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Perceptions of economic policy uncertainty and digital transformation: Evidence from China

Authors:
Jia Xia[1]
Shenglin Ma[2]
Wei Wei[1]

Affiliations:
[1]School of Economics and Finance, Xi'an Jiaotong University, Xi'an, China

[2]School of Economics and Management, North University of China, Taiyuan, China

Corresponding author:
Wei Wei,
wei_wei@mail.xjtu.edu.cn

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Purpose: This study aimed to investigate how perceptions of economic policy uncertainty affect digital transformation within enterprises, facilitating the development of more scientifically grounded transformation strategies and more precise deployment of related initiatives.

Design/methodology/approach: The research focused on A-share listed companies in China from 2010 to 2022, examining the relationship between perceptions of economic policy uncertainty and digital transformation.

Findings/results: The findings demonstrated that perceptions of economic policy uncertainty significantly hindered digital transformation, particularly affecting foundational technology transformation more than digital technology application transformation. Mechanism analysis identified financing challenges and managerial risk aversion as key pathways for this effect. In addition, a higher proportion of institutional investors and larger company size weakened the suppressive impact of economic policy uncertainty on digital transformation. Conversely, when financial institutions held shares, this uncertainty promoted digital transformation.

Practical implications: The study provides new insights and evidence for a deeper understanding of the relationship between economic policy uncertainty and digital transformation. This is particularly valuable for enterprises in formulating informed digital transformation decisions and for governments in crafting economic policies, especially in the face of high economic policy uncertainty.

Originality/value: Existing studies indicate that economic policy uncertainty may facilitate digital transformation but often neglect the financing challenges and risk issues faced by management during such periods. This study provides new evidence on the relationship between economic policy uncertainty and digital transformation, enhancing the exploration of how perceptions of this uncertainty influence transformation through the lenses of financing challenges and managerial risk aversion.

Keywords: economic policy; enterprise perception of uncertainty; digital transformation; financing challenges; managerial risk aversion.

Introduction

With the rapid advancement of digital technologies, the digital economy has become a significant driving force in China's economic development. Given these new opportunities, enterprises seek to transform and upgrade. According to *2022 China Enterprise Digital Transformation Index* published by Accenture, the willingness of Chinese enterprises to invest in digitalisation has continuously increased, with nearly 60% planning to increase their digital investments. However, despite this growing willingness, transformation progress has faced significant challenges. The report highlights that China's digital transformation index experienced its first decline in 2022, with an increasing number of enterprises focusing on 'direct financial returns'. Simultaneously, the Tencent Research Institute's *Digital Transformation Index Report 2022* pointed out that since 2020, the pace of digital transformation has shown a declining trend with fluctuations. Understanding these underlying causes can help enterprises overcome transformation challenges and advance industrial digitalisation.

Notably, alongside the surging interest in the digital economy, China's economic policy uncertainty has also escalated rapidly. In recent years, as global economic complexities have increased, China's macroeconomic policy uncertainty has remained high and continues to rise. According to the Economic Policy Uncertainty Index constructed by Baker et al. (2016), the economic uncertainty index for China was 98.9 in 2010, soaring to 716.8 by 2022, representing an increase of 624.7%.

This rapid growth in economic policy uncertainty presents significant challenges for enterprises because of two primary factors: firstly, the difficulty in predicting future economic policy changes; secondly, the inability to assess the potential consequences of such changes. This causes enterprises to have difficulty in forming stable expectations, which in turn affects their operational decision-making. Existing research confirms that economic policy uncertainty negatively impacts enterprises by constraining investment, influencing innovation, shifting focus away from productive activities and diminishing productivity (Zhou et al., 2023). Among these effects, the impact of economic policy uncertainty on investment is particularly pronounced (Zhang et al., 2024). Digital transformation also constitutes a significant strategic investment for enterprises. Therefore, this article hypothesises that the rising economic policy uncertainty is a critical factor inhibiting digital transformation in enterprises.

Digital transformation, as an emerging strategic change, transcends the mere application of digital technologies (Zhang et al., 2025). It encompasses the comprehensive restructuring of enterprise organisational frameworks, business models, production methods and employment patterns, alongside a shift in management philosophy (Piccoli et al., 2024). The transition involves substantial expenditures of human, financial and material resources from initial investments through to mid-term internalisation and eventual value output, resulting in a high threshold for digital transformation (Chen & Tian, 2022; Meier et al., 2025). When economic policy uncertainty is high, according to risk aversion theory and real options theory, enterprises tend to adopt a wait-and-see approach and are reluctant to undertake major reforms. Meanwhile, according to financing cost theory, enterprises also face circumstances such as capital constraints and elevated financing costs (Zhu & Tao, 2024). Consequently, despite a willingness to undergo digital transformation, enterprises might encounter feelings of powerlessness or apprehension, given the high costs, risks and long timelines associated with such transitions, thereby delaying relevant investments (Jia et al., 2024).

In the light of this analysis, this study explored the relationship between economic policy uncertainty and digital transformation. However, since uncertainty is subjectively perceived by actors and varies across enterprises, a uniform metric fails to capture these perceptual differences (Li et al., 2024b). Therefore, this study adopted the indicator of enterprises' perceptions of economic policy uncertainty. This research sought to address the following questions: Does the perception of economic policy uncertainty inhibit digital transformation in enterprises? What mechanisms underlie this relationship? Are there variations in the impact of enterprises' perceptions of uncertainty on digital transformation under different conditions? To address these questions, this study uses data from Chinese A-share listed companies over the period 2010–2022 to examine how perceptions of economic policy uncertainty influence digital transformation.

Literature review and research hypotheses

Literature review

Digital transformation represents a significant strategic shift, wherein enterprises leverage a new generation of information technology to drive technological change, instigating substantial alterations in organisational attributes to enhance operational processes. This phenomenon has permeated various industries, becoming a primary catalyst for accelerating economic development. With the deepening of digital transformation, academic research has intensified. Current literature on corporate digital transformation can be categorised into two main types: one examines the consequences of digital transformation, such as enhancing resource allocation efficiency (Jiang et al., 2025), fostering corporate social responsibility (Sun et al., 2024), improving supply chain stability (Li et al., 2025), upgrading human capital and increasing labour income (Li et al., 2024a), and promoting corporate innovation (Peng & Jia, 2024). The other category explores the factors influencing digital transformation, a relatively sparse area of research, focusing on aspects such as managerial heterogeneity (Clemente-Almendros et al., 2024), characteristics of institutional investors (Shi et al., 2024), and intergenerational succession in family businesses (Ren et al., 2023). This study aims to contribute to the understanding of the factors influencing digital transformation.

Meanwhile, digital transformation has become a common development trend among emerging economies, with countries such as India, South Africa and Brazil incorporating it as an important component of their national development strategies (Filgueiras et al., 2019; Gaglio et al., 2022; Khurana et al., 2022). However, existing research indicates that compared to developed markets, enterprises in emerging markets commonly face higher levels of policy and environmental uncertainty in their digital transformation processes, including challenges such as inconsistent technical standards, frequently changing regulatory policies and unstable market competition patterns (David et al., 2025; Jia et al., 2024). These uncertainty factors may have more complex impact on enterprises' digital transformation decisions. Therefore, examining the impact of economic policy uncertainty on enterprise digital transformation in the context of emerging markets not only helps enrich relevant theory but also provides important empirical references for other emerging economies.

With regard to economic policy uncertainty, Knight (1921) initially distinguished between risk and uncertainty in his book: *Risk, Uncertainty, and Profit*, positing that risk involves specific probability distributions, whereas uncertainty stems from a lack of awareness regarding events, rendering it a subjective perception of economic agents. This perspective aligns with Keynes's view on uncertainty in his work: *A Treatise on Probability*, where he argues that uncertainty corresponds to probabilistic situations that are not quantifiable and are contingent upon the individual's

knowledge and experience (Keynes, 1921). Consequently, while changes in economic policy objectively exist, uncertainty remains a subjective perception, differing in its impact across individuals (Bloom, 2014). In light of the common practice of using macroeconomic indicators to measure economic policy uncertainty, some scholars introduced perceptions of economic policy uncertainty as a measure to more accurately assess the uncertainty perceived at the micro-enterprise level (Li et al., 2024b). This foundation underpins the use of micro-level indicators of economic policy uncertainty in this study.

Existing research regarding the impacts of economic policy uncertainty has primarily explored two domains: macroeconomic performance and micro-enterprise behaviour. On the macroeconomic front, numerous scholars concur that economic policy uncertainty adversely affects the economy, exacerbating economic fluctuations, influencing economic cycles and hindering recovery (Baker et al., 2016; Born & Pfeifer, 2014). In contrast, scholars hold divergent views regarding its effects on micro-enterprise behaviour. Some contend that economic policy uncertainty escalates financing costs (Tran et al., 2021), reduces fixed asset investment (Zhang et al., 2024) and diminishes innovation expenditure (Liu & Gao, 2024). Conversely, other scholars assert that economic policy uncertainty can stimulate corporate innovation (Zhou et al., 2023). In addition, some researchers argue that the impact of economic policy uncertainty on innovation can be both positive and negative, contingent upon the degree of uncertainty (Lou et al., 2022). Thus, the existing literature has not reached a consensus on the relationship between economic policy uncertainty and corporate investment, necessitating further investigation.

Recent literature has also employed macroeconomic policy uncertainty indicators to examine the relationship between economic policy uncertainty and digital transformation, concluding a positive correlation overall (Cheng & Masron, 2023). However, given that rising economic policy uncertainty may either drive enterprises towards digital transformation or, based on real options theory, inhibit it, existing research presents conflicting theoretical predictions. To address this ambiguity, this study employs micro-level indicators that more accurately capture the perceived uncertainty of different enterprises, thereby addressing gaps in existing research.

Research hypothesis

Firstly, economic policy uncertainty exacerbates enterprises' financing problems. In terms of internal financing, frequent adjustments in economic policies disrupt enterprises' production and operations, intensifying business risks and reducing internal financing capacity (Yu & Tian, 2025). Regarding external financing, uncertainty increases the difficulty for investors to judge future return expectations. According to risk premium theory, investors will demand higher risk compensation, while banks and other financial institutions will tighten credit policies and increase loan approval difficulties, collectively leading to rising external financing costs and declining financing access for enterprises (Tran, 2021). The intensification of financing constraints directly restricts the implementation of digital transformation. As a capital-intensive disruptive innovation activity, digital transformation requires substantial upfront investment in digital infrastructure construction, business process transformation and professional team formation, and is characterised by long investment payback periods and high uncertainty (Jia et al., 2024). When enterprises face the dual constraints of rising capital costs and limited external financing channels, the investment threshold for digital transformation increases significantly. Therefore, economic policy uncertainty ultimately has a negative impact on enterprise digital transformation by deteriorating the financing environment and intensifying capital constraints.

Secondly, economic policy uncertainty increases managerial risk aversion. According to risk aversion theory, when economic policy uncertainty is high, issues such as environmental ambiguity and information asymmetry increase, making it more difficult for managers to identify investment opportunities and leading them to exhibit stronger risk-averse behaviour (Liu & Gao, 2024). Meanwhile, as most company managers hold company shares, the interest alignment mechanism further strengthens their risk-averse attitudes (Zhang et al., 2021). Managerial risk aversion tendencies have an inhibitory effect on digital transformation. Digital transformation is a systemic process involving comprehensive changes across the organisational structure, business models, research and development paradigms, production methods and employment practices (Khurana et al., 2022). Currently, many enterprises in China must begin from scratch when planning digital transformation technology architecture struggling with lack of relevant experience and management capabilities, resulting in considerable difficulties and lengthy timeframes for transformation at all stages (Cheng et al., 2024). Consequently, digital transformation is characterised by long cycles and high risks. Driven by risk-averse psychology, managers tend to postpone or abandon such high-risk investments. Therefore, economic policy uncertainty ultimately has a negative impact on enterprise digital transformation by strengthening managerial risk aversion tendencies.

Thirdly, economic policy uncertainty increases the value of waiting for enterprises. Real options theory posits that when investments are irreversible, the timing of investment can be viewed as a call option; thus, during periods of heightened economic policy uncertainty, the difficulty of decision-making increases, leading to a rise in the value of waiting to invest (Cheng & Masron, 2023). Firstly, the specific characteristics of digital transformation investments are distinctly specialised and irreversible, akin to a call option. Secondly, given the inherently high risks associated with digital transformation, these risks amplify during times of economic policy uncertainty, increasing the complexity of decision-making. Digital transformation involves multiple critical phases, and many enterprises in China generally lack experience in this regard, leading to elevated uncertainties

associated with the transformation itself (Chen & Tian, 2022). When economic policy uncertainty is high, operational risks and employee turnover further exacerbate uncertainties within the digital transformation process (Lou et al., 2022). Moreover, heightened economic policy uncertainty raises transformation costs, diminishing the benefits derived from transformation and increasing the probability of failure (Boah & Ujah, 2024). Ultimately, only a small fraction of enterprises successfully navigate this transformation. Therefore, based on real options theory, rational managers are likely to delay investments related to digital transformation during periods of heightened economic policy uncertainty.

In summary, this study posits the following research hypothesis:

H1: There exists a negative correlation between the perceptions of economic policy uncertainty and enterprise digital transformation.

Empirical research design

Modelling

The following panel data model (Equation 1) was constructed:

$$DIG_{it} = \beta_0 + \beta_1 FEPU_{it} + \beta_2 X_{it} + Firm_i + Year_t + \varepsilon_{it} \quad \text{[Eqn 1]}$$

where i denotes the firm and t denotes the year. DIG_{it} represents digital transformation, $FEPU_{it}$ signifies the perception of economic policy uncertainty. X_{it} represents a set of control variables, $Firm_i$ indicates firm fixed effects, $Year_t$ represents year fixed effects and ε_{it} is the error term. Given the potential for heteroscedasticity and autocorrelation in the error terms, robust standard errors clustered at the firm-level were calculated.

Variable definitions

The dependent variable is digital transformation (DIG). Following Chi et al. (2025), this study obtained DIG data from the China Stock Market & Accounting Research (CSMAR) database, which constructs these indicators using text analysis methods. China Stock Market & Accounting Research extracts digital transformation-related keywords from the Management Discussion and Analysis (MD&A) section of listed companies' annual reports, covering five main technological areas: cloud computing, big data, blockchain, artificial intelligence (AI) and digital technology applications (Table 1–A1 presents a subset of the vocabulary included). The database employs systematic text analysis to identify and count relevant keywords, generating a comprehensive measurement system for enterprise digital transformation levels.

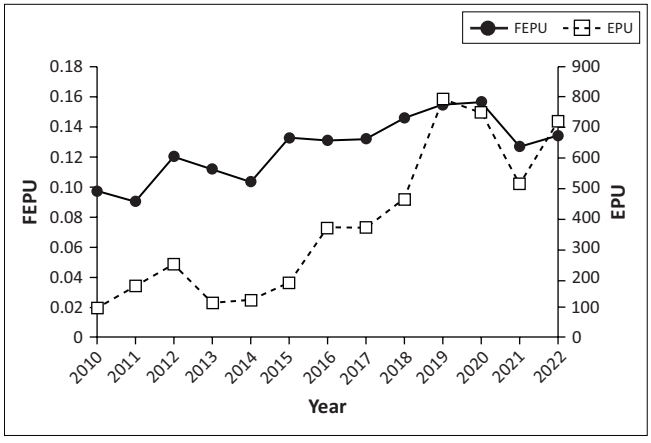
The independent variable is the perception of economic policy uncertainty at the firm-level (FEPU). Following Li et al. (2024b), we constructed an 'uncertainty' dictionary (see Appendix Table 1–A1). We then extracted specific textual content from the MD&A sections of listed companies' annual reports and used Python to calculate the co-occurrence frequency of 'economic policy' and 'uncertainty'-related terms within the same sentence. When these two categories of words are detected co-occurring within the same sentence, we recognise that sentence as expressing 'economic policy uncertainty'. Finally, we measure perception of economic policy uncertainty using the ratio of the total count of 'economic policy' and 'uncertainty'-related words to the total word count in the MD&A section.

To validate the effectiveness of FEPU, we obtained the annual Economic Policy Uncertainty (EPU) index from Baker et al. (2016) and calculated its arithmetic mean for comparison. Subsequently, the time trend of both indices was plotted in Figure 1. Because of the differing scales of the two indices, FEPU was displayed on the left axis while EPU was displayed on the right axis for ease of comparison. Figure 1 indicates that the trends of FEPU and EPU are relatively consistent. Thus, the validity of the constructed FEPU indicator is preliminarily substantiated.

In terms of control variables, following the approaches of Li et al. (2024b), this study controlled for several variables that may influence the estimation results. These included ownership concentration (Top1, measured as the shareholding ratio of the largest shareholder), firm age (Age, measured as years of firm establishment), firm size (Size, measured as the natural logarithm of total assets), return on total assets (ROA, measured as net profit divided by total assets), debt-to-asset ratio (Lev, measured as total liabilities divided by total assets) and cash flow from operations (CFO, measured as net cash flow from operating activities divided by total assets). The study also included firm fixed effects (enterprise dummy variables) and year fixed effects (annual dummy variables).

Data sources and descriptive statistics

This study selected Chinese A-share listed companies as the research sample. Given the rapid development of digital technology in China and the fact that significant digital transformation of firms primarily occurred after 2010, the study established a time frame from 2010 to 2022. The financial



FEPU, Perception of economic policy uncertainty (firm-level); EPU, Economic Policy Uncertainty.

FIGURE 1: Firms' perception of economic policy uncertainty and the Economic Policy Uncertainty index.

data of listed companies used in this article came from the CSMAR database, while the annual reports used in the text analysis came from the Chinese Research Data Services (CNRDS) database. Missing textual data were supplemented by reviewing annual report disclosures from the Shanghai and Shenzhen Stock Exchanges and the Giant Tide Information website. To enhance data validity, the sample was refined in accordance with existing research with the specific processing steps as follows: (1) Exclusion of financial sector companies; (2) Exclusion of companies classified as ST (Special Treatment for financial distress) or PT (Particular Transfer for delisting risk) during the year; (3) Exclusion of samples with missing key variables. This process resulted in a total of 39555 observations. In addition, to mitigate the influence of outliers, this study applied a 1% winsorisation to all firm-level variables.

Table 1 presents the descriptive statistical results. The findings indicate that the average value of DIG is 1.357, with a 25th percentile of 0 and a 75th percentile of 2.303. These results are consistent with previous research, suggesting that a significant number of listed firms in China have not yet undergone digital transformation, and there is considerable disparity among firms. The average value of FEPU is 0.128, with a minimum of 0 and a maximum of 0.512. These results align closely with those of Li et al. (2024b), indicating substantial variation in perceptions of economic policy uncertainty among different firms. This finding underscores the importance of developing a micro-level perception measure for economic policy uncertainty to assess its impact effectively.

TABLE 1: Descriptive statistics.

Variable	Mean	SD	Min	p25	p50	p75	Max
DIG	1.357	1.385	0.000	0.000	1.099	2.303	5.037
FEPU	0.128	0.107	0.000	0.047	0.104	0.182	0.512
FEPU2	2.911	2.135	0.000	1.357	2.491	4.027	10.256
Top	0.347	0.149	0.091	0.231	0.324	0.446	0.750
Size	22.126	1.301	19.723	21.187	21.936	22.864	26.153
Lev	0.416	0.209	0.050	0.247	0.406	0.571	0.903
ROA	0.038	0.065	−0.272	0.014	0.039	0.070	0.202
CFO	0.045	0.071	−0.172	0.006	0.045	0.087	0.248
Age	18.017	5.980	5.000	14.000	18.000	22.000	33.000

SD, standard deviation; Min, minimum; Max, maximum; DIG, digital transformation; FEPU, uncertainty perception; Size, firm size; Lev, leverage; ROA, return on total assets; CFO, cash flow from operations; Age, firm age.

Ethical considerations

This article followed all ethical standards for research without direct contact with human or animal subjects.

Results and analysis

Baseline regression

Table 2 presents the baseline regression results. Column (1) shows results without control variables and fixed effects, column (2) adds fixed effects and column (3) includes both control variables and fixed effects. The FEPU coefficients are significantly negative at the 1% level across all specifications, indicating that uncertainty perception inhibits digital transformation. Economically, using column (3) results, a one standard deviation (SD) increase (0.107) in uncertainty perception reduces DIG by 2.07% (−0.263 × 0.107/1.357).

Digital transformation comprises foundational technology transformation and technology application transformation. Foundational technology transformation involves AI, big data, cloud computing, and blockchain, focusing on digital reform of production models, organisational structures and management practices. It requires substantial initial investment with lengthy cycles and no immediate outputs. Technology application transformation involves mobile internet, industrial internet, e-commerce and smart homes, emphasising integration of digital technologies with business operations. It requires lower initial investment with closer proximity to realising outputs. This study expects uncertainty perception to have stronger inhibitory effects on foundational technology transformation than on technology application transformation. Columns (4) and (5) examine these sub-indicators separately. For foundational technology, the FEPU coefficient is significantly negative at the 1% level, while for technology application, it is significantly negative at the 5% level. Economically, a one

TABLE 2: Baseline regression results.

Variables	(1)	(2)	(3)	(4)	(5)
	DIG	DIG	DIG	DIG	DIG
FEPU	-1.045*** (0.118)	-0.089*** (0.063)	-0.263*** (0.082)	-0.268*** (0.076)	-0.143** (0.056)
Top1	-	-	-0.538*** (0.122)	-0.582*** (0.109)	-0.312*** (0.112)
Size	-	-	0.269*** (0.019)	0.262*** (0.018)	0.182*** (0.018)
Lev	-	-	-0.068 (0.070)	-0.054 (0.065)	-0.018 (0.063)
ROA	-	-	-0.195* (0.105)	-0.401*** (0.097)	-0.049 (0.097)
CFO	-	-	-0.072 (0.079)	-0.072 (0.072)	-0.055 (0.071)
Age	-	-	-0.053** (0.023)	-0.024 (0.020)	-0.060*** (0.022)
Firm Fixed	No	Yes	Yes	Yes	Yes
Year fixed	No	Yes	Yes	Yes	Yes
N	39555	39132	39132	39132	39132
Adj. R^2	0.007	0.756	0.764	0.757	0.764

Note: Table 2 presents baseline regression results for the model that determines the influence of uncertainty perception on digital transformation. FEPU and DIG are measures for uncertainty perception and digital transformation respectively. Control variables include Top1, Size, Lev, ROA, CFO, and Age.

The values in parentheses represent clustered robust standard errors at the company level.

FEPU, uncertainty perception; DIG, digital transformation; Top1, largest shareholder ownership; Size, firm size; Lev, leverage; ROA, return on assets; CFO, cash flow from operations; Age, firm age; Adj, adjusted.

***, 1%; **, 5%; *, 10% significance levels, respectively.

SD increase in uncertainty perception reduces foundational technology transformation by 2.1% and technology application transformation by 1.1%.

Robustness tests

Instrumental variable test

To address endogeneity concerns, this study follows Fisman and Svensson (2007) by using other firms' average perceptions of economic policy uncertainty in the same year, industry and province (IV-FEPU) as an instrumental variable for two-stage least squares (2SLS) regression. This instrumental variable satisfies relevance because firms in the same period, industry and region face similar macroeconomic policy environments, making the average uncertainty perception of other firms highly correlated with the target firm's perception. It satisfies exogeneity because the average perception of other firms primarily reflects objective macroeconomic policy changes and does not directly affect the target firm's digital transformation decisions. To ensure quality, this study excludes year-industry-province samples with fewer than three firms.

Rows (1) and (2) of Table 3 display the results. Row (1) shows the first-stage regression where the instrumental variable coefficient is significantly positive. The Kleibergen-Paap rk LM statistic is 121.01, rejecting the under-identification hypothesis at the 1% level. The Cragg-Donald Wald F statistic is 63.98, exceeding the 10% critical value of 16.38, rejecting the weak instrument hypothesis. Row (2) shows the second-stage results with a significantly negative coefficient, consistent with previous conclusions and confirming that findings are not affected by endogeneity.

Test for lagged effects

Considering that our main regression analysis is based on the contemporaneous effect of FEPU on DIG, the results potentially suffer from simultaneity bias. To further address this potential endogeneity concern, we re-run the regression analysis using lagged values of the independent variable. The regression results are shown in Table 3, indicating that the results remain robust.

TABLE 3: Robustness tests.

Item	Dependent Var	Independent Var	Coef. (SE)	*N*
(1)	FEPU	IV-FEPU	0.916*** (0.023)	29928
(2)	DIG	FEPU	-0.482** (0.196)	29928
(3)	DIG	L.FEPU	-0.159** (0.062)	33347
(4)	DIG	FEPU2	-0.018*** (0.003)	39132
(5)	DIG	FEPU	-0.223*** (0.067)	27917
(6)	DIG	FEPU	-0.294*** (0.114)	31126
(7)	DIG	FEPU	-0.272*** (0.072)	34078
(8)	AI	FEPU	-0.116*** (0.038)	39132
(9)	BD	FEPU	-0.016** (0.008)	39132
(10)	CC	FEPU	-0.146*** (0.045)	39132
(11)	DT	FEPU	-0.199*** (0.044)	39132
(12)	ADT	FEPU	-0.143** (0.056)	39132

Note: Table 3 presents robustness test results examining the relationship between uncertainty perception and digital transformation using various approaches. Control variables and fixed effects are included in all regressions. The values in parentheses represent clustered robust standard errors at the company level.

SE, standard error; FEPU, uncertainty perception; DIG, digital transformation; IV-FEPU, instrumental variable for uncertainty perception; L.FEPU, one-period lagged uncertainty perception; FEPU2, alternative measurement of uncertainty perception; AI, artificial intelligence; BD, blockchain; CC, cloud computing; DT, big data; ADT, application of digital technology.

*** and ** denote significance at the 1% and 5% levels, respectively.

Reconstructing the independent variable

In the baseline analysis, this study measured firms' perceptions of economic policy uncertainty as the proportion of uncertainty words to the total word count in the MD&A section. To ensure robustness across different measurement approaches, the study alternatively measured firms' perceptions using the ratio of economic policy uncertainty sentences to total sentences in the MD&A section (FEPU2). The regression results, displayed in Table 3, show that the estimated coefficient of FEPU2 is significantly negative at the 1% level, confirming the robustness of the study's conclusions.

Change of sample interval

In line with the study by Cheng et al. (2024) and considering that the period from 2015 onwards marked a rapid development of the digital economy in China, this study narrowed the sample range to 2015–2022. The regression results are presented in Table 3, indicating that the findings remain robust.

Exclusion of exaggerated information disclosure by enterprises

To mitigate the impact of exaggerated information disclosure, this study employed a method adapted from Jiang et al. (2025). Firstly, the annual average uncertainty perceptions for other enterprises within the same industry were calculated, excluding years with fewer than three enterprises. Secondly, this average was used as the explanatory variable and each enterprise's uncertainty perception as the dependent variable to compute regression residuals. Finally, samples exceeding the 80th percentile of residuals were excluded to minimise exaggerated disclosure influence. Row (6) of Table 3 shows that findings remain robust after excluding samples with exaggerated uncertainty perceptions.

Omitted variables

To eliminate potential interference from unobservable factors at the industry and regional levels, this study incorporated fixed effects for industry × year, province × year, and industry × year × province in the baseline regression. The regression results are presented in Table 3, indicating that the findings remain robust.

Reconstructing the dependent variable

Following the approach of Zhang and Wang (2024), this study decomposed enterprise digital transformation into five sub-indicators: AI, Blockchain (BD), Cloud Computing (CC), Big Data (DT), and Application of Digital Technology (ADT). Using each sub-indicator as the dependent variable, the regression results in Rows (8–12) of Table 3 show that all coefficients remain significantly negative, confirming the robustness of our findings.

Results

Mechanism analysis

Financing challenges

Based on the theoretical analysis, economic policy uncertainty affects firms through financing channels, impacting internal financing stability and external financing cost and scale. This study uses three measures to capture financing challenges. Firstly, to assess internal financing stability, we measure profitability volatility using the 3-year rolling SD of industry- and year-adjusted ROA, creating a dummy variable roaSD based on the median value. Secondly, external financing cost is measured by the ratio of financial expenses to total liabilities, with a dummy variable Cost defined by the median ratio. Thirdly, the external financing scale is captured by the logarithm of total debt (short-term plus long-term liabilities plus one), with a dummy variable Debt based on the median value.

Drawing on the research of Dust et al. (2014), this study utilised moderation analysis for mechanism testing, with results shown in columns (1–3) of Table 4. The coefficients of FEPU × Roasd and FEPU × Cost were found to be significantly negative, while the coefficient of FEPU×Debt was significantly positive. This indicates that when firms face high instability in internal financing, elevated external financing costs, and reduced external financing scales, the suppressive effect of corporate perceptions of economic policy uncertainty on digital transformation is more significant. This suggests that financing constraints can amplify the adverse effects of firms' perceptions of economic policy uncertainty on enterprise digital transformation.

Managerial risk aversion

Subsequently, this study examined the channel of managerial risk aversion. Drawing on Qian et al. (2023), this study used managerial shareholding ratio (Msr) and board shareholding ratio (Bsr) to measure managerial risk aversion, and then constructed interaction terms with FEPU. Columns (4–5) of Table 4 present the regression results. The coefficients of FEPU×Msr and FEPU×Bsr are significantly negative. This indicates that when the managerial shareholding ratio and board shareholding ratio are higher, the negative impact of economic policy uncertainty perceptions on enterprise digital transformation is greater. This suggests that managerial risk aversion can amplify the adverse effects of firms' perceptions of economic policy uncertainty on enterprise digital transformation.

Heterogeneity analysis

Impact of institutional investors

Institutional investors mitigate the negative effects through three mechanisms. Firstly, they alleviate financing constraints by leveraging scale advantages, professional reputation and network relationships to provide more financing channels and lower costs (Jin et al., 2024). Secondly, they constrain managerial risk aversion through formal and informal governance mechanisms, with their long-term investment orientation supporting digital transformation and reducing managers' tendency to postpone investment (Lewellen & Lewellen, 2022). Thirdly, they optimise investment decisions through superior information collection, processing and analysis capabilities, helping managers cope with external uncertainty and reduce excessive waiting behaviour.

Group-based tests in Table 5 show that when institutional ownership is low, the FEPU coefficient is significantly negative at the 1% level. When institutional ownership is high, the coefficient remains significantly negative but only at the 5% level, with the group difference test significant at the 5% level. This indicates that institutional investors reduce the suppressive effect of uncertainty perception on digital transformation.

TABLE 4: Mechanism tests.

Variables	DIG (1)	DIG (2)	DIG (3)	DIG (4)	DIG (5)
FEPU	-0.144* (0.078)	-0.156* (0.088)	-0.169** (0.083)	-0.137* (0.071)	-0.171** (0.069)
Roasd	0.040** (0.016)	-	-	-	-
FEPU´Roasd	-0.204** (0.100)	-	-	-	-
Debt	-	0.049** (0.024)	-	-	-
FEPU´Debt	-	0.187* (0.107)	-	-	-
Dost	-	-	0.024 (0.019)	-	-
FEPU´Cost	-	-	-0.170* (0.093)	-	-
Msr	-	-	-	0.019** (0.008)	-
FEPU´Msr	-	-	-	-0.315** (-1.55)	-
Bsr	-	-	-	-	0.028** (0.014)
FEPU´Bsr	-	-	-	-	0.289** (0.117)
Control	Yes	Yes	Yes	Yes	Yes
Firm fixed	Yes	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes	Yes
N	33934	39132	39132	37539	37679
Adj. R^2	0.758	0.792	0.792	0.762	0.760

Note: Table 4 presents how uncertainty perception influences digital transformation through financing and managerial risk channels. Control variables are the same as in Table 2.

FEPU, uncertainty perception; DIG, digital transformation; Roasd, dummy variable for internal financing stability; Debt, dummy variable for external financing scale; Cost, dummy variable for external financing cost; Msr, managerial shareholding ratio; Bsr, board shareholding ratio; Adj, adjusted.

**, 5% and *, 10% significance levels, respectively.

Impact of firm size

Given the high costs and risks associated with digital transformation, it poses a significant challenge for firms. For small and medium-sized enterprises (SMEs), their disadvantage in accessing resource factors renders them vulnerable, especially during periods of high economic policy uncertainty, making it difficult to acquire the necessary resources for digital transformation (Clemente-Almendros et al., 2024; Gaglio et al., 2022). In contrast, large enterprises benefit from advantages in organisational structure and resource endowment, allowing them to bear greater risks (Wang & Zhang, 2025). Therefore, it is hypothesised that economic policy uncertainty has a lesser impact on the digital transformation of large enterprises. This study categorised firms within the top 20% of asset size in the same year and industry as large enterprises, creating two groups: large enterprises and SMEs.

Group-based tests are presented in Table 5. The results indicate that in the large enterprise group, the estimated coefficient of FEPU is negative but not significant. In the SME group, the estimated coefficient of FEPU is significantly negative at the 1% level, with the group difference test showing significance at the 5% level. This suggests that when a firm is categorised as a large enterprise, the suppressive effect of firms' perceptions of economic policy uncertainty on digital transformation is weaker.

Impact of holding financial institutions

During periods of heightened uncertainty, financial institutions increase credit costs and reduce credit availability to maintain capital adequacy ratios, creating financing challenges. However, firms holding shares in financial institutions can more easily alleviate high financing costs and credit constraints. This study conducted a group-based analysis according to financial institution shareholding, with results in Table 5. When firms held shares in financial institutions, the coefficient of FEPU was positive, while it was significantly negative at the 1% level when they did not, with the group difference test significant at the 5% level.

TABLE 5: Heterogeneity tests.

Heterogeneity variable	Group	Coef. (SE)	*p*
Institutional ownership	Low	-0.371*** (0.093)	0.019
	High	-0.155** (0.078)	
Firm size	Large	-0.002 (0.127)	0.022
	SME	-0.289*** (0.067)	
Financial institution	Yes	0.289* (0.162)	0.016
	No	-0.302*** (0.065)	
Bank	Yes	0.289* (0.162)	0.049
	No	-0.302*** (0.065)	
Other financial institutions	Yes	0.202 (0.181)	0.082
	No	-0.300*** (0.065)	

Note: Table 5 presents heterogeneity test results. The coefficients shown are for FEPU in regressions where DIG is the dependent variable. Control variables and fixed effects are included in all regressions.

The *P*-value indicates the statistical significance of the difference in the estimated coefficients between the two sample groups, calculated using the Bootstrap method with 1000 repetitions.

SE, standard error; SME, small and medium-sized enterprise.

***, 1%; **, 5%; *, 10% significance levels, respectively.

Given that commercial banks dominate China's financial system, this study further categorised financial institutions into banks and other financial institutions. Results show that when firms held bank shares, the FEPU coefficient was significantly positive at the 10% level, while significantly negative at the 1% level without bank shares. For other financial institutions, firms with shareholdings had positive FEPU coefficients, whereas those without had significantly negative coefficients at the 1% level. This indicates that bank shareholding has a stronger positive effect on the uncertainty-digital transformation relationship than other financial institutions.

Further discussion

In the existing research, scholars often equate digital transformation with ordinary investment or general innovation. However, digital transformation represents a comprehensive, disruptive innovation involving technological changes and transformations in personnel, processes and project portfolios. It is characterised by high costs, prolonged durations and lack of relevant talent and experience. In contrast, general innovation is the lifeblood of enterprises for gaining market power, making firms relatively familiar with it and typically possessing requisite talent and resources. Thus, the impact of uncertainty perception on digital transformation should be more pronounced than on general innovation.

To compare the differences, ordinary investment (INVEST) is measured as the sum of fixed assets, intangible assets and other long-term asset expenditures as a proportion of total assets. Innovation investment (RD) is quantified as the ratio of research and development (R&D) expenditure to total assets. The results in Table 6, columns (1) to (3), show a significant negative correlation between FEPU and both DIG and INVEST, indicating that uncertainty has similar suppressive effects on digital transformation and ordinary investment. The relationship between FEPU and RD was insignificant, which may reflect mixed findings in prior research, where some studies find positive correlations while others find negative correlations. Column (4) includes INVEST and RD as control variables, confirming that baseline conclusions remain robust.

TABLE 6: Additional analysis of FEPU's economic consequences.

Variable	DIG (1)	INVEST (2)	RD (3)	DIG (4)
FEPU	-0.263*** (0.062)	-0.019*** (0.003)	-0.002 (0.001)	-0.274*** (0.070)
Control	Yes	Yes	Yes	Yes
Firm fixed	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes
N	39132.000	39105.000	32505.000	32493.000
Adj. R^2	0.764	0.445	0.667	0.782

Note: Table 6 presents further analysis comparing the effects of uncertainty perception on digital transformation, ordinary investment, and innovation investment. Column (4) includes INVEST and RD as additional control variables.

FEPU, uncertainty perception; DIG, digital transformation; INVEST, ordinary investment measured as the sum of fixed assets, intangible assets, and other long-term asset expenditures as a proportion of total assets; RD, innovation investment measured as the ratio of research and development expenditure to total assets.

***, denotes significance at the 1%.

Theoretical contributions

Our contribution mainly includes the following two aspects. Firstly, this study enriches the exploration of factors influencing digital transformation, offering insights for enterprises in formulating strategies. Previous research primarily focused on aspects such as equity network relationships, managerial characteristics and institutional investor traits (AlNuaimi et al., 2022; Chen & Tian, 2022). This study constructed a micro-level indicator for enterprises' perceptions of economic policy uncertainty and investigated its relationship with digital transformation, establishing a generally negative correlation between the two, with heterogeneous analysis indicating a positive correlation that only existed in certain enterprises with financial institution ownership. These findings contrast with existing literature, providing new evidence for understanding the relationship between economic policy uncertainty and digital transformation.

Secondly, while a limited number of studies have examined the impact of economic policy uncertainty on digital transformation, the theoretical mechanisms and empirical research remain scarce. Some existing studies assert that economic policy uncertainty can facilitate digital transformation (Cheng & Masron, 2023), overlooking the financing challenges and risks faced by management during periods of high economic policy uncertainty. Given the inherently high costs and risks of digital transformation, transitioning during such uncertain times may exacerbate these risks. Thus, this study expands the understanding of the mechanisms through which perceptions of economic policy uncertainty influence digital transformation from the perspectives of financing challenges and managerial risk aversion.

Managerial contributions

Firstly, from the perspective of enterprises, rising economic policy uncertainty increases the difficulty of financing and heightens managers' aversion to high-risk projects. In response to the financing challenges posed by increased economic policy uncertainty, enterprises should, on the one hand, formulate more precise transformation strategies to enhance resource allocation efficiency, reduce trial-and-error costs and avoid crises stemming from blind transformation. On the other hand, enterprises should improve their information technology capabilities, enhance the financial ecosystem and develop diversified financing channels. To address inappropriate investment avoidance behaviours by managers, enterprises should further refine governance mechanisms, fully leverage the supervisory role of investors, reduce losses arising from agency problems and enhance managers' cognitive capabilities and governance skills. In addition, in light of the heterogeneity test results, the presence of institutional investors and shareholdings in financial institutions can mitigate the negative impacts of economic policy uncertainty. This provides insights for enterprises on designing equity distribution and investment strategies to prevent and resolve risks.

Secondly, from the government's perspective, as countries continually adjust their industrial structures and strategic layouts, domestic and international competition has intensified, placing the global economy in a phase of heightened uncertainty. To maintain the sustained and stable development of the economy, the Chinese government has frequently introduced or adjusted economic policies. However, the frequent adjustments of policies have created some negative impacts on enterprises, leading to diminished entrepreneurial confidence and restricted financing. Such issues hinder enterprises in advancing their digital transformation. Therefore, the government should enhance policy stability and transparency, establish a policy announcement system, release information on major policy changes in advance, strengthen policy interpretation and communication, and enhance enterprises' expectations for future development through regular dialogue. Simultaneously, the government may implement targeted fiscal and taxation incentive policies, providing specific tax benefits for digital transformation, such as implementing accelerated depreciation for digital equipment investment and granting tax deductions for research and development expenditure. Finally, the government should construct a differentiated support system, such as providing policy guidance and platform construction for large enterprises, while offering financial support, technical services and personnel training for SMEs. In addition, digital transformation public service platforms should be established to provide one-stop services including technical consulting, talent matching and financing facilitation.

Limitations and directions for future research

Firstly, the impact mechanisms of economic policy uncertainty on digital transformation are complex. This study, combining the high-cost and high-risk characteristics of digital transformation, discusses the impact pathways of financing difficulties and managerial risk aversion. Future research could expand these pathways by incorporating other characteristics of digital transformation. Secondly, this study selects Chinese data as the research sample, and whether the research conclusions are applicable to other countries requires further verification. For example, the financing constraint mechanism and the unique moderating effect of financial institutional ownership identified in this study may be closely related to China's specific financial system and ownership structure. Therefore, future research should conduct verification in countries with different institutional environments. Thirdly, the independent variable used in this study is firms' uncertainty perceptions, which are influenced by managers' personal characteristics such as gender, personality and age. Currently, we have only considered the heterogeneity of firm characteristics. Based on the important mechanism of managerial risk aversion revealed in this study, future research could explore the influence of managers' personal characteristics, such as how managers' educational background and professional experience moderate their perceptions of policy uncertainty and its impact on decision-making.

Conclusion

This study explores the impact of economic policy uncertainty on enterprise digital transformation. The findings reveal that enterprises' perceptions of economic policy uncertainty have a significant negative impact on digital transformation, with a stronger inhibitory effect on foundational technology transformation than on digital technology application transformation. This finding is consistent with real options theory: when uncertainty increases, the waiting option value of digital transformation investments with irreversible characteristics increases, and rational enterprises tend to delay investment to obtain more information. Mechanism analysis indicates that financing constraints and managerial risk aversion play crucial roles. Specifically, based on financing cost theory, policy uncertainty increases enterprise financing costs and reduces financing availability by exacerbating market information asymmetry and risk premiums; meanwhile, according to risk aversion theory, policy uncertainty strengthens managers' risk-averse tendencies in uncertain environments, leading them to exhibit avoidance behaviour towards high-risk, long-cycle digital transformation projects. Furthermore, heterogeneity test results show that when enterprises have a higher proportion of institutional investors and larger firm size, the inhibitory effect of enterprises' perceptions of economic policy uncertainty on digital transformation is weakened, while when enterprises have shareholdings in financial institutions, perceptions of economic policy uncertainty transform into a promoting effect on digital transformation.

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Competing interests

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Authors' contributions

J.X. conducted the writing, methodology and software analysis. S.M. did the investigation and resources gathering. W.W. supervised the study and assisted with the writing.

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Data availability

The data that support the findings of this study are available from the corresponding author, W.W. upon reasonable request.

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Appendix 1 starts on the next page →

Appendix

TABLE 1-A1: Vocabulary list.

Digital transformation lexicons	Uncertainty lexicons
Artificial intelligence	Risk
Machine learning	Uncertainty
Deep learning	Volatility
Cloud computing	Change
Internet of things	Instability
Data mining	Turbulence
Intelligent robots	Danger
Brain-inspired computing	Shock
Intelligent customer service	Disarray
Mobile internet	Unpredictable