through the boundary constraints of traditional factors and shows brand-new data value functions. The existing literature mainly explores the driving factors and economic consequences of digital transformation. On the one hand, research on the promotion of digital transformation from the internal organizational characteristics of enterprises and government financial support (Singh & Hess, 2017; Matarazzo et al., 2021). On the other hand, the microeconomic consequences of digital transformation are investigated, such as supply chain diffusion mechanism, economic uncertainty perception, business performance, input-output efficiency, etc. (Li et al., 2022; Wang et al., 2018; Zhao et al., 2022; Mikalef & Pateli, 2017). However, there is no literature linking enterprise digital transformation with corporate governance or studying the internal mechanism of minority investors' promotion of corporate digital transformation from the micro perspective, which considers how principal-agent problems between management and minority investors affect the digital process. With the rise of real-time network interactive platforms between investors and listed companies in recent years, minority shareholders, as stakeholders, can communicate with enterprises in two directions through question and response, and break through their information barriers. The listed company will appoint a representative (usually the company secretary or securities affairs representative) to check the investor questions received on the interactive platform. In principle, those questions should be fully analyzed, explained, and replied to within two working days (Cai et al., 2022). The active participation of minority shareholders in corporate governance decision-making, supervision performance, and establishing good communication channels on the platform is called "minority shareholders' activism". Because of their large-scale group and funds, minority shareholders can influence corporate decision-making to a certain extent. Nowadays, the development of online social media gives full play to the governance of minority shareholders. In the traditional context, management and major shareholders still occupy the initiative in decision-making, which often determine the development trend and strategic objectives of enterprises. The changing investments in digital transformation are unpredictable in the real economy performance with operational risks. The short-term interests between management and minority shareholders are inconsistent, and the costs caused by principal-agent problems may hinder the corporate digital transformation. Therefore, this paper attempts to explore the spillover effect of minority shareholders' activism on corporate digital transformation and its internal mechanism.

The marginal contributions of this paper are mainly as follows. (1) From the perspective of corporate governance, by capturing the timeliness and positive degree of minority shareholders' activism, it provides direct evidence of the positive relationship between minority shareholders' governance and the corporate digital transformation, which enriches the literature and research on the internal driving factors affecting corporate digital transformation and minority shareholders' activism. (2) It reveals the logic from the supervision and management mechanism of minority shareholders to the improvement of the corporate digital transformation, which verifies the intermediary effect of minority shareholders' activism in alleviating the corporate financing constraints and managerial myopia. The existing literature considers that minority shareholders interact with each other on the network platform to expand external financing and alleviate corporate financing constraints (Gao, 2021). However, it fails to consider the mechanism of financing constraints on corporate digitalization. Some scholars have found that managerial myopia can significantly inhibit corporate digital transformation (Li & Zhai, 2022), but they have not explored the mechanism of minority shareholders' activism acting on managerial myopia. (3) It has important policy implications for the further improvement of the investor interaction system and corporate enthusiasm for digital transformation from the perspective of corporate governance. If the corporate replies are assessed and guaranteed by

the regulatory authorities, the enthusiasm of interaction between minority shareholders and listed companies will be further promoted and a self-strengthening role will be formed. Actively guiding minority shareholders to participate in corporate governance and decision-making can alleviate the opportunistic behavior of management and large shareholders, which establishes strategies with long-term corporate value from a longer-term development perspective.

2. Theoretical Analysis and Research Hypothesis

Under the policy-driven corporate digital transformation in China, many scholars have investigated the problem of corporate digital transformation from various aspects from the causes to the economic consequences. The existing literature is mainly divided into three types. The first type studies the economic effects of corporate digital transformation: digital transformation optimizes the human capital structure through the effects of "technology substitution", "technology complementation", and "scale expansion" (Ye et al., 2022); explored the impact on enterprise performance and total factor productivity (Huang et al., 2019; Liu et al., 2021) promoting enterprise innovation (He et al., 2019); reduce the uncertainty perception of corporate economic policies by alleviating the limited ability to obtain information resources and process information (Fang et al., 2023). As for the internal mechanism of digital transformation to improve business efficiency, enterprises accumulate a large amount of data information in the whole process of "product design → quality monitoring → marketing → order sales → terminal distribution". But the corporate digital transformation promotes enterprises to process data more efficiently and transform them into effective information, so as to assist production and operation decisions (Wu et al., 2021). The second type studies the driving factors of corporate digital transformation: internal factors such as strong integration ability of digital technology resources (Christensen et al., 2016), low proportion of tangible assets, and strong profitability (Zhang, 2021); government fiscal and taxation policies (Yu et al., 2022), market competition pattern (Jiang, 2020), and other external corporate environments. The third type studies the diffusion mechanism of digital transformation among supply chain enterprises: digital transformation of customer companies can spread along the supply chain and drive the digital transformation of upstream companies (Li et al., 2022). The vertical cluster effect of corporate digital transformation in supply chain networks is more significant than the horizontal cluster effect of competitor networks (Du &Huang, 2023). Based on the above literature, there is little research on corporate digital transformation from the perspective of internal corporate governance factors.

Minority investors can express their information demands through the network interactive platform. Hirschman (1970) argues that shareholders' strategies are divided into Loyalty, Exit, and Voice, among which Voice can reflect their activism. In the Internet age, it is the legitimate rights and interests of minority investors to obtain the information they need through interactive platforms. The interactive platform is supervised and assessed by the stock exchange to ensure the efficiency and quality of investors' access to information, while the content openness makes the communication between listed companies and investors effective. A wide range of minority investors work together to integrate and acquire information. Questions with high frequency will arouse listed companies' attention to common problems, thus ensuring that their Voice is effective, and their information demands and decision-making suggestions can be listened to and adopted by corporate management. On the contrary, it is time-consuming and labor-intensive to ask questions on the network interactive platform and track the responses of enterprises. Any minority investor asking questions is equivalent to providing public goods and everyone will have the motivation to get some benefits, which makes it difficult to coordinate with each other in the process of asking questions, resulting in insufficient provision of public goods. According to the strategic complementarities theory, the willingness of minority investors to participate in the online platforms' interaction will increase with the growing number of other participants. The two possible equilibria are that everyone or no one will participate in the interaction. The impact of external events may improve this equilibrium. Zhang Qianqian et al.

(2021) found that minority investors can play activism in time. When hearsay shocks occur, the consistency of investors' questions is on the significant rise. Compared with the traditional investor communication mode, the online communication mode based on the network interactive platform is characterized by the wider participation of investors, higher interaction frequency between investors and listed companies, and better communication quality, so the network interactive platform is the preferred interactive medium for investors at present. To sum up, this paper argues that investors' attention to issues related to digital transformation on the network interactive platform can represent the minority shareholders' activism, which belongs to the Voice of active participation in corporate governance.

Whether the activism of minority investors has a positive governance effect fails to reach a consensus in the existing research. This paper holds that minority investors can influence the decision-making and strategic goal establishment of corporate management to a certain extent by supervision and governance, thus preventing opportunistic behavior caused by managerial myopia. Some research has confirmed that the governance of minority shareholders by voting or selling stocks has a significantly inhibitory effect on the agency cost of managers (Hu et al., 2018). At the same time, some empirical literature questions the effectiveness of shareholders' activism supervision. Bainbridge (2005) studies the ability of shareholders' activism to hinder effective execution by distracting management. Minority shareholders are limited by their short-sighted decision-making and irrational participation in governance, which will increase the possibility of the company manipulating financial data to cater to minority shareholders (Kong & Liu, 2017). This paper assumes that minority shareholders are rational with long-term vision and dynamic consistency of decision-making, which provides empirical evidence of their role in the formation of digital transformation and corporate development strategy.

Based on the above discussion, this paper puts forward the hypothesis:

H1: Minority shareholders' activism has a positive spillover effect on the corporate digital transformation.

H0: Minority shareholders' activism has no or even negative impact on the corporate digital transformation.

3. Research Design

3.1 Data Sources

In this paper, China's A-share non-financial companies from 2011 to 2021 are selected as the initial research samples. The reason why the financial industry samples are excluded is that the financial statements of financial enterprises and non-financial enterprises are different and not comparable, such as financial enterprises considering non-performing loan ratios and bad debt ratios. This sample interval is selected because the update interval of the corporate digital transformation index is 2011-2021. The data is further screened according to the following steps. Firstly, eliminate enterprises with abnormal operating conditions such as ST and ST*. Secondly, eliminate companies listed after 2017. Thirdly, eliminate the sample data of enterprises with insolvency, that is, net assets less than 0. Fourthly, to reduce the influence of extreme values, all numerical variables are reduced at the level of 1%. Fifthly, eliminate the company samples with missing main variables. Besides, the financial data of listed companies come from China Stock Market & Accounting Research Database (CSMAR); the relevant text information and annual report data originate from China Research Data Services (CNRDS).

3.2 Variable Definition

(1) Explained Variable

Corporate digital transformation. Digital transformation is the transformation of enterprise strategic objectives, the innovation of governance structure, and the transformation of internal management mode, involving organizational structure, R&D mode, production mode, and marketing

mode (Qi & Xiao, 2020). Therefore, due to the permeability and dependence of digitalization itself, it is difficult to separate and measure it (Li et al., 2022). In addition, the digital economy has become a new engine for high-quality economic development in recent years, and the concept of digital transformation of enterprises has been put forward and developed recently. There are no relevant statistical indicators in the financial statements of enterprises and most of the statements in the annual reports of enterprises are qualitative analysis, so it is difficult for the above measuring tools to accurately quantify the digital transformation. Thus, the digital transformation index (DT) of CSMAR is used in the basic regression analysis.

(2) Explanatory Variables

Minority shareholders' activism. Because the network interactive platforms such as "e Interaction in Shanghai Stock Exchange" and "Easy Interaction in Shenzhen Stock Exchange" are open and minority shareholders have wide participation as important participants in corporate governance, their information needs deserve attention. Minority investors' activism in digital transformation is reflected in their attention to related issues. If they are interested in corporate digital transformation and think it is valuable to implement it, they will directly interact with enterprises through the network interactive platform. Therefore, this paper uses the number of questions after logarithmic issues in the digital transformation of listed companies (Qnumb) as a measure of digital attention, and then as an agent variable of minority shareholders' activism.

(3) Control Variables

This paper selects a series of variables that have been proven to affect corporate digital transformation in previous studies as control variables. (1) Corporate size (Size), which is measured by the natural logarithm of total corporate assets. (2) Corporate age (Age), which is characterized by the natural logarithmic value of the difference between the sample year and the enterprise establishment year. (3) Asset-liability ratio (Lev), measured by the ratio of total assets to total liabilities. (4) Share concentration (Share), measured by the sum of the shareholding ratios of the top five corporate shareholders. (5) Board size (Board), measured by the natural logarithm of the number of directors. (6) Book-to-market ratio (BM), that is, the ratio of total owner's equity to market value. (7) Return on total assets (Roa), measured by the ratio of net profit to total assets. (8) Proportion of fixed assets (Fixed), measured by the ratio of net fixed assets to total assets. (9) Fixed effects of industry, year, and individual.

3.3 Empirical Model

To test the influence of minority shareholders' activism on corporate digital transformation, this paper constructs the following regression model.

$$DT_{i,t} = \beta_0 + \beta_1 Qnumb_{i,t} + \sum Controls_{i,t} + \varepsilon_{i,t}$$

In the above formula, subscript *i* and *t* represent enterprise and year respectively, and the t statistics after error adjustment of clustering robust standard (Cluster) is adopted by default. DT is the proxy variable of corporate digital transformation, $Qnumb$is the proxy variable of minority shareholders' activism, and $Controls$ is the control variable involved in regression analysis, including enterprise characteristic variable and enterprise governance level variable. $\varepsilon_{i,t}$ represents random error term. In this empirical model, the coefficient $Qnumb$ is the focus. Based on the previous theoretical analysis, there are the following expectations: significantly greater than 0, indicating that minority shareholders' activism greatly improves the corporate digital transformation index, that is, the corporate digital transformation process.

4. Empirical Results

4.1 Descriptive Statistical Analysis

Table 1 demonstrates the descriptive statistical results of the main variables. The average (median) of corporate digital transformation measured by corporate digital transformation index (DT) is 0.37

(0.34) and the standard deviation is 0.11, 0.297 times the average, which indicates that there are some differences in digital transformation among various enterprises. The average (median) of corporate digital transformation measured by corporate digital transformation word frequency (DTF) is 1.41 (1.10) and the standard deviation is 1.39, 0.99 times the average. Meanwhile, the 25% quantile is 0, indicating that at least one-quarter of corporate annual reports still fail to disclose the content of the digital process and the digital level of non-financial listed companies needs to be further improved. The average (median) of Qnumb is 4.24 (4.36), manifesting that investors attach importance to the opportunities and development brought by digitalization, and minority shareholders show high activism, which is consistent with the hypothesis of this paper.

4.2 Basic Regression Analysis

Table 2 shows the results of the correlation tests between corporate digital transformation and minority shareholders' activism. All control variables are included in the following three columns and use clustering robust standard errors. The first column controls the fixed effect of the year, the second column controls the fixed effect of the year and industry, and the third column controls the fixed effect of the year, industry, and individual. Based on the first column, the industry and individual control variables are included, and the relevant regression coefficients are reduced. Because after the control variables are included, some factors affecting the corporate digital transformation are absorbed. The results of the three columns all show that the estimated coefficient of the number of investors' digital questions and responses is positive and significant at 1%, that is, the minority shareholders' activism significantly enhances the corporate digital transformation. From the perspective of economic significance, taking the third column as an example, the corporate digital transformation index will increase by 0.0025 if every standard deviation (1.24) increases in the number of investors' digital questions and responses. The average of the corporate digital transformation index in the sample is 0.37, which means that it will increase by 0.68% if every standard deviation increases in the number of investors' digital questions and responses.

4.3 Robustness Test

To enhance the result robustness, a series of robustness tests are conducted, including replacing the measurement of explanatory variables and explanatory variables as well as eliminating the influence of epidemic factors.

Change the Measurement of Corporate Digital Transformation

Throughout the relevant literature, the common measurements are to use Text Recognition to count the word frequency of digital transformation feature words as proxy variables to measure the digital transformation. As an important strategy for upgrading enterprises in the new era, corporate digital transformation featuring the characteristic information is more easily reflected in the corporate annual report with the summary and instructive natures (Wu et al., 2021). Therefore, the digital transformation index (DT) of the explained variable is replaced by the digital transformation word frequency (DTF) of the corporate annual report. The measurement of Wu Fei (2021) is used to extract the annual reports published by all A-share listed companies of the Shanghai Stock Exchange and Shenzhen Stock Exchange through Python. Combined with important government policy documents, Java PDFBox is used to capture text information to build a data pool containing feature words (artificial intelligence, blockchain, cloud computing, big data) or sentences. Then, according to the feature word map, record related keywords' frequency and sum up the word frequency of technical keywords for logarithmic processing. Taking DTF as the dependent variable in columns (1) and (4) of Table 3, the coefficients increased significantly compared with those of basic regression. However, the variable listed in (4) to prevent the omission of corporate characteristics controls the individual fixed effect based on column (1), whose coefficient is smaller than that in column (1), but it is consistent with the previous hypothesis, proving that the benchmark regression results in this paper are robust.

(2) Change the Proxy Variable of Minority Shareholders' Activism

In benchmark regression analysis, the logarithmic number of questions (Qnumb) of investors' digital questions and responses of listed companies is the proxy of minority shareholders' activism, while the logarithmic number of responses (Respnumb) of investors' digital questions and responses of listed companies is used as the core explanatory variable in robustness test. In column (2) (3), the Respnumb of listed companies is taken as the core explanatory variable, and the coefficients before Respnumb are statistically significant within a 1% confidence interval, with good robustness in results.

(3) Eliminate the Epidemic Impact on the Corporate Digital Transformation

Considering the COVID-19 pandemic after 2020, to ensure the usual business operation of the real economy, the weight of online corporate operations has increased, which has forced corporate digital transformation. Given the aftereffect characteristics of the epidemic, the samples in 2020 and afterwards were excluded from the regression test in column (5), while the core conclusion is the same.

5. Test of Intermediary Mechanism

To analyze how minority shareholders' activism promotes the mechanism of digital transformation of listed companies, this chapter identifies and tests their channel mechanism.

(1) Minority Shareholders' Activism Inhibits Managerial Myopia and Improves Corporate Digital Transformation

The principal-agent problem between the management and minority shareholders of listed companies is prevailing, which reduces the corporate operating efficiency. Considering their career development, reputation, and prestige, the management has more motivation to make investment decisions to obtain stable returns in the short term and sacrifice strategic choices with long-term value for enterprises, which enables R&D investment featuring time inconsistency. From the perspective of time value, digital transformation is a major corporate strategic change, involving the integration and innovation of digital technology and front-end business expansion as well as corporate market integration (Wu et al., 2021), which requires long-term investment of material resources in the early stage. Moreover, is difficult to show its value in the short term and enterprises need to give up considerable cash flow at present. From the perspective of risk, on the one hand, investors may lose confidence due to bad corporate financial data and financial risks of a sharp decline in stock prices; on the other hand, the integration and innovation of front-end digital technology for corporate internal control and business processes will subvert the previous operation mode and trigger operational risks for enterprises (Li & Zhai, 2022). All the above reasons will lead to decision-making and managerial myopia, which inhibits corporate digital transformation.

To safeguard their interests and express their demands, minority shareholders are encouraged to actively participate in major corporate decisions and governance by voting at the shareholders' meeting. Minority shareholders can utilize the media or the external public opinion governance mechanism of emerging investors, so as to criticize the shortcomings, play the role of supervision and governance, and restrain the management from concealing information and shirking responsibility (Wang et al., 2020). Non-controlling shareholders' activism can also make a difference in corporate decision-making. On the one hand, it has rich sources of social capital and provides convenience for corporate innovative financing (Li, 2018). On the other hand, its group is relatively large with various news channels, which can shed light on the corporate development, make up for imperfect management decision-making, and explore valuable innovation opportunities. Therefore, this paper expects that minority shareholders can alleviate managerial myopia through supervision and governance mechanisms, and then improve the corporate digital transformation.

This paper selects the keywords frequency of managerial myopia in the MD&A keyword database from CNRDS and implements logarithmic processing for them as a measure of managerial myopia (MDA). Table 4 uses the mediating effect of managerial myopia to test the mechanism, in which the fixed time effect and the fixed industry effect are controlled. The results show that the coefficient of Qnumb in column (1) is significantly negative and it is statistically significant at 1%, which indicates

that the attention paid to digital transformation by minority shareholders will alleviate managerial myopia. In column (2), the coefficient of MDA is -0. 01, which is significant at 1%, so the lack of a long-term concept of management will significantly inhibit the corporate digital transformation. According to these results, minority shareholders' activism will curb the managerial myopia and then improve the corporate digital transformation.

(2) Minority Shareholders' Activism Alleviates the Corporate Financing Constraints and Improves the Corporate Digital Transformation

From the perspective of financial soundness, minority shareholders' activism improves the corporate performance and cash flow, and reduces the external financing demand. According to the theory of pecking order, enterprise financing generally follows the order of endogenous financing, bond financing, and equity financing. The active participation of minority shareholders in corporate governance can reduce cash flow abuse, boost business efficiency and profitability, so as to obtain more retained earnings for the company, and effectively reduce the corporate debt financing demand and financial leverage to further financing cost reduction (Zeng, 2021).

From the perspective of information disclosure, minority shareholders' activism can reduce the information asymmetry between investors and management. Their information asymmetry is reflected in that the management has more information about the real investment value and operating conditions of the enterprise than the minority investors. Thus, it has the economic motivation to overestimate the corporate value and attract external investment. After the management obtains the cash flow from investors, its actual information of the usage is opaque to investors and even plunders investors' funds. Information asymmetry makes the corporate external financing cost increase greatly because corporate investors will ask the management to give a higher premium to deal with the investment risk caused by information asymmetry (Myers & Majluf, 1984). High-quality network platform interaction can make the information between enterprises and investors transparent, and reduce the financing constraints more effectively, which is manifested in expanding corporate external financing (Gao, 2021). Therefore, the information communication between investors and insiders on the network interactive platform enhances investors' ability of information supervision and governance and urges enterprises to disclose more financial information and non-financial information, which improves the quality and quantity of information disclosure, reduces the information asymmetry, and undercuts the investment risks and hidden dangers of external investors.

Corporate digital transformation is a complex systematic project, which has high requirements and challenges for internal and external financing capabilities. However, minority shareholders actively express their information demands and call for supervision and governance, which alleviates agency problems and information asymmetry, bringing more financing opportunities for enterprises. Therefore, this paper predicts that minority shareholders' activism can improve digital transformation by alleviating corporate financing constraints. Based on the method of Whited (2006), this paper uses the WW index to measure corporate financing constraints. The smaller the WW index, the greater the corporate financing constraints. The regression results in Table 5 show that the pre-Qnumb coefficient is significantly negative, which proves that the attention paid to digital transformation by minority shareholders can effectively alleviate the corporate financing constraints. WW also has a significant negative relationship with the digital transformation index, indicating that the reduction of corporate financing constraints can promote digital transformation, which is consistent with the above hypothesis.

6. Heterogeneity Test

(1) Tone of the Corporate Annual Report

The tone of the annual report measures the positive degree of the corporate digital transformation and the mood of the management for future corporate operation and development. The higher the tone of the annual report, the more optimistic the management is about corporate digital development. If the tone is consistent with the goal of minority shareholders' activism in corporate decision-making

and governance to promote the construction of corporate digital technology infrastructure, the goal between minority investors and management is consistent. At the same time, their cooperation will play a "1 +1 > 2" regulating effect on corporate digital transformation.

Table 6 reports the test results of how minority shareholders' activism affects the corporate digital transformation with different tones in the corporate annual report. TONE1 and TONE2 are different ways to measure the positive degree of tone in annual reports based on the LM dictionary, with their coefficients significantly positive at 1%, which indicates that the positive degree of tone in annual reports can promote corporate digital transformation. The pre-multiplication coefficients are all significant at least 5%, which manifests that minority shareholders' activism can promote the corporate digital transformation with a more positive tone in the annual report.

(2) Agency Cost

The inconsistency between the short-term decision of management and the long-term goal of minority shareholders leads to agency costs, which inhibits digitalization. For the protection of their rights and interests considering corporate development, minority shareholders restrain the opportunistic behavior of large shareholders and management through the governance of voting with their hands and feet, thus significantly alleviating the manager agency cost of corporate cash holdings (Hu et al., 2018). In addition, when the corporate governance is low, the information asymmetry and the agency problem of major shareholders are more serious, and the enthusiasm of minority shareholders to participate in corporate governance through the network interactive platform is higher (Li et al., 2012). Therefore, this paper considers that there is heterogeneity in the promotion of minority shareholders' activism in enterprises with different agency costs.

This paper describes the influence of two types of agency costs. The first type is the manager agency cost, including the ratio of management expenses and sales expenses to operating income (Agency 1), the ratio of management expenses to operating income (Agency 2), and the ratio of operating income to total assets (Agency 3). The second type is the embezzlement of shareholders' interests, including the ratio of other receivables to total assets (Agency 4). According to columns (1), (2), and (4) of Table 7, all three measurements of agency costs can conclude that agency cost inhibits corporate digital transformation. Because Agency 3 measures corporate operational efficiency. The higher the ratio, the lower the agency cost, so there is a slight positive correlation between Agency in column (3) and corporate digital index. Under different measurements, the interaction coefficient is still positive, which shows that minority shareholders' activism promotes corporate digital transformation more significantly in the samples with more serious agency costs. Besides, minority shareholders play a role in external supervision and governance. On the contrary, in the sample with less agency costs, the minority shareholders' activism fails to promote corporate digitalization.

(3) Economic Policy Uncertainty

Economic policy uncertainty is perceived as the uncertainty of business managers, consumers, and other decision-making subjects about economic policy changes. Meanwhile, business expectations for policies are likely to affect their investment, R&D, and other behaviors (Bloom et al., 20107). On the one hand, facing the uncertainty of economic policies, corporate evasive behavior is reflected in more cautious investment decisions (Gulen & Ion, 2015). In other words, when enterprises face the uncertainty of economic policies, they inhibit investment, employment, production, and other behaviors to avoid risks, thus reducing their operating efficiency and innovation. On the other hand, the uncertainty of economic policy aggravates the information asymmetry between corporate investors and corporate internal management, and then reduces corporate external financing ability. Tight budget constraints hinder the systematic reform of digital transformation.

In this paper, China's economic policy uncertainty index constructed by Baker et al. (2013) and jointly disclosed by Stanford University and Chicago University is used to measure the economic policy uncertainty. Conducting text analysis on the *South China Morning Post* in Hong Kong, China, this paper searches for terms about economic policy fluctuations and calculates the frequency to establish monthly economic uncertainty indicators (epu1 & epu2) with a total score of 100. According to the regression test results in Table 8, under two different measurements, the uncertainty of

economic policies has significantly hindered corporate digital transformation. The pre-interaction coefficients are significantly negative at 1%, which indicates that the role of minority shareholders' activism in promoting corporate digital transformation is weakened when economic policies are uncertain. The possible reason is that the role of minority shareholders in corporate decision-making and governance is relatively weak under the uncertain macro environment and government policies.

(4) Management Power

Minority shareholders are at a disadvantage in corporate management, whose interests are easy to be encroached on by the management. Due to the separation of ownership and management rights, management is eager to build a business empire to maximize personal interests rather than shareholders' interests and pursue personal reputation and short-term interests, which leads to moral hazard and adverse selection problems (Jensen & Meckling, 1976). Therefore, this paper speculates that the more centralized the management power, the more obvious the inhibitory effect on the corporate digital transformation.

Adopting the model of Quan Xiaofeng (2010) and Liu Xing (2012), this paper constructs a comprehensive index (power) to measure management power by deconstructing it into organizational structure power, personal ability power, and ownership power. According to the benchmark regression results in Table 9, its effect on digital transformation is significantly negative, so it can be inferred that the concentration of management power will inhibit corporate digital transformation. The possible explanation is that the high concentration of management power will lead to arbitrary decision-making and a narrow horizon, which will trigger the shelving of the strategic goal of digital transformation with long-term value for enterprise development. In addition, the coefficient of cross-multiplication is statistically and significantly positive at 5%, which shows that the minority shareholders play their role in supervision and management. The more centralized the management power is, the minority shareholders will have more economic incentives to exercise their corporate governance power to prevent interest loss.

7. Endogenous Problems

Because listed companies are generally large in scale and strong in economic strength, and for reducing management costs and information asymmetry between departments, they are more inclined to invest in digital transformation. When enterprises have begun to make digital transformation measures, investors may ask questions for understanding the business, so there is a mutual influence between them, which leads to causal interference. In the sample selection, the information related to the digital transformation of listed companies often adopts the way of self-determination whether to disclose, which will trigger sample self-selection errors caused by information disclosure. To ensure the reliability of research conclusions, this paper adopts the instrumental variable method, Heckman's two-stage regression, and propensity score matching (PSM) to alleviate endogenous effects.

7.1 Instrumental Variable Method

As the bridge between listed companies and investors, the secretary of the board of directors discloses timely and accurate information to investors on the network interactive platform according to the regulations of the exchange, which is imperative to improve the interactive information quality between enterprises and investors. Concerning the quality and efficiency of communication information, the experimental results show that the investment possibility judged by investors is higher when the management responds to investors' questions in time with high usability (Gao et al., 2021). The secretary of the board of directors with a strong ability can collect investors' suggestions and problems, then report them to the company for accurate governance, and effectively perform information disclosure because of his or her right to know major issues, thus reducing the agency cost between the company and investors (Li, 2014).

In this part, this paper selects the dummy variable of whether the secretary of the board of directors for the listed company is competent as the tool variable of investors' digital Qnumb in listed

companies. If it is competent, the value is 1, otherwise, it is 0. The reasons are as follows. Firstly, as a high-quality information publisher, the competent secretary of the board of directors can not only ensure effective communication between enterprises and investors, use his professional ability to resolve the information gap between them, but also form a positive feedback mechanism for investors to ask further questions and make investors keep an optimistic attitude towards the corporate operation. Secondly, whether the secretary of the board of directors for a listed company is competent has almost nothing to do with the error item. For example, it is weakly correlated with the corporate characteristics. According to the empirical results in Table 10, in the first stage of regression, compared with listed companies without a competent secretary of the board of directors, Qnumb increased by 0.22 and was statistically significant at 1%, indicating that this dummy variable is a better tool variable. After suppressing endogenous problems, the coefficient of Qnumb is still significantly positive, which proves that the digital attention of minority shareholders significantly improves the digital transformation of listed companies after controlling the reverse causality.

7.2 Heckman's Two-Stage Regression

Because the listed companies on the network interactive platform choose to disclose the data of investors' questions and responses independently, there is a sample self-selection error, so this paper adopts Heckman's two-step regression. In the first stage, "whether Qnumb exceeds the average of all listed companies" (if it exceeds the average, the dummy variable num_Qnumb is 1; otherwise, it is 0) is taken as the dependent variable, with Size, Age, Lev, Share, Board, BM, Roa, Fixed, and SOE as independent variables. The probit model is used for regression to estimate the probability that the interaction of listed companies' network platforms exceeds the average, and the inverse Mills ratio (IMR) is obtained. In the second stage, the estimated IMR as a control variable is included in the second-stage regression equation to adjust the bias of selective disclosure of listed companies. It is observed that the coefficient before IMR is not significant, so there is no serious sample selection error. But controlling it makes the regression result more rigorous, which shows that the promotion effect of minority shareholders' activism is significant.

7.3 Propensity Score Matching (PSM)

The number of questions asked by minority investors about the corporate digital transformation in the network platforms interaction may be related to the enthusiasm of enterprises' disclosure and result from the self-active choice. Because the number of questions in the corporate digital transformation is higher than the average, it is not random, but related to the corporate characteristics. Therefore, this paper uses the propensity score matching and logit estimation model to test its endogeneity. Samples with num_Qnumb value of 1 are divided into treatment groups; otherwise, they are control groups, with all control variables in benchmark regression selected as covariates to match by 1:1 nearest neighbor matching. The regression test results of matched samples show that the relationship between the number of digital questions from investors of listed enterprises and the corporate digital transformation is significantly positive.

8. Conclusions and Policy Recommendations

In the era of the digital economy, to implement the digital China strategy and promote high-quality economic development, enterprises have explored to integrating digital technology with the real economy, and digital transformation is reflected in a series of changes in corporate production. However, due to the structural characteristics of retail investors in China's capital market, the information needs of natural investors as minority shareholders have been paid more and more attention. The popularity of the Internet brings advantages to reducing the cost of information collection, and minority shareholders resort to the network interactive platform connecting investors and listed companies' communication channels. Based on interactive media such as "e Interaction in Shanghai Stock Exchange" and "Easy Interaction of Shenzhen Stock Exchange", minority investors

actively participate in corporate governance by asking questions, which reflects their activism. Therefore, based on the close relationship between digital attention and minority shareholders' activism, this paper constructs the internal mechanism and logical framework of minority shareholders' activism for digital transformation, so as to promote corporate digital transformation through two channels, that is, corporate managerial myopia and financing constraints, and tests its regulatory role.

The results show that: (1) The digital attention of minority shareholders can significantly increase the corporate digital transformation, that is, minority shareholders' activism has a positive spillover effect. (2) Minority shareholders' activism promotes corporate digital transformation by alleviating managerial myopia and participating in the establishment of corporate strategic objectives. (3) Minority shareholders' activism can alleviate the corporate financing constraints by performing their supervision and governance, and then enhance the corporate digital transformation. In addition, differences in macroeconomic uncertainty, tone of the annual report, agency cost, and management power of the enterprise will affect the promotion of minority shareholders' activism to the corporate digital transformation. Meanwhile, the increasing economic policy uncertainty leads to the avoidance of uncertainty by minority shareholders and enterprise management, which hinders corporate digital transformation. The high concentration of management power encroaches on the interests of minority investors encroached, which enables more sufficient economic motivation to correct the corporate decision-making through external supervision, so as to make decisions beneficial to the overall and long-term corporate development.

The research has the following important implications. (1) The regulatory authorities continue to promote the network interactive platform of minority shareholders, optimize the relevant institutional environment, and escort minority shareholders to obtain information and make decisions. Retail investors are generally at an information disadvantage with frequent frictions in access to information. In addition, the market is full of information, and the ability to understand and integrate this kind of information is relatively insufficient due to limited attention. If minority investors change from passively collecting information to actively seeking information, it can reduce their information integration costs. In case of questioning or puzzling the disclosed information, minority investors can use the network interactive platform to explain and feedback to enterprises immediately, so as to provide their opinions and suggestions on corporate decision-making and governance. (2) Create stable policy expectations, keep the time consistency of government policy dynamics, make enterprises targeted, and prevent overreaction. From the perspective of behavioral economics, micro-subjects belong to risk aversion when they feel economic policies uncertainty, and their optimal strategy is probably procrastination. The government uses forward-looking thinking to create stable policy expectations, which makes enterprises surer to make long-term investments in corporate digital transformation. (3) Strengthening the long-term incentive to the management, perfecting the performance evaluation system, and incorporating the index of its contribution to the long-term corporate development can appropriately extend the term of management and make it have a longer-term vision when making decisions. (4) Guide minority shareholders to actively participate in corporate governance and make rational decisions beneficial to long-term corporate development. Minority shareholders need to change their traditional governance roles, give full play to their external supervision, safeguard their rights and interests, and actively participate in enterprise decision-making, so as to correct the opportunistic behavior of management and large shareholders. (5) Continue to follow the development trend of "ABCD" digital technology, call on listed companies to carry out digital transformation, propose supportive policies for enterprises, and promote the digital economy for the high-quality development of China's economy. A differentiated digital transformation mode can be adopted for different enterprises, so that digital technology can fully empower the corporate production links and organizational structure, fully drive financial technology in the innovation and development of entities, and prevent possible risks arising from digital transformation.

There are still some problems to be explored in this paper: (1) The measurement of digital transformation still needs a more perfect method, which involves corporate organizational structure,

production and operation, sales, and other aspects. A digital transformation index based on text analysis is a better measurement at present, but there is still room for further precision. (2) The number of investors' digital questions and responses represents the minority shareholders' activism, and its measurement has low information content. Thus, it is impossible to expound on whether the specific content of questions and responses is "information" or "noise", and the follow-up research can use text analysis to identify it. The minority shareholders' activism is also reflected in their participation in corporate decision-making, but this index is difficult to observe, which still calls for a more comprehensive and perfect index.

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