

Economic Policy Uncertainty and Stock Price Crash Risk: Based on panel data models

Boqiao Du^{1,* , †}, Jiaxin Li^{2, *, †} and Hankun Zhang^{3,* , †}

¹School of Economics and Management, Beijing University of Technology, Beijing, China

²School of Financial Mathematics and Statistics, University of California, Santa Barbara, California, Santa Barbara

³School of Mathematics, University of Birmingham, Birmingham, Britain

*Corresponding author: 18053216@emails.bjut.edu.cn

li909@ucsb.edu

HXZ009@student.bham.ac.uk

[†]These authors contributed equally.

Abstract. We examine the relationship between economic policy uncertainty (EPU) and stock price crash risk based on the stock data of China A-share market from 2007-2019. Correlation analysis, univariate and multivariate test, robustness test and heterogeneity test are used to analyze the data. According to the results, economic policy uncertainty is negatively correlated with stock price crash risk. This correlation is valid since it passes the robustness test of replacing the main independent and the dependent variables. Further analysis reveals that this negative relationship is more obvious in certain situations. Specifically, it includes four cases: (1) the enterprise is not a state-owned enterprise; (2) the Big Four audit is not selected; (3) the proportion of institutional investors is low, and (4) the analyst coverage rate is low. These results shed light for an important influencing factor of stock price collapse and provides a reference value for the prevention and response of stock price collapse.

Keywords: EPU; Stock price crash risk.

1. Introduction

Generally, a stock crash happens when liquidity problems is appeared or bad news is released for a company, which leads to the sharply decrease of stock price due to the large amounts of sellers. The collapse of stock prices is related to numerous factors. For example, Taher and Elhem [1] propose that complex tax aggressiveness can cause managers to act opportunistically and conceal more bad news, which in turn increases the risk of a stock price crash. Moreover, analysts' optimism is another factor that affects the crash risk. According to Cho and Kim [2], optimistic valuations will lead investors to misjudge the firm's situation and induce managers to hide bad news from investors. Additionally, it is more likely to lead to a crash in the stock price when the hoard of bad news gets released in large quantities. Besides, economic policy uncertainty has been shown to be indeed one of the influencing factors in the stock market, as both Chiang [3] and Zhang [4] studies have demonstrated the existence of a relationship between economic policy uncertainty (EPU) and stock price collapse and the necessity to study the relationship between them. The purpose of our study is to investigate the relationship between EPU and stock price crash risk empirically.

Although there are some literatures on the relationship between EPU and crash risk, the relationship between the EPU and the crash risk remains controversial. For example, Jin and Chen [5] argue that there is a significant positive relationship between stock price crash and EPU. For example, when EPU rises, some of the bad news is released, which results in a decrease in investor confidence in firms, i.e., increases the risk of stock market crash in turn. Meanwhile, Luo and Zhang [6] argue that the increase in corporate uncertainty when EPU rises also makes the risk of stock crash increase. However, some papers argue that the two variables are related to each other negatively, e.g., Chiang [3], who argues that an increase in EPU instead makes the stock price crash risk lower in the long run.

Whereas, Attig et al. [7] argue that an increase in EPU makes firms retain their resources as much as possible to face uncertainty, which reduces the stock price crash risk in turn. These results indicate that the impact of EPU on stock prices is important and there is still controversy about the effect of EPU on stock price crash risk. Therefore, we think it is necessary to conduct further research on the latest securities market environment to explore the real relationship between the two.

As a developing country, China provides an ideal setting for investigating the relationship between EUP and stock crash risk. In the Chinese stock market, most of its economic rule, mechanisms, and systems are largely inefficient, including rule of private securities litigation [8], boards of supervisors [9], and external auditing and investor protection and law [10]. Meanwhile, due to the limitation of civil-law socialist nature of China, private investors' interest and right can not be well promoted and protected [11, 8]. As a result, the management has sufficient conditions and motivation to withhold bad news, which leads to the crashed of stock price. Moreover, Chinese stock market is considered as a "policy-driven market," indicating the stock market is sensitive to policy uncertainty. As China has been in the period of economic reformation and marketization in recent years, its economic policies are adjusted frequently, i.e., China is in a period of high EPU. Figure 1 shows the fluctuation of Chinese policy uncertainty over the period from 2000 to 2020, based on data of three EPU index, including SCMPEUP, LANDEPU, and TPU. Starting from 2018, three indexes have continued to be higher than the past, which indicates that China experiences high-EPU period recently. Due to special characteristics of Chinese stock market that differ from developed capital market, we conduct the investigation in China to examine the relation between EPU and stock crash risk. As a representative of developing capital markets, China is developing rapidly. Therefore, such a study in Chinese market provides valuable practical implications and empirical reference that can be widely used in both China and other developing markets.

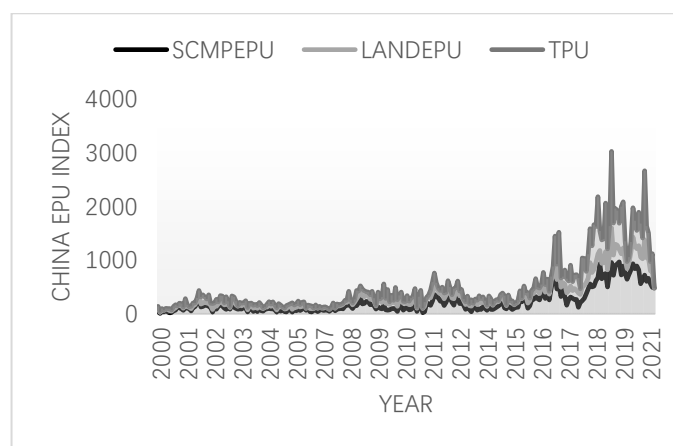


Fig. 1 EPU and TPU over the period from 2000 to 2020

In order to explore the relationship between EPU and the risk of stock crash, we select the data of A-share firms in Chinese stock market from 2007 to 2019. In addition, we use LANDEPU constructed based on two mainland Chinese newspapers: the Renmin Daily and the Guangming Daily. We find that Chinese economic policy uncertainty is negatively associated with the stock price crash risk. This kind of association is robust in a series of robustness checks, including replacing the independent variable LANDEPU with SCMPEPU, replacing the independent variable LANDEPU with Trade Policy Uncertainty Index(TPU), replacing the dependent variable DUVOL with negative return skewness coefficient (NCSKEW). Further analysis demonstrates that the negative effect of economic policy uncertainty on stock price crash risk is more significant for firms that do not choose the Big Four audit. Compared with state-owned enterprises, the negative effect of economic policy uncertainty on stock price crash risk is stronger in non-state-owned enterprises. For companies with high analyst coverage or high proportion of institutional investors, the negative impact of economic policy uncertainty on stock price crash risk is weak.

Our research has the following three contributions:

First, although there have been previous studies on economic policy uncertainty and stock price crash risk, the results of our study are different from other studies [5, 6]. Specifically, we state that the increase of economic policy uncertainty will reduce stock price crash risk. This is different from the conclusions of other studies on this effect, and our study provides an interesting part of the field.

Second, to examine the relationship, we not only use SCMPEPU index constructed by Hong Kong South China Morning Post, but also LANDEPU index and TPU constructed based on mainland newspapers. As far as we know, we are the first to study the relationship between trade policy uncertainty index and stock price crash risk.

Third, we also study whether the firm employs the Big Four auditors, whether the firm is state-owned or private, the analyst coverage rate of the company, and the proportion of institutional investors in the firm's shareholding have the impact on this finding and obtained valuable conclusions.

The remainder of this study is organized as follows. We develop our hypotheses in Section 2, and Section 3 describes the research design, including describing samples, variables, and models. The section 4 carries out the empirical analysis, including the descriptive statistics, the correlation analysis and the main regression. The robustness test is carried out in section 5. Section 6 analyzes the heterogeneity. Section 7 gives a brief summary eventually.

2. Hypotheses development

Previous research argues that managers of listed firms choose to only disclose information that is beneficial to companies' stock price to investors while concealing bad ones because of agency problem. This results in asymmetry of information between insiders and external investors, making it difficult for investors to obtain the actual financial information about companies' operation. However, when the amount of bad news hidden reaches a certain limit, it is impossible to keep it hidden. Hence, investors may know this news at once, leading to a massive sell-off of stocks and huge negative returns, which eventually causes to stock price crashes [12].

Following this argument, subsequent studies continued to examine factors that affect the stock crash risk, including corporate social responsibility [13], religion [14], Corporate board reforms around the world [4], Corporate relationship spending [15], D&O insurance [16], and CEO overconfidence [17]. In summary, one of the important factors in determining the stock price crash risk is manager's self-interest-driven disclosure preferences.

In theory, there are two opposite views on the impact of the EPU on stock price crash risk. First, there is a positive relationship between the EPU and stock price crash risk, which means the higher the EPU, the greater stock price crash risk. According to Ref. [5], they apply the idea of constructing the EPU index from Ref. [18] and use a scaled frequency count of articles about policy-related economic uncertainty in four Chinese securities newspapers to construct the CEPU index. They find that there is a positive and significant relationship between the EPU and stock price crash risk through the utilization of CEPU index. That is because economic policy uncertainty increases the stock crash risk by encouraging managers to withhold bad news and leading to heterogeneous beliefs of plenty of investors [5]. Similarly, they argue that in the high EPU period, the operation of firms faces greater uncertainty in Ref. [6]. High EPU can also have a negative impact on business performance in the short term. As a consequence, managers have a greater incentive to possess surpluses. In addition, investors encounter greater valuation uncertainty and information asymmetries when EPU is high, which means they have to rely more on information that managers disclose when evaluation. Therefore, managers have a greater ability to hide bad news and manipulate earnings. To some extent, managers have an increased incentive and ability to hide bad news when the EPU is high, which increases the stock crash risk.

Second view is that the EPU is related to stock price crash risk negatively. Although Antonakakis et al. [19] announces that in the short run, the dynamic correlation between policy uncertainty and equity returns continues to be negative, Chiang [3] finds that there is a positive relationship between

stock price returns and EPU after a long period of time. Through examining the Chinese stock market, Chiang [3] argues that rising uncertainty causes stock prices to fall, but the stock price could rebound over time and give investors greater returns to compensate for their continued holdings of the stock during the high-EPU periods. Moreover, according to Ref. [7], higher payouts can make managers more disciplined in the use of the firm resources during increased EPU periods. The reason is that increased EPU makes firms more vulnerable to agency issues, which in turn will increase cash reserves that can easily turn into private benefits. On this basis, the market and investors will pay more attention on managers to see whether they deserve such high payouts, which means managers will expose them to subsequent monitoring by the market and investors when they fund future investment in capital market. Thus, we propose that during increased EPU periods, managers will less likely have the disclosure preference motivated by self-interest because of higher payout and subsequent monitoring, which decreases the risk of stock crash.

Hence, we propose two opposite hypotheses about the impact of the EPU on the stock crash risk.

H1a: EPU increases the stock price crash risk.

H1b: EPU decreases the stock price crash risk.

3. Research design

3.1 Data and Sample

Our sample selects firms that listed on the Chinese A-share market over period from 2007 to 2019 and contains relevant data gained from the China Stock Market and Accounting Research (CSMAR) Database. We process the raw data firstly to ensure the accuracy of later empirical analysis. We exclude financial firms and drop firms with fewer than 30 trading weeks in a fiscal year. Our final sample consists of 22571 observations corresponding with firms. To reduce the effects of outliers, we winsorize continuous variables at level of 1% and 99% separately.

3.2 Models

To test our hypotheses that stock crash risk is related to economic policy uncertainty index and other control variables, we applied the regression to construct a function of those factors as following:

$$NCSKEW_{t+1}(DUVOL_{t+1}) = \beta_0 + \beta_1 EPU_t + \sum_{q=2}^m \beta_q (qthControlVariable_t) + \varepsilon_t \quad (1)$$

where $NCSKEW_{t+1}$ and $DUVOL_{t+1}$ represent dependent variables that measure the stock price crash risk and EPU_t is the economic policy uncertainty index that contains $LANDEPU_t$, $SCMEPU_t$, and TPU_t . β_i is the regression coefficients that determines the changing direction of stock price crash risk and economic policy uncertainty index. ε_t represents the error term, while $ControlVariable_t$ includes $Return_t$, Age_t , $Size_t$, Lev_t , BM_t , FRS_t , ROA_t , $Growth_t$, and Ret_t .

3.3 Variables

3.3.1 Stock price crash risk

Following Refs. [20, 21, 22, 4, 6], we use two measures to calculate firm-specific crash risk. We first estimate the following expanded market model:

$$r_{i,t} = \alpha_j + \beta_1 r_{M,t-2} + \beta_2 r_{M,t-1} + \beta_3 r_{M,t} + \beta_4 r_{M,t+1} + \beta_5 r_{M,t+2} + \varepsilon_{i,t} \quad (2)$$

where $r_{i,t}$ is return on stock i in week t and $r_{M,t}$ represents the value-weighted market return for all stocks in month t . The lead and lag terms of market returns are included to allow for nonsynchronous trading [23]. $W_{j,t}$ is the firm-specific monthly return for firm i in month t , which equals to $\ln(1 + \varepsilon_{i,t})$.

The first measure of crash risk is the negative conditional returns skewness (NCSKEW), which is calculated by taking the negative of third moment of firm-specific monthly returns for each year and normalizing it by the standard deviation of firm-specific monthly returns raised to the third power:

$$NCSKEW_{i,t} = - \left[n(n-1)^{3/2} \sum W_{i,t}^3 \right] / \left[(n-1)(n-2) (\sum W_{i,t}^2)^{3/2} \right] \quad (3)$$

where n is the number of trading months for firm i in year t . A higher value of NCSKEW indicated higher crash risk and vice versa. The second measure of crash risk is the down-to-up volatility (DUVOL), which is calculated by following formula:

$$DUVOL_{i,t} = \log \left[(n_u - 1) \sum_{down} W_{i,t}^2 \right] / \left[(n_d - 1) \sum_{up} W_{i,t}^2 \right] \quad (4)$$

where n_u is the number of “up” months and n_d is the number of down months. A higher value of DUVOL suggests greater crash risk.

3.4 Economic policy uncertainty index

In our research, we employ three economic policy uncertainty indexes. First one is the index obtained from Baker et al. [18], which is based on a scaled frequency count of articles about policy-related economic uncertainty in South China Morning Post (SCMP). The second index is developed by Davis et al. [24]. They use two mainland Chinese newspaper, the Renmin Daily and the Guangming Daily, to construct an index through quantifying uncertainty-related concepts. They also constructed a monthly trade policy uncertainty index by using the same two newspapers, which is the third index we apply in our research. All three indexes are at the monthly frequency, and we downloaded them from their website.

4. Empirical analyses

4.1 Descriptive statistics

Table 1 provides descriptive statistics for the variables used in our analysis. The means of NCSKEW and DUVOL which describe the risk of stock crash, are -0.266 and -0.175, respectively. The mean values of economic policy uncertainty (LANDEPU, SCMPEPU) after changing the order of magnitude are 1.658 and 2.991 respectively, and the mean values of trade policy uncertainty TPU after changing the order of magnitude are 2.148. In our sample, the average return on individual stocks is -0.039, the average age of company establishment is 2.761, and the average size of company is 21.861. The average leverage is 0.433, the average book-to-market ratio is 0.616, the average shareholding ratio of the largest shareholder is 0.355. The average return on assets is 0.041, the mean percentage increase in annual sales growth is 0.204, the mean of standard deviation of firm-specific weekly returns is 0.047. The arithmetic mean of ret for the company-specific weekly return after the magnitude change is -0.127, which is in line with Yuan et al. [16].

Table 1. Descriptive statistics

Variable	N	Mean	Sd	Min	P25	P50	P75	Max
NCSKEW _t	22,571	-0.266	0.677	-2.306	-0.643	-0.227	0.153	1.440
DUVOL _t	22,571	-0.175	0.469	-1.306	-0.489	-0.173	0.140	0.984
LANDEPU _t	22,571	1.658	0.921	0.504	1.046	1.243	2.066	3.904
SCMPEPU _t	22,571	2.991	2.132	0.822	1.236	1.813	3.648	7.919
TPU _t	22,571	2.148	2.218	0.107	0.647	0.969	2.904	6.876
Return _t	22,571	-0.039	0.569	-1.489	-0.396	-0.054	0.306	1.397
Age _t	22,571	2.761	0.386	1.386	2.565	2.833	3.045	3.434

Sizet	22,571	21.861	1.344	19.144	20.899	21.713	22.638	25.927
Levt	22,571	0.433	0.214	0.049	0.262	0.424	0.591	0.973
BMt	22,571	0.616	0.239	0.119	0.434	0.618	0.798	1.129
FRSt	22,571	0.355	0.151	0.088	0.235	0.336	0.458	0.755
ROAt	22,571	0.041	0.061	-0.246	0.016	0.040	0.070	0.211
Growtht	22,571	0.204	0.520	-0.600	-0.015	0.116	0.283	3.705
Sigmat	22,571	0.047	0.018	0.017	0.035	0.045	0.057	0.107
rett	22,571	-0.127	0.104	-0.581	-0.160	-0.098	-0.059	-0.014

4.2 Correlation analysis

We calculate the correlation coefficients between variables, Table 2 lists the result of correlation analysis. The results suggest that NCSKEW is significantly and positively correlated with DUVOL (the coefficient is close to 1). There is a significant negative correlation between NCSKEWT, DUVOLT and EPU indicator LANDEPU, which is consistent with Hypothesis 2. In other words, the higher the LANDEPU, the lower the risk of stock crash. The control variables ROA, GROWTH and RET are positively correlated with NCSKEWT and DUVOL, while the control variables AGE and SIZE are negatively correlated with NCSKEWT and DUVOL. These conclusions are consistent with the findings in the literature Luo and Zhang [6].

Table 2. Correlation coefficients between different variables

	NCS KEW t	DU VO Lt	LAN DEP Ut	Retu rnt	Age t	Size t	Levt	BMt	FRS t	RO At	Gro wtht	Sig mat	r e tt
NCS KEW t	1												
DUV OLt	0.873 ***	1											
LAN DEP Ut	- 0.071 ***	- 0.06 2** *	1										
Retur nt	- 0.120 ***	- 0.13 0** *	- 0.166 ***	1									
Aget	- 0.060 ***	- 0.06 0** *	0.326 ***	- 0.00 9	1								
Sizet	- 0.113 ***	- 0.12 5** *	0.148 ***	- 0.05 3** *	0.21 7** *	1							
Levt	- 0.058 ***	- 0.06 8** *	- 0.068 ***	0.06 1** *	0.15 9** *	0.45 1** *	1						

BMt	-	-	0.191	-	0.05	0.53	0.32	1					
	0.069	0.05	***	0.32	0**	4**	0**						
	***	7**		6**	*	*	*						
		*		*									
FRSt	-	-	-	0.00	-	0.20	0.04	0.15	1				
	0.034	0.02	0.072	1	0.13	3**	3**	9**					
	***	9**	***		7**	*	*	*					
		*			*								
ROAt	0.034	0.02	-	0.04	-	-	-	-	0.12	1			
	***	3**	0.020	7**	0.11	0.07	0.37	0.17	8**				
		*	***	*	1**	3**	3**	2**	*				
					*	*	*	*					
Grow	0.014	0.00	-	0.04	-	-	0.04	-	0.02	0.18	1		
tht	**	3	0.043	8**	0.03	0.02	8**	0.01	6**	4**			
			***	*	2**	0**	*	7**	*	*			
					*	*		*					
Sigm	-	-	-	0.27	-	-	-	-	-	-	0.07	1	
at	0.074	0.06	0.214	9**	0.11	0.31	0.01	0.36	0.05	0.04	2**		
	***	3**	***	*	1**	4**	1*	3**	1**	9**	*		
		*			*	*		*	*	*			
rett	0.098	0.08	0.185	-	0.08	0.26	0.00	0.32	0.03	0.04	-	-	1
	***	3**	***	0.29	6**	9**	9	2**	7**	8**	0.06	0.97	
		*		0**	*	*		*	*	*	3**	2**	
				*							*	*	

4.3 Baseline analysis

Table 3 reports the univariate and multivariate test results for the key variables used in this study. DUVOL is the dependent variable representing the risk of stock crash, and LANDEPU is the independent variable representing the uncertainty of economic policy to be studied. The second column of Table 3 is the result of univariate regression after fixed year and industry. The coefficient is -0.054, and statistically significant at the 1% level. In the third column of the table, when the control variables are included in the regression, the result is -0.088, which is statistically significant at the 1% level. In the fourth and fifth columns of the table, when the year and firm are fixed, the results of univariate and multivariate are significantly negative. These results all confirm Hypothesis 2 and are consistent with the results of correlation analysis. On this basis, with the increase of LANDEPU, DUVOL increases significantly. The result is significant, indicating that the negative influence of LANDEPU on the risk of stock price crash cannot be ignore.

Table 3. Univariate and multivariate test for EPU and Stock Price Crash Risk

	(1)	(2)	(3)	(4)
	DUVOLt	DUVOLt	DUVOLt	DUVOLt
LANDEPUt	-0.054*** (-11.52)	-0.088*** (-15.02)	-0.040*** (-12.39)	-0.116*** (-9.33)
Returnt		-0.122*** (-12.89)		-0.115*** (-11.53)
Aget		-0.037*** (-3.59)		-0.004 (-0.08)
Sizet		-0.040*** (-10.08)		-0.022*** (-2.67)

Levt		0.056***		0.040
		(2.73)		(1.19)
BMt		-0.078***		-0.119***
		(-3.63)		(-4.10)
FRSt		0.009		-0.005
		(0.38)		(-0.09)
ROAt		0.049		-0.178**
		(0.76)		(-2.32)
Growtht		0.007		0.004
		(1.22)		(0.69)
Sigmat		0.578		-1.691*
		(0.70)		(-1.86)
rett		0.873***		0.506***
		(6.10)		(3.29)
Constant	-0.093**	1.140***	-0.098***	0.796***
	(-2.12)	(11.62)	(-7.61)	(4.22)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	No	No
Firm fixed effect	No	No	Yes	Yes
N	22,571	22,571	22,571	22,571
Adj R2	0.060	0.096	0.053	0.084

t statistics in parentheses

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

5. Robustness checks

In this section, several robustness tests are conducted to examine the sensitivity of our results, including the method of replacing major independent variables and dependent variables.

5.1 Replace major independent variables

We fix the year and the firm while replace the main independent variable (LANDEPU) for stability test. Our sample data are mainly the listed firms in the Chinese mainland, and we mainly explore the economic policy uncertainty in the Chinese mainland. Thus, the LANDEPU is chosen as the independent variable of the model in the beginning, which serves as the main independent variable representing the EPU in mainland China. This is because it is a statistic constructed by Davis et al. [24], based on two mainland Chinese newspapers: the Renmin Daily and the Guangming Daily.

However, the statistic SCMPEPU constructed by Baker et al. [18], based on the text of Hong Kong South China Morning Post, is also a classic statistic representing the EPU in mainland China. In addition, most of the previous studies on the EPU of China mainly use this index. Therefore, in the robustness test, we replace the independent variable LANDEPU with SCMPEPU to conduct the regression analysis again, which are shown in Table 4.

Table 4. Robust Test 1		
	(1)	(2)
	DUVOLt	DUVOLt
SCMPEPUt	-0.020***	-0.051***
	(-12.39)	(-9.33)
Returnt		-0.115***
		(-11.53)

Aget	-0.004 (-0.08)
Sizet	-0.022*** (-2.67)
Levt	0.040 (1.19)
BMt	-0.119*** (-4.10)
FRSt	-0.005 (-0.09)
ROAt	-0.178** (-2.32)
Growtht	0.004 (0.69)
Sigmat	-1.691* (-1.86)
rett	0.506*** (3.29)
Constant	-0.101*** 0.779*** (-8.04) (4.11)
Year fixed effects	Yes Yes
Firm fixed effect	Yes Yes
N	22,571 22,571
Adj R2	0.053 0.084

t statistics in parentheses

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

The regression coefficient is -0.020, and statistically significant at the 1% level when the control variables are not included, while the coefficient is -0.051 and statistically significant at the 1% level if the control variable is added, This indicates that the replacement of LANDEPU with SCMPEPU has no effect on the results of our study.

Similarly, TPU index was constructed by Davis et al. [24] based on the texts of two mainland Chinese newspapers: The Renmin Daily and The Guangming Daily, to measure the uncertainty of trade policies in mainland China. Although few studies have used TPU index to represent the economic policy uncertainty in China, we believe that TPU can also be used to study the EPU in mainland China to some extent. Therefore, in the robustness test, we replace the independent variable LANDEPU with TPU to conduct the regression analysis again, where the results are summarized in Table 5.

Table 5. Robust Test 2

	(1)	(2)
	DUVOLt	DUVOLt
TPUt	-0.029*** (-12.39)	-0.054*** (-9.33)
Returnt		-0.115*** (-11.53)
Aget		-0.004 (-0.08)
Sizet		-0.022*** (-2.67)

Levt		0.040 (1.19)
BMt		-0.119*** (-4.10)
FRSt		-0.005 (-0.09)
ROAt		-0.178** (-2.32)
Growtht		0.004 (0.69)
Sigmat		-1.691* (-1.86)
rett		0.506*** (3.29)
Constant	-0.115*** (-9.98)	0.743*** (3.87)
Year fixed effects	Yes	Yes
Firm fixed effect	Yes	Yes
N	22,571	22,571
Adj R2	0.053	0.084

t statistics in parentheses

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

When the control variables are not included, the regression coefficient is -0.029, and statistically significant at the 1% level. After the control variable is added, the coefficient is -0.054, and statistically significant at the 1% level. This denotes that the replacement LANDEPU with TPU has no impact on the results of our study.

5.2 Replace dependent variables

We fix the year and industry and replace the dependent variable (DUVOL) for robustness test. Both upstream and downstream volatility (DUVOL) and negative return skewness coefficient (NCSKEW) can be used to characterize stock price crash risk. Generally, many studies choose to use the negative return skewness coefficient (NCSKEW) to represent the risk of stock price crash. Therefore, we replace the dependent variable DUVOL with negative return skewness coefficient (NCSKEW) to conduct robustness test to examine the robustness of the results. The result is shown in Table 6.

Table 6. Robust Test 3

	(1)	(2)
	NCSKEWt	NCSKEWt
LANDEPUt	-0.104*** (-15.93)	-0.158*** (-19.02)
Returnt		-0.163*** (-12.24)
Aget		-0.044*** (-2.88)
Sizet		-0.042*** (-7.22)
Levt		0.090*** (3.04)

BMt		-0.217*** (-6.96)
FRSt		-0.023 (-0.67)
ROAt		0.127 (1.43)
Growtht		0.024*** (2.67)
Sigmat		1.500 (1.21)
rett		1.613*** (7.57)
Constant	-0.055 (-1.08)	1.439*** (10.11)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
N	22,571	22,571
Adj R2	0.058	0.099

t statistics in parentheses

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

When the control variables are not included, the regression coefficient is -0.104, and statistically significant at the 1% level. When the control variable is added, the coefficient is -0.158, and statistically significant at the 1% level.

This indicates that the replacement of NCSKEW with DUVOL has no effect on the results of our study. The above results indicate that the results obtained in the baseline analysis are robust, indicating that Hypothesis 2 is valid and there is indeed a negative relationship between stock crash risk and economic policy uncertainty.

6. Heterogeneity Analysis

To further investigate the effect of variables on the risk of stock price crash, this table uses NCSKEW to determine whether four variables are associated with crash. The four variables are divided into two groups to explore whether the four factors of the big four audit is selected, whether it is a state-owned company, whether it has a high level of analyst coverage, and whether it has a high percentage of institutional investors' shareholding affect the risk of stock price crash. One of the criteria for determining the level of analyst coverage is that if a company's analyst coverage is greater than the average level of analyst coverage. The criterion for determining a high degree of institutional investor ownership is whether it is greater than the average institutional investor ownership. The variable tested is the economic policy uncertainty index, and in parentheses are the t-values of the standard errors of the documents grouped by the year of the company.

6.1 Big 4 audit

According to the results, it can be found that the significance level of not choosing the big four audit has significantly increased relevant to the level of using four audit, which implies that the increase in EPU is more likely to reduce the risk of stock crash if four audit is not used. The possible reason for this is that after selecting a four audit, firms may believe that they are already well regulated, i.e., reduce the level of concern about policy uncertainty. Thus, measures to avoid a stock crash may not be taken accordingly when economic uncertainty increases, leading to an increased likelihood of a crash. When the big four audit is not selected, firms may believe that there are problems with their

regulation. Besides, they are more likely to take appropriate measures to avoid a share price crash when economic policy uncertainty increases to reduce the risk they may face.

6.2 State-owned enterprise

Whether or not the firm is a state-owned enterprise also affects the results. Although the significance level is not significantly different numerically, firms that are not state-owned enterprises are more likely to obtain a lower risk of stock collapse when subject to changes in economic policy uncertainty. The possible reason for this is that SOEs are more taken care of by the state, i.e., have more confidence in their own strength. Moreover, they are more inclined to be able to weather the storm themselves without taking appropriate measures to avoid the risk when EPU increases. Therefore, it may be affected by economic uncertainty, leading to stock price crashes. However, if the firm is not a state-owned enterprise, it receives relatively less support from the state. In this case, the company may be more nervous and take appropriate measures to avoid a share price collapse when economic uncertainty decreases.

Table 7. The Heterogeneity Analysis 1

	(1)	(2)	(1)	(2)
	big41	big40	SOE1	SOE0
LANDEPUt	-0.080** (-2.20)	-0.122*** (-11.40)	-0.110*** (-7.97)	-0.127*** (-7.90)
Returnt	-0.218*** (-4.56)	-0.126*** (-9.39)	-0.149*** (-7.23)	-0.105*** (-6.27)
Aget	0.051 (0.30)	-0.032 (-0.67)	-0.034 (-0.53)	0.003 (0.04)
Sizet	-0.075* (-1.69)	-0.018* (-1.93)	-0.014 (-1.01)	-0.013 (-0.93)
Levt	-0.068 (-0.37)	0.041 (1.07)	-0.014 (-0.24)	0.096* (1.87)
BMt	-0.052 (-0.42)	-0.177*** (-5.66)	-0.261*** (-5.98)	-0.114*** (-2.65)
FRSt	0.497* (1.77)	-0.037 (-0.58)	-0.028 (-0.30)	-0.055 (-0.59)
ROAt	-0.019 (-0.02)	-0.047 (-0.28)	-0.399 (-1.60)	0.194 (0.86)
Growtht	0.023 (0.27)	0.004 (0.22)	0.016 (0.56)	-0.001 (-0.03)
Sigmat	22.701*** (2.63)	32.164*** (12.95)	23.964*** (7.11)	38.225*** (11.52)
rett	5.935*** (3.11)	8.119*** (15.55)	6.392*** (8.99)	9.375*** (13.36)
Constant	1.001 (0.98)	0.072 (0.31)	0.220 (0.66)	-0.330 (-0.99)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
N	15,75	20,996	11,243	11,328
Adj R2	0.115	0.094	0.090	0.098

t statistics in parentheses

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

6.3 Analyst coverage

The degree of analyst coverage also affects the results to some extent. When the degree of analyst coverage is greater, the risk of share price collapse due to rising EPU is reduced relative to firms with low coverage is less. The degree of analyst coverage is influenced by firm fundamentals, with firms with better fundamentals being given higher attention by analysts, resulting in more analyst reports being written and higher analyst coverage being obtained. This means that firms with good fundamentals may be more vulnerable to stock price crashes. The possible reason for this is that there is uncertainty about economic policy that leads to a significant change in expectations for that company. On this basis, there is a high probability that people will sell off a lot of shares of that company, leading to a stock price crash. Conversely, if the firm itself has average fundamentals and low analyst coverage, then it is difficult for people's expectations to drop significantly for this company even if economic uncertainty rises. Thus, it is much less likely to lead to a stock price collapse.

6.4 Percentage of shares held by institutional investors

Finally, the percentage of shares held by institutional investors is also an important factor that affects the outcome. A higher percentage of shares held by institutional investors means that a firm has more money that could be transferred out simultaneously. When economic uncertainty increases, institutions may perceive that a firm's profitability has declined and transfer out a large amount of their own capital. Besides, such selling is likely to lead to an increased risk of stock price collapse. From the results, although the significance does not change, the change in the coefficient shows a weakening of this negative relationship.

Table 8. The Heterogeneity Analysis 2

	(1)	(2)	(1)	(2)
	analyteam1	analyteam0	inst1	inst0
LANDEPUt	-0.105*** (-7.92)	-0.123*** (-6.64)	-0.092*** (-6.52)	-0.167*** (-10.54)
Returnt	-0.108*** (-6.56)	-0.128*** (-5.39)	-0.141*** (-8.27)	-0.121*** (-5.92)
Aget	-0.034 (-0.57)	-0.032 (-0.38)	0.065 (1.03)	-0.056 (-0.73)
Sizet	-0.013 (-1.09)	-0.072*** (-4.15)	-0.039*** (-3.00)	-0.011 (-0.68)
Levt	0.071 (1.50)	-0.018 (-0.26)	-0.016 (-0.31)	0.008 (0.13)
BMt	-0.170*** (-4.45)	-0.109* (-1.90)	-0.194*** (-5.00)	-0.089* (-1.67)
FRSt	-0.036 (-0.43)	0.114 (1.01)	0.127 (1.41)	-0.490*** (-3.37)
ROAt	-0.103 (-0.49)	-0.351 (-1.14)	-0.277 (-1.19)	-0.012 (-0.05)
Growtht	0.011 (0.44)	0.025 (0.75)	0.073*** (2.68)	-0.062** (-2.13)
Sigmat	30.407*** (9.93)	21.926*** (5.09)	28.572*** (9.00)	34.996*** (9.32)
rett	7.669*** (11.81)	6.177*** (6.83)	7.269*** (10.77)	8.779*** (11.21)
Constant	-0.059	1.436***	0.230	0.130

	(-0.20)	(3.50)	(0.71)	(0.33)
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
N	14,224	8,347	13,112	9,459
Adj R2	0.085	0.104	0.083	0.116

t statistics in parentheses
p < 0.1, ** p < 0.05,***p < 0.01

7. Conclusions

In summary, we investigate the effect of EPU on stock crash risk using A-shares in the Chinese stock market during the sample period of 2007 to 2019. First, a model is constructed to analyze the relation between the two with EPU as the independent variable and stock crash risk as the dependent variable. It is found that there is a significant negative relation between the two. For further analysis, a series of robustness tests are carried out by replacing LANDEPU with TPA and SCMPEPU, NCSKEW with DUVOL. According to the regression analysis, the replacement does not affect the negative relation of the results, proving that this negative relation does exist. Next, we conduct a heterogeneity test by controlling for the four groups of variables and analyzing the results. From the analysis, it does not affect the negative relation of the results, though there are some differences in the results of the analysis between whether the Big 4 auditors is selected, whether it is a state-owned enterprise, whether it has a high percentage of institutional ownership and analyst coverage.

Overall, our findings support the view that an increase in economic policy uncertainty reduces the risk of a crash in stock prices, which differ from previous research. Our study provides new conclusions on the impact of EPU on stock crash risk and provides new evidence on the economic consequences of EPU. Our results are beneficial for firms and investors who want to manage the risk of a stock market crash. Through this study, we suggest that the management of the company should strengthen supervision and increase the transparency of the company information when economic policy uncertainty is high, so as to control the risk of stock price collapse.

References

- [1] Hamza, T., ZAATIR, E. (2020). Does corporate tax aggressiveness explain future stock price crash? Empirical evidence from France. *Journal of Financial Reporting and Accounting*.
- [2] Cho, H., Kim, R. (2019). Analysts' optimism and stock crash risk. *Managerial Finance*.
- [3] Chiang, T. C. (2019). Financial risk, uncertainty and expected returns: evidence from Chinese equity markets. *China Finance Review International*.
- [4] Hu, J., Li, S., Taboada, A. G., & Zhang, F. (2020). Corporate board reforms around the world and stock price crash risk. *Journal of Corporate Finance*, 62, 101557.
- [5] Jin, X., Chen, Z., & Yang, X. (2019). Economic policy uncertainty and stock price crash risk. *Accounting & Finance*, 58(5), 1291-1318.
- [6] Luo, Y., & Zhang, C. (2020). Economic policy uncertainty and stock price crash risk. *Research in International Business and Finance*, 51, 101112.
- [7] Attig, N., El Ghouli, S., Guedhami, O., & Zheng, X. (2021). Dividends and economic policy uncertainty: International evidence. *Journal of Corporate Finance*, 66, 101785.
- [8] Zou, H., Wong, S., Shum, C., Xiong, J., & Yan, J. (2008). Controlling-minority shareholder incentive conflicts and directors' and officers' liability insurance: Evidence from China. *Journal of Banking & Finance*, 32(12), 2636-2645.
- [9] Xiao, J. Z., Dahya, J., & Lin, Z. (2004). A grounded theory exposition of the role of the supervisory board in China. *British Journal of Management*, 15(1), 39-55.

- [10] Li, P., Parsa, S., Tang, G., & Xiao, J. Z. (2012). Is there an expectations gap in the roles of independent directors? An explorative study of listed Chinese companies. *British Journal of Management*, 23(2), 206-222.
- [11] Chen, K. C., Chen, Z., & Wei, K. J. (2009). Legal protection of investors, corporate governance, and the cost of equity capital. *Journal of corporate finance*, 15(3), 273-289.
- [12] Jin, L., & Myers, S. C. (2006). R2 around the world: New theory and new tests. *Journal of Financial Economics*, 79(2), 257-292.
- [13] Kim, Y., Li, H., & Li, S. (2014). Corporate social responsibility and stock price crash risk. *Journal of Banking & Finance*, 43, 1-13.
- [14] Callen, J. L., & Fang, X. (2015). Religion and stock price crash risk. *Journal of Financial and Quantitative Analysis*, 169-195.
- [15] Ben, J. H., Li, X., Duncan, K., & Xu, J. (2020). Corporate relationship spending and stock price crash risk: Evidence from China's anti-corruption campaign. *Journal of Banking & Finance*, 113, 105758.
- [16] Yuan, R., Sun, J., & Cao, F. (2016). Directors' and officers' liability insurance and stock price crash risk. *Journal of Corporate Finance*, 37, 173-192.
- [17] Kim, J. B., Wang, Z., & Zhang, L. (2016). CEO overconfidence and stock price crash risk. *Contemporary Accounting Research*, 33(4), 1720-1749.
- [18] Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, 131(4), 1593-1636.
- [19] Antonakakis, N., Chatziantoniou, I., & Filis, G. (2012). Dynamic co-movements between stock market returns and policy uncertainty, MPRA Paper", no. 42905.
- [20] Chen, J., Hong, H., & Stein, J. C. (2001). Forecasting crashes: Trading volume, past returns, and conditional skewness in stock prices. *Journal of financial Economics*, 61(3), 345-381.
- [21] Kim, J. B., Li, Y., & Zhang, L. (2011). CFOs versus CEOs: Equity incentives and crashes. *Journal of financial economics*, 101(3), 713-730.
- [22] Kim, J. B., Li, Y., & Zhang, L. (2011). Corporate tax avoidance and stock price crash risk: Firm-level analysis. *Journal of Financial Economics*, 100(3), 639-662.
- [23] Dimson, E. (1979). Risk measurement when shares are subject to infrequent trading. *Journal of Financial Economics*, 7(2), 197-226.
- [24] Davis, S. J., Liu, D., Sheng, X. S. (2019). Economic policy uncertainty in China since 1949: The view from mainland newspapers. *Work Pap*, 1-35.