

The Impact of Economic Policy Uncertainty on Chinese Firms' Innovation Investment: Impact Direction and Mechanism Analysis

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Abstract. This paper empirically examines the impact of the Chinese economic policy uncertainty (EPU) on corporate innovation. It is discovered that EPU generally has a positive impact on firms' innovation investment and inhibits enterprise innovation investment through real option and financial friction mechanisms, according to EPU index and data from Chinese A-share and growth enterprise market (GEM) listed companies. Further, the real options channel dominates the overall sample, and corporate innovation investment is inhibited by financial frictions more strongly for non-state-owned firms than for state-owned companies. In addition to advancing the understanding of corporate innovation investment, this paper offers empirical support for the role that economic policy uncertainty plays in encouraging corporate innovation investment and verifies the dominant influence mechanism that prevails across various firm types.

Keywords: Economic policy uncertainty, Corporate innovation, Corporate investment, China.

1. Introduction

Firms' innovation is a key strategy for firms to obtain market dominance and increased profits. Future business profitability uncertainty is considerably exacerbated by the increase in policy uncertainty [1]. Numerous academic works have extensively explored the relationship between firms' investments in innovation and the uncertainty of economic policy. Several studies have revealed that businesses' investment in innovation is constrained by economic policy uncertainty [2-4]. However, some research demonstrates that economic policy uncertainty enhances enterprises' innovation investment instead [5-7]. Currently, there is no consensus view on this issue.

According to the current studies, corporate investment is frequently hampered by economic policy uncertainty through two channels: the real option channel and the financial frictions channel. The channels through which the effects of economic policy uncertainty disseminate are currently under debate. The relationship between policy uncertainty and investment has mostly been examined from a single angle by academics. Scholars follow the classic theory of real options under uncertainty and emphasize how the interplay of capital irreversibility and uncertainty increases the value of options [8-9]. As a result, businesses purposefully postpone investment until uncertainty subsides. Gilchrist propose another channel of policy uncertainty transmission, the financial frictions channel [10]. They argue that in an unfavorable financial market environment, higher uncertainty leads to greater losses due to higher agency costs and increased information asymmetry, thus dampening economic activity by increasing firms' cost of capital. These two channels have also been considered potential sources of the economic policy uncertainty that limits enterprises' innovative investment [5, 11], but the dominant route has not been investigated in the academic community.

Economic policy uncertainty affects investment through a variety of routes, implying disparities in policy direction. Real options theory implies that enterprises deliberately cut down on investment as policy uncertainty grows, and therefore minimizes the impact of monetary and fiscal policy interventions. Financial frictions theory contends, in contrast, that economic policies intended to increase financial market liquidity would have a greater impact when enterprises passively reduce their investment due to external financing restrictions.

Currently, Academics have not yet come to a consensus on the way in which economic policy uncertainty affects corporate innovation investment, nor do they investigate the dominant influence mechanism of economic policy uncertainty on corporate innovation investment. The purpose of this study is to conduct regressions on the data of listed Chinese A-share and GEM companies from 2007 to 2021 in order to confirm the direction of the influence of economic policy uncertainty on corporate innovation investment. It also seeks to establish the existence of the real options channel and the financial frictions channel and determine which channel is the dominant channel. Influenced by COVID-19, China's economic policy uncertainty will be at a high level in the long run. China is transitioning from rapid economic growth to high-quality growth at the same time, which necessitates increased investment in corporate innovation from Chinese businesses. Therefore, the issues studied in this paper are very relevant and contemporary, and can give certain policy recommendations for China at present.

2. Theoretical analysis and research hypotheses

2.1. The Impact Direction of EPU on Firms' Investment in Innovation

Even though endogenous growth theory contends that decreased economic policy certainty discourages innovation among businesses. Several studies, however, have demonstrated that economic policy uncertainty encourages business innovation, which increases businesses' investment in innovation. Economic policy uncertainty poses risks for firms, but also opportunities. Firms can strengthen their market position by increasing strategic investments in innovation activities. This further enhances their position in the market and enables them to predict future periods of higher profit margins. Simply put, enterprises often benefit from increased technical innovation in terms of both innovation output and innovation efficiency while facing more economic policy uncertainty. Accordingly, this paper proposes the first hypothesis H1.

H1: Economic policy uncertainty increases firms' investment in innovation.

2.2. Real option theory transmission mechanism

Real option theory takes fixed adjustment cost and waiting option value as the core. Enterprises can select specific investment possibilities by analyzing the profit differential between current investment and future investment thanks to the irreversibility of innovative investment projects or the presence of sunk costs. Since the enterprise's future innovation investment opportunity can be regarded as a call option, the rise of uncertainty will increase the value of the option, so the waiting return will be greater, and the enterprise will take the initiative to reduce the current investment expenditure. Evidently, the value of the waiting option is correlated with the degree of capital irreversibility because, in the event that an investment project fails, a company with a high level of capital irreversibility will have a harder time realizing the capital and will therefore be more cautious when making investment decisions. Firms won't be impacted by the uncertainty shock at its most severe, when the investment project is completely reversible, because they have no incentive to wait. Jens addressed how the policy environment of the market, such as the restriction of capital liquidity and the danger of capital expropriation by the government and other institutions, determines the irreversibility of capital in an economy [12]. The findings demonstrate that regulatory policies that increase investment irreversibility result in higher waiting option values and a consequent increase in investment decrease during uncertain times. Accordingly, this paper proposes the following hypothesis H2 to be tested.

H2: The higher the degree of irreversibility of corporate capital, the stronger the inhibition effect of economic policy uncertainty on corporate innovation investment.

2.3. Financial friction theory transmission mechanism

Due to economic policy uncertainty, financing restrictions imposed on businesses would have an adverse effect on their short-term marginal profitability (projects that postpone profits during the

uncertain policy period will make it more difficult for businesses to remain operational). Furthermore, the inability of businesses to secure sufficient financing to fully boost the growth rate of investment size to satisfy reduced demand also amplifies the restrictive effect of economic policy uncertainty as its influence diminishes. Financial friction is primarily represented in two mechanisms: the external financing premium mechanism and the capital price mechanism. The knowledge asymmetry between the borrower and the lender causes the enterprise's external financing cost to be greater than its internal financing cost, resulting in the external financing premium. Second, it demonstrates the mortgage restriction mechanism in terms of cash availability. In some circumstances, borrowers may be obligated to provide collateral as a requirement for loans, hence any adverse impact on the value of the collateral may undermine enterprises' ability to finance. On the one hand, banks require collateral for loans from businesses when the economy enters a period of highly erratic economic policies. This is because banks must examine businesses' risk and solvency more rigorously and find it harder to keep track of their investment projects. Businesses impacted by the uncertainty of economic policies may experience fund mismatches and asset price declines, which lead to asset shrinkage and lower the value of collateral while delaying new loans [13]. However, because the firm's external financing premium is inversely associated with its net wealth, a worsening in the firm's financial situation will raise the external financing cost. Banks, who serve as the primary creditors, will exercise greater caution when making loans, especially when monetary policy uncertainty is on the rise. This might result in the loan ceiling being reduced, which would increase the cost for businesses to either lower or maintain their investment scale [14]. The aforementioned theories contend that limitations on external funding at the enterprise level and credit supply restrictions at the bank level are the main sources of financial friction influencing decisions about how much a firm invests in innovation. Therefore, the focus of this paper is on examining how economic policy uncertainty affects the efficiency of enterprise R&D investment through financial friction channels from these two perspectives and proposes hypothesis H3.

H3: The greater the degree of financial friction faced by enterprises, the stronger the inhibition effect of economic policy uncertainty on enterprise innovation investment.

2.4. Identification theory of transmission mechanism of economic policy uncertainty

According to Li et al. [15], the impact of economic policy uncertainty causes the two action mechanisms stated above to cause the marginal investment inclination of unit cash flow to fluctuate in two opposite ways. Financial friction is transferred through the cost of firms' external funding, although the cost of internal funds is often lower than that of external funds. Businesses with stronger internal finances (cash flow) are less affected by the impact of uncertainty on their average capital costs and lower capital spending in the face of uncertain economic policy, as demonstrated by enterprises' average marginal investment propensity. The increase in marginal innovation investment inclination brought on by greater economic policy uncertainty may be expressed equally as higher investment-cash flow sensitivity when the decision to invest in innovation is based on cash flow.

Under the real option theory, the existence of a non-convex capital adjustment cost suggests that businesses should make more careful investment decisions during times of high uncertainty. On the one hand, it is claimed by Magud that "caution" indicates a more constrained investment response to changes in the operating environment because enterprises may postpone starting customary expenditures until the uncertainty dissipates [9]. As a result, businesses will have little incentive to invest. On the other hand, a company with stronger cash flow is more resilient to the short-term revenue loss brought on by postponed investment. As a result, if the external financial friction level remains constant, the business is less eager to invest the extra one unit of cash flow created internally, which is the exact opposite consequence of the financial friction channel. This study offers research hypotheses H4a and H4b to ascertain the mechanism of economic policy uncertainty transmission at the company level generally.

H4a: More economic policy uncertainty will enhance the marginal innovation investment tendency of the firm's unit cash flow when the financial friction channel is more significant than the real option channel.

H4b: More economic policy uncertainty will decrease the marginal innovation investment propensity of the firm's unit cash flow when the real option channel is more significant than the financial friction channel.

3. Data

3.1. Data source

With the exception of financial listed companies, non-normal listed companies, and businesses with missing key financial variables, this paper chooses listed companies issuing A shares and Growth Enterprise Market (GEM) in China's Shanghai and Shenzhen markets from the fourth quarter of 2007 to the fourth quarter of 2021 as the research sample. The continuous variables in this study are winsorized at the 1% level at both tails to minimize the effect of outliers. The final sample interval is from the fourth quarter of 2007 to the 4th quarter of 2021. The WIEGO statistical database and the CSMAR database were used to produce the data for this study, and the economic policy uncertainty indicators are obtained from the China Economic Policy Uncertainty Index compiled by Baker et al [16].

3.2. Variable description and descriptive statistics

Table 1 displays the implications and descriptive statistics for the main variables in this study. The calculation method of *InnoInvt* is capital expenditure divided by total assets at the beginning of the time period. *EPU* is calculated as the arithmetic mean of the monthly *EPU* index. *CF* is computed by dividing the total assets at the beginning by the net cash flow from operating activities. *TQ* is calculated by dividing the firm's total market capitalization by its total assets. *GDP* is the year-over-year growth rate of annual *GDP*. *PPE* is fixed assets divided by total assets. *Size* is the natural logarithm of total assets. *Age* is calculated by subtracting the year of establishment from the current year. *Lev* is total liabilities divided by total assets.

Table 1. The implications and descriptive statistics of variables

Variable	Implication	Mean	Std. Dev.	Min	Max
<i>InnoInvt</i>	Innovation investment rate	4.7848	4.8303	0.03	28.13
<i>EPU</i>	EPU index	430.9537	231.7162	98.8882	791.8737
<i>CF</i>	Cash flow	0.1574	0.1103	0.2213	0.6294
<i>TQ</i>	Tobin Q	2.1814	1.9174	0.0320	11.1215
<i>GDP</i>	GDP growth rate	0.0669	0.0192	0.0224	0.1423
<i>PPE</i>	Proportion of fixed assets	0.2087	0.1448	0.0040	0.6425
<i>Size</i>	Size of enterprises	21.1624	1.2728	19.3741	26.0599
<i>Age</i>	Age of enterprises	9.6229	7.2943	1	31
<i>Lev</i>	Debt ratio	0.4108	0.2007	0.0483	0.8956

3.3. Correlation coefficient matrix

The correlation coefficients between the primary variables for the same time period are displayed in Table 2. As can be observed, enterprise innovation investment has a positive correlation with the Tobin Q, cash flow, and economic policy uncertainty index, while having a negative correlation with fixed asset percentage, enterprise size, and debt ratio. Moreover, there is little connection between the variables, and the variance inflation factor for any variable in the regression model is negligible and considerably below 10. Thus, multicollinearity does not pose a significant threat.

Table 2. The correlation coefficients of main variables

	<i>InnoInv_t</i>	<i>EPU</i>	<i>CF</i>	<i>TQ</i>	<i>PPE</i>	<i>Size</i>	<i>Lev</i>
<i>InnoInv_t</i>	1						
<i>EPU</i>	0.0786	1					
<i>CF</i>	0.1210	-0.0223	1				
<i>TQ</i>	0.3213	-0.1078	0.3544	1			
<i>PPE</i>	-0.2484	-0.0833	0.0105	-0.1628	1		
<i>Size</i>	-0.2484	0.1353	-0.4764	-0.4404	0.1134	1	
<i>Lev</i>	-0.2948	0.0463	-0.2291	-0.4319	0.1227	0.4918	1

4. Methodology

4.1. Model Setting

This paper refers to the neoclassical investment Q model, draws on the practices of Gulen and Ion, Li and Yang, Wang et al., Kun et al. [1, 15, 17-18] and adds the necessary control variables. The following baseline regression model is obtained:

$$InnoInv_{i,t} = \beta_1 EPU_{t-1} + \beta_2 CF_{i,t} + \gamma TQ_{i,t} + \delta GDP_{t-1} + Year_t + \alpha_i + \epsilon_{i,t} \quad (1)$$

Among them, the innovation R&D investment rate of enterprise i in year t is represented by $InnoInv_{i,t}$; the index of economic policy uncertainty in this paper uses the value EPU_{t-1} with a lag of one year; $CF_{i,t}$ represents the cash flow of enterprise i in year t ; $TQ_{i,t}$ represents Tobin Q of enterprise i at time t in order to avoid the endogeneity problem; GDP_{t-1} is used to control investment opportunities at the macro level and is measured by the GDP growth rate index lagging one year; $Year_t$ is the annual dummy variable, used to control the time-fixed effect of enterprise investment; α_i is used to control the unobservable fixed effect of the enterprise; $\epsilon_{i,t}$ is the regression residual. In addition, the standard deviation of the regression coefficient is adjusted by the cluster at the enterprise level, in accordance with the methods of Li & Yang and Tan & Zhang [15, 19], in order to get rid of any potential clustering traits in the sample data. This study develops the inspection approach using model (1) as the initial regression model.

4.2. The inspection method of real option channel

If economic policy uncertainty is transmitted through the real options channel, then firms with a high degree of capital irreversibility should curtail their innovation investment more and respond more significantly when faced with the same economic policy uncertainty shock. Therefore, in this study, the benchmark equation is expanded to include measures of company capital irreversibility and associated cross terms with variables indicating economic policy uncertainty:

$$InnoInv_{i,t} = \beta_1 EPU_{t-1} + \beta_2 IR_{i,t} + \beta_3 EPU_{t-1} \times IR_{i,t} + \beta_4 CF_{i,t} + \gamma TQ_{i,t} + \delta GDP_{t-1} + Year_t + \alpha_i + \epsilon_{i,t} \quad (2)$$

$IR_{i,t}$ is the capital irreversibility indicator of the firm. In this paper, the fixed capital ratio (PPE) is employed, which computes an enterprise's capital irreversibility by dividing fixed assets by total assets at the start of the period. When it comes to major capital investments, businesses with fewer fixed assets tend to invest more in human capital than in physical capital. Moreover, businesses with a high share of fixed assets in their total assets tend to have long payback periods [1]. Therefore, the higher the share of fixed assets, the greater the adjustment cost of the firm and the higher the degree of capital irreversibility.

Due to the short lifespan of investment opportunities and the possibility that the value of the options that firms wait for may not be sufficient to offset the cost of postponed investment losses, real options theory further contends that investment decisions in highly competitive industries should be less impacted by shocks associated with economic policy uncertainty. In particular, the Herfindahl

Index (HHI) is used in this study to assess the degree of industry competition. The formula is: $HHI_j = \frac{\sum (X_{i,j}/\sum X_{i,j})^2}{\sum X_{i,j}}$, where $X_{i,j}$ is the sales revenue of enterprise i in industry j , and $\sum X_{i,j}$ is the sum of sales revenue of all enterprises in industry j . The level of industry competition increases with decreasing HHI. The industries in this paper are categorized into two groups, one with lesser competitiveness and the other with higher competitiveness, based on the median of all the industries in which the firms are located. The effect of EPU on corporate investment in two subsamples with various levels of competition is examined in this paper in order to validate the real options channel.

4.3. The inspection method of finance friction channel

Businesses with higher financial friction are more likely to passively cut their investment expenses in response to shocks associated with economic policy uncertainty if financial frictions are a transmission channel of economic policy uncertainty. Therefore, in this paper, the indicators $FF_{i,t}$, which reflect the degree of financial frictions faced by firms, and their cross terms with economic policy uncertainty variables are added to the benchmark regression model in the following form:

$$\begin{aligned} InnoInv_{i,t} = & \beta_1 EPU_{t-1} + \beta_2 FF_{i,t} + \beta_3 EPU_{t-1} \times FF_{i,t} + \beta_4 CF_{i,t} \\ & + \gamma TQ_{i,t} + \delta GDP_{t-1} + Year_t + \alpha_i + \epsilon_{i,t} \end{aligned} \quad (3)$$

This paper verifies the channels of financial frictions from two perspectives: the firm's own level and the primary external funding sources, banks, and other financial institutions, in order to properly extract the information on external financial frictions faced by enterprises. The external financing premium and the collateral constraint mechanism are the main causes of financial frictions, so the indicators that affect the price and volume of external funds supplied in information shared by the firm with the outside world can reflect the severity of financial frictions the firm is experiencing. Three factors—business size, years from establishment, and enterprise debt ratio—are examined in this study as they help explain why firms struggle to obtain external capital.

(1) A firm's size (*Size*), is calculated by the natural logarithm of its total assets. Enterprise size is a significant factor for banks to evaluate when extending loans to businesses. Smaller companies typically have lower loan collateral values than larger companies due to banks' discriminatory lending practices [20]; nonetheless, small and medium-sized enterprises are more susceptible to external financing fees than larger companies [21]. As a result, a business will be smaller the more severe its external financial constraints are.

(2) The enterprise formation years (*Age*), are determined by dividing the current year by the year the company was started. Earlier-founded companies build up more credit and are frequently perceived as having greater fundraising capacity [22]. As a result, the number of years in business indicates how simple it is to secure bank credit.

(3) The firm's debt ratio (*Lev*), is calculated by dividing total liabilities by total assets. The debt ratio provides an accurate picture of a company's financial condition, prior liquidity accumulation, and net worth. The debt ratio, thus, in the context of imperfect capital markets, symbolizes the credit quality of the financier, and the higher the debt ratio, the more challenging it is for a firm to obtain new bank loans. According to Zhao, the Bernanke model also demonstrates a positive relationship between the level of external financing premium and a firm's leverage ratio [23]. As a result, the restriction on external funding that a company confronts increases with its debt ratio.

4.4. Identification method of the dominant mechanism

The two channels predict different directions of changes in firms' marginal propensity to invest in additional 1 unit of cash flow when economic policy uncertainty increases. This paper, which adapts Tan and Zhang's methodology, adds cross terms of cash flow and economic policy uncertainty variables to the benchmark equation, as well as variables indicating the degree of firms' external financing constraints to control for the level of financial frictions at the firm level, before exploring the primary economic policy uncertainty transmission mechanism [19].

$$\begin{aligned} InnoInv_{i,t} = & \beta_1 EPU_{t-1} + \beta_2 CF_{i,t} + \beta_3 EPU_{t-1} \times CF_{i,t} + \beta_4 FF_{i,t} \\ & + \gamma TQ_{i,t} + \delta GDP_{t-1} + Year_t + \alpha_i + \epsilon_{i,t} \end{aligned} \quad (4)$$

Under the real options theory, $\beta_3 < 0$, because firms with high cash flows are the ones that can wait and will therefore put off investing in innovation, which is reflected in a reduced inclination to invest on the marginal level. Otherwise, the financial frictions mechanism predicts $\beta_3 > 0$, which means the less the enterprises with abundant cash flow are affected by external financing constraints, the smaller the increase of capital cost, and thus the weaker the constraints on the capital input and operation maintenance of investment projects, which is manifested as increased marginal investment inclination.

5. Results

5.1. The regression results of the real option mechanism

Table 3 shows the regression results for model (2). The benchmark regression model's regression results are displayed in Column (1). EPU_{t-1} has a statistically significant positive effect on the explanatory variable of firm innovation investment rate at the significance level of 1%, demonstrating that the level of firm innovation is indeed boosted by economic policy uncertainty. Thus, hypothesis H1 can be accepted. Column (2) shows the regression results of the capital irreversibility variable $IR_{i,t}$, i.e. percentage of fixed assets. Larger $IR_{i,t}$ values represent a higher degree of capital irreversibility. The regression result demonstrates that the correlation between capital irreversibility and economic policy uncertainty cross-term is strongly negative at the 5% level, showing that the significant share of fixed assets hinders the positive impact of EPU on innovation investment. The success of the genuine options channel is thus confirmed, supporting hypothesis H2.

This paper calculates the HHI of 12 industries (aside from the financial and insurance industries) by industry sector for each period in accordance with the Industry Classification Guidelines for Listed Companies published by the China Securities Regulatory Commission in order to examine another prediction based on the real options theory that firms in industries with a higher degree of competitiveness are less affected by economic policy uncertainty in their innovation investment. Industry competitiveness is divided into two categories: high level of competitiveness and low level of competitiveness based on the HHI's median value. The regression results are shown in columns (3) and (4) of Table 3. The EPU_{t-1} coefficient of the group with a lower level of competition is positively significant at the 1% level, while the EPU_{t-1} coefficient of the group with a high level of competition has lost its significance. This finding is consistent with the theoretical analysis since it shows that as competition increases, businesses' investments in innovation are less affected by the uncertainty of economic policy. The approach from Lian et al., utilizing the Bootstrap method to replicate the sampling test, is used in this study to evaluate the coefficient difference across groups given that the Wald test may suffer from small sample bias and the traditional Chow test has strong hypothesis conditions [20]. The result of 1000 simulations shows that the p-value of the coefficient difference test is 0.036, which can reject the null hypothesis that the coefficient of EPU_{t-1} do not differ between the two groups at the 5% level of significance. This indicates that the effect of economic policy uncertainty on enterprise investment varies significantly between enterprises with different levels of industry competition and, consequently, the effectiveness of real options channel transmission is further confirmed.

Table 3. The regression result of real option mechanism

	(1) Baseline Regression	(2) <i>PPE</i>	(3) Low Level Of Competition	(4) High Level Of Competition
EPU_{t-1}	0.0007*** (0.0001)	0.0011*** (0.0002)	0.0012*** (0.0002)	0.0006 (0.0005)
$IR_{i,t}$		1.5240*** (0.4865)	1.6637*** (0.5182)	1.4421 (1.1497)
$EPU_{t-1} \times IR_{i,t}$		-0.0018** (0.0008)	-0.0021** (0.0008)	0.0003 (0.0016)
Control Variable	YES	YES	YES	YES
Company FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	20,950	20,950	18,691	2,226
Adjusted R-squared	0.023	0.025	0.026	0.014

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.2. Regression results of financial friction mechanism

This study investigates how corporate investment is affected by the combination of the firm's own external finance limitations and economic policy uncertainty (see Table 4). In this paper, when using firms' size and years of establishment as proxies for financial frictions $FF_{i,t}$, larger values indicate a smaller degree of financing constraints. When using debt ratio as a proxy for $FF_{i,t}$, larger values indicate greater financing constraints. The cross-term coefficients of *Age* and EPU_{t-1} , *Size* and EPU_{t-1} are positively significant, according to the regression results in Table 4. However, the cross-term coefficient of *Lev* and EPU_{t-1} is not significant, but the coefficient is negative, indicating a high debt ratio has decreasing effect on innovation investment when EPU grows. These findings show that when economic policy uncertainty increases, the amount of financial friction decreases, which in turn causes a greater increase in the rate at which financial friction-affected enterprises invest in innovation. Therefore, hypothesis H3 is verified and accepted.

Table 4. The regression result of financial friction mechanism

	(1) <i>Size</i>	(2) <i>Age</i>	(3) <i>Lev</i>
EPU_{t-1}	-0.0035** (0.0018)	-0.0004* (0.0003)	0.0010*** (0.0004)
$FF_{i,t}$	-0.1381 (0.0950)	0.0590*** (0.0195)	-0.8272* (0.4404)
$EPU_{t-1} \times FF_{i,t}$	0.0002** (0.0001)	0.0001*** (0.0000)	-0.0005 (0.0007)
Control Variable	YES	YES	YES
Company FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	20,950	20,950	20,950
Adjusted R-squared	0.024	0.026	0.025

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.3. Identification of the dominant mechanism

The efficiency of the real options mechanism and the financial friction mechanism in transferring economic policy uncertainty to listed enterprises to affect their investment decisions in China is verified in this study based on the findings of the aforementioned experiments. This study aims to determine which of the two channels is relatively dominant in terms of the model (4). In Table 5, the regression coefficients of the cash flow and EPU cross terms are negative over the entire sample, indicating a downward shift in the marginal propensity to invest per unit of cash flow when policy uncertainty rises and that each unit of cash flow increases within the firm does not mitigate the negative impact of economic policy uncertainty on investment. Thus, it demonstrates that the financial friction mechanism is not the primary cause of the decline in investment. In other words, the major method for lowering the costs associated with innovation investment for Chinese listed companies is the real options mechanism. In light of this, hypothesis H4b is supported and hypothesis H4a is rejected.

Table 5. The Regression Result of Dominant Mechanism Identification

	(1) <i>Size</i>	(2) <i>Age</i>	(3) <i>Lev</i>
EPU_{t-1}	0.0010*** (0.0002)	0.0004** (0.0002)	0.0009*** (0.0002)
$EPU_{t-1} \times CF_{i,t}$	-0.0015 (0.0010)	-0.0013 (0.0010)	-0.0012 (0.0010)
$FF_{i,t}$	-0.0854 (0.0915)	0.0709*** (0.0184)	-1.0195*** (0.3779)
Control Variable	YES	YES	YES
Company FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	20,950	20,950	20,950
Adjusted R-squared	0.024	0.025	0.026

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.4. Robustness check

(1) Endogeneity problems. In the benchmark model, the number of control variables is increased and firm fixed effects and seasonal effects are also accounted for to minimize any endogeneity issues brought about by leaving out explanatory factors. The lagged one-period value of the economic policy uncertainty index EPU_{t-1} and the GDP growth rate GDP_{t-1} are additionally employed to avoid endogeneity problems.

(2) Robustness check for economic policy uncertainty. First off, this article substitutes the data source for uncertainty in economic policy. This paper attempts to replace the Chinese economic policy uncertainty index constructed by Davis et al., which quantifies the economic policy uncertainty from two Chinese mainland newspapers: the Renmin Daily and the Guangming Daily [24]. This study also makes use of the index developed by Huang and Luk, who calculated it using data from 10 distinct Chinese newspapers. Second, this article modifies the process for determining the average EPU value [25]. The weighted average is used by Tan and Zhang to determine the variable EPU [19]. Ultimately, the regression findings show that there are no significant differences between these two approaches.

6. Discussion

Based on the findings, it is concluded in this paper that, in a sample of Chinese listed companies from the years 2007 to 2021, both the real options channel and the financial frictions channel inhibit

the effect of EPU on firms' investment in R&D innovation, with the real options channel playing the dominant role. Shi and Zhang claim that Chinese state-owned companies benefit more from easier access to outside funding and experience fewer financial constraints when engaging in innovative activities [26]. This paper further discusses this issue by dividing the sample of all firms into state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs), and re-running the regressions for both the real options and financial friction channels. The results in Tables 6 and 7 show that for SOEs, the coefficients of the interaction terms of EPU_{t-1} and PPE , EPU_{t-1} and Lev are significant at the 5% level, while the coefficients of the interaction terms of EPU_{t-1} and $Size$, EPU_{t-1} and Age are not significant. The findings are reversed for non-state-owned businesses, where the coefficients of the interaction terms of EPU_{t-1} and $Size$, EPU_{t-1} and Age are significant at the 1% level, but the coefficients of EPU_{t-1} and PPE , EPU_{t-1} and Lev are completely non-significant. This suggests that the real options channel is the dominating channel for SOEs, whereas the financial frictions channel is the major channel for non-SOEs.

The findings of this study demonstrate how enterprises' investments in innovation are facilitated by the unpredictability of economic policy. The real options channel and the financial frictions channel inhibit the promotional effect of economic policy uncertainty on firms' innovation investment. The real options channel predominates in the sample of Chinese publicly listed enterprises from 2007 to 2021. Real options are the primary conduit of influence for Chinese state-owned businesses, while the principal avenue of influence for Chinese non-SOEs is the financial friction channel.

The findings of this paper are highly congruent with the actual circumstance. According to Luo et al., businesses can only prosper from economic policy uncertainty, which encourages innovation [27]. The profitability of businesses is substantially impacted by the degree of economic policy uncertainty [1]. Businesses will lose their competitive edge or suffer from market impacts if they don't spend more on innovation. The position of the company eventually declines or possibly fails. As a result, businesses will increase their spending on innovation when economic policy uncertainty is high. At the same time, government does not guarantee the credit of non-SOEs, therefore when they borrow money from banks, they are rated lower than SOEs, which makes it more challenging for them to raise money. SOEs, on the other hand, do not need to worry about credit default risk and are less affected by financial friction channels.

This study has strong policy implications. The government should take action to address financing issues, such as accommodative fiscal and monetary policies, raising the level of capital supply, and extending access to financing for SMEs, in light of the evidence proving the existence of the financial friction channel. In this way, these actions can help lessen the negative effects of economic policy uncertainty. The influence of fiscal and monetary policy is constrained in the short run due to the level of capital irreversibility. The negative effect of real options channels on company innovation can be lessened by governments implementing long-term reforms to alleviate physical capital frictions. Ultimately, despite the fact that economic policy uncertainty can encourage businesses to invest in innovation, this article does not advise the government to maintain economic policy uncertainty at a high level due to the additional negative impacts.

The limitation of this study is that it only verifies the real options channel and the financial frictions channel, which have the effect of discouraging firms from investing in innovation, rather than the channels that affect how economic policy uncertainty influences firms' innovation investment. Second, given that this article only looks at a small sample of Chinese businesses between 2007 and 2021, it needs to be determined whether its conclusions can be generalized. The aforementioned restrictions can be further investigated by using a sample of businesses from other nations and examining the mechanisms by which economic policy uncertainty encourages corporate innovation investment.

Table 6. The regression results for SOEs

	(1) <i>PPE</i>	(2) <i>Size</i>	(3) <i>Age</i>	(4) <i>Lev</i>
EPU_{t-1}	0.0013*** (0.0003)	0.0020 (0.0022)	-0.0002 (0.0004)	0.0014*** (0.0004)
$IR_{i,t}$	1.5374** (0.7274)			
$EPU_{t-1} \times IR_{i,t}$	-0.0023** (0.0009)			
$FF_{i,t}$		-0.0866 (0.1682)	0.1016*** (0.0232)	-0.8480 (0.7126)
$EPU_{t-1} \times FF_{i,t}$		-0.0001 (0.0001)	0.0000 (0.0000)	-0.0016** (0.0008)
Control Variable	YES	YES	YES	YES
Company FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	6,642	6,642	6,642	6,642
Number of Symbol	1,069	1,069	1,069	1,069
Adjusted R-squared	0.038	0.034	0.041	0.041

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.

Table 7. The regression results for non-SOEs

	(1) <i>PPE</i>	(2) <i>Size</i>	(3) <i>Age</i>	(4) <i>Lev</i>
EPU_{t-1}	0.0010*** (0.0003)	-0.0087*** (0.0028)	-0.0008** (0.0003)	0.0007 (0.0005)
$IR_{i,t}$	1.5005** (0.6317)			
$EPU_{t-1} \times IR_{i,t}$	-0.0013 (0.0012)			
$FF_{i,t}$		-0.2167* (0.1225)	0.0327 (0.0269)	-1.0912* (0.5671)
$EPU_{t-1} \times FF_{i,t}$		0.0004*** (0.0001)	0.0001*** (0.0000)	0.0001 (0.0010)
Control Variable	YES	YES	YES	YES
Company FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	14,308	14,308	14,308	14,308
Number of Symbol	2,418	2,418	2,418	2,418
Adjusted R-squared	0.021	0.022	0.025	0.022

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1