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How Does Corporate Digital Transformation Influence Family Control: Resource Constraint or Governance Enhancement?

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Abstract

For family firms operating within the digital economy, aligning digital transformation (DT) with governance reform is critical, as this synergy strengthens competitive positioning through improved organizational adaptability. Drawing on resource dependence theory and agency theory, this paper explores how corporate DT shapes family control using a sample of Chinese A-share listed family enterprises from 2008 to 2022. The study reveals the following. (1) corporate DT has a negative effect on family control. Distinguishing between foundational and application-level DT, our results reveal that the depth of underlying digital technology is negatively and significantly correlated with family control, while the coefficient on practical digital applications is statistically insignificant. This finding holds across robustness checks. (2) The analysis of resource constraint effects shows that when family firms are faced with more serious family human capital and financial capital constraints, the negative impact of DT and digital underlying technology on family control is more significant. (3) Evidence regarding the governance-enhancing effect reveals that, among enterprises with greater agency costs, DT mitigates internal information asymmetry and improves internal control quality, which raises families' willingness to decrease their control intensity. This suggests that enterprise DT negatively affects family control through both resource constraint and governance enhancement effects. This study contributes novel understandings of the consequences of DT in family firms and offers important practical implications for corporate governance.

Keywords: *DT, Family Control, Resource Constraint, Governance Enhancement*

JEL Classification: D21, G30

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1 INTRODUCTION

Notable examples of firms adopting chief data officer (CDO) roles include global industry leaders such as Burberry, L'Oréal, McDonald's, Pfizer, and Starbucks, which have reported significant improvements in financial performance (Nie et al., 2019). Amid the global wave of digital transformation (DT), enterprises around the world actively introduce strategic investors (Du et al., 2024) and appoint CDOs to their executive teams (Singh et al., 2020). These initiatives enable firms to leverage digital technologies to boost operational performance and maintain long-term competitiveness, and have profoundly reshaped organizational governance structures. Given that family firms account for a substantial share of the global economy and

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contribute approximately 60% of China's GDP (Xie et al., 2023), exploring how DT drives shifts in the governance structures of family firms constitutes a vital research topic.

Conventional wisdom posits that family governance is often outdated and inefficient, leading to rigid, conservative, and resistant internal structures (König et al., 2013). Human and financial capital provided by family networks constitutes a vital resource for new ventures. Nevertheless, as firms expand, resource constraints stemming from family ownership create substantial obstacles to family firm growth (Chauhan et al., 2024; Staniewski et al., 2025). Against the backdrop of global efforts to develop the digital economy centered on DT, digital technologies have been widely adopted within traditional firms to foster innovation. This process enhances scalability, broadens market reach, and accelerates strategic execution (Iansiti & Lakhani, 2020; Saura & Bužinskienė, 2025; Zhu et al., 2025). Such transformation requires heavy capital outlays, involves considerable technological complexity, and features uncertain return cycles (Hanelt et al., 2021). Family firms suffering severe resource constraints struggle to rely on internal funds to fully implement digital strategies. An important question therefore emerges: will family-controlled governance models, which rely on resource mobilization and power allocation based on kinship and blood ties, evolve to adapt to market competition and sustain long-term growth? This question remains timely and worthy of rigorous academic inquiry.

Most existing studies treat family control as an antecedent variable to investigate its influence on DT. Prior research indicates that family governance shapes firms' resource endowments, capabilities and risk preferences, thereby affecting the implementation of DT strategies (Appleton et al., 2024; Ceipek et al., 2021a; Soluk et al., 2021). Nevertheless, how DT influences family control remains underexplored. Historically, the evolution of organizational governance models has often accompanied advances in technology. As DT reshapes products and operational processes, firms need to deploy core digital technologies to overhaul legacy technical systems and governance architectures (Westerman, 2016). Digital technology has thus become indispensable for corporate growth, demanding corresponding adjustments to corporate governance structures. While several studies have examined how corporate DT affects corporate governance, few focus specifically on representative samples of family-owned firms. Singh et al. (2020) find that companies increasingly appoint CDOs to their top management teams. Jiang et al. (2022) argue that enhanced information sharing strengthens internal controls, improves monitoring mechanisms, and curbs managerial discretionary behaviors.

This study finds that DT influences family control via two primary mechanisms: the resource constraint effect and the governance enhancement effect. The resource constraint effect suggests that advancing DT requires continuous investment in digital know-how and capital. Owing to their unique family governance arrangements, family firms often face constraints in accessing the financial, managerial and technological resources needed for transformation (Sirmon et al., 2008). Such resource pressure may drive controlling families to scale back family control so as to acquire vital external resources for digital initiatives. The governance enhancement effect indicates that DT improves organizational information transparency, restrains executive discretionary power, and mitigates agency costs arising from managerial self-serving behavior, rent-seeking and resource misallocation (Chen et al., 2024; Fang et al., 2023; Riaz et al., 2022). It also helps standardize controlling families' supervision over non-family executives. Improvements in internal governance thereby create conditions under which controlling families are willing to reduce family control.

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Using a sample of China's A-share listed family enterprises spanning 2008 to 2022, this paper analyzes how DT affects family control and explores the underlying mechanisms. This study makes contributions to existing literature along three dimensions. First, it extends research concerning the consequences of DT within family firms. Extant scholarship mainly identifies determinants of DT in family businesses yet largely neglects how DT shapes family governance structures. The paper finds that DT exerts a negative influence on family control, thereby expanding our understanding of how technological change affects corporate governance.

Second, this study draws on agency theory and resource dependence theory to analyze how DT shapes family control, enabling a more comprehensive understanding of challenges confronting family governance in the digital era. Most existing studies adopt the socio-emotional wealth (SEW) framework to investigate how family governance influences digital transformation (Ceipek et al., 2021a; Du et al., 2024). Whereas SEW theory highlights controlling families' incentives to preserve non-financial endowments, agency and resource dependence perspectives clarify the conditions under which these incentives are strengthened or weakened. This study finds that DT affects family control primarily for firms with high agency costs and severe constraints on financial and human capital. The evidence confirms that DT shapes family control via governance and resource channels. Accordingly, this paper extends the explanatory framework beyond the SEW lens to explain heterogeneous responses across family firms engaged in DT.

Third, by decomposing DT into two categories—underlying digital technology and digital technology applications—this study illustrates that DT represents a complex and evolving strategic choice. The findings reveal that foundational digital technologies such as artificial intelligence, blockchain, cloud computing and big data exert a stronger influence on family control than application-oriented digital technologies. Since deploying such underlying technologies demands substantial inputs of technological know-how, expertise and capital from family firms, controlling families are incentivized to adjust family control accordingly.

2 THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

2.1 CORPORATE DT AND FAMILY CONTROL

Prior research suggests that family firms risk undermining their competitive advantages as they scale up, unless they concurrently professionalize governance structures and enhance managerial capabilities (Fang et al., 2025). The digital economy—characterized by rapid iteration, knowledge intensity, and platform-based competition—places a premium on professional management. Nevertheless, path dependence, insider talent exclusion and entrenchment effects embedded in family control substantially limit organizational adaptability (Bennedsen et al., 2007), leaving these firms susceptible to intensified competition within the digital landscape. Although DT provides an important channel to revitalize competitive strengths (He et al., 2025), its full potential hinges on governance arrangements that accommodate strategic reorientation and actively advance transformation implementation. Such alignment is essential to nurture a co-evolutionary "transformation–governance" dynamic, enabling family firms to attain sustained competitive growth in the digital era.

Prior research on family firm governance has largely developed along two broad strands: institutional and market factors (Griffin et al., 2018; La Porta et al., 1999). From the institutional perspective, formal institutions such as legal systems, as well as informal institutions including culture, religion, and customs, exert significant influences. The market perspective, by contrast,

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focuses on competitive pressures and growth demands. A shared premise underpinning these studies is that technology is treated as exogenous, causing scholars to overlook its function as a core driver of governance evolution (Jin & Zhang, 2018).

Since the widespread adoption of information technology (IT) by firms in the 1980s, scholars have stressed that enterprises need to build appropriate management and authority allocation frameworks to cope with costs and risks stemming from IT investments. Against this backdrop, the concept of IT governance emerged (Ho et al., 2010; Sambamurthy & Zmud, 1999). Researchers argue that IT investments must be matched with sound IT governance to drive business growth (Brynjolfsson & Hitt, 2000). The subsequent proliferation of digital technologies enables broader data and knowledge exchange and profoundly reshapes internal organizational arrangements concerning control, coordination, incentives and trust. These shifts pose new challenges to existing governance architectures, stimulating the development of theoretical frameworks for digital governance to advance DT (Hanisch et al., 2023).

Family firms are prevalent in China and have widely embraced DT (Liu & Wang, 2023). A white paper on China's digital economy development reports that China's digital economy reached 39.2 trillion yuan in 2020, accounting for 38.6% of national GDP. DT in family firms constitutes critical microfoundations for the development of China's digital economy. By deploying digital technologies to dismantle internal hierarchical barriers, DT improves cross-departmental collaboration and facilitates flatter, more decentralized organizational architectures (Cristo-Andrade et al., 2024; Verhoef et al., 2021). Such changes may weaken controlling families' exclusive information advantages and push governance structures to evolve from closed toward open models. DT requires firms to respond swiftly to market changes (Hernández-Perlines et al., 2024; Zhang et al., 2025). Accordingly, family-owned enterprises need to break away from ingrained family-based management and adopt professional arrangements such as agile organizations and digital supply chains, gradually scaling back family control. We therefore propose the following hypothesis:

H1: DT exerts a negative effect on the level of family control in family-owned firms.

2.2 RESOURCE CONSTRAINT EFFECTS OF ENTERPRISE DT

Resource dependence theory argues that firms obtain vital resources from external stakeholders, and such resources shape corporate development trajectories (Du & Luo, 2016). Financial resources, digital human capital and managerial capabilities constitute major obstacles for medium-sized enterprises (SMEs) pursuing DT (Horváth & Szabó, 2019), and these constraints are particularly salient within family firms. Excessive pursuit of family control may lead to inefficient resource allocation and hinder DT initiatives (Hao et al., 2025). Firms' competitive advantage increasingly relies on their capacity to implement digital strategies. To fully harness digital technologies, corporate governance is gradually shifting from a financial capital orientation toward an intellectual capital orientation (Bertani et al., 2021). Open collaboration acts as an important mechanism enabling family firms to overcome resource shortages and strengthen competitiveness (Audretsch et al., 2025). Faced with resource scarcity and the urgency of DT, family firms tend to reduce family control to secure essential transformative resources such as technology, talent and capital.

This study first examines how human capital constraints within family-dominated executive teams moderate the relationship between DT and family control. As DT advances, family firms tend to scale back family control to acquire digital technological expertise. Family members

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occupy dominant positions within the core executive teams. To preserve family authority, family managers often adopt conservative strategic stances even when DT promises economic benefits (Ceipek et al., 2021a; König et al., 2013). For family firms, the gains from DT reach beyond short-run professionalization and support long-term organizational survival (Bürgel & Hiebl, 2023). Bornhausen and Wulf (2024) argue that family businesses should welcome non-family executives and tap diverse resources such as external knowledge, technology and information to advance DT.

Research suggests that "de-familying" management helps firms access external professional managerial resources (Zhong et al., 2022). Executive teams bear responsibility for firms' core strategic decisions, and family members commonly hold key positions such as chairperson or general manager in family-owned enterprises. Long-tenured family executives suffer from strong organizational inertia, tend to underestimate the complexities of DT, and maintain inertial mindsets during transformation, which leads to disjointed and impractical digital initiatives (Hao et al., 2025). To properly resolve internal and external conflicts and improve resource utilization efficiency, firms need to recruit professional talent including CDOs and AI engineers to advance DT (Firk et al., 2021). We therefore posit the following hypothesis:

H2a: The negative effect of DT on family control is greater in firms with higher family human capital constraints.

This paper further examines the financial resource constraint effect among family firms. We argue that family enterprises tend to scale back family control to attract external capital for advancing DT. Family firms generally favor internal financing (Chrisman et al., 2015), a preference that may limit the availability of corporate financial resources (De Massis et al., 2018). Prior evidence indicates that ownership de-familying improves family firms' access to external capital (Zhong et al., 2022). Implementing DT generates considerable direct and indirect costs. Direct costs include spending on digital hardware, software and technical infrastructure, whereas indirect costs cover consulting, continuous training and technical maintenance required to operate digital systems (Ghobakhloo et al., 2022). Additional outlays consist of R&D investments targeting emerging technologies such as artificial intelligence algorithm development and blockchain applications, as well as pilot investments for small-scale digital scenarios (e.g., smart factory trials). Such undertakings carry inherent failure risks. Collectively, digital transformation demands large-scale, sustained financial inputs. To facilitate smooth DT progress, family firms under severe financial constraints have to secure funding via external debt, equity financing and other channels. We therefore posit the following hypotheses.

H2b: The negative effect of DT on family control is greater among firms with higher financial resource constraints.

2.3 GOVERNANCE ENHANCEMENT EFFECTS OF ENTERPRISE DT

Agency theory posits that the separation of ownership and control may lead managers to prioritize personal utility, which can trigger wasteful deployment of corporate resources and suboptimal investment decisions (Fama & Jensen, 1983). Under separated ownership and control, managers may exploit information asymmetries to divert corporate resources for private gains, generating agency costs. By contrast, family firms combine ownership and management, resulting in relatively mild agency conflicts (Villalonga & Amit, 2006). Recent research shows that DT improves firm-level information transparency, substantially curbs

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managerial discretion, and reduces agency costs stemming from managerial rent-seeking and inefficient resource allocation (Chen et al., 2024; Fang et al., 2023; Riaz et al., 2022). This creates favorable conditions for family firms to attract external resources.

First, digital technologies permeate all facets of corporate production, operation, and management, greatly broadening the scope of operational information accessible to firms. Drawing on data generated from business activities, real-time monitoring systems enable timely detection of operational risks and internal control deficiencies. This function strengthens controlling families' oversight over non-family members' strategic decisions and financial conduct, limiting their potential self-serving behavior. DT enhances internal information transparency and breaks down information silos. It restricts managerial discretion over accounting choices, better aligns executive compensation with principals' wealth-maximization objectives, and mitigates managerial private benefit extraction and corporate resource misallocation (Chen et al., 2022; Fang et al., 2023).

Second, firms can leverage the aggregation, integration, and analysis of massive internal and external data. This data enable firms to detect correlations among business variables, deliver precise identification of operational pain points, customer demands and shifting external environments, and lower managers' reliance on experience and intuition during decision-making (Bloom et al., 2012). Specifically, data analytics mitigates irrational decision-making, raises the probability of effective strategic choices, and supports orderly incentive arrangements for managers. Digital technologies such as blockchain foster a new form of technology-enabled trust, which differs from family-centered interpersonal trust and emphasizes technical rationality (Sama et al., 2022). Features including disintermediation, high transparency, traceability, robust security, immutability and automatic execution (Underwood, 2016) underpin online reputation systems (Song & Mao, 2022), strengthening oversight over managers. Taken together, these channels substantially alleviate agency costs arising from goal divergence between controlling families and non-family executives. We thus formulate the following hypothesis:

H3: The negative effect of DT on family control is greater among firms characterized by high agency costs.

2.4 HETEROGENEOUS CHARACTERISTICS OF DT

This paper decomposes DT into two dimensions: digital technology applications and underlying digital technologies. The former focuses on deploying digital tools within specific business operations, products, or processes. Such applications generally feature lower technical barriers, deliver more predictable and immediate returns, and are sometimes adopted to meet firms' legitimacy demands (He et al., 2025). For example, market-oriented business model innovation (e.g., B2B, B2C and C2C) can broaden channels for existing businesses, generate tangible commercial value, and yield quick outcomes (Dwivedi, 2025). Traditional firms commonly launch online pilot projects in particular business segments. Once these pilots succeed, enterprises extend digital practices to additional segments and eventually realize full operational digitalization. Within this process, family firms are able to draw effectively on their established resource endowments.

To unlock the full potential of DT, firms must pursue comprehensive innovation in legacy technological systems and governance architectures. Beyond transforming products and processes, organizations need to deploy core underlying digital technologies (He et al., 2025).

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Such holistic transformation drives sweeping changes in management, production, and business models, substantially strengthening firms' capacity to obtain operational information, detect internal control defects in a timely manner, and identify operational risks.

For instance, data mining (DM) and decision support systems (DSS) mitigate irrational decision-making. Office automation (OA) systems facilitate coordination across production, operation and management teams (Newell & Marabelli, 2015), yet these digital tools may suffer from poor alignment with daily collaborative workflows. As another illustration, when firms adopt smart factories to upgrade production systems, decision-makers need to manage the full process spanning site preparation, equipment deployment, and performance evaluation. This transformation requires inputs including land resources, automated production equipment and staff training, and such solutions are not universally viable across all industries (Aaldering & Song, 2021). On the one hand, far-reaching DT exposes substantial shortages within the family's existing resource pool (Nambisan et al., 2019); on the other hand, it empowers controlling families with robust monitoring mechanisms to restrain non-family managers' self-serving behaviors. Combined, these two forces raise the probability that entrenched family governance arrangements will undergo adjustments. We thus formulate the following hypothesis:

H4: Underlying digital technology has a greater negative impact on family control than digital technology applications.

The conceptual framework is illustrated in Fig. 1.

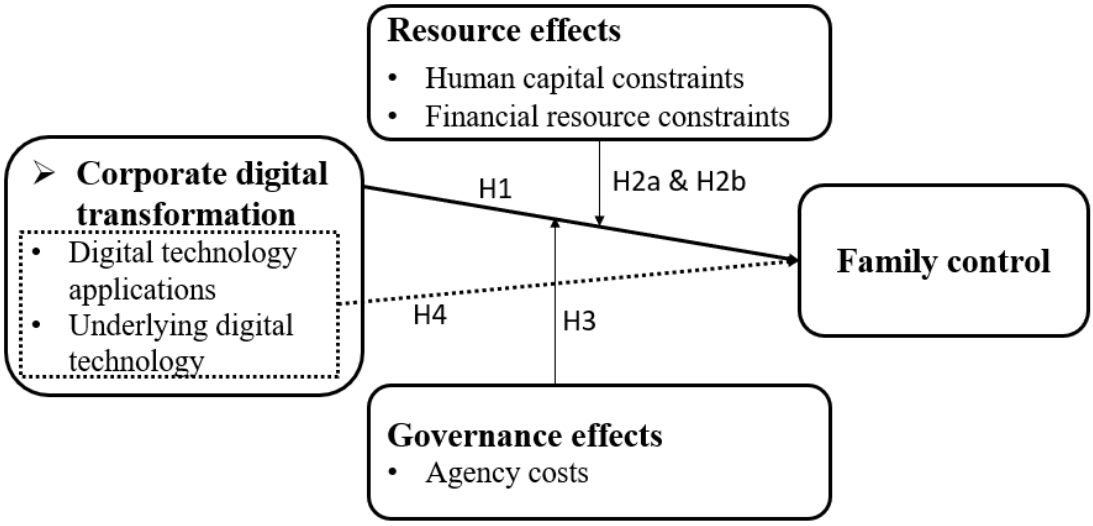


Fig. 1 – Conceptual framework. Source: own research

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3 RESEARCH DESIGN

3.1 DATA SOURCES

Following Daspit et al. (2021), this study defines family firms as A-share listed firms with a controlling shareholder, in which at least one family member other than the primary controller holds ownership stakes, participates in management, or exercises control. This paper draws on a sample of Chinese A-share listed family enterprises covering 2008–2022. The sample covers all industrial sectors except the financial industry, which follows separate accounting standards. It includes high-tech firms as well as traditional manufacturing and service enterprises. To mitigate the influence of outliers and inconsistent accounting practices on estimation results, we conduct the following data preprocessing: (1) exclude firms experiencing abnormal operations, namely special treatment (ST) firms; (2) drop observations with missing values. We further remove samples with fewer than three consecutive years of data, given that short panel records lack sufficient within-firm variation; prior evidence suggests that firms' strategic adjustment cycles last roughly three years. The final sample includes 15,787 firm-year observations. In addition, to prevent outliers from biasing our empirical results, all continuous variables are Winsorized at the 1% and 99% levels. Data are sourced exclusively from the China Stock Market & Accounting Research (CSMAR) Database, a comprehensive dataset widely used for research on China's financial and economic markets.

3.2 VARIABLE DESCRIPTION

(1) Dependent variable: family control ($FamC$). Prior literature adopts two main approaches to measure family control. The first uses a dummy variable based on participation by the ultimate controller and their family members to identify family-controlled listed firms (De Massis et al., 2018). The second employs continuous indicators such as family ownership to quantify the degree of family control. Aligned with our research focus on family firms, this study measures family control using the equity share held by the ultimate controller's family in the listed firm, following the calculation method proposed by La Porta et al. (1999).

(2) Independent variable: digital transformation (DT). Following Wu et al. (2021), we construct the DT indicator based on the frequency of relevant keywords extracted from listed firms' annual reports. Keywords are classified into five categories: AI, blockchain, cloud computing, big data, and digital technology applications. We add one to the total keyword count and then apply logarithmic transformation. The first four categories, referred to as "ABCD" technologies, represent the foundational digital infrastructure underpinning DT, while the fifth captures application-layer practices such as e-commerce and digital marketing.

The management discussion and analysis (MD&A) section of annual reports reflects the priority of DT on firms' strategic agendas. Even considering firms' selective strategic disclosure behavior (He et al., 2025), analyzing digital-related terminology in annual reports can reveal subtle insights into managers' cognition and strategic intentions toward DT. In addition, text mining techniques support rigorous, large-sample longitudinal analysis of DT dynamics. Accordingly, measuring the intensity of DT among listed firms via keyword frequency statistics is methodologically feasible and theoretically justified.

This paper measures underlying digital technology ($DTECH$), which captures firms' engagement in foundational digital technologies and stands for deep-level digital transformation. We calculate DTECH using keyword frequency counts related to "ABCD"

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technologies. The aggregate count plus one is then log-transformed. By contrast, digital technology applications (DTA) reflect superficial digital transformation, where firms deploy digital technologies merely to support product-level applications. DTA is constructed based on the frequency of application-oriented digital keywords; we add one to the total count and apply logarithmic transformation accordingly.

(3) Mechanism variable. We examine two resource constraints: financial capital (FC) and family human capital (HC). In line with Hadlock and Pierce (2010), the SA index is adopted to measure financing constraints; larger absolute values imply tighter financial constraints. Drawing on Ceipek et al. (2021b), this study uses family members' educational attainment to proxy family human capital. Lower values of this indicator indicate more severe shortages of family human capital. Generally, individuals with longer educational experience possess richer knowledge, broader horizons and higher comprehensive capabilities, which helps them deliver sound strategic judgments about DT.

This study employs agency costs to reflect corporate governance conditions (Agency). DT generates governance-enhancing effects by reducing internal information asymmetry and alleviating firms' principal-agent conflicts. Following Ang et al. (2000), we measure agency costs using the administrative expense ratio (administrative expenses / operating income). This indicator captures the efficiency of controlling operating expenses, including managerial perks.

(4) Control variables. Consistent with prior studies (Hernández-Perlines et al., 2025; Liu & Wang, 2023), we include a set of control variables. The first group covers firm development indicators: firm age ($FirmAge$, observation year minus founding year), firm size ($FirmSize$, natural logarithm of total assets), leverage (Lev, total liabilities / total assets), and return on assets (ROA, net profit divided by average total assets). The second group reflects governance characteristics: board size ($Bdnum$, number of all directors including the chairperson), CEO duality ($Dual$, equals 1 if the chairperson and CEO are the same person, and 0 otherwise), and ownership balance ($Balance$, aggregate shareholdings of the 2nd–5th largest shareholders relative to the largest shareholder). The third category captures attributes of the ultimate controller: controller age ($ControllerAge$, observation year minus the controller's birth year). We further incorporate firm, year and industry fixed effects to mitigate omitted variable bias.

3.3 MODEL SPECIFICATION

A fixed-effects model is utilized in this paper to test the relationship between DT and family control.

$$FamC_{it} = \alpha_0 + \alpha_1 \mathrm{DT_{it}/DTA_{it}/DTECH_{it}} + \alpha_2 X_{it} + FIRM + YEAR + INDUSTRY + \varepsilon_{it} \quad (1)$$

where $\mathrm{FamC_{it}}$ is the family control of the firm i year t; $\mathrm{DT_{it}/DTA_{it}/DTECH_{it}}$ are the core explanatory variables, i.e., enterprise DT, DTA, and DTECH in year t of the firm i; X_{it} are the control variables, along with firm, year, and industry fixed effects to absorb unobserved factors affecting family control; ε_{it} is the error.

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4 RESULTS AND DISCUSSION

4.1 DESCRIPTIVE STATISTICS

Table 1 reports the descriptive statistics for the main variables. Family control has a mean of 43.78%, ranging from 12.93% to 80.78% across the sample, suggesting that the level of family control in Chinese family firms remains quite high. DT has a mean of 1.354, with a sample range of 0 to 4.963. Regarding its two subdimensions, underlying digital technology (DTECH) has a mean of 0.915, with a sample range of 0 to 4.159, while digital technology applications (DTA) have a mean of 0.864, with a sample range of 0 to 4.635. The overall average DT level of China's family-owned firms remains relatively low, with superficial applications of digital technology somewhat surpassing the implementation of deeper underlying technologies.

In terms of firm age, the youngest family firm in the sample operates for only 4 years, whereas the oldest has existed for 31 years. Firm size ranges from 19.818 to 24.939. Financial leverage varies between 0.046 and 0.836. Firm profitability varies from -0.634 to 0.326. Board size ranges from 5 to 12. Approximately 41.4% of the sample firms holds the dual position of chairman and CEO. The ownership balance ranges from 0.053 to 2.854. The youngest actual controller of a family business is 32 years old, and the oldest is 75 years old.

Tab. 1 – Descriptive statistics. Source: own research

Variables (Unit)	Obs.	Mean	S.D.	Min.	Median	Max.
FamC (%)	15787	43.775	15.852	12.930	43.070	80.780
DT (Times)	15787	1.354	1.376	0.000	1.099	4.963
DTA (Times)	15787	0.915	1.105	0.000	0.693	4.159
DTECH (Times)	15787	0.864	1.195	0.000	0.000	4.635
FirmAge (Year)	15787	16.884	5.803	4.000	17.000	31.000
FirmSize (Yuan)	15787	21.782	1.042	19.818	21.663	24.939
Lev	15787	0.373	0.190	0.046	0.359	0.836
Roa	15787	0.066	0.122	-0.634	0.076	0.326
Bdnum (Person)	15787	8.091	1.416	5.000	9.000	12.000
Dual	15721	0.414	0.493	0.000	0.000	1.000
Balance	15787	0.825	0.601	0.053	0.672	2.854
ControllerAge (Year)	15787	53.398	8.491	32.000	53.000	75.000

4.2 CORRELATION ANALYSIS

Table 2 presents the correlation matrix of key variables. Digital transformation (DT), digital technology applications (DTA), and underlying digital technologies (DTECH) are significantly negatively correlated with family control, offering preliminary supportive evidence for hypothesis H1. Nevertheless, formal regression analysis is necessary to further confirm such relationships. Except for pairwise correlations among DT, DTA and DTECH, all other pairwise correlation coefficients are below 0.75. Since DT, DTA and DTECH are not simultaneously included in the same regression specification, no severe multicollinearity concerns arise among the variables.

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Tab. 2 – Correlation coefficient. Source: own research

	FamC	DT	DTA	DTECH	FirmAge	Lev	FirmSize	Roa	Balance	Bdnum	Controller Age	Dual
FamC	1											
DT	-0.076***	1										
DTA	-0.049***	0.865***	1									
DTECH	-0.093***	0.856***	0.547***	1								
FirmAge	-0.118***	0.103***	0.062***	0.108***	1							
Lev	-0.100***	0.029***	0.052***	0.006	0.148***	1						
FirmSize	-0.100***	0.151***	0.158***	0.105***	0.247***	0.505***	1					
Roa	0.222***	-0.081***	-0.062***	-0.080***	-0.081***	-0.167***	0.045***	1				
Balance	-0.178***	0.072***	0.051***	0.074***	-0.011	-0.091***	-0.034***	-0.018**	1			
Bdnum	-0.101***	-0.053***	-0.022***	-0.064***	-0.029***	0.050***	0.135***	0.050***	0.061***	1		
Controller Age	0.001	-0.011	-0.029***	0.002	0.160***	-0.053***	0.077***	0.008	0.009	0.056***	1	
Dual	0.053***	0.031***	0.021***	0.030***	-0.031***	-0.066***	-0.112***	-0.005	-0.039***	-0.128***	-0.164***	1

Note: *** p<0.01, ** p<0.05, * p<0.1

4.3 HYPOTHESIS TESTING

Table 3 illustrates how corporate DT shapes family control. Columns (1), (2), and (3) separately report the regression outcomes for overall DT, DTA, and DTECH. We employ robust standard errors across all regressions to account for heteroskedasticity, and all estimations are conducted using Stata 16SE. As shown in column (1), DT is significantly and negatively related to family control (coefficient = -0.3636, $p < 0.05$). Economically, a one-unit increase in DT reduces family control intensity by 0.3636 units. This finding supports hypothesis H1 and aligns with Liu and Wang (2023). Comparisons between columns (2) and (3) reveal heterogeneous patterns. DTA carries a negative coefficient lacking statistical significance (coefficient = -0.1917), while DTECH imposes a statistically significant negative impact on family control. A one-unit increase in DTECH corresponds to a 0.4644-unit drop in family control (coefficient = -0.4644, $p < 0.01$), thereby supporting hypothesis H4.

Tab. 3 – Effects of DT on family control. Source: own research

	(1)	(2)	(3)
Variables	FamC	FamC	FamC
DT	-0.3636**		
	(0.1480)		
DTA		-0.1917	
		(0.1602)	
DTECH			-0.4644***
			(0.1546)
FirmAge	-0.5157	-0.5163	-0.5097
	(0.7052)	(0.7076)	(0.7070)
FirmSize	-1.5694***	-1.6276***	-1.5574***
	(0.4889)	(0.4863)	(0.4873)
Lev	2.1751	2.1855	2.2302*
	(1.3518)	(1.3554)	(1.3494)
Roa	8.3480***	8.3669***	8.3516***
	(0.8060)	(0.8070)	(0.8038)
Bdnum	0.0915	0.0876	0.0891
	(0.1403)	(0.1406)	(0.1408)
Dual	0.8235**	0.8283**	0.8365***
	(0.3243)	(0.3251)	(0.3230)
Balance	-5.2024***	-5.2083***	-5.1889***
	(0.6318)	(0.6328)	(0.6313)
ControllerAge	-0.0075	-0.0074	-0.0070

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	(0.0259)	(0.0259)	(0.0258)
Constant	94.4833***	95.6977***	94.0335***
	(11.4783)	(11.4512)	(11.4683)
Firm & Year & Industry FF	√	√	√
Obs.	15,721	15,721	15,721
R^2	0.3580	0.3572	0.3583

Note: The values in parentheses are robust standard errors. *** p<0.01, ** p<0.05, * p<0.1. "√" denotes that the corresponding fixed effects are controlled for. The same notation applies to Tables 5 through 11. FF is short for fixed effect.

Tab. 4 – Effects of family human capital constraints. Source: own research

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	FamC	FamC	FamC	FamC	FamC	FamC
	High HC constraint	Low HC constraint	High HC constraints	Low HC constraint	High HC constraint	Low HC constraint
DT	-0.2634	-0.2924				
	(0.1780)	(0.2259)				
DTA			-0.0928	-0.2407		
			(0.1916)	(0.2401)		
DTECH					-0.4956***	-0.2544
					(0.1813)	(0.2399)
Control variables	√	√	√	√	√	√
Firm & Year & Industry FF	√	√	√	√	√	√
Obs.	9,632	6,089	9,632	6,089	9,632	6,089
R^2	0.3048	0.4447	0.3043	0.4444	0.3060	0.4444

Note: The control variables in table 5 and the following tables are the same as in table 4. "HC" is short for human capital.

To capture family human capital constraints, this study adopts the average educational attainment of family members as the proxy and splits the full sample into two subgroups based on the sample mean. Firms with below-average family educational attainment are defined as facing severe human capital constraints, and vice versa. As shown in table 4, DTECH significantly reduces family control only in the high human capital constraint group (coefficient = -0.4956, $p < 0.01$). The effect turns statistically insignificant for firms with low human capital constraints (coefficient = -0.2544). Economically, a one-unit rise in DTECH is associated with a 0.4956-unit decline in family control among firms under high human capital constraints. The coefficients of DT (coefficient = -0.2634 vs. -0.2924) and DTA (coefficient = -0.3144 vs. 0.0146) are insignificant in both subgroups, with negligible cross-group differences. These results reveal that human capital constraints magnify the negative effect of DTECH on family control, offering partial support for hypothesis H2a.

To proxy financial capital constraints, this study adopts the SA index and partitions the sample into two subgroups according to the sample mean of the absolute SA index values. Firms with absolute SA values above the sample mean are classified as facing higher financial capital constraints, and vice versa. As shown in table 5, DT (coefficient = -0.3988) and DTECH (coefficient = -0.4484) yield significantly negative coefficients at the 5% level exclusively for the subsample facing high financial constraints, whereas neither variable produces statistically meaningful effects among firms with low financial constraints. Economically, within the high-constraint group, a one-unit increase in DT and DTECH corresponds to a 0.3988-unit and a 0.4484-unit reduction in family control, respectively. The coefficients for DTA are not statistically significant in either subgroup (coefficient = -0.3144 vs. 0.0146), with no substantial cross-group differences. The results reveal that severe financial constraints magnify the adverse

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impacts of aggregate DT and foundational digital technology on family control, which lends additional support to hypothesis H2b.

Tab. 5 – Effects of financial capital constraints. Source: own research

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	FamC	FamC	FamC	FamC	FamC	FamC
	High FC Constraint	Low FC Constraint	High FC Constraint	Low FC Constraint	High FC Constraint	Low FC Constraint
DT	-0.3988**	-0.0794				
	(0.2030)	(0.1724)				
DTA			-0.3144	0.0146		
			(0.2207)	(0.1831)		
DTECH					-0.4484**	-0.0406
					(0.2019)	(0.1980)
Control variables	√	√	√	√	√	√
Firm & Year & Industry FF	√	√	√	√	√	√
Obs.	7,867	7,854	7,867	7,854	7,867	7,854
R^2	0.2111	0.4707	0.2103	0.4707	0.2112	0.4707

Note: "FC" is short for financial capital.

To capture internal governance quality, this study uses agency costs as a proxy measure and divides the full sample into two subgroups according to the sample mean. Specifically, firms with agency costs above the mean are classified as having weaker internal governance, whereas those below the mean are deemed to have stronger governance. As shown in table 6, DT (coefficient = –0.3323, $p < 0.1$) and DTECH (coefficient = –0.4210, $p < 0.05$) exert significant negative impacts exclusively in the high agency cost group. Their coefficients remain statistically insignificant for the low agency cost subsample. Economically, among high-agency-cost firms, each one-unit increase in DT and DTECH reduces family control by 0.3323 units and 0.4210 units, respectively. The coefficients on DTA are not statistically significant in either subgroup (coefficient = -0.3144 vs. 0.0146), and no substantial cross-group differences are detected. These findings reveal that the negative effect of DT on family control, especially its underlying technological path, is more salient among firms characterized by weaker internal governance, which supports hypothesis H3.

Tab. 6 – Governance enhancement effects. Source: own research

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	FamC	FamC	FamC	FamC	FamC	FamC
	High AC	Low AC	High AC	Low AC	High AC	Low AC
DT	-0.3323*	-0.2483				
	(0.1769)	(0.1951)				
DTA			-0.2352	-0.1936		
			(0.1895)	(0.2109)		
DTECH					-0.4210**	-0.2334
					(0.2037)	(0.2052)
Control variables	√	√	√	√	√	√
Firm & Year & Industry FF	√	√	√	√	√	√
Obs.	5,958	9,763	5,958	9,763	5,958	9,763
R^2	0.4467	0.3129	0.4461	0.3127	0.4470	0.3128

Note: "AC" is short for agency cost.

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Additionally, DTECH shows a significantly stronger negative effect on family control in the severe resource constraints and high agency cost subsamples, while DTA remains insignificant throughout. These findings further validate hypothesis H4.

These findings indicate that technology plays a crucial role in the evolution of governance paradigms within family firms. Controlling families often remain concerned about agency risks stemming from non-family managers and external financing (Chrisman & Patel, 2012). Nevertheless, the urgency and necessity of DT push family firms to recruit non-family digital specialists and obtain external funding. These steps grant firms access to essential resources such as knowledge, technology and capital to support DT implementation (Bornhausen & Wulf, 2024). Meanwhile, digital technologies equip controlling families with feasible monitoring tools to oversee non-family members' behaviors. This function alleviates agency costs and creates conditions for families to scale back family control (Chen et al., 2024). DT elevates internal information transparency and reinforces internal control systems. It restrains managerial discretion and mitigates agency problems including managers' private benefit extraction and resource misallocation (Chen et al., 2024; Fang et al., 2023; Riaz et al., 2022). In this regard, DT acts as an effective governance mechanism that enables family firms to access external resources more smoothly.

Furthermore, we find that underlying digital technologies exert a stronger negative effect on family control than digital technology applications. Such foundational technologies enable firms to renovate and upgrade legacy technical architectures and realize digital transformation across production systems. These initiatives feature high technical complexity and uncertain outcomes, demanding massive resource inputs and exposing firms to elevated risks (Hanelt et al., 2021). By contrast, digital technology applications focus on deploying digital tools to achieve immediate operational efficiency gains (He et al., 2025). Traditional family firms usually launch online pilot projects within selected business segments. These digital practices exhibit lower technical complexity, deliver faster and more predictable returns, and impose weaker demands for heterogeneous resources. Compared with foundational digital initiatives, shallow digital transformation generates milder resource constraints and yields limited improvements in corporate governance.

4.4 ROBUSTNESS CHECK

As the first robustness test to mitigate reverse causality concerns, we adopt one-period lagged independent variables for regression estimation. Results are reported in table 7. DT still exerts a significant negative effect on family control. Column (2) shows that lagged DTA (L.DTA) yields a negative and statistically significant impact on family control at the 5% level. This evidence indicates a delayed effect of DT on family control. As digital transformation advances, firms face growing demand for external resources while internal governance mechanisms are strengthened. Combined, these forces impose downward pressure on family control.

Tab. 7 – Regression results of explanatory variables lagged one period. Source: own research

	(1)	(2)	(3)
Variables	FamC	FamC	FamC
L.DT	-0.4920***		
	(0.1453)		
L.DTA		-0.3404**	
		(0.1621)	
L.DTECH			-0.4986***

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			(0.1541)
Control variables	√	√	√
Firm & Year & Industry FF	√	√	√
Obs.	13,584	13,584	13,584
R^2	0.3408	0.3396	0.3405

Second, inconsistent definitions of family firms across prior literature may affect empirical results. Following the convention that uses ownership thresholds to identify family firms, we adopt 10%, 20% and 30% cutoffs for family control. Observations with family ownership below each threshold are excluded, and we re-run the regressions accordingly. Estimation results are summarized in table 8. DT and underlying digital technologies continue to generate significant negative effects, whereas the coefficient on digital technology applications remains statistically insignificant. This confirms that our core conclusions are robust to changes in sample selection criteria.

Tab. 8 – Regression results of changing the definition of family business. Source: own research

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	FamC	FamC	FamC	FamC	FamC	FamC	FamC	FamC	FamC
	>10%	>20%	>30%	>10%	>20%	>30%	>10%	>20%	>30%
DT	-0.3636**	-0.3073**	-0.2413*						
	(0.1480)	(0.1508)	(0.1369)						
DTA				-0.1917	-0.1712	-0.1455			
				(0.1602)	(0.1637)	(0.1502)			
DTECH							-0.4644***	-0.3711**	-0.2676*
							(0.1546)	(0.1550)	(0.1442)
Control variables	√	√	√	√	√	√	√	√	√
Firm & Year & Industry FF	√	√	√	√	√	√	√	√	√
Obs.	15,721	14,810	12,240	15,721	14,810	12,240	15,721	14,810	12,240
R^2	0.3580	0.3569	0.3741	0.3572	0.3563	0.3737	0.3583	0.3571	0.3741

Third, this study employs propensity score matching (PSM) to match each treated observation with comparable untreated observations, alleviating sample selection bias that may distort coefficient estimates. We convert continuous DT, DTA and DTECH into dummy variables based on the sample mean. Afterwards, we implement 1:1 nearest-neighbor matching conditional on firm-level covariates. Regressions are re-estimated using the matched sample, and results are shown in table 9. After correcting for sample selection bias, DT and DTECH exert significant negative effects on family control, whereas the coefficient on DTA remains statistically insignificant. These outcomes align with our baseline results.

Tab. 9 – Regression results after PSM. Source: own research

	(1)	(2)	(3)
Variables	FamC	FamC	FamC
DT	-0.2943**		
	(0.1467)		
DTA		-0.1847	
		(0.1673)	
DTECH			-0.2777*
			(0.1575)
Control variables	√	√	√

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Firm & Year & Industry FF	√	√	√
Obs.	14,310	12,582	11,384
R^2	0.3444	0.3404	0.3465

Finally, we expand the set of control variables. China is a large transitional economy featuring regional divergence in formal institutions (e.g., marketization level) and informal institutional factors (e.g., Confucian culture and kinship culture), both of which shape corporate behavior. We further include province fixed effects to absorb unobservable institutional and cultural heterogeneity. Table 10 reports the corresponding results. Coefficient signs and significance levels remain consistent with the baseline outputs in table 4. Therefore, our conclusions regarding how DT shapes family firm governance are robust.

Tab. 10 – Regression results with province fixed effect. Source: own research

	(1)	(2)	(3)
VARIABLES	ControlProportion	ControlProportion	ControlProportion
DT	-0.3247**		
	(0.1461)		
DTA		-0.1654	
		(0.1599)	
DTECH			-0.4232***
			(0.1528)
Controls	√	√	√
Firm & Year & Industry FF	√	√	√
Province FF	√	√	√
Obs.	15,721	15,721	15,721
R^2	0.3696	0.3689	0.3699

5 CONCLUSIONS

5.1 RESEARCH CONCLUSION

DT and adjustments to family governance serve as two pivotal pillars for family firms to sustain competitive advantages. The coordination between these two dimensions is especially vital for family firms operating within the digital economy. This study primarily investigates how DT influences family control. It identifies a governance channel whereby digitalization reshapes the internal power structure of family firms. Such changes exert direct impacts on organizational adaptability and, in turn, firms' competitive status. Based on a sample of Chinese A-share listed family firms spanning from 2008 to 2022, this paper provides novel insights into the evolution of family governance models amid digital transformation.

This study yields the following findings: (1) DT exerts a negative effect on family control. Further decomposition of DT indicates that this effect originates exclusively from underlying digital technology, while digital technology applications produce no significant influence. (2) Evidence on resource constraints effects show that DT and DTECH impose stronger negative impacts on family control when family firms suffer more acute shortages of family human capital and financial capital. (3) Evidence on governance improvement effect suggests that, for firms with severe agency conflicts, DT reduces internal information asymmetry and strengthens internal control. Such changes encourage controlling families to scale back family control. This research identifies DT as a vital catalyst for organizational transformation within family firms, highlighting its essential role in reshaping governance frameworks and strategic decision-

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making. The findings may motivate future research on DT and associated governance issues in family businesses.

5.2 PRACTICAL IMPLICATIONS

Our results show that DT drives family firms to reduce family control and shift toward professional management. Nevertheless, such an effect mainly originates from underlying digital technologies rather than digital technology applications. Although lower family control may trigger short-term frictions between family authority and strategic adjustments, DT undoubtedly serves as a vital channel to sustain the long-term viability of family businesses. Family decision-makers should fully assess resource demands and implementation barriers for different transformation paths. Accordingly, they need to prudently balance DT and family governance to ease internal conflicts and guarantee transformation efficiency. Meanwhile, policymakers can roll out targeted training programs to facilitate the upgrading and professional development of family firms.

Second, the results reveal that the negative effect of DT on family control is strengthened for family firms facing severe human and financial resource constraints. Resource shortages push these firms to introduce external capital and professional talents to advance DT. Family firm decision-makers should acknowledge that high-quality human capital is critical to sustaining and improving corporate operating performance. Firms are encouraged to actively integrate internal and external talent resources and rationally schedule the phased implementation of DT. Meanwhile, governments authorities can launch high-end talent recruitment programs to help local enterprises meet their human resource needs promptly.

Lastly, our findings verify that DT exerts a more pronounced negative influence on family control among firms with severe agency conflicts. By improving internal information transparency and upgrading corporate governance, DT provides an effective governance platform that enables family firms to attract external professionals and capital. Enterprises should fully leverage next-generation information technologies to continuously optimize governance structures. Such improvements facilitate access to talent, capital and other resources necessary for strategic transformation and support sustainable long-term development.

5.3 RESEARCH LIMITATIONS AND PROSPECTS

This research has several limitations that suggest promising directions for future studies. Our study identifies governance mechanisms through which DT affects family control—and theorizes their implications for competitiveness. However, we do not directly test whether such governance shifts translate into measurable performance gains (e.g., total factor productivity, Tobin's Q, market share, or innovation output). This represents an important avenue for follow-up research. Future work may incorporate firm performance outcomes into the analytical framework to complete the logical chain linking governance changes to competitive consequences, which can offer direct empirical support for the competitiveness mechanism proposed in this paper. Moreover, this study measures DT based on keyword frequency extracted from annual reports. In future research, this textual approach can be combined with large language models to improve measurement accuracy and indicator reliability. Finally, our sample is limited to Chinese family firms. The conclusions mainly apply to listed Chinese family enterprises after 2008, and the results cannot be readily generalized to other institutional

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environments or unlisted family businesses. Subsequent research can expand the sample to cover firms from diverse countries and regions to enable cross-country comparisons of how DT shapes family control under different institutional contexts.

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