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Digital Transformation, Firm Boundaries, and Market Power: Evidence from China's Listed Companies

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Abstract: Digital transformation is seen as an "elixir" for companies to improve their economic performance and expand their market power in the digital economy. Therefore, how does digital transformation affect enterprises' market power? This paper used machine learning to construct a digital transformation index and used panel data of listed enterprises from 2008 to 2020 to study the impact of digital transformation on market power and its mechanism of action. The findings showed that digital transformation significantly increases market power, and this conclusion still holds after considering potential endogeneity issues and conducting robustness tests. The results of mechanism analysis revealed that digital transformation facilitates endogenous scale expansion and promotes merger and acquisition (M&A), which reshapes firm boundaries and, thus, enhances market power. This paper revealed new changes in the micro-organization of enterprises in the context of digital transformation and provided micro-evidence for the industrial organization effect of digital transformation.

Keywords: digital transformation; market power; firm boundaries

1. Introduction

After agriculture and industry, the digital economy is the main economy. The "White Paper on the Development of China's Digital Economy (2023)" shows that the scale of China's digital economy reached RMB 50.2 trillion in 2022, indicating that the digital economy has become the main force of contemporary economic development. President Xi Jinping emphasized that it is necessary to accelerate the development of the digital economy and promote the deep integration of the digital economy and the real economy. Digital transformation aims to use digital technologies to systematically reconfigure corporate business models and influence market structures and economic performance. However, it is still unclear whether digital transformation expands or narrows the market power of enterprises. As a measure of a firm's ability to control the market, market power reflects the changes in market structure and enterprise performance. As a result, researching how digital transformation changes market power lays the theoretical groundwork for developing market policies that will help businesses grow and become more powerful.

Market power has always been a focus of research in industrial organizations, and many literature works have identified its macro- and micro-level determining elements. Researchers have discovered that market power is influenced at the macro-level by factors including the proportion of foreign capital [1], economic cycles [2], and tariffs [3]. On the micro-level, scholars have explored the impact of firm size [4] and M&A [5] on market power. Within the digital economy, digital technology is gradually penetrating all aspects of business and driving optimal market restructuring. As a new engine for business development, digital transformation is changing the cost structure and reshaping the firm boundaries, which will inevitably affect market power, but current micro-evidence is still lacking.

Digital transformation is an important symbol of moving from traditional business to a digital ecology at the micro-level and a micro-mirror of the deep convergence of informationization and industrialization at the macro-level. Along with digital transformation, scholars have made significant progress on digital transformation's economic effects in recent years. Some scholars examine digital transformation's influence on innovation [6], and organizational change [7] from a corporate governance perspective. Other scholars examine corporate digital transformation's influence on optimizing the capital market environment and reducing capital market risks [8] from the capital market view. Digital transformation has brought about a profound impact at both the micro-enterprise level and the macro-economic level. Market power is the bridge between internal corporate governance and macroeconomic performance. Dissecting the mechanisms underlying the changes in corporate market power under digital transformation can help bridge the gap between micro-and macro-effects. Currently, the key to digital transformation is to reduce costs and increase efficiency, and changes in cost structures will reshape the firm boundaries. In addition, the 2021 China Enterprise Digital Transformation Index shows that the gap in revenue growth between companies that have successfully undergone digital transformation and the average company has widenedfrom 1.4 times to 3.7 times. Therefore, we cannot help but think: Will digital transformation "reshuffle" the market and change corporate market power? What are the underlying mechanisms? The answers to these questions can theoretically help clarify the microscopic mechanism of industrial organization change under digital transformation and also have important practical significance for precise measures to improve corporate high-quality development.

From the applications and characteristics of digital transformation, it can be found that it may have the following two effects on corporate market power. Based on economies of scope, digital transformation breaks through geographic location and language constraints, allowing firms to operate in multiple markets simultaneously, improving service quality and market power. Based on economies of scale, suppliers and partners of firms can also share consumer data and technical expertise through digital transformation in order to facilitate firms to build a business ecosystem and increase their market power and market share. However, there is a lack of direct empirical analysis on the impact of digital transformation on market power.

This paper first used the Python web crawler to obtain the annual reports of listed companies from 2008 to 2020. It then used text analysis to examine the frequency of words in the annual reports of listed companies based on the extracted common lexicon and calculated the digital transformation index of each listed company in each year. Then, the panel data were constructed by combining the relevant financial indicators. The impact of digital transformation on market power and its mechanism were elucidated by empirical analysis. The following are the paper's primary conclusions: First, digital transformation increases corporate market power. Considering the possible endogeneity issues, this paper adopted the instrumental variables approach for endogeneity analysis and still obtained consistent conclusions. In addition, the conclusions still held after robustness tests. Second, this article found through mechanism analysis that digital transformation not only stimulates the endogenous scale expansion of firms, but also promotes M&A and restructuring, which expands the firm boundaries and, thus, increases the market power.

Compared with previous studies, the potential contributions of this paper are as follows. First, this paper explored the industrial organization effects of digital transformation from the micro-enterprise level. Scholars have studied digital transformation's economic effects from a micro-perspective. In contrast, some scholars have examined digital transformation's influence on the macroeconomy. However, few scholars have built a bridge between the micro-effects and macro-effects of digital transformation from the perspective of corporate market power. Moreover, how digital transformation changes firm boundaries has become one of the three important questions to tackle in digital economy research [9]. This paper also provided a research basis to answer further how industrial structure and economic performance change under digital transformation. Second, re-

garding the construction of the indicators, this paper optimized digital transformation measurement based on machine learning methods. The deep integration of digital and traditional economies makes measuring enterprise digital transformation more difficult, and there is no scholarly consensus yet. Currently, scholars mostly measure corporate digital transformation at the macro-level [10], and the degree of digital transformation at the micro-level is not perfect. Some scholars focus on one aspect of digital technology, such as Rammer et al. [11], who used industrial robot data to examine the influence of AI on labor, employment, and industrial innovation. In addition, some scholars have measured digital transformation in a single dimension, such as digital innovation [12]. However, digital transformation is a systematic redefinition of enterprise organizational processes, business models, and product forms using digital technologies, including many elements such as digital assets, talent, and innovation. Thus, an effective portrayal of enterprise digital transformation should consider all these aspects. Therefore, we refer to Li et al. [6] and use the text mining method in machine learning for digital transformation index construction based on the lexicon formed by common word extraction. Third, this paper provided empirical evidence for enterprises to grow bigger and stronger with the help of digital transformation, but also provided empirical evidence and policy reference to strengthen digital economy governance.

2. Theoretical Analysis and Hypothesis

Digital transformation refers to the redefinition of corporate organizational processes, business models, and product forms by digital technologies, which reshape firm boundaries and, thus, affect market structures and patterns. Based on the inherent logic of external expansion and internal growth, this paper analyzed the mechanism of digital transformation on market power in two ways: M&A and the establishment of subsidiaries. The mechanistic framework is presented in Figure 1.
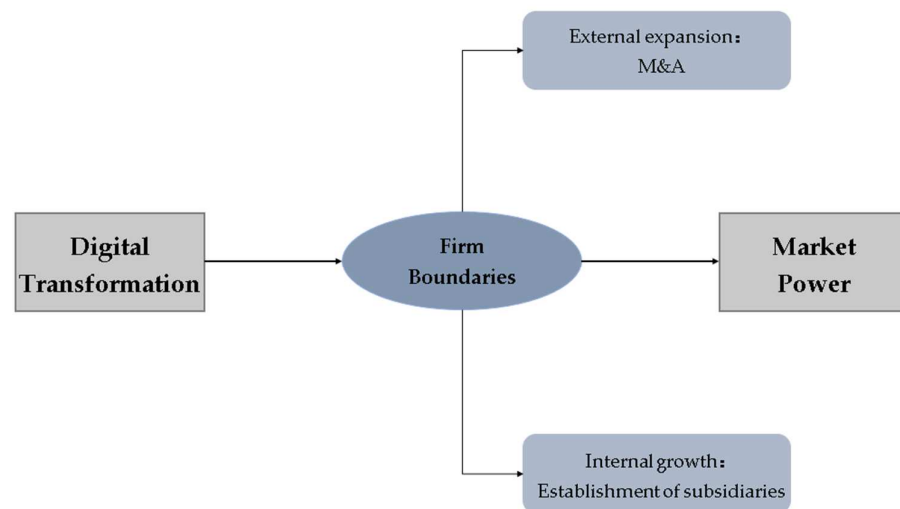

Figure 1. Mechanistic framework.

2.1. Digital Transformation Enables External Expansion and Increases Market Power by Promoting Corporate M&A

The cost structure change under digital transformation will promote M&A from both internal and external aspects. Internally, digital transformation has the effect of reducing costs and increasing efficiency. Based on neoclassical economics theory, companies have an incentive to promote M&A. On the other hand, externally, digital transformation, as an important initiative for high-quality corporate development, will release favorable information to the capital market, consequently pushing up share prices. Based on behavioral finance theory, firms can initiate M&A.

From neoclassical economics theory, specific industry shocks and productivity differences are the main causes of M&A [13]. High-productivity firms are more inclined

to buy assets, while low-productivity firms are more inclined to sell assets [14]. Digital transformation involves incorporating data as a new production factor into business management [15] to reduce cost and efficiency. Specifically, digital transformation will affect enterprise productivity and, thus, M&A on both the demand and supply side. On the demand side, digital transformation alleviates productivity inefficiencies caused by asymmetric information. Digital transformation reduces the cost of information gathering, facilitates more-targeted production planning, and improves enterprise productivity. On the supply side, digital technologies such as AI have replaced many jobs and automated business production. Compared with ordinary employees, intelligent machines are not limited by physical strength and energy, so they can produce for an extra-long time and with extra-high efficiency. In addition, digital transformation allows enterprise production data visualization, and enterprises can monitor the production status at any time. Digital technology has enabled sales to break through the limitations of geographic location. The business scope and sales path of enterprises can be opened. The expansion of consumption will increase production, increasing productivity. Productivity increases in some firms widen the productivity gap between industries. High-productivity firms will become potential M&A parties in the market, expanding their corporate boundaries and increasing their market power by acquiring low-productivity firms.

From behavioral finance theory, the stock value is the main driver of M&A in the financial market. Subject to irrational expectations, management tends to practice arbitrage in non-efficient stock markets through M&A [16]. When the stock price increases, M&A will be more frequent. The essence of digital transformation is to revolutionize business management and modelling using digital technologies. Therefore, digital transformation means releasing good news to the market and increasing the stock price. Confronted with rising stock prices, companies may acquire other companies to complete their industrial layout and increase their market power. On the other hand, companies' shareholders are likely to practice arbitrage through M&A, thus promoting M&A and increasing market power. Therefore, the share price effect of digital transformation will cause frequent M&A and, thus, increase market power.

Whether analyzed in neoclassical economic or behavioral finance theory, digital transformation creates and satisfies the requirements for M&A. Therefore, digital transformation will inevitably promote M&A. Enterprises broadening their boundaries through M&A will also lead to an increase in market power. This paper puts forth the following hypothesis:

Hypothesis 1 (H1). *Digital transformation enables external expansion and increases market power by promoting corporate M&A.*

2.2. Digital Transformation Enables Internal Growth and Increases Market Power by Facilitating the Establishment of Subsidiaries

Establishing subsidiaries is an important means to achieve scale expansion and increase market power [17]. However, asymmetric information and management costs between subsidiaries and parent companies have always prevented setting up subsidiaries. Digital transformation uses digital technology to reduce the cost of setting up subsidiaries and amplify the advantages of subsidiaries, thus enabling companies to increase their market power by setting up subsidiaries.

Specifically, digital transformation's information dissemination and management structure changes help weaken the communication and management costs between subsidiaries and parent companies. In information dissemination, digital technology breaks through the limitations of time and space, which helps business collaboration and information sharing between subsidiaries and parent companies and reduces communication costs. In management structure, digital transformation changes the enterprise's original management process and organizational structure [18]. Digital transformation brings the finance, personnel, production, and sales of subsidiaries and parent companies under the same digital system [19], realizing the automation and intelligence of management and reducing management costs. In addition, digital transformation will amplify the

advantages of subsidiaries in production, sales, and innovation. For production, digital transformation helps subsidiaries determine reasonable input–output ratios and realize the efficient production management of subsidiaries, so they can provide more products for the parent company. The most-important thing for sales is customer preference and product pricing. Big data can accurately reveal customer preferences [20] and overcome the friction in the corporate demand accumulation process [21], making sales more targeted and increasing customer stickiness. In addition, firms can set prices based on individual demand functions in product pricing, acquiring more consumer surplus capacity and increasing the advantage of subsidiaries in sales. Product innovation is an important asset for subsidiaries to develop their markets [22,23]. Digital technology is the key to product innovation. The learning ability of AI will largely reduce the uncertainty of product innovation, shorten the product innovation cycle, and seize the first opportunity for the subsidiary to develop the market. The development and growth of subsidiaries in production, sales, and marketing will provide the parent company with more resources, products, and information and pull the parent company to increase its market power.

Digital transformation reduces the cost of setting up subsidiaries, prompting them to gain a larger market share and greater market power through establishing subsidiaries. This paper presents the following hypothesis:

Hypothesis 2 (H2). *Digital transformation enables internal growth and increases market power by facilitating the establishment of subsidiaries.*

3. Research Methodology

3.1. Variables

3.1.1. Explanatory Variable

The key to an in-depth examination of digital transformation lies in effectively measuring the digital transformation index. Through the literature review, it was found that the key to the reasonable measurement of digital transformation lies in solving the following problems. First, the research perspective was chosen from the research questionnaire. There is a large amount of literature on digitization at the macro-level. Ran et al. [24] and Wu et al. [25] studied the impacts of digital on natural resources and environmental pollution using the digital economy development index at the provincial and city level. Second, the characteristics of digital transformation should be comprehensively and effectively portrayed. In the existing literature, some scholars take a specific aspect of digital transformation such as digital innovation [12] and ICT investment [26] as a proxy variable for digital transformation. This approach has difficulty reflecting the full picture of enterprise digitization. Third, machine learning techniques are used wisely. It is now possible to measure digital transformation using machine learning. The key to this approach is to extract digital-transformation-related information. To some extent, the greater the terms related to digital transformation, the faster the digital transformation process. Although many terms differ in specific designations depending on corporate attributes, they express similar meanings. However, the existing literature has an insufficient common vocabulary for the thesaurus construction [27], resulting in a large cross-sectional bias in the digital transformation index. No bias can be eliminated even with individual fixed-effects models. In addition, there is a "long-tail feature" in word frequency statistics. If each word is counted individually, there is a problem with excessive computation. The "long-tail feature" will also bring large statistical bias if the low-frequency words are neglected.

According to the above analysis, it can be found that the construction of the thesaurus is crucial to comprehensively reflect the dynamics of digital transformation from the micro-level. Therefore, this paper constructed the lexicon from the common characteristics and target concepts of enterprise digital transformation to avoid the bias caused by individual characteristic factors [28]. Then, we manually filtered out the phrases with poor relevance to digital transformation and eliminated them after using Python to extract the 4-digit terms linked to common words from the annual reports of all listed firms. Finally, we

obtained the word frequency of each phrase. Finally, we summed up the word frequency of each phrase to obtain the total word frequency and normalized it to obtain the digital transformation index.

3.1.2. Explained Variable

Market power is the firm's ability to significantly influence market prices within a market and is often used to measure the monopolistic tendencies of the firm. Product price is central to defining market power. This paper used corporate price markup to measure market power. The specific approach is as follows.

$$mkp_{it} = \theta_{it}^x (\alpha_{it}^x)^{-1} \tag{1}$$

θ_{it}^x indicates the output elasticity of intermediate goods' inputs. X is for intermediate goods. α_{it}^x is the share of expenditures on intermediate goods.

The parameter estimation of the firm's production function was performed using the transcendental logarithmic production function. The specific settings are as follows:

$$
\begin{aligned}
lny_{it} = {} & \beta_l lnl_{it} + \beta_k lnk_{it} + \beta_m lnm_{it} + \beta_{ll}(lnl_{it})^2 + \beta_{kk}(lnk_{it})^2 + \\
& \beta_{mm}(lnm_{it})^2 + \beta_{lk} lnl_{it} lnk_{it} + \beta_{lm} lnl_{it} lnm_{it} + \beta_{km} lnk_{it} lnm_{it} + \\
& \beta_{lkm} lnl_{it} lnk_{it} lnm_{it} + \psi_{it} + \varepsilon_{it}
\end{aligned}
\tag{2}
$$

y is the gross industrial output value. l, k, and m denote labor, capital, and intermediate input factors, respectively. ψ refers to the heterogeneous productivity of firms. ε denotes a random error term. According to the DLW method, a two-step estimation of the production function was used: in the first step, the model was estimated by using the proxy variables of productivity to obtain the estimated values of the explanatory variables. In the second step, the parameters of the production function were estimated using GMM estimation. The expression for the estimated input–output elasticity of intermediate goods is given below.

$$\theta_{it}^x = \beta_m + 2\beta_{mm} lnm_{it} + \beta_{lm} lnl_{it} + \beta_{km} lnk_{it} + \beta_{lkm} lnl_{it} lnk_{it} \tag{3}$$

By substituting the output elasticity of the input factor θ_{it}^x into the calculation of mkp_{it}, the value of the corporate markup rate was estimated.

3.1.3. Control Variables

This paper chose the following control variables: Size, Roa, Top, Lev, Fix. Table 1. provides the specific meaning of each variable.

Table 1. Variable definitions.

Types	Abbreviation	Definition
Explanatory Variable	Digital	Standardized digital transformation thesaurus word frequency
Explained Variable	Power	Price mark-up
Control Variables	Size	ln(1 + total assets)
	Roa	Net profit/total assets
	Top	Shareholding ratio of the largest shareholder
	Lev	Total liabilities/total assets
	Fix	Fixed assets/total assets

3.2. Model

This paper constructed a regression model (2) to explore the impact of digital transformation on market power:

$$Power_{it} = \alpha + \beta Digital_{it} + \gamma Control_{it} + \mu_i + \delta_t + \psi_{ind} + \lambda_r + \varepsilon_{it} \tag{4}$$

The explained variable $Power_{it}$ is market power. $Digital_{it}$ represents the degree of corporate digital transformation. $Control_{it}$ are the control variables. μ_i indicates individual fixed-effects. δ_t indicates the time fixed-effects. ψ_{ind} indicates the industry fixed-effects. λ_r indicates the region fixed-effects. ε_{it} denotes the random error term. The coefficient β of $Digital_{it}$ represents the direction and magnitude of the impact of digital transformation on market power.

3.3. Data Sources

The data on market power used in this paper were measured by the authors using the DLW method. The digital transformation index was calculated using the text mining method. Other data were sourced from the CSMAR. In order to make the sample data more representative, this paper excluded the following sample data: (1) financial, ST, and * ST enterprises; (2) enterprises with serious missing data; (3) financial anomalies. In addition, we performed linear interpolation and average interpolation on a few lost data. The finalized sample for the article was the panel data of 2900 listed firms from 2008–2020, with 24,361 observations in the measurement model.

4. Results

4.1. Descriptive Statistics

Table 2 provides the fundamental statistical properties of the key variables. Digital transformation had a mean value of 3.224, a minimum value of 0, and a maximum value of 7.368. These data indicated a significant difference in the progress of digital transformation among different firms, and some firms have not even carried out digital transformation yet. The samples had good differentiation.

Table 2. Descriptive statistics.

Variable	N	Mean	SD	Min	Max
Power	24,361	1.270	0.207	0.211	2.981
Digital	24,361	3.224	1.246	0	7.368
Size	24,361	22.17	1.328	15.38	28.64
Roa	24,361	0.0370	0.124	−3.164	10.40
Top	24,361	34.92	14.95	2.197	89.99
Lev	24,361	0.447	0.210	0.00700	1
Fix	24,361	0.227	0.157	0	0.929

4.2. Regression Results and Analysis

Digital transformation will impact corporate market power, while companies will proactively embrace digital technologies and undergo digital transformation to improve their market power. As a result, market power and digital transformation may be mutually causally related. The following two instrumental variables were chosen to evaluate the results of this paper to alleviate endogeneity problems.

(1) We referred to Li et al. [6] and chose a one-period lagged digital transformation index to replace the current period value for 2SLS estimation. The instrumental variable satisfies the requirement of exogeneity because the current period's corporate market power does not affect the digital transformation in the previous period. At the same time, digital transformation takes a long time to accumulate, and the digital transformation of the lagged period is correlated with the current period. Therefore, the instrumental variables satisfy the requirement of correlation. The regression results are displayed in column (1) of Table 3. The results showed that the Anderson canon. corr. LM statistic had a *p*-value of 0, indicating that there was no problem of under-identification of the instrumental variables. The value of the Cragg–Donald–Wald F statistic was also greater than the stock-Yogo's critical value of 16.38, indicating that there was no problem of weak instrumental variables. The explanatory variables were positive, indicating that the digital

transformation significantly increased the market power, and the conclusions of this paper remained robust.

(2) Mail was the main form of communication for people in the early days. To some extent, the number of post offices influenced access to digital technologies, subsequently affecting the popularity and development of digital technologies. However, the number of post offices minimally impacts corporate market power currently. In this paper, the number of post offices per million people in each province in 1984 was chosen as the instrumental variable to satisfy both the requirement of exclusivity and the requirement of relevance. In addition, we constructed the interaction term between the number of post offices per million people in 1984 and the IT services in the previous year for each province as the second instrumental variable in this paper, drawing on Nunn and Qian [29]. The regression results are shown in Column (2) of Table 3. The results showed that the Anderson canon. corr. LM statistic had a *p*-value of 0, indicating that there was no problem of under-identification of the instrumental variables. The value of the Cragg–Donald–Wald F statistic was also greater than the stock-Yogo's critical value of 16.38, indicating that there was no problem of weak instrumental variables. The core explanatory variable was positive, fully consistent with the previous results.

Table 3. Impact of digital transformation on market power.

	(3)	(4)
	IV1	IV2
Digital	0.006 **	0.074 **
	(0.003)	(0.030)
Size	−0.019 ***	−0.032 ***
	(0.002)	(0.006)
Roa	−0.056 ***	−0.070 ***
	(0.010)	(0.013)
Top	0.000 ***	0.000
	(0.000)	(0.000)
Lev	−0.079 ***	−0.081 ***
	(0.007)	(0.013)
Fix	0.368 ***	0.346 ***
	(0.010)	(0.014)
_cons		
N	21,147	19,931
R^2	0.305	0.133

Note: *** and ** respectively represent statistical significance at the 1% and 5% levels.

4.3. Intrinsic Mechanisms of Digital Transformation Affecting Market Power: Firm Boundaries

The previous empirical results revealed that digital transformation increases corporate market power. However, it is unclear through which channels digital transformation affects market power. Therefore, this paper adopted the stepwise regression method to test the channels of influence of digital transformation on firms' market power.

4.3.1. Digital Transformation Promotes M&A for External Expansion

To test whether M&A is a channel through which digital transformation affects market power, this paper adopted the number of M&As as a measure of corporate M&A activity and runs regressions. The results in Column (1) and Column (2) of Table 4 indicate that digital transformation promotes the occurrence of the outbound M&A activities of enterprises. Theoretically, digital transformation provides companies with new resource elements, namely data and information. The rapid flow of data and information helps firms to respond positively to market demand and effectively integrate external market resources, which drives productivity gains and stock prices and promotes the occurrence of M&A activities. Digital transformation's impact on corporate M&A was, thus, confirmed.

Table 4. Mechanism analysis.

	(1)	(2)	(3)	(4)
	MA	**Power**	**Subsidiary**	**Power**
Digital	0.047 ***	0.050 ***	0.041 ***	0.028 ***
	(0.016)	(0.001)	(0.006)	(0.001)
MA		0.004 ***		
		(0.001)		
Subsidiary				0.019 ***
				(0.001)
Size	0.298 ***	−0.025 ***	0.374 ***	0.017 ***
	(0.027)	(0.001)	(0.010)	(0.002)
Roa	0.476 **	−0.284 ***	−0.277 ***	−0.267 ***
	(0.238)	(0.022)	(0.094)	(0.016)
Top	−0.017 ***	−0.000 ***	0.004 ***	−0.001 ***
	(0.002)	(0.000)	(0.001)	(0.000)
Lev	0.150	−0.267 ***	0.268 ***	−0.145 ***
	(0.110)	(0.007)	(0.043)	(0.007)
Fix	0.032	0.334 ***	0.116 **	0.337 ***
	(0.141)	(0.009)	(0.057)	(0.010)
_cons	−5.226 ***	1.726 ***	−6.582 ***	0.792 ***
	(0.576)	(0.022)	(0.224)	(0.036)
N	23,550	23,719	24,195	24,195
R^2	0.325	0.295	0.818	0.781

Note: *** and ** respectively represent statistical significance at the 1% and 5% levels.

The synergism and scope economy effects of M&A increase firms' market power. Previous studies have confirmed this view [30,31]. The synergism is specifically reflected in that firms can reduce the cost of opening new markets, improve the industrial chain layout, and increase their market share and market power through M&A. In addition, the scope economy effect of M&A is also conducive to improving market power. The scope economy effect of M&A refers to the expansion of business operations. Business expansion is reflected in the increased number and variety of products. The increase in product quantity means that the firm's market share is encroached upon by other firms, which further squeezes the survival space of other firms and increases the market power [32]. The increase in the variety of products enhances the overall bargaining power of the firm's products. The increase in bargaining power enhances the firm's monopoly and market power. From the above analysis, it is clear that M&A does lead to increased market power. Therefore, the hypothesis that digital transformation increases market power by promoting outbound M&A was confirmed.

4.3.2. Digital Transformation Promotes the Establishment of Subsidiaries for Internal Growth

To verify whether establishing subsidiaries is a channel through which digital transformation affects market power, this paper used the number of subsidiaries to measure mediating variables and performed regression analysis. The results in Column (3) and Column (4) of Table 4 show that digital transformation motivates firms to establish subsidiaries. Theoretically, the technological advantage of digital transformation effectively reduces the communication cost and information asymmetry between the parent company and the subsidiary. Besides, the new changes brought by digital transformation amplify the role of subsidiaries with respect to the parent company. As a result, companies are more motivated to set up subsidiaries under the influence of digital transformation. The impact of digital transformation on the establishment of subsidiaries by companies was, thus, confirmed.

Regarding how establishing subsidiaries affects market power, this paper examined its impact on market power in terms of the motivation for setting up subsidiaries. There

are two main reasons to establish subsidiaries. One is to divest the firm's original assets from poor businesses [33]; the other is business expansion [34]. However, regardless of the reason for setting up a subsidiary, establishing subsidiaries increases market power for the firm. On the one hand, by divesting troubled or underperforming businesses, companies can increase their core businesses' competitiveness and market power by divesting them of a steady flow of capital to their core businesses. On the other hand, business expansion inherently represents increased corporate market power. In addition, if a subsidiary is established due to business expansion, the subsidiary can use the parent company's original resources and experience to dominate in new business areas. The size of the parent firm will likewise grow when the subsidiary's size increases, increasing the firm's market monopoly and market power. From the above analysis, it can be seen that establishing subsidiaries increases corporate market power. Therefore, the hypothesis that digital transformation increases market power through the establishment of subsidiaries internally was confirmed.

5. Discussion and Conclusions

5.1. Discussion

Accelerating the realization of economic and social informatization, digitalization and intelligence have become a global development consensus. However, the "head effect" in various industries has become increasingly obvious in the digital era. Therefore, has digital transformation increased or decreased the market power of enterprises? The answer to this question will help enterprises understand digital transformation's economic effects and promote the optimization and adjustment of market structure. In this background, this paper innovatively constructed a digital transformation lexicon based on the objectives and common features of digital transformation. It used machine learning to obtain the digital transformation index by counting the frequency of words in their annual reports. Then, this paper empirically analyzed the effect of digital transformation on market power and further investigated its mechanism of action.

However, there are still some shortcomings in this paper. As the data were limited to availability, digital transformation's influence on the market power was solely examined in this research using information from publicly traded corporations. However, listed companies are normally large, so there may be some problems of sample selectivity. Therefore, the findings of this paper do not necessarily apply to small- and medium-sized enterprises. Regarding indicator construction, the digital transformation index used in this paper was indirectly obtained from the annual reports of listed companies through text analysis. Despite the measurement method being further optimized based on the previous work, there may still be some errors. In the future, we will enrich the sample data as much as possible. We will further innovate the measurement method to more accurately measure digital transformation. We will also expand the content of the study to provide more empirical evidence for industrial organizational change under digital transformation.

5.2. Conclusions

The findings of this paper were as follows. First, digital transformation increases market power. The findings of this paper remained robust after performing robustness and endogeneity treatments. Second, we found that outward M&A and inward establishment of subsidiaries are two important ways digital transformation affects a firm's market power through mechanism analysis. Based on the above findings, this paper obtained the following insights: Digital transformation is increasingly disruptive to traditional enterprises. Therefore, enterprises should seize the opportunity and surge in the digital wave. Enterprises should lay out digital transformation strategies oriented toward business transformation, accelerate the formation of their required digital capabilities, and realize the transformation of business models as soon as possible. Furthermore, governments are expected to focus closely on the market effects of digital transformation and guide enterprises in digital transformation while preventing the disorderly expansion of capital, improving market regulation, and facilitating high-quality economic development.

References

1. Sembenelli, A.; Siotis, G. Foreign Direct Investment and Mark-up Dynamics: Evidence from Spanish Firms. *J. Int. Econ.* **2008**, *76*, 107–115. [CrossRef]
2. Toolsema-Veldman, L. Monetary Policy and Market Power in Banking. *Economics* **2004**, *83*, 71–83. [CrossRef]
3. Cole, M.T.; Eckel, C. Tariffs and Markups in Retailing. *J. Int. Econ.* **2018**, *113*, 139–153. [CrossRef]
4. Mukherjee, S.; Chanda, R. Tariff Liberalization and Firm-Level Markups in Indian Manufacturing. *Econ. Model.* **2021**, *103*, 105594. [CrossRef]
5. Stiebale, J.; Vencappa, D. Acquisitions, Markups, Efficiency, and Product Quality: Evidence from India. *J. Int. Econ.* **2018**, *112*, 70–87. [CrossRef]
6. Li, C.; Xu, Y.; Zheng, H.; Wang, Z.; Han, H.; Zeng, L. Artificial Intelligence, Resource Reallocation, and Corporate Innovation Efficiency: Evidence from China's Listed Companies. *Resour. Policy* **2023**, *81*, 103324. [CrossRef]
7. Vial, G. Understanding Digital Transformation: A Review and a Research Agenda. *J. Strateg. Inf. Syst.* **2019**, *28*, 118–144. [CrossRef]
8. Jiang, K.; Du, X.; Chen, Z. Firms' Digitalization and Stock Price Crash Risk. *Int. Rev. Financ. Anal.* **2022**, *82*, 102196. [CrossRef]
9. Nagle, F.; Seamans, R.; Tadelis, S. Transaction Cost Economics in the Digital Economy: A Research Agenda. *SSRN Electron. J.* **2020**. [CrossRef]
10. Hao, X.; Wen, S.; Xue, Y.; Wu, H.; Hao, Y. How to Improve Environment, Resources and Economic Efficiency in the Digital Era? *Resour. Policy* **2023**, *80*, 103198. [CrossRef]
11. Rammer, C.; Fernández, G.P.; Czarnitzki, D. Artificial Intelligence and Industrial Innovation: Evidence from German Firm-Level Data. *Res. Policy* **2022**, *51*, 104555. [CrossRef]
12. Liu, Y.; Dong, J.; Mei, L.; Shen, R. Digital Innovation and Performance of Manufacturing Firms: An Affordance Perspective. *Technovation* **2022**, *119*, 102458. [CrossRef]
13. Harford, J. What Drives Merger Waves? *J. Financ. Econ.* **2005**, *77*, 529–560. [CrossRef]
14. Maksimovic, V.; Phillips, G.; Yang, L. Private and Public Merger Waves. *J. Financ.* **2013**, *68*, 2177–2217. [CrossRef]
15. Ardolino, M.; Rapaccini, M.; Saccani, N.; Gaiardelli, P.; Crespi, G.; Ruggeri, C. The Role of Digital Technologies for the Service Transformation of Industrial Companies. *Int. J. Prod. Res.* **2017**, *56*, 2116–2132. [CrossRef]
16. Shleifer, A.; Vishny, R.W. Stock Market Driven Acquisitions. *SSRN Electron. J. Financ. Econ.* **2001**, *70*, 295–311. [CrossRef]
17. Vahlne, J.-E.; Schweizer, R.; Johanson, J. Overcoming the Liability of Outsidership—The Challenge of HQ of the Global Firm. *J. Int. Manag.* **2012**, *18*, 224–232. [CrossRef]
18. Bloom, N.; Garicano, L.; Sadun, R.; Van Reenen, J. The Distinct Effects of Information Technology and Communication Technology on Firm Organization. *Manag. Sci.* **2014**, *60*, 2859–2885. [CrossRef]
19. Makridakis, S. The Forthcoming Artificial Intelligence (AI) Revolution: Its Impact on Society and Firms. *Futures* **2017**, *90*, 46–60. [CrossRef]
20. Matarazzo, M.; Penco, L.; Profumo, G.; Quaglia, R. Digital Transformation and Customer Value Creation in Made in Italy SMEs: A Dynamic Capabilities Perspective. *J. Bus. Res.* **2021**, *123*, 642–656. [CrossRef]
21. Foster, L.; Haltiwanger, J.C.; Syverson, C. The Slow Growth of New Plants: Learning about Demand? *SSRN Electron. J.* **2012**, *83*, 91–129. [CrossRef]
22. Hottman, C.J.; Redding, S.J.; Weinstein, D.E. Quantifying the Sources of Firm Heterogeneity. *Q. J. Econ.* **2016**, *131*, 1291–1364. [CrossRef]
23. Zhou, K.Z.; Gao, G.Y.; Zhao, H. State Ownership and Firm Innovation in China: An Integrated View of Institutional and Efficiency Logics. *Adm. Sci. Q.* **2016**, *62*, 375–404. [CrossRef]
24. Ran, Q.; Yang, X.; Yan, H.; Xu, Y.; Cao, J. Natural Resource Consumption and Industrial Green Transformation: Does the Digital Economy Matter? *Resour. Policy* **2023**, *81*, 103396. [CrossRef]
25. Wu, D.; Xie, Y.; Lyu, S. Disentangling the Complex Impacts of Urban Digital Transformation and Environmental Pollution: Evidence from Smart City Pilots in China. *Sustain. Cities Soc.* **2022**, *88*, 104266. [CrossRef]
26. Cheng, Y.; Zhou, X.; Li, Y. The Effect of Digital Transformation on Real Economy Enterprises' Total Factor Productivity. *Int. Rev. Econ. Financ.* **2023**, *85*, 488–501. [CrossRef]

27. Chen, P.; Kim, S. The Impact of Digital Transformation on Innovation Performance—the Mediating Role of Innovation Factors. *Heliyon* **2023**, *9*, e13916. [CrossRef]
28. Li, C.; He, S.; Tian, Y.; Sun, S.; Ning, L. Does the Bank's FinTech Innovation Reduce Its Risk-Taking? Evidence from China's Banking Industry. *J. Innov. Knowl.* **2022**, *7*, 100219. [CrossRef]
29. Nunn, N.; Qian, N. US Food Aid and Civil Conflict. *Am. Econ. Rev.* **2014**, *104*, 1630–1666. [CrossRef]
30. Nocke, V.; Yeaple, S. An Assignment Theory of Foreign Direct Investment. *Rev. Econ. Stud.* **2008**, *75*, 529–557. [CrossRef]
31. Blonigen, B.A.; Pierce, J.R. Evidence for the Effects of Mergers on Market Power and Efficiency. *SSRN Electron. J.* **2016**. [CrossRef]
32. Neary, J.P. Cross-Border Mergers as Instruments of Comparative Advantage. *Rev. Econ. Stud.* **2007**, *74*, 1229–1257. [CrossRef]
33. Berry, H. When Do Firms Divest Foreign Operations? *Organ. Sci.* **2013**, *24*, 246–261. [CrossRef]
34. Lu, J.W.; Xu, D. Growth and Survival of International Joint Ventures: An External-Internal Legitimacy Perspective. *J. Manag.* **2006**, *32*, 426–448. [CrossRef]