Economic Policy Uncertainty and Corporate Digital Transformation Empirical Evidence from Chinese Listed Companies

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Abstract

In recent years, frequent uncertain events such as the Russia-Ukraine conflict, the COVID-19 pandemic, and the China-US trade war have profoundly impacted the global economy, forcing enterprises to adjust their development strategies accordingly. With the application of emerging technologies such as big data, the Internet of Things, cloud computing, and artificial intelligence, digital transformation has become a source of competitive advantage and an inevitable path for sustainable development for many Chinese enterprises. Based on this, this paper utilizes data from A-share listed companies from 2007 to 2020 to examine the impact of economic policy uncertainty (EPU) on corporate digital transformation. The conclusions are as follows: After a series of robustness tests, baseline regressions indicate that economic policy uncertainty forces corporate digital transformation. Mechanism analysis shows that rising economic policy uncertainty compels digital transformation by increasing corporate R&D investment. Heterogeneity analysis reveals that, against the backdrop of EPU, non-manufacturing firms, state-owned enterprises (SOEs), small enterprises, and firms with separated chairperson and CEO positions exhibit stronger willingness and higher success rates in digital transformation compared to their counterparts. This paper reveals the internal logic of how economic policy uncertainty affects corporate digital transformation, contributing to guiding enterprises in adopting appropriate strategies when facing uncertainty and promoting high-quality enterprise development. It holds significant theoretical value and practical implications.

Keywords: Economic Policy Uncertainty; Digital Transformation; R&D Investment

1. Introduction

The world is undergoing profound changes unseen in a century. Recent shocks, particularly the Russia-Ukraine conflict, the COVID-19 pandemic, and the China-US trade war, have had far-reaching impacts on the global economy (Wang Chao et al., 2025), filling it with uncertainty. Facing this complex and volatile economic environment, future risks and opportunities for enterprises are further amplified. The multi-dimensional impact of economic policy uncertainty induces a series of systemic changes in corporate strategic decision-making, production and operations, resource allocation, risk management, and organizational behavior. In his speech at the 20th National Congress of the Communist Party of China (CPC), General Secretary Xi Jinping pointed out that China is currently at a stage where strategic opportunities and risk challenges coexist, and uncertainties have significantly increased. The report of the 20th CPC National Congress also clearly stated that improving economic stability should focus on high-quality development, driven by multi-dimensional coordination including innovation-driven growth, domestic demand expansion, security safeguards, reform empowerment, and livelihood support. The 2025 "Government Work Report" issued by the State Council also emphasized the importance of economic stability. Against this backdrop of economic policy uncertainty, technological innovation, particularly digital transformation, has become a key driver for stabilizing economic growth and promoting high-quality development (Wen Ke et al., 2025). Therefore, digital transformation is particularly crucial in the context of economic policy uncertainty. The CPC Central Committee has deeply integrated digital transformation into the top-level design of national development, strengthening its strategic role through policy support. The report of the 20th CPC National Congress emphasized the need to "accelerate the development of the digital economy, promote deep integration of the digital economy and the real economy," and "promote high-end, intelligent, and green development of manufacturing." The "Action Plan for Empowering SMEs through Digital Transformation (2025-2027)" jointly issued by four departments including the Ministry of Industry and Information Technology (MIIT) and the Ministry of Finance outlines goals and measures for SME digital transformation. The "Key Points for Digital Economy Development in 2025" jointly issued by the National Development and Reform Commission (NDRC) and the National Data Administration also explicitly states the importance

of digital transformation in driving real economy development. According to 2025 statistics, 86.19% of enterprises have considered and implemented digital transformation in their business plans, with only 13.81% yet to start. Digitized enterprises span multiple sectors including manufacturing, services, and agriculture, significantly enhancing their competitiveness. Digital transformation greatly improves enterprises' ability to collect, store, process, and apply data. The use of digital technologies such as big data and cloud computing makes enterprises more efficient in production processes and management, helping to enhance their market competitiveness.

Literature related to this paper mainly falls into three strands. The first strand concerns the influencing factors of corporate digital transformation. Regarding internal characteristics, Li Sifei et al. (2023) showed that generational succession in family firms significantly inhibits digital transformation; Li Ruixi (2023) found that management incentives promote corporate digital transformation; Zhang Zhiyuan and Ma Yongfan (2022) studied the impact of different types of customer relationships on digital transformation. Regarding the external environment, Wang Hai et al. (2023) discovered that the implementation of digital infrastructure policies helps drive corporate digital transformation; Wu Fei et al. (2021) demonstrated that fiscal technology expenditures significantly drive corporate digital transformation and improve economic performance.

The second strand concerns the impact of economic policy uncertainty on other economic outcomes. Li Fengyu et al. (2015) found that EPU significantly inhibits corporate fixed-asset investment; Yu Shaojie et al. (2025) found that EPU negatively affects corporate operating performance; Zheng Rui et al. (2024) studied how EPU inhibits breakthrough innovation; Pan Pan et al. (2020) found that EPU affects corporate financing channels; Huang Zhuo et al. (2018) researched the heterogeneous impact of EPU on investment by firms with different ownership types; Liu Tingzhu (2020) studied the comprehensive impact of EPU on corporate innovation, investment efficiency, and other behaviors.

The third strand focuses specifically on the impact of EPU on corporate digital transformation. Regarding EPU inhibiting digital transformation: Li Rui et al. (2025) found that local government official turnover leading to policy uncertainty significantly inhibits corporate digital transformation; Dong Zhu et al. (2024) found that EPU exacerbates managerial myopia, leading firms to cut long-term digital investment; Hong Jiao (2023) found that firms, unable to quantify long-term returns due to EPU, rely on internal cash flow and reduce digital investment. Regarding EPU promoting digital transformation: Wang Chao et al. (2023) discovered that EPU forces service industries and non-state-owned enterprises to reduce costs and increase efficiency through digitalization, enhancing risk-bearing capacity; Pan Yi et al. (2023) studied how EPU promotes corporate digital development through three paths: increased government subsidies, reduced financing constraints, and increased R&D investment; Xu Heng et al. (2023) found that EPU increases corporate non-productive costs, forcing firms to reduce operational risks through digital transformation.

In summary, while economic policy uncertainty and corporate digital transformation have attracted widespread academic discussion, there remains significant disagreement about the relationship between the two. Based on data from A-share listed companies from 2007 to 2020, this paper explores how economic policy uncertainty affects corporate digital transformation. The results show that economic policy uncertainty forces corporate digital transformation, and this phenomenon is more pronounced in non-manufacturing firms, state-owned enterprises (SOEs), small enterprises, and firms with separated chairperson and CEO positions. Furthermore, mechanism analysis indicates that economic policy uncertainty stimulates firms to increase R&D investment and innovation. Compared to other literature, the marginal contributions of this paper are threefold: First, it enriches the literature on the drivers of corporate digital transformation, broadening the research field. Previous literature mainly studied the outcomes of digital transformation, whereas this paper explores its antecedents. Second, it investigates the relationship between EPU and corporate digital transformation. Existing research primarily examines the impact of EPU on corporate investment, innovation, stock returns, etc. This paper, within the context of the digital economy, studies the direct link between EPU and digital transformation and its influencing factors. These conclusions have positive implications for guiding enterprises to adopt appropriate strategies when facing uncertainty and promoting high-quality development. Third, this paper uses corporate R&D investment as a mechanism variable to analyze the relationship between EPU and digital transformation. Mechanism analysis shows that R&D investment is an important channel through which EPU affects digital transformation; EPU forces firms to increase R&D investment, thereby promoting digital transformation.

2. Theoretical Analysis

On one hand, increased economic policy uncertainty further highlights the role of digitalization in responding to external risks. Rising EPU increases corporate operating costs and risks, thereby creating pressure that forces enterprises toward

digital transformation. Digital transformation, oriented towards enhancing efficiency and effectiveness, stimulates the innovation-driven potential of data elements, ultimately achieving the goal of high-quality development for enterprises against an unstable economic backdrop (Xu Xianchun et al., 2021). EPU can also bring new opportunities and market space for enterprises, enabling them to gain greater competitive advantages (René Belderbos et al., 2019). For enterprise development, future uncertainty may bring good opportunities. The People's Bank of China stated in its "China Monetary Policy Implementation Report for the First Quarter of 2020" that "the global economy faces extreme uncertainty." For example, during the uncertain backdrop of the COVID-19 pandemic in 2020, the Anta Group achieved omnichannel digitalization: integrating POS and online data for dynamic inventory replenishment in response to demand changes, and predicting consumption trends through big data, shortening new product development cycles by 40%. During the pandemic, online sales accounted for over 30%, offsetting offline losses. Similarly, facing economic instability due to the pandemic, Yunnan Haobang Pharmaceutical established Yunnan's first enterprise internet hospital, integrating online pharmaceutical supply chains and introducing AI medical assistants to address the shortage of primary medical resources. It was successfully selected as a benchmark for digital transformation in Yunnan's manufacturing sector in 2025, driving coordinated transformation across the upstream and downstream industrial chain. When encountering cost and risk challenges, enterprises increase investment in technological innovation to enhance production efficiency and maintain market competitiveness. Harsh survival realities force firms to enhance technological innovation capabilities and cultivate core competencies. Moreover, the dynamic environment contains diverse technological innovation knowledge and information, allowing enterprises to access new knowledge, enrich their knowledge reserves, and promote the enhancement of technological innovation capabilities (Zhao Hong et al., 2017). The core motivations for corporate R&D investment include policy compulsion and strategic proactivity, while digital transformation is the key vehicle for converting R&D outcomes into sustainable competitive advantages. First, digital transformation can be a passive response to policy pressure: EPU exacerbates market volatility and financing constraints, forcing firms to invest in digital technologies to enhance operational resilience; environmental policies or trade barriers can also force firms to invest in green digital R&D. Second, digital transformation is an active strategic layout: because EPU intensifies industry reshuffling, firms need to build technological barriers through digital R&D to seize the technological window and consolidate market position. Therefore, when enterprises encounter extreme uncertainty or face critical survival moments, they will collect, integrate, and utilize all available resources to improve innovation efficiency, promote technological innovation, and cope with rapidly rising operating costs and risks in a volatile macro environment. Furthermore, the risk-taking attributes of entrepreneurs also drive firms to proactively identify opportunities amidst uncertainty to achieve value creation and profit enhancement (Xiong Zhengde et al., 2025). Based on this, this paper proposes the following hypothesis:

H_0 : Economic policy uncertainty forces corporate digital transformation.

On the other hand, excessively high economic policy uncertainty can also inhibit the long-term resource investment required for digital transformation and amplify transformation risks. Specifically, the unpredictability of the policy environment makes it difficult for firms to assess the long-term benefits and risks of digital transformation. Factors such as official turnover and unclear policy direction make it difficult to predict long-term policy orientations, complicating the assessment of digital transformation's returns and risks (Li Rui et al., 2025). Policy adjustments leading to tighter bank credit and rising corporate financing costs conflict with the substantial capital needs of digital transformation (technology equipment, talent acquisition, system updates). Financing constraints severely weaken transformation capabilities, particularly for SMEs and highly leveraged firms. Simultaneously, policy fluctuations directly increase operating costs and market demand volatility, crowding out digital budgets and reducing firms' stable expectations of returns. These mechanisms jointly create a dual dilemma for enterprises under EPU: "dare not transform" due to risk aversion and "unable to transform" due to resource crowding, posing significant constraints, especially for firms with weak financing capacity and low risk tolerance. Therefore, this paper proposes the following hypothesis:

H_1: Economic policy uncertainty inhibits corporate digital transformation.

3. Research Design

3.1 Sample Selection

This paper uses A-share listed companies from 2007 to 2020 as the initial sample. The following treatments are applied: (1) Exclude ST/*ST listed companies; (2) Exclude financial firms classified according to the CSRC industry classification; (3) Exclude firms with missing financial data; (4) To mitigate the influence of outliers, continuous financial variables are

winsorized at the 1% and 99% levels. The final sample consists of 15,672 firm-year observations. Raw data comes from the CSMAR database.

3.2 Variable Definition

1. Economic Policy Uncertainty (EPU) is the explanatory variable. Scholars commonly use the method developed by Baker et al. (2016) to measure China's EPU index. The core of this method is analyzing daily news reports from Hong Kong's South China Morning Post. The proportion of articles containing the three keywords "economy," "policy," and "uncertainty" relative to the total number of articles published each day is used to represent the degree of China's economic policy uncertainty (Li Zengfu et al., 2022). To confirm the validity of this measurement, Baker et al. further verified it by having experts judge whether these articles truly conveyed information about economic policy uncertainty. The results showed that the experts' judgments were largely consistent with the keyword-based results. Additionally, Baker et al.'s research demonstrated that this EPU indicator is not only strongly correlated with pure economic uncertainty and policy uncertainty indicators but also provides additional information beyond them. These verifications indicate that the EPU measurement method established by Baker et al. is scientifically sound and reasonably reflects China's economic policy uncertainty. Therefore, this paper adopts this method to measure EPU.

2. Corporate Digital Transformation (Digital) is the dependent variable. To measure the degree of corporate digital transformation, this paper primarily references the method proposed by Wu Fei et al. (2021). It analyzes the textual content of listed companies' annual reports, using computer programs to identify the frequency of keywords related to digitalization. A higher frequency of keywords typically indicates a higher degree of digital transformation. To enhance reliability and accuracy: (a) The proportion of digital keywords to the total words in the annual report is calculated to avoid inflated scores due merely to longer reports; (b) A more comprehensive list of digital-related vocabulary compiled and summarized by Zhao Chenyu et al. (2021) is adopted to ensure broader and more accurate identification; (c) Particular attention is paid to keyword statistics in the "Management Discussion and Analysis (MD&A)" section, as it better reflects actual strategic directions. To address potential bias arising from "beautification" or "exaggeration" of digital content in annual reports and enhance the persuasiveness of the conclusions, this paper follows the approach of Tao Feng et al. (2023), calculating another important indicator: the proportion of digital-related intangible asset value to the firm's total intangible asset value. This ratio also reflects the degree of digitalization from an asset investment perspective. In summary, two different approaches are used to measure corporate digital transformation to mutually verify and comprehensively and objectively reflect the actual situation.

3. Control Variables.Drawing on existing literature, the following variables are controlled for:
AssetSize: Firm size, measured as the natural logarithm of total assets.
ROA: Return on assets, calculated as net profit divided by total assets.
ROE: Return on equity, calculated as net profit divided by net assets.
DAR: Debt-to-asset ratio, calculated as total liabilities divided by total assets.
CashFlowStatus: Cash flow level, calculated as cash flow from operating activities divided by total assets.
GrowthOpportunity: Represents the firm's expected potential for future value appreciation through investment, reflecting the market's assessment of its expansion capabilities (e.g., new products, new markets).
SOE: Ownership nature, assigned a value of 1 for state-owned enterprises (SOEs), 0 otherwise.
GDP: GDP growth rate, the year-on-year GDP growth rate.
CPI: Consumer Price Index, reflecting the trend of price level changes over time for a basket of consumer goods and services.

3.3 Model Specification

To test the impact of economic policy uncertainty on corporate digital transformation, the following regression model (1) is established:

$$Digital_{it} = \beta_0 + \beta_1 EPU_t + \sum Controls + Firm + \varepsilon_{it}$$

Where subscript i denotes the firm, t denotes the year. The dependent variable Digital_{it} represents the degree of corporate digital transformation. EPU_t represents the economic policy uncertainty index. $\sum \text{Controls}$ represents the control variables. Firm represents firm fixed effects. ε_{it} is the random error term. To mitigate issues of serial correlation and heteroskedasticity in the time series, standard errors are clustered at the firm level.

3.4 Descriptive Statistics

Descriptive statistical results (Table 1) show that the mean of Digital is 10.144, the median is 10.159, the standard deviation is 0.265, the minimum value is 9.497, and the maximum value is 10.729. This indicates that the level of digital transformation among these firms is generally high, with very little variation between firms, and the distribution is roughly symmetrical. The standard deviation of EPU is 1.174, with minimum and maximum values of 0.921 and 3.904 respectively, indicating significant fluctuations in China's economic policy uncertainty across different years. This high volatility and wide range suggest that firms faced an extremely unstable policy expectation environment during the study period. Entrepreneurs and managers faced substantial policy risk when formulating medium- to long-term strategies. The distributions of other financial variables and control variables are similar to those in previous literature and fall within reasonable ranges, indicating the representativeness of the sample and supporting the validation of hypothesis H_0.

Table 1. Descriptive Statistical Analysis

VarName	Obs	Mean	SD	Min	Median	Max
Digital	15672	10.144	0.265	9.497	10.159	10.729
EPU	15672	2.289	1.174	0.921	2.066	3.904
ROA	15672	4.947	6.698	-26.832	4.859	22.760
DAR	15672	41.125	19.445	5.915	40.284	87.816
ROE	15672	5.952	12.600	-61.373	6.665	33.628
GrowthOpportunity	15672	2.088	1.291	0.859	1.678	8.321
CashFlowStatus	15672	0.057	0.073	-0.145	0.054	0.281
AssetSize	15672	22.197	1.152	20.100	22.060	25.680
SOE	15672	0.326	0.469	0.000	0.000	1.000
GDP	15672	106.221	1.790	102.300	106.800	107.900
CPI	15672	102.236	0.473	101.400	102.100	102.900
RDSpendSumRatio	15672	4.538	4.459	0.024	3.550	26.280
USEPU	15672	1.747	0.711	0.925	1.532	3.263

4. Regression Results

4.1 Baseline Regression

Table 2 presents the baseline fixed-effects regression results examining the impact of economic policy uncertainty on corporate digital transformation, using a stepwise regression approach. Column (1) includes only EPU. Column (2) adds firm-level control variables. Column (3) further adds macro-level control variables. It can be seen that across columns (1) to (3), the coefficient of the explanatory variable EPU is consistently positive and statistically significant at the 1% level. This means that economic policy uncertainty forces corporate digital transformation, validating Hypothesis H_0.

Regarding the control variables, firm size (AssetSize) is positively correlated with the degree of digital transformation, indicating that larger firms are more inclined towards digital transformation, consistent with the conclusions of Zhu Shujin et al. (2023) and Zhu Ying et al. (2023). At the macro level, GDP growth (GDP) is positively correlated with digital transformation, indicating that macroeconomic prosperity provides firms with more abundant resources and optimistic market expectations, thereby promoting digital transformation.

Table 2. Baseline Regression

	(1)	(2)	(3)

	Digital	Digital	Digital
EPU	0.127***	0.090***	0.163***
	(113.50)	(71.78)	(88.53)
ROA		-0.002***	-0.001***
		(-3.70)	(-3.05)
DAR		-0.001***	-0.000
		(-5.23)	(-0.55)
ROE		0.000	0.000**
		(1.30)	(2.10)
GrowthOpportunity		0.011***	0.003***
		(8.96)	(2.60)
CashFlowStatus		-0.081***	-0.021
		(-3.96)	(-1.11)
AssetSize		0.174***	0.113***
		(54.63)	(36.37)
SOE		-0.031***	-0.006
		(-3.24)	(-0.74)
GDP			0.025***
			(27.85)
CPI			-0.146***
			(-52.70)
_cons	9.853***	6.109***	19.530***
	(3514.53)	(90.00)	(63.12)
Firm FE	Yes	Yes	Yes
N	15672	15672	15672
Adj. R^2	0.391	0.512	0.606

Note: ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively; t-statistics based on cluster-robust standard errors (clustered at the firm level) are in parentheses; same below.*

4.2 Robustness Checks

To verify the robustness of Hypothesis H_0, this paper conducts robustness tests including replacing the dependent variable, replacing the explanatory variable, and adding more control variables.

1. Replacing the Dependent Variable Measurement: In the baseline regression, Digital was measured using the natural logarithm of the total count of digital transformation keywords mentioned in annual reports. To avoid potential measurement error bias, this paper uses the natural logarithm of the total character count (Digital1) and the natural logarithm of the total sentence count (Digital2) of these keywords as alternative measures. The regression results in Columns (1) and (2) of Table 3 show that the coefficient of EPU remains positive and significant at the 1% level, consistent with the baseline regression.

2. Replacing the Explanatory Variable Measurement: To avoid potential bias from the EPU calculation method, this paper calculates the annual EPU index (EPU1) by taking the arithmetic average of monthly EPU values within the same year. Additionally, Trade Policy Uncertainty (TPU) is used as an alternative explanatory variable. The regression results in Columns (3) and (4) of Table 3 show that the coefficients of EPU1 and TPU remain positive and significant at the 1% level, confirming the robustness of the results.

3. Adding More Control Variables: Control variables Idr (independent director ratio), Dual (CEO duality), and Top1 (largest shareholder ownership) are added. The regression result in Column (5) of Table 3 shows that the coefficient of EPU remains positive and significant at the 1% level. This indicates that the compelling effect of EPU on digital transformation is not disturbed by internal corporate governance characteristics. The findings in Columns (1) to (5) all show significant positive coefficients for the explanatory variables at the 1% level, verifying the reliability of Hypothesis H_0.

Table 3. Robustness Checks

	(1)	(2)	(3)	(4)	(5)
	Digital1	Digital2	Digital	Digital	Digital
EPU	0.156***	0.179***			0.162***
	(87.40)	(96.94)			(85.62)
EPU1			0.163***		
			(88.53)		
TPU				0.058***	
				(91.24)	
ROA	-0.001***	-0.002***	-0.001***	-0.001***	-0.001***
	(-3.02)	(-3.53)	(-3.05)	(-2.60)	(-2.81)
DAR	-0.000	-0.001***	-0.000	0.000	-0.000
	(-0.24)	(-5.26)	(-0.55)	(0.01)	(-0.40)
ROE	0.000**	0.000*	0.000**	0.001**	0.000**
	(2.09)	(1.85)	(2.10)	(2.40)	(2.05)
GrowthOpportunity	0.003**	0.007***	0.003***	-0.001	0.003**
	(2.32)	(5.96)	(2.60)	(-0.44)	(2.43)
CashFlowStatus	-0.021	0.014	-0.021	-0.034*	-0.021
	(-1.15)	(0.78)	(-1.11)	(-1.84)	(-1.11)
AssetSize	0.108***	0.085***	0.113***	0.106***	0.113***
	(35.80)	(27.18)	(36.37)	(34.12)	(35.98)
SOE	-0.002	-0.014	-0.006	-0.006	-0.007
	(-0.29)	(-1.58)	(-0.74)	(-0.72)	(-0.84)
GDP	0.026***	0.024***	0.025***	-0.019***	0.025***
	(29.91)	(27.69)	(27.85)	(-28.62)	(27.63)
CPI	-0.141***	-0.183***	-0.146***	-0.131***	-0.145***
	(-52.80)	(-66.22)	(-52.70)	(-49.91)	(-51.78)
Idr					0.000
					(0.94)
Dual					0.009**
					(2.36)
Top1					-0.000
					(-1.35)
_cons	19.906***	21.234***	19.530***	23.036***	19.479***

	(66.41)	(68.48)	(63.12)	(71.36)	(62.26)
Firm FE	Yes	Yes	Yes	Yes	Yes
N	15672	15672	15672	15672	15491
Adj. R^2	0.592	0.614	0.606	0.615	0.606

4.3 Endogeneity Analysis

Potential endogeneity issues in this paper's estimation results may stem from two main sources: First, corporate digital transformation might inversely affect economic policy formulation, leading to a correlation between the explanatory variable EPU and the error term – that is, endogeneity caused by reverse causality. Second, there may be macro factors simultaneously influencing both economic policy uncertainty and corporate digital transformation; if these are not controlled for, estimation bias would result – that is, endogeneity caused by omitted variables.

Therefore, to address the estimation bias caused by endogeneity, this paper draws on the research approach of Peng Yuchao et al. (2018), constructing an instrumental variable (IV) based on the economic policy uncertainty (USEPU) of China's major trading partner, the United States. Reasons for IV Suitability: Firstly, US economic policy uncertainty can affect China's economic policy uncertainty through channels like Sino-US trade or financial linkages, satisfying the relevance condition. Secondly, it possesses geographical and institutional isolation; US policymaking is independent of Chinese corporate decisions and is unlikely to directly influence the digital transformation of Chinese enterprises, satisfying the exogeneity condition. Furthermore, US economic policy uncertainty can only impact Chinese corporate digitalization through China's own economic policy uncertainty, satisfying the exclusion restriction. The first-stage regression results for the instrumental variable are shown in Column (1) of Table 4, and the second-stage regression results are shown in Column (2) of Table 4. The first-stage F-statistic is 63.73, greater than 10, verifying the relevance of the instrumental variable. The coefficient of the explanatory variable EPU remains significantly positive (0.560***), demonstrating that economic policy uncertainty still compels corporate digital transformation even after accounting for endogeneity. This also confirms that the estimation results supporting Hypothesis H_0 are robust.

Table 4. Instrumental Variable Approach

	(1)	(2)
	EPU	Digital
EPU		0.560***
		(9.44)
USEPU	-0.282***	
	(-7.98)	
ROA	-0.004**	-0.001
	(-2.08)	(-1.53)
DAR	-0.003***	0.001***
	(-7.90)	(4.79)
ROE	-0.001	0.002***
	(-0.68)	(3.48)
GrowthOpportunity	-0.063***	0.027***
	(-14.91)	(6.55)
CashFlowStatus	0.217***	-0.227***
	(2.73)	(-5.52)
AssetSize	0.075***	0.027***
	(12.83)	(4.90)
SOE	-0.130***	-0.031***

	(-11.26)	(-3.19)
GDP	-0.531***	0.188***
	(-40.98)	(7.36)
CPI	0.972***	-0.499***
	(58.69)	(-9.58)
_cons	-41.678***	39.283***
	(-31.70)	(15.00)
Firm FE	Yes	Yes
N	15672	15672
F	63.73	——

4.4 Heterogeneity Analysis

The baseline regression finds that economic policy uncertainty exerts a compelling effect on corporate digital transformation, incentivizing firms to accelerate digital changes and enhance their digital level. However, due to differences in resource endowments and industries, the degree of uncertainty impact and the coping capacity vary significantly across different types of firms. To delve deeper into the differential responses of firms to digital transformation under uncertainty, this paper conducts heterogeneity analysis of the baseline results from four perspectives: manufacturing vs. non-manufacturing industry, ownership nature (state-owned vs. non-state-owned), firm size, and CEO duality (separation vs. unity of chairperson and CEO positions).

1. Manufacturing vs. Non-manufacturing Enterprises

Typically, manufacturing firms are capital-intensive, facing higher costs and longer timeframes for digital transformation. In contrast, non-manufacturing firms (e.g., services) are often asset-light, with lower transformation costs and higher market sensitivity, enabling faster digital responses to demand fluctuations. Therefore, the digital outcomes for manufacturing and non-manufacturing firms facing EPU may differ significantly. Columns (1) and (2) of Table 5 present the regression results for the impact of EPU on manufacturing and non-manufacturing firms, respectively. The results show that rising uncertainty significantly boosts digital levels in both firm types, indicating that environmental changes exert a compelling effect on both. However, comparing the regression coefficients of the explanatory variable (EPU) across the two subsamples reveals that this effect is more pronounced for non-manufacturing firms. Reasons: On one hand, manufacturing digitalization often requires highly customized solutions like industrial internet, automation equipment, and specialized technical personnel, leading to high investment costs; generic digital solutions are often less applicable. Non-manufacturing sectors like services primarily apply digital technologies such as the Internet, big data, and cloud computing, resulting in lower technical difficulty for transformation. On the other hand, compared to manufacturing, non-manufacturing firms possess higher strategic flexibility, allowing them to adjust business models faster when policies change, thereby enhancing their risk-coping capacity in uncertain times (Zhang Feng et al., 2019). Zhao Chenyu (2021) found that corporate digital transformation requires real-time data analysis and personalized customization, and new technologies like big data, cloud computing, and data mining provide crucial support for improving the quality of transformation. Therefore, non-manufacturing firms are more likely to benefit from digital transformation in the digital economy era.

2. State-Owned Enterprises (SOEs) vs. Non-State-Owned Enterprises (NSOEs)

Compared to NSOEs, SOEs, due to their inherent ties to the government, can access more financial resources and actively respond to digital transformation policies. This advantage enables them, under EPU, to have the mandate, resources, and motivation to advance digital transformation, highlighting a "policy-driven compelling effect." Column (3) of Table 5 shows that the compelling effect of EPU on NSOEs' digital transformation is not very pronounced. This suggests that under strong financing constraints, high policy risk, and no government backing, survival pressures overwhelm development imperatives for NSOEs, limiting the compelling effect of EPU shocks on their digital transformation. In contrast, Column (4) shows a significantly stronger compelling effect of EPU on SOEs' digital transformation, with the coefficient significant at the 1% level.

3. Different Firm Sizes

Compared to large enterprises, smaller firms generally have weaker capital and talent bases, lower digitalization levels, and lagging transformation processes. However, amidst the shocks of EPU, small firms, with limited resources and weaker risk-bearing capacity, are more likely to strive for survival and seize opportunities by embracing digital transformation to enhance market competitiveness (Wang Chao et al., 2023). Column (5) of Table 6 shows that EPU has a stronger compelling effect on the digital transformation of small firms, with the coefficient significant at the 1% level. Small firms have flexible decision-making mechanisms; facing uncertainty, they may be more inclined to quickly embrace digitalization to improve efficiency, reduce costs, and open new channels for survival and growth. Column (6) of Table 6 shows a weaker compelling effect of EPU on the digital transformation of large enterprises. Large enterprises have complex organizational structures and long decision-making chains, potentially suffering from path dependence and transformation inertia. The complex environment brought by EPU may increase their decision-making difficulty, leading them to adopt more conservative strategies, temporarily slowing large-scale, disruptive transformation efforts, and prioritizing stability.

4. Separation vs. Unity of Chairperson and CEO Positions (CEO Duality)

The moderating effect of corporate governance structure on digital transformation may be concentrated in the power configuration of the decision-making layer. Among these, the unity of the chairperson and CEO positions (Dual) is a typical feature of governance centralization, profoundly influencing a firm's strategic choices in response to policy shocks. To verify this heterogeneous governance transmission mechanism, this paper groups firms based on the Dual variable for regression testing. Column (7) of Table 6 shows that EPU has a stronger compelling effect on the digital transformation of firms with separated chairperson and CEO positions, with the coefficient significant at the 1% level. When EPU rises, firms with separated positions, due to effective board monitoring curbing managerial myopia, are more likely to convert external pressure into motivation for digital transformation. Board supervision is relatively effective, and the decision - making process focuses more on risk control and long-term value. Column (8) of Table 6 shows that EPU has a weaker compelling effect on firms with unified positions. Reasons: On one hand, unification grants decision-makers more efficient resource mobilization capability, potentially accelerating crisis response. On the other hand, excessive power concentration easily induces managerial short-termism (e.g., reducing long-cycle investments), which becomes more pronounced when policy uncertainty rises (Zhang Feng et al., 2019), leading to cuts in digital investment to maintain short-term performance.

Table 5. Heterogeneity Analysis (1)

	(1)	(2)	(3)	(4)
	Manufacturing	Non-Manufacturing	Non-SOEs	SOEs
	Digital	Digital	Digital	Digital
EPU_	0.161***	0.168***	0.161***	0.164***
	76.39)	(44.33)	(69.56)	(51.56)
ROA	-0.001***	-0.001	-0.002***	-0.000
	(-2.76)	(-1.28)	(-2.62)	(-0.07)
DAR	0.000	-0.000	0.000	-0.001**
	(0.17)	(-1.22)	(0.16)	(-2.15)
ROE	0.001**	0.000	0.000	0.000
	(2.07)	(0.56)	(1.42)	(0.72)
GrowthOpportunity	0.002	0.005**	0.004***	0.000
	(1.64)	(2.16)	(2.95)	(0.02)
CashFlowStatus	-0.029	-0.005	-0.007	-0.052
	(-1.34)	(-0.13)	(-0.30)	(-1.51)
AssetSize	0.109***	0.119***	0.118***	0.102***
	(27.87)	(22.33)	(31.35)	(17.11)
SOE	-0.012	0.009	0.016	-0.014
	(-1.23)	(0.56)	(0.39)	(-0.33)

GDP	0.023***	0.029***	0.024***	0.026***
	(22.07)	(17.04)	(22.57)	(15.88)
CPI	-0.142***	-0.156***	-0.142***	-0.151***
	(-44.81)	(-27.85)	(-41.27)	(-32.07)
_cons	19.480***	19.993***	19.202***	20.093***
	(53.96)	(32.69)	(49.97)	(37.52)
Firm FE	Yes	Yes	Yes	Yes
N	11387	4285	10556	5116
Adj. R^2	0.609	0.601	0.611	0.574

Table 6. Heterogeneity Analysis (2)

	(5) Small Firms	(6) Large Firms	(7) Separation	(8) Unity (Dual)
	Digital	Digital	Digital	Digital
EPU_	0.159***	0.156***	0.162***	0.153***
	(60.35)	(54.92)	(72.73)	(38.08)
ROA	-0.002***	-0.001	-0.002***	-0.001
	(-2.77)	(-0.82)	(-2.94)	(-0.91)
DAR	0.000*	-0.001***	-0.000	0.000
	(1.70)	(-3.38)	(-0.16)	(0.97)
ROE	0.001	0.000	0.001**	0.000
	(1.57)	(0.55)	(2.45)	(0.29)
GrowthOpportunity	0.005***	-0.001	0.001	0.005**
	(3.23)	(-0.48)	(0.92)	(2.11)
CashFlowStatus	-0.038	0.009	-0.048**	0.055
	(-1.52)	(0.30)	(-2.11)	(1.57)
AssetSize	0.149***	0.117***	0.113***	0.111***
	(26.22)	(21.25)	(28.52)	(16.87)
SOE	0.001	-0.024*	-0.023**	0.045*
	(0.05)	(-1.84)	(-2.21)	(1.90)
GDP	0.023***	0.025***	0.025***	0.023***
	(18.52)	(19.41)	(22.76)	(13.91)
CPI	-0.135***	-0.140***	-0.147***	-0.129***
	(-33.39)	(-34.58)	(-44.13)	(-23.02)
_cons	17.905***	18.878***	19.625***	18.065***
	(38.23)	(40.44)	(52.32)	(29.09)
Firm FE	Yes	Yes	Yes	Yes
N	8018	7654	11102	4391
Adj. R^2	0.544	0.555	0.578	0.478

4.5 Mechanism Analysis

The above analysis demonstrates that increased economic policy uncertainty exerts a compelling effect on corporate digitalization, stimulating firms to accelerate digital transformation, and that digitalization indeed enhances risk-bearing capacity. Furthermore, this compelling effect is more pronounced in non-SOEs, smaller firms, firms with separated leadership, and non-manufacturing firms. To unveil the mechanism and conditions linking economic policy uncertainty and digital transformation, this paper employs research and development (R&D) investment (RDSpendSumRatio) as the mechanism variable. To test the impact of EPU on R&D investment, Equations (2) and (3) are established:

$$RDSpendSumRatio_{it} = \beta_0 + \beta_1 EPU_t + \sum Controls + Firm + \varepsilon_{it} \quad (2)$$

$$Digital_{it} = \beta_0 + \beta_1 RDSpendSumRatio_{it} + \sum Controls + Firm + \varepsilon_{it} \quad (3)$$

The regression results for Equations (2) and (3) are shown in Columns (1) and (2) of Table 7, respectively. The results indicate that the coefficient of EPU on R&D investment is 0.117 and significantly positive at the 1% level (Column 1), meaning that rising EPU increases corporate R&D investment. The coefficient of R&D investment on digital transformation is 0.003 and significantly positive at the 1% level (Column 2), indicating that increased R&D investment also enhances the level of corporate digitalization. Interpretation: Real options theory suggests that economic policy uncertainty incentivizes firms to invest in R&D activities that create future options. Moderate environmental pressure provides motivation for innovation. Firms can not only reduce risks by improving technology through R&D but also seize emerging technology windows (e.g., AI, IoT) through R&D. Firms with strong R&D investment see improved production efficiency, enabling them to enhance data collection and analysis systems and promote the application of digitalization, thus achieving higher success rates in digital transformation. In summary, economic policy uncertainty has a positive compelling effect on digital transformation, promoting corporate innovation and enhancing survival capabilities.

Table 7: Mechanism Analysis

	(1)	(2)
	RDSpendSumRatio	Digital
EPU	0.117***	
	(4.07)	
RDSpendSumRatio		0.003***
		(4.40)
ROA	-0.104***	-0.002***
	(-14.41)	(-3.99)
DAR	-0.029***	-0.001***
	(-15.16)	(-5.90)
ROE	0.012***	-0.000
	(3.41)	(-0.37)
GrowthOpportunity	0.016	-0.008***
	(0.86)	(-5.41)
CashFlowStatus	-1.008***	0.025
	(-3.47)	(1.07)
AssetSize	0.178***	0.248***
	(3.64)	(71.67)
SOE	-0.058	-0.015
	(-0.43)	(-1.38)
GDP	-0.036**	-0.026***

	(-2.57)	(-30.51)
CPI	0.056	-0.004
	(1.28)	(-1.57)
_cons	0.103	7.924***
	(0.02)	(22.30)
Firm FE	Yes	Yes
N	15672	15672
Adj. R^2	-0.129	0.366

5. Conclusions and Research Implications

Currently, the economic environment is complex and volatile. Rising economic policy uncertainty increases market risks, triggers economic turbulence, and profoundly impacts the macroeconomy and corporate behavior. How to respond to economic policy uncertainty has become a crucial research topic, vital to economic operational efficiency and the strategic goal of China's high-quality economic development. This paper focuses on the compelling effect of economic policy uncertainty on corporate digital transformation, analyzing data from A-share listed companies from 2007 to 2020. Building on regressions with only EPU, and after adding firm-level and macro-level control variables, along with a series of robustness tests, the baseline regression results indicate that economic policy uncertainty compels corporate digital transformation. Furthermore, after addressing endogeneity using instrumental variables, the conclusion that EPU forces digital transformation remains valid. Additionally, using R&D investment as a mechanism variable, the results show that rising EPU compels digital transformation by increasing corporate R&D investment. Finally, heterogeneity analysis from four perspectives – manufacturing vs. non-manufacturing, ownership nature, firm size, and CEO duality – reveals that the compelling effect of EPU on digital transformation is more significant in non-manufacturing firms, state-owned enterprises (SOEs), small enterprises, and firms with separated chairperson and CEO positions. Based on these findings, this paper proposes the following policy implications:

For the Government:

First, against the backdrop of rapidly changing macroeconomic policies, it is essential to pay high attention to the potential risks arising from policy uncertainty and strive to maintain the stability and continuity of economic policies.

Second, addressing the lack of motivation for digital upgrading among some enterprises, the government should introduce supportive policies to guide them, such as providing fiscal and tax incentives, to genuinely reduce transformation concerns and enhance their initiative.

Third, this paper's heterogeneity analysis found that SOEs and SMEs achieve higher success rates in digital transformation. Due to differences in ownership and equity nature, corporate behavioral logic varies. SOEs, backed by state support, possess strong risk resistance and have the resources and motivation for digital transformation. SMEs, with their flexible decision-making mechanisms, may be more inclined to quickly embrace digitalization to improve efficiency, reduce costs, and open new channels for survival and growth when facing uncertainty. Therefore, the leading role of SOEs and SMEs should be fully leveraged. They should accelerate their own digitalization processes first, setting industry benchmarks to drive the overall industrial chain towards accelerated digital transformation, thereby enhancing the resilience of the entire economic system against external policy environment changes.

For Enterprises:

First, engaging in digital transformation helps cultivate an entrepreneurial risk-taking spirit. Today, risk-taking firms are more likely to break free from traditional technological path dependence. For example, companies like Apple and Tesla have reshaped industries through disruptive innovation, driven fundamentally by entrepreneurs' strategic bets on unknown technologies. The window for digital transformation is short; risk-taking enterprises can quickly seize ecological niches, gaining first-mover advantages in global markets. Furthermore, in the future, a risk-taking spirit will push firms to explore cutting-edge technologies. Companies will become more willing and generous in investing in technological R&D, which will not only enhance innovation capabilities but also boost corporate vitality, making them more competitive in future markets.

Second, enterprises should accelerate the construction of their digital transformation capabilities, seizing the challenges and opportunities presented by economic policy uncertainty. Firms can access government-supported industrial internet platforms to obtain basic digital toolkits for free and enjoy policy subsidies. They can also partner with universities to establish training bases, bringing in senior talent for on-site guidance to compensate for technical talent gaps. Enterprises should respond agilely to policy changes and actively seek specialized digital loans and tax benefits.

Third, it is recommended that enterprises adopt a separation of the chairperson and CEO positions (non-duality). Under separation, the chairperson focuses on strategic oversight while the CEO manages daily operations, creating a system of checks and balances. Empirical studies show that CEO duality easily leads to power concentration; the CEO might pursue self-interest through information asymmetry, and oversight is weaker. Under separation, the board's regular accountability mechanisms can constrain opportunistic behavior. It also facilitates more rational decision-making, considering long-term value such as investing in digital R&D, avoiding short-termism, and effectively strengthening the positive impact of digital transformation.

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