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Digital Transformation and Marketing Capability: The Moderating Role of Digital Marketing

Jingyu Xiong

Shanghai Ocean University, Shanghai, China
3562210342@qq.com

Abstract. Based on the resource-based view and contingency theory, this study investigates the impact of digital transformation on corporate marketing capabilities and examines the moderating role of digital marketing. Using a sample of Chinese A-share listed companies from 2016 to 2024, the empirical analysis reveals that digital transformation significantly enhances marketing capabilities, while digital marketing further strengthens the causal relationship between them. Heterogeneity analysis shows that these effects vary across firms at different life cycle stages and with different pollution attributes. This study extends existing research on the microeconomic consequences of digital transformation and provides practical insights for firms in converting digital resources into competitive advantages in marketing.

Keywords: digital transformation, marketing capability, digital marketing, moderating effect

1. Introduction

Digital technology is reshaping how businesses operate and behave in the market, making digital transformation increasingly important for enterprises. Companies are investing heavily in building digital infrastructure and developing technical capabilities, yet digital initiatives do not always translate into improved market performance [1]. Therefore, this gives rise to a critical research question concerning whether digital transformation improves firms' marketing capability.

Existing research has confirmed that digital transformation can bring numerous economic outcomes, including enhanced enterprise innovation, operational efficiency, and business performance [2]. However, the current research on how digital transformation affects an enterprise's marketing capabilities is still relatively limited. Most literature regards marketing capabilities as the result of the joint influence of other organizational and market factors, and pays less attention to the potential driving factor of digital transformation. Therefore, the relationship between digital transformation and marketing capabilities has not been fully explored. Moreover, the conclusions drawn from current empirical studies often ignore the heterogeneity of enterprises, and tend to be uniform across different types of enterprise groups [3].

The resource-based view provides a theoretical basis for the connection between digital transformation and an enterprise's marketing capabilities. Digital transformation can create valuable intangible resources, enhancing an enterprise's ability to process information, identify market opportunities, and allocate resources [4]. Such capabilities can strengthen the marketing activities of

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enterprises and thereby enhance their marketing efficiency. The contingency theory further indicates that the value that organizational resources can bring about is influenced by external environmental conditions [5].

This paper, based on the data of Chinese listed companies from 2016 to 2024, explores the impact of digital transformation on the marketing capabilities of enterprises. Firstly, this study examines the digital-driven marketing performance from the perspective of enterprise capabilities, providing new empirical evidence for research in the field of digital economy. Secondly, through the analysis of moderating effects, the study views digital marketing as a boundary condition, clarifying the situations where the effect of digital transformation is more significant. Finally, based on the enterprise life cycle and the characteristics of polluting industries, heterogeneity tests are conducted to further reveal the differences in the above relationship among different enterprise groups.

2. Research hypothesis

Digital transformation enables firms to deploy digital technologies across operational processes, which accumulates unique digital resources and improves internal resource allocation efficiency. The digital transformation of enterprises reshapes the information processing mechanism, enhancing their ability to identify market signals and consumer demands. According to the resource-based view, these digital resources constitute strategic assets that can be used to support marketing activities. Marketing capabilities rely on effective information acquisition and resource integration to achieve market performance [6]. As digital transformation improves information collection and resource coordination, it is expected to yield greater marketing capability.

H1: Digital transformation significantly promotes corporate marketing capability.

Although digital transformation provides a technological foundation for enhancing marketing capabilities, its actual impact on marketing capabilities varies among different enterprises. The effectiveness of organizational practices depends on the degree of match between the practice methods and the contextual conditions [5]. Digital marketing capability acts as a critical contextual factor governing whether digital resources can be fully transformed into marketing outputs. Firms endowed with stronger digital marketing capability are better able to activate digital infrastructure, optimize customer communication and allocate marketing resources. As a result, the positive association between digital transformation and marketing capability should be amplified when digital marketing capability is high.

H2: Digital marketing capability strengthens the positive association between digital transformation and corporate marketing capability.

3. Research design

3.1. Sample and data

This research selects Chinese A-share listed corporations over 2016–2024 as the analytical sample. All variables are sourced from the CSMAR database and the annual reports of listed companies. Consistent with conventional empirical practices, this paper eliminates ST and *ST labeled firms, financial sector enterprises, as well as observations suffering from missing values. The resultant final sample comprises 15,741 firm-year observations.

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3.2. Variable and empirical model

3.2.1. Dependent variable: Markcap (CMkt)

Firm-level marketing capability is measured using a stochastic frontier production function. Specifically, sales revenue is treated as the output, while selling expenses (XS), general and administrative expenses (XGA), accounts receivable (RECT), customer base (IBC), and intangible assets (INTA) are treated as marketing-related inputs. The Cobb–Douglas stochastic frontier is specified as follows:

$$lnSales_{it} = \beta_0 + \beta_1 lnXS_{it} + \beta_2 lnXGA_{it} + \beta_3 lnRECT_{it} \quad (1)$$

$$+\beta_4 lnIBC_{it} + \beta_5 lnINTA_{it} + \varepsilon_{it} - u_i$$

where ε_{it} is the random error term and $u_i \geq 0$ captures firm i's marketing inefficiency, representing the distance between actual sales and the sales frontier. Marketing capability is then calculated as:

$$\mathrm{Cmkt_i} = \exp(-\mathrm{u_i}) \quad (2)$$

A higher Cmkt indicates stronger marketing capability. $\mathrm{IBC_{it}}$ is measured as $\mathrm{Sales_{i,t-1}} \times \mathrm{Sales_{i,t-2}}$. Given the relatively short sample period, we adopt a time-invariant specification in which marketing inefficiency does not vary across years.

3.2.2. Independent variable: degree of corporate digital transformation (Digitaltrans)

The data related to enterprise digital transformation adopts the calculation method based on text mining from the existing literature [7]. In this study, the annual report text information of A-share listed companies was extracted, and relying on the digital technology keyword dictionary, the keyword frequency statistics were conducted for each enterprise - annual observation value. The aggregated keyword frequencies were used to construct a comprehensive index, which reflects the degree of enterprise digital transformation.

3.2.3. Moderating variable: digital marketing(MarketS)

Digital marketing data are obtained from corporate annual financial reports. Adopting the measurement approach proposed in existing studies [8], this variable reflects the extent of firms' engagement in digital-oriented marketing initiatives. It gauges firms' digital-driven marketing investment and practices extracted from textual information disclosed in corporate financial statements.

3.2.4. Control variables

Following previous researches [6, 7], firm characteristics including firm size(Size), growth rate (Growth), return on assets (ROA), debt-to-asset ratio (Lev), firm age (FirmAge), cash flow (CashFlow), gross profit ratio (GrossProfit) and industry competition (HHI) are controlled in the model .

Empirical model

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$$\mathrm{CMkt}_{i,t} = \alpha_0 + \alpha_1 \mathrm{DigitalTrans}_{i,t} + \alpha_2 \mathrm{X}_{i,t} + \mathrm{Year} + \mathrm{Industry} + \varepsilon_{i,t} \quad (3)$$

$$CMkt_{i,t} = \beta_0 + \beta_1 DigitalTrans_{i,t} + \beta_2 MarketS_{i,t} + \beta_3 (DigitalTrans_{i,t} \times MarketS_{i,t}) \quad (4)$$
$$+ \beta_4 X_{i,t} + Year + Industry + \varepsilon_{i,t}$$

In equation (3) and (4), $\mathrm{CMkt}_{i,t}$ denotes the marketing capability of firm i in year t, $\mathrm{DigitalTrans}_{i,t}$ is the degree of corporate digital transformation. $\mathrm{MarketS}_{i,t}$ shows the level of firm-level digital marketing. The interaction term $\mathrm{DigitalTrans}_{i,t} \times \mathrm{MarketS}_{i,t}$ is used to capture how digital marketing changes the effect of digital transformation on marketing capability. $\mathrm{X}_{i,t}$ denotes the vector of control variables, while Year and Industry capture year- and industry-fixed effects. $\varepsilon_{i,t}$ is the error term.

3.3. Descriptive statistics

Table 1. Descriptive statistics

VARIABLES	N	mean	sd	min	max
Digitaltrans	15,741	0.121	0.247	0	1
Markcap	15,741	0.0989	0.0535	0.0393	0.458
Size	15,741	22.37	1.349	19.80	26.45
Lev	15,741	0.418	0.199	0.0487	0.908
ROA	15,741	0.0302	0.0730	-0.556	0.222
GrossProfit	15,741	0.300	0.180	-0.0636	0.871
CashFlow	15,741	0.0491	0.0668	-0.194	0.267
Growth	15,741	0.140	0.385	-0.673	4.728
FirmAge	15,741	3.032	0.277	1.792	4.190
HHI	15,741	0.0786	0.0879	0.0130	0.667

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1 presents the descriptive statistics of the core variables. The mean value of Digitaltrans is 0.121, with a standard deviation of 0.247, indicating that the overall level of digital transformation in enterprises is relatively low and there are significant differences among enterprises. The mean value of Markcap is 0.0989, with a range of 0.0393 to 0.458.

4. Empirical results

4.1. Baseline regression

Table 2 presents the baseline estimates. The specification in Column (1) is estimated with Digitaltrans plus year and industry fixed effects only, and the model in Column (2) is further augmented with the control set. Digitaltrans coefficients are 0.0004 (Column 1) and 0.0005 (Column 2), both significant at 1 %, verifying H1 that digital transformation boosts marketing capability.

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Column (3) introduces MarketS and Digitaltrans×MarketS; the positive interaction coefficient 0.0449 ($p<0.1$) confirms the moderating effect and supports H2.

Table 2. Baseline regression and moderating effect analysis

	(1) Markcap	(2) Markcap	(3) Markcap
Digitaltrans	0.0004***	0.0005***	0.1002***
	(20.6763)	(21.3061)	(18.2544)
DigitaltransXMarketS			0.0449*
			(1.8051)
MarketS			-0.0084***
			(-3.2939)
Controls	No	Yes	Yes
Year fe	Yes	Yes	Yes
Industry fe	Yes	Yes	Yes
N	15741	15741	15741
r2_a	0.2545	0.2755	0.2771

4.2. Heterogeneity analysis

4.2.1. Firm life-cycle attributes

Firms' resources and strategies vary across life cycles, moderating digital transformation's marketing effect [9]. Table 3 reports significant positive results for all groups: growth coef.=0.0954 ($p<0.01$), maturity coef.=0.0779 ($p<0.01$), decline coef.=0.1308 ($p<0.01$). The effect is strongest for declining firms aiming to reverse operations.

4.2.2. Pollution attributes

Heavily-polluting firms bear high environmental compliance costs that crowd out digital marketing resources [10]. Table 3 Column (4) finds an insignificant digital transformation effect for these firms, while Column (5) identifies a significant positive effect for low-pollution firms (coef.=0.1091, $p<0.01$). Low-pollution firms gain more marketing benefits from digital transformation. Strict environmental rules crowd out heavy polluters' digital marketing resources.

Table 3. Heterogeneity analysis

	(1) Growth	(2) Matuity	(3) Decline	(4) Heavy-polluting	(5) Low-polluting
Digitaltrans	0.0954***	0.0779***	0.1308***	0.0143	0.1091***
	(14.7447)	(5.9467)	(14.2486)	(1.3949)	(21.4290)
Controls	Yes	Yes	Yes	Yes	Yes

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Table 3. (continued)

_cons	0.0572***	0.0375	0.0788***	0.0201**	0.0688***
	(5.7825)	(1.1730)	(3.5433)	(2.5349)	(6.6100)
Year fe	Yes	Yes	Yes	Yes	Yes
Industry fe	Yes	Yes	Yes	Yes	Yes
N	10586	1586	3497	3101	12640
r2_a	0.2687	0.2108	0.3078	0.5199	0.2753

4.3. Robustness tests

4.3.1. Instrumental variable (IV) method

This study relies on a 2SLS instrumental-variable strategy to handle endogeneity concerns arising to mitigate concerns about reverse causation and unobserved confounders. The industry-year average value of digital transformation (mean_digital) is constructed as the instrumental variable [7]. The first-stage regression reveals a significant positive association between the instrumental variable and Digitaltrans (coef.=0.0005, $p<0.01$). In the second-stage estimation, digital transformation still exerts a significantly positive effect on marketing capability (coef.=0.0994, $p<0.01$). The Kleibergen–Paap rk LM statistic equals 146.048 ($p<0.001$), which permits us to reject the null hypothesis of underidentification. The corresponding rk Wald F statistic is 179.411, comfortably exceeding the Stock–Yogo critical values, so weak instruments do not appear to be a concern in our estimation.

4.3.2. An alternative measure of digital transformation

I employ Digital_abs, the natural logarithm of digital-related intangible assets, as an alternative proxy for digital transformation [7]. As reported in Table 4 Column (3), the core variable remains significantly positive (coef.=0.1055, $p<0.01$), which is consistent with the baseline outcome.

4.3.3. Adding additional control variables

Four additional corporate governance variables including Dual, Indep, Board, and TobinQ are incorporated into the benchmark model to account for governance-related confounding factors. In Column (4) of Table 4, digital transformation still enters with a significantly positive yelds (coef.=0.0976, $p<0.01$), leaving the core finding unchanged.

4.3.4. Adding firm fixed effects

After further controlling for firm-level fixed effects to absorb time-invariant firm heterogeneity, the regression result is displayed in Table 4 Column (5). Digital transformation still yields a significant positive coefficient (coef.=0.1055, $p<0.01$). Across all robustness checks, the core finding remains stable.

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Table 4. Robustness tests

	(1)	(2)	(3)	(4)	(5)
	2SLS Stage 1	2SLS Stage 2			
	Digitaltrans	Markcap	Markcap	Markcap	Markcap
Digitaltrans		0.0994***		0.0976***	0.1055***
		(37.4259)		(5.3321)	(21.0639)
mean-digital	0.9870***				
	(47.5434)				
Digital_abs			0.0005***		
			(11.5168)		
Controls	Yes	Yes	Yes	Yes	Yes
_cons	0.3188***	0.0542	0.1111***	0.0657***	0.0860***
	(9.0839)	(1.3868)	(11.2253)	(5.9550)	(7.5951)
Year/Industry FE	Yes	Yes	Yes	Yes	Yes
N	15741	15741	15740	15741	15299
r2_a	0.3186	-0.0804	0.1150	0.2747	0.2769

5. Conclusion and Implication

This study finds that digital transformation significantly improves firms' marketing capability, and digital marketing capability strengthens this effect. The results remain robust across alternative measures, instrumental-variable estimation, additional controls, and firm fixed effects. The effect also varies across firm life-cycle stages and pollution levels.

These findings extend research on digital transformation by linking it to marketing capability. They also suggest that firms should develop digital marketing capabilities alongside digital transformation to better convert digital resources into marketing outcomes

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