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Female Executives and Digital Transformation in Enterprises

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Abstract: In the digital era of the economy, digital transformation has become an important path for high-quality development of Corporates. This article is based on the Guotai An database and uses Chinese companies from 2010 to 2021 as research samples to empirically examine the impact of the proportion of female executives on corporate digital transformation. The study found that: (1) The proportion of female executives can enhance a company's level of digitalization. (2) This effect is mainly achieved through increasing the company's research and development intensity, thereby improving its digitalization level. (3) The role of female executives in promoting digitalization is more pronounced in non-state-owned, large companies with dispersed equity ownership.

Keywords: Female executives, Digitalization, R&D intensity, Corporate governance

1. Introduction

In the era of the digital economy, digital transformation has become an important path for businesses to achieve high-quality development. In the wave of digitalization, in order to keep up with the pace of the times and survive in fierce market competition, it is imperative for companies to undergo digital transformation and upgrade. This is not only a necessary requirement to adapt to the development of the times but also a crucial stage in the development of enterprise informatization. Furthermore, in the digital age, businesses face many challenges, including intensified market competition, accelerated technological updates, and changes in consumer behavior, among others. Digital transformation can help companies adapt to and address the constantly changing business environment and market demands. It can improve operational efficiency and productivity, helping companies stand out in the competitive landscape and achieve sustained growth.

On the other hand, it has been proven that having female executives benefits a company's financial performance [1]. Compared to male executives, female executives are more risk-averse and have a higher sensitivity to financial activities, thereby reducing opportunistic behavior by corporate managers. Research has shown that the appointment of female executives in companies is positively correlated with company returns, based on a statistical analysis combining the results of 140 studies [1]. Therefore, it can be seen that female executives can provide an economic foundation for the digital transformation of businesses.

Research literature review, research motivation, and research question: Existing studies on female executives mainly analyze the impact of the proportion of female executives on a company's financial performance. These studies mainly focus on the influence of female executives on corporate tax incentives, labor-capital financial distribution, and whether female executives can improve various

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financial indicators such as return on assets (ROA). Against the backdrop of digitalization becoming an important path for businesses to achieve high-quality development, does the presence of female executives also have an impact on a company's level of digitalization? There is limited research on this question in existing literature. According to relevant studies, it is undeniable that female executives have been proven to potentially have a positive impact on a company's labor-capital financial distribution and return rates, variables that may further affect a company's level of digitalization.

Based on this, this study selects data from Guotai An to establish a fixed-effects model and empirically test whether the proportion of female executives in a company has a positive impact on its digital transformation. The research findings indicate that:

(1) The proportion of female executives can enhance a company's level of digitalization.

(2) This effect is mainly achieved through increasing the company's research and development intensity, thereby improving its digitalization level.

(3) The role of female executives in promoting digitalization is more pronounced in non-state-owned, large companies with dispersed equity ownership.

These results suggest that having a higher proportion of female executives can contribute positively to the digital transformation of companies, particularly by boosting research and development efforts. Furthermore, the impact of female executives on digitalization is more significant in non-state-owned companies, larger enterprises, and those with more dispersed ownership structures.

The marginal contributions of this study can be summarized in the following three aspects:

Firstly, this article contributes to the existing literature on the impact of female executives on corporate governance. Existing research mainly focuses on how female executives improve financial performance, their influence on labor-capital financial distribution, and their impact on company innovation.

Secondly, this study contributes to the literature on factors affecting digital transformation in companies. In contrast to existing literature, this study primarily explores internal factors that influence digital transformation. Existing literature mainly analyzes the impact of technology and funding on digital transformation, with fewer studies focusing on internal factors. While Wu Yuhui discussed the relationship between executive IT background and digital transformation[2], the impact of executive gender on digital transformation was not addressed.

Lastly, this study employs a rigorous empirical methodology to ensure the robustness and validity of the research findings. Through careful theoretical analysis and empirical testing, the study confirms the mechanism through which the proportion of female executives affects the level of digitalization in companies. Additionally, this article further examines the heterogeneity of this impact.

Overall, this study makes significant contributions by addressing the influence of female executives on corporate governance and digital transformation, exploring internal factors affecting digital transformation, and employing a rigorous empirical approach to analyze the mechanisms and heterogeneity of these effects.

The rest of this paper is organized as follows: Chapter Two Literature Review and Hypotheses, Chapter Three Methodology, Chapter Four Results, Chapter Five Discussion, Chapter Six Conclusion.

2. Literature Review and Hypotheses

2.1. Female executives contribute to improving a company's financial performance

Gender as an important managerial characteristic has received widespread attention from scholars. Numerous studies have shown that female executives are more risk-averse [3]. Female executives

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can also develop rational financial allocation policies [4]. Thus, the company's financial performance can be enhanced.

Firstly, female executives exhibit a greater aversion to risk and possess higher sensitivity towards the financial activities of a company, which reduces opportunistic behaviors among corporate managers. Research indicates that female executives are relatively cautious and less overconfident, enabling them to make prudent decisions and mitigate risks. This contributes to enhancing the financial soundness of the company [5]. Moreover, excessive corporate investments significantly increase various costs and lower investment efficiency. Female executives are more sensitive in this regard, effectively curbing the company's tendencies towards overinvestment and improving investment efficiency [5]. In addition, female executives enhance the organization's ability to interpret complex environments and help the organization establish cognitive focus. Therefore, in crisis situations, female executives have a significant positive impact on the company's turnaround [6]. Post C and Byron K conducted a meta-analysis of 140 studies, concluding that appointing female executives is positively correlated with company returns [1].

Secondly, female executives can develop rational financial allocation policies, particularly in labor and capital distribution. Yuan Fang pointed out that female executives are more altruistic, emphasizing ethics, morality, and employee welfare. [4] Li Lan et al. also found through surveys that female entrepreneurs prioritize employees more than their male counterparts and adopt a leadership style that combines firmness and flexibility. [7] In any company, employees are invaluable assets, and their satisfaction and motivation directly impact the company's financial status. [8] Wang Hongfang et al. confirmed the inverted U-shaped relationship between employee compensation and job satisfaction. [9] It means that a certain level of compensation can motivate employees, but when the salary exceeds a certain threshold, it may fail to meet employees' needs for autonomy and a sense of belonging, leading to a decrease in job satisfaction. Research has found that female executives pay more attention to minority groups in the workplace, thus reducing discriminatory incidents within the company [10], effectively narrowing the gender pay gap among employees. Therefore, it can be inferred that female executives tend to allocate employee wages fairly to ensure their reasonable interests, thereby improving the company's financial position.

2.2. Female executives and corporate innovation

Zeng Ping and Wu Qihong selected the companies listed on the ChiNext board of the Shenzhen Stock Exchange between 2009 and 2010 as their research subjects. Through multiple regression analysis, they concluded that there is a significant link between female executives and technological innovation in enterprises. [11] Shao Jianbing pointed out that corporate innovation investment has characteristics such as long-term returns, high investment amounts, and strong uncertainty in investment outcomes, which are influenced by managers' willingness to engage in innovative activities. [12] The research results showed that female managers exhibit lower levels of overconfidence and higher risk aversion, leading to fewer M&A and expansion behaviors during operations [13]. This indicates that female executives have less motivation to invest in innovation. However, Shao Jianbing also pointed out that the decision-making behavior of female managers is influenced by the environment they are in. [12] Different promotion paths and incentive mechanisms lead female executives to adopt different behavioral styles. For example, female Chief Technology Officers (CTOs), compared to other female executives, possess broader management experience and generally have higher levels of education, which results in greater acuity in innovation decision-making. They are able to grasp the dynamics of innovation activities and place a higher emphasis on innovation investment. To some extent, this overcomes the inherent personality shortcomings attributed to gender and breaks through the "glass ceiling" effect in career advancement.

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Secondly, organizational redundancy refers to various resources within a company or organization that exceed normal demand and can be freely allocated [14]. It can effectively buffer external environmental changes and risks brought about by research and development innovation to some extent. Redundant resources are often regarded as catalysts for innovation as they provide additional resources necessary for exploring solutions and opportunities within an enterprise [15]. Cao Jiajia pointed out that female executives tend to make decisions that maintain higher financial flexibility, which can significantly promote organizational redundancy within a company. [16] Research has shown that women have a strong risk aversion awareness and exhibit a cautious and prudent approach, contrasting with the bold and aggressive style often associated with men. Therefore, they demonstrate higher prudence in financial decision-making [17], such as engaging in fewer debt financings. Moreover, studies indicate that companies led by female CEOs tend to hold more cash, have lower debt ratios, and make lower capital expenditures [13]. Female executives often lean towards making conservative decisions that reserve more redundant resources for the company to mitigate the impact of innovation risks. Shao Jianbing pointed out that reserved borrowing capacity serves as a support for investment in innovation. [12] The higher the reserved borrowing capacity, the greater the opportunity for companies to invest in innovation.

2.3. Female executives and digital transformation in enterprises

Enterprise digital transformation essentially involves the unified integration of digital technologies throughout the entire organization. From startups to multinational corporations, these technologies have changed and optimized the way companies deploy and manage their day-to-day operations [18]. In the era of digitalization, it is imperative for companies to follow the pace of the times and survive in fierce market competition by undergoing digital transformation. Digital transformation can help companies adapt to and address the constantly changing business environment and market demands, improve operational efficiency and productivity, and enable them to stand out in corporate competition. Through their research, Ning Zhao and Jianxin Ren found that digital transformation significantly impacts improving capacity utilization and serves as an important driver for production and innovation within enterprises [19]. Furthermore, Nancy White suggests that enterprise digital transformation can lead to cost reduction, improved product and service quality, reduced time-to-market, enhanced customer experience, and foster a positive company culture [20]. The development of technology has provided a technical foundation for enterprise digital transformation, which requires sufficient financial support from businesses [21]. Additionally, existing literature indicates a strong connection between executives with an IT background and enterprise digital transformation [2]. However, there is currently limited research directly studying the relationship between female executive teams and enterprise digital transformation. Nonetheless, previous studies have demonstrated that the characteristics of female executive teams may have significant implications for enterprise digital transformation.

H1: Based on the information provided, we can hypothesize that a higher proportion of female executives has a positive impact on enterprise digital transformation.

3. Methodology

3.1. Regression Model

To test the hypotheses proposed in this paper, a fixed-effects model is constructed. This study controls for other variables that may influence the level of digitalization in companies, while also controlling for time fixed effects, individual fixed effects, and interaction fixed effects between industry and city. The regression equation is as follows:

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$$Dig_{it} = \alpha + \beta_1 \text{Female}_{it} + X_{it}^{'} \varphi + \eta_i + \gamma_t + \mu_{ind \times t} + \varepsilon_{ct}$$

Where:

Dig represents the level of digitalization of company i in year t.

Female represents the proportion of female executives in company i in year t.

X represents the set of control variables.

η_c represents individual fixed effects.

γ_t represents time fixed effects.

$\mu_{ind \times t}$represents interaction fixed effects between industry and city.

ε_{ct}represents the random disturbance term.

3.2. Data Source and Variable Setting

Data Source: The data used in this study is sourced from the Guotai An database. Guotai An database is a financial database launched by Guotai An Corporation, which contains comprehensive financial data and information covering various fields such as stocks, bonds, funds, futures, and foreign exchange. It is one of the most authoritative databases in the Chinese financial industry and widely utilized in financial institutions, investment companies, securities firms, banks, and other sectors.

The data has been processed as follows:

(1) Companies classified as ST (Special Treatment) have been excluded.

(2) Companies in the financial industry have been excluded.

(3) Companies with an insufficient asset-liability coverage ratio have been excluded.

(4) Companies with fewer than 50 employees have been excluded.

(5) The upper and lower 1% of all continuous variables has been winsorized.

Variable Setting: The dependent variable is the level of digitalization of companies, measured by "word frequency" in annual reports. The independent variable is the proportion of female executives. The control variables include:

Age: The difference between the year of company establishment and the current year.

Size: The natural logarithm of total assets.

Lev: Total liabilities divided by total assets.

ROA: Net profit to total assets ratio.

Top1: Proportion of shares held by the largest shareholder.

Cashflow: Ratio of current assets to current liabilities.

DOI: 10.54254/2754-1169/73/20230840

Table 1: for specific variable definitions.

Dependent variable	Digitalization Level	Dig	Logarithm of word frequency in company annual reports, measuring the level of digitalization.
Independent variable	Proportion of Female Executives	Female	Ratio of female executives to total executives, measuring the representation of women in top management.
Control variables	Company Age	Age	Difference between the year of company establishment and the current year.
	Company Size	Size	Natural logarithm of total assets, representing the scale of the company.
	Capital Structure	Lev	Total liabilities divided by total assets, indicating the financial leverage of the company.
	Return on Assets	ROA	Net profit to total assets ratio, measuring the profitability of the company.
	Top Shareholder Ownership	Top1	Proportion of shares held by the largest shareholder.
	Current Ratio	Cashflow	Ratio of current assets to current liabilities, reflecting the company's liquidity.

4. Results

4.1. Descriptive statistics

Descriptive statistics are presented in Table 2: From Table 2, it can be observed that the dependent variable "Dig" has a mean of 1.2276, a median of 0.6931, a standard deviation of 1.3654, with a minimum value of 0 and a maximum value of 4.9767. This provides insights into the basic characteristics of the level of digitalization in companies.

The independent variable "Female1" (proportion of female executives) has a mean of 0.1613 and a median of 0.1429, indicating that only 16% of female executives are present in listed companies. The standard deviation is 0.1650, with a maximum value of 0.6667 and a minimum value of 0.

The descriptive statistics for other control variables are presented in Table 2. It can be observed that the descriptive statistics of the selected control variables are similar to those found in related literature [22], confirming the effectiveness and accuracy of the data processing in this study.

gen Female1 = the number of female executives/the number of total executives

DOI: 10.54254/2754-1169/73/20230840

Table 2: Descriptive statistics

Variable	Mean	p50	SD	Max	Min
dig	1.2276	0.6931	1.3654	4.9767	0.0000
Female1	0.1613	0.1429	0.1650	0.6667	0.0000
R & D investment intensity	4.6870	3.6200	4.7277	27.4900	0.0200
Profit	0.0626	0.0733	0.1365	0.3468	-0.7618
Age	16.9966	17.0000	5.8690	32.0000	4.0000
Size	22.0001	21.8272	1.2901	25.9847	19.4304
Lev	0.4114	0.4027	0.2040	0.8845	0.0497
ROA	0.0426	0.0415	0.0617	0.2112	-0.2346
Top1	35.0611	33.0000	15.0130	75.0000	8.9200
TobinQ	2.0493	1.6302	1.2968	8.5446	0.8683
Cashflow	2.6281	1.6784	2.8531	18.0746	0.3152

4.2. Regression

The study utilizes a stepwise regression approach, sequentially adding control variables, time fixed effects, industry fixed effects, and the fixed effects between industry and city to examine the impact of the number of female executives on the level of digitalization. The results are presented in Table 3. The regression coefficients for Female1 are 0.8816, 0.7931, 0.5445, 0.1917, and 0.1521 in columns (1) to (4), respectively. These coefficients are statistically significant at the 1% level in columns (1) to (4), and at the 5% level in column (5). This indicates a positive correlation between the proportion of female executives and the level of digitalization, supporting the hypothesis of this study.

Regarding the control variables, taking column (5) as an example, the regression coefficient for Age is 0.0067, which is statistically significant at the 5% level and negative. This suggests that the age of the company influences its digital transformation, possibly due to older companies being relatively more conservative. In addition, the regression coefficients for Lev and Top1 are 0.2837 and 0.0028, respectively, both statistically significant at the 1% level and negative. This implies that higher leverage and a higher proportion of shares held by the largest shareholder inhibit the digitalization process. One possible explanation is that high debt levels hinder sufficient funding for digital transformation, while a dominant position of the largest shareholder may constrain the digitalization process to some extent. On the other hand, the regression coefficient for Size is 0.1813, statistically significant at the 1% level and positive. This indicates that larger total assets accelerate the process of digital transformation. ROA and Cashflow show no significant effects, suggesting that they do not play a prominent role in the digitalization process.

Table 3: Regression

	(1)	(2)	(3)	(4)	(5)
	dig	dig	dig	dig	dig
Female1	0.8816***	0.7931***	0.5445***	0.1917***	0.1521**
	(0.1714)	(0.1342)	(0.1357)	(0.0575)	(0.0705)
Age		0.0190***	-0.0208***	-0.0063***	-0.0067**
		(0.0033)	(0.0063)	(0.0023)	(0.0026)
Size		0.2194***	0.1220***	0.1746***	0.1813***
		(0.0311)	(0.0281)	(0.0166)	(0.0155)

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Table 3: (continued).

Lev		-1.0803***	-0.3568	-0.2215**	-0.2837***
		(0.2622)	(0.2209)	(0.0894)	(0.1003)
ROA		-0.9264**	-0.3278	-0.0691	0.0280
		(0.3926)	(0.3536)	(0.1987)	(0.2035)
Top1		-0.0103**	-0.0078**	-0.0021**	-0.0028***
		(0.0040)	(0.0036)	(0.0008)	(0.0008)
TobinQ		0.1065**	0.0929**	0.0366***	0.0330***
		(0.0425)	(0.0421)	(0.0084)	(0.0086)
Cashflow		-0.0006	0.0070	-0.0113	-0.0121
		(0.0095)	(0.0090)	(0.0072)	(0.0079)
Time fixed effects	No	No	Yes	Yes	Yes
Industry fixed effects	No	No	No	Yes	Yes
Fixed effects between industry and city	No	No	No	No	Yes
N	35264	32139	32139	32139	30464
Adj. R^2	0.0113	0.0689	0.1797	0.4920	0.4971

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels respectively (two-tailed). The values in parentheses indicate robust standard errors.

4.3. Change Independent variable

To further investigate the impact of different types of female executives, replacing Female1 with Female2 (number of female directors / total number of directors) and Female3 (number of female executives in regulatory positions / total number of executives in regulatory positions), the results are presented in Table 4. The regression coefficient for Female2 is 0.1162, significant at the 5% level, and positive. The regression coefficient for Female3 is 0.3333, significant at the 1% level, and positive.

These results indicate that female executives can indeed contribute to the digitalization process of companies, and the significance level is higher for executives in regulatory positions compared to the board of directors. This suggests that having a higher proportion of women in key regulatory roles has a stronger positive impact on digitalization efforts.

gen female2 = number of female directors / total number of directors

gen female3 = number of female executives in regulatory positions / total number of total executives in regulatory positions

Table 4: regression coefficient

	(1) Dig	(2) Dig
Female2	0.1162**	
	(0.0473)	
Female3		0.3333***
		(0.0553)
Control variables	Yes	Yes
Time fixed effects	Yes	Yes

DOI: 10.54254/2754-1169/73/20230840

Table 4: (continued).

Industry fixed effects	Yes	Yes
Fixed effects between industry and city	Yes	Yes
N	30466	30469
Adj. R^2	0.4969	0.4975

4.4. Tobit model

Changing the model to the Tobit model as shown in Table 5 while maintaining control variables and time fixed effects, the results are as follows:

In column (1) of Table 5, with the inclusion of control variables and time fixed effects, the regression coefficient for Female1 is 0.7088, significant at the 1% level, and positive. This indicates a positive correlation between the proportion of female executives and the level of digitalization.

After adding industry fixed effects in column (2), the regression coefficient for Female1 becomes 0.9208, still significant at the 1% level and positive. This suggests that the positive relationship between the proportion of female executives and digitalization remains even after controlling for industry-specific factors.

Subsequently, with the addition of fixed effects between industry and city in column (3), the regression coefficient for Female1 decreases to 0.0622. Although the significance level decreases, it remains positive, indicating a continuing positive relationship between the proportion of female executives and digitalization even after accounting for industry and city specific characteristics.

These results suggest that even when using the Tobit model, there is still a positive correlation between the presence of female executives and the level of digitalization in companies.

Table 5: Changing the model to the Tobit model

	(1) Dig	(2) Dig	(3) Dig
Female1	0.7088*** (0.0605)	0.9208*** (0.0729)	0.0622 (0.0614)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Industry fixed effects	No	Yes	Yes
Fixed effects between industry and city	No	No	Yes
N	32139	32109	32139
Adj. R^2			

4.5. Endogeneity

Considering the potential issues of omitted variables and endogeneity in Model , this study introduces the proportion of female executives in other companies in the same industry within the local area as an instrumental variable. The two-stage model is used to re-examine the impact of the proportion of female executives on the level of digitalization. The reason for selecting this variable as an instrument is that it is correlated with the proportion of female executives in the focal company but unrelated to its digitalization level, satisfying the requirements of relevance and exogeneity.

The results of the instrumental variable regression are presented in Table 6, column (1). After addressing the endogeneity issue using the instrumental variable approach, the regression coefficient

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for female executives on the level of digitalization is 0.2368, significant at the 5% level. This further confirms the robustness of the conclusions drawn in this study.

Furthermore, to address potential omitted variable concerns, this study incorporates "Fixed effects between time and city" and "Fixed effects between time and industry" in addition to the instrumental variable approach. The results are shown in columns (2) and (3) of Table 5. The regression coefficients for female executives on the level of digitalization are 0.1494 and 0.0774, respectively, significant at the 1% and 5% levels.

In conclusion, after mitigating potential endogeneity biases, the findings of this study remain robust.

Table 6: endogeneity

	(1) Dig	(2) Dig	(3) Dig
Female1	0.2368**	0.1494***	0.0774**
	(0.1076)	(0.0371)	(0.0392)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	No	No
Industry fixed effects	Yes	No	No
Fixed effects between industry and city	Yes	Yes	Yes
Fixed effects between time and city	No	Yes	Yes
Fixed effects between time and industry	No	No	Yes
N	30464	30397	30165

4.6. Winsorization

To ensure the accuracy and reliability of the data, we conducted a winsorization procedure to address potential outliers. The results are presented in Table 7.

In column (1) of Table 7, utilizing a winsorization approach with a truncation threshold of 1.5%, the regression coefficient for Female1 is 0.1556, significant at the 5% level, and positive.

We further adjusted the truncation threshold to 2.5% in column (2) of Table 7, resulting in a regression coefficient for Female1 of 0.1580, still significant at the 5% level, and positive.

Lastly, under a winsorization range of 5%, as shown in column (3) of Table 7, the regression coefficient for Female1 is 0.1624, also significant at the 5% level, and positive.

These findings consistently indicate that, when ensuring the accuracy of the data through winsorization, female executives play an important role in enhancing the level of digitalization within companies.

Table 7: winsorization

	(1)1.5% Dig	(2)2.5% Dig	(3)5% Dig
Female1	0.1556**	0.1580**	0.1624**
	(0.0707)	(0.0716)	(0.0721)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Fixed effects between industry and city	Yes	Yes	Yes
N	30464	30464	30464

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4.7. Removing certain sample periods

To further ensure the accuracy of the data, we conducted an analysis by removing certain sample periods. The results are presented in Table 8.

Firstly, we removed samples before 2012 due to their distant time frame. The regression coefficient for Female1 is 0.1899, significant at the 5% level, and positive.

Secondly, considering the impact of the COVID-19 pandemic, we excluded samples after 2019. In this case, the regression coefficient for Female1 is 0.1595, significant at the 5% level, and positive.

Lastly, focusing on the period between 2012 and 2019, the regression coefficient for Female1 is 0.2098, also significant at the 5% level, and positive.

Overall, after controlling for different sample periods, the results consistently support the hypothesis that female executives have a positive impact on the level of digitalization.

Table 8: result of removing certain sample periods

	(1) Removed samples before 2012 Dig	(2) Removed samples after 2019 Dig	(3)2012-2019 Dig
Female1	0.1899** (0.0834)	0.1595** (0.0673)	0.2098** (0.0832)
Control variables	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Fixed effects between industry and city	Yes	Yes	Yes
N	24822	25046	19404
Adj. R^2	0.4785	0.4940	0.4830

4.8. Mediating effect

Based on the hypothesis, we expect that the proportion of female executives may influence the level of digitalization in companies through the mediating effects of return on net assets (RONA) and research and development (R&D) intensity. Following the approach used by Wen Zhonglin [23], this study examines the mediating effects of RONA and R&D intensity. The results are presented in Table 9.

Columns (1)-(3) of Table 9 display the regression results with RONA as the mediating variable. We find that the regression coefficient for the proportion of female executives on RONA is 0.0031, but it is not statistically significant at the 10% level. Additionally, when including RONA as a variable in column (3), the regression coefficient for Female1 does not exhibit significant changes. This suggests that RONA cannot serve as a mediating variable for the relationship between the proportion of female executives and the level of digitalization.

On the other hand, columns (4)-(6) of Table 9 present the regression results with R&D intensity as the mediating variable. We find that the regression coefficient for the proportion of female executives on R&D intensity is 0.1302, significant at the 5% level. When including R&D intensity in column (6), the regression coefficient for Female1 decreases to 0.7502, and the regression coefficient for R&D intensity is 0.1082, significant at the 1% level. This indicates that the proportion of female executives can enhance the level of digitalization in companies through increasing R&D intensity. Specifically, the effect of the proportion of female executives on digitalization through improved R&D intensity accounts for approximately 4% of the total effect.

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In summary, the findings suggest that the proportion of female executives can positively impact the level of digitalization in companies through increased R&D intensity. However, RONA does not serve as a significant mediating variable in this relationship.

Table 9: result of mediating effect

	(1) Dig	(2) RONA	(3) Dig	(4) Dig	(5) R&D	(6) Dig
Female1	0.7931*** (0.0451)	0.0031 (0.0021)	0.7924*** (0.0451)	0.7804*** (0.0524)	0.1302** (0.0528)	0.7502*** (0.0494)
RONA			0.2151* (0.1228)			
R&D						0.1082*** (0.0019)
Control variables	Control	Control	Control	Control	Control	Control
N	32139	32139	32139	26251	26251	26251
Adj. R^2	0.0689	0.8041	0.0690	0.0560	0.1878	0.1616

4.9. Heterogeneity test

To account for heterogeneity across different types of companies, a heterogeneity test was conducted, and the results are presented in Table 10. The table includes six different types of enterprises.

In the case of (1) state-owned enterprises, the regression coefficient for Female1 is 0.0333, which is not statistically significant. On the other hand, for (2) non-state-owned enterprises, the regression coefficient for Female1 is 0.1118, significant at the 5% level. This suggests that the proportion of female executives has a stronger positive impact on the level of digitalization in non-state-owned enterprises compared to state-owned enterprises. One possible reason is that state-owned enterprises may face constraints imposed by relevant policies, leading to reduced autonomy in innovation among the company's management.

Furthermore, for (3) large enterprises, the regression coefficient for Female1 is 0.2351, significant at the 1% level, while for (4) small enterprises, it is not significant. This finding indicates a correlation with the total assets of the enterprise, where large enterprises have more funds available for digital transformation.

Lastly, for (5) firms with concentrated ownership, the regression coefficient for Female1 is 0.1302, significant at the 5% level, while for (6) firms with dispersed ownership, the coefficient is 0.1832, significant at the 1% level. This suggests that in firms with dispersed ownership, the proportion of female executives can have a stronger positive impact on the level of digitalization.

In conclusion, the results indicate that the impact of the proportion of female executives on the level of digitalization varies across different types of companies. Non-state-owned enterprises, large enterprises, and firms with dispersed ownership tend to benefit more from an increased representation of female executives in terms of enhancing digitalization.

Table 10: heterogeneity

	(1) State-owned enterprises Dig	(2) Non-state-owned enterprises Dig	(3) Large enterprises Dig	(4) Small enterprises Dig	(5) Concentrated ownership Dig	(6) Dispersed ownership Dig
Female1	0.0333	0.1118**	0.2351***	0.0509	0.1302**	0.1832***

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Table 10: (continued).

	(0.0644)	(0.0477)	(0.0569)	(0.0523)	(0.0528)	(0.0558)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects between industry and city	Yes	Yes	Yes	Yes	Yes	Yes
N	10870	18481	15152	14131	14575	14836
Adj. R^2	0.4853	0.4992	0.5057	0.4985	0.4730	0.5102

5. Discussion

This study elucidates the relationship between female executives and the level of digitalization in companies, exploring the influencing factors of the digitalization process from an internal perspective. A diverse board of directors is beneficial for enhancing corporate governance. A diverse board can attract experts and talents from different fields and industries, providing the company with a broader range of management experience and specialized knowledge, thereby improving corporate governance. Furthermore, board members with different cultural backgrounds, industry experiences, and professional knowledge can bring diverse perspectives and ways of thinking to the company, enhancing its adaptability and innovation capabilities, thus promoting digital transformation. Therefore, companies should focus on increasing experts and talents from different fields and industries on their boards of directors.

There may be limitations to this article. Due to data constraints, the data selected for this study covers the period from 2010 to 2021, which has limited scope. Moreover, this study focuses on Chinese companies, and the influence may vary in countries with different cultural backgrounds. Additionally, the measurement of female executives could be more comprehensive, considering factors such as age, educational background, and work experience, for more in-depth research.

Future studies can focus on the impact of female executives on different aspects of digitalization, the variations in their influence across different regions and countries, and the influence of female executives with different educational backgrounds on digitalization.

6. Conclusion

In the wave of digitalization, it is imperative for businesses to keep up with the times and survive in fierce market competition by undergoing digital transformation and upgrading. Digital transformation can help companies adapt to and respond to constantly changing business environments and market demands, improve operational efficiency and productivity, and help them stand out in corporate competition. Female executives, compared to male executives, are more averse to risks and are more sensitive to financial activities, thereby reducing opportunistic behaviors of corporate managers and improving the financial condition of the company. As a result, the company has more funds to invest

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in digital research and development. This article examines the impact of the proportion of female executives on the level of digitalization in companies.

The study found that:

(1)The proportion of female executives can enhance the level of digitalization in companies.

(2)This effect is mainly achieved through increasing research and development intensity, thus improving the level of digitalization in companies. The proportion of female executives accounts for approximately 4% of the total effect by increasing research and development investment intensity to enhance the level of digitalization.

(3)The positive impact of female executives on the level of digitalization in companies is more pronounced in non-state-owned, large enterprises, and companies with dispersed ownership.

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