International Review of Financial Analysis 90 (2023) 102843

Contents lists available at ScienceDirect

International Review of Financial Analysis

journal homepage: www.elsevier.com/locate/irfa

Does geopolitical risk affect firms' idiosyncratic volatility? Evidence from China

Xiaohang Ren [a], Yuxuan Cao [a], Pei Jose Liu [b,*], Dun Han [c]

[a] School of Business, Central South University, Changsha 410083, China
[b] Newcastle University Business School, Newcastle University, Newcastle, UK
[c] Queen's Management School, Queen's University Belfast, Belfast, UK

ARTICLE INFO

Keywords:
Geopolitical risk
Idiosyncratic risk
Idiosyncratic volatility
The South China Sea dispute

ABSTRACT

Using 2663 Chinese A-share listed companies from 2003 to 2019, we investigate the relationship between geopolitical risk (GPR) and firm idiosyncratic volatility through panel fixed effects and attempt to explain the mechanism. The main findings are presented as follows. First, GPR can explain the change of firms' idiosyncratic volatility. Different industry conditions and ownerships have heterogeneous effects on the firms' idiosyncratic volatilities. In addition, the interaction terms of ownership concentration, competitive intensity and operating leverage with GPR are statistically significant, and they interact with GPR to affect firms' idiosyncratic volatility. After we conduct a series of robustness tests using methods such as instrumental variables, we innovatively introduce the South China Sea dispute as an external event and use the DID (Difference-in-difference) model to analyze the impact of geopolitical events on corporate risk-taking, our findings remain valid. Our research contributes to a better understanding of geopolitical risk and firms' idiosyncratic volatility.

1. Introduction

There is no doubt that firms are exposed to a variety of risks, one of which is geopolitical risk (GPR) arising from geopolitical events. Geopolitical risk is the risk of affecting normal international relations arising from shocks and frictions between states, military-related conflicts, threats of war and terrorism (Caldara and Iacoviello, 2022; Lee and Lee, 2020). A large number of scholars have focused their research on the macroeconomic influence of geopolitical risks such as financial development and stock market performance (Lee and Lee, 2020; Lu, Gozgor, Huang, and Lau, 2020). There are some empirical works examining the effects of geopolitical risk on corporate finance activities, including corporate cash reserves (Lee and Wang, 2021), corporate investment decisions, and corporate financing (Khoo and Cheung, 2022). However, the impact of geopolitical risk on firms' idiosyncratic risk-taking remains largely unexplored. There is a paucity of literature on whether and how GPR affects idiosyncratic volatility and thus firm risk-taking. It is confirmed that idiosyncratic risks are associated with growth opportunities by influencing upward trend in idiosyncratic volatility (Bekaert, Hodrick, and Zhang, 2012; Cao, Simin, and Zhao, 2006). Firm's idiosyncratic risks are often linked to firm-specific variations in returns. Idiosyncratic risks can be reduced through diversification and, together with non-diversifiable systematic risk, constituting the total risk of individual stocks.

However, the literature on how changes in GPR lead to changes in investment decisions and consequently affect firms' idiosyncratic risk is still under development. The extant research has largely overlooked the impact of variations in geopolitical risk on corporate risk-taking behavior and the resultant implications for firms' heterogeneously distributed vulnerability to external disturbances. Hence, examining how shifts in the geopolitical environment influence corporate investment conduct and the resulting idiosyncratic volatility remains an understudied but vital avenue for increasing our comprehension of firms' risk exposures and susceptibilities. Filling this gap in the literature would potentially yield useful insights into the mechanisms through which geopolitical uncertainties on corporate decision-making and idiosyncratic risks.

We perform a regression analysis using annual data for Chinese A-share listed companies from 2004 to 2019. The results show that generally an increase in GPR reduces the idiosyncratic risk of a firm. We then conduct various heterogeneity analysis. The results show that firms respond differently to GPR, depending on ownership types and industry market conditions. We notice that idiosyncratic volatilities of state-owned firms tend to decrease more under increasing geopolitical

* Corresponding author.
E-mail addresses: domrxh@csu.edu.cn (X. Ren), caoyuxuan@csu.edu.cn (Y. Cao), pei.liu@newcastle.ac.uk (P.J. Liu), d.han@qub.ac.uk (D. Han).

https://doi.org/10.1016/j.irfa.2023.102843
Received 4 March 2023; Received in revised form 28 July 2023; Accepted 1 August 2023
Available online 4 August 2023

uncertainties. Besides, market conditions also matter. Unfavorable industry market conditions lead to an increase in idiosyncratic volatility. In addition, we examine the moderating effects of ownership concentration, industry competition intensity and operating leverage on the relationship between GPR and firm idiosyncratic risk, and find the effects are significant. Finally, we conduct various robustness tests by applying industry-fixed models, removing 2003 and 2004 data, and using 2SLS model to re-estimate the results. The results remain consistent, which confirm the reliability of the benchmark regression results.

China's exposure to geopolitical risk was increasing in these years. The 2012 South China Sea dispute is a significant geopolitical event shock that China faced in the past decade. To further investigate the impact of GPR on firm risk-taking, this dispute is introduced as an external shock, and we employ a difference-in-differences model (DID) to explore the change before and after this shock. To balance the differences in covariates, we use a propensity score matched (PSM) sample to estimate the DID. Both sets of results support our conclusion that GPR influences firms' idiosyncratic volatility negatively at a significant level, confirming that GPR impedes firms' risk-taking.

There are several contributions. First, this study provides a new perspective for investigating the association between GPR and firms' risk-taking. While previous research has examined either GPR or idiosyncratic volatility independently, we combine GPR and geopolitical event shocks to examine the impact of uncertainty on firm risk-taking. This perspective reveals how macro-level geopolitical uncertainties transmit to micro-level risks firms choose to undertake. All types of industries are affected by GPR and the study of geopolitical uncertainty has greater microeconomic relevance than the study of broad external shocks (Yu, Xiao, and Li, 2021). Therefore, our findings offer practical implications for corporate risk governance under geopolitical uncertainty. Since all firms face GPR to some extent, our results suggest that firms should monitor and manage GPR exposure to mitigate excess idiosyncratic volatility that may threaten performance and stability. This has relevance for firms and regulators seeking to control risks at the industry and macroeconomic levels. Secondly, this study contributes to the understanding of the role and impact of GPR on economic development. As previous studies have shown, for emerging countries, geopolitical shocks can lead to significant economic contraction (Cheng and Chiu, 2018). By studying Chinese firms, we illustrate how GPR affects firm behavior and economic outcomes in an emerging market context. Emerging economies are often more vulnerable to geopolitical shocks that disrupt investment, trade and growth (Lee and Wang, 2021). Our evidence that GPR increases Chinese firms' idiosyncratic volatility reveals one channel through which geopolitical risks influence microeconomic outcomes. This contributes to understanding how GPR impacts macroeconomic development. Finally, our results indicate that GPR fluctuations contain useful information about firms' idiosyncratic risks. Changes in GPR may serve as leading indicators of shifts in firms' risk appetites and future idiosyncratic volatility. This has practical relevance for analysts and investors seeking to predict and hedge idiosyncratic risks.

The remaining section of the paper is organized as follows. Section 2 reviews the related literature and formulates the hypotheses. Section 3 presents the data and methods. Section 4 empirically describes the regression results and conducts a series of robustness tests after examining whether different circumstances affect this relationship. Section 5 further introduces geopolitical shocks. The final section concludes the paper.

2. Literature review and hypothesis development

Geopolitical risk arising from geopolitical conflicts is an important factor affecting economic output, growth and the business cycle in both the short and long term (Antonakakis, Gupta, Kollias, and Papadamou, 2017; Cheng and Chiu, 2018). In recent years, the risks posed by GPR, along with terrorism and unilateralism, have attracted the attention of many scholars around the world (Abdel-Latif and El-Gamal, 2020).

There is a growing awareness that the business environment, economic growth and financial markets volatilities are not only related to economic factors but also to geopolitical risks that induce shocks (Antonakakis et al., 2017; Balcilar, Bonato, Demirer, and Gupta, 2018; Cheng and Chiu, 2018). Previous literature mainly focusses the impact of GPR on volatility in equity and commodity markets (especially on oil markets) (Alqahtani, Bouri, and Vo, 2020; Corbet, Gurdgiev, and Meegan, 2018; Gkillas, Gupta, and Pierdzioch, 2020). Apergis and Apergis (2016) find that the geopolitical risks (especially terrorist attacks) can lead to higher cumulative abnormal returns for firms. Antonakakis et al. (2017) use monthly stock and oil data that cover a period from 1899 to 2016 to investigate the relationship between GPR and stock volatility. They find that GPR can have a significantly negative impact on both oil returns and volatility. In addition, Balcilar et al. (2018) conclude that GPR has a greater effect on market volatility than on returns by examining the sample from BRICS countries.

Many studies have also focused on the impact of geopolitical risk on corporate investment. Due to the broad scope of geopolitical risk, investors generally use GPR as a determining factor in their investment decisions (Caldara and Iacoviello, 2022). Lee and Wang (2021) find a significant negative relationship between geopolitical risk and irreversible capital investment, which is more pronounced for firms with more cash holdings. Le and Tran (2021) confirm this conclusion and further argue that the negative impact of geopolitical risk on corporate investment is more severe for firms with a higher degree of investment irreversibility. In response to the uncertainty caused by geopolitical risks, firms tend to adopt a 'wait-and-see' strategy, reducing investment spending or temporarily postponing investment decisions to avoid excessive risk-taking (Bernanke, 1983). When facing geopolitical risk, firms tend to hold less irreversible assets thus reduce their investments (Caldara and Iacoviello, 2022). Some studies find the negative relationship between geopolitical risks and corporate investment remain robust after controlling for other investment opportunities and uncertainties such as economic policy uncertainty (EPU) and macroeconomic uncertainty (MU) (Le and Tran, 2021; Oanh and Hoang, 2021). However, there is also literature showing that uncertainty is positively associated with business investment. Abel and Eberly (1994) show that uncertainty is non-degradingly related to investment, but positively associated in certain circumstances.

For the majority of US listed firms, there is a significant negative correlation between idiosyncratic risk and investment (Panousi and Papanikolaou, 2012). Banerjee and Gupta (2017) argue that corporate investments, especially those risky but return enhancing investments, are associated with risk-taking behavior. The geopolitical risk may delay firms' investments and reduce their willingness to take risks. Malagon, Moreno, and Rodríguez (2015) use the asset-pricing model and confirm investment is associated with idiosyncratic volatility. Most literature points out that corporate investment decisions are influenced by geopolitical events negatively, particularly corporate risk decisions, which means that there is an impact on corporate risk-taking behavior (Block, 2012; Koirala, Marshall, Neupane, and Thapa, 2020; Smales, 2021).

Based on the above literature, we propose the following hypothesis:

Hypothesis 1. GPR can explain the change of firms' idiosyncratic volatility.

Geopolitical risk is essentially an external shock to the region where a firm is located. Geopolitics risks have impacts on business risk-taking through a number of channels. Different market conditions affect the choice of risk-taking by firms differently. When market conditions are favorable, firms pursue riskier projects. Bolton, Chen, and Wang (2013) argue that market conditions affect the timing of risky investments. When market conditions are unfavorable, firms are more likely to experience financing constraints with higher external financing costs therefore reduce investment (Gupta and Krishnamurti, 2018).

Investment behavior is closely related with firm's idiosyncratic risks (Panousi and Papanikolaou, 2012). Thus, unfavorable market conditions lead to increased risk aversion and lower levels of risk-taking by firms. However, for firms in favorable market conditions, uncertainty is more of an investment opportunity and thus idiosyncratic risk is positively influenced by GPR. In addition to market conditions, the ownership type also has an impact on the idiosyncratic risks. Due to the dual agency problem in state-owned enterprises (SOEs), managements are likely to use their delegated decision-making power to obtain their own interests rather than to promote the shareholders' objectives (Ho, Phung, and Nguyen, 2021). In addition, since SOEs bear responsibility for more than just profit-making, we can infer that SOEs face greater idiosyncratic volatility in the face of geopolitical risk shocks.

The above discussion inspires us that firms may bear different idiosyncratic risks when being exposed to conditions, leading to our following hypothesis.

Hypothesis 2a. The impact of GPR on firm's risk-taking will be heterogeneous among firms, depending on industrial market conditions. If the market environment is favorable, GPR has a positive impact on firm idiosyncratic risk and vice versa.

Hypothesis 2b. The impact of GPR on firm's risk-taking will be heterogeneous among firms, depending on ownership types, in which SOEs are more affected.

3. Data and methodology

3.1. Data and sample

We collect the monthly Chinese Geopolitical Risk (GPR) index[1] from Caldara and Iacoviello (2022). The sample in this study comprises Chinese A-share listed companies from 2003 to 2019 which collected from CSMAR (China Stock Market & Accounting Research). The data are representative for subsequent empirical study. We apply the following criteria to select the sample: no special treatment or transfers, non-negative book-to-market (BM) ratio, publicly disclosed, operation for more than 1 year and financial firms are also excluded. To minimize the effect of outliers, the data were winsorized at 1% in both tails in our empirical analysis. We finally obtain 26,111 annual observations, with a total sample of 2663 A-share listed companies.

3.2. Variables

3.2.1. Firm's idiosyncratic volatility

There are many measurements of idiosyncratic risk (Yin and Lu, 2022), but the most commonly used idiosyncratic risk is return on assets or earnings volatility (Armstrong and Vashishtha, 2012; Banerjee and Gupta, 2017; Kim, Patro, and Pereira, 2017). We choose the idiosyncratic volatility as a proxy of a firm's risk-taking (Ding, Jia, Qu, and Wu, 2015; He, Qin, Liu, and Wu, 2022). We therefore run the Fama–French three-factor model to measure the idiosyncratic volatility (IVOL).

$$r_t^i - r_t^f = \alpha^i + \beta^{M,i}\left(r^M - r^f\right)_t + \beta^{SMB,i} SMB_t + \beta^{HML,i} HML_t + \varepsilon_t^i$$

where r_t^i is the return of stock i on day t, and r_t^f refers to the risk-free return of stock i on day t. In addition, $(r^M - r^f)$, SMB_t, HML_t are the three factors at a daily frequency, which represents the size and the BM ratio of the firm on the t-th day respectively. The regression residuals ε_t^i are the idiosyncratic returns of stock i on the *t-th* day. Thus, the IVOL of return, belonging to the stock i, in the *j-th* month, which has t trading days, is the standard deviation of the ε_t^i. The IVOL is calculated as:

$$IVOL_j^i = \sqrt{Var\left(\varepsilon_t^i\right)}$$

[1] Data is available from https://www.matteoiacoviello.com/gpr.html.

3.2.2. Geopolitical risks

The independent variable in this study is the geopolitical risk (GPR) index. The GPR index is constructed based on the news associated with geopolitical events such as wars and terrorist attacks which may pose threat to current international relations. Daily GPR index is calculated by text-searching the number of words in publications related to geopolitical events. To match the frequency, we converted the monthly GPR indices into annual data by taking annual averages. Caldara and Iacoviello (2022) find that a higher value of GPR index is typically associated with increased political and economic uncertainty, social unrest, and conflicts, all of which are considered indicators of higher geopolitical risk (Antonakakis et al., 2017). Therefore, a higher value of GPR usually represents higher geopolitical risk.

3.2.3. Control variables

To account for the influence of the other factors on idiosyncratic risk, we control several variables, including firm size (Size), market leverage (ML), price-to-book value (PTBV), tangibility ratio (Tangibility), return on equity (ROE), consumer price index (CPI) and the growth rate of the real gross domestic product (GDP). Definitions for these proxies are shown in Table 1. In addition, all the control variables are lagged one year to minimize endogeneity issues and avoid potential omitted variable bias.

3.3. Summary statistics and correlation

Descriptive statistics for the main variables are presented in Table 2. The mean and median value of idiosyncratic risks (IVOL) are 0.242 and 0.215, respectively. The mean value of the geopolitical risk in China between 2003 and 2019 is 0.549 with a minimum value of 0.348 and maximum value of 0.917. Our GPR index remains relatively flat, with a standard deviation of 0.204. The average value of size is 22.13, which indicates these sample firms are generally large. As an indicator of the firm's profitability, ROE is averaged at 0.019 with the median at 0.061.

Table 1
Variable definitions.

Variable type	Variable name	Definition
Dependent variable	IVOL	The idiosyncratic risk of firm i in period T
Independent variable	GPR	Geopolitical risks index.
Control variables	SIZE	Log of the firm's total market value as of the end of the fiscal year
	ML	Market leverage, the percentage of total debt in the sum of market capitalization and total debt.
	PTBV	Price to book value, calculated as the price per share divided by net asset value per share.
	Tangibility	The ratio of total tangible assets divided by total assets. The total tangible assets equal total assets minus net intangible assets minus net goodwill.
	ROE	The firm's total profit divided by the average balance of shareholders' equity at of the end of the fiscal year.
	CPI	The natural logarithm of index number with fixed base period, base: 2000–12 = 100.
	GDP	The growth rate of GDP deflated by the consumer price index data.
	H_5	The Herfindahl index, calculated as the sum of squares of the firm's top five major shareholders' shareholdings.
	H_10	The Herfindahl index, calculated as the sum of squares of the firm's top ten major shareholders' shareholdings.
	HHI	The Herfindahl–Hirschman index, the calculation is shown in the passage.
	OL	Operating leverage, calculated as percentage change in EBIT divides percentage change in sales revenue.

Table 2
Summary statistics of variables.

Variable	Mean	SD	Max	Min	p5	p25	p50	p75	p95
IVOL	0.242	0.133	0.743	0.002	0.0810	0.151	0.215	0.303	0.502
GPR	0.549	0.204	0.917	0.348	0.373	0.388	0.436	0.814	0.917
Size	22.13	1.369	28.64	12.31	20.18	21.24	22.01	22.90	24.54
ML	0.232	0.118	0.744	0	0.0450	0.136	0.232	0.327	0.418
PTBV	4.533	25.53	2001	0.121	0.893	1.588	2.516	4.156	9.640
Tangibility	0.928	0.0970	1	0.0760	0.733	0.916	0.960	0.983	1
ROE	0.019	4.745	713.2	−186.6	−0.198	0.0220	0.061	0.110	0.215
CPI	4.877	0.123	5.022	4.594	4.636	4.776	4.929	4.978	5.021
GDP	0.0220	0.008	0.0490	0.006	0.0110	0.0150	0.0180	0.029	0.035

Notes: This table presents the summary statistics of the variables used in the analysis. All variables are defined in detail in Table 1.

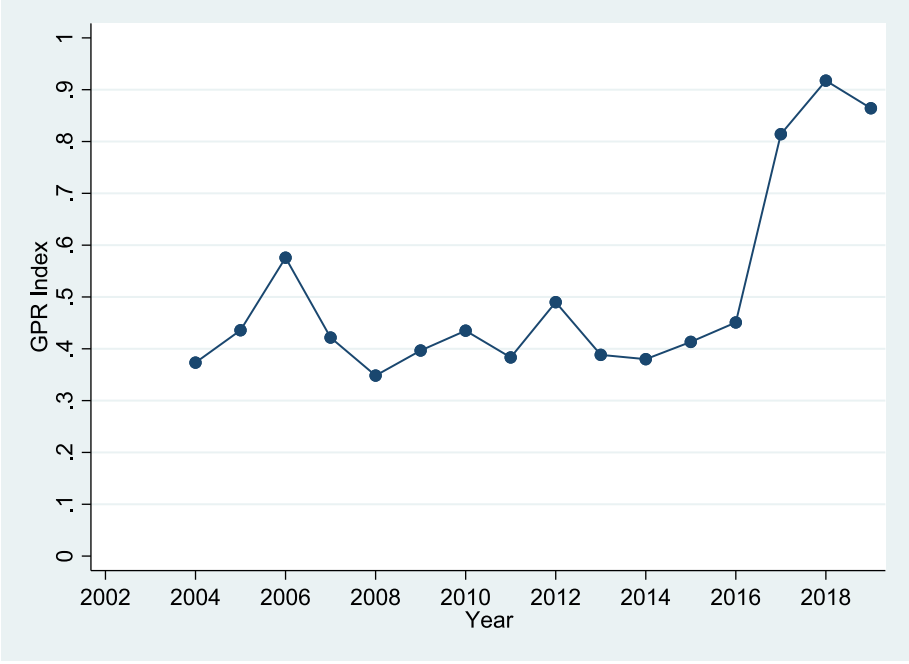

Fig. 1. Average annual GPR index.

Fig. 1 shows an overall upward trend of the GPR index from 2003 to 2019. Especially from 2016 to 2018, the GPR index increased sharply due to the South China Sea Dispute, indicating a rapid increase in geopolitical uncertainty during this period.

Table 3 lists the pairwise correlation coefficients for the variables. In terms of the Pearson's correlation coefficients, IVOL is negatively related to geopolitical uncertainty and statistically significant at 1% level. The absolute values of the correlation coefficients do not exceed 0.5, suggesting the absence of serious multicollinearity.

4. Empirical results and discussion

4.1. Baseline results

This study employs a benchmark model to examine the impact of geopolitical risks on firms' idiosyncratic volatility, and we use a panel regression model with individual fixed effects according to Ren, Zhang, Yan, and Gozgor (2022) and Yin and Lu (2022). We estimate the specifications as follows.

Table 3
Correlation coefficients.

	IVOL	*GPR*	*Size*	*ML*	*PTBV*	*Tangibility*	*ROE*	*CPI*	*GDP*
IVOL	1								
GPR	−0.109***	1							
Size	−0.109***	0.196***	1						
ML	−0.145***	0.012**	0.460***	1					
PTBV	0.047***	−0.036***	−0.144***	−0.088***	1				
Tangibility	−0.008	−0.137***	0.01	0.143***	−0.012*	1			
ROE	−0.019***	−0.013**	−0.007	−0.025***	0.153***	0.00800	1		
CPI	−0.050***	0.556***	0.330***	−0.184***	−0.002	−0.192***	−0.003	1	
GDP	0.049***	−0.322***	−0.263***	0.154***	−0.003	0.150***	0.003	−0.830***	1

Notes: The table reports the correlation coefficients of key variables used for analysis. Variables are defined in detail in Table 1. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

$$Risk_{i,t} = \alpha_0 + \alpha_1 GPR_t + \sum \beta Controls_{i,t-1} + Ind_i + \varepsilon_{i,t} \quad (1)$$

We use model (1) to explore the effect of GPR on firms' risk-taking. Table 4 presents the baseline regression results. The first column shows that the coefficient of GPR on the idiosyncratic volatilities is significantly negative at the 1% level. After adding other control variables, the coefficient of GPR remains significant and negative the 1% level. These results show that when a firm is facing higher GPR, it will take fewer risks to avoid volatility.

From the results in column (8), we can conclude that 1 unit increase in GPR is associated with 0.092 unit decrease in firm's idiosyncratic risks. The results confirm Hypothesis 1 that increased GPR will lead to the reduction of corporate risk-taking behavior. Geopolitical uncertainty has a negative correlation with firms' idiosyncratic volatility, which suggests an increase in GPR reduces future growth opportunities for firms since IVOL is associated with the growth opportunities (Cao et al., 2006). In that case, the firm managers are less willing to take risks which can stimulate firms' growth in order to avoid idiosyncratic risks.

It can also be seen from column (8) that the coefficients of firm size, price-to-book value and ROE are all significantly negative, which means firms with smaller size, lower price-to-book ratio and lower ROE, tend to bear greater idiosyncratic volatility. Returns on equity is associated risk premium, which is a vital component when considering corporate finance and management. However, the relationship between market leverage and IVOL is statistically positive, which is consistent with the previous study that higher debt is generally associated with higher risk (Magnanelli and Izzo, 2017).

4.2. Heterogeneity analysis

We then examine the effects in subsample under different industrial market conditions and various ownership types. First, we divide the industrial market environment into two groups: those with favorable industrial market environment and which is unfavorable. According to the previous study, geopolitical risks have different effects in firms which are faced with different market conditions (Qin, Hong, Chen, and Zhang, 2020). Market conditions matter to the adjustment of leverage (Frank & Goyal, 2004). Favorable market conditions are usually indicated positive industry returns in the previous month. We obtain the industry returns by weighting the stock returns of firms in each industry by market value. Following Yin and Lu (2022), if the industry return in the last month is positive, then the industry market is on the rise. Conversely, the market environment for that industry is unfavorable when the previous month's industry return is negative. A dummy variable (R_ind) representing the market condition is defined. When the market conditions are favorable, which means the industry return is positive, this variable is equal to 1, and 0 otherwise. The results are shown in Table 5, with the sample classified based on industrial market conditions. It concludes that GPR has a significantly positive influence on firm's idiosyncratic volatility when the market condition is favorable,

Table 5
Heterogeneity analysis based on different types of industrial market conditions.

Variables	Dependent variable: idiosyncratic volatility	
	Favorable	Unfavorable
	(1)	(2)
GPR	0.111***	−0.078***
	(7.77)	(−9.98)
Size	−0.035***	−0.028***
	(−9.74)	(−10.44)
ML	0.250***	0.230***
	(9.11)	(11.34)
PTBV	−0.003***	−0.002***
	(−5.53)	(−3.36)
Tangibility	−0.027	−0.028
	(−1.02)	(−1.39)
ROE	0.009	−0.043***
	(0.85)	(−5.35)
CPI	−0.968***	0.237***
	(−12.88)	(11.03)
GDP	−7.472***	0.176
	(−11.35)	(0.64)
IE	Yes	Yes
Constant	5.857***	−0.294***
	(16.26)	(−3.30)
Observations	12,038	13,135
R-squared	0.125	0.042

Notes: This table reports the regression results for the effects of geopolitical uncertainty on firms' risk-taking considering industrial market conditions. Variable definitions are reported in Table 1. The t-statistics are reported in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

Table 4
Baseline results.

Variables	Dependent variable: idiosyncratic volatility							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GPR	−0.089***	−0.063***	−0.062***	−0.060***	−0.061***	−0.063***	−0.070***	−0.092***
	(−21.25)	(−12.59)	(−12.18)	(−11.78)	(−11.81)	(−12.21)	(−12.54)	(−14.51)
Size		−0.014***	−0.017***	−0.021***	−0.022***	−0.021***	−0.026***	−0.029***
		(−8.97)	(−11.21)	(−13.78)	(−13.76)	(−13.09)	(−11.74)	(−12.66)
ML			0.173***	0.183***	0.184***	0.167***	0.192***	0.225***
			(12.63)	(11.56)	(11.58)	(10.29)	(11.01)	(12.24)
PTBV				−0.001**	−0.001**	−0.001***	−0.001***	−0.002***
				(−2.40)	(−2.42)	(−3.14)	(−3.54)	(−4.71)
Tangibility					−0.020	−0.019	−0.020	−0.020
					(−1.14)	(−1.08)	(−1.14)	(−1.15)
ROE						−0.021***	−0.019***	−0.020***
						(−3.30)	(−2.93)	(−3.09)
CPI							0.053***	0.198***
							(3.48)	(8.04)
GDP								1.737***
								(7.21)
IE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.291***	0.579***	0.623***	0.709***	0.734***	0.723***	0.586***	−0.087
	(126.03)	(17.88)	(18.98)	(21.40)	(18.37)	(17.96)	(10.29)	(−0.83)
Observations	26,111	23,364	22,793	22,506	22,506	22,506	22,506	22,506
R-squared	0.019	0.022	0.031	0.036	0.036	0.036	0.037	0.040

Notes: This table shows regression results for the effect of geopolitical uncertainty on firm-level idiosyncratic volatility. Variable definitions are explained in detail in Table 1. The t-statistics are reported in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

while a significantly negative influence under the unfavorable condition. One possible explanation is that when a firm is in a good industrial market environment, it has better growth prospects and is willing to invest more to capture growth opportunities. Therefore, these firms may bear more idiosyncratic volatilities. However, when the industrial market environment tends to be unfavorable, firms are likely to be more cautious when making investment decisions.

We also find that there exists a relationship between corporate risk-taking and ownership. Risk-taking behavior is influenced by the purpose of the investing, for example, state-owned firms generally undertake more social responsibilities, thus preferring to control idiosyncratic risks (Boubakri, Cosset, and Saffar, 2013). Besides, it may also exacerbate the agency problem. Managers may avoid risk-taking to protect private benefits when there exists a divergence between shareholder control rights and real cash flow rights, which can influence the motivations of corporate risk-taking (Su, Li, & Wan, 2017). Therefore, taking firm ownership into account, we divide firms into state-owned enterprises (SOEs) and non-state-owned firms (N-SOEs) based on ownership type and thus generate a dummy variable (State) which equals 1 when the largest share of the firm belongs to the state, and 0 otherwise. Table 6 shows the basic regression results that GPR has a significantly negative impact on idiosyncratic risks in both SOEs and N-SOEs at 1% level. However, the absolute value of SOEs (−0.192) is greater, which indicates idiosyncratic volatility of state-owned firms tend to decrease more when facing increasing geopolitical uncertainties. It can be explained that diversified firms are inclined to avoid risks more willingly when faced with increasing turbulence since a group of shareholders will act from a diversified position which causes the absolute coefficient to be higher (Eisenmann, 2002). State ownership may encourage excess risk-taking, which is a consequence brought by double agency problem. Managers are willing to take more risks to achieve their reputation and disguise true management style for the sake of career concerns (Citci and Inci, 2016). Besides, the representatives of SOEs will also undertake more risks for both economic and political incentives (Ho et al., 2021).

Table 6
Heterogeneity analysis based on different types of ownership.

Variables	Dependent variable: idiosyncratic volatility	
	N-SOEs	SOEs
	(1)	(2)
GPR	−0.092***	−0.136***
	(−9.78)	(−19.17)
Size	−0.031***	−0.037***
	(−9.53)	(−12.53)
ML	0.242***	0.272***
	(8.64)	(12.45)
PTBV	−0.003***	−0.002***
	(−4.98)	(−3.03)
Tangibility	−0.030	0.010
	(−1.36)	(0.39)
ROE	−0.038***	−0.001
	(−4.07)	(−0.17)
CPI	0.193***	0.415***
	(4.96)	(18.86)
GDP	0.327	4.289***
	(0.87)	(17.11)
IE	Yes	Yes
Constant	0.022	−1.066***
	(0.13)	(−11.51)
Observations	11,767	13,406
R-squared	0.041	0.063
Chow Test	20.94	
DIFF	0.044***	

Notes: This table reports the regression results for the effects of geopolitical uncertainty on firms' risk-taking considering ownership type. Variable definitions are reported in Table 1. The t-statistics are reported in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

Therefore, compared with SOEs, N-SOEs tend to bear fewer risks.

To sum up, the negative impact of GPR on firms' idiosyncratic volatility varies according to industrial market conditions and ownership types. Among these, firms under unfavorable industrial market conditions, no matter owned by states or not, all provide empirical support for Hypothesis 1.

4.3. Channel analysis

The ownership concentration matters when the firms are faced with risks (John, Litov, and Yeung, 2008; Tran and Le, 2020). Ownership concentration affects the firm's performance through its influence on firm's management to protect investors' interest. Tran and Le (2020) speculates there existed a relationship between ownership concentration and information disclosure, thus affecting the decision process. We speculate that, as ownership concentration increases, decision-making efficiency increases, and the response to changes on uncertainty speeds up, therefore the impact of geopolitical uncertainty rises. To examine this, we employ the Herfindahl index, which is calculated as the sum of squares of the firm's top five (or ten) major shareholders' shareholdings (shown as H_5 and H_10, respectively) and interact them with GPR. The Herfindahl Index highlights the disparity in shareholder ownerships. The closer the index is to 0, the smaller the difference in the shareholdings of the top five (or ten) shareholders, indicating a more dispersed ownership of the company. Our regression results are shown in Table 7.

$$Risk_{i,t} = \alpha_0 + \alpha_1 GPR_t + \alpha_2 HHI_{t-1} + \alpha_3 GPR_t * HHI_{t-1} + \sum \beta Controls_{i,t-1} + Ind_i + \varepsilon_{i,t} \quad (2)$$

In Table 7, column (1) shows the estimation results based on variable H_5, and column (2) shows the results based on variable H_10. The coefficients of interaction terms between ownership concentration and geopolitical uncertainty (H_5×GPR, H_10×GPR) are significant and negative, which indicate that firms with higher ownership concentration tend to suffer less idiosyncratic volatility from geopolitical uncertainties. That is, the impact of GPR on the heterogeneous volatility of firms is greater when the HHI is high. When the market has a high concentration of suppliers (high HHI), the impact of geopolitical risk changes on companies is greater. Because companies are dependent on a limited number of suppliers, they face more severe impacts when major suppliers are restricted. These results correspond to those of Yin and Lu (2022), who consider that shareholders' reactions to new uncertainty information are positively related to the increasing of firm ownership concentration. Our study demonstrates the impact of geopolitical uncertainty on corporate risk-taking while considering the factors that influence the risk decisions influenced by owners.

Competition intensity within an industry is a crucial factor affecting firms' willingness to take risks. Firms with less competitive intensity are usually more willing to take risks since they have a better ability to pass on the loss to customers through price changing (Gupta and Krishnamurti, 2018). Raith (2003) points out that there exists a positive relationship between competition intensity and firms' risk-taking. In an industry which is highly competitive, firms are willing to make more investments to seek more opportunities for survival and growth. As a result, such firms are more likely to pursue higher profits when faced with geopolitical uncertainties. To study how GPR influences firms' idiosyncratic volatility in different competitive industrial conditions, the Herfindahl–Hirschman index (HHI) is used to measure the level of the competition within an industry as follows:

$$HHI_j = sum\left[\left(X_{i,j}/X_j\right)^2\right] \quad (3)$$

where $X_{i,j}$ is the total assets of firm i in industry j, and X_j is the total assets of industry j. We employ the HHI on total assets as an indicator of

Table 7
Channel analysis.

Variables	Dependent variable: idiosyncratic volatility			
	Ownership concentration		Industry Competition	Operating leverage
	(1)	(2)	(3)	(4)
GPR	−0.127***	−0.128***	−0.146***	−0.069***
	(−23.03)	(−23.16)	(−17.42)	(−8.13)
H_5	−0.022			
	(−1.63)			
H_10		−0.038***		
		(−2.90)		
HHI_H			−0.039***	
			(−4.93)	
HHI_M			0.009	
			(0.86)	
OL_L				0.077***
				(11.76)
OL_M				0.045***
				(7.14)
H_5×GPR	−0.063***			
	(−2.78)			
H_10×GPR		−0.060***		
		(−2.71)		
HHI_H×GPR			0.042***	
			(4.41)	
HHI_M×GPR			−0.010	
			(−0.56)	
OL_L×GPR				−0.091***
				(−8.52)
OL_M×GPR				−0.064***
				(−5.95)
Size	−0.033***	−0.034***	−0.032***	−0.031***
	(−15.61)	(−15.80)	(−15.43)	(−14.88)
ML	0.254***	0.261***	0.250***	0.252***
	(15.27)	(15.62)	(15.09)	(15.29)
PTBV	−0.002***	−0.002***	−0.002***	−0.003***
	(−6.00)	(−6.13)	(−5.96)	(−6.91)
Tangibility	−0.008	−0.005	−0.021	−0.025
	(−0.49)	(−0.28)	(−1.26)	(−1.55)
ROE	−0.018***	−0.018***	−0.021***	−0.029***
	(−2.90)	(−2.87)	(−3.34)	(−4.59)
CPI	0.337***	0.333***	0.336***	0.318***
	(18.62)	(18.35)	(18.62)	(17.64)
GDP	2.764***	2.725***	2.793***	2.680***
	(13.63)	(13.46)	(13.75)	(13.25)
IE	Yes	Yes	Yes	Yes
Constant	−0.701***	−0.669***	−0.681***	−0.684***
	(−9.22)	(−8.75)	(−8.82)	(−9.08)
Observations	25,172	25,165	25,173	25,173
R-squared	0.048	0.049	0.046	0.052

Notes: This table reports the regression results of channel analysis. Column (1) and (2) shows the effects of geopolitical uncertainty on firms' risk-taking considering ownership type. Column (3) and (4) show the effects of geopolitical uncertainty on firms' risk-taking considering industry competition and operating leverage, respectively. See variable definitions in Table 1. The t-statistics are reported in parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

industry competition because it can better reflect the relative size of the firms (Graham, 2000). We order the HHI values and obtain the highest, middle and lowest one-third HHI values. In the analysis, HHI_H equals 1 when the firm belongs to the high third, and 0 otherwise. HHI_M equals 1 when the firm belongs to the middle third, and 0 otherwise. We run the following regression model with fixed effects:

$$Risk_{i,t} = \alpha_0 + \alpha_1 GPR_t + \alpha_2 GPR_t{}^{*} HHI_{H_{t-1}} + \alpha_3 GPR_t{}^{*} HHI_{M_{t-1}} + \alpha_4 HHI\_H_{t-1} + \alpha_5 HHI\_M_{t-1} + \sum \beta Controls_{i,t-1} + Ind_i + \varepsilon_{i,t} \quad (4)$$

Table 7 presents the results. We focus on the coefficients of the interaction terms. As the interaction term (HHI_H×GPR) shows, GPR significantly affects the idiosyncratic volatility when the firm is faced with a highly competitive industry. It is noticeable that the coefficient of interaction term is 0.042 and statistically significant, which indicates that a high level of competition interacts with GPR to increase idiosyncratic volatility. One possible reason is that, as markets become more competitive, principals will offer managers more compensation as an incentive, which is a more effective form of corporate governance than the supervisory effects of the market and institutional owners of corporate control. As a result, managers will take more risks in the search for profits (Giroud & Mueller, 2010). At the same time, increased geopolitical uncertainty makes firm idiosyncratic volatility more destabilizing. Managers' willingness to take risks is stimulated by an increasingly competitive market and external discipline due to strong corporate governance (Sheikh, 2019). Our results are inconsistent with Gupta and Krishnamurti (2018), who show that firms' risk-taking is more likely to be influenced by the macroeconomic conditions rather than by the intensity of industrial competition. In fact, our findings are consistent with the literature supporting the hypothesis of competition as a substitute for corporate governance mechanism (Ammann, Oesch, and Schmid, 2013).

A company's financial condition also plays a role in the impact of geopolitical uncertainty on corporate risk-taking. Operating leverage is positively associated with profitability, which may stimulate managers to take more risks in order to gain more profits. We further investigate whether operating leverage will have an impact on how GPR affects firms' risk-taking according to Yin and Lu (2022). We use operating leverage (OL) as an indicator to classify our sample firms into three categories. Yearly operating leverage is calculated as follows:

$$OL = \frac{EBIT + Fixed\ Cost}{EBIT} \quad (5)$$

where earnings before interest and taxes (EBIT) equals revenue minus expenses excluding tax and interest, and the fixed cost includes depreciation, selling and administration costs. We also sort the operating leverage in order. There are three OL dummies defined according to whether a firm has a high operating leverage, medium operating leverage, or low operating leverage. The two dummy variables added will capture the effect of low operating leverage and medium leverage on the risk-taking. In our analysis, OL_L equals 1 when the firm belongs to the low third, and 0 otherwise. OL_M equals 1 when the firm belongs to the middle third, and 0 otherwise. We run the following regression model with individual-fixed effects:

$$Risk_{i,t} = \alpha_0 + \alpha_1 GPR_t + \alpha_2 GPR_t{}^{*} OL\_L_{t-1} + \alpha_3 GPR_t{}^{*} OL\_M_{t-1} + \alpha_4 OL\_L_{t-1} + \alpha_5 OL\_M_{t-1} + Ind_i + \sum \beta Controls_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

Results are shown in Table 7. The impact of geopolitical uncertainty on corporate risk-taking is consistent with the results of our previous analysis. There still remains a statistically significant negative relationship between the GPR and idiosyncratic volatility (−0.069). The interaction term between operating leverage and geopolitical uncertainty are both negative and significant. According to the interaction results, the firms which have the lowest operating leverage tend to take fewer risks compared to others. This suggests that when firms face higher geopolitical risk, highly leveraged firms may face greater idiosyncratic risk relative to less leveraged firms. Our results differ from the findings of Yin and Lu (2022), who argue that firms with low operating leverage already take fewer risks and are therefore willing to take new ones. Our study argues that operating leverage is a reflection of the risk preferences of corporate managers, and that those managers of firms with low operating leverage tend to take less risk in all aspects.

4.4. Considering industry fixed effects

To verify the reliability of the results of the benchmark regression model, a series of robustness tests were conducted. Although we use

individual fixed effects in this study, given the relevant literature (Serfling, 2014), we also use industry fixed effects to test the stability of the effect of GPR. We run the regression with the individual fixed effect on the sample according to the first-level classification of the industry code from CSMAR. The results are shown in Table 8. GPR still has a significantly negative effect on IVOL when the industry-fixed model is used. The real options channel is still taking on the risk of geopolitical uncertainty affecting firms, and firms exposed to geopolitical uncertainty will experience less idiosyncratic volatility.

4.5. Shorter estimation windows

We exclude 2003 and 2004 from the regression analysis and Table 8 presents the results. Due to the Chinese Split Share Structure Reform in 2005, there were some data inconsistencies and missing values in the financial statement data of Chinese A-share listed companies in the early years of our sample before 2005. By excluding these years from the robustness analysis, we can ensure the reliability and consistency of our results and avoid potential biases that may arise from data quality issues. After excluding 2003 and 2004, the results are still consistent with our previous analysis. This does not affect our empirical results, which are robust.

4.6. Alternative measures of the GPR

Caldara and Iacoviello (2022) similarly constructed the world GPR index. We refer to their study for robustness checks using the global GPR index instead of the Chinese GPR index. Table 8 documents the empirical results of our regressions. Our results show that there is still a strong negative correlation between GPR_global and the heterogeneity risk of listed companies, which indicates that our results are robust.

4.7. Employing an instrumental variable

GPR can affect firms in a variety of ways, and potential endogenous problems can arise as a result. We use the average GPR of other Asian countries as an instrumental variable this time to mitigate the effect of endogeneity in the two-stage least square (2SLS) model regression. Table 8 shows the results. The estimation results of the first stage are presented in column (5). The coefficient of the instrumental variable GPR2 is significant at the 1% level, passing the weak instrument test. The estimation results of the second stage are presented in column (6). The coefficient of the estimated GPR remains significantly negative after the introduction of instrumental variables, demonstrating the reliability and robustness of our benchmark regression results.

5. Further analysis

In the regressions of the baseline model, we find a significantly negative correlation between GPR and idiosyncratic volatilities. External events can influence firms' investment decisions and thus risk-taking, and GPR can complicate this process. Meanwhile, we may have overlooked variables that affect both GPR and firm risk-taking, which may affect the robustness of our conclusions. Therefore, in order to further investigate the impact of changes in external political events on firm risk-taking, we treat the South China Sea Dispute as an exogenous shock in a difference-in-difference (DID) framework and capture the impact received by firm risk-taking through changes in idiosyncratic volatility.

The South China Sea extends from the Straits of Singapore and Malacca in the southwest to the Strait of Taiwan in the northeast. Being an important shipping lane and trade route, it is of great importance to the vast majority of the world's countries. According to U.S Energy Information Administration (EIA) (2019),[2] the South China Sea is presumed to contain approximately 11 billion barrels of oil and 190 trillion cubic feet of natural gas from discovered and probable reserves. Nearly 14 million barrels of crude oil are shipped through the South China Sea each day, accounting for one-third of global oil shipments. In April 2012, the Philippines illegally detained Chinese fishermen in the waters near Huangyan Island, triggering a maritime confrontation in the South China Sea.

We use the DID approach to determine the impact of GPR on firms' idiosyncratic volatility before and after the dispute. The impact of the South China Sea dispute on firm risk-taking is estimated by the difference in idiosyncratic volatilities between the treatment and control groups. Following the previous literature (Ren et al., 2022; Yin and Lu, 2022), firms are categorized into low, medium and high based on their idiosyncratic volatility. We treat companies with low idiosyncratic volatility as the treatment group, and those with high idiosyncratic volatility as the control group. We run the following regression model with individual-fixed effects:

$$Risk_{i,t} = \beta_0 + \beta_1 Treat_{it} + \beta_2 Time_{it} + \beta_3 Treat_{it} * Time_{it} + \beta_4 GPR_t + Ind_i + \sum \beta Controls_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

where i and t represent the firm and year, respectively. $Time_{it}$ is an event dummy variable equal to 1 for observations occurring in 2012 or later, and 0 otherwise. $Treat_{it}$ is an event dummy variable which represents external shocks from the dispute. The impact of GPR on firms' risk-taking is captured by the DID estimator $Treat_{it}$ * $Time_{it}$ as well as individual-fixed effects.

The coefficient of Treat is significantly negative at the 1% level, suggesting that GPR destructs firms' risk-taking. We should focus on DID, an interaction term between Treat and Time, which measures the impact of GPR on Chinese firms' risk-taking following the 2012 South China Sea dispute. Based on the results in columns (1) and (2), we can find that the coefficient of DID is significantly positive at the 5% level. This result suggests that firms' idiosyncratic risk increased when the 2012 South China Sea dispute occurred This result is inconsistent with our empirical result, and we argue that the reason is unlike other geopolitical events, the South China Sea crisis has a greater impact on the idiosyncratic risk of coastal trading firms or energy firms compared to inland firms. Besides, Yu et al. (2021) point out that firms in energy sector are influenced significantly through investment by the South China Sea Dispute. Some literature provide support on the positive relationship between investment and firm risk-taking. Serfling (2014) notes that some CEOs reduce the possible risk-taking of their firms by choosing less risky investments. Lian, Ma, and Wang (2019) find that when interest rates are low, people tend to choose risky investments, which leads to institutional and firm face higher risks. When the impact of geopolitical risk is wider, the risk from GPR is counted as a systemic risk rather than an idiosyncratic risk, so the firm's IVOL appears to be decreasing while the firm's total risk is increasing. Only when the scope of GPR is limited, the risks associated with GPR are counted as firm idiosyncratic risks, resulting in an increase in IVOL for some specific firms. We then perform a parallel trend test, which is shown in Fig. 2. The covered short straight line perpendicular to the horizontal axis is the 95% confidence interval of the regression coefficient of each period and the dummy variable of the Treat group. We can see from the graph that the coefficients of Before2 and Before1 are not statistically significant. However, the coefficients are highly statistically significant in 2012 following the external event shock and in the following two years. It suggests that the impact of the South China Sea dispute on risk-taking for businesses is ongoing, with the impact of geopolitical uncertainty

[2] EIA, 2019. South China Sea. https://www.eia.gov/international/analysis/regions-of-interest/South_China_Sea (accessed 16 October 2022).

Table 8
Robustness checks.

Variables		Dependent variable: idiosyncratic volatility				
				OLS	2SLS	
				IVOL	GPR	IVOL
	(1)	(2)	(3)	(4)	(5)	(6)
GPR2					2.710***	
					(214.08)	
GPR	−0.098***	−0.026***		−0.121***		−0.208***
	(−19.62)	(−3.98)		(−22.10)		(−32.56)
GPR_global			−0.107***			
			(−13.12)			
Size	−0.016***	−0.024***	−0.025***	−0.032***	−0.0265***	−0.0306***
	(−17.70)	(−9.55)	(−10.66)	(−15.09)	(−16.78)	(−14.52)
ML	0.109***	0.162***	0.156***	0.247***	0.422***	0.276***
	(10.89)	(8.62)	(8.98)	(14.93)	(35.70)	(17.11)
PTBV	−0.000	−0.002***	−0.001***	−0.002***	−0.00638***	−0.00308***
	(−0.38)	(−4.38)	(−2.63)	(−5.87)	(−24.99)	(−8.11)
Tangibility	−0.019*	−0.021	−0.006	−0.020	−0.0469***	−0.0371*
	(−1.88)	(−1.16)	(−0.33)	(−1.25)	(−3.84)	(−2,28)
ROE	−0.025***	−0.022***	−0.019***	−0.020***	−0.00706	−0.0261***
	(−4.25)	(−3.20)	(−3.11)	(−3.21)	(−1.68)	(−4.12)
CPI	0.214***	−0.265***	−0.023	0.334***	1.124***	0.468***
	(14.72)	(−9.01)	(−1.17)	(18.46)	(103.67)	(24.53)
GDP	1.962***	−1.554***	0.112	2.793***	2.969***	3.928***
	(9.61)	(−6.08)	(0.52)	(13.76)	(29.13)	(18.07)
IE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.436***	2.116***	0.972***			
	(−6.29)	(16.66)	(11.72)			
Observations	25,173	22,779	22,506	25,179	24,965	24,965
R-squared	0.040	0.072	0.037	0.0289	0.0335	0.0335

Notes: This table reports the regression results of the robustness checks. Column (1) shows the effects of geopolitical uncertainty on firms' risk-taking with an individual-fixed and industry fixed model. Column (2) reports the results of robustness check with the sample period from 2005 to 2019. Column (3) reports the results of robustness check when using the global GPR indicator as an alternative measure of GPR in China. Column (4)(5)(6) reports the results of robustness check with the sample period from 2005 to 2019. Variable definitions are reported in Table 1. The t-statistics are reported in the parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

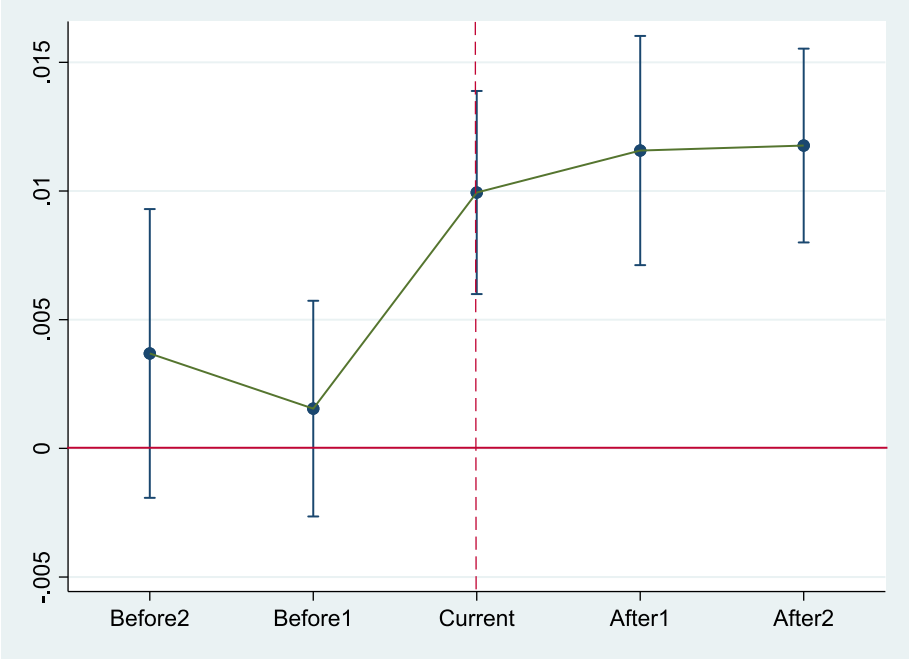

Fig. 2. Idiosyncratic volatility of firms in treatment group from 2010 and 2015 (the South China Sea dispute happened in 2012).

increasing over the next two years.

Next, to further balance the observed covariate differences between the treatment and control groups, we re-estimate the DID using a propensity-score-matched (PSM) sample. Fig. 3 shows the balance of data before and after matching at the same time. The standardized deviations for most variables narrowed after matching, indicating good matching quality. We match all control variables specified in the baseline model on a one-to-one basis without substitution. The regression

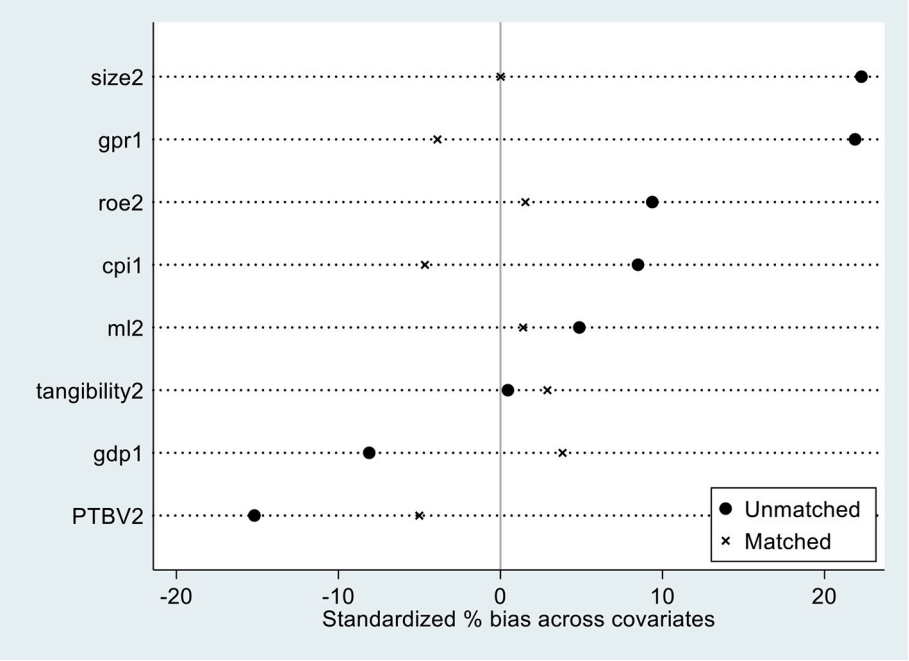

Fig. 3. The standardized deviations across covariates.

Table 9
The effect of the South China Sea Dispute in 2012.

Variables	Dependent variable: idiosyncratic volatility			
	DID		PSM + DID	
	(1)	(2)	(3)	(4)
$Time_{it}$	−0.016***	−0.016***	−0.016***	−0.016***
	(−8.19)	(−4.50)	(−8.18)	(−4.51)
$Treat_{it}$	−0.186***	−0.175***	−0.186***	−0.175***
	(−105.47)	(−100.54)	(−105.43)	(−100.53)
$Treat_{it}$ * $Treat_{it}$	0.011***	0.005**	0.011***	0.005**
	(4.80)	(2.08)	(4.79)	(2.07)
GPR		−0.055***		−0.055***
		(−13.59)		(−13.58)
Size		−0.022***		−0.022***
		(−13.64)		(−13.65)
ML		0.169***		0.169***
		(13.56)		(13.53)
PTBV		−0.002***		−0.002***
		(−6.86)		(−6.88)
Tangibility		0.003		0.003
		(0.20)		(0.21)
ROE		−0.013***		−0.013***
		(−2.77)		(−2.77)
CPI		0.221***		0.221***
		(15.47)		(15.48)
GDP		1.002***		1.000***
		(5.08)		(5.06)
IE	Yes	Yes	Yes	Yes
Constant	0.312***	−0.300***	0.312***	−0.300***
	(250.45)	(−5.24)	(250.32)	(−5.25)
Observations	26,111	25,179	26,105	25,173
R-squared	0.407	0.419	0.407	0.419

Notes: This table reports the results of the difference-in-differences (DID) approach surrounding the occurrence of the South China Sea dispute. All variables are defined in detail in Table 1. The t-statistics are in the parentheses. The symbols ***, **, and * indicate significance at the 1%, 5%, and 10% confidence levels, respectively.

results are presented in columns (3) and (4) of Table 9. The coefficient of DID remains positive at the 5% level. The regression results are consistent with those of the general DID estimates, confirming the reliability of our DID benchmark regression results.

6. Conclusions

In this study, we examine the impact of geopolitical risk on Chinese firms' idiosyncratic volatility. Data on Chinese A-share listed companies from 2003 to 2019 are chosen as the sample for the benchmark regression, and we found that GPR significantly reduce firm idiosyncratic risk. A series of robustness tests confirm this finding. The results of the DID model estimation including geopolitical shock also complement the findings.

The results also show that GPR has different effects on the risk-taking of firms in different market conditions and with different ownership. Firms in unfavorable market conditions tend to reduce risk-taking due to restricted scope for growth. When compared with SOEs, non-state-owned firms tend to bear fewer risks because SOEs' managers will take risks to achieve their goals (Ho, Phung and Nguyen, 2020). We further examine the impact of a firm's ownership concentration, competition intensity and operating leverage on the relationship between geopolitical risk and firms' idiosyncratic volatility. The findings confirm the basic conclusion that geopolitical uncertainty weakens firm risk-taking, but suggest that these factors interact differently with oil uncertainty in different contexts to influence firm risk-taking.

This study also provides a new perspective for exploring the relationship between geopolitical uncertainty and the level of microeconomics. For an emerging country like China, it is particularly important to be aware of the impact of geopolitical risks on the economy (especially energy supply) (Yu et al., 2021). Geopolitical risk does not necessarily represent downside risk, and under certain conditions it can provide growth opportunities for companies. If firm managers can understand the impact of geopolitical risk on idiosyncratic volatility, they can appropriately use geopolitics to promote firm growth. Our empirical research provides answers to facilitate this understanding. Our study not only extends the literature on the factors that influence corporate risk-taking, but also highlights the important role of geopolitical information. These findings are important for fully understanding the relationship between geopolitical risks and corporate risk-taking and the mechanisms required for firms to respond reasonably to external political events in order to avoid being unduly influenced.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

This work was supported by the Natural Science Fund of Hunan Province (2022JJ40647).

References

Abdel-Latif, H., & El-Gamal, M. (2020). Financial liquidity, geopolitics, and oil prices. *Energy Economics, 87*, Article 104482.
Abel, A., & Eberly, J. (1994). A unified model of investment under uncertainty. *American Economic Review, 84*, 1369–1384.
Alqahtani, A., Bouri, E., & Vo, X. V. (2020). Predictability of GCC stock returns: The role of geopolitical risk and crude oil returns. *Economic Analysis and Policy, 68*, 239–249.
Ammann, M., Oesch, D., & Schmid, M. M. (2013). Product market competition, corporate governance, and firm value: Evidence from the EU area. *European Financial Management, 19*(3), 452–469.
Antonakakis, N., Gupta, R., Kollias, C., & Papadamou, S. (2017). Geopolitical risks and the oil-stock nexus over 1899–2016. *Finance Research Letters, 23*, 165–173.
Apergis, E., & Apergis, N. (2016). The 11/13 Paris terrorist attacks and stock prices: The case of the international defense industry. *Finance Research Letters, 17*, 186–192.
Armstrong, C. S., & Vashishtha, R. (2012). Executive stock options, differential risk-taking incentives, and firm value. *Journal of Financial Economics, 104*(1), 70–88.
Balcilar, M., Bonato, M., Demirer, R., & Gupta, R. (2018). Geopolitical risks and stock market dynamics of the BRICS. *Economic Systems, 42*(2), 295–306.
Banerjee, R., & Gupta, K. (2017). The effects of environmental sustainability and R&D on corporate risk-taking: International evidence. *Energy Economics, 65*, 1–15.
Bekaert, G., Hodrick, R. J., & Zhang, X. (2012). Aggregate idiosyncratic volatility. *Journal of Financial and Quantitative Analysis, 47*(6), 1155–1185.
Bernanke, B. S. (1983). Irreversibility, uncertainty, and cyclical investment. *The Quarterly Journal of Economics, 98*(1), 85–106.
Block, J. H. (2012). R&D investments in family and founder firms: An agency perspective. *Journal of Business Venturing, 27*(2), 248–265.
Bolton, P., Chen, H., & Wang, N. (2013). Market timing, investment, and risk management. *Journal of Financial Economics, 109*(1), 40–62.
Boubakri, N., Cosset, J.-C., & Saffar, W. (2013). The role of state and foreign owners in corporate risk-taking: Evidence from privatization. *Journal of Financial Economics, 108*(3), 641–658.
Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review, 112*(4), 1194–1225.
Cao, C., Simin, T., & Zhao, J. (2006). Can growth options explain the trend in idiosyncratic risk? *The Review of Financial Studies, 21*(6), 2599–2633.
Cheng, C. H. J., & Chiu, C.-W. (2018). How important are global geopolitical risks to emerging countries? *International Economics, 156*, 305–325.
Citci, S. H., & Inci, E. (2016). The masquerade ball of the CEOs and the mask of excessive risk. *Economic Modelling, 58*, 383–393.
Corbet, S., Gurdgiev, C., & Meegan, A. (2018). Long-term stock market volatility and the influence of terrorist attacks in Europe. *The Quarterly Review of Economics and Finance, 68*, 118–131.
Ding, S., Jia, C., Qu, B., & Wu, Z. (2015). Corporate risk-taking: Exploring the effects of government affiliation and executives' incentives. *Journal of Business Research, 68*(6), 1196–1204.
Eisenmann, T. R. (2002). The effects of CEO equity ownership and firm diversification on risk taking. *Strategic Management Journal, 23*(6), 513–534.
Frank, M. Z., & Goyal, V. K. (2004). The effect of market conditions on capital structure adjustment. *Finance Research Letters, 1*(1), 47–55.
Giroud, X., & Mueller, H. M. (2010). Does corporate governance latter in competitive industries? *Journal of Financial Economics, 95*(3), 312–331.
Gkillas, K., Gupta, R., & Pierdzioch, C. (2020). Forecasting realized gold volatility: Is there a role of geopolitical risks? *Finance Research Letters, 35*, Article 101280.
Graham, J. R. (2000). How big are the tax benefits of debt? *The Journal of Finance, 55*(5), 1901–1941.
Gupta, K., & Krishnamurti, C. (2018). Do macroeconomic conditions and oil prices influence corporate risk-taking? *Journal of Corporate Finance, 53*, 65–86.
He, F., Qin, S., Liu, Y., & Wu, J. (2022). CSR and idiosyncratic risk: Evidence from ESG information disclosure. *Finance Research Letters, 49*, Article 102936.
Ho, T., Phung, D. N., & Nguyen, Y. N. (2021). State ownership and corporate risk-taking: Empirical evidence in Vietnam. *Australian Economic Papers, 60*(3), 466–481.
John, K., Litov, L., & Yeung, B. (2008). Corporate governance and risk-taking. *The Journal of Finance, 63*(4), 1679–1728.
Khoo, J., & Cheung, A. (2022). Managerial ability and debt maturity. *Journal of Contemporary Accounting & Economics, 18*(1), Article 100295.
Kim, K., Patro, S., & Pereira, R. (2017). Option incentives, leverage, and risk-taking. *Journal of Corporate Finance, 43*, 1–18.
Koirala, S., Marshall, A., Neupane, S., & Thapa, C. (2020). Corporate governance reform and risk-taking: Evidence from a quasi-natural experiment in an emerging market. *Journal of Corporate Finance, 61*.
Le, A.-T., & Tran, T. P. (2021). Does geopolitical risk matter for corporate investment? Evidence from emerging countries in Asia. *Journal of Multinational Financial Management, 62*, Article 100703.
Lee, C.-C., & Lee, C.-C. (2020). Insurance activity, real output, and geopolitical risk: Fresh evidence from BRICS. *Economic Modelling, 92*, 207–215.
Lee, C.-C., & Wang, C.-W. (2021). Firms' cash reserve, financial constraint, and geopolitical risk. *Pacific-Basin Finance Journal, 65*, Article 101480.
Lian, C., Ma, Y., & Wang, C. (2019). Low interest rates and risk-taking: Evidence from individual investment decisions. *The Review of Financial Studies, 32*, 2107–2148.
Lu, Z., Gozgor, G., Huang, M., & Lau, C. K. (2020). The impact of geopolitical risks on financial development: Evidence from emerging markets. *Journal of Competitiveness, 12*, 93–107.
Magnanelli, B. S., & Izzo, M. F. (2017). Corporate social performance and cost of debt: The relationship. *Social Responsibility Journal, 13*(2), 250–265.
Malagon, J., Moreno, D., & Rodríguez, R. (2015). The idiosyncratic volatility anomaly: Corporate investment or investor mispricing? *Journal of Banking & Finance, 60*, 224–238.
Oanh, H. K., & Hoang, K. (2021). The bright side of geopolitical risk: Evidence from Chinese firms. *Journal of Financial Economic Policy, 13*(3), 353–370.
Panousi, V., & Papanikolaou, D. (2012). Investment, idiosyncratic risk, and ownership. *The Journal of Finance, 67*(3), 1113–1148.
Qin, Y., Hong, K., Chen, J., & Zhang, Z. (2020). Asymmetric effects of geopolitical risks on energy returns and volatility under different market conditions. *Energy Economics, 90*, Article 104851.
Raith, M. (2003). Competition, risk, and managerial incentives. *American Economic Review, 93*(4), 1425–1436.
Ren, X., Zhang, X., Yan, C., & Gozgor, G. (2022). Climate policy uncertainty and firm-level total factor productivity: Evidence from China. *Energy Economics, 113*, Article 106209.
Serfling, M. A. (2014). CEO age and the riskiness of corporate policies. *Journal of Corporate Finance, 25*, 251–273.
Sheikh, S. (2019). CEO power and corporate risk: The impact of market competition and corporate governance. *Corporate Governance: An International Review, 27*(5), 358–377.
Smales, L. A. (2021). Geopolitical risk and volatility spillovers in oil and stock markets. *Quarterly Review of Economics and Finance, 80*, 358–366.
Su, K., Li, L., & Wan, R. (2017). Ultimate ownership, risk-taking and firm value: evidence from China. *Asia Pacific Business Review, 23*(1), 10–26.
Tran, N., & Le, C. (2020). Ownership concentration, corporate risk-taking and performance: Evidence from Vietnamese listed firms. *Cogent Economics & Finance, 8*.
Yin, L., & Lu, M. (2022). Oil uncertainty and firms' risk-taking. *Energy Economics, 108*, Article 105922.
Yu, Z., Xiao, Y., & Li, J. (2021). How does geopolitical uncertainty affect Chinese overseas investment in the energy sector? Evidence from the South China Sea Dispute. *Energy Economics, 100*, Article 105361.