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Research on How Executive Connections Affect Enterprise Digital Transformation: Empirical Evidence from China

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Abstract: In the context of the digital economy, the external connection of executives provides enterprises with a good idea to amplify their potential for digital transformation with the help of external forces. Therefore, we conduct a theoretical exploration and an empirical analysis of the relationship between executive connections and enterprise digital transformation. As the research sample, we use the A-share manufacturing companies listed in China from 2012 to 2021. According to sufficient verifications, we discover that executive connections can effectively support digital transformation. From the perspective of each subdivision dimension, executive business connections, executive technical connections, and executive financial connections can significantly promote digital transformation, among which executive technical connections have the greatest favorable impact. However, the impact of executive political connections on digital transformation is not obvious. Additionally, executive connections primarily foster enterprise digital transformation by reducing enterprise asset specificity. The results of the boundary mechanism test demonstrate that the external environmental dynamics and the internal dynamic capabilities reinforce the positive effect of executive connections on digital transformation. These findings contribute to a deeper understanding of the role of executive connections in digital transformation and provide practical guidance for firms to accelerate digital transformation.

Keywords: digital economy; digital transformation; executive connections; asset specificity

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1. Introduction

Against the backdrop of continuous breakthroughs in the updating and iteration of digital technologies, digital transformation has been the general trend for enterprises [1]. It increasingly becomes a "mandatory topic" related to the survival and long-term development of enterprises, showing strong resilience and potential. In essence, digital transformation refers to a process in which enterprises use innovative digital technologies to comprehensively reshape business processes, organizational structure, management systems, and business models, and then build a data-centered value creation system [2–4]. It is evident that digital transformation is a complex and systematic strategy, which also requires multiple optimizations of enterprises in technology, resources, information, and other aspects. So, as the main maker and executor of major strategic decisions of enterprises [5], the top management team has an important impact on the formulation and implementation of digital transformation strategies [6,7]. Further, the external connection formed by senior executives through part-time employment in other companies or based on their working experience in universities, research institutes, financial institutions, and government agencies, as the critical channel connecting enterprises with the external environment, plays the role of an information bridge, resource transportation, and learning imitation. It can help enterprises obtain substantial support on information, technology, human resources, and capital in the process of digital transformation, and realize inter-enterprise strategy and resource sharing [8], which affects the orderly promotion of enterprise digital transformation.

Although the executive connection is a crucial factor in promoting enterprise digital transformation, there are particularly few studies that combine executive connections with

practical data on firms' digital transformation. Therefore, we use resource-based theory and higher-order theory as our theoretical basis, classify executive connections into business connections, technical connections, financial connections, and political connections based on the nature of linkage subjects, and then study the impact of executive connections on digital transformation. Further, asset specificity is selected for our exploration of the mechanism of executive connections affecting digital transformation. In addition, considering that digital transformation is a strategic behavior of enterprises, it will also be influenced by enterprise characteristics and the external environment. We select dynamic capabilities and environmental dynamics as internal and external contextual factors to examine what role they play in the process of executive connections to promote enterprise digital transformation.

The possible research contributions of this paper are as follows. First, existing research on the economic consequences of digital transformation has been abundant, but there is a relative lack of research on the antecedent variables of digital transformation. Based on the integration of higher-order theory and resource-based theory, we explore whether corporate executive connections can greatly foster digital transformation, which is an effective extension of the research on the antecedents of digital transformation. Second, we classify executive connections into business connections, technical connections, financial connections, and political connections according to the nature of linkage subjects, and investigate the impact of executive connections on digital transformation, which is a useful supplement to the research on the economic consequences of executive connections. Third, the exploration of the mediating role of asset specificity helps to further identify the process by which executive connections affect digital transformation. Finally, to provide firms with useful references when making strategic decisions that are conducive to digital transformation, we further identify whether there is a significant difference in the impact of executive connections on digital transformation within different contexts.

2. Theoretical Analysis and Hypothesis Development

The literature review reveals that the economic effects of digital transformation have been adequately discussed in existing studies. For instance, digital transformation can lower the level of information asymmetry among firms [9], facilitate green innovation [10], increase total factor productivity [11], strengthen corporate social responsibility [12], enhance financial performance [13], and preserve a firm's competitive advantage [14]. However, concerning the influence factors of enterprise digital transformation, the research is still in its early stages and is not systematic. Nambisan et al. [15] discuss the differential effects of causal decision logic and effectual decision logic on digital transformation from the perspective of managers' decision logic choices. Li et al. [16] find that digital transformation could be effectively driven by managers' digital perceptions. Sun et al. [17] document that the top management team decides whether or not a firm should undertake digital transformation, and their supportive attitude is a prerequisite. Based on the imprinting characteristics of the top management team, Zhang and Chen [18] demonstrate that executives' prior education and professional experiences contribute to the acquisition of firms' digital technology. In short, there are particularly few studies that combine executive connections with practical data on firms' digital transformation. Therefore, we will investigate this issue through thorough theoretical exploration and empirical tests.

2.1. The Relationship between Executive Connections and Enterprise Digital Transformation

Based on the nature of the external subjects to which executives are attached, we categorize executive connections as business connections, technical connections, financial connections, and political connections. Specifically, business connections relate to the linkages made between senior executives and suppliers, customers, partners, and rivals [19]. Technical connections are described as the relationships between senior executives and academic institutions and research centers [20]. Financial connections refer to the connections between senior executives and financial institutions, such as banks and insurance

companies [21]. Political connections indicate the relationships between senior executives and government departments, such as commerce departments and tax departments [22]. Executive connections, which serve as the primary channel for enterprises to communicate with the external environment, reflect an organization's ability to obtain and integrate both internal and external resources and are crucial to its level of digital transformation [23].

First of all, the business connections formed by senior executives through personal relationships and social interaction can provide enterprises with a channel for efficient learning and communication. By imitating and learning from other enterprises, enterprises can increase the effectiveness of their digital transformation and reduce decision-making risks [24,25]. Moreover, the knowledge, technology, talent, and innovation resources embedded in the business connection satisfy the prerequisites to develop or introduce digital technology and lay a good foundation for enterprises to apply it. Secondly, due to the interactions between the top management team and universities and research institutes, enterprises can continue to have access to cutting-edge knowledge, experience, and technical capabilities [26]. The accumulation of such knowledge and skills can not only provide intelligence support and complementary technical support for digital transformation [27], but also help enterprises develop a forward-looking perspective and a strategic vision, so as to identify and utilize digital opportunities creatively and actively explore the methods and approaches of digital transformation [28,29].

Furthermore, if senior executives have worked for financial institutions such as banks, securities firms, fund management firms, etc., or have other close linkages to them, enterprises may find it easier to access direct benefits such as low-interest loans, loan extensions, long-term loans, and increased credit [30,31]. This can alleviate financial constraints and guarantee enterprises' ongoing investment in digital transformation. Additionally, for enterprises undergoing digital transformation, the development of strong financial ties can introduce the supervision of financial institutions, such as banks [32,33], which prevents ineffective investments from their professional perspective and enhance the investment effectiveness of digital projects. Finally, the government has launched a series of special subsidies to support the digital transformation of real enterprises, including fiscal and tax incentives, credit incentives, special fund support, etc. Based on the stable relationships established between executives and government institutions, enterprises are more likely to obtain government support and subsidies [34,35], seize the digital development opportunities brought by the institutional reform, and gain the first-mover advantage in the digital transformation of enterprises.

Based on the above analysis, the following hypothesis is proposed in this paper.

H1. *All else being equal, firms with higher levels of executive connections exhibit better performance in digital transformation.*

2.2. The Mediating Role of Asset Specificity

Asset specificity refers to the degree to which an enterprise invests in assets that have specific uses and are difficult to shift to other uses, including the specificity of material assets and the specificity of human capital. It will increase the adjustment cost of enterprises. Enterprise digital transformation has the distinctive characteristics of "not breaking but not standing" and "breaking before standing". It not only involves the updating and upgrading of enterprise machinery, equipment, supporting facilities, and other physical assets but also raises the demand for high-quality and skilled workers. The original material assets and human capital of the enterprise will be challenging to be applied in digital transformation if the specificity of enterprise assets is high, leading to the incompatibility of digital technology and original assets. Even though these specific assets can be transformed and upgraded in certain ways and subsequently employed in enterprise transformation, they will bring huge adjustment costs and weaken the flexibility of enterprises to implement the strategic change of digital transformation. However, if senior management members have established complete executive connections through personal relationships, social interactions, or working experience, the flow of information and resources between enterprises will be

smoother and the sharing degree of material assets and human capital will be higher, which effectively lowers the specific asset investment of enterprises. On the one hand, the reduction in specific assets can alleviate the financing constraints faced by enterprises and save a large amount of money for digital transformation. On the other hand, it can mitigate the path dependence of enterprises, help enterprises quickly integrate internal and external resources, make corresponding organizational adjustments and, ultimately, accelerate the process of enterprise digital transformation.

Based on the above analysis, the following hypothesis is proposed in this paper.

H2. *All else being equal, executive connections drive enterprise digital transformation by reducing enterprise asset specificity.*

2.3. The Moderating Role of Environmental Dynamics and Dynamic Capabilities

With the rapid development of the digital economy, new knowledge and opportunities are emerging, and the speed of technological innovation and product change is significantly accelerated, resulting in the increasing dynamic of the environment in which firms operate. Environmental dynamics refer to the fact that the external environment of a firm is constantly changing and difficult to predict accurately [36], which can increase the importance of relational factors in the digital transformation process. First, when firms are faced with high environmental dynamics and are challenged to keep their competitive advantage, they are more likely to seek strategic change and thus have a stronger motivation to conduct digital transformation. In such a situation, key resources such as knowledge, manpower, and technology, as well as facilitative advantages in financing and innovation that firms acquire through executive connections, will be more easily applied to digital transformation. As a result, the impact of executive connections on digital transformation will be increased. Second, it is more unclear and risky for firms to implement digital transformation in a dynamic environment due to increased information asymmetry and an unpredictable trajectory of technological progress. However, the executive connections can improve the organization's information edge, enhance its understanding of the experience and possible hazards connected with digital transformation, and efficiently decrease the high uncertainty and risk in the process [37]. Finally, the enterprise's digital transformation benefits from this, and the impact of executive connections on digital transformation is further amplified in high-dynamic environments.

In order to adapt to a dynamically changing environment, a company must have the capacity to acquire, rearrange, and reconfigure both internal and external resources, which is called dynamic capabilities [38]. In the context of the digital economy, the development of dynamic capabilities is crucial to enterprise digital transformation. Specifically, strong dynamic capabilities can improve the enterprise's flexibility and agility in a dynamically changing environment. Based on this, enterprises can rapidly integrate internal and external resources and respond to environmental changes brought on by adjustments to organizational strategy and the use of digital technologies. Then, they swiftly introduce new technologies to efficiently promote the growth of digital transformation. Further, the disparities in the dynamic capabilities of different companies have a significant influence on the enabling effect of executive connections on enterprise digital transformation. In particular, the stronger dynamic capability supports efficient coordination and management of the numerous, varied, and dispersed resources embedded in executive connections. This can make it easier to integrate and rebuild external network resources with existing resources, avoid conflicts over resource use, reduce the cost of resource silence, and quickly transform external network resources into a key driver of digital transformation [39], thus enhancing the enabling effect of executive connections on digital transformation.

Based on the above analysis, the following hypotheses are proposed in this paper.

H3a. *Environmental dynamics play a positive moderating role in the relationship between executive connections and enterprise digital transformation.*

H3b. *Dynamic capabilities play a positive moderating role in the relationship between executive connections and enterprise digital transformation.*

Ultimately, we construct a theoretical model of executive connections affecting enterprise digital transformation based on the theoretical analysis and Hypotheses H1, H2, H3a, and H3b, as illustrated in Figure 1.

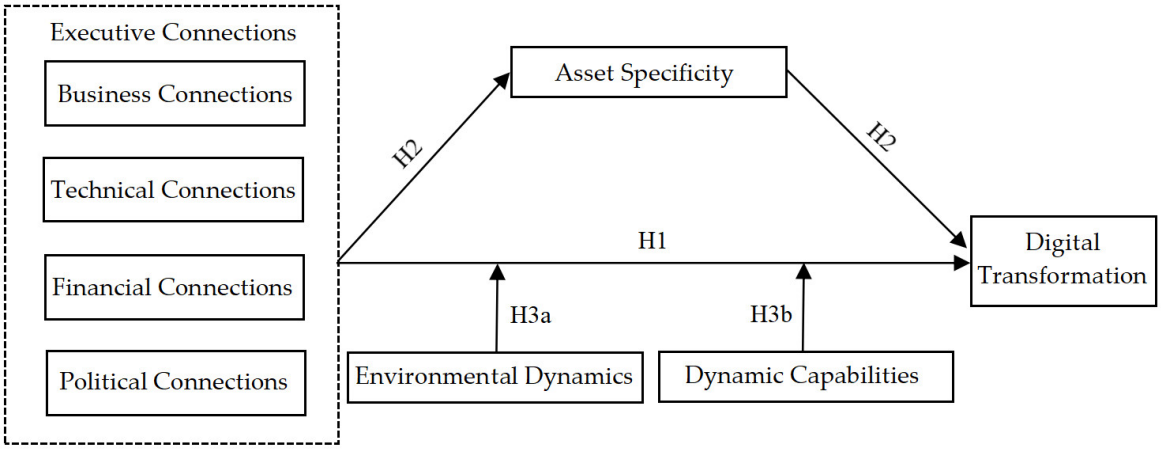

Figure 1. The theoretical model of executive connections influencing digital transformation.

3. Research Design

On the basis of the above theoretical analysis, we will conduct a corresponding research design to test the hypotheses proposed in Section 2 with practical data. Specifically, Section 3 includes Section 3.1 on the model and variable definitions and the Section 3.2 on sample sources.

3.1. Model and Variable Definitions

Based on the above theoretical analysis, we specify the regression models (1) to (4) as follows:

$$Digital_{it} = \beta_0 + \beta_1 Connection_{it} + \gamma Controls_{it} + \delta_Y + \mu_P + \varepsilon_{it} \quad (1)$$

$$Mediator_{it} = \beta_0 + \beta_1 Connection_{it} + \gamma Controls_{it} + \delta_Y + \mu_P + \varepsilon_{it} \quad (2)$$

$$Digital_{it} = \beta_0 + \beta_1 Connection_{it} + \beta_2 Mediator_{it} + \gamma Controls_{it} + \delta_Y + \mu_P + \varepsilon_{it} \quad (3)$$

$$Digital_{it} = \beta_0 + \beta_1 Connection_{it} + \beta_2 Moderator_{it} + \beta_3 Moderator_{it} * Connection_{it} + \gamma Controls_{it} + \delta_Y + \mu_P + \varepsilon_{it} \quad (4)$$

where $Digital_{it}$ is the degree of digital transformation of firm i in year t, $Connection_{it}$ is the level of executive connections of firm i in year t, $Mediator_{it}$ indicates the degree of asset specificity of firm i in year t (AS_{it}), $Moderator_{it}$ indicates the dynamic of the environment of firm i in year t (ED_{it}) and the dynamic capability of firm i in year t (DC_{it}), respectively, $Controls_{it}$ is the set of control variables, δ_Y are year-fixed effects, μ_P are region-fixed effects, and ε_{it} are random disturbance terms. In this paper, we test Hypothesis H1 using model (1), test Hypothesis H2 using models (2) and (3), and test Hypotheses H3a and H3b using model (4).

Digital is our independent variable, and it measures the degree of enterprise digital transformation. In economics research, scholars often use the textual analysis method to search for the frequency of occurrence of target words to create relevant indicators. The higher the frequency of occurrence of the target words, the more importance enterprises attach to the issues represented by the target words. Therefore, referring to scholars' indirect measures of top management teams' attention through textual analysis [40], we adopt the textual analysis method to create the digital transformation indicator of manufacturing

enterprises. In the first step, we use python language to write a crawler program. Then, we crawl all the annual reports of A-share listed manufacturing companies in China from 2012 to 2021 from CNINFO and retain the Management Discussion and Analysis (MD&A) section of the annual report. In the second step, by manually sorting the annual reports of benchmark enterprises of digital transformation and using python software to automatically divide the words, we identify the basic forms of information presentation related to digital transformation in the annual reports. In the third step, the keywords are expanded by manual means and a computer association algorithm to form the final keyword dictionary. In the fourth step, the keyword frequencies are extracted using python language, and word frequency statistics and aggregation are performed. Finally, we obtain the comprehensive indicator of digital transformation performance (*Digital*). The keyword mapping includes AI, BI, intelligent manufacturing, machine learning, data mining, data processing, data analysis, IoT, RFID, mobile Internet, cloud services, cloud platform, 5G, Hadoop, CRM, REP, and so on.

Connection is our independent variable, and it measures the level of executive connections, which consists of business connections, technical connections, financial connections, and political connections. Based on the study of Ni and Zou [41], we choose four key indicators for a principal component analysis to measure the overall level of executive connections, including the proportion of executives who are also directors of other firms, the proportion of executives with a scientific research background, the proportion of executives with a financial background, and the proportion of executives with a political background. Specifically, the business connection (*Business*) is measured as the number of executives who also serve as directors in other firms in a given year divided by the total number of executives, the technical connection (*Technology*) is measured as the number of executives with working experience in academic institutions such as universities, research institutes or with an R&D career background divided by the total number of executives, the financial connection (*Finance*) is measured as the number of executives with working experience in financial institutions such as banks, insurance companies, and securities companies divided by the total number of executives, and the political connection (*Politics*) is measured as the number of executives with working experience in government agencies such as taxation, industry, and commerce divided by the total number of executives.

AS is our mediating variable, which reveals the degree of enterprises' asset specificity. To measure an enterprise's asset specificity, we add up its net fixed assets, net construction in progress, intangible assets, and long-term amortization expense, and then divide it by its total assets.

ED and *DC* are our moderating variables, which reveal the dynamics of the environment in which the firm operates and the strength of the firm's dynamic capabilities, respectively. First, drawing on the study of Ghosh and Olsen [42], we calculate the ratio of the standard deviation to the mean of the firm's operating income over the past five years and then take the logarithm to measure environmental dynamics. Second, following the measures of Yang et al. [43], a principal component analysis is conducted based on four indicators: R&D expenditure intensity, the ratio of intangible assets, the ratio of personnel with a graduate degree or above, and return on assets, to obtain a comprehensive indicator of dynamic capabilities.

With reference to the extant literature [44,45], we identify and control for a wide range of firm and industry characteristics that may influence firms' digital transformation (*Controls*). To control for the effect of financial risk on digital transformation, we include two variables from prior studies: the debt-to-asset ratio (*Debt*) and the cash holding level (*Cash*), measured as net cash flow from operating activities divided by total assets. We also include the return on assets (*ROA*) in our regressions to control for the effect of firms' profitability on digital transformation. Since the development of digital activities may also be influenced by corporate governance features, we include in our regressions the number of board of directors (*Board*), the percentage of top ten shareholders' shareholding (*Share*), and the duality (*Duality*), indicating whether or not the chairman and the general manager

are served by one person. As a control for the firms' nature of property rights, we include the firms' ownership (*SOE*) that equals one if the firm is stated-owned and zero otherwise. To control for the characteristics of corporate executives, we include the average age of executives (*AverageAge*) and the percentage of male executives (*Gender*) in our regressions. We measure a firm's size and age by its natural logarithm of total assets (Size) and the number of years listed (*Age*), respectively. Given that firms' digital transformation is highly correlated with their industries' digital transformation, we include an indicator variable (*IDT*) to reflect the variances of digital transformation in different industries which are defined as the mean of the degree of digital transformation for all firms in the same industry. In addition, we include year-fixed effects and region-fixed effects in all our regressions to control for possible time trends and regional effects of digital transformation during our sample period.

3.2. Sample Sources

In order to explore the impact of executive connections on digital transformation, we take A-share listed manufacturing firms in China from 2012 to 2021 as the research sample. Among them, the majority of the firms are in the manufacturing of computers, communication, and other electronic equipment (c39), followed by chemical raw materials and chemical products manufacturing (c26), special equipment manufacturing (c35), pharmaceutical manufacturing (c27), and other industries. Compared with other industries, traditional manufacturing industries need to activate their potential through digital transformation and achieve comprehensive transformation and upgrading. China is a typical relationship-based country [46], with a strong focus on maintaining and utilizing relationships, and it is more representative to use China as the research object. This also enables the findings to be broadly generalized to other countries. The digital transformation data used in this paper is obtained through manual collation and web crawling of the annual reports of the listed manufacturing firms, which are downloaded from CNINFO. The executive connection data and other microdata at the firm level are obtained from CSMAR database. To ensure the accuracy of the data, we exclude samples with abnormal financial data, missing data, and ST and ST* firms. Finally, we winsorize all continuous variables at the 1% and 99% percentiles to mitigate the concern of outliers and obtain a sample of 16,014 firm-year observations. The statistical evaluation tools used in this paper are relatively mature, including STATA17 and SPSS26.

4. Empirical Results and Explanations

Section 4 reports the main research results of this paper, and we also explain and analyze the results accordingly.

4.1. Summary Statistics

Table 1 provides the results of descriptive statistics for the regression variables. The results show that the mean of the executive connections (*Connection*) is 0.994, the standard deviation is 0.485, the minimum is 0.390, and the maximum is 2.680, indicating that the level of the executive connections has a large variability across manufacturing listed firms. The digital transformation of firms (*Digital*) has a mean of 6.752, a standard deviation of 14.495, a minimum of 0, and a maximum of 92, which reveals that there are significant differences in the degree of digital transformation among different firms, and there are still some firms that have not undergone digital transformation. In addition, except for the firm's age (*Age*) and the average age of executives (*AverageAge*), there are significant disparities in all control variables, and the digital transformation performance of firms may be affected by such disparities.

Table 1. Summary statistics on regression variables.

	N	Mean	Std.	Min	Max
Connection	16,014	0.994	0.485	0.390	2.680
Digital	16,014	6.752	14.495	0	92
Size	16,014	21.963	1.151	19.936	25.450
Age	16,014	9.671	7.238	0	26
ROA	16,014	0.049	0.063	−0.192	0.232
Debt	16,014	0.384	0.192	0.053	0.864
Cash	16,014	0.053	0.065	−0.130	0.239
Board	16,014	8.404	1.499	5	13
Share	16,014	0.600	0.150	0.253	0.960
AverageAge	16,014	49.118	3.057	41.706	56.333
Gender	16,014	0.813	0.110	0.500	1
IDT	16,014	7.272	7.652	0.111	28.200

4.2. Executive Connections and Digital Transformation

Table 2 exhibits the regression results related to the impact of the executive connection and its dimensions on digital transformation. Firstly, the significant and positive coefficient (1.006) on *Connection* shown in column (1) of Table 2 suggests that the executive connection provides support for digital transformation through information exchange, knowledge sharing, and resource complementation, and can effectively improve the digital transformation performance of firms. These findings are consistent with Hypothesis 1 that firms with a higher level of executive connections exhibit better performance in digital transformation, and thus Hypothesis 1 (H1) in this paper is verified.

Table 2. The impact of executive connections and their dimensions on digital transformation.

Variables	(1) *Digital*	(2) *Digital*	(3) *Digital*	(4) *Digital*	(5) *Digital*
Connection	1.006 *** (4.645)				
Business		1.468 *** (3.968)			
Technology			1.970 *** (5.133)		
Finance				2.460 *** (2.896)	
Politics					0.669 (0.610)
Controls	Included	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included	Included
Region fixed effects	Included	Included	Included	Included	Included
N	16,014	16,014	16,014	16,014	16,014
Adjusted R^2	0.228	0.228	0.228	0.227	0.227
F-value	332.870 ***	332.170 ***	333.450 ***	331.280 ***	330.310 ***

Note: *t*-values are in parentheses and *** indicates $p < 0.01$.

Secondly, columns (2), (3), and (4) of Table 2 show that the coefficients on individual components of *Connection*, including *Business*, *Technology*, and *Finance*, are all positive and significant at the 1% level, which documents that the three types of executive connections mentioned above can potentially enhance the digital transformation performance of firms by empowering them with critical resources such as information, technology, human resources, and capital required for digital transformation. However, the coefficient on *Politics* is positive but not significant. The possible reason for this situation is that although the executive connection is able to bring financial, talent, technological, and other resource support and policy benefits to the enterprise, it requires a lot of time and effort to maintain strong relationships and also exposes the company to more government intervention,

which leads to the insignificant impact of the executive connection on enterprise digital transformation.

To further distinguish the relative importance of different types of executive connections on digital transformation, we calculate the ΔR^2 value in the regressions [47]. The larger the ΔR^2 value, the greater the influence of the corresponding executive connection on digital transformation. In columns (1) to (4) of Table 3, we find $\Delta R^2_{Model1–Model2} = R^2_{Model1} - R^2_{Model2} = 0.2315 - 0.2307 = 0.0008$, $\Delta R^2_{Model1–Model3} = 0.0012$, and $\Delta R^2_{Model1–Model4} = 0.0003$, reflecting the explanatory variance of the business connection, the technical connection, and the financial connection on enterprise digital transformation, respectively. Based on the above findings, it can be seen that the technical connection plays the greatest role in the performance of firms' digital transformation, followed by the business connection. These demonstrate that digital transformation, as a kind of organizational change driven by advanced digital technologies, such as AI and big data, has a high demand for cutting-edge scientific knowledge and technological capabilities, and it is more necessary to obtain cutting-edge scientific knowledge and technological knowledge with the assistance of technical connections. Meanwhile, in the process of digital transformation, firms also face the high-uncertainty and need to acquire critical information and relevant experience from business connections to reduce the uncertainty and risk of transition.

Table 3. The relative importance of different types of executive connections in digital transformation.

Variables	(1) *Digital*	(2) *Digital*	(3) *Digital*	(4) *Digital*
Business	1.419 ***		1.410 ***	1.468 ***
	(3.835)		(3.807)	(3.972)
Finance	1.914 **	2.105 **	2.272 ***	
	(2.244)	(2.471)	(2.671)	
Technology	1.896 ***	1.889 ***		1.970 ***
	(4.927)	(4.906)		(5.136)
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Region fixed effects	Included	Included	Included	Included
N	16,014	16,014	16,014	16,014
R^2	0.2315	0.2307	0.2303	0.2312
F-value	279.940 ***	303.790 ***	302.740 ***	304.850 ***

** $p < 0.05$, and *** $p < 0.01$.

4.3. The Mediating Effect of Asset Specificity

In the previous section, we demonstrate a positive and significant relationship between executive connections and digital transformation. However, we haven't specified how executive connections affect firms' digital transformation. Thus, in this part, we employ stepwise regression to examine the mediating effect of asset specificity. Table 4 reports the regression results.

First, in column (2), we find a significantly negative coefficient (−0.017) on *Connection* with asset specificity as the dependent variable, suggesting that the executive connection can effectively reduce the investment of enterprise-specific assets. Further, after including the mediating variable (*AS*) in the regression model (1), we document a positive and significant coefficient (0.780) on *Connection* in column (3), which is lower than the estimated coefficient (1.006) in column (1), and the coefficient on *AS* is also significant and negative, revealing that the executive connection could boost digital transformation by lowering asset specificity of firms. In addition, the confidence interval obtained based on the bootstrap test is (0.197, 0.324), being a positive interval excluding the value of 0, and the z-statistic value of *AS* in the Sobel test is positive and significant (7.555). The proportion of the mediating effect in the total effect is 23.4%. All these results reveal that the executive connection can reduce enterprise asset specificity through resource sharing and then promote digital

transformation in ways of saving funds and improving the flexibility of transformation. Finally, Hypothesis 2 (H2) of this paper is verified.

Table 4. The mediating effect of asset specificity.

Variables	(1) *Digital*	(2) *AS*	(3) *Digital*
Connection	1.006 ***	−0.017 ***	0.780 ***
	(4.645)	(−7.072)	(3.639)
AS			−13.183 ***
			(−18.784)
Controls	Included	Included	Included
Year fixed effects	Included	Included	Included
Region fixed effects	Included	Included	Included
N	16,014	16,014	16,014
z-value			7.555
Confidence interval			(0.197, 0.324)
Adjusted R^2	0.228	0.213	0.245
F-value	332.870 ***	291.980 ***	341.360 ***

*** $p < 0.01$.

4.4. The Impact of Environmental Dynamics and Dynamic Capabilities on the Relationship between Executive Connections and Digital Transformation

Table 5 reports the regression results of the moderating effects of environmental dynamics and dynamic capabilities. First, we observe that environmental dynamics exhibit a positive moderating effect between executive connections and enterprise digital transformation with an interaction coefficient of 0.951 in column (2) of Table 5, which is statistically significant at the 5% level. This indicates that in a high environmental dynamic scenario, companies are more inclined to use the executive connection to obtain social resources and support from outside stakeholders in order to lower the uncertainty and risk in the transformation process, which makes the enabling effect of executive connections on digital transformation increase. Thus, Hypothesis 3a (H3a) of this paper is verified. Second, the regression results in column (4) show that the coefficient on the interaction between executive connections and dynamic capabilities is 1.215, which is significant at the 1% level, and thus dynamic capabilities also produce a significant and positive moderating effect between executive connections and digital transformation. This finding suggests that excellent dynamic capability helps companies to rapidly access and integrate external resources embedded in the executive connection, flexibly respond to the environmental changes brought by organizational strategy changes and digital technology applications, and further enhance the empowering effect of the executive connection on digital transformation. Thus, Hypothesis 3b (H3b) of this paper is verified.

Additionally, in order to intuitively demonstrate the moderating effect of environmental dynamics and dynamic capabilities, we divide environmental dynamics and dynamic capabilities into high and low cases based on positive and negative standard deviations and perform a simple slope analysis on the relationship between executive connections and enterprise digital transformation. The moderating effect diagrams are shown in Figures 2 and 3. It can be seen that as the external environment dynamics increase, the influence of executive connections on enterprise digital transformation turns from negative to positive, which is consistent with the expectation of Hypothesis 3a. The positive impact of executive connections on enterprise digital transformation is increasingly enhanced with the improvement of the dynamic capabilities of enterprises. This is consistent with the expectation of Hypothesis 3b.

Table 5. The moderating role of environmental dynamics and dynamic capabilities.

Variables	(1) *Digital*	(2) *Digital*	(3) *Digital*	(4) *Digital*
Connection	1.690 *** (4.756)	1.386 *** (3.834)	1.068 *** (4.657)	0.993 *** (4.339)
ED		1.532 *** (5.675)		
Connection × *ED*		0.951 ** (1.967)		
DC				1.320 *** (8.061)
Connection × *DC*				1.215 *** (4.370)
Controls	Included	Included	Included	Included
Year fixed effects	Included	Included	Included	Included
Region fixed effects	Included	Included	Included	Included
N	9958	9958	13,297	13,297
Adjusted R^2	0.233	0.236	0.224	0.228
F-value	132.190 ***	154.530 ***	234.640 ***	271.690 ***

** $p < 0.05$, and *** $p < 0.01$.

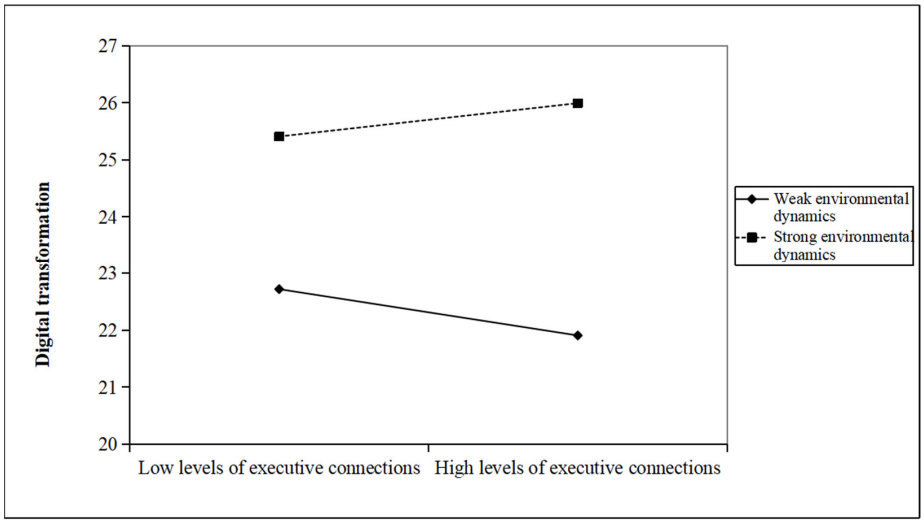

Figure 2. Diagram of the moderating effect of environmental dynamics.

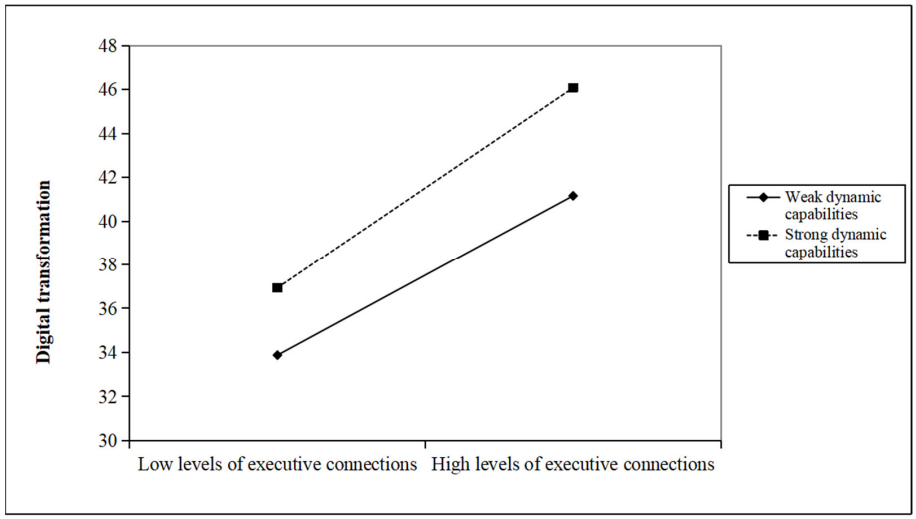

Figure 3. Diagram of the moderating effect of dynamic capabilities.

5. Robustness Tests and Endogeneity Mitigation

In order to verify the robustness and reliability of our research results, we conduct a series of robustness tests and endogeneity treatments. The details are as follows.

5.1. Robustness Tests

We perform multiple robustness tests. First, the model setting is changed. On the basis of controlling for both annual and regional fixed effects, we add firm fixed effects to our regression to control for the impact of factors unobserved at the firm level, and the result is reported in column (1) of Table 6, without substantial changes.

Table 6. Robustness tests.

Variables	(1) *Digital*	(2) $Digital_a$	(3) *Digital*
Connection	0.204 ** (1.975)	0.278 *** (7.769)	0.403 (1.526)
Controls	Included	Included	Included
Year fixed effects	Included	Included	Included
Region fixed effects	Included	Included	Included
Firm fixed effects	Included	Excluded	Excluded
N	16,014	15,915	11,907
Adjusted R^2	0.249	0.025	0.226
F-value	32.440 ***	27.180 ***	229.180 ***

** $p < 0.05$, and *** $p < 0.01$.

Second, we use $Digital_a$ as an alternative measure of digital transformation. Specifically, in order to take other firms within the same industry as a reference, we apply the textual analysis method to obtain the number of keywords related to digital transformation in the firm's annual report, and $Digital_a$ is defined as the number of keywords in each firm's annual report divided by the mean of keywords in all firms for the same industry during the same year. The result displayed in column (2) of Table 6 shows a significant and positive coefficient on *Connection*, confirming the main result reported in Table 2.

Third, the placebo test. We randomly match the independent variable (*Connection*) in the original data with the dependent variable (*Digital*) to disrupt the original one-to-one correspondence. If the estimated coefficient of *Connection* is still significant after random matching, it suggests the possibility of a pseudo-regression in the previous regression. As shown in column (3) of Table 6, after performing this placebo treatment, the estimated coefficient on *Connection* is 0.403 and insignificant, indicating that the relationship between executive connections and corporate digital transformation is not random. In summary, the findings of this paper are robust.

5.2. Endogeneity Mitigation

To mitigate the endogeneity problem that may be caused by sample self-selection, we use propensity score matching to control for it. Specifically, based on the annual median of *Connection*, we set up a treatment group and a control group, representing the firm-year observations with a high level of executive connections and with a low level of executive connections, respectively. Then, the matching covariates are selected, such as firm size, listed years, executive education, nature of ownership, executive age, management shareholding, industry, executive gender, and the number of executives, in order to apply the nearest neighbor matching, radius matching, and kernel matching to features matching. Before the PSM regression, the balanced hypothesis tests for all covariates have been passed, and the average treatment effect (ATT) of firms is significantly positive at the 1% level under the above three matching principles. Finally, Table 7 reports the regression results for the matched sample. The results show that the estimated coefficients on *Connection* remain

significant and positive across all three columns (1) to (3) after controlling for the bias of sample selection, suggesting that our findings are robust.

Table 7. Endogeneity test: PSM.

Variables	(1) Nearest Neighbor Matching	(2) Radius Matching	(3) Kernel Matching
Connection	0.766 **	1.094 ***	1.094 ***
	(2.441)	(4.911)	(4.911)
Controls	Included	Included	Included
Year fixed effects	Included	Included	Included
Region fixed effects	Included	Included	Included
N	7581	14,963	14,963
Adjusted R^2	0.217	0.226	0.226
F-value	149.360 ***	308.440 ***	308.440 ***
ATT	Difference = 0.863 ***	Difference = 0.806 ***	Difference = 0.796 ***
	(T = 2.610)	(T = 3.240)	(T = 3.190)

** $p < 0.05$, and *** $p < 0.01$.

In this paper, there may be an endogeneity problem caused by reverse causality, i.e., the deeper the digital transformation of a firm, the more willing the firm is to rely on executive connections to obtain external resource support and accelerate the digital transformation process which, in turn, is more likely to build and maintain the external executive connections. Given this, we adopt the lagged regression method to control for it, and the independent variable of executive connections is regressed with one and two lags, respectively. Table 8 reports the results of the lagged regressions. In column (1), the estimated coefficient on *PreConnection1* is 1.009 and is positive and significant. In column (2), the estimated coefficient on *PreConnection2* is 1.120, which is still significant at the 1% level. The above results document that after dealing with the endogenous explanatory variable, the executive connection can still effectively contribute to the digital transformation of the company.

Table 8. Endogeneity test: the lagged regression.

Variables	(1) *Digital*	(2) *Digital*
PreConnection1	1.009 ***	
	(3.969)	
PreConnection2		1.120 ***
		(3.745)
Controls	Included	Included
Year fixed effects	Included	Included
Region fixed effects	Included	Included
N	13,427	11,196
Adjusted R^2	0.223	0.217
F-value	256.360 ***	215.530 ***

*** $p < 0.01$.

6. Summary

This section is a summary of the full text. According to the above theoretical exploration and empirical analysis, we list the important research conclusions. On this basis, we conduct a comparative discussion with the findings of other authors. Then, we put forward corresponding countermeasures and suggestions based on the research conclusions. Finally, we indicate the limitations of this study and the future research direction.

6.1. Conclusions

The executive connection is a key access point for firms to external resources and capabilities and provides a good idea for firms to leverage the power of external entities to amplify their digital transformation potential. Hence, in the initial study, we expect the executive connection to effectively assist in digital transformation and thus accelerate its development. We also suppose that there are variations in the impact of different types of executive connections. These conjectures are perfectly confirmed by our main empirical results. Specifically, we find that the executive connection can greatly promote enterprise digital transformation. The business connection, technical connection, and financial connection are all beneficial to digital transformation, among which the technical connection has the greatest favorable effect, followed by the business connection. The influence of the political connection on digital transformation is not obvious. In addition, we confirm that the executive connection can effectively reduce enterprise asset specificity which, in turn, drives the development of digital transformation. The results of the boundary mechanism test demonstrate that the external environmental dynamics and the internal dynamic capabilities reinforce the enabling effect of executive connections on corporate digital transformation.

6.2. Discussion

Compared with the findings of other authors, first of all, we document the impact of the connections of all executives on digital transformation rather than just focusing on the connection of the CEO. It is frequently more valuable for enterprise research to concentrate on the overall characteristics of top management teams than on the individual executive. Secondly, we distinguish the differentiated impact of different types of executive connections on digital transformation, which can assist enterprises in taking more precise measures to promote their digital transformation. Thirdly, we innovatively identify the mediating role of asset specificity, as well as the moderating role of environmental dynamics and dynamic capabilities. This makes our research results more comprehensive and in-depth.

6.3. Suggestions

From the above findings, we conclude the following insights. First, enterprises need to strengthen the executive connection's empowering effect on digital transformation. Companies should be fully aware of how information exchange, knowledge sharing, and resource complementation based on the executive connection affect their digital transformation. Then, they increasingly focus on the construction and maintenance of executive connections, such as the technical connection and the business connection, and thoroughly explore the heterogeneous information, knowledge, experience, and skills among external subjects to provide the necessary intellectual and technical support for digital transformation. On the basis of this, companies also need to control their degree of relationship with the government to ensure the empowering effect of the executive connection. This includes maintaining excellent relations with the government while still keeping an appropriate distance from it.

Second, enterprises need to be clear about the impact of asset specificity on the digital transformation empowered by executive connections. Enterprises should keep their specific asset investment within a reasonable range. They can fully utilize the existing executive connections to integrate and share resources among enterprises and reduce their specific asset investment without affecting daily operations. When asset specificity is lower, enterprises are better able to respond to changes brought on by digital transformation and also effectively mitigate the financial constraints they encounter during this process.

Third, enterprises must pay attention to the moderating effect of external environmental dynamics and enterprise dynamic capabilities on the relationship between executive connections and digital transformation. To a certain extent, strong environmental dynamics and enterprise dynamic capabilities expand the space for the effectiveness of the execu-

tive connection and promote the development of digital transformation at a higher level. Therefore, when companies are faced with a more dynamic environment, they should increasingly focus on strengthening their digital transformation by leveraging executive connections. Additionally, enterprises should simultaneously concentrate on developing their dynamic capabilities, forming the ability to flexibly respond to changes in the digital environment and rapidly integrate internal and external resources, so that external resources could be transformed into the key driving force to promote the development of digital transformation.

Finally, in order to create a superior environment for enterprises' digital transformation, the government should continue to optimize the macro policy system, and increase the special financial support, financing convenience, and fiscal and tax preference for enterprises to carry out digital transformation. Meanwhile, government agencies must avoid excessive intervention and give enterprises full autonomy in digital transformation to activate the potential of enterprises.

6.4. Limitations and Outlook

Finally, although the research hypotheses proposed in this paper have been basically verified, there are still the following limitations which need to be continuously improved in future research. In terms of research objects, this study mainly focuses on the digital transformation of manufacturing enterprises and lacks attention and discussion on other key industries, including the construction industry, the wholesale and retail industry, etc. Future studies can expand the sample to the whole industry. This not only can broaden the coverage of research objects but can also conduct a comparative study of different industries and analyze the industrial differences in executive connections, enabling enterprise digital transformation. In terms of the measure of digital transformation, this paper adopts the textual analysis method to extract the number of keywords related to digital transformation in the firm's annual report to measure the degree of enterprise digital transformation. The main limitation of this method is that it is difficult to avoid the situation of "inconsistent words and deeds" of enterprises. That is to say, the keywords about digitalization mentioned in the annual report are just to express the enterprise's plans or assumptions and the real implementation is not carried out, and even the enterprise intentionally exaggerates the degree of its digital transformation. Given this, future studies can take the indicator of hardware and software investment related to digital transformation into consideration when measuring the degree of enterprise digital transformation, build a comprehensive indicator, and improve the accuracy of the measure of digital transformation.

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Data Availability Statement: The original contributions presented in this study are included in the article; further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as potential conflict of interest.

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