Economic Policy Uncertainty and Corporate Collaborative Innovation: Empirical Evidence from Chinese Listed Companies

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Abstract. This paper examines the impact of economic policy uncertainty on corporate collaborative innovation. Against the backdrop of intensifying uncertainty, firms face heightened external volatility and tighter capital constraints, which prompt them to adopt collaborative innovation as a strategic means to reduce R&D expenditures and mitigate risks. Using panel data from A-share listed companies spanning 2008 to 2021, and employing the number of patents jointly applied for by firms with other entities as a proxy for collaborative innovation, we construct econometric models for empirical analysis. The results reveal that economic policy uncertainty exerts a significantly positive effect on collaborative innovation behavior. Further heterogeneity analysis indicates that this positive effect is considerably more pronounced among state-owned enterprises, firms in high-tech industries, and those with lower financing constraints. Overall, this research not only enriches the existing literature on economic policy uncertainty and corporate innovation, but also offers valuable policy implications for decision-makers, assisting firms in optimizing their innovation activities amidst uncertainty and fostering high-quality economic development.

Keywords: Economic policy uncertainty, Corporate collaborative innovation, High-quality development.

1. Introduction

Innovation is regarded as the key driving force for promoting economic growth and achieving high-quality development. In the report of the 20th National Congress of the Communist Party, General Secretary Xi Jinping emphasized the core role of innovation in the country's modernization process, clearly stating that technology is the primary productive force, talent is the core resource, and innovation is the primary driving force. As the basic units of a market economy, enterprises' innovation capabilities are not only directly linked to their own competitive advantages and profitability, but also play a key role in the national strategy for innovation-driven development, having a profound impact on macroeconomic growth and the overall development level of the country. At present, the world is experiencing changes unseen in a century, with factors such as new technological revolutions, adjustments in economic globalization, and intensified great-power competition creating major impacts across many areas. The series of measures taken by governments in response inevitably increases the uncertainty of economic policies. This new development context has made Chinese enterprises realize the importance and urgency of innovation, and how to drive responses to external uncertainties through innovation, ultimately seeking high-quality development of listed companies themselves, has become an important issue facing both the Chinese government and enterprises.

Based on this, under the broader environment where the sense of urgency for innovation, the tightening of funds, and the pessimism about future expectations brought by economic policy uncertainty are all increasing day by day, this paper explores whether economic policy uncertainty will prompt enterprises to choose collaborative innovation to resist external risks. It aims to provide clear direction and specific measures for how Chinese enterprises can withstand external environmental shocks and accelerate their own transformation and upgrading, as well as offer

important insights and reference value for promoting high-quality economic development in China and enhancing the position of industries in the global value chain.

2. Literature Review

2.1. Impact of Economic Policy Uncertainty on Corporate Behavior

Economic policy uncertainty refers to the degree to which economic agents cannot accurately predict whether, when, and how the government will alter its current economic policies (Gulen et al., 2016) [1]. As key microeconomic agents and the primary targets of economic policy implementation, firms are significantly affected by such uncertainty. Current research has extensively focused on how economic policy uncertainty shapes corporate behavioral decisions—a topic of great theoretical and practical significance.

The uncertainty exerts influence on various corporate dimensions, including investment and financing, operations, and corporate governance. Regarding investment and financing behaviors, Li and Yang (2016) [2] find that the overall investment level of Chinese firms declines with rising uncertainty, and this effect becomes more pronounced during economic downturns. Disaggregating by specific capital allocations, rising uncertainty leads firms to reduce fixed asset investment, increase R&D expenditure, decrease speculative financial assets, and increase value-preserving financial assets (Peng et al., 2018) [3]. Concerning operational behaviors, Gu et al. (2018) [4] further demonstrate that uncertainty positively affects patent applications, thereby enhancing innovation efficiency. Meanwhile, heightened uncertainty also reduces merger and acquisition activities (Bonaime et al., 2018) [5] and elevates corporate cash holdings (Wang et al., 2014) [6]. At the corporate governance level, Rao and Xu (2017) [7] find that an increase in uncertainty lowers the probability of executive turnover, which firms adopt as a risk-hedging strategy; this relationship is more pronounced among firms with weaker risk-taking capacity. Furthermore, Chen et al. (2016) [8] show that policy uncertainty arising from official turnover intensifies corporate tax avoidance, and this effect is more significant in regions with lower tax enforcement intensity.

2.2. Determinants of Collaborative Innovation

Collaborative innovation refers to the process of transcending the boundaries of innovation entities, facilitating the effective integration of innovation resources and factors, stimulating the vitality of "talent, capital, information, and technology" to achieve mutual benefit and win-win outcomes, and ultimately enhancing firm value and core competitiveness (Chen et al., 2012) [9]. Existing research has mainly explored two dimensions of collaborative innovation: external driving factors and internal motivators.

For external drivers, institutional support and market competition are key foci of research. At the institutional level, a favorable environment shaped through government policy formulation plays a significant role in promoting corporate collaborative innovation. For instance, Fan et al. (2014) [10], through a case study, found that policy support helps firms construct collaborative innovation networks, thereby improving innovation performance. At the market level, Huang et al. (2021) [11] find that the degree of industry competition exerts a "U-shaped" impact on firms' willingness to engage in collaborative innovation—that is, as competition intensifies, this willingness first decreases and then increases. For internal motivators, two primary aspects are identified: external resource acquisition and the sharing of risks and costs. First, firms pursue collaborative innovation to acquire complementary resources (Zhang et al., 2018) [12]. Heterogeneous resources are crucial for gaining competitive advantage, and the development of a single firm is often constrained by internal and external resource limitations. Therefore, transcending organizational boundaries to collaborate with external partners has become an important pathway for firms to break through innovation bottlenecks and obtain competitive advantages (Yang et al., 2020) [13]. Second, R&D activities are inherently characterized by high risk, strong positive externalities, and the need for continuous investment. Moreover, investors find it difficult to assess the quality of R&D projects or form clear return

expectations in a short time (Hall et al., 2010) [14], and external financing is often challenging to secure (Stiglitz et al., 1981) [15]. Thus, when external environmental uncertainty intensifies and firms face financing difficulties, collaborative innovation can help them diversify R&D risks and share R&D costs, thereby generating synergies and achieving economies of scale (Zhou et al., 2017) [16].

2.3. Literature Review Summary

Existing research has demonstrated that economic policy uncertainty affects multiple dimensions of corporate behavior, including investment, operations, and governance, and that heightened uncertainty can stimulate firms' innovation activities. Meanwhile, collaborative innovation enables firms to acquire complementary resources and share risks. Nevertheless, the specific impact of economic policy uncertainty on corporate collaborative innovation, as well as the underlying mechanisms through which this influence operates, remain underexplored in the current literature. To address this gap, this paper investigates the effect of economic policy uncertainty on corporate collaborative innovation, aiming to fill the theoretical void and provide practical guidance for policy formulation and corporate strategy, thereby assisting firms in optimizing their innovation activities amidst uncertainty.

3. Theoretical Analysis and Research Hypotheses

An increase in economic policy uncertainty renders the market environment in which firms operate increasingly severe and complex, directly affecting their production, operations, and strategic decision-making. Challenges arising from changes in the external environment can severely undermine independent innovation activities, which are characterized by long cycles, high risks, and substantial investment requirements. Under such circumstances, collaborative innovation, with its core principles of “resource sharing,” “cost sharing,” and “risk sharing,” demonstrates unique advantages and inherent value [17]. Consequently, firms’ willingness to engage in collaborative innovation is likely to intensify.

First, when economic policy uncertainty intensifies, financial institutions such as banks find it difficult to assess the quality and future prospects of firms’ investment projects in a short time, leading to increased information asymmetry between firms and financial institutions. In response, banks and other financial institutions tend to adopt tighter lending policies (Baum et al., 2009) [18]. Moreover, heightened uncertainty elevates firms’ financial and operational risks, prompting external investors to downgrade their earnings expectations for affected firms, which severely disrupts external financing activities and weakens firms’ external financing capacity. Consequently, when a standalone firm faces severe financing constraints, it cannot satisfy the substantial capital demand required for independent innovation (Hall et al., 2010) [14]. Drawing on resource dependence theory, firms that collaborate with external partners can access diverse complementary knowledge and resources, thereby reducing the costs of information searching and resource acquisition (Liu et al., 2022) [19]. Against the backdrop of heightened economic policy uncertainty and tightening liquidity, firms face the dual challenge of urgent innovation needs and financial constraints. In this context, seeking external partnerships and implementing collaborative innovation strategies to reduce R&D costs becomes a rational economic choice for firms.

Second, under conditions of economic policy uncertainty, the business environment becomes more complex, which in turn elevates firms' operational risks. Furthermore, policy uncertainty negatively affects managers' psychological expectations, undermines their confidence, and may lead to pessimistic emotions and attitudes in decision-making, which translate into a strong aversion to risk (Wu et al., 2022) [20]. Collaborative innovation can help firms mitigate these risks. On the one hand, collaborating with external partners in R&D activities allows firms to share the high risks of technological development and improve R&D efficiency, thereby generating synergies and achieving economies of scale (Zhou et al., 2017) [16]. On the other hand, collaboration partners not only share

high-quality resources but also access tacit information that is not readily available in public markets, reducing potential risks during the R&D process (Huang et al., 2022) [21].

Based on the above analysis, we propose the core research hypothesis of this study:

Hypothesis 1: Economic policy uncertainty positively promotes corporate collaborative innovation.

4. Research Design

4.1. Sample Selection and Data Sources

This paper selects A-share listed companies from 2008 to 2021 as the research sample, and performs the following screening and processing procedures: (1) excluding ST and *ST listed companies; (2) excluding firms in the financial and insurance industries; (3) excluding observations with missing key variable data; and (4) winsorizing all continuous variables at the 1st and 99th percentiles to mitigate the influence of extreme outliers. After the above screening and processing, a total of 23,326 firm-year observations are obtained. The firm-level financial and governance data are sourced from the CSMAR database, while the patent data for corporate collaborative innovation are obtained from the patent search database of the China National Intellectual Property Administration. Data processing and analysis are conducted using Excel 2016 and Stata 15.

4.2. Model Specification

Following the approach of Gu et al. (2018) [4], we construct the following econometric model to examine the impact of economic policy uncertainty on corporate collaborative innovation:

$$LnCoin_{i,t} = \alpha_0 + \alpha_1 EPU_{i,t-1} + Controls_{i,t-1} + \mu_t + \lambda_{ind} + \Upsilon_{area} + \varepsilon_{i,t} \quad (1)$$

where $LnCoin_{i,t}$ is the dependent variable, representing the degree of corporate collaborative innovation; $EPU_{i,t-1}$ is the core explanatory variable, denoting the economic policy uncertainty faced by the firm; $Controls_{i,t-1}$ are the control variables selected for this model, including firm size, firm age, Tobin's Q, profitability, tangible asset ratio, cash flow ratio, and others; μ_t, λ_{ind}, and Υ_{area} represent year, industry, and region fixed effects, respectively; and $\varepsilon_{i,t}$ is the error term. To mitigate potential endogeneity concerns, all explanatory variables and control variables (except firm age) are lagged by one period.

4.3. Definition of Main Variables

4.3.1. Dependent Variable: Corporate Collaborative Innovation

Prior studies suggest that joint patent applications serve as an effective protection mechanism to safeguard the exclusive and exclusive rights of collaborative innovation technologies and to prevent other competitors from infringing on the interests of collaborative innovation entities. Patents, as a key indicator of R&D output, more accurately reflect the degree of technological exchange and integration among innovation actors compared to R&D input metrics such as R&D expenditure or the number of R&D personnel. Following the approach of Sun et al. (2019) [22], we measure corporate collaborative innovation ($LnCoin_{i,t}$) using the number of patents jointly applied for by a firm with other external entities, with data obtained from the patent search database of the China National Intellectual Property Administration.

Table 1. Variable Definitions

Variable Type	Variable Name	Symbol	Definition
Dependent Variable	Collaborative Innovation	*LnCoin*	ln(1 + number of joint patent applications with external entities)
Independent Variable	Economic Policy Uncertainty	*EPU*	Annual average of monthly China EPU index / 100
Control Variable	Firm Size	*Size*	Natural logarithm of total year-end assets
	Firm Age	*Age*	ln(current year − founding year + 1)
	Return on Equity	*Roe*	Net profit / total net assets
	Operating Cash Flow Ratio	*Cashflow*	Net operating cash flow / total assets
	Tobin's Q	*Tobin Q*	(Market value of tradable shares + non-tradable share book value + total liabilities) / total assets
	Tangible Asset Ratio	*Tangible*	(Total assets − net intangibles − net goodwill) / total assets
	Financial Leverage	*FL*	(Net profit + income tax + financial expenses) / (Net profit + income tax)
	Year Fixed Effect	μ	Year dummy variables
	Industry Fixed Effect	λ	Industry dummy variables
	Regional Fixed Effect	Υ	Province dummy variables

4.3.2. Core Explanatory Variable: Economic Policy Uncertainty

To measure economic policy uncertainty in China, this paper adopts the China Economic Policy Uncertainty Index constructed by Baker et al. (2016) [23], with data downloaded from the official website in structured tabular format. Baker et al. (2016) [23] selected the South China Morning Post as a representative news retrieval platform because it provides timely coverage of China's economic developments and is the most widely circulated and influential English-language newspaper in Hong Kong. This index is derived from the proportion of articles in the South China Morning Post that simultaneously contain the four keywords "China," "economy," "uncertainty," and "policy," relative to the total number of articles published in that month. The validity and applicability of this index have been well supported by numerous existing studies.

4.3.3. Control Variables

To rule out the confounding effects of other factors, we draw on the studies of Wu and Tang (2016) [24] and others, and select the following control variables: firm size (Size), firm age (Age), return on equity (Roe), cash flow ratio (Cashflow), Tobin's Q (Tobin Q), tangible asset ratio (Tangible), and leverage ratio (FL). In addition, we include year, industry, and region dummy variables in the regressions. The definitions of the main variables are summarized in Table 1.

5. Empirical Results

5.1. Descriptive Statistical Analysis

Table 2 presents the descriptive statistics of the main variables in this study. The statistical results show that the mean value of the corporate collaborative innovation indicator is 0.496, indicating that collaborative innovation among Chinese firms remains at a relatively low level. Meanwhile, the median value of this indicator is 0, suggesting that a considerable number of firms did not engage in collaborative innovation with other entities during the sample period. The mean value of the economic policy uncertainty indicator is 3.380, reflecting a relatively high level of uncertainty; moreover, the standard deviation reaches 2.307, indicating substantial variation in the degree of economic policy uncertainty faced by firms across different years. Detailed information on the other control variables is also reported in Table 2.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
LnCoin	23326	0.496	1.104	0.000	4.883	0.000
EPU	23326	3.380	2.307	0.989	7.919	2.444
Size	23326	22.275	1.281	19.930	26.071	22.083
Age	23326	2.842	0.343	1.792	3.497	2.890
Roe	23326	0.067	0.120	-0.520	0.344	0.073
Cashflow	23326	0.047	0.067	-0.143	0.227	0.045
Tobin Q	23326	2.051	1.256	0.882	7.948	1.644
Tangible	23326	0.915	0.093	0.545	1.000	0.948
FL	23326	1.332	0.969	-0.423	6.740	1.074

5.2. Baseline Regression Analysis

The baseline regression results of this paper are reported in Table 3. Column (1) of Table 3 presents the univariate regression results of the economic policy uncertainty index on corporate collaborative innovation, with a regression coefficient of 0.078 that is significant at the 1% level, indicating that economic policy uncertainty promotes corporate collaborative innovation. Column (2) reports the results after including a full set of control variables, with the regression coefficient being 0.038, which also passes the significance test at the 1% level, further corroborating the above finding. Moreover, the goodness-of-fit of the model increases from 0.053 to 0.059, suggesting that the regression results are stable and the baseline model specification is reasonable. Regarding the control variables, the coefficients of firm size, firm age, return on equity, and leverage ratio are statistically significant, indicating that the promoting effect of economic policy uncertainty is more pronounced for firms with larger size, longer establishment history, higher return on equity, and lower leverage. These regression results support Hypothesis 1.

Table 3. Baseline Regression Results

Variables	(1) *LnCoin*	(2) *LnCoin*
L.EPU	0.078***	0.038***
	(0.004)	(0.011)
L.Size		0.099***
		(0.015)
Age		0.206**
		(0.098)
L.Roe		0.310***
		(0.059)
L.Cashflow		0.057
		(0.095)
L.Tobin Q		-0.006
		(0.007)
L.FL		-0.011**
		(0.006)
Constant	0.687*	-2.241***
	(0.366)	(0.550)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Province Fixed Effects	Yes	Yes
Observations	19240	19240
Adjusted R^2	0.053	0.059

Notes: ***, *, * denote statistical significance at the 1%, 5%, and 10% levels, respectively; robust standard errors reported in parentheses.

5.3. Robustness Tests

5.3.1. Endogeneity Concerns

Given that economic policy is a macro-level national policy, the micro-level behaviors of individual firms are unlikely to exert a substantial influence on it. Therefore, there is almost no reverse causality between corporate innovation activities and economic policy uncertainty (Gu et al., 2018)[4]. Moreover, all explanatory variables and control variables in this study are lagged by one period,

which effectively mitigates potential reverse causality concerns. In addition, we control for year, industry, and region fixed effects in the empirical analysis, thereby reducing endogeneity arising from omitted variables. To eliminate the potential influence of the lagged dependent variable, we follow the approach of Fang et al. (2015) [25] by including the one-period lag of the dependent variable as an additional control. The regression results are reported in Column (1) of Table 4, where the coefficient of EPU is 0.041 and remains significant at the 1% level, once again confirming that economic policy uncertainty promotes corporate collaborative innovation.

5.3.2. Alternative Measure of Economic Policy Uncertainty

Our core explanatory variable is constructed based on the China Economic Policy Uncertainty Index compiled by Baker et al. (2016) [23], which is originally available at a monthly frequency and thus needs to be converted into annual data. In our baseline model, this conversion is performed by taking the arithmetic mean of the monthly values and dividing by 100. Following Li et al. (2022) [26], we adopt an alternative weighting scheme that assigns higher weights to the monthly index values closer to the end of the year, and recalculate the annual China Economic Policy Uncertainty Index using a weighted average method, with monthly weights ranging successively from 1/78, 2/78, 3/78, ... up to 11/78 and 12/78. The regression results are reported in Column (2) of Table 4, where the coefficient of the re-constructed explanatory variable is 0.038 and remains significant at the 1% level, confirming that our findings are robust to alternative measures of economic policy uncertainty.

5.3.3. Alternative Measure of Collaborative Innovation

Our dependent variable is constructed based on the number of patents jointly applied for by firms with other entities. Following Chen et al. (2023) [27], we note that invention patents represent original outcomes with high technological content and better capture technological innovation capability compared to other types of patents. Accordingly, we re-measure corporate collaborative innovation using the number of jointly applied invention patents by listed firms. The regression results are presented in Column (3) of Table 4, where the coefficient of EPU is 0.040 and passes the significance test at the 1% level, once again validating the robustness of our results.

5.4. Heterogeneity Analysis

According to Gu et al. (2018) [4], a rise in economic policy uncertainty brings about a selection effect on firms' innovation behavior. Accordingly, we examine three dimensions of firm heterogeneity: ownership type, industry attribute, and financing constraints. Specifically, we incorporate these variables and their interaction terms with economic policy uncertainty into the baseline model.

5.4.1. Firm Ownership Type

Listed firms in China can be classified into state-owned enterprises (SOEs) and non-state-owned enterprises based on ownership type, and these two types of firms differ considerably in terms of resource acquisition capability, government policy support, and market responsiveness. Using the basic information of listed firms from the CSMAR database, we construct an ownership dummy variable (SOE), coded as 1 for SOEs and 0 for non-SOEs, and include this variable and its interaction term with EPU in the baseline model. The regression results are reported in Column (1) of Table 5. The interaction term between ownership type and economic policy uncertainty is significantly positive at the 1% level, indicating that the promoting effect of economic policy uncertainty on collaborative innovation is stronger for SOEs than for private firms. This may be attributable to the fact that SOEs possess stronger resource mobilization capacity and greater policy adaptability in response to policy changes, enabling them to more effectively capitalize on the opportunities arising from economic policy uncertainty.

Table 4. Robustness Test Results

Variables	(1) *L.LnCoin*	(2) *LnCoin*	(3) *LnCoin2*
L.EPU	0.041***		0.040***
	(0.011)		(0.009)
L.EPU2		0.038***	
		(0.011)	
L.Size	0.112***	0.099***	0.081***
	(0.015)	(0.015)	(0.013)
Age	0.231**	0.206**	0.146*
	(0.097)	(0.098)	(0.083)
L.Roe	0.116**	0.310***	0.269***
	(0.058)	(0.059)	(0.050)
L.Cashflow	-0.017	0.057	0.007
	(0.093)	(0.095)	(0.080)
L.Tobin Q	-0.002	-0.006	-0.004
	(0.007)	(0.007)	(0.006)
L.FL	0.003	-0.011**	-0.010**
	(0.006)	(0.006)	(0.005)
Constant	-2.649***	-2.233***	-1.894***
	(0.542)	(0.551)	(0.465)
Year Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes
Observations	19240	19240	19240
Adjusted R^2	0.059	0.059	0.062

Notes: ***, *, * denote statistical significance at the 1%, 5%, and 10% levels, respectively; robust standard errors reported in parentheses.

5.4.2. Industry Attribute

Table 5. Heterogeneity Regression Results

Variables	(1) *LnCoin*	(2) *LnCoin*	(3) *LnCoin*
L.EPU×SOE	0.029***		
	(0.005)		
L.EPU×Hightech		0.008*	
		(0.005)	
L.EPU×SA			0.026***
			(0.006)
SOE	-0.236***		
	(0.044)		
Hightech		-0.493	
		(0.307)	
SA			-0.065**
			(0.025)
L.EPU	0.014	0.039***	0.053***
	(0.012)	(0.011)	(0.012)
Constant	-2.591***	-2.572***	-1.639***
	(0.553)	(0.544)	(0.569)
Control Variables	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes
Observations	18854	19,240	19,240
Adjusted R^2	0.063	0.060	0.060

Notes: ***, *, * denote statistical significance at the 1%, 5%, and 10% levels, respectively; robust standard errors reported in parentheses.

In general, the product characteristics of high-tech industries necessitate that firms maintain continuous innovation vitality to avoid being eliminated, and technological leaders in such industries can reap substantial rewards. Following the high-tech industry classification standard of the National

Bureau of Statistics of China, we categorize firms into high-tech industry firms (coded as 1) and non-high-tech industry firms (coded as 0), and include the interaction term between industry attribute (Hightech) and EPU in the regression. The results, presented in Column (2) of Table 5, show that the interaction term coefficient is significantly positive, suggesting that the promoting effect of economic policy uncertainty on collaborative innovation is more pronounced for firms in high-tech industries. When economic policy uncertainty rises, firms in high-tech industries—characterized by high knowledge and technology intensity, high velocity, and high returns—must maintain rapid adaptability to changing market conditions, and are therefore more likely to seize opportunities brought by uncertainty and accelerate their development through collaborative innovation.

5.4.3. Financing Constraints

As discussed above, economic policy uncertainty exacerbates firms' financing difficulties, which in turn may promote collaborative innovation. Following Gu et al. (2020) [28], we employ the SA index as a proxy for financing constraints, where a larger absolute value of the SA index indicates more severe financing constraints. We split the sample firms into two groups based on the median of the absolute value of the SA index: firms above the median are classified as the high financing constraints group (coded as 0), and those below the median as the low financing constraints group (coded as 1). The regression results are reported in Column (3) of Table 5, where the interaction term coefficient is significantly positive, indicating that the promoting effect is more pronounced for firms with lower financing constraints. This phenomenon can be explained by the logic of diminishing marginal effects: in the low financing constraints group, the dampening effect of economic policy uncertainty on corporate financing is stronger, and thus its promoting effect on collaborative innovation should also be more evident; conversely, in the high financing constraints group, the dampening effect is weaker, and consequently the promoting effect on collaborative innovation is relatively limited.

Table 6. Economic Consequence Test: TFP Growth

Variables	*L.TFP_OP*
EPU×LnCoin	0.002**
	(0.001)
EPU	0.009
	(0.006)
LnCoin	-0.010
	(0.008)
Constant	-3.328***
	(0.268)
Control Variables	Yes
Fixed Effects	Yes
Observations	19,240
Adjusted R^2	0.636

Notes: ***, *, * denote statistical significance at the 1%, 5%, and 10% levels, respectively; robust standard errors reported in parentheses.

6. Further Analysis

To further examine the economic consequences of economic policy uncertainty–induced collaborative innovation, we employ total factor productivity (TFP) as an outcome variable. TFP is a critical factor in the process of economic development, serving as a driving force for sustained economic growth and a key lever for achieving high-quality development (Guo et al., 2022) [29]. The Report to the 20th National Congress of the Communist Party of China explicitly states that “we need to accelerate the development of a modernized economic system, with a focus on enhancing total factor productivity, and strengthen the resilience and security of industrial and supply chains.” Under the impetus of economic policy uncertainty, a pertinent question arises: can firms' collaborative

innovation improve total factor productivity, thereby promoting high-quality development? To address this question, we follow Lu and Lian (2012) [30] and adopt the OP semi-parametric estimation method to calculate firm-level total factor productivity, and examine the aforementioned economic consequences. The regression results are reported in Table 6, where the variable *L.TFP_OP* denotes the one-period lagged total factor productivity estimated using the OP method. The coefficient of the interaction term *EPU* × *LnCoin* is significantly positive at the 5% level, indicating that, under the influence of economic policy uncertainty, firms' collaborative innovation significantly enhances their future total factor productivity. In other words, engaging in collaborative innovation enables firms to better cope with the shocks of economic policy uncertainty and contributes to their high-quality development.

7. Conclusion and Policy Implications

7.1. Research Conclusions

To investigate the impact of economic policy uncertainty on corporate collaborative innovation, this study utilizes data from the CSMAR database and other sources, employing the number of patents jointly applied for by listed firms with other entities as the dependent variable. We construct econometric models based on the economic policy uncertainty index, incorporate firm-level control variables, and conduct robustness tests, heterogeneity analyses, as well as the economic consequences. The main findings are as follows:

First, an increase in economic policy uncertainty significantly promotes corporate collaborative innovation.

Second, heterogeneity analysis reveals that the promoting effect is more pronounced for state-owned enterprises (SOEs) than for private firms, as SOEs possess stronger resource mobilization capacity and greater policy adaptability in response to policy changes. Firms in high-tech industries, which require rapid responsiveness to changing market conditions, are more likely than those in non-high-tech industries to pursue collaborative innovation for their own development. Moreover, due to the logic of diminishing marginal effects, economic policy uncertainty exerts a stronger dampening effect on corporate financing for firms with lower financing constraints, thereby leading to a more evident promoting effect on their collaborative innovation.

Third, engaging in collaborative innovation enables firms to better cope with the shocks of economic policy uncertainty and contributes to their high-quality development.

7.2. Policy Implications

First, strengthen collaborative innovation cooperation between SOEs and private firms. SOEs should fully leverage their advantages in abundant innovation resources and jointly undertake technological breakthroughs with private firms, as well as co-host major national science and technology projects, so as to address the "bottleneck" issues in key core technologies. The government may facilitate the establishment of innovation consortia and other collaborative platforms to enhance the sharing of innovation resources, encourage SOEs to actively open up their innovation resources to private firms, and promote mutual complementarity and win-win outcomes in innovation interactions.

Second, develop specialized science and technology parks and innovation bases. Local governments should be encouraged to build specialized science and technology parks and innovation bases that attract the agglomeration and development of small and medium-sized enterprises along related industrial chains. By promoting collaborative innovation among upstream and downstream firms, resource utilization efficiency can be improved, forming regional innovation hubs. The government may provide tax incentives, financial support, and other incentive measures to attract and nurture high-tech firms, while strengthening intra-regional and inter-regional technological cooperation and knowledge sharing.

Third, optimize the corporate financing environment and alleviate financing constraints. Given the dampening effect of economic policy uncertainty on corporate financing, the government should accelerate the establishment of a diversified financing system, expedite financial reform and innovation, innovate collateral and pledge methods, and promote the development of a social credit system, so as to alleviate the difficulties of expensive and slow access to financing for firms. In addition, measures such as increasing the super-deduction ratio for R&D expenses, relaxing guarantee loan conditions, and reducing guarantee interest rates can help ease firms' financing burdens and increase their R&D expenditure.

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