Essays on Corporate Risk

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To my grandmother Junxiang Yang

Abstract

There is widespread recognition that corporate risk can substantially affect firms' operations. However, one challenging problem, which still requires investigation, is how firms assess their risk profiles. The main objective of this thesis is to systematically assess corporate risk profiles, with comprehensive attention to the effectiveness of risk management schemes, the identification of the firm characteristic-based internalised transmission mechanism of macroeconomic uncertainty, and the evaluation of the internalized macroeconomic uncertainty from the perspective of corporate investment. Motivated by exploring the role of corporate risks in firms' operations, this thesis carries out three independent but related studies focusing on the Chinese market to contribute to this strand of literature by discussing the effectiveness of risk hedging strategy by financial derivatives, exploring the transmission mechanism of uncertainty exposure, and investigating the investment efficiency of firms with different exposures under different periods of uncertainty.

The first empirical study investigates the factors influencing firms' hedging decisions and the impact of hedging on firm performance. The results indicates that larger firms with more operational cash flow, less tax shielding, higher R&D investment level, and higher possibility of bankruptcy are more likely to use financial derivatives to hedge firm risks, while the firms' ownership structure does not play a significant role in the process. The study also documents that, in general, using derivatives negatively affects the firms' performance in the Chinese market, and such effect shows no difference between the state-owned and non-state-owned firms. After separating the outperforming firms with the underperforming firms, the study further finds that the negative effect of derivatives on firm performance only exists among underperforming firms. This suggests that while poorly performing firms are more likely to

invest in financial derivatives, such a decision typically exacerbates rather than alleviates poor performance.

The second study examines the role of corporate natures under economic policy uncertainty. Through introducing Bali, Brown, and Tang (2017)'s firm-level economic policy uncertainty exposures (EPU exposure), this study finds that EPU exposure is positively related to the proportion of state ownership. Moreover, debt financing serves as the channel through which state ownership exposes firms to economic policy uncertainty (EPU). Specifically, a higher percentage of state ownership results in higher leverage which, in turn, increases EPU exposure.

After exploring the firms' EPU exposure as well as the underlying mechanism, the third essay presents investment strategy from the perspectives of risk and corporate investment efficiency to empirically contribute to the epistemology on the controversy between risk and return. This essay finds EPU and a firm's EPU exposure have inhibitory effects on a firm's investment efficiency, with the effect of EPU exposure being exacerbated in a volatile market year. When the sample is split into four groups by EPU exposure and EPU, investment efficiency in higher EPU exposed firms presents a significant bifurcation, with the highest investment efficiency in lower EPU times and the lowest in higher EPU times, whereas there is no significant difference in lower EPU exposed firms. Consistent with the perspective of Fletcher (2000), this essay suggests investing in higher EPU exposed firms in tranquil market years and in lower EPU exposed firms in turbulent times.

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This PhD journey has not only enabled me to achieve my academic goals but has also brought about a significant transformation in my outlook towards life. This journey has shaped my philosophy of life and has opened up new avenues of thinking, which have had a profound impact on my personal and professional growth. The knowledge and experience gained during this journey have filled me with hope and optimism for the future, and I am grateful for this newfound sense of purpose and direction. The lessons learned during this PhD journey will stay with me for a lifetime. I would like to take this opportunity to express my heartfelt gratitude to everyone who has supported me throughout my PhD journey.

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Chapter 1. Introduction

Corporate risk refers to the probability of costly lower-tail outcomes, which affects the value of assets and liabilities of firms (Merna & Al-Thani, 2008). Over the past few decades, the economic rationale for corporate risk, which has a crucial influence on corporate risk-taking behaviour and risk management, has been under the microscope (Merna & Al-Thani, 2008; Sitkin & Pablo, 1992). Although the risk is inherent in every business operation, there is still much to learn about the mechanism of corporate risk and the way firms govern their risk. The focus of this thesis is to assess the effectiveness of risk management, to explore the identification the channel of exposure transmission, and assessment of exposure impact.

Scholars have acknowledged that understanding of the risks of corporations and implementing appropriate risk management strategies can benefit shareholders because of various concavities in the risk profile of firm value (Loderer & Pichler, 2000; Merna & Al-Thani, 2008; Tufano, 1996). They develop the epistemology of risk into two main research fields in finance - corporate risk management (Froot, Scharfstein, & Stein, 1993; MacKay & Moeller, 2007) and corporate risk-taking (Acharya, Amihud, & Litov, 2011; John, Litov, & Yeung, 2008). However, there is mixed evidence that the predictions from the literature explain the practice of corporate risk strategies (Bodnar, Giambona, Graham, & Harvey, 2019), so researchers still grapple with the basic question of what corporate risk is (Damodaran, 2007).

Although the study of risk has deep roots in corporate finance, significant gaps exist in the understanding of corporate risk and its relationship to traditional corporate finance (Ellul, 2015; Tufano, 1996). First, corporations' disclosure of their risk management programmes only reveal minimal detail (Tufano, 1996). The lack of data on risk management presents a major challenge in studying corporate risk. Second, it is notoriously difficult to measure disaggregated risk exposures for each firm in a given year (Dittmar & Lundblad, 2017; Fama & French, 1997). Fama and French (1997) attempt to determine industry risk exposures and point out that time-varying embedded in the estimation of risk exposures exacerbates the measurement problem. Third, the empirical evidence continues to be mixed. To illustrate this, empirical evidence presents that larger companies engage more in risky management behaviour (C. Géczy, Minton, & Schrand, 1997), however, smaller firms are arguably more influenced by credit rationing (Bodnar et al., 2019). The cause of the mixed results is the lack of a systematic lens on corporate risk.

To respond to this call, this thesis is based on the largest emerging market - China. Three research questions are used to systematically explore the role of corporate risk governance. First, as the most common mean of risk management, how effective is hedging with financial derivatives in corporations? Although much of this work is discussed in literature based on developed economies, comprehension of the findings is the first step in understanding corporate risk. Second, how are macroeconomic risks transmitted to enterprises? Answering this question borrows heavily from corporate finance by melding traditional firm characteristics and firm-level risk exposure. The last step looks at the assessment of exposure impact: How can we assess the impact of exposure in corporations? The findings represent an extension of the understanding of risk exposure in corporate investment strategies.

1.1. Essay one

Several theoretical and empirical studies have proven that risk management in corporations becomes relevant due to the presence of various frictions in the market; such as taxes, information asymmetry, and agency conflict; which create a rationale for lowering the volatility of earnings through hedging (J. B. Lin, Pantzalis, & Park, 2007; Pincus & Rajgopal, 2002; Smith & Stulz, 1985). Financial derivatives are an important component of managing risks facing corporations (W. Guay & Kothari, 2003) and are expected to improve firm performance when hedging positions in derivatives carry an incommensurate premium with risk, or where active trading activities of derivatives create a profit. The origins of the empirical exploration of the impact of hedging by derivatives contracts on firm value can be traced back to the seminal work of Allayannis and Weston (2001), which directly test the relation between the use of foreign currency derivatives and firm value using a sample of 720 large U.S. nonfinancial firms between 1990 and 1995. These authors find that firms with hedging positions have a 4.87% premium on firm value. Carter, Rogers, and Simkins (2006b) report an even higher premium of approximately 14% by examining the case of fuel hedging in 28 U.S. airlines. They conclude that the use of derivatives for hedging allows firms to seize operation opportunities when the market is unstable for the airline industry, thereby mitigating the underinvestment problem. However, W. Guay and Kothari (2003) investigate the economic effects of hedging positions in derivatives and debate that hedging through the use of derivatives cannot have an impact of the magnitude claimed on firm value, since the potential gains on derivatives are negligible compared to cash flow or movement in equity value. Jin and Jorion (2006) employ a same-industry sample and reinforce that there is no discernible effect of hedging on firm value in the oil and gas industry.

Despite extant studies related to hedging trying to portray success stories that are consistent with various theories, the interpretation of the empirical results is debated. This bifurcated interpretation stems from the divergent implications between shareholder value maximisation theory and the manager's personal utility maximisation theory. Shareholder value maximisation theory claims three typical lines of explanation, which are reducing the expected cost of financial distress, generating tax advantages by the reduction of expected taxes and increase of debt capacity, and relieving the problem of underinvestment by stabilising internal cash flow (Jin & Jorion, 2006). From the perspective of shareholder value maximisation theory, the cost savings from hedging are expected to be reflected in an increasing firm value in the market. On the other hand, the manager's personal utility maximisation argument states that hedging is motivated by the incentive of managers to maximise their personal utility (Smith & Stulz, 1985), and results in an irrelevance between hedging and the market value of firms.

Proceeding from the research gap between shareholder value maximisation theory and manager's personal utility maximisation theory, Chapter 2 extends the understanding of motivating factors that result in firms' investment in financial derivatives by determining the common characteristics shared by the firms that have invested in derivative use, and contributes to the literature through empirical evidence from emerging economies by testing how the use of financial derivatives influences corporate performance. This study finds that, in the Chinese market, larger firm size, more operating cash flow, less tax shielding, higher research and development investment, and greater possibility of bankruptcy are the main factors that influence a firm's consideration of investing in derivatives. Derivative usage has a negative influence on the performance of firms, and this finding is not altered by whether or not the firms are state-owned. In addition, this study separates the sample into firms with better performance and those with poorer performance, and finds that the use of derivatives in poorer firms is the source of the negative effects.

1.2. Essay Two

With the first essay suggesting that the use of derivates in the Chinese market seems to show poor risk management ability in private or state-owned firms, one may wonder whether the mechanism of risk transmission varies dependent on the nature of firms; for example, what the role of ownership structure is in determining companies' risk profiles. The ownership structure is an important governance mechanism in determining companies' risk profiles, as it has impacts on agency costs (Jensen & Meckling, 1976), and the propensity of risk-taking in financing (Froot et al., 1993; Smith Jr & Watts, 1992). Chapter 3 investigates the impact of state ownership on firm-level EPU exposure.

Economic policy uncertainty (EPU) is the risk of economic policy change that cannot be accurately predicted by market participants (Gulen & Ion, 2016). It has been widely recognised that EPU has considerable effects on economic development and economic agents' behaviour (Cheng, Shi, Yu, & Zhang, 2019; Demir & Ersan, 2017; Julio & Yook, 2012; G. Zhang, Han, Pan, & Huang, 2015). Research on corporate ownership structure and financial constraints under the effect of EPU is not new. However, previous studies mainly test the impacts of state ownership and financial constraints under EPU shocks by using moderation effects (Yiping Huang, Ji, Ni, Tan, & Wang, 2020; G. Liu, Hu, & Cheng, 2021; H. Shen, Hou, Peng, Xiong, & Zuo, 2021; Y. Wang, Chen, & Huang, 2014; G. Zhang et al., 2015; W. Zhang, Zhang, Tian, & Sun, 2021), and data grouping by ownership structure (F. Wen, Li, Sha, & Shao, 2021). Both of these methods apply the country-level EPU index directly, implicitly assuming all firms have the same exposure to EPU shocks. Until recently the studies have not addressed the issue of what direct role state ownership and financial constraints play in affecting corporate policy uncertainty exposure. To address this concern, a challenging problem is to measure heterogeneous corporate exposure to EPU. Corporate exposure to EPU is defined as the sensitivity of the firm' excess return to EPU, indicating the extent to which firms are influenced by EPU (Bali et al., 2017).

Motivated by the theoretical gap between institutional theory and agency theory, and the empirical gap related to the direct role state ownership and financial constraints play in affecting corporate exposure to EPU, Chapter 3 seeks to address the following two questions. Does state ownership affect firm-level EPU exposure? Does state ownership affect EPU exposure through enhancing leverage?

Utilising data on 4,674 A-share listed firms in China from 2000-2021, Chapter 3 finds the impact of state ownership on EPU exposure is economically significant: EPU exposure increases by 17.6% with a one standard deviation increase in the proportion of state ownership in companies. Second, leverage is higher in SOEs, and this translates into higher EPU exposure. Specifically, a one standard deviation increase in the proportion of state ownership is associated with an increase in the market long-term debt ratio of 3.58%, and a one standard deviation growth in the long-term debt ratio generates a 28.3% rise in exposure to EPU. Our findings suggest that debt financing serves as the channel through which state ownership exposes firms to EPU.

1.3. Essay Three

After discussing internal mechanisms of economic policy uncertainty transmission in China's listed firms, Chapter 4 explores how EPU exposure affects individual firms' investment efficiency by proposing two research questions. Does the investment efficiency of firms vary according to EPU and their EPU exposure? Do high-EPU-risk firms display a significant difference in investment efficiency in high- and low-EPU periods? This study hypothesises that firms' heterogeneous EPU exposures inhibit firm investment and result in less investment efficiency.

Investment efficiency is defined as the extent to which the firm's investment policy seizes investment opportunities (S. Chen, Sun, Tang, & Wu, 2011). Due to the irreversibility nature of investment projects or the sunk cost, firms weigh up the profit difference between current and future investments when they cannot accurately predict changes in economic policy and their potential effects (Y. Wang et al., 2014). The higher degree of uncertainty creates a greater return on waiting for future investment, thereby placing a higher value on the option of waiting. Gulen and Ion (2016) find precautionary delays of irreversible investment in firms due to increasing uncertainty in economic policies. In Chapter 4, this thesis explores a Chinese setting to examine whether the shock of economic policy uncertainty to firms constitutes another friction leading to investment inefficiency.

Using data on 4,889 A-share listed firms in China from 1998-2021, Chapter 4 finds that firms' investment efficiency reduces with an increase in EPU exposure. Second, EPU exposure has a greater impact on investment efficiency in times of high EPU. By grouping samples by EPU and EPU exposure, Chapter 4 highlights that high-EPU-risk firms enjoy the highest investment efficiency in low-EPU periods but become the most inefficient in high-EPU periods. In contrast, this study does not find a significant difference in investment efficiency in low-EPU-risk firms between high and low EPU times. These results reveal differences in investment efficiency across firms with different EPU exposures and under different market conditions. This study contributes to the empirical evidence to address the risk-return puzzle by providing the suggestion that high-EPU risk firms perform better in tranquil years, while low-EPU risk counterparts invest more efficiently in turbulent years.

1.4. The Sequence of the Thesis

The core part of this dissertation comprises three essays, building upon corporate finance, governance, and risk management. To present the dissertation in a methodical manner, these three essays will appear as three independent chapters. The remainder of this thesis is structured as follows.

Chapter 2 presents the first essay, which examines the use, and the effectiveness, of using financial derivatives in the Chinese market. This essay answers the research questions - what kind of firms are more likely to use financial derivatives, and how the use of financial derivatives influences corporate performance. Chapter 3 attempts to extend the philosophy of the mechanism of risk transmission by introducing firm-level EPU exposure. Building upon the research gap between institutional theory and agency theory, this study addresses the issue of what direct role state ownership and financial constraints play in affecting corporate policy uncertainty exposure. Extending upon Chapter 3, Chapter 4 investigates the impact of firm-level EPU exposure on firm investment efficiency and provides empirical evidence to respond to the call for clarity on the risk-return puzzle. The main implications and suggestions for the intended direction of future research are presented in the concluding Chapter 5.

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Chapter 2. Use of Derivative and Firm Performance: Evidence from the Chinese Shenzhen Stock Exchange[1]

2.1. Introduction

Increasing research attention has been paid to the financial instruments of derivative use, due to their increasing popularity with firms. Derivatives refer to financial investments like options and futures, which are used to hedge the financial risks from unexpected changes in interest rates, exchange rates, and commodity prices. Firms use financial derivatives to hedge their exposure to various sorts of risk in order to increase their firm value. However, the effectiveness of derivative use on risk management and value creation has been debated among researchers. According to Modigliani and Miller (1958), in a perfect market, risk management should not be relevant to a firm's value. In addition, Modigliani and Miller (1958) believe that risk can be actively managed by shareholders through diversifying their investments. Such a theory suggests that firms, by simply reducing the variations of their cash flows or firm values, do not create extra value to shareholders and, thus, firms should not hedge.

Several academic pioneers have investigated the relationship between hedging by investing in financial derivatives and firm value. Carter, Rogers, and Simkins (2006a) study data from the U.S. airline industry between 1992-2003. Allayannis and Ofek (2001) test currency derivatives using a sample of S&P 500 nonfinancial firms from 1993. W. R. Guay (1999) collected data from COMPUSTAT on 254 firms from 1990 to 1994, and divides it into derivative users and non-derivative users. These studies, in general, find that using derivatives results in a reduction of risk and an increase of firm performance.

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[1] A paper based on this chapter, entitled "Use of Derivative and Firm Performance: Evidence from the Chinese Shenzhen Stock Exchange" was published in the Journal of Risk and Financial Management, 2021, 14(2).

The above studies largely focus on firms listed in developed markets where relevant regulations, laws, accounting standards, and enforcements are well established. In contrast to the abundant studies in developed economies, little attention has been paid to developing markets. This has raised a new question of whether these findings or conclusions also apply to developing/emerging economies. Different from developed markets, the financial markets of emerging countries are less efficient, and can be subject to unsound and incomplete laws and regulations. In such markets, the financial derivative market itself may not be well developed. People's understanding or knowledge of these complicated financial instruments may also be limited. Hence, the effectiveness of the derivatives may be even more debatable than in the developed markets. Moreover, in these kinds of markets, governments sometimes impose administrative controls which lead to financial markets being distorted towards the direction of government policy. For example, during the Chinese stock market crash in July 2015, the China Securities Regulatory Commission (CSRC) limited stock index futures trading, banned short selling, cut margin ratios, locked up the holdings of large shareholders, and investigated shorting big blocks. In addition, on January 4th, 2016, the CSRC implemented a two-step circuit breaker in the Shenzhen Stock Market, which led to January 7th having a total trading time of just fifteen minutes. After just four days, the CSRC canceled this mechanism. Such practice seems to be suggesting that the financial derivative markets, rather than helping companies in controlling for risks, are particularly dangerous during market turmoil and, thus, must be constrained.

This study aims to explore the use, and the effectiveness, of using financial derivatives in one of the largest and most important emerging markets - the Chinese stock market. Notably, this study addresses two research questions. The first one is what kind of firms are more likely to use financial derivatives. Put another way, what are the common characteristics shared by firms that have invested in derivative use. The answer to this question is important, as it helps us gain a better understanding of the motivating factors that result in firms' investment in financial derivatives. There has been an abundant number of empirical studies exploring which factors or imperfections cause firms to hedge using derivatives, but the findings remain mixed. For example, Allayannis and Weston (2001), examine the relationship between firm value and the use of foreign currency derivatives by studying 720 large firms from 1990 to 1995. They find that the market value of firms using hedging derivatives is approximately 5% higher than those not using hedging instruments. Similarly, Carter et al. (2006a) report an even higher hedging premium of approximately 10%. Conversely, W. Guay and Kothari (2003), through studying a sample of nonfinancial derivative users, argue that the use of derivatives is not significantly associated with the value of firms. They argue that this is because the potential premiums on hedging instruments are small compared to cash flows in equity value. Jin and Jorion (2006) use a sample from the U.S. oil and gas industry to examine the differences between firms using hedging derivatives and those that are not. They find no obvious relationship between using derivatives and a firm's market value. Carter et al. (2006a), Froot et al. (1993), and Bartram, Brown, and Fehle (2009) look at the relation between corporate performance and derivative use, and provide evidence that using derivatives is unnecessary for avoiding an underinvestment problem, because internal cash and cash equivalents can address this without taking on risk.

This study tries to identify, among my sample companies, which elements or imperfections contribute to the increasing propensity of companies to hedge using derivatives, in the real world rather than in a theoretical setting. In particular, under the special background of emerging markets like China, it will be interesting and meaningful to see whether the conclusion is different from those drawn from the developed markets.

The second question this study explores is how the use of financial derivatives influences corporate performance, which has been largely missing from the literature on emerging economies. As discussed above, derivatives could be particularly dangerous or even detrimental if not used properly. Given that financial derivative markets are relatively young and underdeveloped in China, results from our study could provide extra implications for firms and practitioners, as well as for market regulators. Furthermore, in Chinese markets, there are two main types of companies; state-owned, and privately-owned firms. While enjoying more financial support from the government, the state-owned firms are also subject to government control to a greater extent. By looking at the differences between these two types of companies in their usage, and the effectiveness, of derivatives, this thesis may derive more findings on how government intervention may affect firms' risk management, as well as their efficiency.

The main findings of this study are summarised as follows: Firstly, this chapter finds that, in the Chinese market, a firms' size, operating cash flow, tax shielding, research and development investment, and the possibility of bankruptcy are the main factors that influence a firm's considerations when investing in derivatives. Secondly, the nature of a firm (i.e., whether it is privately-owned or state-owned) is not a deciding factor in derivative investment. Thirdly, derivative usage has a negative influence on the performance of firms, with this finding not altered by whether or not firms are state-owned. This finding is robust under different performance measures, and it is robust when taking into account the lag-in-time effect of derivatives. Fourthly, this study separates the sample into firms with better performance and those with poorer performance. We find that the use of derivatives in poorer firms is the source of the negative effects, because derivatives investment has no significant influence on sample firms that have better performance. This study considers that the flawed nature of the Chinese derivatives market, the fact that it is subject to severe controls, and a scarcity of professionals employed in Chinese enterprises who are adept at investing in derivatives may be the main reasons for the negative relationship.

The empirical results suggest that derivatives deteriorate firm performance, which seems contrary to common belief. We conduct further tests to explore this issue by reexamining the relationship between derivative use and firm performance among the top-performing and the bottom-performing firms. The results show that the negative relation only exists at a significant level among bottom-performing firms, but disappears among top-performing firms. Such results suggest that one possible reason for firms' failure to use derivatives successfully may be their lack of expertise and experience. Thus, it seems unlikely that poorly performed firms will improve their situation by adopting financial derivatives.

The structure of this study is as follows: Section 2.2 presents the literature review, Section 2.3 outlines the data description and the research methods, Section 2.4 contains the empirical analysis, and Section 2.5 presents the conclusions.

2.2. Theoretical Foundation

Financial derivatives have been used by firms as an approach to deal with the financial risks associated with their business transactions, which are generated from unexpected changes in the market. Modigliani and Miller (1958) introduce the classic theory that shareholders can manage risk by themselves through diversifying their investments in a perfect market, where there is no asymmetry of information, no transaction costs, and no taxes and agency costs. This means that hedging at the corporate level is not related to a firm's value under such a situation. Similarly, in 2002, Warrant Buffet, the financial investment guru, referred to financial derivatives as 'financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal'. Such a statement suggests that, if not used properly, financial derivatives may cause even greater risks and reduce firm values, rather than reduce risk and add value to the firm.

Nevertheless, a tremendous number of enterprises do invest in financial derivatives in order to hedge risk, which results from frictions in the market. Thus, there is a need to investigate what factors contribute to firms' decisions to invest in financial derivatives and whether firms can benefit from their investment in derivatives.

3.2.1. Firms Characteristics and Use of Financial Derivatives

Prior research has identified certain firm characteristics as the factors at the firm level that can lead to derivative use. Based on a study of 720 large U.S. companies, Allayannis and Weston (2001) find that companies are more likely to use foreign currency derivatives in order to manage risks if they have a larger size and greater leverage, profitability, and investment growth, as well as less financial constraints. Further, empirical findings suggest that hedging through investing in financial derivatives is able to relieve underinvestment problems, when firms enjoy growth opportunities and when external financing is expensive (Froot et al., 1993; Jin & Jorion, 2006). Also, the tax liability is considered as a factor associated with derivative use. Smith and Stulz (1985) suggest that firms' hedging behaviour may be prompted by tax incentives. When the after-tax incomes of firms demonstrate more convex functions, the expected taxes can be reduced by derivatives usage. Similarly, Graham and Rogers (2002) suggest that hedging through financial derivatives at a corporate level is associated with tax incentives, because derivative use can improve debt capacity and increase tax benefits.

The leverage ratio of the firm is also confirmed as an influencing factor (Lau, 2016). The leverage ratio affects a firm's performance, particularly when interest rates change, and thus it can influence a firm's decision whether to invest in financial derivatives as a hedging method. For companies with high leverage ratios, the high level of default risk is embedded in their fixed repayment obligations, and their operational cash flow will encounter increasing volatility. Compared with firms with low operating leverage, firms with high leverage will have to endure growing expected costs associated with the possibility of bankruptcy, financial distress, and reduced firm value. Hedging by using financial derivatives allows these firms to have more leverage on debt financing and to generate a greater firm value through tax savings. This is because hedging by using derivatives can preserve internal cash flow and increase a firm's investment success, so that additional cash is generated from derivative use (Carter et al., 2006a). Also, costs associated with bankruptcy risk and potential financial distress can be reduced through hedging by investing in derivatives (Arnold, Rathgeber, & Stöckl, 2014; Smith & Stulz, 1985).

Smith and Stulz (1985) believe that companies, whose cash flow or income is greatly affected by foreign exchange risk, prefer to use derivatives. Bartram et al. (2009) examine the automobile industry and note that movement in the foreign exchange rate is a significant factor in derivative usage. The risk exposure from movement in the foreign exchange rate, as one of three main risks (i.e., unexpected movement of interest rates, foreign exchange rates, and commodity prices) for companies, is highly associated with production cost, profits, and sales of firms.

Based on a sample of S&P 500 manufacturing firms from the Compustat database covering the period from 1993 to 2001, Haushalter, Klasa, and Maxwell (2007) test the hedging effect of cash holding. Findings from this study suggest that cash-holding and derivative use have a substitute relationship, as both cash-holding and hedging derivative use allow enterprises to minimise their need for external capital. Therefore, it is expected there is a negative relationship between cash-holding and derivative use. Based on a differential effect between ambiguity and risk, Friberg and Seiler (2017) argue that higher ambiguity is associated with greater cash holdings, whereas more risk causes a higher probability of derivative use. Financial constraints are identified as a significant factor influencing firms' decision on whether to invest in derivatives as a means of hedging (Froot et al., 1993). When deadweight costs are included in the costs of external capital, the underinvestment problem will emerge, as internal cash flow will be severely insufficient; hedging by using derivatives can generate extra cash flow that allows firms to circumvent the underinvestment problem (Froot et al., 1993).

Smith and Stulz (1985) state that managers of companies with large stocks and risk aversion are more inclined to use derivatives for hedging. R. M. Stulz (1984) points out that, if the interests of management are mainly affected by fluctuations of the company's value, and the cost of the company's use of derivatives is lower than the manager's own safe-haven costs, then risk-averse managers will perform hedging. C. C. Géczy, Minton, and Schrand (2007) find that information asymmetry between a company's management and shareholders can affect a company's hedging behaviour.

In summary, prior research has identified firm characteristics in terms of firm size, return on assets, return on equity, R&D investment, CEO shareholding rate, leverage, cash holding, foreign exchange gain, and tax liability as the main factors that will be likely to influence a firm's derivative use. Thus, these factors will be included in the empirical analysis as the explanatory variables to address the first question of this study.

3.2.2. Derivative Use and Firm Performance

As shown in the last section, various factors at a corporate level can lead to firms' investment in financial derivatives for hedging. However, research results are inconclusive regarding whether derivative use is associated with better performance or value of the firm. Based on a sample of 720 large firms for the period from 1990 to 1995, Allayannis and Weston (2001) examined the relationship between firm value and the use of foreign currency derivatives. Results from this study suggest that, on average, the market value of firms that use hedging derivatives is approximately 5% higher than that of firms that do not use any hedging instruments. Similarly, another study by Carter et al. (2006a) reports a higher hedging premium of approximately 10%.

On the other hand, based on a sample of derivative users of nonfinancial firms, W. Guay and Kothari (2003) find that derivative usage does not have a significantly positive influence on a firm's value, as the potential premium on hedging instruments is small compared to cash flows in equity value. Therefore, they suggest that the effect of derivative use is spurious, and that the slight change in premium is driven by other forms of risk management. Similarly, based on a sample of companies from the U.S. oil and gas industry, Jin and Jorion (2006) find that there is no difference in market value between firms that use hedging derivatives and those that do not. Furthermore, Kim, Mathur, and Nam (2006) argue that the positive impact on firm value of using derivatives, as reported by Allayannis and Weston (2001), is difficult to interpret, because of issues such as changes in risk exposure throughout the sample, and endogeneity between firm value and hedging. Another empirical study based on U.S. airline companies demonstrates that the premium generated from derivative use can be attributed to solving underinvestment (Carter et al., 2006a). However, derivative use is not the only way to resolve the underinvestment problem. Froot et al. (1993) suggest that firms tend to choose underinvestment when they encounter significant distress. They further argue that underinvestment occurs when internal cash flow is low and the costs of external capital, including deadweight costs, are high. Thus, there is no consensus regarding whether hedging by using financial derivatives will solve this problem of underinvestment. On the other hand, it is clear that derivative use is not the only way for a firm to address the underinvestment problem. For example, cash-holding and cash equivalents could be regarded as a more direct method for firms to deal with an underinvestment issue.

Based on a sample of firms from 39 countries, Allayannis, Lel, and Miller (2012) examine the interactive relationship between corporate governance, investment in foreign financial derivatives, and firm performance. Findings from this study suggest that, when companies have strong internal and external corporate governance, there will be a positive relationship between derivative use and firm performance (Allayannis et al., 2012). However, the results from this multi-national study regarding a positive link between derivative use and firm performance differ from those generated from single-country studies. For example, based on a sample of firms from France, Khediri (2010) finds that, when a firm increases its investment in financial derivatives, the value of the firm tends to reduce rather than increase, and that this reduction of firm value is caused by a lack of premium value being assigned to the firm's derivative use. Similarly, based on a firm sample from the Australian market, Nguyen and Faff (2010) find that, when a firm makes investments in financial derivatives, the value of the firm tends to decrease. Thus, although a large number of empirical studies have focused on the relationship between derivative use and firm performance, their empirical results regarding this relationship still conflict with each other.

A potential factor leading to the conflicting results regarding the relationship between derivative use and firm performance is the difference in industries from which firm samples are drawn. Material supply chains and the costs of primary goods outputs in some industries are exposed to significant volatility, leading to negative consequences on both sales and the cost of sales in these industries (Lau, 2016). Therefore, when operating in these industries, firms are more likely to invest in financial derivatives, as derivative use may lead to more consistent pricing on raw materials and, thus, allow avoidance of unnecessary losses. However, the particularities of specific industries may contribute to the bias in empirical findings regarding the relationship between derivative use and firm performance. For example, based on a sample of firms operating in the U.S. oil and gas industry, Jin and Jorion (2006) find that firm value is not affected by derivative use. However, Carter et al. (2006a) point out that the results from Jin and Jorion (2006)'s study may be biased, given the fact that firms operating as investors in the U.S. oil and gas industry do not tend to invest in financial derivatives for the purpose of hedging.

The inconclusive empirical findings regarding the relationship between derivative use and firm performance lead to the second research question of whether firms would benefit from their investment in financial derivatives.

2.3. Research Design and Methodology

2.3.1. Sample Description

This study aims to answer two questions: (1) What factors affect a firm's decision to use financial derivatives? and (2) Does derivative use by a firm lead to a positive effect on its performance? Data for this study were collected from China Securities Market and Accounting Research (CSMAR). The Shenzhen Stock Market was established in 1990. There are two stock exchange markets in China. While state-owned corporations are mainly listed on the Shanghai Stock Market, companies listed on the Shenzhen Stock Market are mostly privately-owned. Previous studies have suggested that firms that face large risk are more likely to use financial derivatives in their operations, and that financial derivative use tends to have a positive impact on a firm's value (Allayannis & Weston, 2001; Carter et al., 2006a). Compared with state-owned companies, privately-owned firms in China tend to suffer more severe financial constraints and face more financial difficulties in their operations, due to a lack of government support. Therefore, it is appropriate to draw the sample for this study from the companies listed in the Shenzhen Stock Market.

The sample of this study includes 2,529 firms listed on the Shenzhen Stock Exchange and the Growth Enterprise Market of China. Our unbalanced panel data consists of 8,129 firm-year observations of derivative use and 12,177 firm-year observations for performance, covering an 11-year period from 2005 to 2015. In order to eliminate bias generated from the differences between industries, firms from all industries listed in the Shenzhen Stock Exchange have been included in this study, with the exception of the financial industry. The reason for excluding firms from the financial industry is that firms in this industry may invest in financial derivatives for reasons other than hedging. Including financial firms may result in bias. Therefore, financial firms (e.g., banks, insurance, and investment companies), companies subject to Special Treatment (ST), and Particular Transfer (PT) are excluded from the sample. Table 2.1 provides a description of the data.

Table 2. 1. Data Description (Excluding Financial Firms)

Variable	N	Mean	SD	Min	P25	P50	P75	Max
Derivative_dummy	8129	0.0630	0.243	0	0	0	0	1
ROA	12177	0.0410	0.0400	-0.0410	0.0140	0.0370	0.0670	0.125
ROE	12177	0.0730	0.0690	-0.0790	0.0300	0.0700	0.113	0.213
Ln (Tobin's Q)	11628	0.456	0.894	-2.739	-0.110	0.480	1.020	6.891
Tobin's Q	11628	2.121	1.670	0.350	0.896	1.616	2.774	6.595
EBTA	12151	0.408	0.300	0.0650	0.190	0.324	0.529	1.207
Leverage	12177	0.428	0.213	0.0910	0.248	0.420	0.603	0.802
Net Profit Margin	12158	0.154	7.507	-277.9	0.0230	0.0670	0.141	715.1
Assets Turnover	12177	0.600	0.387	0.144	0.313	0.498	0.770	1.600
Size	12177	21.92	1.331	14.94	21.00	21.75	22.64	28.51
Operating Cash Flow	12158	0.0700	0.149	-0.267	-0.00200	0.0690	0.155	0.368
CEO_TS	11841	0.138	0.212	0	0	0.00100	0.256	0.897
Z	11627	0.618	0.383	0.162	0.333	0.518	0.785	1.603
Cash Holding	12152	0.423	0.421	0.0430	0.130	0.260	0.554	1.616
Capital Expenditure	12158	0.123	0.131	0.00400	0.0290	0.0740	0.164	0.492

Notes: This table reports the information obtained from the sample, which has been collected from the CSMAR from 2005 to 2015. This sample covers 8,129 derivative observations and 12,177 firm performance observations in the Shenzhen Stock Exchange and the Growth Enterprise Market (GEM).

To eliminate the impact of industry, our regression model controls the variable of industry. This variable is denoted by the industry codes developed by China Securities Regulatory Commission (CSRC). When operationalising the variable in the study, I keep the original CSRC codes for the primary classification of the industries (i.e., the first letter of the CSRC industry codes for industries is retained), with the exception of the manufacturing industry. As shown in Table 2.2, over 60% of the companies in the sample come from the single industry of manufacturing, and this severe outlier in terms of industry could generate bias in the model estimations. Thus, firms in the manufacturing industry require a secondary classification. Table A.2.1 in Appendix shows the industry classification structure and codes used in this chapter.

Table 2. 2. Industrial Distribution of Sample (Excluding the Financial Industry)

Industry.	Frequency.	Percentage	Cumulation
A	39	1.54	1.54
B	67	2.65	4.19
C	1,629	64.41	68.6
D	85	3.36	71.97
E	64	2.53	74.5
F	151	5.97	80.47
G	83	3.28	83.75
H	10	0.4	84.14
I	139	5.5	89.64
K	132	5.22	94.86
L	27	1.07	95.93
M	18	0.71	96.64
N	24	0.95	97.59
O	3	0.12	97.71
P	1	0.04	97.75
Q	3	0.12	97.86
R	29	1.15	99.01
S	25	0.99	100
Total	2,529	100	

Notes: This table shows the industry distribution of all 2,529 firms in the sample. The first column shows the CSMAR industry code. The manufacturing industry, which is represented by the code C, occupies 64.41% of the total sample. Therefore, the firms in the manufacturing industry have been assigned secondary classification codes.

Based on the difference in ownership, the firms included in the sample can be divided into two groups; privately-owned, and state-owned. In comparison with state-owned companies, private firms are more likely to use derivatives to hedge against financial risks. State-owned companies are significantly different from privately-owned firms in their objectives, resource endowment, operational risks, and government intervention (Yang, Jia, Liu, & Yin, 2017). With support from the Chinese government, state-owned firms have easier access to financial and credit approval than their privately-owned counterparts. Due to encouragement from the Chinese government, banks provide more financial support to state-owned firms, even though some of them have lower productivity than privately-owned enterprises, resulting in low levels of efficient capital investment by state-owned companies (Chang & Boontham, 2017; Song, Storesletten, & Zilibotti, 2011). Even now, over 30 years after the reform and opening-up of the Chinese economic policies, there is still a bias against privately-owned firms in markets and banks, such as through charging higher interest rates and imposing harsher conditions (Yang et al., 2017). Therefore, private firms rely more on their internal funds, such as cash and cash equivalents, than state-owned companies, and have greater incentives to use derivatives in order to stabilise their cash flows.

Table 2.3 demonstrates the differences in characteristics between firms that use and those that do not use derivatives. The differences between users and non-users of derivatives lead to the first research question of the study: Which factors lead to the use of derivatives by Chinese firms? Moreover, observing the performance indicators (measured as ROA, ROE, and Tobin's Q) as shown in Table 2.3, non-users of derivatives slightly outperform derivative users. This observation suggests it is uncertain that derivative use has a positive effect on firm performance. Therefore, this study develops the second research question of this study: Do firms truly benefit from their derivative use?

Table 2. 3.The Description of Derivative Using Firms and Non-Derivative Using Firms

Panel A

	Derivative_dummy = 0							
Variables	N	Mean	SD	Min	P25	P50	P75	Max
Derivative_dummy	7618	0	0	0	0	0	0	0
ROA	7049	0.0`450	0.0400	-0.0410	0.0170	0.0420	0.0710	0.125
ROE	7049	0.0720	0.0660	-0.0790	0.0310	0.0690	0.109	0.213
Ln (Tobin's Q)	6697	0.627	0.829	-2.182	0.137	0.635	1.150	6.891
Tobin's Q	6697	2.375	1.678	0.350	1.147	1.886	3.158	6.595
Growth	7031	0.392	0.280	0.0650	0.195	0.319	0.498	1.207
Leverage	7049	0.377	0.207	0.0910	0.200	0.350	0.534	0.802
Net Profit Margin	7037	0.237	8.859	-58.38	0.0310	0.0830	0.160	715.1
Asset Turnover	7049	0.564	0.362	0.144	0.304	0.470	0.708	1.600
Size	7049	21.56	1.089	14.94	20.83	21.44	22.14	26.07
Operating Cash Flow	7037	0.0700	0.149	-0.267	-0.00400	0.0710	0.157	0.368
CEO_TS	6975	0.197	0.232	0	0	0.0590	0.399	0.897
Z	6697	0.584	0.357	0.162	0.327	0.491	0.728	1.603
Cash Holding	7034	0.490	0.458	0.0430	0.149	0.316	0.675	1.616
Capital Expenditure	7037	0.137	0.137	0.00400	0.0370	0.0870	0.185	0.492

Panel B

	Derivatives_dummy = 1							
Variables	N	Mean	SD	Min	P25	P50	P75	Max
Derivatives_dummy	511	1	0	1	1	1	1	1
ROA	476	0.0400	0.0380	-0.0410	0.0140	0.0360	0.0620	0.125
ROE	476	0.0740	0.0680	-0.0790	0.0320	0.0650	0.115	0.213
Ln (Tobin's Q)	454	0.306	0.826	-2.489	-0.178	0.366	0.860	2.829
Tobin's Q	454	1.816	1.396	0.350	0.837	1.442	2.364	6.595
EBTA	475	0.283	0.216	0.0650	0.146	0.220	0.342	1.207
Leverage	476	0.443	0.209	0.0910	0.274	0.442	0.615	0.802
Net Profit Margin	475	0.0590	0.0820	-0.443	0.0170	0.0410	0.0850	0.601
Asset Turnover	476	0.788	0.409	0.144	0.455	0.759	1.034	1.600
Size	476	22.21	1.340	19.63	21.19	21.97	22.86	27.14
Operating Cash Flow	475	0.0640	0.116	-0.267	0.0120	0.0640	0.124	0.368
CEO_TS	474	0.153	0.222	0	0	0.0190	0.260	0.775
Z	454	0.804	0.403	0.162	0.474	0.780	1.047	1.603
Cash Holding	474	0.264	0.310	0.0430	0.0710	0.156	0.305	1.616
Capital Expenditure	475	0.103	0.112	0.00400	0.0290	0.0620	0.136	0.492

Notes: Panel A presents the information regarding derivative non-users and Panel B presents the information regarding derivative users. The firm performance of derivative non-users (the median value of ROA, ROE, Ln(Tobin's Q) and Tobin's Q) is slightly better than that of derivative users.

2.3.2. Estimation Models

Our empirical estimations were based on the dataset of the unbalanced panel data. In comparison to other types of data, such as time-series data and cross-sectional data, panel data is a type of longitudinal data with unique advantages, including its ability to detect and measure statistical effects that either pure time series or cross-sectional data cannot, as well as the ability to minimise estimation biases that may arise from aggregating time series groups in aggregating time series groups into a single time series. However, when using panel data for estimation, some potential problems need to be addressed. First, there is a probability that the variables from different firms in the data are not independent. Second, when the estimations involve many parameters, standard regression methods could become ill-posed. Our study addresses the issue of potential correlations among the sampled firms. We perform regression analysis clustered by firms. To meet the independent and identical distribution, this study allows the correlation among residuals with groups, but reject the presence of correlation between different groups.

An alternative modelling method is linear stochastic approximations. Stochastic approximation methods are a family of iterative methods typically used for root-finding problems or for optimisation problems. The recursive update rules of stochastic approximation methods can be used for solving linear systems when the collected data is corrupted by noise, or for approximating extreme values of the function which cannot be computed directly by only estimation via noisy observations (Kouritzin, 1996; Nemirovski, Juditsky, Lan, & Shapiro, 2009; Toulis & Airoldi, 2015). A major advantage of linear stochastic approximation methods lies in that they can facilitate estimation with a large amount of data, in which model parameters are updated sequentially using small batches of data at each step (Toulis & Airoldi, 2015).

2.3.2.1. Estimation Model for Firm Characteristics and Derivative Use

Based on our review of previous studies in the last section regarding firm characteristics and derivative use, this study develops the following model to examine factors that lead to derivative use by Chinese firms:

$$\text{Derivatives\_dummy}_{it} = \beta_{\text{i}} + \beta_1 \ln(\text{size}_{i,t}) + \beta_2 \text{OPERCF\_a}_{i,t} + \beta_3 \text{Leverage}_{i,t} + \beta_4 \text{ExGain}_{i,t} + \beta_5 Oprevenuegrowth_{i,t} + \beta_6 \text{CEO\_TS}_{\text{i,t}} + \beta_7 \text{RD\_dummy}_{i,t} + \beta_8 \text{Z}_{i,t} + \beta_9 Dep\_a_{i,t} + \beta_{10} ROA_{i,t} + \beta_{11} ROE_{i,t} + \beta_{12} Tobin's\ Q_{i,t} + Ind + Year + \varepsilon \quad (2.1)$$

$$\text{Derivatives\_dummy}_{it} = \beta_i + \beta_1 \ln(\text{size}_{i,t}) + \beta_2 \text{OPERCF\_a}_{i,t} + \beta_3 \text{Leverage}_{i,t} + \beta_4 \text{ExGain}_{i,t} + \beta_5 Oprevenuegrowth_{i,t} + \beta_6 \text{CEO\_TS}_{i,t} + \beta_7 \text{RD\_dummy}_{i,t} + \beta_8 \text{Z}_{i,t} + \beta_9 Dep\_a_{i,t} + \beta_{10} ROA_{i,t} + \beta_{11} ROE_{i,t} + \beta_{12} Tobin's\ Q_{i,t} + \beta_{13} \text{SOE}_i + Ind + Year + \varepsilon \quad (2.2)$$

where, $\text{Derivatives\_dummy}_{it}$ is the dependent variable that equals 1 if firm i uses derivatives at time t, otherwise it equals 0. Equation (2.1) provides a baseline model to examine the relationship between firm characteristics and derivative use. Equation (2.2) adds firm ownership (SOE) to examine the effect of the firm's ownership structure on derivative use.

The explanatory variables are:

(1) $\ln(\text{size}_{i,t})$ is the size level of a firm i at time t;

(2) $\text{OPERCF\_a}_{i,t}$ is the operational cash flow of a firm i at time t;

(3) $\text{Leverage}_{i,t}$ is the leverage ratio, which is calculated by dividing debt by size;

(4) $\text{ExGain}_{i,t}$ indicates the exchange gains of firm i at time t;

(5) $Oprevenuegrowth_{i,t}$ is the growth rate of the operational revenue of a firm i at time t;

(6) $\text{CEO\_TS}_{\text{i,t}}$ is the stockholding ratio of CEO of firm i at time t;

(7) $\text{RD\_dummy}_{i,t}$ is a dummy variable to judge if firm i has made research and development investment at time t;

(8) $\text{Z}_{i,t}$ is the Altman Z-score, which measures the bankruptcy risk of firm i at time t;

(9) $Dep\_a_{i,t}$ measures the tax shield of firm i at time;

(10)-(12) Three variables representing the performance of the firm, measured by ROA, ROE and Tobin's Q, respectively;

(13) SOE_i is the dummy variable to analyse ownership of the firms, which equals to 0 if the observation is a private enterprise, and equals to 1 if the observation is a state-owned enterprise; and

(14) – (15) *Ind* and *Year* are industry- and year-specific fixed effects;

(15) ε is the idiosyncratic error term at time t.

The Logit model has been selected to estimate this function, as the dependent variable of derivative use is a binary-choice dummy. The Logit model is a widely used analytical method for binary-choice estimation. In comparison to the Probit model, it provides an unambiguous and concise setting on result explanation, because the cumulative distribution function in logistic distribution specifies an analytical expression, while the standard distribution in the Probit model does not (Wooldridge, 2010). As shown in Table 2.3 (Panel A and Panel B), the data for firms' derivative use are highly unbalanced, with an overwhelming majority of firms reported as non-derivative users. If untreated, the empirical estimation may suffer from potential event bias. Following (King & Zeng, 2001), this study applies the bias-corrected estimations in our regression analysis so that the empirical results will not be biased from the unbalanced distribution of the derivative use as the dummy variable.

As shown in Table 2.5 in the Results section, four model specifications are performed. Model (2.1) is the benchmark regression used to test the common phenomenon. Model (2.2) adds two fixed variables ($industry$ and $Year$) in order to control the effects of industry and time. In Model (2.3), the full sample is split into two groups of state-owned and privately-owned firms by adding the variable of SOE to examine the differences between these two types of firms in terms of their derivative use. Based on Model (2.3), Model (2.4) controls the effects of industry and time.

2.3.2.2. Estimation Model for Derivative Use and Firm Performance

In order to examine the relationship between derivative use and firm performance, Models (2.3) and (2.4) are developed, and three variables are adopted as the measures of firm performance. Following previous studies (Bartram, Brown, & Conrad, 2011; Jin & Jorion, 2006), Tobin's Q is adopted to measure a firm's market value on the stock exchange market, and it is used as a proxy of firm performance in Models (2.3) and (2.3a). By measuring the market value created over the book value, Tobin's Q helps to produce market values comparable across sample firms and mitigates any scale effects. Following previous research

(Choi, Mao, & Upadhyay, 2013; Gay, Lin, & Smith, 2011), Model (2.4) uses Return on Assets (ROA) and Return on Equity (ROE) as indicators for firm performance in this study.

$$\text{Tobin's Q}_{i,t} = \beta_1 + \beta_1 * \text{Derivatives}_{\text{dummy}_{i,t}} + \sum_K \beta_K * CONTROL_{i,t}^K + Ind + Year + \varepsilon \quad ,$$

(2.3)

$$\text{Tobin's Q} = \frac{((Total\ shares\ Outstanding - Bshares\ Outstanding)*P_A + BShares\ Outstanding*P_b*exchange\ rate)}{(Total\ Assets)}$$

(2.3.a)

$$\text{Firm performance}_{i,t} = \beta_i + \beta_1 * \text{Derivatives}_{\text{dummy}_{i,t}} + \beta_2 * \text{Derivatives}_{\text{dummy}_{i,t}} * \text{SOE}_i + \sum_K \beta_K * CONTROL_{i,t}^K + Ind + Year + \varepsilon$$

(2.4)

In Models (2.3) and (2.4), derivative use is the independent variable. In Model (2.4) Derivatives_dummy_(i,t)*SOE_i is included to measure the different effects between privately- and state-owned companies. The control variables and their definitions are shown in Table 2.4.

Table 2. 4. Description of Control Variables

Control Variable	Definition
SOE	The dummy of a firm's nature from CSMAR, which equals to 0 if the firm is privately-owned and equals to 1 if the firm is state-owned. It is used to control the effects of a firm's ownership structure.
Size	The Napierian Logarithm of a firm's total assets, to control the relationship between a firm's size and its performance.
Operating Cash Flow	A firm's cash flow scaled by total assets to control the relationship between a firm's operations and its performance.
Depreciation	Depreciation scaled by total assets to establish the effects of tax shields on a firm's performance.
CEO_TS	The ratio of shareholding by a CEO is introduced to control the potential relationship between agent costs and a firm's performance.
RD_dummy	Used to establish whether companies invest in research and development to control the underinvestment problem and firm performance.
Z	The Altman Z-score is used to control the influences of bankruptcy costs on a firm's performance. This variable is calculated as: $Z = 0.012 * X_1 + 0.014 * X_2 + 0.033 * X_3 + 0.006 * X_4 + 0.999 * X_5$, where, X_1 = (liquid asset-liquid debt)/total assets; X_2 = retained earnings/total assets; X_3 = EBIT/total assets; X_4 = market value of common shares and preferred stock/total debt; X_5= total sales/total assets.
Leverage	The leverage ratio is calculated as total debt over total assets, to establish the relationship between capital structure and a firm's performance.

Exchange Gain	Exchange gain scaled by total assets is used to control the impacts of movements of foreign exchange rates on a firm's performance.

Following Lau (2016), a pooled Ordinary Least Square (OLS) regression model is adopted to empirically examine the effect of derivative use on firm performance. In the pooled OLS model, clustering by each firm can cut out potential interactions among individual firms and, thus, generate the independence of probability. Before performing a dynamic panel data analysis, three statistical issues require special treatment. First, firm-specific, time-specific, and industry-specific effects in the dataset may have potential implications in empirical estimations, because the residuals of a given firm, a given year, or a given industry may be correlated across years or firms (i.e., time-series dependence and cross-sectional dependence). Second, the choice between fixed-effects and random-effects model specifications needs to be made. Third, although this chapter focuses only on the use of financial derivatives with the purpose of hedging, the relationship between derivative use and its explanatory variables may not be clear-cut. As the nature of hedging by using derivatives is a type of investment, the reverse causality may arise with the feedback effects between firm profitability and corporate hedging capacity.

A number of diagnostic tests are used to address these three statistical issues. First, the Hausman test is performed. The results suggest that the idiosyncrasies in the cross-section data need to be fixed and, thus, the fixed-effects model is adopted for model estimation. Second, time-effects and industry-effects are also controlled in the model estimation, and the results are reported following benchmark regressions in the respective tables of results. Third and more importantly, robust standard error estimations with a fixed-effects model are performed to control the potential problems with the endogeneity in the data. Prior research suggests that robust standard error estimations (FE-SE or RE-SE) in either a fixed-effects or random-effects model are found to be unbiased due to the permanent firm-effect (Abadie, Athey, Imbens, & Wooldridge, 2017; Cameron & Miller, 2015; Petersen, 2009). Thus, the potential concern of endogeneity is effectively mitigated.

As shown in Tables 2.6, 2.7, and 2.8, four model specifications of the pooled OLS estimation are performed for each of the three performance measures respectively (ROA, Tobin's Q, and ROE). The first one is a benchmark regression, including all the control variables except the variable of SOE. The second regression model controls the effects of time and industry. The third regression (Model 2.4) adds Derivatives_dummy_(i,t)*SOE_i and the control variable of SOE. Based on regression three, the fourth regression controls the effects of time and industry.

2.4. Empirical Results and Discussion

2.4.1. Firm Characteristics and Derivative Use

Table 2.5 demonstrates the empirical results from the fixed effect models regarding the factors that influence companies' decisions on whether to use financial derivatives. Six variables of firm size, operational cash flow, tax shield (measured as depreciation divided by total assets), R&D investment, bankruptcy possibility (represented by the Z-score), and Tobin's Q, are significant across all four model specifications. As shown in Model specifications 2.3 and 2.4, ROA is significant after controlling the variable of firm ownership. However, the variable of firm ownership is insignificant after controlling the effects of time and industry.

Table 2. 5. Factors that Impact a Firm's Decision to Use Derivatives

	(1)	(2)
	Derivatives_dummy	Derivatives_dummy
SOE		-0.186
		-1.05
Ln(size)	0.491***	0.489***
	8.18	8.20
Cash Flow	1.504*	1.485*
	1.83	1.81
Depreciation	-1.027*	-1.042*
	-1.66	-1.69
CEO_TS	0.003	0.031
	0.01	0.11
RD_dummy	0.469***	0.473***
	2.92	2.94
Z	0.596***	0.595***
	8.34	8.35
Leverage	0.008	0.014
	0.04	0.08
Exchange Gain	-0.000	-0.000
	-0.70	-0.70
Growth	-0.001	-0.001
	-0.51	-0.53
ROE	0.875	0.882
	1.39	1.41
ROA	-2.735	-2.755*
	-1.64	-1.68
Tobin's Q	-0.144***	-0.145***
	-3.14	-3.16
Fixed Effects	Yes	Yes
N	7715	7715

Notes: This table shows the factors that may affect firms' decisions regarding hedging using derivatives. These factors are: firm size, operating cash flow, tax shield (represented by depreciation divided by total assets), research and development investment, possibility of bankruptcy (represented by Z-score), ROA, and Tobin's Q. After controlling the effects of time and industry, the nature of a firm is not a deciding factor of derivative usage. t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01.

The significant effect of firm size suggests that larger companies are more likely to invest in financial derivatives. Two factors may contribute to this result. First, larger firms have a higher level of risk exposure in comparison to smaller firms, due to their more extensive operations. Second, larger firms are financially more capable of performing complex derivative operations by hiring professional managers. Firms with more cash flow are more likely to use derivatives, as these firms have a stronger need to stabilise their daily operations against the financial risks from the uncertainty associated with unexpected changes of exchange and interest rates. A higher R&D level indicates that the firms have more investment opportunities. As a result, these firms are more likely to engage in derivative use to safeguard their R&D investment. A lower Altman Z-score means a firm has a larger probability of bankruptcy. Therefore, a positive relationship between a Z-score and the derivative usage dummy indicates that firms with lower bankruptcy risk are more likely to use derivatives. The negative impact of tax shields (represented by depreciation to total assets) on a firm's derivative use indicates that companies enjoying more tax benefits tend to reduce their derivative investment.

When it comes to the influence of a firm's performance variables, the negative relationships between derivative use and ROA, as well as between derivative use and Tobin's Q, support the suggestion that firms in the Chinese market tend to invest in financial derivatives with the purpose of improving firm performance.

2.4.2. Derivative Use and Firm Performance

In this section, this study addresses the issue of whether investment in financial derivatives can result in an improvement of firm performance. Here, firm performance is measured by three indicators; ROA, ROE, and Tobin's Q.

Table 2. 6. The Effects of Derivative Use on ROA

	(1)	(2)	(3)	(4)
	ROA	ROA	ROA	ROA
Derivative_dummy	-0.007***	-0.006***	-0.012**	-0.008
	(-4.39)	(-3.39)	(-2.09)	(-1.56)
Derivative_dummy *SOE			0.005	0.003
			(0.80)	(0.53)
SOE	0.002	0.002	0.002	0.002
	(1.53)	(1.13)	(1.24)	(0.93)
Size	0.007***	0.008***	0.007***	0.008***
	(16.29)	(19.07)	(16.28)	(19.05)
Asset Turnover	0.023***	0.031***	0.023***	0.031***
	(19.90)	(24.40)	(19.89)	(24.39)
Net Profit Margin	0.000***	0.000***	0.000***	0.000***
	(4.46)	(5.04)	(4.45)	(5.03)
Leverage	-0.107***	-0.105***	-0.107***	-0.105***
	(-46.18)	(-43.90)	(-46.16)	(-43.89)
Fixed Effects	NO	Yes	NO	Yes
N	7512	7512	7512	7512
R2	0.238	0.315	0.239	0.315
Adjust R2	0.238	0.310	0.238	0.310

Notes: In this table, four regressions are introduced. The first column is the benchmark regression of Model (2.3). The second column is based on the first regression but controls the effects of time and industry. The third column is the benchmark regression of Model (2.4). The fourth column is based on the third regression but controls the effects of time and industry. This table shows that using derivatives has negative effects on ROA, and that the nature of a company has no impact on the outcomes of using derivatives. Some variables are automatically removed by the Stata program due to multicollinearity. t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01.

Table 2.6 demonstrates the effect of derivative use on ROA as one measure of firm performance. As shown in Table 2.6, four model specifications are performed. Model 2.1 is the benchmark model. Based on Model 2.1, Model 2.2 adds two control variables of time and industry. Model 2.3 tests derivative use on ROA in terms of the two different firm groups (state-owned and private firms) by adding the dummy variable SOE. Based on Model 2.3, Model 2.4 adds the two control variables of time and industry. Some control variables are automatically removed by the Stata program due to multicollinearity.

The results shown in Table 2.6 suggest that derivative use negatively affects ROA (Model 2.1), although the negative impact is slightly reduced when the effects of time and industry are controlled in Model 2.2. The results from Model 2.3 demonstrate that private enterprises are more seriously exposed to the negative effects of using derivatives (-0.014), while state-owned companies also suffer from these negative effects of derivative use, but to a lesser degree than the private firms. The reason for the difference probably lies in the fact that state-owned companies have better access to significant financial support from the Chinese government. The financial support from the government can lead to increased profitability and investor confidence, thus partly offsetting the negative effects of using derivatives, such as the negative return of derivatives and the loss of effectiveness when risks erupt in the whole market (e.g., when the stock market crashed in 2015).

In order to further examine the relationship between derivative use and firm performance, this study replaces the performance measure ROA with another two performance indicators; Tobin's Q, and ROE. Table 2.7 presents the model results with Tobin's Q as the performance measure. Similar to Table 2.6, this study performs four model specifications. As shown in Table 2.7, derivative use has a significant but negative effect on the dependent variable of Tobin's in both Models 2.2 and 2.4. These results confirm the negative effect of derivative use on firm performance. Further, this negative effect is consistent across both state-owned and private firms.

Table 2. 7. The Effects of Derivative Use on Tobin's Q

	(1)	(2)	(3)	(4)
	Tobin's Q	Tobin's Q	Tobin's Q	Tobin's Q
Derivative_dummy	-0.033	-0.079***	-0.193*	-0.163**
	(-1.06)	(-3.29)	(-1.94)	(-2.17)
Derivative_dummy *SOE			0.176*	0.093
			(1.70)	(1.19)
SOE	-0.030	-0.002	-0.045	-0.011
	(-1.03)	(-0.11)	(-1.48)	(-0.46)
Size	-0.312***	-0.364***	-0.312***	-0.364***
	(-39.07)	(-57.01)	(-39.10)	(-57.03)
Asset Turnover	0.012	0.175***	0.012	0.175***
	(0.60)	(9.50)	(0.58)	(9.48)
Net profit margin	0.004***	0.004***	0.004***	0.004***
	(4.12)	(5.41)	(4.09)	(5.40)
Leverage	-1.327***	-1.083***	-1.326***	-1.083***
	(-31.06)	(-31.12)	(-31.04)	(-31.11)
Fixed Effects	NO	Yes	NO	Yes
N	7140	7140	7140	7140
R2	0.439	0.685	0.439	0.685
Adjust R2	0.438	0.683	0.438	0.683

Notes: In this table, four regressions are introduced. The first column is the benchmark regression of Model (2.3). The second column is based on the first regression but controls the effects of time and industry. The third column is the benchmark regression of Model (2.4). The fourth column is based on the third regression but controls the effects of time and industry. This table shows that using derivatives brings negative effects on Tobin's Q and that the nature of a company has no impact on the outcomes of using derivatives, after controlling the effects of time and industry. t statistics in parentheses * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

The same procedure of four model specifications is performed after adopting ROE as the measure of firm performance. The results are presented in Table 2.8. The regression results are qualitatively the same as when using ROA and Tobin's Q as measures of firm performance. Thus, the negative effect of derivative use on firm performance is further confirmed.

Table 2. 8.The Effects of Derivative Use on ROE

	(1)	(2)	(3)	(4)
	ROE	ROE	ROE	ROE
Derivative_dummy	-0.010***	-0.006*	-0.016	-0.010
	(-3.14)	(-1.95)	(-1.57)	(-1.00)
Derivative_dummy *SOE			0.007	0.004
			(0.65)	(0.42)
SOE	0.004	0.003	0.003	0.003
	(1.39)	(1.12)	(1.14)	(0.95)
Size	0.012***	0.014***	0.012***	0.014***
	(15.83)	(18.45)	(15.81)	(18.44)
Asset Turnover	0.037***	0.054***	0.037***	0.054***
	(17.95)	(23.66)	(17.94)	(23.65)
Net Profit Margin	0.000***	0.000***	0.000***	0.000***
	(4.62)	(5.18)	(4.61)	(5.17)
Leverage	-0.065***	-0.067***	-0.065***	-0.067***
	(-15.60)	(-15.52)	(-15.59)	(-15.52)
Control Year and industry	NO	Yes	NO	Yes
N	7512	7512	7512	7512
R2	0.073	0.175	0.073	0.175
Adjust R2	0.072	0.169	0.072	0.169

Notes: In this table, four regressions are introduced. The first column is the benchmark regression of Model (2.3). The second column is based on the first regression but controls the effects of time and industry. The third column is the benchmark regression of Model (2.4). The fourth column is based on the third regression but controls the effects of time and industry. This table shows that using derivatives has negative effects on ROE, and that the nature of a company has no impact on the outcomes of using derivatives. t statistics in parentheses * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

In summary, derivative use tends to exert a negative effect on firm performance as measured by the indicators ROA, ROE, and Tobin's Q. This means that using derivatives reduces a company's performance. Two factors may be associated with the negative effects of derivative use on firm performance in the context of firms from China. First, compared with developed markets, the market of financial derivatives in China is flawed and suffers from tight control by government agencies. Insufficient hedging instruments mean that Chinese firms often fail to manage the risks through using derivatives. Moreover, intervention actions taken by various government agencies such as the China Securities Regulatory Commission (CSRC) after the stock market crashed in 2015, have led to a high level of difficulty for Chinese firms when they attempt to invest in derivatives and, thus, it is impractical for

Chinese firms to use investment in financial derivatives as an effective method when managing business risks. Second, there is a severe lack of skills and expertise in Chinese firms in relation to business transactions relating to investment in financial derivatives. Investments in financial derivatives made by inexperienced operators contribute to the risks experienced by corporations and reduce their performance.

It takes time for derivative use to generate influence on firm performance, and this is especially so when the firms first initiate derivative use. In order to consider the time effect of derivative use, this study examines the relationship between derivative use and firm performance using a time lag of one year. For this analysis, firm performance is measured by the three financial indicators of ROA, ROE, and Tobin's Q. Table 2.9 shows the effect of derivative use in the past on firm performance in the current period. The first column for each performance indicator presents the results of the benchmark regression, and the results shown in the second column have controlled time and industry effects. As shown in Table 2.9, derivative use has a significant and negative effect on both ROA and ROE as the measures of firm performance, and these negative effects remain when the time lag effect is controlled. On the other hand, derivate use has no significant effect on firm performance when performance is measured by Tobin's Q.

Table 2. 9. The Lagged Effects of Derivative Use on Firm Performance

	ROA	ROA	ROE	ROE	TQ	TQ
$\text{Lag(Derivative\_dummy)}_{-1}$	-0.08***	-0.008***	-0.013***	-0.011***	-0.037	-0.039
	(-3.99)	(-3.95)	(-3.64)	(-3.27)	(-0.55)	(-0.63)
SOE	-0.002	-0.002	-0.000	-0.001	-0.071	-0.054
	(-1.02)	(1.29)	(-0.03)	(-0.38)	(-1.26)	(-1.04)
Size	-0.002***	-0.001***	0.006***	0.007***	-0.660***	-0.694***
	(-5.42)	(-3.97)	(9.61)	(11.46)	(-52.03)	(-59.28)
Asset Turnover	0.013***	0.013***	0.037***	0.034***	-0.305***	-0.245***
	(12.79)	(12.45)	(19.78)	(18.72)	(-8.55)	(-7.48)
Net Profit Margin	0.000*	0.000**	-0.000*	-0.000	0.000	0.001
	(1.68)	(2.05)	(-1.67)	(-1.40)	(0.20)	(0.92)
Fixed Effects	NO	YES	NO	YES	NO	YES
N	11429	11429	11429	11429	10788	10788
R2	0.0175	0.0378	0.0426	0.0624	0.2140	0.3488
Adjust R2	0.0171	0.0367	0.0422	0.0613	0.2136	0.3480

Notes: In this table, three different indicators of firm performance (ROA, ROE, and Tobin's Q) are used to test the lagged effects of using derivatives. For each indicator, the first column is the benchmark regression. The second column is based on the first regression, but the effects of time and industry are controlled. This table shows that derivative usage on forwarding time has a significantly negative influence on ROA and ROE, but no significant impact on firm value. t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01.

Table 2.9 demonstrates the negative effect of using derivatives in the past on the firm's current performance. This negative effect from a time lag is consistent with the results from the empirical analyses in the last section. Two factors may explain this negative effect even when the lagged time effect is controlled. Firstly, the ineffectual operation of investment in financial derivatives may increase the risk exposure of companies and then damage the firm's performance. Secondly, investment in hedging is not free. Usually, hedging by derivatives sacrifices returns as a prerequisite. Therefore, when firms increase investment in financial derivatives, investing firms will expect firm performance to decline in the future to some extent. The lack of impact on firm value (presented by Tobin's Q) may be due to derivative use only affecting the value of the firm during the current period. However, in the subsequent time periods, internal factors can have more obvious effects on firm value than that just caused by derivative investment.

2.4.3. Further Empirical Analysis

The results generated from our examination of the first research question (what type of firms is more likely to invest in financial derivatives) suggest that firms with poorer performance are more likely to invest in derivatives. However, the results from our examination of the second research question (the relationship between derivative use and firm performance) demonstrate that derivative use tends to reduce, rather than improve, firm performance. To examine these seemingly contradictory empirical results, this study conducts the following further empirical analysis.

To conduct this further analysis, this study splits the full sample of firms into sub-samples. First, based on differences in terms of ROA among the sampled firms, this study splits the full sample into two sub-samples; firms with ROA value higher (lower) than the median value of the full sample. Second, based on differences in terms of ROE among the sampled firms, this study also splits the full sample into two sub-samples; firms with ROE value higher (lower) than the median value of the full sample. Then, this study introduces the performance indicator Tobin's Q as the dependent variable to examine the relationship between derivative use and firm performance. The expected result is that derivative use will lead to a reduction of performance for those firms whose operations are less successful.

For this further regression analysis of the relationship between derivative use and firm performance, this study adopts the conceptual model developed by Carter et al. (2006a). The model is provided below. All the control variables included in the model are listed in Table 2.10.

$$\text{Tobin's Q} = \text{Derivative\_dummy}_{i,t} + \textstyle\sum_K \beta_K * CONTROL_{i,t}^{K} + \varepsilon$$

Table 2. 10. The Control Variables for the of the Further Test

Control Variables	Definition
$\text{Size}_{i,t}$	The Napierian Logarithm of a firm's total assets, to control the relationship between a firm's size and its performance.
$\text{Dividend\_dummy}_{i,t}$	Dividend payout dummy: If the observation pays dividends on time *i*, the variable is equal to 1, otherwise it is equal to 0.
$\text{CapitalExpenditure\_a}_{i,t}$	The ratio of capital expenditure over total assets, which controls the effects of growth opportunities.
$\text{CF\_a}_{i,t}$	Using a firm's cash flow, scaled by total assets, to control the relationship between a firm's operations and its performance.
$\text{Cash\_s}_{i,t}$	The ratio of cash to sales, to control the influences of liquidity.
$\text{CEO\_TS}_{i,t}$	CEO options-to-shares outstanding, to control the potential relationship between agent costs and a firm's performance.
Year	To control the effects of time.
Industry	To control industry effects.

2.4.3.1. Further Empirical Analysis

Table 2.11 shows the results for the relationship between derivative use and ROA as the measure of firm performance for the two sub-samples with ROA value higher and lower, respectively, than the median value of the full sample. As shown in Column 1 in Table 2.11, the coefficient for the effect of derivative use carries a negative sign for the sub-sample with better performance (ROA> median), indicating a potentially negative effect on Tobin's Q as a measure of firm performance. However, this effect is not significant. On the other hand, the negative effect of derivative use for sub-sample with poorer performance (ROA < median) is highly significant. These results clearly demonstrate that derivative use has a negative effect on performance, mainly for those firms that perform poorly.

Table 2. 11. The Effects of Derivatives Usage on Tobin's Q for Groups Separated by the Median ROA Value

	ROA > Median (0.0370)	ROA < Median (0.0370)
Derivative_dummy	-0.047	-0.089***
	(-1.47)	(-2.70)
Size	-0.364***	-0.511***
	(-42.89)	(-64.77)
Dividend_dummy	-0.024	0.036
	(-0.53)	(0.69)
Capital Expenditure	0.203***	0.130**
	(2.99)	(2.05)
Cash Holding	0.100***	0.173***
	(4.62)	(7.77)
Cash Flow	0.399***	0.101*
	(7.04)	(1.79)
CEO_TS	0.087**	-0.025
	(2.51)	(-0.61)
Fixed Effects	YES	YES
N	3756	3202
R2	0.649	0.755
Adjust R2	0.643	0.751

Notes: In this table, the sample is grouped by the median value of ROA (0.0370). For the group in which ROA is greater than the median value, the use of derivatives has no significant impact on firm value. For the group in which ROA is less than the median value, a significantly negative relationship between derivatives usage and firm value has been found (at the 99% confidence interval). t statistics in parentheses * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

As described earlier, this study also creates two sub-samples based on the difference between firms that have ROE value higher and lower than the median value of the full sample. This study examines the effect of derivate use on Tobin's Q as the measure of firm performance. The results of the regression analysis are shown in Table 2.12. For the sub-sample of firms with higher ROE value (Column 1), the effect of derivative use has a negative value, but this negative coefficient is statistically insignificant, suggesting that derivative use does not have a significant effect on Tobin's Q as a proxy for firm performance. On the other hand, the effect of derivative use on Tobin's Q is negative and significant for the sub-sample with lower ROE value (Column 2). These results confirm the findings from Table 2.11.

Table 2. 12. The Effects of Derivatives Usage on Tobin's Q for Groups Separated by the Median ROE Value

	ROE> median (0.0700)	ROE < median (0.0700)
Derivative_dummy	-0.051	-0.069**
	(-1.47)	(-2.16)
Size	-0.395***	-0.529***
	(-45.70)	(-65.48)
Dividend_dummy	-0.032	0.015
	(-0.61)	(0.33)
Capital Expenditure	0.195***	0.147**
	(2.59)	(2.52)
Cash Holding	0.194***	0.172***
	(7.88)	(8.76)
Cash Flow	0.488***	0.140***
	(7.92)	(2.70)
CEO_TS	0.130***	-0.011
	(3.39)	(-0.31)
Control Year and Industry	YES	YES
N	3521	3441
R2	0.676	0.741
Adjust R2	0.670	0.737

Notes: In this table, the sample is grouped using the median value of ROE (0.0700). Similar to Table 2.10, for the group in which the ROE is greater than the median value, the use of derivatives has no significant impact on firm value. For the group in which ROE is less than the median value, a significantly negative relationship is found between derivative usage and firm value (at the 95% confidence interval). t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01.

2.4.3.2. Robustness Tests

For the robustness test, observations have been grouped, for both ROA and ROE, into those which occupy the lowest 25% of the whole sample, and those which occupy the highest 25% of the whole sample. The model developed by Carter et al. (2006a) is again used in this test. The condensed data represents the extreme observations from the sample and leads to a stricter test. It is expected that the relationship between derivatives usage and Tobin's Q will be significant and negative in the groups which represent the firms with the lowest ROA and ROE. Furthermore, it is expected that this relationship will be insignificant in the groups which represent the firms with the highest ROA and ROE. The results of this robustness test are shown in Tables 2.13 and 2.14.

Table 2.13 shows that, for the firms in the group with the lowest 25% ROA, using derivatives has a -0.075 effect on their value (Tobin's Q), which is significant at the 99% confidence interval. Conversely, when it comes to the firms in the group which has the highest 25% ROA, derivative usage does not have any impact on a firm's value.

Table 2. 13. The Effects of Derivative Usage on Tobin's Q for Groups with High and Low ROA

	ROA > p75（0.0670）	ROA< p25（0.0140）
Derivative_dummy	0.116	-0.075***
	(1.17)	(-2.73)
Size	-0.374***	-0.485***
	(-16.33)	(-72.06)
Dividend_dummy	-0.195	0.016
	(-1.25)	(0.37)
Capital Expenditure	0.272	0.112**
	(1.21)	(2.07)
Cash Holding	0.096	0.159***
	(1.44)	(8.51)
Cash Flow	0.026	0.137***
	(0.14)	(2.87)
CEO_TS	0.328***	0.012
	(3.37)	(0.36)
Fixed Effects	YES	YES
N	539	4345
R2	0.669	0.746
Adjust R2	0.633	0.743

Notes: This table presents the relationship between the use of derivatives and firm value by using a more extreme grouping method. The sample is separated into two groups; one that includes the firms which have the greatest 25% ROA from the total sample (0.0670), and one that includes firms with the lowest 25% ROA from the total sample (0.0140). In keeping with the previous findings, for the group with lower ROA, derivative usage has a significantly negative impact on firm value (at the 99% confidence interval), whereas, for the group with higher ROA, there are no significant effects on firm value from using derivatives. t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01.

The same grouping method is used for ROE (as shown in Table 2.14). Although the coefficient of derivative usage in the group which includes firms with the lowest 25% ROE (-0.062) is slightly lower than the group in which observations are lower than the median value of ROE of the sample (-0.069), the significant and negative relationship substantiates the previous findings.

Table 2. 14. The Effects of Derivatives Usage on Tobin's Q for Groups with High and Low ROE

	ROE >p75 (0.113)	ROE <p25 (0.030)
Derivative_dummy	-0.028	-0.062**
	(-0.44)	(-2.34)
Size	-0.412***	-0.500***
	(-25.70)	(-73.99)
Dividend_dummy	-0.016	0.027
	(-0.15)	(0.69)
Capital Expenditure	0.291*	0.148***
	(1.68)	(2.95)
Cash Holding	0.241***	0.187***
	(4.02)	(11.28)
Cash Flow	0.240*	0.221***
	(1.93)	(5.02)
CEO_TS	0.466***	0.096***
	(5.35)	(3.28)
Fixed Effects	YES	YES
N	955	5033
R2	0.737	0.726
Adjust R2	0.721	0.723

Notes: This table presents the relationship between the use of derivatives and firm value by using a more extreme grouping method. The sample is separated into two groups: one that includes the firms which have the greatest 25% ROE from the total sample (0.113), and one that includes firms with the lowest 25% ROE from the total sample (0.030). In keeping with the previous findings, for the group with lower ROE, derivative usage has a significantly negative impact on firm value (at the 95% confidence interval), whereas, for the group with higher ROA, there are no significant effects from using derivatives on firm value. t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01.

In summary, through conducting additional regression analyses by splitting full samples into sub-samples along the two dimensions of ROA and ROE, respectively, our further analyses and robust tests confirm the results generated from our initial analysis regarding the relationship between derivative use and firm performance.

2.5. Conclusion

This study aims to examine derivative use as a hedge against financial risks at the firm level in the research setting of emerging economies. While investment in financial derivatives is quite common for firms from developed economies, it is still a newly emerged economic and business phenomenon. Thus, there is a need to study firms' derivative use in the context of firms from emerging economies. This study addresses two research questions regarding investment in financial derivatives by firms from emerging economies. They are: (1) What factors at the firm level lead the firms to invest in financial derivatives? and (2) Can derivative use lead to improvement of firm performance? These two research questions are examined in the context of Chinese firms listed on the Shenzhen Stock Exchange. Empirical data are collected from the CSMAR. In addition, data regarding firms' derivative use are collected manually for all the individual firms included in the sample. In total, the full sample includes 15,309 firm-year observations, covering a period of 11 years from 2005 to 2015.

To address the first research question, this chapter follows prior studies in the developed economy setting to examine whether the firm characteristics in terms of firm size, operational cash flow, R&D investment, tax shielding, the possibility of bankruptcy, and firm ownership would result in firms' investment in financial derivatives. To address the second research question, this study adopts the conceptual model developed by Lau (2016) for regression analysis. Further, this study performs additional analyses and robustness tests to examine the relationship between derivative use and firm performance by splitting the full sample into sub-samples along the two dimensions of ROA and ROE.

This study contributes to the literature of derivative use by providing the following empirical findings based on the research setting of firms from China as a leading emerging economy. First, our study has identified the firm characteristics of firm size, operational cash flow, R&D investment, tax shield, and the possibility of bankruptcy as factors that determine firms' decisions to invest in financial derivatives. Second, firms' ownership structure in terms of state or private ownership does not affect a firm's decision on derivative use. Third, as a general tendency, derivative use has a negative effect on the firm's performance and state or private ownership does not change this negative effect. Fourth, firms with poorer performance are more likely to invest in financial derivatives, but derivative use tends to further reduce, rather than improve, the performance of these firms.

These empirical findings have theoretical as well as practical implications regarding derivative use by firms from emerging economies like China. First, prior research identifies an association between certain firm-specific characteristics and firm investment in financial derivatives in the context of firms from developed economies (Allayannis & Ofek, 2001; Haushalter, 2001; Kuersten & Linde, 2011; Titman & Grinblatt, 2002). The empirical evidence based on our empirical findings confirms such an association in the setting of firms from China as an emerging economy. Second, and more importantly, our empirical findings shed new light on the relationship between derivative use and firm performance. Prior research in the context of firms from developed economies suggests that derivative use tends to lead to an improvement of firm performance (Allayannis & Weston, 2001; Carter et al., 2006a). The findings from our study provide empirical evidence of a negative effect of derivative use on firm performance. Moreover, while firms with poorer performance are more likely to invest in financial derivatives with the purpose of facilitating the improvement of performance, derivative use by these firms would further reduce their performance. We think that two factors may contribute to such a vicious cycle. The first is the serious flaws in the development of the derivatives market in developing or emerging economies, given its status of late development and poor institutional quality. The second is firms' lack of experienced professionals to operate the transactions for investment in financial derivatives. Third, the empirical findings regarding the relationship between derivative use and firms have practical implications both for policymakers and managerial executives in the emerging economy setting. For policymakers in developing and emerging economies, it is important to provide a business environment with a high institutional quality for the development of derivative market performance. For the managerial executives of firms in developing and emerging economies, it is imperative to develop the skills and expertise required to effectively operate investment in financial derivatives.

2.6. Appendix to Chapter 2

Table A.2. 1. The Industry Classification

Industry codes	Industry names	Industry codes	Industry names
A	Agriculture, forestry, animal husbandry and fishery	B	Mining industry
C13	Agricultural and sideline food processing industry	C14	Food Manufacturing
C15	Wine, Beverage, and Refined Tea Manufacturing	C16	Tobacco manufacturing
C17	Textile Industry	C18	Textile and Apparel and Apparel Industry
C19	Leather, fur, feathers, and their products and footwear	C20	Wood processing and wood, bamboo, rattan, palm, and grass products industry
C21	Furniture manufacturing industry	C22	Papermaking and paper product industry
C23	Printing and Recording Media Copying Industry	C24	Culture, Education, Industry, Sports, and Entertainment Products Manufacturing
C25	Oil, coal, and other fuel processing industries	C26	Chemical raw materials and chemical manufacturing
C27	Pharmaceutical Manufacturing	C28	Chemical Fiber Manufacturing
C29	Rubber and plastic products industry	C30	Non-metallic mineral products industry
C31	Ferrous metal smelting and rolling processing industry	C32	Non-ferrous metal smelting and rolling processing industry
C33	Metal Products Industry	C34	General Equipment Manufacturing
C35	Special Equipment Manufacturing	C36	Automotive Manufacturing
C37	Railway, shipbuilding, aerospace, and other transportation equipment manufacturing	C38	Electrical Machinery and Equipment Manufacturing
C39	Computer, communications, and other electronic equipment manufacturing	C40	Instrumentation Manufacturing
C41	Other manufacturing	C42	Waste Resources Comprehensive Utilisation Industry
C43	Metal products, machinery, and equipment repair industry	D	Industry of electric power, heat, gas and water production and supply
E	Construction industry	F	Wholesale and retail industry
G	Transport, storage and postal service industry	H	Accommodation and catering industry
I	Industry of information transmission, software and information technology services	K	Real estate industry

L	Leasing and commercial service industry	M	Scientific research and technical service industry
N	Water conservancy, environment and public facility management industry	O	Industry of resident service, repair and other services
P	Education	Q	Multimodal transport and transport agency
R	Industry of culture, sports and entertainment	S	Diversified industries

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Conceptualization, Yantao Wen, Sasha Molchanov, Martin Berka and Yafeng Qin; Methodology, Yantao Wen; Software, Yantao Wen; Validation, Sasha Molchanov, Martin Berka and Yafeng Qin; Formal analysis, Yantao Wen; Investigation, Yantao Wen; Resources, Yantao Wen; Data Curation, Yantao Wen; Writing—original draft preparation, Yantao Wen.; Writing—review and editing, Sasha Molchanov, Martin Berka and Yafeng Qin.

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Chapter 3. State Ownership and Exposure to Economic Policy Uncertainty: The Role of Leverage [2]

3.1. Introduction

Ownership structure is an important governance mechanism that significantly impacts a company's risk profile by influencing agency costs (Jensen & Meckling, 1976) and the propensity of risk-taking in financing (Froot et al., 1993; Smith Jr & Watts, 1992). In the context of Chinese economy, the state sector plays a crucial role with many firms having long-standing connections with the government. Although China is the largest emerging market, its government still plays a decisive role in regulating economic development, leading to frequent policy interventions (Luo, Chen, & Wu, 2017). Economic policy uncertainty (EPU) refers to the risk associated with economic policy changes that cannot be accurately predicted by market participants (Gulen & Ion, 2016). Important role of the Chinese government in the economy and frequent policy interventions make China an intriguing market for studying the influence of state ownership on firms' operations under EPU shocks.

The influence of state ownership on firms' operations under EPU shocks is particularly important for two reasons. First, recent years have seen an increase in government policies favoring the state sector. State-owned enterprises (SOEs) dominate the capital market in China and have crowded out private firms in industries such as natural resources, civil aviation, real estate, and finance (S. Chen et al., 2011). Second, state ownership is commonly used as a policy instrument by the government to exert influence over enterprises aiming to stabilize society, foster economic development, and undertake initiatives such as promoting

[2] A paper based on this chapter has been accepted by the 7th Vietnam International Conference in Finance and is under review at Journal of Banking and Finance.

employment and rescuing financially distressed firms (Inoue, Lazzarini, & Musacchio, 2013). Motivated by these observations, I am interested in investigating the underlying mechanism through which state ownership affects the firms' macroeconomic policy risk profile. This study investigates the impact of state ownership on firm-level economic policy uncertainty exposure. We hypothesize that firms with higher degrees of state ownership have higher exposure to EPU. Furthermore, this study proposes that the specific mechanism driving this relationship is the high level of debt financing that is facilitated by state ownership.

Over the years, research on the impact of state ownership on corporations under EPU shocks has gradually emerged, concentrating primarily on corporate risk-taking (F. Wen et al., 2021; W. Zhang et al., 2021), capital structure (X. Li, 2020; G. Zhang et al., 2015), credit allocation (Y. Huang et al., 2020), and tax avoidance (H. Shen et al., 2021). However, the impact of state ownership is still ambiguous, both theoretically and empirically. On the one hand, institutional theory highlights internal factors, such as state ownership, that can mitigate external institutional pressure (L. Cui & Jiang, 2012). State-owned firms have natural political relations with policymakers (Francis, Hasan, & Sun, 2009; Khaw, Liao, Tripe, & Wongchoti, 2016; W. Zhang et al., 2021). Such connections enable firms to possess implicit guarantees against default (Y. Huang et al., 2020). G. Zhang et al. (2015) demonstrate that state ownership attenuates the negative effect of EPU on leverage and identify that fewer financial constraints resulting from state ownership protect firms from deterioration of the external financing environment caused by EPU. Y. Huang et al. (2020) find that the disparity in credit allocation between SOEs and non-state-owned enterprises (non-SOEs) in responding to EPU can be attributed to the implicit guarantees provided by the government.

On the other hand, agency theory states that agency costs placed upon SOEs increase due to a lack of proper monitoring and the pursuit of politically motivated goals (W. Huang, Jiang, Liu, & Zhang, 2011). Maintaining economic and social stability, instead of maximizing profits in SOEs, has been the government's primary goal (Inoue et al., 2013). As a result, SOEs pursue not only operational goals, but also social and political objectives (Bruton, Peng, Ahlstrom, Stan, & Xu, 2015; Wu, Wu, & Rui, 2012). Mixed political and business objectives result in SOEs undertaking projects that lead to financial losses, but generate political advantages (Tihanyi et al., 2019). F. Wen et al. (2021) point out that EPU reduces corporate risk-taking, and state ownership encourages firms to invest in relatively high-risk projects as they have fewer financial constraints. W. Huang et al. (2011) find that agency problems drive an increased investment-cash flow sensitivity in SOEs, resulting in over-investment when there is sufficient capital.

The two strands of literature discussed above highlight the importance of incorporating financial constraints into the analysis of the relationship between state ownership and EPU. SOEs face fewer financial constraints because of the 'political pecking order' in the allocation of credit (Ding, Guariglia, & Knight, 2013; Poncet, Steingress, & Vandenbussche, 2010). State ownership empowers firms to enjoy easier access to debt financing (Faccio, Masulis, & McConnell, 2006) and allows them to borrow at favourable interest rates (Dewenter & Malatesta, 2001). In China, the government plays dual roles as the majority SOE shareholder and the owner of all major banks (K. Li, Yue, & Zhao, 2009). SOEs have access to subsidized credit from the banks, and lending decisions of state-owned banks may be politically motivated (Sapienza, 2004).

The literature on corporate ownership structure and financial constraints under the effect of EPU is extensive. However, for a long time, the literature has not addressed the direct impact of state ownership and financial constraints on policy uncertainty exposure. Previous studies mainly test the impacts of state ownership and financial constraints under EPU shocks by looking at the interaction term between EPU index and political connection variables (Y. Huang et al., 2020; G. Liu et al., 2021; H. Shen et al., 2021; Y. Wang et al., 2014; G. Zhang et al., 2015; W. Zhang et al., 2021), and separate the sample firms based on ownership structure (F. Wen et al., 2021). These studies apply the country-level EPU index directly, implicitly assuming all firms have the same exposure to EPU shocks. However, firms' capabilities to predict and respond to policy changes vary due to their individual characteristics. Although EPU does not differ in the market, the exposure of firms to EPU does (Bali et al., 2017; X. Li, 2020). This raises a challenging problem of how individual firms' characteristics are related to heterogeneous firm-level economic policy uncertainty exposure.

Motivated, in part, by the current research gap in the empirical literature detailed above, this chapter seeks to address the following two questions. Does state ownership affect firm-level economic policy uncertainty exposure? And, if the effect indeed exists, is it transmitted through leverage?

Using data on 3,404 A-share listed firms in China from 2000-2021, this study examines how state ownership affects companies' risk profiles. Consistent with our expectations, the impact of state ownership on economic policy uncertainty exposure is economically significant. First, the exposure to economic policy uncertainty increases by 17.6% with a one standard deviation increase in the state's ownership of a company. Second, higher leverage in SOEs causes higher exposure to economic policy uncertainty: a one standard deviation increase in the proportion of state ownership is associated with an increase in the market long-term debt ratio of 3.58% and a one standard deviation increase in the long-term debt ratio generates a 28.3% increase in the exposure to EPU. This suggests that debt financing is the channel through which state ownership exposes firms to EPU. Our results hold after conducting a series of robustness checks, including adjusting robust standard errors by clustering by firms, controlling for firm-, time-, and industry- fixed effects, addressing the potential issues of omitted variable problem, and mitigating concerns related to reverse causality.

We contribute to the literature in two important ways. First, our study extends beyond using the macroeconomic EPU index by using a measure of firm-level economic policy uncertainty exposure developed by Bali et al. (2017). Specifically, this study explores how the ownership structure influences firms' heterogeneous exposures to macro-level uncertainty. Second, our study reconciles the seemingly opposing views of institutional theory and agency theory, and presents empirical evidence that the increase of corporate risk associated with state ownership stems from the alleviation of financial constraints. To the best of our knowledge, this study is the first of its kind to explore the implications of state ownership on corporate exposure to policy uncertainty from the perspective of easing financing constraints.

The remainder of the chapter proceeds as follows. The next section reviews the related literature, after which this study develops the hypotheses. Section 3.3 details a description of the sources of data, the measurement of the variables, and the estimation procedure. The following section discusses the empirical results, while section 3.5 is the robustness analysis. The final section concludes the chapter.

3.2. Hypothesis Development

Literature shows that state ownership enhances firms' access to debt (Firth, Lin, Liu, & Wong, 2009). R. Stulz (1988) reviews controlling shareholders as a factor to exhibit higher financial leverage since debt financing increases their voting control for a given level of equity investment and reduces the risk of a hostile takeover. Lee, Lee, Zeng, and Hsu (2017) indicate that increase in EPU raises the volatility of expected earnings by firms, thereby firms resort to external sources of finance to survive in turbulent periods. To avoid economic turmoil, the government protects SOEs through credit expansions (Q. Wang, Wong, & Xia, 2008). Li et al. (2009) investigate the association between ownership structure and debt financing and document a positive effect of state ownership on firms' leverage and access to long-term debt. Faccio et al. (2006) examine firm performance before and after bailout and find that lenders are more willing to extend credit to firms with political connections than to their nonconnected peers. Based on these findings, this study expects state ownership to have a positive relationship with leverage.

H1: State ownership has a positive impact on debt financing.

The idea that country-level EPU can affect firms' capital structure is not new. Financial frictions become more pronounced with increases in EPU, including banking credit costs, default risk, and equity risk premia (G. Liu et al., 2021). G. Zhang et al. (2015) highlight the effect of EPU on firms' capital structure through two alternative channels – the supply effect and the demand effect. Increase in EPU will deteriorate the external financing environment and reduce firms' financing demand. Increasing economic policy uncertainty exacerbates information asymmetry between borrowers and creditors and leads to higher default risk due to more volatile cash flow in firms. Risk premium of bonds also increases with rising EPU (P. Gao, Murphy, & Qi, 2019). In a deteriorating external financing environment and unstable internal cash flows, rising leverage ratios reduce financial flexibility of firms and raise their risk of default, thereby expose firms to greater EPU shocks. On the other hand, under the shock of economic policy uncertainty, firms will implement more conservative strategies in making investment (G. Zhang et al., 2015). As a result, a scenario where firms reduce their financing demands emerges in the context of increased economic policy uncertainty. We thus expect to observe a positive relationship between leverage and economic policy uncertainty exposure.

H2: Debt financing has a positive impact on firms' economic policy risk exposure.

State ownership enhances firms' access to debt financing, which, in turn, is expected to increase policy uncertainty exposure. Therefore, combining the two hypotheses discussed above, this study thus expects state ownership to be positively related to firm-level EPU exposure, and the specific mechanism of this relationship is debt financing. In other words, this study expects leverage explained by state ownership to positively impact firm-level EPU exposure.

H3: State ownership positively impacts firms' economic policy risk exposure via enhancing debt financing.

3.3. Data and Methodology

3.3.1. Sample Description

We use the Chinese Stock Market and Accounting Research (CSMAR) database as the primary data source. We use China Economic Policy Uncertainty Index[3] constructed by Yun Huang and Luk (2020)'s as the EPU measure. The Huang-Luk EPU index has some advantages over other alternatives such as that constructed by Baker, Bloom, and Davis (2016). The Hung-Luk EPU index is based on broader economic news coverage and a more widespread readership (Jiang, Zhu, Tian, & Nie, 2019; X. Li, 2020).

Our sample includes all A-shares listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange. We eliminate financial firms, Special Treatment (ST) firms[4], and Particular Transfer (PT) firms[5] to ensure the accuracy of the research results because these firms have unusually high leverage ratios. All listed firms in China were required to adopt a unified set

[3] Downloaded from: https://economicpolicyuncertaintyinchina.weebly.com/
[4] Firms that have abnormal financial conditions due to the inability to generate profits over two or more consecutive years.
[5] Firms whose stocks are suspended from listing since the firms are incapable of making profits over three or more consecutive years.

of accounting standards and principles from 2000 (Q. Chen, Chen, Schipper, Xu, & Xue, 2012). Since most of the firm characteristics variables employed in this study are calculated from accounting data, this study follows Megginson, Ullah, and Wei (2014) and set the time period from 2000 to 2021 to ensure the consistency of variables over time. The final sample contains 34,967 firm-year observations, covering 3,404 listed firms.

3.3.2. Economic Policy Uncertainty (EPU) exposure

In order to obtain firm-level economic policy uncertainty exposure, this study follows Bali et al. (2017) to estimate EPU betas by using a Fama-French three-factor model augmented with the EPU index as follows:

$$R_{i,t} - r_{f,t} = \alpha_{i,t} + \beta_{i,t}^{mkt} MKT_t + \beta_{i,t}^{smb} SMB_t + \beta_{i,t}^{hml} HML_t + \beta_{i,t}^{epu} LEPU_t + e_{i,t}$$

(3.1)

where, $R_{i,t}$ is the contemporaneous return on firm *i* at month *t*, $r_{f,t}$ is the risk-free rate. EPU is the Huang-Luk economic policy uncertainty index, and $LEPU_t$is the logarithm of EPU at month *t*. MKT_t, SMB_t, and HML_t are the Fama-French factors. We estimate the time-varying $\beta_{i,t}^{epu}$ for each firm from the monthly rolling regressions over a 24-month window[6], allowing $\beta_{i,t}^{epu}$ to vary across firms and over time. We note that, for firms with negative $\beta_{i,t}^{epu}$, returns are negatively correlated with EPU, implying a less optimal hedge; these firms experience lower excess returns following an increase in EPU. In contrast, positive $\beta_{i,t}^{epu}$ suggests that the returns of the stocks are positively correlated with increases in EPU. These firms should be viewed as relatively safe firms at times of increased economic uncertainty (Bali et al., 2017).

[6] This study also estimates $\beta_{i,t}^{epu}$ using 36-month rolling window for robustness check and obtain consistent results. To maximise the availability of observations, this study employs the $\beta_{i,t}^{epu}$ from the monthly rolling regressions over a 24-month window.

3.3.3. State Ownership and Control Variables

Following Fama and French (2002), K. Li et al. (2009), and Pessarossi and Weill (2013), this study employs long-term debt over the market value of the total assets ratio (*LTD*) to measure firms' leverage. We use market values for the leverage estimation because Welch (2004) indicates that market-based debt ratios can more accurately describe the relative ownership of the firm by creditors and equity holders.

Following prior studies (Boubakri & Saffar, 2019; L. Cui & Jiang, 2012), this study measures state ownership in a firm as a total percentage of equity owned by the Chinese government and its agencies. Specifically, based on Delios, Wu, and Zhou (2006)'s definition of "government ownership" and the classification standard for the nature of business owners of the CSMAR database, this study calculates state ownership (*StateProp*) as the fraction of equity owned by the central government, local governments, government ministries, government bureaus, administrative organizations, state asset investment bureaus, and state asset management bureaus. This measure covers all listed firms ultimately controlled by local, provincial, or national-level governments in China (Delios et al., 2006). We then classify a firm as a non-SOE firm if its state ownership is zero, or a SOE firm if its state ownership is positive.

In terms of selecting control variables, this study follows the extant studies based on the pecking order of financing theory and trade-off theory (Fama & French, 2002; G. Huang, 2006; X. Li, 2020; Rajan & Zingales, 1995) and control for firm characteristics as follows. Firm size (*Size*) is the logarithm of total assets. Profitability (*Profitability*) is measured by the ratio of operating profit to total assets. Asset tangibility (*Tangibility*) is calculated by the ratio of net fixed assets to total assets. Market to book ratio (*Growth*) is the proxy for a firm's growth prospect, calculated as the market value of assets divided by the book value of total assets. We estimate firms' non-debt tax shield (*Shield*) using the ratio of depreciation of fixed assets to total assets. We define the percentage rate of outstanding shares held by the larger shareholders as the proxy for ownership concentration. We remove firm-year observations with missing values on any of the firm characteristic variables, and winsorize each variable at 1% of both tails to reduce the impact of outliers. Our final sample consists of a total of 34,967 firm-year observations, including 12,313 drawn from SOE firms and 22,654 from non-SOE firms.

Table 3. 1. Descriptive Statistics

Panel A Full samples								
	N	mean	max	min	SD	p25	p50	p75
EPU beta	34967	-0.0140	0.999	-0.992	0.151	-0.0860	-0.0180	0.0540
StateProp	34967	0.119	0.739	0	0.212	0	0	0.150
LTD	34967	0.0530	0.403	0	0.0800	0.00100	0.0180	0.0710
Size	34967	21.99	25.97	19.37	1.295	21.06	21.82	22.74
Profitability	34967	0.0370	0.227	-0.275	0.0710	0.0120	0.0380	0.0710
Fixed asset ratio	34967	0.255	0.745	0.00400	0.173	0.119	0.221	0.360
Growth prospect	34967	1.941	8.270	0.877	1.232	1.198	1.530	2.187
Tax shield	34967	0.0220	0.0740	0.00100	0.0150	0.0110	0.0190	0.0310
Ownership concentration	34967	0.361	0.877	0.00300	0.157	0.238	0.338	0.472

Panel B SOEs								
	N	mean	max	min	SD	p25	p50	p75
EPU beta	12313	-0.0180	0.969	-0.990	0.158	-0.0910	-0.0200	0.0520
StateProp	12313	0.338	0.739	0.0000152	0.232	0.114	0.341	0.538
LTD	12313	0.0650	0.403	0	0.0920	0.00200	0.0250	0.0870
Size	12313	21.94	25.97	19.37	1.375	20.93	21.72	22.74
Profitability	12313	0.0340	0.227	-0.275	0.0680	0.0110	0.0350	0.0650
Fixed asset ratio	12313	0.301	0.745	0.00400	0.186	0.153	0.270	0.430
Growth prospect	12313	1.620	8.270	0.877	0.884	1.117	1.331	1.767
Tax shield	12313	0.0250	0.0740	0.00100	0.0160	0.0130	0.0220	0.0340
Ownership concentration	12313	0.406	0.877	0.0470	0.164	0.273	0.392	0.534

Panel C NSOEs								
	N	mean	max	min	SD	p25	p50	p75
EPU beta	22654	-0.0120	0.999	-0.992	0.146	-0.0840	-0.0170	0.0550

StateProp	22654	0	0	0	0	0	0	0
LTD	22654	0.0460	0.403	0	0.0720	0	0.0150	0.0620
Size	22654	22.01	25.97	19.37	1.249	21.12	21.87	22.73
Profitability	22654	0.0390	0.227	-0.275	0.0720	0.0130	0.0400	0.0740
Fixed asset ratio	22654	0.230	0.745	0.00400	0.160	0.105	0.199	0.322
Growth prospect	22654	2.116	8.270	0.877	1.353	1.270	1.667	2.426
Tax shield	22654	0.0210	0.0740	0.00100	0.0150	0.0100	0.0180	0.0290
Ownership concentration	22654	0.337	0.824	0.00300	0.147	0.223	0.314	0.433

Notes: EPU beta is the firm's policy unvertainty sensitivity, which is the coefficient of the EPU index calculated by the Fama-French three factors model. *StateProp* is the proportion of state ownership in firms' ownership structure. *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. Firm-year observations with missing values on any of the firm characteristic variables are removed and all variables are winsorized at 1% in both tails to reduce the impact of outliers. Our sample consists of totally 34,967 firm-year observations, including 12,313 from SOE firms and 22,654 from non-SOE firms.

Table 3.1 presents the descriptive statistics on all the variables for SOE and non-SOE firms, separately. Among the SOEs, the government and its agencies own, on average, 33.8% of the shares of the firms. Comparing the firm characteristics of the different types of the firms, as can be seen, SOEs and non-SOEs are approximately of the same size, but SOEs are on average less profitable, have less growth prospects, higher fixed asset ratio, tax shield, and ownership concentration. Most importantly, SOEs have much higher leverage. The average (mean) market long-term debt ratio in SOEs is 6.4%, which is 41.3% higher than the average debt ratio of 4.6% for non-SOEs. This is consistent with the view that SOEs have fewer financial constraints than non-SOEs.

3.3.4. Model Specification

In section 3.2, this study hypothesizes that state ownership enhances firms' access to debt financing, which, in turn, is expected to increase policy uncertainty exposure. To verify the hypotheses, this study starts by estimating the baseline model to test the relationship between state ownership and long-term debt ratio as follows:

$$LTD_{i,t} = \alpha_i + \beta_1 StateProp_{i,t-1} + \sum_k \beta_k \, controls_{k,i,t-1} + e_{i,t} \qquad (3.2)$$

where, $LTD_{i,t}$ is the long-term debt ratio of firm i at the end of year t. $StatePorp_{i,t-1}$ is the proportion of state ownership in firm i at the end of the previous year. We include firm size, profitability, fixed asset ratio, growth prospects, tax shield, and ownership concentration as control variables. We expect a positive relationship between state ownership and long-term debt ratios.

We also use the following model to test the relationship between long-term debt and EPU betas:

$$EPU\ beta_{i,t} = \alpha_i + \beta_1 LTD_{i,t-1} + \sum_k \beta_k\ controls_{k,i,t-1} + e_{i,t} \quad (3.3)$$

where, $EPU\ beta_{i,t}$ is firm i's economic policy uncertainty exposure estimated by Equation Firms with higher leverage ratios tend to have more volatile cash flows and less financial flexibility, and thus are more vulnerable to EPU shocks. Therefore, this study expects a negative relationship between long-term debt ratios and EPU betas.

We then estimate the following model to explore the direct relationship between state ownership and EPU betas:

$$EPU\ beta_{i,t} = \alpha_i + \beta_1 StateProp_{i,t-1} + \sum_k \beta_k\ controls_{k,i,t-1} + e_{i,t} \quad (3.4)$$

Following our baseline hypotheses, state ownership enhances firms' debt financing, and increased debt financing increases EPU exposure. We expect a negative association between state ownership and EPU betas.

With the aim to identify the role of debt financing in the relationship between state ownership and EPU exposure, this study follows Richardson (2006) and McNichols and Stubben (2008) and separate firms' long-term debt into parts that are explained and unexplained by state ownership, and test the impact of both these two parts on economic policy uncertainty exposure.

$$EPU\ beta_{i,t} = \alpha_i + \alpha_1 \widehat{LTD}_{i,t} + \sum_k \alpha_k\ controls_{k,i,t-1} + \varepsilon_{i,t} \tag{3.5}$$

$$EPU\ beta_{i,t} = \gamma_i + \gamma_1 e_{i,t} + \sum_k \gamma_k\ controls_{k,i,t-1} + \varepsilon_{i,t} \tag{3.6}$$

Where, $\widehat{LTD}_{i,t}$ is the fitted value of the long-term debt ratio calculated in Equation (2), which represents the part of leverage explained. $e_{i,t}$ is the residual from Equation (2). The comparable coefficients (α_1 and γ_1) allow us to identify the divergence effect between the easing of financial constraints by state ownership and the debt financing unrelated to state ownership on firms' economic policy uncertainty exposure.

Through the Hausman test, this study chooses the fixed effects model with robust standard errors, which allows us to capture the unobserved heterogeneity across individual firms over the random effects model. We adopt heteroskedasticity-robust standard errors adjusted for clustering at the firm level. To mitigate possible reverse causality problems and for better identification, this study lags all the independent variables by one year relative to the year in which the dependent variable is measured.

3.4. Empirical Results

3.4.1. Baseline Findings

Table 3.2 reports the relationship between state ownership and debt financing from estimating Equation (3.2). The coefficient on state ownership is positive and statistically significant at the 1% level after controlling the heterogeneous firm characteristics. The long-term debt ratios appear to increase with state ownership. This result is consistent with our hypothesis that state ownership enhances firms' long-term debt financing. As Faccio et al. (2006) and K. Li et al. (2009) point out, state ownership eases firms' access to debt financing.

In China, the dominant roles of the Chinese government in SOEs and in domestic banks result in investments of SOEs being supported through heavily subsidized bank loans, leading to relatively higher leverage in SOEs.

Table 3. 2. The Estimation Results of the Relationship between State Ownership and Long-term Debt Financing by Fixed-effect Model

	(1) Market long-term debt ratio
StateProp	**0.00894****
	(2.29)
Size	0.0209***
	(19.64)
Profitability	-0.0749***
	(-8.22)
Fixed asset ratio	0.0513***
	(5.21)
Growth prospect	-0.00366***
	(-9.17)
Tax shield	-0.771***
	(-7.90)
Ownership concentration	0.0244**
	(2.55)
_cons	-0.391***
	(-14.01)
Clustered by firms	Yes
Firm fixed effect	Yes
Year fixed effect	Yes
Robust Standard Error	Yes
R square	0.1437
N	30058

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress market long-term debt ratios on the proportion of state ownership and EPU betas on market long-term debt ratios using the fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 3.3 reports the relationship between debt financing and EPU exposure estimated by Equation (3.3). The negative relationship between long-term debt ratios and EPU betas demonstrates that long-term debt financing increases firms' EPU exposures, which is consistent with our expectations. An extensive body of literature has demonstrated a positive association between debt financing and risk (Lev, 1974; Mandelker & Rhee, 1984). Hackbarth, Miao, and Morellec (2006) find that debt financing increases the likelihood of costly financial distress. Firms' future cash flows will be more volatile under growing EPU. Increasing long-term debt financing with more volatile cash flows reduces financial flexibility, hence expanding firms' exposure to changes in economic policies.

Table 3. 3. The Estimation Results of the Relationship between Long-term Debt Financing and EPU Exposures by Fixed-effect Model.

	(1) EPU beta
Market long-term debt ratio	**-0.0496*** (-2.85)**
Size	0.0139*** (10.39)
Profitability	-0.00900 (-0.58)
Fixed asset ratio	0.0437*** (3.72)
Growth prospect	0.00322*** (2.96)
Tax shield	-0.388*** (-3.01)
Ownership concentration	0.0268** (2.33)
_cons	-0.375*** (-8.04)
Clustered by firms	Yes
Firm fixed effect	Yes
Year fixed effect	Yes
Robust Standard Error	Yes
R square	0.0182
N	30058

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress market long-term debt ratios on the proportion of state ownership and EPU betas on market long-term debt ratios using the fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

To measure the practical importance of our results, this study uses the average value of the market long-term debt ratio and EPU betas to determine the economic significance of the average slope coefficients of state ownership proportion and long-term debt financing in Tables 3.2 and 3.3. Both the impacts of state ownership on long-term debt financing and the effects of long-term debt financing on EPU betas are economically significant at 0.00894 and -0.0496: A one standard deviation increase in the proportion of state ownership, ceteris paribus, is associated with an increase in market long-term debt ratio of 3.58% relative to the sample mean, which translates to a 626,500,000 CNY increase in the firms' debt (multiplied by the mean market value of total assets). Similarly, holding all else constant, a one standard deviation growth in long-term debt financing is associated with a 28.3% rise in exposure to EPU.

3.4.2. Direct Impact of State Ownership on EPU Exposure

In the previous sections, this study has provided evidence that state ownership facilitates firms' long-term debt financing which, in turn, increases economic policy uncertainty exposure. In this section, this study presents the direct estimation results on the relationship between state ownership and EPU exposure from Equation (3.4).

Table 3. 4. Estimating Direct Relationship between State Ownership and EPU Exposures using Fixed-effect Model

	(1) EPU beta
StateProp	**-0.0116**** **(-2.00)**
Size	-0.00546*** (-2.94)
Profitability	0.0769*** (5.39)
Fixed asset ratio	0.000519 (0.05)
Growth prospect	-0.00273** (-2.41)
Tax shield	-0.104 (-0.93)
Ownership concentration	0.000145 (0.01)
_cons	0.0589 (1.21)
Clustered by firms	Yes
Firm fixed effect	Yes
Year fixed effect	Yes
Robust Standard Error	Yes
R square	0.1826
N	30058

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress EPU betas on the proportion of state ownership using the fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

We present the results in Table 3.4. The results show that state ownership has a negative effect on EPU betas, which implies increased economic policy uncertainty exposure with the increase in state ownership. Specifically, a standard deviation increase in state ownership proportion is associated with a 17.6% increase in exposures to EPU relative to the sample mean, which is economically significant. The finding is consistent with our expectations.

Firms with a significant degree of state ownership are concerned with achieving political and social goals, such as maintaining employment levels, channeling policies, and stabilising regional development (Khaw et al., 2016). It is, therefore, intuitive that SOEs may have higher exposure to economy-wide policy uncertainty compared with non-SOEs.

3.4.3. Leverage as a Channel of State Ownership Influence

To test the conjecture that state ownership increases firms' economic policy uncertainty exposures through promoting debt financing, this study follows the method used by Richardson (2006) and McNichols and Stubben (2008) to estimate the fitted values and residuals of the market long-term debt ratio from Equation (3.2), and then test the explanatory power of both values to firms' economic policy uncertainty exposures. Table 3.5 presents the estimation results from models (3.5) and (3.6).

Table 3. 5. Estimation Results from the Role of Leverage in the Relationship between State Ownership and EPU Betas by Fixed-effect Models

	(1) EPU beta	(2) EPU beta
Fitted value of market long-term debt ratio	**-1.292**** **(-2.00)**	
Residuals		**2.528** **(0.65)**
Size	0.0215 (1.56)	-0.00578*** (-3.10)
Profitability	-0.0199 (-0.39)	0.0784*** (5.39)
Fixed asset ratio	0.0669* (1.94)	0.000338 (0.03)
Growth prospect	-0.00745*** (-2.76)	-0.00282** (-2.44)
Tax shield	-1.101** (-2.15)	-0.121 (-1.07)
Ownership concentration	0.0317 (1.47)	-0.00591 (-0.52)
_cons	-0.446* (-1.72)	0.0299 (0.46)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1826	0.1824
N	30058	30058

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Fitted values of book long-term debt ratio* are the fitted values estimated by the regressions between state ownership and market long-term debt ratio, which is the explained part of firms' leverage by state ownership. *Residuals* are the unexplained part of EPU by state ownership extracted in the regression between state ownership and market long-term ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We follow Richardson (2006) and McNichols and Stubben (2008) and estimate the fitted values, as the part of market long-term debt explained by state ownership, and the residuals, as the part of market long-term debt unrelated to state ownership from Equation (3.1). We employ fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Column (1) of Table 3.5 shows that the coefficient of the fitted value of market long-term debt ratio is negative and statistically significant. the coefficient of the residuals, which indicates the effect of unexplained part of leverage by state ownership, is insignificant. In Column (2), the part of leverage that is not explained by state ownership is insignificantly related to EPU exposure. This implies that even though leverage significantly impacts policy uncertainty exposure, and state ownership is one of the driving forces behind this relationship, factors unrelated to state ownership do not play a significant role in explaining the leverage-uncertainty relationship. The results in Table 3.5 indicate that the increased leverage of a firm that is purely driven by state ownership tends to increase the firm's EPU exposure measured by a lower EPU beta. This is consistent with our expectations.

Overall, our results are in supportive of our hypotheses. We find that a higher percentage of state ownership results in higher economic policy uncertainty exposure, and the channel of this effect is SOE-induced increases in leverage. In the next section, this study examines the robustness of our findings.

3.5. Robustness Tests

To robustify our results in Table 3.2 through Table 3.5, this study conducts a set of rigorous robustness checks, including addressing potential omitted variables, reverse causality, industry effects, and the divergent effect of different types of SOE[7].

[7] This study also performs univariate regressions and employ state ownership dummy variable as alternative measure to improve the robustness of the empirical results. To save space, this study reports the results from Table A3.7 to Table A3.9.

3.5.1. Omitted Variables

In the main analysis, this study establishes that economic policy uncertainty exposure is driven by high levels of debt which is, in turn, enhanced by state ownership. A possibility remains that the relationship is driven by other factors, namely, managerial risk-taking.

A number of studies establish that managerial risk-taking reflects a wide array of strategic choices with uncertain consequences (Hoskisson, Chirico, Zyung, & Gambeta, 2017; Pepper & Gore, 2015). Shi, Aguilera, and Wang (2020) show that firms with a high percentage of state ownership are more likely to commit misconduct. To examine whether the positive relationship between state ownership and firms' economic policy uncertainty exposure is attributed to managerial risk-taking, this study forms two sub-samples on firm-year based on separating the full sample by the times of high and low interest rates. In times of high interest rates[8], the increased cost of debt financing will induce managers to become more sensitive to unpredictable risk and result in a reduction in corporate investment. In contrast, managers in SOEs will instigate a more aggressive investment strategy in times of low interest rates, in order to reduce the costs of debt financing. In other words, we are less likely to observe managerial misbehaviour (in a sense of extending leverage), which is more likely to occur in times of low interest rates (J. Shen, Firth, & Poon, 2016). Therefore, the effects of state ownership on economic policy uncertainty exposures will become weaker (stronger) in times of higher (lower) interest rates. The results are presented in Tables 3.6 -3.8.

[8]This study employs the Chinese Interbank Offered Rate as the measure of interest rates. According to X. Liu and Fu (2016), the Interbank Offered Rate is the only direct market rate in China's currency market.

Table 3. 6. Robust test: Estimating Effects of State Ownership on Leverage in the Times of Higher and Lower Interest Rates

	(1) CHIBOR>Median Market long-term debt ratio	(2) CHIBOR<Median Market long-term debt ratio
StateProp	**0.00889**** **(1.98)**	**0.00813*** **(1.69)**
Size	0.0211*** (17.99)	0.0196*** (15.30)
Profitability	-0.0874*** (-7.29)	-0.0602*** (-5.81)
Fixed asset ratio	0.0459*** (4.10)	0.0442*** (4.04)
Growth prospect	-0.00246*** (-4.65)	-0.00549*** (-9.43)
Tax shield	-0.795*** (-6.55)	-0.705*** (-6.60)
Ownership concentration	0.00702 (0.64)	0.0497*** (4.58)
_cons	-0.408*** (-12.53)	-0.361*** (-11.69)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1375	0.1563
N	16092	13966

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We separate our sample by China Interbank Offered Rate (CHIBOR) and test the effects of state ownership on leverage in times of higher and lower interest rates, respectively. We employ fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 3. 7. Robust test: Estimating Effects of Leverage on EPU Betas at the Higher and Lower Interest Rate Time

	(1) CHIBOR>Median EPU beta	(2) CHIBOR<Median EPU beta
Market long-term debt ratio	**-0.0879***** **(-3.78)**	**-0.0373** **(-1.59)**
Size	0.0361*** (18.73)	0.00942*** (5.40)
Profitability	0.00722 (0.32)	-0.0259 (-1.21)
Fixed asset ratio	0.0480*** (3.01)	0.0286* (1.91)
Growth prospect	0.0112*** (7.55)	0.00501*** (3.32)
Tax shield	-0.503*** (-2.83)	-0.572*** (-3.49)
Ownership concentration	0.00991 (0.60)	0.0418*** (2.88)
_cons	-0.870*** (-16.44)	-0.255*** (-4.32)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.0567	0.0279
N	16092	13966

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We separate our sample by China Interbank Offered Rate (CHIBOR) and test the effects of leverage on EPU betas in times of higher and lower interest rates, respectively. We employ fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 3. 8. Robust test: Estimating Effects of State Ownership on EPU Betas at the Higher and Lower Interest Rate Time

	(1) CHIBOR>Median EPU beta	(2) CHIBOR<Median EPU beta
StateProp	**-0.0255*** (-3.50)**	**-0.0202** (-2.57)**
Size	0.0325*** (17.35)	0.00707*** (3.99)
Profitability	0.0271 (1.22)	-0.0202 (-0.96)
Fixed asset ratio	0.0424*** (2.69)	0.0271* (1.82)
Growth prospect	0.0111*** (7.52)	0.00447*** (2.89)
Tax shield	-0.438** (-2.50)	-0.550*** (-3.38)
Ownership concentration	0.0196 (1.17)	0.0551*** (3.50)
_cons	-0.794*** (-15.29)	-0.204*** (-3.38)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.0565	0.0283
N	16092	13966

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We separate our sample by China Interbank Offered Rate (CHIBOR) and test the effects of state ownership on EPU betas in times of higher and lower interest rates, respectively. We employ fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

The results are consistent with our baseline estimations reported in Tables 3.2 to 3.4, and there are no substantial differences in relationships between state ownership, leverage, and EPU exposure in times of high and low interest rates. In fact, the coefficients in regressions between leverage and EPU beta (Table 3.7), and state ownership and beta (Table 3.8), are larger in times of high interest rates, which is consistent with the notion that leverage is riskier in times of high interest rates (Andrade & Kaplan, 1998; Cathcart, Dufour, Rossi, & Varotto, 2020). No evidence supports that state ownership extends firms' EPU exposure through managerial misbehaviour. These results confirm that our previous results are robust and do not suffer from the omitted variable bias.

3.5.2. Reverse Causality

We also acknowledge that potential reverse causality may be another source of endogeneity that may not be fully addressed by lagging explanatory variables. De La Bruslerie and Latrous (2012) indicate that ownership structure is an endogenous variable for leverage decisions. In addition, firms may adjust their optimal capital structure based on EPU shocks (X. Li, 2020). In order to address this concern, this study adopts a two-stage least squares (2SLS) approach to re-estimate the baseline relationships.

Following Li et al. (2008) and Molina (2005), this study uses: (a) The proportion of employees in the private sector and legal effectiveness as instrumental variables for state ownership; and (b) the history of past market valuation and marginal tax rate as instrumental variables for long-term debt. Table 3.8 reports the results estimated by 2SLS.

Table 3. 9. Robust test: The Estimation Results of Baseline Regressions (Sample period 2000-2020)

	(1) StateProp	(2) Market long-term debt ratio	(3) Market long-term debt ratio	(4) EPU beta
Proportion of Employees in Private Section	-0.769*** (-22.04)			
Legal effectiveness	-0.253*** (-37.64)			
StateProp		**0.0452*** (4.93)**		
Past market valuation			-0.0108*** (-8.32)	
Marginal tax rate			0.00879*** (2.75)	
Market long-term debt ratio				**-0.786*** (-3.62)**
Size	-0.00517** (-2.55)	0.0255*** (23.00)	0.0233*** (25.77)	0.0267*** (4.94)
Profitability	0.00505 (0.18)	-0.122*** (-11.56)	-0.155*** (-15.68)	-0.107*** (-2.81)
Fixed asset ratio	0.0354* (1.65)	0.128*** (11.31)	0.150*** (13.62)	0.132*** (3.67)
Growth prospect	-0.0238*** (-16.50)	-0.00257*** (-4.68)	-0.00426*** (-9.87)	-0.000543 (-0.34)
Tax shield	0.410* (1.90)	-0.933*** (-9.29)	-0.966*** (-10.01)	-1.121*** (-4.60)
Ownership concentration	0.395*** (23.82)	-0.0314*** (-3.76)	-0.0111* (-1.84)	-0.0100 (-1.25)
Clustered by firms	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Wald F test		0.000		0.000
Hansen J		0.2953		0.5533
N	23157	23157	24829	24829

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress market long-term debt ratios on the proportion of state ownership and EPU betas on market long-term debt ratios using two-stage least squares (2sls). Columns (1) and (2) report the two stages estimation results between state ownership and debt financing. Following H. Li, Meng, Wang, and Zhou (2008), this study uses the proportion of employees in the private section and legal effectiveness as the instrumental variables. Columns (3) and (4) report the two stages estimation results between debt financing and EPU exposure. Following Molina (2005), this study introduces past market valuations and marginal tax rates as instrumental variables. The sample period is 2000-2020 due to the availability of data for instrumental variables. All explanatory variables and control variables are lagged by one period. Factors that influence long-term debt financing and EPU exposures and fixed effects are controlled. Standard errors are clustered at the firm level and corrected for heteroscedasticity. The Wald F test (weak identification test) and Hansen J test (over-identifying restrictions) prove the validity of the instrumental variables. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 3.9[9] reports the estimation results between state ownership and debt financing and between debt financing and economic policy uncertainty exposure by using 2SLS. Referring to Li et al. (2008), the role of state ownership is expected to diminish with relatively developed markets and legal systems. In Column (1), this study finds that the proportion of employees in the private section and legal effectiveness negatively impact state ownership in the first stage of the regression, echoing the outcomes by Li et al. (2008). We conduct the Wald F-test of the exogenous IV variables in the first stage of the regression. The null hypothesis of the test is that the instruments do not explain differences in the proportion of state ownership. We reject the null hypothesis at the 1% level. Also, the Hansen J test (over-identifying restrictions) reinforces the validity of instrumental variables. We also refer to Molina (2005) and adopt past market valuations and marginal tax rates as instrument variables in the relationship between debt financing and economic policy uncertainty exposure. The signs of instrumental variables in the first stage regression, reported in Column (2), are consistent with trade-off literature (Fama & French, 2002). F-test and Hansen J test confirm the validity of instrumental variables.

Columns (2) and (4) show the estimation results from the second stages of 2SLS regressions. The coefficient on state ownership is positive and statistically significant at the 1% level after controlling the heterogeneous firm characteristics. The long-term debt ratios appear to increase with the presence of state ownership. The negative relationship between long-term

[9] Due to the availability of data for proportion of employees in the private section and legal effectiveness, the sample period in Table 3.9 is from 2000 to 2020.

debt ratios and EPU betas demonstrates that long-term debt financing will increase firms' economic policy uncertainty exposures. The baseline results estimated by 2SLS are consistent with our results from OLS in terms of the level of significance and the magnitude of the coefficients, further confirming the robustness of our empirical findings.

3.5.3. Firms with Positive EPU Beta versus Firms with Negative EPU Betas

In Section 3.2, I note that firms with positive EPU betas are relatively safe at times of increased economic policy uncertainty and those with negative EPU betas have less optimal hedges so to experience lower excess returns following an increase in EPU. To further identify the impact of state ownership on firm-level economic policy uncertainty exposure and the role of debt financing in this relationship in different EPU exposed firms, this study conducts a grouping analysis by separating the sample into the group of firms with positive EPU beta and the counterpart with negative EPU betas and re-testing our baseline estimations.[10]

Table 3.10 shows the estimation results of the relationship between state ownership and long-term debt financing in the groups for firms with positive and negative EPU betas. The results indicate that state ownership promotes corporate debt financing for both of firms with positive and negative EPU betas. The larger coefficient for firms with positive EPU betas suggests that the relatively safe firms enjoy a stronger capability of debt financing by state ownership.

[10] I am grateful for the valuable comments from the reviewers of Journal of Banking and Finance.

Table 3. 10. The Estimation Results of the Relationship between State Ownership and Long-term Debt Financing in Different Groups.

	(1) EPU beta>0 Market long-term debt ratio	(2) EPU beta<0 Market long-term debt ratio
StateProp	**0.0102*** **(1.77)**	**0.00741*** **(1.65)**
Size	0.0182*** (13.89)	0.0223*** (16.20)
profitability	-0.0630*** (-4.83)	-0.0817*** (-6.66)
Fixed asset ratio	0.0421*** (3.13)	0.0535*** (4.79)
Growth prospect	-0.00467*** (-7.56)	-0.00283*** (-5.74)
Tax shield	-0.612*** (-4.44)	-0.899*** (-7.93)
Ownership concentration	0.00157 (0.12)	0.0289** (2.55)
_cons	-0.317*** (-8.39)	-0.425*** (-12.03)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1408	0.1370
N	11732	16696

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress market long-term debt ratios on the proportion of state ownership and EPU betas on market long-term debt ratios using fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 3.11 presents the effect of debt financing on EPU betas in groups of firms with positive and negative EPU betas. Debt financing has a statistically significant and negative effect on

EPU beta in the group of firms with positive EPU betas, but becomes insignificant in the group of firms with negative EPU betas. These results imply that the increase in debt financing deteriorates the performance of the relatively safe firms under EPU by increasing their exposure to EPU and does not have an effect on the firms that have been highly exposed to EPU.

Table 3. 11. The Estimation Results of the Relationship between Long-term Debt Financing and EPU Exposures in Different Groups.

	(1) EPU beta>0 EPU beta	(2) EPU beta<0 EPU beta
Market long-term debt ratio	**-0.0372**** **(-2.00)**	**-0.0146** **(-1.10)**
Size	0.000370 (0.27)	0.00704*** (6.47)
profitability	0.00111 (0.06)	-0.0191 (-1.44)
Fixed asset ratio	0.0144 (1.15)	-0.00461 (-0.50)
Growth prospect	0.0120*** (10.34)	-0.00883*** (-11.16)
Tax shield	-0.114 (-0.93)	-0.153 (-1.56)
Ownership concentration	-0.0121 (-1.01)	0.0258*** (2.86)
_cons	0.0799** (2.13)	-0.284*** (-8.88)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1408	0.1370
N	11732	16696

Notes: Dependent variables: *EPU beta* is the firm's policy risk sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress market long-term debt ratios on the proportion of state ownership and EPU betas on market long-term debt ratios using fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 3.12 reports the effect of state ownership on EPU betas in different groups. As can be seen, state ownership has a significantly negative impact on EPU beta in the groups of firms with positive EPU betas and is insignificant in the group of firms with negative EPU betas, implying that state ownership increases EPU exposure to relatively safe firms and has no influence on underperforming firms under EPU shocks.

Table 3. 12. Estimating Direct Relationship between State Ownership and Economic Policy Uncertainty Exposures in Different Groups.

	(1) EPU beta>0 EPU beta	(2) EPU beta<0 EPU beta
StateProp	-0.0120** (-2.00)	-0.00608 (-1.51)
Size	-0.00237* (-1.80)	0.00684*** (6.67)
profitability	0.0110 (0.67)	-0.0126 (-1.03)
Fixed asset ratio	0.0116 (0.97)	-0.00452 (-0.50)
Growth prospect	0.0119*** (10.80)	-0.00906*** (-11.58)
Tax shield	-0.0983 (-0.82)	-0.132 (-1.42)
Ownership concentration	-0.00397 (-0.33)	0.0260*** (2.92)
_cons	0.130*** (3.58)	-0.277*** (-8.92)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes

R square	0.1408	0.1370
N	11732	16696

Notes: Dependent variables: *EPU beta* is the firm's policy risk sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress EPU betas on the proportion of state ownership using fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively

Therefore, by integrating the results from Tables 3.10 to 3.12, this study can conclude that the growth of debt financing and state ownership lead to an increase in firms' EPU exposure driven by the fact that they deteriorate the performance of firms that initially outperformed under EPU.

3.5.4. Financially Liberalized Industries versus Non-financially Liberalized Industries

We conduct further test to confirm our findings. Following O'Connor, Deng, and Luo (2006), this study separates industries by sales growth rates[11]. Sales growth rates serve as a proxy for industry financial liberalization. Industries with higher sales growth rates are more financially liberalized as they have alternative sources of capital, which may decrease their reliance on the state (O'Connor et al., 2006). Hence, if the observed relationship between uncertainty exposure and state ownership is driven by the leverage, such relationship should be stronger among industries with lower sales growth rates, or industries that rely more on the government in obtaining capitals. To test such conjecture, this study separates our sample firms into industries with high or low sales growth rates, and test the relationships between leverage and state ownership, leverage and EPU exposure, and state ownership and EPU exposures. The results are reported in Appendix Table A3.2, A3.3, and A3.4 respectively. As expected, state ownership has no significant impact on leverage in industries with higher

[11] The industry classification based on sales growth rates is detailed in Appendix Table A3.12.

sales growth rates, whereas it increases firms' leverage ratios in the industries with lower sales growth rates. Second, debt financing has no significant effect on EPU betas in industries with higher sales growth rates, but significantly increases economic policy uncertainty exposure in industries with lower sales growth rates. Finally, state ownership has no significant impact on EPU betas in the industries with higher sales growth rates. In comparison, state ownership increases firms' economic policy uncertainty exposures in the industries with lower sales growth rates.

We also test the effects of both explained and unexplained parts of leverage on EPU exposure in these two kinds of industries. The results are reported in Appendix A3.5. Consistent with our expectation, the explained part of leverage has a significant impact on EPU exposure in the less financially liberalised industries but has no significant influence in more financially liberalised industries, suggesting that leverage related to state ownership in the industries with more reliance on the state increases economic policy uncertainty exposure. The results from these industry tests confirm the debt financing-related effect of state ownership on firms' economic policy uncertainty exposure, reinforcing our findings.

3.5.5. Central Government Controlled SOEs versus Local Government Controlled SOEs.

Cheung, Rau, and Stouraitis (2010) examine whether companies benefit or lose from the presence of government shareholders and find divergent impacts of related party transactions on minority shareholders for companies with ties to local government compared to those with ties to the central government. An additional question arises, in further justifying the role of state ownership in firms' exposure to EPU: Whether the differences between the incentives and behaviors of central and local governments may differ in their influence on firms' EPU exposure. To examine the effects of different level of government, this study separates our sample into central government controlled and local government controlled SOEs and test the effect of leverage on EPU exposure in these two groups. Table A3.6 reports the results. Leverage becomes more pronounced to increases in EPU exposure in central government controlled SOEs compared to local government controlled counterparts. Consistent with Y. Lin, Fu, and Fu (2021), central government controlled SOEs undertake more obligations to advance national industrial and welfare priorities and are much more social-oriented than local SOEs.

3.5.6. The Analysis of Difference

To further confirm whether substantial changes in the proportion of state ownership affect EPU exposures differently, this study performs paired T-tests in SOEs to examine the difference in EPU betas between pre- and post-substantial changes of state-owned shares. First, this study defines substantial increases (decreases) as the increase (decreases) in state ownership greater than one standard deviation in the given year. Pre-substantial increase (decrease) in state-owned shares is the previous year of the substantial increases (decreases). Post-substantial increase in state-owned shares is the current year of the substantial increases (decreases). Then, this study conducts the analysis of difference for EPU exposures between pre-substantial increases in state ownership and post-substantial increases in state ownership, and between pre-substantial decreases in state ownership and post-substantial decreases in state ownership by using paired t-tests. The results are reported in Table A.3.7, presenting that EPU exposures do not have significant differences between pre- and post-substantial increases, but are significantly reduced after substantial decreases in state ownership. The results from paired T-tests indicate that EPU exposure in SOEs has no significant difference after substantial increases in state shareholding, whereas substantial decreases in the proportion of state ownership significantly reduce firms' exposure to EPU. The results reinforce our previous findings.

3.5.7. The Mediating Effect

Table 3.5 provides supporting evidence of the mediating role of leverage by showing that only the part of leverage explained by state ownership is associated with EPU exposure. It may remain ambiguous whether state ownership affects EPU exposures completely or only partially through leverage. This section particularly focuses on the robustness of the mediating role of financial leverage plays in the relationship between state ownership and EPU exposure.[12]

The manifestation of a mediation effect necessitates the fulfillment of four conditions as suggested by Baron and Kenny (1986). Initially, there must exist a correlation between the independent and dependent variables. Subsequently, a correlation between the independent variable and the mediator variable is essential. Thirdly, a correlation between the mediator and dependent variable must be established. Lastly, a crucial condition involves the alteration of the effect exerted by the independent variables on the outcome variable when accounting for the mediating variable.

The results in Tables 3.2 to 3.4 clearly present that state ownership impacts debt financing and both debt financing and state ownership affect EPU exposure. Then, this study adds debt financing as a mediator in the direct regression of state ownership on EPU exposure, reported in Table A.3.11. The results show that the coefficient of state ownership shifts from -0.0116 to -0.0103 with a decline of significance level from 5% to 10, providing the support that debt financing has a partial mediation effect in the relationship between state ownership and EPU beta.

[12] I thank the valuable comments from the overseas examiner of PhD Examination.

3.5.8. The Volatility of EPU Beta

This study also follows Chauhan and Jaiswall (2023) and Luo and Zhang (2020) to employ the absolute value of EPU beta to capture the firms' sensitivity to EPU.[13] The EPU exposure is considered by taking the absolute value of EPU coefficient as either a significant positive or negative coefficient implies a pronounced influence of EPU fluctuations on the associated underlying stock.

Table A.3.12 reports the effect of debt financing and state ownership on the absolute value of EPU betas estimated by first order difference regressions. As can be seen, both changes in debt financing and changes in the proportion of state ownership have a positive impact on changes in the absolute value of EPU beta. Consistent with the expectation of this study, both the growth of debt financing and the proportion of state ownership augment the firms' volatility of EPU beta, reinforcing our findings.

3.6. Conclusion

This chapter explores the impact of state ownership on corporate economic policy uncertainty exposure from the perspective of debt financing in the sample of 3,118 Chinese A-share listed enterprises. I adopt firm-level heterogeneous exposure to macro-level EPU by using the method of Bali et al. (2017). Motivated by the research gap between institutional theory and agency theory, our study contributes to the literature by providing empirical evidence to reveal the mechanism by which state ownership affects the company policy risk profile.

First, inspired by Boubakri and Saffar (2019), which proves a positive relation between state ownership and the use of bank debt financing, and DeAngelo, Gonçalves, and Stulz (2018), which observe a reduced financial flexibility in high levered firms, I examine a setting in

[13] I appreciate the valuable comments from domestic examiner of PhD Examination and Bart Frijns, the guest editor from the global finance journal.

which state ownership is significantly positively related to corporate debt financing and debt financing, in turn, increases firms' exposures to EPU. Following the above baseline results, this study explores the direct association between state ownership and firms' economic policy uncertainty exposure to investigate the implication of state ownership on policy risk management. This chapter finds a positive relationship between state ownership and economic policy uncertainty exposures, which translates to an average 17.6% increase in economic policy uncertainty exposure with a one standard deviation growth in the proportion of state ownership. To further identity the role of easing financial constraints in the relationship, which is highlighted as the main advantage of state ownership in both institutional theory and agency theory, this study distinguishes politically motivated leverage from general debt financing of the company and find that debt financing serves as the channel through which state ownership exposes firms to EPU. Our findings are robust to considering the endogeneity problem from omitted variable bias and reverse causality.

Through investigating the largest and most rapidly growing emerging economy, with significant mixed ownership reform, I believe that the research findings of this chapter, in which is to the best of my knowledge the first study of its kind, could draw several implications. An increase of corporate risk with state ownership may be attributed to the easing of financial constraints. The findings may also imply that diversified sources of capital can insulate firms from EPU shocks. The analysis of the relationship between state ownership and firms' exposure to EPU presented in this chapter suggests new questions that may warrant additional research, such as the role of investment and budget constraints in this relationship.

3.7. Appendix to Chapter 3

Table A.3. 1. Correlation Coefficient

	EPU beta	StateProp	LDMA	Size	profitability	Fixed asset ratio	Growth prospect	Tax shield	Ownership concentration
EPU beta	1								
StateProp	-0.0272	1							
	0								
LDMA a bu w	0.00800	0.109	1						
	0.135	0							
Size	0.0543	-0.0441	0.456	1					
	0	0	0						
profitability	0.0223	0.00780	-0.111	0.105	1				
	0	0.144	0	0					
Fixed asset ratio	-0.0306	0.219	0.341	0.0709	-0.0575	1			
	0	0	0	0	0				
Growth prospect	0.0220	-0.208	-0.308	-0.322	0.0857	-0.158	1		
	0	0	0	0	0	0			
Tax shield	-0.0381	0.155	0.175	0.0547	-0.0707	0.768	-0.0900	1	
	0	0	0	0	0	0	0		
Ownership concentration	-0.0235	0.404	0.0944	0.128	0.142	0.147	-0.158	0.131	1
	0	0	0	0	0	0	0	0	

Table A.3. 2. Estimating Effects of State Ownership on Leverage in Different Industries.

	(1) Industries with **lower** sales growth rates Market long-term debt ratio	(2) Industries with **higher** sales growth rates Market long-term debt ratio
StateProp	**0.0173*** (3.77)**	**-0.00957 (-1.30)**
Size	0.0181*** (13.25)	0.0248*** (14.29)
Profitability	-0.0656*** (-6.01)	-0.0860*** (-5.52)
Fixed asset ratio	0.0632*** (5.34)	0.0329** (2.20)
Growth prospect	-0.00309*** (-7.02)	-0.00396*** (-5.52)
Tax shield	-0.925*** (-7.35)	-0.573*** (-3.52)
Ownership concentration	0.0229* (1.94)	0.0253 (1.54)
_cons	-0.339*** (-9.37)	-0.511*** (-11.91)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1102	0.1896
N	19542	10516

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. Following O'Connor et al. (2006), this study separates industries by sales growth rates. Industrial-level sales growth rates measure the liberalisation of industries. Higher (lower) sales growth rates indicate the industry has less (more) reliance on capital promoted by the state. This study employs fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 3. Estimating Effects of Leverage on EPU Betas in Different Industries.

	(1) Industries with **lower** sales growth rates EPU beta	(2) Industries with **higher** sales growth rates EPU beta
Market long-term debt ratio	**-0.0445****	**-0.0280**
	(-2.10)	**(-0.91)**
Size	0.0118***	0.0152***
	(6.84)	(5.50)
Profitability	0.00183	-0.0482
	(0.10)	(-1.62)
Fixed asset ratio	0.0520***	0.0385*
	(3.66)	(1.91)
Growth prospect	0.00288**	0.00393**
	(2.10)	(2.00)
Tax shield	-0.274*	-0.753***
	(-1.76)	(-3.19)
Ownership concentration	0.0340**	0.0257
	(2.41)	(1.09)
_cons	-0.341***	-0.362***
	(-6.44)	(-5.45)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.0126	0.0176
N	19542	10516

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. Following O'Connor et al. (2006), this study separates industries by sales growth rates. Industrial-level sales growth rates measure the liberalisation of industries. Higher (lower) sales growth rates indicate the industry has less (more) reliance on capital promoted by the state. This study employs fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 4. Estimating Effects of State Ownership on EPU Betas in Different Industries.

	(1) Industries with **lower** sales growth rates EPU beta	(2) Industries with **higher** sales growth rates EPU beta
StateProp	**-0.0197***** **(-2.72)**	**-0.00451** **(-0.47)**
Size	-0.00465* (-1.94)	-0.0102*** (-3.10)
Profitability	0.0772*** (4.53)	0.0619** (2.27)
Fixed asset ratio	0.0109 (0.85)	-0.00960 (-0.54)
Growth prospect	-0.00110 (-0.78)	-0.00655*** (-3.21)
Tax shield	-0.115 (-0.85)	-0.268 (-1.29)
Ownership concentration	0.00179 (0.13)	-0.00738 (-0.33)
_cons	0.0402 (0.68)	0.210*** (2.89)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1696	0.2111
N	19542	10516

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. Following O'Connor et al. (2006), this study separates industries by sales growth rates. Industrial-level sales growth rates measure the liberalisation of industries. Higher (lower) sales growth rates indicate the industry has less (more) reliance on capital promoted by the state. this study employs fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 5. Estimation Results from the Role of Debt Financing in the Relationship between State Ownership and EPU Betas in Different Kinds of Industries.

	Low Sales Growth Rates		High Sales Growth Rates	
	(1)	(2)	(3)	(4)
	EPU beta	EPU beta	EPU beta	EPU beta
Fitted value of market long-term debt ratio	**-2.202*** **		**-0.504**	
	(-2.72)		**(-0.47)**	
Residuals		**1.984**		**8.778**
		(0.39)		**(1.25)**
Size	0.0414**	-0.00511**	0.000313	-0.0107***
	(2.41)	(-2.12)	(0.01)	(-3.20)
Profitability	-0.0879	0.0784***	0.0241	0.0688**
	(-1.36)	(4.53)	(0.29)	(2.48)
Fixed asset ratio	0.124***	0.0120	0.0163	-0.0117
	(2.87)	(0.92)	(0.28)	(-0.66)
Growth prospect	-0.00916***	-0.00110	-0.00839*	-0.00714***
	(-2.72)	(-0.77)	(-1.84)	(-3.37)
Tax shield	-1.813***	-0.138	-0.657	-0.323
	(-2.83)	(-1.01)	(-0.78)	(-1.50)
Ownership concentration	0.0556**	-0.00787	0.00492	-0.0127
	(2.09)	(-0.56)	(0.13)	(-0.56)
_cons	-0.821**	0.0183	0.00775	0.142*
	(-2.56)	(0.21)	(0.02)	(1.72)
Clustered by firms	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Robust Standard Error	Yes	Yes	Yes	Yes
R square	0.1696	0.1690	0.2111	0.2114
N	19542	19542	10516	10516

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Fitted values of book long-term debt ratio* are the fitted values estimated by the regressions between state ownership and market long-term debt ratio, which is the explained part of firms' leverage by state ownership. *Residuals* are the unexplained part of EPU by state ownership extracted in the regression between state ownership and market long-term ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. Following O'Connor et al. (2006), this study separates industries by sales growth rates. Industrial-level sales growth rates measure the liberalisation of industries. Higher (lower) sales growth rates indicate the industry has less (more) reliance on capital promoted by the state. This study employs fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 6. Estimating Effects of Leverage on EPU Betas in Central Government-controlled and Local Government-controlled SOEs.

	(1) Central Government EPU beta	(2) Local Government EPU beta
Market long-term debt ratio	**-0.0998***	**-0.0565****
	(-1.85)	**(-2.31)**
Size	0.0220***	0.00955***
	(6.09)	(3.74)
Profitability	-0.0171	-0.0568*
	(-0.35)	(-1.94)
Fixed asset ratio	0.0343	0.0313*
	(1.01)	(1.86)
Growth prospect	0.00458	-0.00580**
	(1.50)	(-2.56)
Tax shield	0.207	-0.602***
	(0.67)	(-2.82)
Ownership concentration	0.0144	0.0427**
	(0.42)	(2.11)
_cons	-0.454***	-0.240***
	(-4.58)	(-3.63)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.0521	0.0340
N	4414	9558

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. This study separates samples in central government-owned and local government-owned SOEs. This study employs fixed effects modelling with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 7. The Analysis of Difference for EPU betas in Different Groups using T-tests.

Panel A: Substantial increase in state-owned shares		
	(1) Group 0 Pre-change Mean	(2) Group 1 Post-change Mean
EPU beta	**-0.00761**	**-0.00682**
N	1,010	1,010
t-test	**0.1875**	
p-value	**0.4263**	

Panel B Substantial reduction in state-owned shares		
EPU beta	**-0.0311**	**-0.0249**
N	1,646	1,646
t-test	**2.0195****	
p-value	**0.0218**	

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. This study conducts t-tests for EPU exposures between pre-substantial increase in state ownership and post-substantial increase in state ownership, and between pre-substantial decrease in state ownership and post-substantial decrease in state ownership. Substantial increases (decreases) are defined as the increase (decrease) in state ownership greater than the standard deviation in the year. Pre-substantial increase (decrease) in state-owned shares is the previous year of the substantial increases (decreases). Post-substantial increase in state-owned shares is the current year of the substantial increases (decreases). ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 8. The Univariate Estimation for the Relationship between State Ownership and Debt Financing by OLS.

	(1) Market long-term debt ratio	(2) Market long-term debt ratio
StateProp	0.0627***	
	(9.14)	
Size		0.0278***
		(22.16)
Profitability		-0.124***
		(-13.03)
Fixed asset ratio		0.197***
		(15.28)
Growth prospect		-0.00468***
		(-7.60)
Tax shield		-1.116***
		(-10.38)
Ownership concentration		-0.00411
		(-0.61)
_cons	0.0174***	-0.555***
	(5.18)	(-20.76)
Cluster by Firm	Yes	Yes
Year-fixed Effect	Yes	Yes
R square	0.0366	0.3246
N	30058	30058

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. This study estimates univariate regression between market long-term debt ratios and the proportion of state ownership and multivariate regression between market long-term debt ratios and firms' characteristic factors using OLS with robust standard error. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 9. The Estimation Results of Baseline Regressions by OLS.

	(1) Market long-term debt ratio
StateDummy	**0.00444***** **(3.35)**
Size	0.0235*** (25.04)
Profitability	-0.0785*** (-9.54)
Fixed asset ratio	0.0889*** (8.72)
Growth prospect	-0.00436*** (-11.04)
Tax shield	-0.744*** (-8.29)
Ownership concentration	0.0246*** (3.59)
_cons	-0.467*** (-21.95)
Clustered by firms	Yes
Fixed effect	No
Robust Standard Error	Yes
R square	0.1199
N	30058

Notes: Dependent variables: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Independent variables: *StateDummy* is the state ownership dummy, which equals to 1 if the state ownership proportion of the firm is greater than 0 in the year, otherwise equals to 0. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress market long-term debt ratios on the state ownership dummy and EPU betas using OLS with robust standard error and EPU betas on market long-term debt ratios using fixed effect model with robust standard errors. The fixed effects are not controlled in regression 1 due to the multicollinearity between fixed effect dummies and the state ownership dummy. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 10. Estimating Direct Relationship between State Ownership and EPU Exposures using OLS.

	(1) EPU beta
StateDummy	-0.00349* (-1.83)
Size	0.0103*** (12.17)
Profitability	0.00506 (0.37)
Fixed asset ratio	0.0159* (1.73)
Growth prospect	0.00376*** (3.69)
Tax shield	-0.420*** (-4.17)
Ownership concentration	0.00315 (0.45)
_cons	-0.241*** (-12.28)
Clustered by firms	Yes
Robust Standard Error	Yes
R square	0.0098
N	30058

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateDummy* is the state ownership dummy, which equals to 1 if the state ownership proportion of the firm is greater than 0 in the year, otherwise equals to 0. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress EPU betas on the state ownership dummy using OLS with robust standard errors. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 11. The Mediation Effect of Debt Financing.

	(1) EPU beta	(2) EPU beta
StateProp	**-0.0116**** **(-2.00)**	**-0.0103*** **(-1.73)**
Market long-term debt ratio		**-0.0342**** **(-2.11)**
Size	-0.00546*** (-2.94)	0.00287 (1.53)
Profitability	0.0769*** (5.39)	0.0451*** (2.93)
Fixed asset ratio	0.000519 (0.05)	0.00338 (0.31)
Growth prospect	-0.00273** (-2.41)	0.00522*** (4.67)
Tax shield	-0.104 (-0.93)	-0.142 (-1.20)
Ownership concentration	0.000145 (0.01)	-0.00535 (-0.45)
_cons	0.0589 (1.21)	-0.386*** (-8.12)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1826	0.1899
N	30058	30058

Notes: Dependent variables: *EPU beta* is the firm's policy uncertainty sensitivity, which is the coefficient of EPU index calculated by the Fama-French three factors model. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. Mediator: *Market long-term debt ratio* is the long-term debt to market value of total assets ratio. Control variables: *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress EPU betas on the proportion of state ownership using the fixed effect model with robust standard error. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 12. The Effects of Debt Financing and State Ownership on the Absolute Value of EPU Beta using First Difference Regression.

	(1) Changes in absolute value of EPU beta	(2) Changes in absolute value of EPU beta
Changes in Market long-term debt ratio	**0.0328****	
	(2.40)	
Changes in StateProp		**0.0117***
		(1.89)
Changes in Size	0.00565*	0.0108***
	(1.76)	(3.21)
Changes in profitability	0.00284	0.0233*
	(0.25)	(1.89)
Changes in Fixed asset ratio	-0.00807	-0.0354***
	(-0.82)	(-3.29)
Changes in Growth prospect	0.00452***	0.0119***
	(4.31)	(12.45)
Changes in Tax shield	-0.157	-0.348***
	(-1.41)	(-2.73)
Changes in Ownership concentration	-0.0689***	-0.0746***
	(-4.94)	(-5.16)
_cons	-0.0174***	-0.0180***
	(-39.15)	(-37.66)
Clustered by firms	Yes	Yes
Firm fixed effect	Yes	Yes
Year fixed effect	Yes	Yes
Robust Standard Error	Yes	Yes
R square	0.1408	0.1370
N	29799	29799

Notes: Dependent variables: *Absolute Value of EPU beta* is the absolute value of coefficient of EPU index calculated by the Fama-French three factors model, representing the volatility of firms' EPU sensitivity. Independent variables: *StateProp* is the proportion of state ownership in firms' ownership structure. *Size* is the nature logarithm of total assets. *Profitability* is the ratio of operating profit to total assets. *Fixed asset ratio* is tangibility measured by the ratio of net fixed assets to total assets. *Growth prospect* is the growth prospect measured by the market value of assets divided by total assets. *Tax shield* is the non-debt tax shield using the ratio of depreciation of fixed assets to total assets. *Ownership concentration* measures ownership concentration using the percentage rate of outstanding shares held by the larger shareholder. We regress Absolute Value of EPU beta on the market long-term debt ratios and the proportion of state ownership using first differences with robust standard error. Estimators are switched to first differences by using the value on the current period minus that on the previous period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.3. 13. The Industry Classification Based on the Sales Growth Rates.

(1) Industries with lower sales growth rates		(2) Industries with higher sales growth rates	
Industry codes	**Industry names**	**Industry codes**	**Industry names**
A01	Agriculture	A02	Forestry
A03	Animal Husbandry	A04	Fishery
B08	Ferrous metal mining and dressing industry	A05	Agriculture, forestry, animal husbandry, fishery, and auxiliary activities
B11	Mining and auxiliary activities	B06	Coal mining and washing industry
C13	Agricultural and sideline food processing industry	B07	Oil and gas extraction industry
C14	Food Manufacturing	B09	Non-ferrous metal mining and dressing industry
C15	Wine, Beverage, and Refined Tea Manufacturing	B10	Non-metallic mining and mining industry
C17	Textile Industry	C21	Furniture manufacturing industry
C18	Textile and Apparel and Apparel Industry	C23	Printing and Recording Media Copying Industry
C19	Leather, fur, feathers, and their products and footwear	C24	Culture, Education, Industry, Sports, and Entertainment Products Manufacturing
C20	Wood processing and wood, bamboo, rattan, palm, and grass products industry	C33	Metal Products Industry
C22	Paper and Paper Products Industry	C38	Electrical Machinery and Equipment Manufacturing
C25	Oil, coal, and other fuel processing industries	C39	Computer, communications, and other electronic equipment manufacturing
C26	Chemical raw materials and chemical manufacturing	C40	Instrumentation Manufacturing
C27	Pharmaceutical Manufacturing	C42	Waste Resources Comprehensive Utilisation Industry
C28	Chemical Fiber Manufacturing	C43	Metal products, machinery, and equipment repair industry
C29	Rubber and plastic products industry	D45	Gas production and supply industry
C30	Non-metallic mineral products industry	D46	Water production and supply
C31	Ferrous metal smelting and rolling processing industry	E47	Housing Construction Industry
C32	Non-ferrous metal smelting and rolling processing industry	E48	Civil Engineering Construction Industry
C34	General Equipment Manufacturing	E49	Construction and Installation Industry
C35	Special Equipment Manufacturing	E50	Building decoration, decoration, and other

			construction industry
C36	Automotive Manufacturing	F52	Retail
C37	Railway, shipbuilding, aerospace, and other transportation equipment manufacturing	G53	Railway transport industry
C41	Other manufacturing	G54	Road transport industry
D44	Electricity, heat production and supply	G58	Multimodal transport and transport agency
F51	Wholesale Industry	G59	Handling and storage industry
G55	Water transport industry	G60	Postal industry
G56	Air transport industry	L71	Leasing industry
H61	Accommodation Industry	L72	Commerce service industry
H62	Catering industry	M73	Development of researches and tests
I63	Telecommunications, radio, television, and satellite transmission services	M74	Profession skill service industry
I64	Internet and related services	M75	Science and technology promotion and application service industry
I65	Software and Information Technology Services	O81	Other services
K70	Realty business	P82	Education
N77	Ecological protection and environmental management	Q83	Health industry
N78	Public facility management	R86	Radio, TV, film, and audiovisual product industry
O79	Neighbourhood services industry	R87	Culture and art industry
O80	Repair of motor vehicles, electronics, and household products	R88	Sports industry
R85	Journalism industry	S90	Public administration and social organisation

Notes: Following O'Connor, Deng, and Luo (2006), this study separates industries by sales growth rates. Industrial-level sales growth rates measure the liberalisation of industries. Higher (lower) sales growth rates indicate the industry has less (more) reliance on capital promoted by the state (O'Connor et al., 2006). The first column shows the industries with higher sales growth rates, while the second column reports the industries with lower sales growth rates.

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Chapter 4. Economic Policy Uncertainty Exposure and Corporate Investment Efficiency: Evidence from China[14]

4.1. Introduction

As efficient capital allocation plays a paramount role in firm performance, it is not surprising that emerging literature in the field focuses on the role of risk in capital allocation decisions (Afridi & Suleman; X. Chen, Le, Shan, & Taylor, 2020; Gulen & Ion, 2016; Y. Wang et al., 2014). Economic policy plays an irreplaceable role as an important tool for regulatory institutions to shape the environment in which firms operate. Economic policy uncertainty refers to the uncertainty associated with economic policy changes that cannot be accurately predicted by market participants (Gulen & Ion, 2016). Corporate investment decisions are inherently prospective in nature and encompass a data-intensive process driven by the analysis of aggregated information. Economic policy uncertainty creates unpredictability for firms regarding the timing, content, and potential impact of policy decisions. China, as a representative government-oriented country, frequently changes economic policies to regulate the economy (Kang, Lee, & Ratti, 2014). This study explores a Chinese setting to attempt to extend the understanding of how the interplay between economic policy uncertainty exposure and aggregate economic policy uncertainty impacts firms' investment sensitivity to growth opportunities.

Modigliani and Miller (1958) indicate that, in a frictionless market, the investment opportunity is the sole factor in predicting firms' capital allocation. According to the perspective of Modigliani and Miller (1958), prior studies define investment efficiency as how well a firm's capital allocation is aligned with its growth opportunities (R. Chen, El Ghoul, Guedhami, & Wang, 2017; S. Chen et al., 2011; McLean, Zhang, & Zhao, 2012). Due

[14] This paper has been accepted by the 27th Annual (2023) New Zealand Finance Colloquium.

to the various frictions in real world markets, firms' investment decisions may deviate from investment opportunities, leading to sub-optimal investment and the reduction of investment efficiency.

It has been widely recognized that EPU has considerable effects on economic development and economic agents' behaviour, including increasing cash holdings (Demir & Ersan, 2017), reducing external financing (G. Zhang et al., 2015), and reducing investment expenditures (Julio & Yook, 2012). Over the years, one strand of the literature has documented that EPU has a negative effect on corporate investment decisions (Afridi & Suleman, 2022; X. Chen et al., 2020; Y. Wang et al., 2014). Previous studies identify that EPU results in delayed corporate investments due to the real option value of a 'wait and see' approach generated by the presence of adjustment costs or irreversibility (Afridi & Suleman, 2022; X. Chen et al., 2020). Since firms become more prudent during high-uncertainty periods and tend to delay large and risky investments, investment efficiency reduces through underinvestment. Kong, Li, Wang, and Peng (2022) conclude that EPU inhibits investment scale and efficiency by Chinese listed firms, while exacerbating the risk of over- or under-investment.

However, due to the difficulty in empirically observing the heterogeneous risk shock to a firm's internal EPU exposure, the above studies mix the macroeconomic level uncertainty with the firm-level investment decisions and have ignored the issue of what role a firm's internal exposure plays in affecting corporate investment. Applying the country-level EPU index implicitly assumes all firms have the same exposure to EPU shocks. Firms' capabilities to predict and implement policies vary as to their individual characteristics. Although EPU does not differ in the market, the exposures of firms to EPU do (Bali, 2017; Li, 2020). T. Liu, Chen, and Yang (2022) highlight that financial constraints and capital intensity moderate the impact of macro EPU on investment decisions. Similarly, Y. Wang et al. (2014) find that the higher the return on invested capital, the more internal finance and non-state ownership mitigate the negative shock of EPU to a firm's investment. Extant literature attempts to explore the impact of country-level EPU on firms' investment decisions (P.-F. Chen, Lee, & Zeng, 2019; Jing, Lu, Zhao, & Zhou, 2023; Kong et al., 2022). However, these studies take less account into a firm's heterogeneous exposure to EPU, which may lead to omitted variable bias, namely the observed relationship between EPU and corporate investment decisions can be driven by firm-level characteristics. Individual firms have heterogeneous exposure to EPU based on their own characteristics and, thus, investment efficiency is expected to vary significantly as a result of the heterogeneous exposure, even in the same EPU period. Therefore, mixing macroeconomic level uncertainty as a one-size-fits-all regressor with firm-level investment may disguise the philosophy between firms' risk and investment efficiency.

Motivated by the current research gap, this chapter seeks to address the following two questions. Does the investment efficiency of firms vary according to EPU and their EPU exposure? Do high-EPU-exposed firms have a significant difference in investment efficiency in high- and low-EPU periods? Building on prior studies, I look to Bali et al. (2017), which develops heterogeneous firm-level EPU exposure, and investigates investment efficiency in high- and low-EPU-exposed firms during different EPU periods. This amounts to asking whether idiosyncratic EPU exposure interacts with EPU as a systematic factor in affecting firms' investment sensitivity to growth opportunities.

Using data on 4,889 A-share listed firms in China from 1998-2021, first, this study follows prior literature to confirm the effect of EPU on investment efficiency. Consistent with the perspectives of extant studies (Afridi & Suleman, 2022; Kong et al., 2022; Y. Wang et al., 2014), EPU has a significantly negative impact on firms' investment efficiency. Second, this study introduces Bali et al. (2017)'s EPU beta and test how firm-level EPU exposure affects investment efficiency. Consistent with our expectation, firms' EPU exposure reduces their investment efficiency. We separate our sample by EPU and find that EPU exposures have more impact on investment efficiency in high EPU periods.

Based on the above findings, this study groups samples by EPU and EPU exposure and contribute to the literature by presenting an interplay between EPU and EPU exposure in affecting investment efficiency. To be specific, high-EPU-exposed firms enjoy the highest investment efficiency in low EPU periods but become the most inefficient in high EPU periods. By contrast, low-EPU-exposed firms have no significant difference in investment efficiency between high and low EPU times. Collectively, this chapter suggests that, first, the shock of EPU to firms results in a failure to convert investment opportunities into efficient investment. Second, high-EPU-exposed firms perform better in tranquil years, while low-EPU-exposed counterparts invest more efficiently in turbulent years.

4.2. Research Hypotheses

Economic policy uncertainty (EPU) is the risk of economic policy change that cannot be accurately predicted by market participants (Gulen & Ion, 2016). Changes in economic policy transform the operational environment confronting the firm. Thus, the investment efficiency of the firm is potentially impacted by uncertainty about future government policies and the effects of future policies. Gulen and Ion (2016) state that economic policy uncertainty (EPU) leads to disincentives to corporate investment by inducing precautionary delays of irreversible investment. However, firms may deviate from optimal investment as it may depress corporate investment in growth opportunities. S. Chen et al. (2011) identify investment efficiency as the sensitivity of investment expenditure to investment opportunities. Accordingly, EPU may distort firms' investment behaviours and harms investment efficiency. EPU exposures refer to the shock to firms from the situation of the failure to predict exactly whether, when, or how the government will change economic policies (Cui et al., 2021). The firms with high EPU exposures bear the greater brunt of EPU, resulting in lower investment efficiency. Thus, this study develops the following hypothesis:

Hypothesis 1. Economic policy uncertainty negatively affects investment efficiency.

EPU deteriorates the external financing environment and raises the volatility of expected earnings; thereby, firms' cash flows will be more volatile in times of uncertainty (Lee et al., 2017; G. Liu et al., 2021). Firms' capabilities to predict and implement policies impact the shock of EPU on corporate investment. EPU exposures refer to the shock to firms from the situation of the failure to predict exactly whether, when, or how the government will change economic policies (X. Cui, Wang, Liao, Fang, & Cheng, 2021). More EPU exposures subject the company to a stronger effect from EPU. Panousi and Papanikolaou (2012) indicate that firm-level idiosyncratic risk depresses corporate investment. The real options arguments conclude that firms weigh the profit difference between current and future investments under the shock of EPU due to the irreversibility of investments and sunk cost of projects (Y. Wang et al., 2014). In the time of a higher degree of EPU, the larger the EPU exposure, the more volatile the cash flow for future investment, hence the more the return on waiting for future investment. Consequently, companies, ceteris paribus, suffer a decline of investment efficiency from their current investment spending. Thus, this study develops the following hypothesis:

Hypothesis 2. Economic policy uncertainty affects investment efficiency through EPU beta. In the time of high EPU, firms with greater EPU exposure have a poorer quality of investment efficiency than firms with low EPU exposures.

A general consensus in the literature is that growing economic policy uncertainty represents a deterioration of the investment opportunity set (Nicholas Bloom, 2009; Nick Bloom, Bond, & Van Reenen, 2007; X.-M. Li, 2017). Bernanke (1983) proposes the real options theory and documents that the option value of delaying investment would increase due to the changed timing of investment caused by uncertainty and irreversibility of investment. Dixit, Dixit, and Pindyck (1994) conclude that high uncertainty generates a more valuable benefit of waiting for more information, leading firms to defer investment with high sunk costs due to the irreversibility of investment. Real options theory provides a widely accepted explanation for firms' investment strategy under the shock of uncertainty. Building on the framework of real options theory, a series of theoretical and empirical works find a negative impact of macroeconomic uncertainty on corporate investment (Bonaime, Gulen, & Ion, 2018; Gulen & Ion, 2016; Jens, 2017; Julio & Yook, 2012). If it is the case that an external uncertain environment impacts the firms' investment efficiency through the real options channel, the slow-down effect should depend on the extent to which uncertainty translates to firms' heterogeneous exposure to macroeconomic uncertainty.

Therefore, the effect of uncertainty on investment efficiency should be stronger for firms with greater exposure to uncertainty and weaker for firms with smaller exposure to uncertainty. Thus, this study proposes the following hypotheses:

Hypothesis 3. Firms with high EPU exposure have a significant reduction in investment efficiency between low- and high-EPU periods, while firms with low EPU exposure have no significant reduction in investment efficiency between low- and high-EPU periods.

4.3. Data and Methodology

4.3.1. Data

This study uses the Chinese Stock Market and Accounting Research (CSMAR) database as our primary data source. Our sample includes A-shares listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange. I eliminate financial firms, Special Treatment

(ST) firms[15], and Particular Transfer (PT) firms[16] to ensure the accuracy of the research results. Since most of the firm characteristics variables employed in this study are calculated from accounting data, this chapter bases these on the largest availability and set a time period from 1998 to 2021 to ensure the consistency of the variables over time. The final sample contains 35,403 firm-year observations, covering 4,889 listed firms.

This chapter employs the EPU index[17] developed by Baker et al. (2016) to measure EPU. Baker et al. (2016) base their measure on coverage of policy-related economic uncertainty in the *South China Morning Post* and construct the EPU indexes for the intensity of concerns about economic policy uncertainty. The EPU index is the most widely accepted indicator of uncertainty (X. Cui et al., 2021; Gulen & Ion, 2016). To control for the impact of extreme outliers, all continuous variables are winsorized at the 1% level at both tails. Table 4.1 provides the descriptive statistics of the examined variables, including the mean, standard deviation, first quartile (Q1), median, third quartile (Q3), and maximum and minimum values, which helps to develop a better understanding of the effect of EPU exposure on investment efficiency and builds up a good platform for testing the developed hypotheses.

4.3.2. Model Specifications

4.3.2.1. The Estimation of EPU betas

With the aim to estimate the firm-level EPU exposure, I based my testing on Bali et al. (2017), using the following model:

$$R_{i,t} - r_{f,t} = \alpha + \beta_{it}^{mkt} MKT_t + \beta_{it}^{smb} SMB_t + \beta_{it}^{hml} HML_t + \beta_{it}^{epu} LEPU_t + e_t \quad (4.1)$$

where, $R_{i,t}$ is the contemporaneous return on firm *i*, $r_{f,t}$ is the risk-free rate. EPU is Huang-Luk's economic policy uncertainty index, and $LEPU_t$ is the logarithm of EPU at time *t*. MKT_t,

[15] Firms that have abnormal financial conditions due to the inability to generate profits over two consecutive years or more.
[16] Firms whose stocks are suspended from listing since the firms are incapable of making profits over three or more consecutive years.
[17] The official website is http://www.policyuncertainty.com/china_monthly.html

SMB_t, and HML_t are three Fama-French factors, which represent the excess market returns, the factors small-minus-big, and the factors high-minus-low, respectively. The time-varying β_{it}^{epu} is firm-level EPU exposure, which is for each firm by the monthly rolling regressions over a 24-month window[18]. For firms with negative (positive) $\beta_{i,t}^{epu}$, returns are negatively (positively) correlated with EPU, implying a less (more) optimal hedge; these firms experience lower (higher) excess returns following an increase in EPU. To make it easier to understand, I multiply the original EPU betas by minus one and get the reversed EPU betas. Higher reversed EPU betas mean higher EPU exposures.

4.3.2.2. The Effect of EPU on Investment Efficiency

To verify that EPU engenders disincentives for corporate investment by precipitating precautionary postponement of irreversible investment decisions, I consider that investment efficiency drops when the variation of EPU increases (Hypothesis 1). Thus, this study adds changes in the natural logarithm of the EPU index and the interaction term between Tobin's Q and changes in the natural logarithm of the EPU index in the model used by R. Chen et al. (2017). The changes in the natural logarithm of the EPU index capture the variation of EPU (W.-L. Huang, Lin, & Ning, 2020), and the interaction term between Tobin's Q and changes in the natural logarithm of the EPU index tests how investment efficiency responds to economic policy variation.

$$Inv_{i,t} = \beta_0 + \beta_1 TQ_{i,t-1} + \beta_2 Change\ in\ lnEPU_{t-1} + \beta_3 TQ_{i,t-1} * Change\ in\ lnEPU_{t-1} + \beta_4 CFO_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 SEO_{i,t-1} + \beta_7 Size_{i,t-1} + \beta_8 Listage_{i,t-1} + \varepsilon_{i,t} \quad (4.2)$$

[18] This study also estimates $\beta_{i,t}^{epu}$ using 36-month rolling window for robustness check and obtain consistent results. To maximise the availability of observations, this study employs the $\beta_{i,t}^{epu}$ from the monthly rolling regressions over a 24-month window.

where, $Change\ in\ lnEPU \equiv lnEPU_t - lnEPU_{t-1}$ captures the variation of EPU. $TQ_{i,t-1} * Change\ in\ lnEPU_{t-1}$ is the interaction term between Tobin's Q and changes in the natural logarithm of the EPU index.

$Inv_{i,t}$ is the investment expenditure in firm *i* at time *t*, which is measured as cash payment for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by beginning total assets. $TQ_{i,t-1}$ represents investment opportunities, which is measured as the sum of the market value of tradable shares, the book value of non-tradable shares, and liabilities, divided by the book value of total assets. $Change\ in\ lnEPU \equiv lnEPU_t - lnEPU_{t-1}$ captures the variation of EPU. $TQ_{i,t-1} * Change\ in\ lnEPU_{t-1}$ is the interaction term between Tobin's Q and changes in the natural logarithm of the EPU index. Control variables include a firm's net operating cash flows ($CFO_{i,t-1}$), leverage ($Lev_{i,t-1}$), cash proceeds from seasoned equity offerings ($SEO_{i,t-1}$), a firm's size ($Size_{i,t-1}$), and a firm's listing age ($Listage_{i,t-1}$).

I expect that the variation of EPU leads to the precautionary postponement of irreversible investment and reduces a firm's investment efficiency by deviating corporate investment from growth opportunities. Therefore, the estimated β_3 is expected to have a negative sign.

4.3.3. The Effect of EPU Exposure on Investment Efficiency

To verify Hypotheses 2, this chapter introduces firm-specific EPU exposure and the interaction term between Tobin's Q and EPU exposure into the model used by R. Chen et al. (2017). This study assumes that firms' EPU exposures to EPU reduce their investment efficiency; thereby, the sign of the interaction term is expected to be negative.

$$Inv_{i,t} = \beta_0 + \beta_1 TQ_{i,t-1} + \beta_2 Reversed\ EPU\ beta_{i,t-1} + \beta_3 TQ_{i,t-1} * Reversed\ EPU\ beta_{i,t-1} + \beta_4 CFO_{i,t-1} + \beta_5 Lev_{i,t-1} + \beta_6 SEO_{i,t-1} + \beta_7 Size_{i,t-1} +$$

$$\beta_8 Listage_{i,t-1} + \varepsilon_{i,t} \quad (4.3)$$

where $Reversed\ EPU\ beta_{i,t-1}$ measures firm-specific EPU exposure. $TQ_{i,t-1} * Reversed\ EPU\ beta_{i,t-1}$ is the interaction term between investment opportunities and firm-specific EPU exposures.

Through the Hausman test, I conduct multivariate regressions using the fixed effect models with robust standard errors that allow us to capture the unobserved heterogeneity across individual firms over the random effects model. I adopt heteroscedasticity-robust standard errors adjusted for clustering at the firm level. To mitigate possible reverse causality problems and for better identification, I lag all the independent variables by one year, relative to the year in which the dependent variable is measured.

Table 4. 1. Descriptive Statistics

	N	mean	min	p25	p50	p75	max	SD
Investment Expenditure to Total Assets	31399	0.0450	-0.0400	0.0110	0.0310	0.0640	0.248	0.0490
Changes in lnEPU	31399	0.134	-0.764	-0.0570	0.116	0.383	0.841	0.393
Reversed EPU beta	31399	0.0000604	-0.00290	-0.000117	0.0000182	0.000186	0.00461	0.000430
Tobin’s Q	31399	2.609	0.892	1.376	1.952	3.013	13.73	2.051
Book Total Debt Ratio	31399	0.476	0.0530	0.319	0.476	0.625	1.036	0.208
Size	31399	22.06	19.21	21.15	21.92	22.82	25.93	1.314
Seasoned Equity Offering	31399	2.341	0	0	0	0	22.11	6.551
Listed Year	31399	2.211	1.099	1.792	2.197	2.708	3.258	0.611
Operating Cash Flow to Total Assets	31399	0.0480	-0.188	0.00800	0.0470	0.0900	0.259	0.0740

Notes: *Investment Expenditure to Total Assets* presents a firm’s investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by beginning total assets. EPU is the EPU index developed by Baker et al. (2016), and *Changes in lnEPU* are the first-order difference in the natural logarithm of the EPU index. *Tobin’s Q* Changes in lnEPU* captures the interaction effect between investment opportunities and changes in market conditions on a firm’s investment expenditure. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm’s listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. All variables are winsorized at 1% in both tails to reduce the impact of outliers.

As shown in Panel A of Table 4.1, the average values of Investment Expenditure to Total Assets and Tobin's Q are 0.0450 and 2.609, respectively. The maximum and minimum values of Reversed EPU beta are 0.000430 and -0.00290, with the standard deviation of 0.000430, which is consistent in magnitude with the results of X.-M. Li and Qiu (2022).

Table 4.2 presents the correlation matrix. As shown in this Table, all correlation coefficients of the examined variables are moderately low, indicating that multicollinearity should not be a problem in our study.

Table 4. 2. Correlation Coefficient

	Investment Expenditure to Total Assets	Changes in lnEPU	Reversed EPU beta	Tobin's Q	Book Total Debt Ratio	Size	Seasoned Equity Offering	Listed Year	Operating Cash Flow to Total Assets
Investment Expenditure to Total Assets	1								
Changes in lnEPU	-0.030*** 0	1							
Reversed EPU beta	0.024*** 0	0.013** 0.0221	1						
Tobin's Q	-0.037*** 0	0.025*** 0	0.00800 0.157	1					
Book Total Debt Ratio	-0.054*** 0	-0.035*** 0	0.046*** 0	-0.218*** 0	1				
Size	0.083*** 0	0.083*** 0	-0.087*** 0	-0.411*** 0	0.269*** 0	1			
Seasoned Equity Offering	0.093*** 0	0.056*** 0	-0.009* 0.0941	0.029*** 0	-0.046*** 0	0.130*** 0	1		
Listed Year	-0.193*** 0	0.081*** 0	-0.051*** 0	-0.111*** 0	0.214*** 0	0.298*** 0	-0.038*** 0	1	
Operating Cash Flow to Total Assets	0.219*** 0	0.00100 0.798	-0.015*** 0.00770	0.058*** 0	-0.174*** 0	0.071*** 0	-0.045*** 0	-0.044***	1

4.4. Empirical Results

4.4.1. The Effects of EPU and EPU Exposures on Investment Efficiency

Following the extant literature, this study first examines the direct effect of EPU on a firm's investment efficiency. Table 4.3 presents the estimation results on how EPU influences firms' investment efficiency using individual-, time-, and industry-fixed effect models. In line with previous studies, the coefficient for Tobin's Q is positive and statistically significant at the 1% level, confirming the fundamental hypothesis of the measurement of investment efficiency. The regression coefficient for the interaction term between Tobin's Q and the EPU index has a negative sign at the 10% significance level, indicating that firms' investment efficiency reduces in times of increasing EPU. EPU reduces firms' investment efficiency through declining the sensitivity of corporate investment on investment opportunities, resulting in suboptimal investment decisions, which confirms our Hypothesis 1.

Table 4. 3. The Interactive Effect of Investment Opportunities and EPU on Investment Expenditure

	(1) Investment Expenditure to Total Assets
Tobin's Q t-1	0.00221*** (6.82)
Changes in lnEPU t-1	0.00279** (2.00)
Tobin's Q t-1* Changes in lnEPU t-1	**-0.000810** (-2.12)**
Book Total Debt Ratio t-1	-0.0330*** (-10.39)
Size t-1	0.00500*** (6.26)
Seasoned Equity Offering t-1	0.000408*** (10.64)
Listed Year t-1	-0.0181*** (-10.64)
Operating Cash Flow to Total Assets t-1	0.0501*** (10.95)
Constant	-0.0234 (-1.27)
Clustered by Firm	YES
Year-Fixed Effect	YES
Firm-Fixed Effect	YES
Observations	31,399
R-squared	0.097

Notes: Dependent variables: *Investment Expenditure to Total Assets* presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by the beginning total assets. Independent variables: EPU is the EPU index developed by Baker et al. (2016), and *Changes in lnEPU* are the first-order difference in the natural logarithm of the EPU index. *Tobin's Q* Changes in lnEPU* captures the interactive effect between investment opportunities and changes in market conditions on a firm's investment expenditure. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. I regress Investment Expenditure to Total Assets on the interaction between Tobin's Q and Changes in lnEPU using the fixed effect model with robust standard errors. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

The above empirical results indicate that enterprises suffer from the reduction of investment efficiency with an increase in EPU. On this basis, this study tests the impact of firm-level EPU exposure on corporate investment efficiency, as well as the impact in times with different levels of EPU. Table 4.4 reports the results of regressing investment expenditures on the interaction between reversed EPU betas and Tobin's Q. Recall that, in testing the second hypothesis, which predicts that firms with greater EPU exposure have a worse quality of investment efficiency than firms with low EPU exposures, this study estimates investment efficiency by regressing investment expenditures on investment opportunities and test the effect of EPU exposures. Consistent with the results of previous literature (R. Chen et al., 2017; S. Chen et al., 2011) and, as expected, the coefficients of Tobin's Q are all positive and pass the 1% significance level. The negative coefficients of interaction between reversed EPU betas and Tobin's Q suggest that firms' investment efficiency reduces with the increase of EPU exposures, confirming our second hypothesis. In Columns 2 and 3, this study divides the sample by the median value of the EPU index and perform the sub-sample tests of the effect of EPU exposures on investment efficiency in times of lower and higher EPU, respectively. I analyse them separately to avoid the use of a three-way interaction variable and to simplify the explanation of results by easing the restrictions on the consistency of coefficients for each of the non-comparison variables and the same error distribution of groups. The regression coefficients of the interaction term indicate that EPU exacerbates the worsening quality of investment efficiency resulting from EPU exposures.

Table 4. 4. The Effect of EPU Exposures on Investment Efficiency

	(1)	(2) lnEPU<Medium	(3) lnEPU>Medium
	Investment Expenditure to Total Assets	Investment Expenditure to Total Assets	Investment Expenditure to Total Assets
Reversed EPU beta t-1	0.501 (0.48)	0.390 (0.29)	-0.330 (-0.17)
Tobin's Q t-1	0.00199*** (7.22)	0.00221*** (4.45)	0.00164*** (5.46)
Reversed EPU beta t-1 * Tobin's Q t-1	**-0.519**** **(-2.30)**	**-0.159** **(-0.35)**	**-0.684**** **(-2.22)**
Book Total Debt Ratio t-1	-0.0327*** (-10.32)	-0.0397*** (-8.40)	-0.0272*** (-7.15)
Size t-1	0.00488*** (6.14)	0.00164 (1.26)	0.00611*** (6.31)
Seasoned Equity Offering t-1	0.000409*** (10.67)	0.000618*** (7.99)	0.000238*** (5.55)
Listed Year t-1	-0.0180*** (-10.62)	-0.0155*** (-5.15)	-0.0155*** (-6.64)
Operating Cash Flow to Total Assets t-1	0.0502*** (10.95)	0.0487*** (7.11)	0.0364*** (7.05)
_cons	-0.0204 (-1.11)	0.0539* (1.84)	-0.0583*** (-2.62)
Clustered by Firm	YES	YES	YES
Year-Fixed Effect	YES	YES	YES
Firm-Fixed Effect	YES	YES	YES
R squared	0.097	0.063	0.083
N	31,399	14,401	16,998

Notes: Dependent variables: *Investment Expenditure to Total Assets* presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by the beginning total assets. Independent variables: *Reversed EPU beta* is estimated by the Fama-French Three Factors Model (Equation 4.1). *Tobin's Q* presents a firm's investment opportunities, which is calculated by the sum of the market value of equity and liabilities, divided by the book value of total assets. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. First, this study regresses Investment Expenditure to Total Assets on the interaction between Tobin's Q and Reversed EPU beta using the fixed effect model with robust standard errors (Column 1). Then, this study separates the sample by the medium value of lnEPU and test the effect of EPU exposure on investment efficiency in times of lower and higher EPU. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Though not a focus of this chapter, I also identify strong and consistent evidence on the effects of control variables with the previous prediction (S. Chen et al., 2011). A firm's leverage (*Book Total Debt Ratio*) is negatively related to investment expenditure. Consistent with Jensen (1986) and S. Chen et al. (2011), the interest and constraints of additional debt financing in high-leveraged firms inhibit their ability to invest. Firm size (*Size*) positively impacts investment, in line with the finding from R. Chen et al. (2017) and Hadlock and Pierce (2010), with larger firms having more investment due to fewer financial constraints. Seasoned equity offerings (*Seasoned Equity Offering*) exhibit a positive relationship with investment. Consistent with the perspective of Walker and Yost (2008), capital expenditure increases following a seasoned equity offering. Firms with longer listing time (*Listed Year*) have less investment activities, given that they are more likely to be in the mature or declining phase of the business life cycle (S. Chen et al., 2011). Operating cash flows (*Operating Cash Flow to Total Assets*) positively impact investment expenditure, as it allows firms to enjoy more financial resources for investment (Richardson, 2006).

4.4.2. The Results from Different Groups of EPU and EPU Exposures

The preceding section presents the estimation results with the negative impacts of EPU and EPU exposure on investment efficiency by using the full sample. These results may disguise the difference in investment efficiency among firms with different EPU exposures and the times with different levels of EPU. To overcome the drawback from general estimation and further confirm investment efficiency in firms with higher and lower exposures and low- and high-EPU periods, concerning Hypothesis 3, this study separates the sample into different groups for empirical tests using some predetermined criteria.

First, I independently separate the sample of firms based on the EPU index and firms' EPU exposures. Then, I form four groups: Groups 1 and 2 consist of the firms with lower EPU exposures in the lower and higher EPU times; and groups 3 and 4 contain firms with higher EPU exposures in the lower and higher EPU times.

Table 4. 5. The Investment Efficiency for Different Groups in Low and High EPU Times

	(1) Low reversed EPU betas		(2) High reversed EPU betas	
	Low EPU	High EPU	Low EPU	High EPU
	Investment Expenditure to Total Assets	Investment Expenditure to Total Assets	Investment Expenditure to Total Assets	Investment Expenditure to Total Assets
Tobin's Q t-1	**0.00186** **(2.21)**	**0.00150***** **(3.08)**	**0.00219***** **(3.98)**	**0.00118** **(1.98)**
Book Total Debt Ratio t-1	-0.0421*** (-5.20)	-0.0227*** (-4.01)	-0.0455*** (-7.70)	-0.0125 (-1.53)
Size t-1	0.00208 (0.94)	0.00430** (2.43)	0.000940 (0.58)	0.00375* (1.74)
Seasoned Equity Offering t-1	0.000808*** (5.49)	0.0000745 (1.33)	0.000645*** (6.56)	0.000346*** (3.92)
Listed Year t-1	-0.0115 (-1.53)	-0.00789 (-1.61)	-0.0154*** (-2.77)	-0.0138** (-2.53)
Operating Cash Flow to Total Assets t-1	0.0393*** (3.54)	0.0201*** (2.95)	0.0335*** (4.09)	0.0294*** (2.98)
_cons	0.0363 (0.67)	-0.0375 (-0.87)	0.0745** (2.00)	-0.0152 (-0.31)
T test for difference analysis	**1.34**		**4.51**	
P value of T test	**0.2475**		**0.0336**	
Clustered by Firm	YES	YES	YES	YES
Year-Fixed Effect	YES	YES	YES	YES
Firm-Fixed Effect	YES	YES	YES	YES
R squared	0.0569	0.0251	0.0639	0.0793
N	4887	8719	8414	5542

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

Notes: Dependent variables: Investment Expenditure to Total Assets presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by the beginning total assets. Independent variables: Tobin's Q presents a firm's investment opportunities, which is calculated by the sum of the market value of equity and liabilities, divided by the book value of total assets. Following Chen et al. (2011), this study includes several control variables. Book Total Debt Ratio is calculated by total liabilities to total assets. Size is measured by the natural logarithm of total assets. Seasoned Equity Offering is the natural logarithm of cash proceeds from seasoned equity offerings. Listed Year is the natural logarithm of a firm's listing age at the year. Operating Cash Flow to Total Assets is measured by operating cash flows scaled by total assets. First, this study separates the sample by both the medium values of reversed EPU beta and lnEPU. Second, this study regresses Investment Expenditure to Total Assets on Tobin's Q using the fixed effect model with robust standard errors for each group. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 4.5 set out the results in regard to whether different EPU exposures and country-level EPU impact firms' investment efficiency. All coefficients of Tobin's Q are significant and positive, indicating that this is an effective measure of investment efficiency. Considering the firms with lower EPU exposures in columns 1 and 2, the T-test for difference analysis is insignificant, indicating no significant difference in investment efficiency between low- and high-EPU periods in the statistics. Turning to the firms with higher EPU exposures, they enjoy the highest investment efficiency in the times of lower EPU, but the lowest investment efficiency in the times of higher EPU. The T-test of the difference is statistically significant. Thus, high-EPU-exposed firms have a significant reduction in investment efficiency between low- and high-EPU periods, whereas low-EPU-exposed firms have no significant reduction in investment efficiency between low- and high-EPU periods. These results support our hypothesis 3.

4.5. Robustness Checks

4.5.1. Estimations Using Propensity Score Matching (PSM)

In Section 4.2, this study discusses how firms differ in their capabilities to predict and implement policies, and hence, the impact of EPU shocks on firm investment. One potential concern is that firms with higher EPU exposures may have different features than those exposed less to EPU. Thus, our results may be influenced by sample selection bias. This study executes propensity score matching (PSM) to calculate the average treatment effects of EPU exposure on investment efficiency. The PSM method facilitates the conceptualization of non-randomized studies as quasi-randomized experiments (Wellalage & Fernandez, 2019).

As a robustness check of our main results, this chapter follows prior studies and conduct the propensity score matching in two steps (Chatjuthamard, Wongboonsin, Kongsompong, & Jiraporn, 2020; R. Chen et al., 2017; Rosenbaum & Rubin, 1983). In the first step, I form an EPU beta dummy, which equals one if the reversed EPU beta is greater than the median level in the given firm-year and equals to 0 otherwise, while splitting our sample into treatment (higher EPU exposure) and control (lower EPU exposure) groups based on the EPU beta dummy. Second, I run a logistic regression with a set of five firm characteristics as the control variables to predict the probability of being highly exposed under EPU shock (propensity score). The addition of these controls ensures accurate equilibrium between treatment and control sub-samples (Austin, 2011). Then, for each observation in the treatment group, this chapter identifies an observation in the control group with the nearest propensity score. As such, our treatment and control groups are nearly indistinguishable along every observable dimension, with the exception of EPU exposure. In the last step, I estimate our regression on the matched sample. Through eliminating the observable differences, the difference in investment efficiency is attributed to the varying EPU exposures rather than to other firm characteristics.

To verify that our PSM approach is successful, I employ diagnostic tests. Panel A in Table 4.6 reports the descriptive statistics on firm characteristics between the treatment and control groups. After matching on the propensity score, this study finds no systematic differences in the added covariates between the treatment and control subjects, indicating strong corroboration for our estimates (Austin, 2011).

Table 4. 6. Robust Test: The Effect of EPU Exposure on Investment Efficiency by PSM

Panel A. Diagnostic Tests for Propensity Score Matching	(1)	(2)		(3)	(4)	(5)	
	Unmatched	Mean				t-test	
	Matched	Treatment	control	%bias	%reduct bias	t	p>t
Book Total Debt Ratio t-1	U	.4781	.47683	0.6		0.51	0.613
	M	.47812	.47965	-0.7	-20.6	-0.64	0.525
Size t-1	U	21.935	22.154	-16.7		-13.88	0.000
	M	21.935	21.947	-0.9	94.6	-0.81	0.420
Seasoned Equity Offering t-1	U	2.2669	2.5214	-3.8		-3.19	0.001
	M	2.267	2.2602	0.1	97.3	0.09	0.927
Listed Year t-1	U	2.1483	2.2612	-19.0		-15.74	0.000
	M	2.1482	2.1444	0.7	96.6	0.57	0.569
Operating Cash Flow to Total Assets t-1	U	.04809	.04755	0.7		0.61	0.544
	M	.04808	.04811	-0.0	94.3	-0.04	0.971

Panel B The effect of EPU exposure on investment efficiency by PSM	Investment Expenditure to Total Assets
Tobin's Q t-1	**0.00332*** (8.77)**
Reversed EPU beta Dummy_Med t-1	0.00315*** (3.15)
Reversed EPU beta Dummy_Med t-1* Tobin's Q t-1	**-0.000893*** (-2.61)**

Book Total Debt Ratio t-1	-0.0342*** (-10.10)
Size t-1	0.00577*** (6.64)
Seasoned Equity Offering t-1	0.000408*** (10.09)
Listed Year t-1	-0.0189*** (-7.71)
Operating Cash Flow to Total Assets t-1	0.0443*** (9.44)
Constant	-0.0394* (-1.92)
Clustered by Firm	YES
Year-Fixed Effect	YES
Firm-Fixed Effect	YES
R- squared	0.090
N	27,560

Notes: Dependent variables: *Investment Expenditure to Total Assets* presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by the beginning total assets. Independent variables: *Reversed EPU beta Dummy_Med* equals one if reversed EPU beta is greater than the median level in the given firm-year and equals to 0 otherwise. *Tobin's Q* presents a firm's investment opportunities, which is calculated by the sum of the market value of equity and liabilities, divided by the book value of total assets. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. This study defines the firm with higher EPU exposure as the treatment group and the firms with lower EPU exposure as the control group. Panel A compares firm characteristics between the treatment group and the control group. Panel B presents the estimation results based on the matched sample. This study controls time- and firm specific-fixed effect and adopt the robust standard errors clustered at the firm level in the regression. Firms' characteristic factors are controlled and lagged for one period. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Panel B in Table 4.6 shows the regression analysis using the propensity score matched sample. Consistent with the results shown in Table 4.4, this study continues to find the coefficient of interaction between the reversed EPU beta and Tobin's Q to be negative and statistically significant, even after controlling for all observable firm characteristics with PSM. This result suggests that firms' investment efficiency reduces with increases in EPU exposures, and appear to be robust.

4.5.2. Estimations Using Two-stage Least Square Regression (2SLS)

Reverse causality may also be an endogeneity concern in our empirical setting. X. Cui et al. (2021) consider a mutual influence between corporate investment and EPU exposure. Bhattacharya, Hsu, Tian, and Xu (2017) find that both corporate investment and EPU may be impacted by unobservable factors. This study further mitigates endogeneity concerns by employing widely the used instrumental variable method to address any reverse causality.

Table 4. 7. Robust Test: The Estimation Results of Baseline Regressions by 2SLS

	(1) Reversed EPU beta	(2) Investment Expenditure to Total Assets
Reversed EPU beta ind	0.817***	
	(5.96)	
Reversed EPU beta ind *Tobin's Q	0.112**	
	(1.89)	
Reversed EPU beta t-1		61.753***
		(4.31)
Reversed EPU beta t-1*Tobin's Q		**-8.393****
		(-1.99)
Tobin's Q t-1	-1.03e-06	0.000263
	(-0.29)	(0.75)
Book Total Debt Ratio t-1	.000172***	-0.0123***
	(11.68)	(-5.71)
Size t-1	-.0000305***	0.00453***
	(-12.66)	(12.80)
Seasoned Equity Offering t-1	3.89e-07	0.000545***
	(1.15)	(11.91)
Listed Year t-1	-.0000282***	-0.0132***
	(-8.97)	(-28.51)
Operating Cash Flow to Total Assets t-1	.0000985***	0.147***
	(2.67)	(33.51)
_cons	0.000640***	-0.0328***
	(12.50)	(-4.18)
P-value of LM statistic		0.0009
P-value of Wald F test		0.000
N	31399	31399

Notes: Dependent variables: *Investment Expenditure to Total Assets* presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by beginning total assets. Independent variables: *Reversed EPU beta* is estimated by Fama-French Three Factors Model (Equation 4.1). *Tobin's Q* presents a firm's investment opportunities, which is calculated by the sum of the market value of equity and liabilities, divided by the book value of total assets. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. Size is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. This study examines the impact of EPU exposure on investment efficiency using two-stage least squares regression (2SLS). This study employs the mean value of firm-level EPU exposure in the same industries as the instrumental variable. This study estimates the impact of EPU exposure on investment efficiency using the two-stage least squares method (2SLS). Following X. Cui et al. (2021), this study employs the mean value of firm-level EPU exposure in the same industries as the instrumental variable. All explanatory variables and control variables are lagged by one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. The LM statistic (under-identification test) and Wald F test (weak identification test) prove the validity of the instrumental variables. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Following X. Cui et al. (2021), this study adopts the mean value of firm-level EPU exposure in the same industries as the instrumental variable. The industry-specific EPU exposure will impact the EPU exposure of an individual firm within a given industry and is expected to affect investment by the firm only by influencing the firm's own exposure to EPU. This study further examines the impact of EPU on investment efficiency based on the instrumental variable method; the results are presented in Table 4.7. Consistent with our previous finding, the coefficient of interaction between reversed EPU beta and Tobin's Q is significantly negative at the 5% level. Thus, the results from the 2SLS estimation support our finding that EPU exposure reduces firms' investment efficiency.

4.5.3. The Alternative Measurement for Investment Efficiency

In Equations 4.2 and 4.3, this chapter measures investment opportunities as Tobin's Q, and investment efficiency as the sensitivity between investment expenditure and Tobin's Q. R. Gao and Yu (2020) review and integrate the empirical literature on the measurement of investment efficiency in finance and accounting areas, and discuss the advantages and disadvantages of each type of measure. To confirm that above results are not sourced from the bias of measurement of investment efficiency, this study conducts a robustness test by using an alternative measurement of investment efficiency. I follow Biddle, Hilary, and Verdi (2009) and S. Chen et al. (2011) in using sales growth to measure investment opportunities. Sales growth is defined as the annual change in sales revenue scaled by lagged sales.

Table 4. 8. Robust Test: The Effect of EPU Exposures on Investment Efficiency using Alternative Measurement for Investment Efficiency

	(1) Investment Expenditure to Total Assets	(2) lnEPU<Medium Investment Expenditure to Total Assets	(3) lnEPU>Medium Investment Expenditure to Total Assets
Reversed EPU beta t-1	0.244 (0.39)	-0.266 (-0.41)	4.930*** (3.22)
Sales growth t-1	0.000082** (2.18)	0.000102 (0.83)	0.000064** (2.50)
Reversed EPU beta t-1 * Sales growth t-1	**-0.0876*** **(-1.71)**	**0.00485** **(0.08)**	**-0.147***** **(-3.37)**
Book Total Debt Ratio t-1	-0.0186*** (-7.76)	-0.0250*** (-7.62)	-0.00793*** (-2.90)
Size t-1	0.00545*** (11.32)	0.00715*** (11.00)	0.00319*** (6.17)
Seasoned Equity Offering t-1	0.000627*** (14.51)	0.000898*** (11.49)	0.000473*** (9.50)
Listed Year t-1	-0.0130*** (-18.67)	-0.0162*** (-14.98)	-0.0103*** (-13.91)
Operating Cash Flow to Total Assets t-1	0.140*** (24.53)	0.155*** (20.03)	0.124*** (18.00)
_cons	-0.0476*** (-4.84)	-0.0695*** (-5.16)	-0.0131 (-1.24)
Clustered by Firm	YES	YES	YES
Year-Fixed Effect	YES	YES	YES
Firm-Fixed Effect	YES	YES	YES
R squared	0.131	0.101	0.139
N	31,372	15,905	15,467

Notes: Dependent variables: *Investment Expenditure to Total Assets* presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by the beginning total assets. Independent variables: *Reversed EPU beta* is estimated by the Fama-French Three Factors Model (Equation 4.1). *Sales growth* is the alternative measure of a given firm's investment opportunities, which is calculated by annual change in sales revenue scaled by lagged sales. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. This study employs a fixed effects model with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

The results are reported in Table 4.8. Our main conclusions remain the same when using the alternative measurement. The estimation coefficient of interaction between reversed EPU beta and sales growth using the full sample is still negative, suggesting a reduction of investment efficiency with the increase of EPU exposure. In times of lower EPU, EPU exposure has no significant effect on investment efficiency, whereas the coefficient of interaction between reversed EPU beta and sales growth is significantly negative at the 1% level in times of higher EPU. These estimates confirm a statistically significant impact of EPU exposure on investment efficiency and reinforce the robustness of our findings.

4.6. Further Tests

4.6.1. The Impact of Government Intervention

Previous studies document that government intervention, as a form of friction, distorts firms' investment behaviour and prevents firms from making optimal investment decisions (R. Chen et al., 2017; S. Chen et al., 2011; O'Toole, Morgenroth, & Ha, 2016)[19]. However, the basic premise of these studies is the inconsistency between firm self-interest and the norms of their institutional fields. Y. Wen, Berka, Molchanov, and Qin (2023) prove that state ownership exposes firms to EPU due to the promotion of embracing social and economic objectives in corporate operations. Thus, this study bridges government intervention and EPU exposure, which measures the extent to which the firm is influenced by policies in the given year, to investigate whether the impact of EPU exposure on investment efficiency is shaped by government intervention. This study refers to the method used by Kiyota and Urata (2004) and Plümper and Troeger (2007) to separate firms' EPU exposure into the part explained by state ownership and the part not explained by state ownership, and test the impacts of these two parts on investment efficiency. The part of reversed EPU beta explained by state ownership is viewed as the EPU exposure caused by the government intervention, while the part of EPU exposure not explained by state ownership is labelled as unrelated to political

[19] We appreciate the helpful comments of participants at the Economics and Finance Seminar Series of Massey University.

connections. Table 4.9 presents that the effects of these separate parts of EPU exposure on investment efficiency.

Table 4. 9. The Effect of Explained and Unexplained Part of EPU Exposure by State Ownership on Investment Efficiency

	(1) Investment Expenditure to Total Assets	(2) Investment Expenditure to Total Assets
Tobin's Q t-1	0.00185*** (5.88)	0.00188*** (6.03)
Explained part of reversed EPU by SOE t-1	0.625 (0.78)	
Explained part of reversed EPU by SOE t-1* Tobin's Q t-1	**-0.00183** **(-0.35)**	
Unexplained part of reversed EPU by SOE t-1		0.00770 (0.64)
Unexplained part of reversed EPU by SOE t-1* Tobin's Q t-1		**-0.00810**** **(-2.48)**
Book Total Debt Ratio t-1	-0.0422*** (-6.42)	-0.0397*** (-8.40)
Size t-1	0.00512*** (3.74)	0.00164 (1.26)
Seasoned Equity Offering t-1	0.000345*** (6.76)	0.000618*** (7.99)
Listed Year t-1	-0.0171*** (-9.05)	-0.0155*** (-5.15)
Operating Cash Flow to Total Assets t-1	0.0513*** (10.06)	0.0487*** (7.11)
_cons	-0.0212 (-0.72)	0.0539* (1.84)
Clustered by Firm	YES	YES
Year-Fixed Effect	YES	YES
Firm-Fixed Effect	YES	YES
R squared	0.083	0.084
N	25,300	25,300

Notes: Dependent variables: *Investment Expenditure to Total Assets* presents a firm's investment expenditure in a year, which is measured as cash payments for fixed assets, intangible assets, and other long-term assets from the cash flow statement, minus cash receipts from selling these assets, scaled by beginning total assets. Independent variables: *Explained part of reversed EPU by SOE* is the fitted value of reversed EPU beta estimated by the regression between reversed EPU beta and the proportion of state-owned shares, which represents the part of EPU exposure related to state ownership. *Unexplained part of reversed EPU by*

SOE is the residual of reversed EPU beta estimated by the regression between reversed EPU beta and the proportion of state-owned shares, which represents the part of EPU exposure unrelated to state ownership. *Tobin's Q* presents a firm's investment opportunities, which is calculated by the sum of the market value of equity and liabilities, divided by the book value of total assets. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. This study employs a fixed effects model with robust standard errors for the estimations. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Column (1) of Table 4.9 shows an insignificant coefficient of the interaction term between reversed EPU beta and Tobin's Q, indicating that the part of EPU exposure related to government intervention has no impact on investment efficiency. By contrast, the coefficient of the interaction term between the unexplained part of reversed EPU beta by state ownership and Tobin's Q, shown in Column (2) of Table 4.9, is negative at the 5% significance level, which reinforces that EPU exposure reduces firms' investment efficiency. The results in Table 4.9 suggest that firms' investment efficiency reduces due to a more straight-forward effect of increasing EPU exposure, while government intervention has no significant impact on investment efficiency from the perspective of risk.

4.6.2. The Comparisons to Other Measures of Corporate Investment

In Section 4.5.3, I prove that the findings survive the robustness check of an alternative measure of investment efficiency. One may wonder whether investment efficiency is a more effective indicator to evaluate corporate investment[20]. To verify the effectiveness of investment efficiency, this study conducts comparisons between investment efficiency and other measures of evaluating corporate investment. The most obvious and relevant comparator to our study is corporate innovation investment, as presented by X. Cui et al. (2021), which is measured by R&D to total assets ratio, and R&D to sales ratio. Although these two measures differ conceptually in several respects, to throw some light on the role of these differences, this study regresses stock returns on investment efficiency and two

[20] We appreciate the insightful comments of participants at 27th Annual (2023) New Zealand Finance Colloquium.

measures of corporate innovation investment. A firm's stock price tends to respond favorably to announcements of major corporate decisions and can be salient to investors in reflecting the evaluation of information about the prospects for the particular decision that the firm is undertaking (Titman, Wei, & Xie, 2004).

Table 4.10 presents the comparison between investment efficiency and corporate innovation investment on stock returns. As can be seen, all three measures are highly statistically significant, but investment efficiency enjoys the largest coefficient of 7.683. To measure the practical importance of our results, this study uses the average value of stock returns to determine the economic significance of the average slope coefficients of investment efficiency and two measures of innovation in Table 4.10. The impacts of investment efficiency and the two measures of innovation on the stock return are economically significant at 7.683, 2.889, and 0.953, respectively: A one standard deviation increase in investment efficiency, ceteris paribus, is associated with an increase in stock returns of 0.515 relative to the sample mean. In contrast, holding all else constant, a one standard deviation growth in the R&D to total assets ratio is associated with a 0.225 rise in stock returns. Similarly, the stock return will increase by 0.163 with a one standard deviation growth in the R&D to sales ratio

Table 4. 10. The Effects of Investment Efficiency and Innovation on Stock Returns by Lagged One Period

	(1) Stock return with Dividends	(2) Stock return with Dividends	(3) Stock return with Dividends
Investment Efficiency t-1	**7.683***** **(2.66)**		
R&D to Total Assets t-1		**2.889***** **(6.67)**	
R&D to Sales t-1			**0.953***** **(4.63)**
Book Total Debt Ratio t-1	0.126 (1.19)	-0.117*** (-2.94)	-0.102** (-2.55)
Size t-1	-0.0156 (-1.14)	0.0232*** (3.48)	0.0210*** (3.14)
Seasoned Equity Offering t-1	-0.0000210 (-0.01)	0.00339** (2.57)	0.00334** (2.52)
Listed Year t-1	0.113** (2.09)	-0.0153 (-1.56)	-0.0200** (-2.01)
Operating Cash Flow to Total Assets t-1	0.410** (2.13)	0.774*** (6.52)	0.892*** (7.54)
_cons	-0.0617 (-0.46)	-0.298** (-2.16)	-0.228* (-1.65)
Robust Standard Error	Yes	Yes	Yes
R squared	0.0222	0.0317	0.0262
N	5215	5215	5215

Notes: Dependent variables: *Stock return with Dividends* is the annual stock return, which is calculated by the comparable closing price of the stock with cash dividend reinvested on the last trading day of year *t*, to that on the last trading day of the year *t-1*. Independent variables: *Investment Efficiency* is the sensitivity of investment expenditure to investment opportunities (Tobin's Q). We follow X. Cui et al. (2021) by employing *R&D to Total Assets* and *R&D to Sales* as the measures of corporate innovation investment. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. We regress stock return with dividends on investment efficiency and both measures of corporate innovation investment using OLS with robust standard errors. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

We further look at the long-lag effects of investment efficiency and two measures of corporate innovation investment on stock returns. Ravenscraft and Scherer (1982) demonstrate that the mean lags for the overall impact of R&D on profitability is two years in the U.S. market. By performing two-year lagged regressions, this study aims to identify the divergent implications between investment efficiency and corporate innovation investment more clearly. Table 4.11 shows that the impacts of both measures of corporate innovation investment on stock returns become insignificant, while investment efficiency still boosts stock returns at the 5% significance level, confirming that investment efficiency is a more effective indicator to measure corporate investment. The findings remain after employing return on assets (ROA) as the alternative measure of firm performance, as shown in the Appendix, Section 4.8.

Table 4. 11. The Effects of Investment Efficiency and Innovations on Stock Returns by Lagging Two Periods

	(1) Stock return with Dividends	(2) Stock return with Dividends	(3) Stock return with Dividends
Investment Efficiency t-2	**13.69**** **(2.23)**		
R&D to Total Assets t-2		**0.937** **(1.48)**	
R&D to Sales t-2			**0.0475** **(0.17)**
Book Total Debt Ratio t-2	0.325 (1.52)	-0.133** (-2.15)	-0.139** (-2.20)
Size t-2	-0.0246 (-0.87)	0.0353*** (3.13)	0.0334*** (2.99)
Seasoned Equity Offering t-2	-0.00550* (-1.75)	0.000339 (0.18)	0.000306 (0.16)
Listed Year t-2	0.228** (2.01)	-0.0173 (-1.05)	-0.0204 (-1.23)
Operating Cash Flow to Total Assets t-2	-0.135 (-0.36)	0.609*** (3.51)	0.628*** (3.59)
_cons	-0.454** (-2.07)	-0.536** (-2.35)	-0.469** (-2.07)
Robust Standard Error	Yes	Yes	Yes
R squared	0.0153	0.0134	0.0125
N	2355	2355	2355

Notes: Dependent variables: *Stock return with Dividends* is the annual stock return, which is calculated by comparable closing price of the stock with cash dividend reinvested on the last trading day of year *t*, to that on the last trading day of the year *t-1*. Independent variables: *Investment Efficiency* is the sensitivity of investment expenditure to investment opportunities (Tobin's Q). We follow X. Cui et al. (2021) to employ *R&D to Total Assets* and *R&D to Sales* as the measures of corporate innovation investment. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. We employ long-lag estimation to test the effects of investment efficiency and both measures of corporate innovation investment on the stock returns with dividends using OLS with robust standard errors. Firms' characteristic factors are controlled and lagged for two periods. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

4.7. Conclusion

Prior studies suggest that the presence of EPU depresses firms' investment and reduces investment efficiency. However, mixing macroeconomic level uncertainty with firm-level investment may disguise the varying investment efficiency based on their own characteristics. To shed light on the effects of heterogeneous policy-related exposure on investment efficiency, this study introduces Bali et al. (2017)'s EPU beta and test how investment efficiency varies with firm-level EPU exposure. Using the sample of listed firms in the Chinese market over the period of 1998 to 2021, our study contributes to the literature by providing empirical evidence to reveal the mechanism by which investment efficiency varies under the shock of EPU. Through investigating the largest and most rapidly growing emerging economy, this study finds that firms' EPU exposure reduces their investment efficiency, suggesting that firms tend to depress their investment when facing an EPU shock. Second, by grouping samples by EPU and EPU exposure, this study finds that high-EPU-exposed firms enjoy the highest investment efficiency in low-EPU periods but become the most inefficient in high-EPU periods, whereas low-EPU-exposed firms have no significant difference in investment efficiency between high and low EPU times. This indicates that high-EPU-exposed firms perform better in tranquil years, while their low-EPU-exposed counterparts invest more efficiently in turbulent years.

4.8. Appendix to Chapter 4

Table A.4. 1. The Effects of Investment Efficiency and Innovation on Firm Value with Consistent Sample

	(1) ROA	(2) ROA	(3) ROA
Investment Efficiency t-1	**2.970**** **(2.51)**		
R&D to Total Assets t-1		**1.694***** **(5.62)**	
R&D to Sales t-1			**0.234** **(1.62)**
Book Total Debt Ratio t-1	0.536*** (9.26)	0.427*** (11.37)	0.426*** (11.02)
Size t-1	-0.145*** (-8.21)	-0.122*** (-7.45)	-0.130*** (-7.83)
Seasoned Equity Offering t-1	-0.000425 (-0.81)	0.000803*** (3.43)	0.000795*** (3.37)
Listed Year t-1	0.0460* (1.94)	-0.00852 (-0.62)	-0.00246 (-0.18)
Operating Cash Flow to Total Assets t-1	-0.126* (-1.90)	0.0218 (0.75)	0.0279 (0.95)
_cons	2.823*** (7.79)	2.557*** (7.11)	2.760*** (7.57)
Clustered by Firm	YES	YES	YES
Year-Fixed Effect	YES	YES	YES
Firm-Fixed Effect	YES	YES	YES
R squared	0.2120	0.2264	0.2112
N	5215	5215	5215

Notes: Dependent variables: *ROA* is the return on assets. Independent variables: *Investment Efficiency* is the coefficient for Tobin's Q, estimated by the regression between Tobin's Q and investment expenditure. *R&D to Total Assets* is the ratio calculated by R&D expenses divided by total assets. *R&D to Sales* is the ratio calculated by R&D expenses divided by sales revenue. Following X. Cui et al. (2021), *R&D to Total Assets* and *R&D to Sales* represent the firms innovation investment. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. The explanatory variable and control variables are lagged by one year. We regress ROA on investment efficiency and both measures of corporate innovation investment using OLS with robust standard errors. Firms' characteristic factors are controlled and lagged for one period. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table A.4. 2. The Effects of Investment Efficiency and Innovation on Firm Value by Lagging Two Periods

	(1) ROA	(2) ROA	(3) ROA
Investment Efficiency t-2	**95.90***** **(4.62)**		
R&D to Total Assets t-2		**-14.15***** **(-5.99)**	
R&D to Sales t-2			**-4.880***** **(-5.10)**
Book Total Debt Ratio t-2	4.543*** (4.39)	0.412 (1.04)	0.0466 (0.11)
Size t-2	0.0252 (0.59)	0.199*** (6.79)	0.00462 (0.11)
Seasoned Equity Offering t-2	-0.0359*** (-5.49)	0.00340 (1.48)	0.00460* (1.94)
Listed Year t-2	-0.0792 (-0.17)	-0.450 (-1.34)	0.191 (0.51)
Operating Cash Flow to Total Assets t-2	-5.471*** (-4.45)	-1.176*** (-2.84)	-1.358*** (-2.72)
_cons	2.823*** (7.79)	2.564*** (7.13)	2.760*** (7.57)
Clustered by Firm	YES	YES	YES
Year-Fixed Effect	YES	YES	YES
Firm-Fixed Effect	YES	YES	YES
R squared	0.2120	0.2258	0.2112
N	2355	2355	2355

Notes: *ROA* is the return on assets. *Investment Efficiency* is the coefficient for Tobin's Q, estimated by the regression between Tobin's Q and investment expenditure. *R&D to Total Assets* is the ratio calculated by R&D expenses divided by total assets. *R&D to Sales* is the ratio calculated by R&D expenses divided by sales revenue. Following X. Cui et al. (2021), *R&D to Total Assets* and *R&D to Sales* represent the firms innovation investment. Following Chen et al. (2011), this study includes several control variables. *Book Total Debt Ratio* is calculated by total liabilities to total assets. *Size* is measured by the natural logarithm of total assets. *Seasoned Equity Offering* is the natural logarithm of cash proceeds from seasoned equity offerings. *Listed Year* is the natural logarithm of a firm's listing age at the year. *Operating Cash Flow to Total Assets* is measured by operating cash flows scaled by total assets. We employ long-lag estimation to test the effects of investment efficiency and both measures of corporate innovation investment on ROA using OLS with robust standard errors. Firms' characteristic factors are controlled and lagged for two periods. Standard errors are clustered at the firm level and corrected for heteroscedasticity. ***, **, and * indicate the 1%, 5%, and 10% significance levels, respectively.

Chapter 5. Concluding Remarks

This thesis contributes to the understanding of corporate risk through three self-contained essays, exploring the effectiveness of risk management strategies, the internalised transmission mechanism of macroeconomic policy uncertainty, and the assessment of EPU exposure impact in corporations. This thesis overcomes the limitations on corporations' disclosure of their risk management programmes and the difficulty of measuring risk exposures for each firm in a given year, and provides consistent evidence by focusing a systematic lens on corporate risk. Combining the findings of all three studies, this thesis concludes that, in emerging economies such as China, the lack of well-developed market conditions, including limited access to financial services, weak regulatory frameworks, and underdeveloped financial markets, hinders effective risk management for financial derivatives to enhance firm value. By studying the shock of economic policy uncertainty to firms, I propose that macro-economic uncertainty exposure relies on the traditional characteristics of the firm, such as debt financing and ownership structure, for its transmission to the company. Firms' exposure to economic policy uncertainty, as an internalised macro risk, combined with the macroeconomic environment, will have a significant impact on the operation of the company. As such, policymakers, corporations, and investors must take a nuanced approach to risk management, taking into account both the unique characteristics of the macroeconomic environment and the risk profile faced by individual companies.

This thesis suggests that policymakers should focus on creating an environment that is conducive to the successful management of risks, such as by improving the functioning of financial markets and ensuring economic stability. From the perspective of corporations, effective risk management requires a focus on traditional corporate characteristics, such as an effective internal governance mechanism. Finally, investors should take note of both the specific risks faced by individual companies and the broader macroeconomic environment when making investment decisions. This requires a deep understanding of the firm's risk profile, and an awareness of the broader economic trends and risks that may jointly affect the company's performance.

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