Executive Digital Background and Artificial Intelligence Use: A Study Based on Empirical Model

Shengnan Xu[1,*], Shijie Yuan[2]

[1]School of Business Administration, Zhongnan University of Economics and Law, Wuhan, China, 430060

[2]School of Finance, Harbin University of Commerce, Harbin, China, 150028

* Corresponding Author Email: xushengnan@stu.zuel.edu.cn

Abstract. In the era of digital change, Artificial Intelligence (AI) has become an indispensable tool for enterprises to enhance competitiveness and optimize operations. Executives, as the core of decision-making in enterprises, profoundly impact enterprises' digitalization. This study delves into the intriguing realm of corporate artificial intelligence by examining the impact of executives' digital backgrounds on A-share listed companies in China's Shanghai and Shenzhen stock markets from 2001 to 2021. The findings reveal a significant influence of executives' digital background on the integration of corporate AI, even after thorough endogeneity and robustness tests. Furthermore, the study's heterogeneity analysis highlights how this positive influence is particularly pronounced in eastern and western regions, non-polluting industries, and asset-intensive enterprises. Ultimately, this research provides guidance for advancing AI application in enterprises and driving digital transformation.

Keywords: executives' digital backgrounds, artificial intelligence, digital economy.

1. Introduction

AI is a disruptive and strategic technology that is shaping the future and driving scientific and technological revolution. The 2024 Government Work Report proposes deepening research and development in big data and AI, launching "AI+" initiatives, and fostering internationally competitive digital industry clusters. AI drives digital economy, creates new business models, enhances efficiency. Executives play a crucial role in enterprise development[1], influencing strategic decisions and long-term growth[2]. Their personal traits[3] and functional backgrounds[4] impact corporate innovation[5], digital transformation[6], and internal control, ultimately influencing the firm's strategic decisions and direction.

The characteristics and backgrounds of the executive team significantly impact a firm's development, but little literature explores the correlation between AI usage and the executive team. This paper aims to investigate how the digital expertise of executives influences the level of AI integration in enterprises and how this varies among firms.This paper's potential contributions include: (1) This paper finds that executives' digital background can significantly enhance corporate AI use. (2) Heterogeneity analysis shows that the effect of executives' digital background is more significant for eastern and western firms, non-heavily polluting industries, and asset-intensive firms. The research findings offer valuable guidance for government policy-making, and assist enterprises in navigating technological innovation.

2. Theoretical Analysis and Research Hypotheses

Artificial intelligence represents quality productive forces, offering immense potential to elevate operational efficiency, refine decision-making processes, and drive innovation[7]. In the current wave of digital transformation, the digital proficiency of the executive team holds paramount importance[8]. Executives equipped with a solid digital background are adept at seamlessly integrating cutting-edge technologies like artificial intelligence into the day-to-day operations and management of the enterprise, owing to their profound understanding and adept mastery of digital technologies. This

adeptness significantly amplifies the enterprise's capacity to create value[9]. These executives can anticipate the potential and trajectories of digital technologies, which challenge conventional modes of thinking and facilitate quantum leaps in development. Consequently, they are inclined to advocate for integrating and utilizing AI technologies to bolster enterprises' overall competitiveness and market positioning.

Based on these tenets, this paper posits the following hypotheses:

H1: Executive digital background exerts a significantly positive influence on the extent of enterprise AI utilization.

3. Research Design

3.1. Sample Selection and Data Source

This paper selects A-share listed companies in China's Shanghai and Shenzhen markets from 2001 to 2021 as the research object, and the data source is mainly CSMAR database. The paper screens the initial samples: (1) proposes samples of companies that are ST, ST* and forcibly delisted during the sample period; (2) proposes samples with missing data; and (3) shrinks the upper and lower 1% of the continuous variables. The panel data consisting of 47,451 observations are obtained.

3.2. Model Design and Variable Description

3.2.1. Model Design

This paper investigates the impact of executives' digitalization level on the degree of corporate AI use, and the following basic regression model is constructed:

$$AI_{use_{i,t}} = \alpha_0 + \alpha_1 Executive_{digit_{i,t}} + \sum_k \gamma_k \, Control_{k,i,t} + Year, Industry\ fixed\ effects + \varepsilon_{i,t} \quad (1)$$

In equation (1), $AI\_use_{i,t}$ represents the degree of AI usage of enterprises i in t year, $Executive\_digit_{i,t}$ represents the level of executive digitization of enterprises i in t year, α_0 is the constant term, α_1 is the regression coefficient, $Control_{k,i,t}$ represents the control variables, γ is the regression coefficient of each control variable, $Year, Industry\ fixed\ effects$ represents the fixed effects of year and industry, and $\varepsilon_{i,t}$ is the random error term.

3.2.2. Explanation of variables

(1) Dependent variable: the degree of enterprise artificial intelligence use (AI_use)

Based on the previous method, the frequency of 73 AI-related words is counted in annual reports, and then logarithmized to measure the degree of enterprise AI use[10]. A higher value indicates more frequent mention of AI-related words and a greater use of AI technology in the enterprise's operations.

(2) Independent variables: executive digitization level (Executive_digit)

The paper examines executives' digital background using professional experience, work history, and social capital. It calculates a variable for executives' digital background by taking the natural logarithm of the total number of executives with a digital background and adding 1. This variable reflects the overall digitalization level of executives in the enterprise.

(3) Control Variables

Following the existing studies, this paper adopts firm-level control variables such as enterprise size (Size), gearing ratio (Lev), profitability (Roa), current ratio (Liquid), equity concentration (Top1), and equity checks and balances (Balance1). The definition of each variable is shown in Table 1.

Table 1. Definition of variables

Variable Type	Variable Name	Variable Symbol	Variable Definition
Explanatory variable	Degree of AI use in enterprises	AI_use	Frequency of "Artificial Intelligence" association in annual reports of corporations in natural logarithms
Explanatory variable	executives' digitalization background	Executive_digit	Total number of executives with digitization background plus 1 taking natural logarithm
Control variable	Enterprise size	Size	Natural logarithm of total assets
	Total assets in natural logarithms	Lev	Ratio of total liabilities to total assets
	Return on assets	Roa	Return on assets calculated as the ratio of net income to total assets in the fiscal year
	Current Ratio	Liquid	Current Assets/Current Liabilities
	Concentration of shareholding	Top 1	Percentage of shares held by the first largest shareholder
	Equity checks and balances	Balance 1	Proportion of shares held by the second largest shareholder / Proportion of shares held by the first largest shareholder

4. Empirical results and analysis

4.1. Descriptive statistical analysis

The statistical findings presented in Table 2 indicate that the mean values for the degree of enterprise AI use (AI_use) and the level of executive digitization (Executive_digit) are 0.536 and 0.204, respectively. Their respective standard deviations are 1.023 and 0.800, with minimum values of 0 and maximum values of 5.866 and 14. This suggests significant variation in the levels of executive digitization and AI use across enterprises.

Table 2. Descriptive statistics of main variables

variable	N	Mean	Dd	Min	P50	Max
AI_use	47451	0.536	1.023	0	0	5.866
Executive_digit	47451	0.204	0.800	0	0	14
Size	41346	22.00	1.307	19.16	21.80	26.45
Lev	41346	0.438	0.203	0.0270	0.438	0.908
Roa	39177	0.0370	0.0640	-0.373	0.0360	0.257
Liquid	41346	2.352	2.716	0.198	1.542	35.50
Top 1	39425	35.25	15.18	8.087	33	75.84
Balance 1	39424	0.348	0.291	0.00200	0.260	1

4.2. Benchmark regression results

The regression results depicting the influence of executives' digital background on firms' AI usage are presented in Table 3. Column (1) displays the initial regression findings without the inclusion of any control variables, while columns (2) and (3) present the results after progressively incorporating year effects, industry effects, and control variables. In column (3), the coefficient for executives' digitization background is 0.132, signifying a significant positive correlation at the 1% level after the addition of further control variables using two-way fixed effects. This indicates that executives' digitization level directly impacts the extent of firms' AI usage.

Table 3. Benchmark regression results

VARIABLES	(1)	(2)	(3)
		AI_use	
Executive_digit	0.252***	0.139***	0.132***
	(38.217)	(7.554)	(7.598)
Size			0.134***
			(10.984)
Lev			-0.166***
			(-2.783)
Roa			-0.141
			(-1.603)
Liquid			-0.017***
			(-4.396)
Top 1			-0.006***
			(-6.811)
Balance 1			-0.075*
			(-1.898)
Constant	0.643***	-0.089	-2.426***
	(44.161)	(-0.584)	(-9.440)
Year/Industry	No	Yes	Yes
Observations	47,451	41,346	37,392
R^2	0.0211	0.289	0.299

***, **, * Indicate statistical significance at the levels of 1 percent, 5 percent, and 10 percent, respectively.And same as below.

4.3. Endogeneity test

4.3.1. Instrumental variable method

To address self-selection bias, this paper re-test the mean of digitization levels of executives in the same industry as an instrumental variable.[7] The regression results are presented in Table 4. The first-stage regression indicates a significantly positive effect of the instrumental variable on the independent variable, executive digitization level. The coefficient is 0.392, and the F-value is 139.37, indicating no weak instrumental variable. In the second-stage regression results, the executive digitization level is significant at the 1% level with a positive coefficient, demonstrating strong explanatory power of the instrumental variable team endogenous variables.

Table 4. Regression results of instrumental variables

VARIABLES	(1) first-stage Executive_digit	(2) Second-stage AI_use
IV	0.392***	
	(11.805)	
Executive_digit		3.577***
		(11.796)
Constant	-0.423***	0.027
	(-4.332)	(0.073)
Controls/Year/Industry	Yes	Yes
Observations	37,288	37,288
R^2	—	-5.692

4.3.2. Heckman two-stage model

To address the sample self-selection, this paper uses the Heckman two-stage model for testing. The regression results are shown in Table 5, as can be seen in column (1), after adding financial

leverage(FL) and gross sales margin(Grossprofit), the results are significant at the 1% level; as can be seen in column (2), after adding the inverse Mills ratio(Imr), the effect of executive digitization level on the extent of corporate AI use is significantly positive at the 1% level.

Table 5. Heckman two-stage test results

VARIABLES	(1) AI_use_if	(2) AI_use
Executive_digit	0.148***	0.070***
	(38.001)	(3.604)
Imr		0.251**
		(2.557)
Constant		-5.963***
		(-8.513)
Controls/Year/Industry	Yes	Yes
Observations	37,110	11,804
R^2	—	0.333

4.4. Robustness test

To ensure the robustness of the results, this paper performs three robustness checks. To exclude the interference of province-level factors, this paper adds province-fixed effects, and the results are shown in column (1) of Table 6; in 2017, the State Council released the New Generation of Artificial Intelligence Development Plan, this paper deletes the samples before 2017, and the results are shown in column (2); the executives other backgrounds may affect the corporate decision-making, and thus adds the executives' overseas backgrounds and financial backgrounds as control variables, and the results are shown in column (3). The results of all three tests are significantly positive at the 1% level, proving that the results are robust.

Table 6. Robustness regression results

VARIABLES	(1) Province Fixed AI_use	(2) Delete pre-2017 AI_use	(3) Add control variables AI_use
Executive_digit	0.129***	0.147***	0.130***
	(7.416)	(7.832)	(7.502)
Size	0.133***	0.069***	0.132***
	(10.865)	(6.522)	(10.783)
Lev	-0.165***	-0.130***	-0.163***
	(-2.776)	(-2.603)	(-2.735)
Roa	-0.141	0.373***	-0.138
	(-1.614)	(3.799)	(-1.568)
Liquid	-0.018***	-0.010***	-0.017***
	(-4.570)	(-3.405)	(-4.388)
Top 1	-0.006***	-0.004***	-0.006***
	(-7.042)	(-5.387)	(-6.867)
Balance 1	-0.080**	-0.085**	-0.078**
	(-2.039)	(-2.512)	(-1.996)
Overseaback			0.033**
			(2.399)
Finback			0.008
			(0.612)
Constant	-2.389***	-1.092***	-2.386***
	(-5.103)	(-5.103)	(-9.255)
Year/Industry	Yes	Yes	Yes
Province	Yes	No	No
Observations	37,392	22,711	37,392
R^2	0.301	0.186	0.299

4.5. Heterogeneity analysis

4.5.1. Regional Heterogeneity

The findings in columns (1), (2), and (3) of Table 7 indicate that executives' digital backgrounds significantly positively impact AI usage in Eastern and Western firms. Fierce market competition in the Eastern region pushes firms to invest more in AI, while recent policies in the Western region, such as the "Western Development," encourage firms to use advanced technologies.

4.5.2. Industry Heterogeneity

The regression results in Columns (4)(5) of Table 7 suggest that the impact of executive digitization level on the degree of AI use is significantly positive in non-polluted sectors but not significant in polluted industries. This suggests that firms in non-polluting industries will prioritize technological innovation to improve competitiveness, while polluting industries may focus more on meeting environmental requirements due to policy pressures.

4.5.3. Heterogeneity of enterprises

Columns (6)(7) of Table 7 show that the impact of executives' digitalization background is more significant for non-asset-intensive firms relative to asset-intensive firms. This is attributed to the emphasis on technological innovation and flexibility in non-asset-intensive firms, making the digital background of the executive team a more influential factor in driving technology adoption.

Table 7. Heterogeneity test regression results

VARIABLES	(1) Eastern Region	(2) Central Region	(3) Western Region	(4) Polluting Industries	(5) Non-Polluting Industries	(6) Asset Intensive	(7) Non-Asset Intensive
				AI_use			
Executive_digit	0.133***	0.037	0.180***	0.061	0.121***	0.087*	0.126***
	(7.482)	(0.776)	(3.786)	(1.517)	(7.111)	(1.877)	(7.280)
Constant	-2.760***	-1.731***	-1.537***	-1.161***	-2.610***	-1.129***	-2.612***
	(-8.710)	(-2.998)	(-2.796)	(-4.193)	(-8.158)	(-4.244)	(-8.514)
Controls/Year/Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,271	5,536	4,585	9,225	28,167	7,334	30,058
R^2	0.309	0.296	0.301	0.168	0.328	0.173	0.318

5. Conclusions

Executive background and Artificial Intelligence (AI) technology have emerged as critical factors as organizations deepen their digital transformation. Although studies have explored their respective impacts, there needs to be more apparent conclusions as to whether executive digital background directly affects the extent of AI use in enterprises.The study analyzes the impact of executives' digitalization level on corporate artificial intelligence (AI) use and its internal mechanism by constructing an empirical model. The key findings are: (1) Executive digitization significantly increases corporate AI use, even after rigorous testing. (2) Heterogeneity analysis reveals that executive digitization has a more significant effect on the use of AI in eastern and western regions, non-polluting industries, and non-asset-intensive firms.

The findings of this paper yield the following insights:

The government should invest in educational resources, improve academic structure, and foster collaboration between universities and enterprises to develop high-quality talents. It should establish a multi-level talent training system, devise flexible recruitment policies, and strengthen global collaborations. Additionally, the policy environment should be optimized to facilitate enterprises' application of artificial intelligence through supportive measures and cross-sectoral collaboration.

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