Essays on Corporate Hedging from the Perspective of Non-Financial Firms

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Zhenkai Wang

20318882

Supervised by Dr Amrit Judge and Dr Kim Ly

Nottingham University Business School

University of Nottingham

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"Life is like a box of chocolates, you never know what you're going to get." Before I began my doctoral studies, I anticipated that this "chocolate" would be bitter, especially since my doctoral journey started during the Covid-19 pandemic. As I embarked on this journey, I found my assumption to be partially correct. Although pursuing a Ph.D. is indeed a long and arduous journey, my doctoral experience has become rich and memorable due to the many people I encountered along the way. I would like to take this opportunity to express my heartfelt gratitude to these people.

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Chapter 1: Introduction

This thesis discusses three important topics related to corporate hedging. The first study investigates the determinants of corporate hedging through a comparative analysis of Mainland China and Hong Kong non-financial firms. The second study examines the impact of corporate hedging on the default risk of Chinese non-financial firms and explores the moderating effect of state ownership on this effect. The final study shifts the focus to non-financial firms in the United Kingdom, studying the effect of economic policy uncertainty on firms' interest rate swaps usage and interest rate debt structure.

The question of why non-financial firms hedge is one of the most extensively examined topics in corporate finance. The first study aims to address this issue within the Chinese context. Based on a sample of 501 Chinese non-financial firms listed on the HK Stock Exchange from 2008 to 2016, our findings reveal that larger firms, those possessing a higher likelihood of financial distress, those with greater foreign sales, and those with lower capital expenditure are more inclined to hedge. Given the "one country, two systems" policy in China, Mainland China operates as a socialist economy while Hong Kong represents a capitalist economy. This provides us with an excellent opportunity to examine whether these differences play a crucial role in influencing corporate hedging decisions in the two coexisting economic systems. We find that the likelihood of financial distress plays a more important role in the hedging decisions of Hong Kong companies versus firms in Mainland China. We find that state-owned enterprises, especially those in Mainland China, demonstrate a lower propensity to hedge. Our results also show that state ownership is a more effective substitute for IR derivatives hedging than FX derivatives hedging. Finally, we show that government policy which increased derivatives regulation results in a reduction in the likelihood of hedging by Mainland China firms, whilst having no impact on Hong Kong firms.

The second study investigates the impact of corporate hedging on default risk within the context of China, which is one of the most fundamental questions in corporate risk management. Based on manually collected hedging data for 501 non-financial Chinese firms listed on the Hong Kong Stock Exchange over the period 2008 to 2020, our findings reveal that hedging has a significant mitigating effect on a firm's default risk. Notably, we provide unambiguous evidence that the effectiveness of corporate hedging in reducing the likelihood of bankruptcy is sensitive to the type of hedging method employed. Specifically, the use of interest rate derivatives is the most effective in mitigating default risk for firms. As a typical emerging economy, Chinese financial market relies heavily on government intervention, and thus, state ownership plays a pivotal role in Chinese corporate behaviour (Opie et al., 2019; Jia et al., 2019). Our findings highlight that state-owned enterprises are less prone to default and that state ownership significantly moderates the negative effect of corporate hedging on the probability of default, suggesting a substitution effect. Furthermore, our analysis reveals that this substitution effect of state ownership varies depending on firm size. In essence, we find that state ownership is a more effective substitute for hedging among large state-owned enterprises, particularly in the case of derivatives hedging. However, this substitution effect begins to weaken after 2017 and experiences a sharp decline in 2020, which coincides with a significant softening of the implicit Chinese government guarantee provided to state-owned enterprises. Moreover, we find that the moderating effect of state ownership is much stronger during periods of high economic policy uncertainty.

Macroeconomic policy is a vital tool for the government to implement economic and financial management and regulation (McGrattan and Prescott, 2005). However, the extent and manner in which governments implement various economic policies introduce inherent uncertainty, which has significant implications for market stability and corporate activity, thus attracting considerable academic attention. In this context, using the news-based UK economic policy uncertainty index developed by Baker et al. (2016) and employing unique hand collected interest rate swaps data for a sample of

UK non-financial listed firms from 1999 to 2021, we find that a one standard deviation increase in economic policy uncertainty decreases firms' usage of swapping to floating-rate debt by 16% and increases their usage of swapping to fixed-rate debt by 10%. Furthermore, we find that a one standard deviation increase in economic policy uncertainty reduces firms' final floating-rate debt by 3%. These results are both statistically and economically significant. Our findings show that firms that exhibit negative cash flow interest rate sensitivity, those faced with financial constraints and those dependent on bank debt, significantly decrease their usage of swapping to floating-rate debt and increase their usage of swapping to fixed-rate debt and as a result lower the amount of floating-rate debt when faced with elevated levels of economic policy uncertainty. On the other hand, we find that when facing high economic policy uncertainty, firms with positive cash flow interest rate sensitivity only reduce their usage of swapping to floating-rate debt while firms with high bond debt adopt alternative strategies other than interest rate swaps to reduce their floating-rate debt. Furthermore, we find that economic policy uncertainty has no significant impact on financially unconstrained firms' interest rate swap usage and floating-rate debt.

Chapter 2: Why Chinese Non-Financial Firms Hedge? A Comparison between Mainland Chinese and Hong Kong Firms

Abstract

Based on a sample of 501 Chinese non-financial firms listed on the Hong Kong (HK) Stock Exchange from 2008 to 2016, we examine the economic motives for corporate hedging. Our findings reveal that larger firms, those possessing a higher likelihood of financial distress, those with greater foreign sales, and those with lower capital expenditure are more inclined to hedge. We find that the likelihood of financial distress plays a more important role in the hedging decisions of HK enterprises versus firms in Mainland China. We find that state-owned enterprises, especially those in Mainland China, demonstrate a lower propensity to hedge. Our results also show that state ownership is a more effective substitute for IR derivatives hedging than FX derivatives hedging. Finally, we show that government policy which increased derivatives regulation results in a reduction in the likelihood of hedging by Mainland China firms, whilst having no impact on HK firms.

Keywords: Mainland China; Hong Kong**;** corporate hedging; foreign debt; derivatives; financial distress; state ownership.

1. Introduction

The question of why non-financial firms hedge is one of the most extensively examined topics in corporate finance. Over the last 30 years, a substantial body of theoretical and empirical research has emerged to investigate the economic rationale underlying the corporate hedging decision. These studies provide four primary determinants of the decision to hedge. Specifically, these drivers are financial distress costs (Smith and Stulz, 1985; Allayannis and Weston, 2001; Judge, 2006; Haushalter et al., 2007; Purnanandam, 2008; Lin et al., 2008; Bartram et al., 2009; Lau, 2016; Friberg and Seiler, 2017; Bartram, 2019), the underinvestment problem (Froot et al., 1993; Allayannis and Weston, 2001; Graham and Rogers, 2002; Carter et al., 2006; Géczy et al., 2007; Bartram et al., 2009; Bartram, 2019), exposure to financial price changes such as foreign currency (Géczy et al., 1997; Bartram et al., 2010; Yip and Nguyen, 2012; Jorge and Augusto, 2016; Bae et al., 2018), and economies of scale in hedging activities (Smith and Stulz, 1985; Froot et al., 1993; Stulz, 1996; Allayannis and Weston, 2001; Adam, 2002; Judge, 2006; Bartram et al., 2009; Carroll et al., 2017; Bretscher et al., 2018; Bartram, 2019; Bodnar et al., 2019). However, it is worth noting that the majority of the extant empirical literature focuses on firms in developed countries rather than those in emerging economies. As the second-largest economy and the largest emerging market globally, China has witnessed a rapid development of its derivatives and foreign currency (FC) debt markets since 2005. In 2018, the aggregate value of derivative contracts in the Chinese financial market reached approximately USD 15 trillion, exceeding the country's GDP of around USD 13.9 trillion for the same year (Mao, 2019). By the end of the third quarter of 2021, more than 1,300 listed Chinese firms employed derivatives for hedging, issuing a record-breaking 32,000 hedging announcements.[1]

Despite the large number of Chinese firms using derivatives for hedging purposes there are only a relatively small number of empirical studies investigating corporate

[1] News source: Securities Times. 2021-10-18. Website: https://news.stcn.com/sd/202110/t20211018_3768002.html.

hedging in a Chinese setting. The majority of these studies, however, focus on the effects of hedging strategies with very few examining the determinants of hedging. Therefore, based on a substantial sample comprising 501 Chinese non-financial firms listed on the Hong Kong Stock Exchange (HKSE) from 2008 to 2016, we conduct a comprehensive examination of the economic rationale underlying corporate hedging in China. Furthermore, our research design enables us to breakdown our sample into 245 Mainland China firms and 256 HK firms to examine whether the factors influencing their respective hedging decisions are different or vary in extent. Given the "one country, two systems" policy in China, Mainland China operates as a socialist economy whereas HK represents a capitalist economy.[2] This study is the first to examine whether these differences play an important role in influencing corporate hedging decisions in the two economic systems that coexist side by side.

Given the substantial number of Chinese firms stating that they use FC debt for hedging purposes, our study incorporates a wider definition of hedging that includes FC debt users and not just derivative users. Furthermore, we examine the determinants of several categories of hedging decision for both Mainland China and HK firms to investigate whether the determinants of hedging differ across different types of hedging as well as between these two economic systems.[3] To the best of our knowledge, this is the first study to examine the drivers of all hedging, interest rate (IR) derivatives use, foreign exchange (FX) hedging and FC debt hedging in the Chinese context, filling a significant gap in the extant literature.

Our study is most closely related to the work of Hu and Wang (2004), Sun and Morley (2021) and Wen et al. (2021). These three papers, however, provide very little support for the theories of hedging. For example, none of these papers provide any link between financial distress factors and the likelihood hedging that is consistent with expectations. The evidence on FX risk and hedging is mixed with only one study

2 "A White Paper on the Implementation of 'One Country, Two Systems' in the Hong Kong Special Administrative Region". Website: https://www.gov.cn/xinwen/2014-06/10/content_2697833.htm.

3 We construct several categories of hedging that encompass all hedging (using derivatives or FC debt), derivatives use, FC debt use, FX derivatives use, IR derivatives use, and FX hedging (using FX derivatives or FC debt).

reporting a significant positive relationship. The only evidence that is remotely consistent with prior literature is the link between firm size and hedging with two of the three studies reporting a positive link. The inconclusiveness of the results in these three studies might be down to the fact that they focus on derivatives hedging and ignore the use of other tools of hedging such as FC debt. This is potentially an important oversight by these studies. Our careful examination of Mainland China and HK firms financial statements reveals that many non-derivative users employ FC debt to hedge their risks, and so including these hedging firms in the non-derivative users sample may blur the differences between derivative and non-derivative users, potentially leading to weaker or biased findings. Our study is the first to identify and address this issue. We do this by simply excluding firms using FC debt from the sample of non-derivative users when examining the determinants of derivative use. Similarly, we apply the same approach to mitigate the bias for FC debt, FX derivatives, IR derivatives, and FX hedging. Furthermore, we employ predicted classification and Receiver Operating Characteristic (ROC) curve measurements to compare the discrimination ability and performance of the model before and after bias mitigation. Combining the outcomes of these two assessments, we observe a substantial enhancement in the model's discrimination ability and performance after bias mitigation. Moreover, we also employ a multinomial logit model to control for this bias. It is noteworthy that the results based on a multinomial logit estimation are consistent with our bias-mitigated findings, while exhibiting considerable disparities with the results without bias mitigation. This further substantiates the importance of our bias mitigation approach.

Based on our bias-mitigated model we find, unlike all the aforementioned previous studies, that Chinese firms (both Mainland China and HK firms) with a higher likelihood of financial distress are more inclined to conduct hedging activity. We also find that larger Chinese non-financial firms and those with greater FX risk exposure are also more inclined to hedge. We find that the influence of variables proxying for the likelihood of financial distress on the hedging decision are more significant among

HK firms. Moreover, we find that the impact of FX risk exposure as a driver of hedging is more pronounced for Mainland China firms. This may be due to the RMB exchange rate reform in China in 2005. Specifically, this reform delinked the RMB from the US dollar and introduced a managed floating exchange rate system based on market with reference to a basket of currencies (Zhou, 2005). As a result, Chinese firms became increasingly susceptible to FX risks (He et al., 2023), particularly increasing their FX risk exposures to the US dollar (He et al., 2024). On the other hand, since the implementation of the linked exchange rate system in Hong Kong in 1983, the HK dollar exchange rate has remained stable within the range of 7.75 to 7.85 HK dollar per 1 US dollar.[4] Consequently, compared to HK firms, Mainland China companies face higher FX risks and thus are more likely to hedge their FX risk exposures.

Mainland China and HK provide a unique setting to examine the role of state ownership on the corporate hedging decision. In both regions we find the existence of state-owned enterprises (SOEs), but in Mainland China there is greater stewardship of these firms by government. For the first time, our results show that SOEs are less likely to engage in hedging activity and we find this in both Mainland China and HK. This is consistent with SOEs having an implicit government guarantee (IGG) such that they will be supported in the event of financial difficulties (Lin and Tan, 1999; Kornai et al., 2003; Brandt and Li, 2003; Chang and Boontham, 2017), which decreases the likelihood of bankruptcy and therefore the need to hedge. More importantly, we find that the negative effect of state ownership on the likelihood of hedging is more than twice the size for Mainland China firms compared to HK firms. Mainland China SOEs are 14% less likely to hedge compared to only 6% less likely for HK SOEs. These results are consistent with the laissez-faire approach adopted by the Chinese state when it comes to rescuing SOEs in HK. To the best of our

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[4] Hong Kong Monetary Authority. Website: https://www.hkma.gov.hk/gb_chi/key-functions/money/linked-exchange-rate-system/.

knowledge, this study is the first to empirically demonstrate this differential impact of state ownership in a Chinese corporate hedging context.

Following the substantial loss of 11.4 billion RMB incurred by 68 Chinese SOEs in derivatives transactions during the subprime crisis, the Ministry of Finance of the People's Republic of China (MOF) and State-Owned Assets Supervision and Administration Commission (SASAC) implemented a series of policies[5] to strengthen the supervision of firms derivatives transactions from 2010. Our study is the first to show that these government policies significantly reduce the likelihood of hedging by Mainland China firms. The effect is economically significant with a 20% decrease in the probability of hedging. Furthermore, in accordance with the White Paper on the Implementation of "One Country, Two Systems" in the Hong Kong Special Administrative Region and Article 106 of the Basic Law of the Hong Kong Special Administrative Region of the People's Republic of China[6], the Hong Kong Special Administrative Region maintains an independent economic system. This implies that the economic and financial systems of HK operate independently of central government regulation. Therefore, policies implemented by the MOF and SASAC are not expected to have a substantial impact on firms based in Hong Kong. Consistent with this, our findings confirm that a series of MOF and SASAC policies aimed at strengthening the regulation of derivatives usage do not significantly affect the hedging activities of HK companies.

Our study is the first to show in a Chinese context that variables proxying for the probability of financial distress have a greater impact on the likelihood of IR derivatives usage compared to other types of hedging. Furthermore, to the best our knowledge, we are the first study to find that amongst all categories of derivatives hedging, state ownership has the largest negative impact on the use of IR derivatives.

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[5] A series of policies promulgated based on the 'Several Opinions on Strengthening Corporate Financial Management in Response to the Current Financial Crisis’ (MOF, 2009) and the 'Notice on Further Strengthening the Regulation of Financial Derivatives Business of Central Enterprises' (SASAC, 2009).

[6] The Basic Law of the Hong Kong Special Administrative Region of the People's Republic of China. Website: https://www.gov.cn/test/2005-07/29/content_18298.htm.

This result is consistent with our expectations since the use of IR derivatives is designed to directly reduce a firm's default risk and given Chinese SOEs tend to experience a lower probability of financial distress due to the IGG, we would expect a strong substitutive relationship between state ownership and the use of IR derivatives. These novel findings enhance our current understanding of the economic rationale underlying corporate hedging in the Chinese context and provide important new insights for the corporate hedging literature.

Finally, to address potential endogeneity, we employ lagged regressors and a two-stage estimation technique. Our previous findings remain robust even after controlling for potential endogeneity, indicating that this study may not be subject to a serious endogeneity issue.

The remainder of this study proceeds as follows: In Section 2, we review the relevant literature and develop our hypotheses. Section 3 describes our sample selection, data collection, and methodology. We present the empirical results in Section 4 and conclude in Section 5.

2. Literature review and hypothesis development

2.1 Literature review

In the past two decades, a substantial body of research has emerged to explore the rationale behind corporate hedging. As a seminal paper, Smith and Stulz (1985) introduce a value-maximizing function, highlighting financial distress costs as a primary driver for corporate hedging. Subsequently, through the development of a dynamic model for a company issuing equity capital and zero-coupon bonds to invest in a risky asset, Purnanandam (2008) further substantiates this assertion. By employing different proxies for financial distress costs (IR coverage, leverage, liquidity and profitability), extant empirical research provides evidence for the role of financial distress costs in determining corporate hedging decisions (Allayannis and

Weston, 2001; Judge, 2006; Haushalter et al., 2007; Lin et al., 2008; Bartram et al., 2009; Lau, 2016; Friberg and Seiler, 2017; Bartram, 2019).

Bessembinder (1991) and Froot et al. (1993) posit that companies with high costs of underinvestment are more inclined to hedge to augment their internal wealth. However, there is a lack of consensus regarding the effect of hedging in mitigating the underinvestment problem within the empirical literature. On one hand, Graham and Rogers (2002) and Géczy et al. (2007) find evidence in support of the theory of underinvestment costs. On the other hand, by employing market-to-book ratio to reflect a firm's growth opportunities, Bartram et al. (2009) and Bartram (2019) find a significant reduction in the use of derivatives when growth opportunities are high. According to meta-regression analysis conducted by both Geyer-Klingeberg et al. (2018) and Geyer-Klingeberg et al. (2019), the empirical evidence supporting corporate hedging as a strategy to mitigate underinvestment appears to be weak.

Based on a sample of 372 non-financial firms from the Fortune 500 in 1990, Géczy et al. (1997) find that companies with higher FX exposure are more inclined to engage in hedging activities. Bartram et al. (2010), Yip and Nguyen (2012), Jorge and Augusto (2016) and Bae et al. (2018) provide similar evidence to support this finding.

Despite the assertions indicated by Smith and Stulz (1985) and Froot et al. (1993) that small firms tend to favour hedging due to their elevated bankruptcy risk and high information asymmetry, the majority of empirical studies have shown that larger companies are more inclined to engage in hedging activities (Allayannis and Weston, 2001; Adam, 2002; Judge, 2006; Bartram et al., 2009; Carroll et al., 2017; Bretscher et al., 2018; Bartram, 2019; Bodnar et al., 2019).

It is worth noting that the literature above primarily focuses on enterprises in developed countries such as the United States, rather than those in emerging economies. As the second-largest economy and the largest emerging market globally, China has witnessed a rapid evolution of its derivatives and FC debt markets since

2005. In 2018, the aggregate value of derivative contracts in the Chinese financial market reached approximately USD 15 trillion, exceeding the country's GDP of around USD 13.9 trillion for the same year (Mao, 2019). By the end of the third quarter of 2021, more than 1,300 listed Chinese firms employed derivatives for hedging, issuing a record-breaking 32,000 hedging announcements.[7] Despite the strong growth in derivative instruments, literature exploring the determinants of derivative use or corporate hedging in the Chinese context remains rather limited.

Hu and Wang (2005) are the first to investigate the determinants of FX derivatives usage in the Chinese context. Based on 369 HK non-financial firms, they examine the applicability of classical hedging theories including financial distress costs, underinvestment, economies of scale and tax shield. Surprisingly, their findings reveal that none of these theories hold true. Moreover, Hu and Wang (2005) report a significant negative link between FX risk exposure and FX derivatives usage. Subsequently, based on a sample of 316 Chinese multinational corporations (MNCs) from 2012 to 2017, Sun and Morley (2021) provide evidence for the positive relationship between FX risk exposure and the use of FX derivatives. Wen et al. (2021) conduct a study using a sample comprising 2529 firms listed on the Shenzhen Stock Exchange (SZSE) over an 11-year period spanning from 2005 to 2015, and report that FX risk exposure has no significant influence on the usage of derivatives.

Sun and Morley (2021) employ leverage as a proxy of the likelihood of financial distress and find it has no significant impact on the usage of FX derivatives. Meanwhile, Wen et al. (2021) employ Z-score and cash holdings as proxies of a firm's bankruptcy risk. Surprisingly, they find that companies with a lower likelihood of financial distress prefer to use derivatives, which is contrary to hedging theory.

In testing whether the costs of underinvestment play a role in a firm's hedging decision, Sun and Morley (2021) employ the ratio of capital expenditure to sales as a

[7] News source: Securities Times. 2021-10-18. Website: https://news.stcn.com/sd/202110/t20211018_3768002.html.

proxy of a firm's underinvestment problem and discover that companies with lower capital expenditure are more likely to use FX derivatives. In contrast, Wen et al. (2021) find that a company's growth opportunities proxied by research and development expenses has a positive impact on the employment of derivatives. In the context of economies of scale and hedging activities among Chinese non-financial enterprises, the aforementioned three studies all find that larger firms are more inclined to engage in hedging.

As a typical emerging economy, the Chinese economy relies heavily on government support and or intervention. Compared to non-SOEs, SOEs have much easier to access government subsidies, bank loans and other forms of financial support due to the IGG, particularly when they experience financial difficulty (Lin and Tan, 1999; Kornai et al., 2003; Brandt and Li, 2003; Chang and Boontham, 2017). An important implication of the IGG is that SOEs might experience a lower probability financial distress, which can have a significant impact on corporate behaviour or decision making (Opie et al.,2019; Jia et al., 2019). One manifestation of this impact on corporate behaviour is a reduced incentive to engage in hedging activities. Among these limited Chinese studies, there is only Wen et al. (2021) examining the impact of state ownership on corporate hedging, but they find that state ownership has no significant influence on corporate hedging.

2.2 Hypothesis Development

Our review of the empirical corporate hedging literature suggests that there is a lack of consensus on what are the determinants of corporate hedging in the Chinese context. Among this small number of studies, the focus is either an examination of all derivatives usage or FX hedging, with no studies investigating the use of IR derivatives. Given the aforementioned limitations, inconsistencies and gaps in the Chinese empirical corporate hedging literature, this study conducts a comprehensive examination of whether traditional hedging theory holds true in the Chinese context.

This study pays particular attention to theories relating to the likelihood of financial distress, costs of underinvestment, economies of scale and levels of financial price exposure.

It has been noted above that state ownership has the potential to influence Chinese corporate decision making. The evidence on the impact of this influence on corporate hedging is inconclusive. Therefore, this study will reexamine the influence of state ownership on Chinese firms' decision to hedge. Furthermore, given the "one country, two systems" policy in China, where Mainland China operates as a socialist economy with substantial reliance on governmental intervention and HK represents a capitalist economy where the government plays a less prominent role (Gu et al., 2023), we predict that state ownership should have a weaker impact on the hedging decisions of HK firms. We will test this by dividing our sample into Mainland China and HK firms to compare the differential impact of state ownership.

Chinese government legislation introduced in 2010 by the MOF and SASAC to regulate and supervise the use of financial derivatives has the potential to restrict their use by firms. In this study we will investigate whether this is indeed the effect. Furthermore, according to the White Paper on the Implementation of "One Country, Two Systems" in the Hong Kong Special Administrative Region and Article 106 of the Basic Law of the Hong Kong Special Administrative Region of the People's Republic of China, the economic and financial systems of HK operate independently of central government regulation. Hence, legislation aimed at strengthening the regulation of derivatives transactions is not expected to have a substantial impact on HK firms hedging decision. This study will test whether this is in fact the case.

3. Data and methodology

3.1 Chinese stock market

Under the "one country, two systems" framework, China has two parallel stock markets: the A-share market located in the Mainland China and the Hong Kong stock market. The former consists of three stock exchanges: the Shanghai Stock Exchange (SHSE), the Shenzhen Stock Exchange (SZSE), and the newly established Beijing Stock Exchange (BJSE). The establishment of the SHSE was driven by the need for China's economic reforms and opening-up. Officially launched on November 26, 1990, it marked the beginning of China's capital markets. As the first stock exchange on the Mainland China, the SHSE was initially designed to support economic system reforms, promote corporate financing, and foster the development of capital markets. It is the largest stock exchange in Mainland China, with its market capitalization accounting for nearly 60% of the total market capitalization of the A-share market in 2024.[8] The SZSE, established in 1991, is the second-largest securities exchange in Mainland China. Unlike the SHSE, the SZSE was initially focused on small and medium-sized enterprises, aiming to support financing for innovative companies. In 1999, the SZSE launched the ChiNext board to specifically serve high-tech and innovative companies.[9] Moreover, the BJSE was established on November 15, 2021. Compared to the SHSE and SZSE, the Beijing Stock Exchange is relatively young, but its development goals are clear, focusing primarily on equity financing for small and medium-sized enterprises, particularly innovative ones.[10]

On the other hand, the HKSE was established in 1891, initially created by a group of investors as a stock trading market in Hong Kong. After years of development, the HKSE gradually became one of the world’s leading stock exchanges. Following Hong Kong's return to China in 1997, the status of the HKSE was further strengthened, becoming a key bridge between China and global capital markets. In 2000, the HKSE merged with the Hong Kong Futures Exchange, Hong Kong Clearing, and other entities to form the current Hong Kong Exchanges and Clearing Limited. The HKSE is one of the largest stock markets globally, consistently ranking within the top ten in terms of market capitalization. In 2024, the total market capitalization of the HKSE

[8] Shanghai stock exchange. Website: https://www.sse.com.cn/market/stockdata/statistic/.

[9] Shenzhen stock exchange. Website: http://www.szse.cn/.

[10] Beijing stock exchange. Website: https://www.bse.cn/index.html.

was approximately HKD 5 trillion (roughly USD 6.4 trillion)[11].

Notably, unlike the A-share market, the HKSE is a globalized capital market, serving not only Chinese companies but also firms from around the world. From an investor's perspective, the HKSE is known for its open and accessible trading environment for global investors (Ho and Odhiambo, 2015). On the contrary, although Mainland China introduced the Qualified Foreign Institutional Investors scheme in December 2002, which allowed foreign investors to enter the domestic A-share market for the first time, foreign investors still face significant restrictions in investing in A-shares compared to local investors (Ding et al., 2018).

3.2 Chinese derivatives market

Similar to China's stock markets, China’s derivatives markets also operate with parallel developments in Mainland China and Hong Kong. Considering that this study focuses on FX, IR, and commodity price (CP) derivatives, we will discuss the historical development of these three types of derivatives only, excluding others such as stock index futures. The first derivatives introduced in Mainland China were CP derivatives. In 1990, the Shanghai Futures Exchange (SHFE) was established as the first commodity futures exchange in the Mainland China, with copper futures as its initial product, followed by contracts for aluminium, rubber, and other commodities. In 1993, the Dalian Commodity Exchange and the Zhengzhou Commodity Exchange were established, further expanding the range of tradable products in the commodity futures market to include agricultural products, metals, and energy, forming a relatively comprehensive commodity futures market system. In 1994, Mainland China initiated FX system reforms, establishing a unified interbank FX market and introducing a preliminary market-based pricing mechanism for the RMB exchange rate. This mechanism laid the foundation for the emergence of the FX derivatives market, though the type of FX derivatives remained limited. Due to the 1997 Asian

[11] Hong Kong stock exchange. Website: https://www.hkex.com.hk/?sc_lang=zh-HK.

financial crisis, Mainland China imposed stricter controls on capital and FX markets, leading to slower development of FX derivatives. In 2000, with the rapid expansion of the CP derivatives market, the Chinese government began implementing strict regulations on exchanges and futures products, removing some inactive or high-risk contracts to better regulate the market. In November 2001, China joined the World Trade Organization (WTO), committing to open its domestic market to international capital by 2006 to establish itself as a significant future participant in global financial markets (Tunaru et al., 2006). This led to a breakthrough in the development of the derivatives market in Mainland China in the following years. In 2004, as demand for energy products like oil and natural gas grew, energy futures contracts began to emerge. In 2005, Mainland China further reformed the RMB exchange rate mechanism, allowing the RMB to fluctuate within a controlled range. This policy stimulated demand from firms for FX hedging tools, leading to the introduction of FX swaps and forward contracts. In 2006, the Chinese government announced its commitment to fully uphold its fundamental WTO accession commitments by opening the RMB retail business to foreign banks.[12] Specifically, a key policy direction was to encourage foreign banks to incorporate locally, granting them full qualifications to engage in renminbi retail services upon registration. Additionally, locally incorporated foreign banks would be eligible to provide credit card services and consulting services. In the same year, the interbank FX market launched the RMB/USD FX swap, the first FX derivative in Mainland China, providing firms with tools for managing FX risk. Meanwhile, IR derivatives in Mainland China began to develop. The formation of the National Association of Financial Market Institutional Investors facilitated the gradual introduction of IR swaps and other IR derivatives, providing Mainland China firms with tools to manage IR risk, though trading volumes remained low. In 2008, as part of efforts to liberalize IRs, the interbank market introduced Shanghai Interbank Offered Rate (Shibor)-based IR swaps, providing Mainland China firms with more flexible tools for managing IR risk. Mainland

[12] The Complete Record of China's Reform and Opening-Up (1978-2018). Website: http://rhb.reformdata.org/#/column/1/1307.

China’s derivatives market then experienced rapid growth. In 2011, the interbank FX market introduced spot RMB/USD trading and expanded FX forwards, swaps, and currency swaps, enabling firms to hedge their FX risk. In 2012, Mainland China launched futures contracts for commodities like gold and crude oil. In 2015, further liberalization of the IR derivatives market led to the introduction of various Shibor-based IR swap products, increasing demand from Mainland China firms for IR risk management. In 2018, as China's capital market progressively opened to foreign investors, Mainland China introduced FX derivatives tied to the RMB and several major international currencies to help firms hedge their FX risk. In the same year, SHFE launched crude oil futures, which allowed foreign investors to participate. This is Mainland China’s first commodity futures contract accessible to international investors. In 2019, Mainland China introduced more globally aligned commodity futures such as iron ore and natural gas, further elevating China’s position in the global commodity derivatives market.

Hong Kong derivatives market developed earlier than Mainland China derivatives market. Moreover, HK has a focus initially on FX derivatives rather than CP derivatives, which may be due to HK’s role as a major international financial market. In the 1970s, HK’s FX derivatives market emerged alongside rapid economic growth, initially centred on spot FX trading. Soon after, HK’s CP derivatives market began to take shape, focusing primarily on precious metals futures. By the 1980s, the international character of HK’s FX market had become more pronounced, with the introduction of simple FX derivatives like forwards and swaps. Meanwhile, many multinational banks established FX trading departments in HK, making it an essential hub for FX trading in the Asia-Pacific region. Concurrently, the Hong Kong Commodity Exchange launched futures products for gold, silver, and other commodities. Similar to Mainland China, IR derivatives were the last to develop in Hong Kong. It was not until 1990 that interbank IR swaps appeared, though the market remained small and primarily involved banks and institutional investors. In the 21st century, as the HK market matured, firms’ demand for IR derivatives gradually increased. The HKSE and the interbank market introduced various IR swaps and options to help firms manage long-term IR fluctuations. Additionally, as global demand for commodities grew, the HKSE launched more energy derivatives and industrial metals futures to meet companies' hedging needs. In 2011, the HKSE introduced Hong Kong Interbank Offered Rate (HIBOR)-based IR swaps, which became a major tool for hedging IR risk, especially for loans and fixed-income products. In 2012, the HKSE launched RMB/USD futures, making it the first financial market in the world to trade RMB currency futures. In 2014, the HKSE introduced RMB IR swaps based on HIBOR, catering to the risk management needs of offshore RMB market investors. During the same year, the HKSE acquired the London Metal Exchange, deepening its influence in the global commodity futures market. In 2015, as China gradually opened its capital account, Hong Kong introduced more RMB FX derivatives, allowing investors to engage in cross-border investments and hedge FX risks. Trading volumes for RMB/USD, RMB/EUR, and other currency futures and options grew steadily. In 2018, the HKSE launched various RMB-based FX derivatives, including RMB FX swaps and FX options, establishing HK as one of the major offshore RMB markets globally. To support RMB internationalization, the HKSE also introduced RMB-denominated commodity futures, including crude oil futures.

Similar to the differences between Mainland China and HK stock markets, the primary distinction in their derivatives markets also lies in the degree of openness. Hong Kong's derivatives market is highly internationalized, allowing full access for global investors to trade derivatives such as FX, IR and CP derivatives. In contrast, Mainland China' derivatives market remains less open, primarily serving the hedging needs of local firms. It was not until 2018 that the SHFE launched the first Mainland China' derivative product open to foreign investors, which is the crude oil futures contract. However, the internationalization of FX and IR derivatives in Mainland China remains very limited. Moreover, in the development of the derivatives market in Mainland China, regulatory oversight and restrictions are frequently implemented.

This regulatory environment leads companies in Mainland China to primarily use derivatives for hedging purposes rather than for speculation. The existing literature provides evidence that derivatives serve a risk-reducing function for firms in Mainland China (Xie & Yang, 2017; Shao et al., 2019; Zhang et al., 2020; Guo et al., 2021; Cheng & Cheung, 2021). On the other hand, the development of the derivatives market in Hong Kong is characterized by openness and diversity. This environment allows derivatives in Hong Kong to be used not only for hedging but also frequently for investment and even speculation (Hon et al., 2015).

3.3 Sample selection

There are two main reasons for our choice of companies listed on the HKSE. For one thing, these firms generally exhibit greater sophistication and possess extensive experience in risk management, thereby providing a more abundant dataset concerning corporate hedging compared to companies listed on the A-share markets. This is related to the development of the derivatives market. Based on Section 3.2, HK already had a well-established derivatives market in the early 21st century, while Mainland China only began to offer more than one type of FX and IR derivative after 2008. On the other hand, the accounting standards system on the HKSE is more closely aligned with international financial reporting standards compared to that of firms listed on Chinese A-share markets. In 2004, the Hong Kong Institute of Certified Public Accountants announced that, effective January 1st, 2005, the Hong Kong Accounting Standards would undergo restructuring to completely align with the International Accounting Standards and International Financial Reporting Standards. This alignment results in corporations listed on the HKSE disclosing more precise and detailed risk management information. On the other hand, although the application of the China Accounting Standards for Business Enterprises from 2007 mandating increased disclosure on risk management, there are still considerable limitations in the disclosure of hedging information among firms listed on the A-share markets (Guo et al., 2021). Moreover, based on Section 3.2, despite Hong Kong's derivatives market having an early start and reaching maturity in the early 21st century, Mainland China only began establishing a relatively functional derivatives market from 2008 onward. Considering that nearly half of the firms in our sample are Mainland China companies, which are likely to use derivatives instruments available in the Mainland China derivatives market, we select the fiscal year 2008 as the initial year of our sample.

We downloaded the list of companies listed on the HKSE from the Capital IQ database[13] and determined their operational status by checking whether their market capitalization in 2008 was positive, identifying 992 companies in normal operation. Subsequently, based on the location of these firms' headquarters, we excluded firms outside Mainland China and HK, such as those headquartered in Singapore or Australia, leaving a total of 982 companies. Then, following the majority of prior literature (Bartram, 2019; Wen et al., 2021), we exclude financial firms from our sample, since financial institutions may employ derivatives for speculative purposes and some financial firms engage in both derivative investments and sales simultaneously. After this adjustment, 882 companies remain in our sample. Next, we conducted a thorough review of the annual reports disclosed by these 882 companies, excluding 381 firms that did not report information on the use of derivatives or FC debt, those for which it was unclear whether derivatives or FC debt were used for hedging or speculative purposes, and those that used derivatives or FC debt explicitly for speculation. This resulted in a remaining 501 companies, which constitute our final sample. Furthermore, based on the location of corporate headquarters, we segment our sample into 245 Mainland China firms and 256 HK firms to examine the differential determinants influencing their respective hedging decisions.

3.4 Data collection

In this study, we used a keyword search approach and manually collected corporate hedging data from audited financial statements. We follow the literature such as

[13] Given that all our financial data are sourced from the Capital IQ database, downloading the firm list from this database facilitates subsequent matching of hedging and financial data.

Bartram (2019) and Wen et al. (2021) and search for the following keywords to identify hedging firms: ‘hedging’, ‘derivative’, ‘foreign currency risk’, ‘interest rate risk’, ‘commodity price risk’, ‘foreign debt’. Some examples of the kind of corporate hedging information found in Chinese annual reports is presented in Appendix B.

3.5 Variable construction

3.5.1 Dependent variable

Given the limited availability of notional principal data on derivatives usage among Chinese firms, we follow the methodology employed by Bartram (2019) and Wen et al. (2021) by constructing a dummy variable to indicate whether a company uses derivatives (FX or IR derivatives), where a value of 1 signifies usage and 0 otherwise. Panel A of Table 1 shows that the proportion of derivatives users among Mainland China firms stands at 24.3%, which substantially surpasses the proportion reported by Guo et al. (2021) (11.1%) and Wen et al. (2021) (6.3%). Among HK firms, derivatives users account for 31.4%, which is 29% higher than the corresponding figure for Mainland China companies. However, both Mainland China and HK firms use derivatives at notably lower rates of frequency compared to firms in developed countries such as US at 65.1% (Bartram, 2019) and UK at 87.8% (Judge et al., 2024).

We further categorize derivatives users into those employing FX, IR, or CP derivatives. FX derivatives emerge as the most common type of derivative used by Mainland China and HK firms, 19.7% and 25.3%, respectively. This is consistent with Guo et al. (2021). IR derivatives are the second most common type of derivative used by firms in our sample. The use of IR derivatives is more popular among HK firms compared to Mainland China firms, with twice the proportion of HK firms using IR derivatives (17.6%) compared Mainland China firms (8.0%). However, the use of CP derivatives is more frequent among Mainland China firms compared to HK firms, 6.0% and 3.8%, respectively.

An examination of Chinese firms annual reports indicates that FC debt serves as a frequent means for FX hedging complementing FX derivatives.[14] Panel B of Table 1 shows that 55% of firms in Mainland China employ FC debt for FC hedging. The corresponding figure for HK firms is lower at 46%, indicating that hedging with FC debt is more popular in Mainland China.

Our hedging data in Panel B of Table 1 indicates that the use of FC debt is the most preferred hedging method among Chinese non-financial enterprises. For example, in Mainland China 55% of firms use FC debt for hedging whereas only 24.3% use derivatives. This is possibly due to lower transaction costs of FC debt use compared to FX derivatives in the Chinese financial market. Panel B of Table 1 shows that all hedgers, defined as firms using derivatives and or FC debt for hedging, constitute 60.1% of Mainland China firms and 54.7% of HK firms, which are approximately twice the proportions of their respective derivatives users (24.3% in Mainland China and 31.4% in Hong Kong). These findings clearly show the important role of FC debt use in Chinese corporate hedging. Panel B of Table 1 shows that FX hedgers, defined as firms using FC derivatives and or FC debt for hedging, account for 59% of Mainland China firms and 52.4% of HK firms.

3.5.2 Independent variables

Following Clark and Judge (2008), Bartram et al. (2009) and Lau (2016), we employ IR coverage, leverage, liquidity and profitability as proxies for the likelihood of financial distress which are sourced from the Capital IQ database. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage denotes the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Subsequently, based on Sun and Morley (2021), we select Capex ratio, calculated as capital expenditure over sales, as the

[14] Cash inflows in FC can be matched with cash outflows of FC-denominated debt, which can mitigate a firm's FX risk exposures. Hence, we build a binary variable to measure a firm's FC debt use, which is equal to 1 if the firm uses FC debt and 0 otherwise.

measure of a firm's growth opportunities. We use the proportion of total FC sales over total sales to measure companies' FX risk exposure. Due to the pegging currency policy between the HK dollar and the RMB, FX risk exposure between these two currencies is extremally minimal (Hu and Wang, 2005). Hence, we do not treat HK dollar revenues as FC for firms in Mainland China, nor RMB revenues as FC for companies in HK. Based on Bartram (2019), we employ the natural logarithm of market capitalization as a proxy for firm size. Data relating to financial distress, growth opportunities and firm size are sourced from Capital IQ and our proxy for FX risk exposure is obtained from firms annual reports. Apart from IR coverage and FX risk exposure, all these independent variables are winsorized at the top and bottom 1 percent level to alleviate the influence of outliers. The IR coverage ratio is right censored at 100 for the same purpose.

We use the China Stock Market & Accounting Research (CSMAR) database and the State-owned Assets Supervision and Administration of the State Council website to identify which firms in our sample are SOEs. Finally, we employ the year 2010 as a demarcation point to build an indicator variable reflecting the influence of government regulation implemented by the MOF and SASAC aimed at strengthening the supervision of derivatives use by firms. This variable takes a value of 0 in the years 2008 and 2009, and a value of 1 thereafter. Table A-1 in Appendix A presents variable definitions and their predicted signs.

3.6 Methodology

3.6.1 Estimation model

Given that the dependent variables in this study are binary variables, the logit or probit model is deemed more suitable for estimating the hedging model. Moreover, Wooldridge (2010) asserts that the logistic cumulative distribution provides an analytical expression, whereas the standard distribution in the Probit model does not. This characteristic of the logistic model enables a more concise and unambiguous framework for explaining results compared to the Probit model. Therefore, following

Géczy et al. (1997) and Wen et al. (2021), we choose the logit model to estimate the hedging model, formulated as follows:

$$Log\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \beta_0 + \beta_1 INT_{i,t} + \beta_2 LEV_{i,t} + \beta_3 LIQ_{i,t} + \beta_4 PRO_{i,t} + \beta_5 GRO_{i,t} + \beta_6 FXR_{i,t} + \beta_7 SIZ_{i,t} + \beta_8 SOE_i + \beta_9 POL_t + Industry_i + Year_t \quad (1)$$

Where $P_{i,t}$ is the likelihood of hedging; $INT_{i,t}$ is the IR coverage of firm i at time t; $LEV_{i,t}$ is the leverage of firm i at time t; $LIQ_{i,t}$ is the liquidity of firm i at time t; $PRO_{i,t}$ is the profitability of firm i at time t; $GRO_{i,t}$ is the growth opportunity of firm i at time t; $FXR_{i,t}$ is the FX risk exposure of firm i at time t; $SIZ_{i,t}$ is the firm size of firm i at time t; SOE_i represents whether firm i is SOE; POL_t measures whether time t is influenced by government policy. Moreover, we introduce industry and year dummies to control for the fixed effects of industry and time. Additionally, robust standard errors are chosen to control for heteroskedasticity.

Furthermore, it is worth noting that the estimated coefficients of the logit model cannot be interpreted directly as in a linear regression model, since these coefficients signify the effects of firm characteristic variables on the log-odds rather than the likelihood of hedging. Hence, we calculate the marginal effects of the independent variables on the likelihood at the means of the regressors, to quantify the incremental change in the probability of hedging due to a unit change in the firm characteristic variable. We partition our sample into Mainland China and HK firms to compare the differential determinants influencing hedging decisions in these two regions. We begin by examining the determinants of all hedging and then go onto examine several categories or types of hedging, namely derivatives users, FC debt users, FX derivatives users, IR derivatives users, and FX hedgers to analyse the distinct drivers influencing each category separately. To the best of our knowledge, this is the first study investigating the determinants of all hedging, FX hedging, and IR derivatives usage in the Chinese context.

3.6.2 Method to deal with bias

It is worth noting that some non-derivatives users may use FC debt as a method to hedge their risks. Hence, categorizing these firms as non-hedgers could weaken the observed differences between hedgers and non-hedgers, potentially introducing bias into the analysis (Clark and Judge, 2008). Table 1 shows that 35.8% of Mainland China companies only use FC debt to manage their risks and the proportion of FC debt only users among HK firms stands at 23.3%, these are both sizeable proportions. Consequently, including these firms in the non-derivatives group could significantly reduce the differences between derivatives users and non-derivatives users, leading to weaker or biased results. For example, the discrepancies in findings regarding the relationship between financial distress costs and derivatives usage, as reported by Sun and Morley (2021), and Wen et al. (2021), could potentially be attributed to this bias. To address this issue, firms that use FC debt among non-derivatives users are excluded from the analysis when investigating the determinants of all derivatives. The same approach is used to control for such bias in relation to FC debt use, FX derivatives use, IR derivatives use, and FX hedging. The steps taken to address this bias are summarized in Table 2. In our empirical analysis we test the performance of the model before and after the removal of the aforementioned bias to examine whether removing the bias strengthens our results. We employ the predicted classification to compare the models' discriminatory capabilities before and after bias removal, aiming to assess any potential improvement in model performance. Furthermore, for the first time, we employ ROC curve methodology in the corporate hedging field. Specifically, we construct ROC curves for hedging models both before and after bias mitigation to precisely determine the degree of improvement in our results. Compared to the predicted classification, the ROC curve provides a more accurate assessment, facilitating non-parametric testing to further compare the statistical significance of differences between the two models (DeLong et al., 1988; Fawcett, 2006). Therefore, we not only propose a methodology to mitigate potential bias, but also employ a statistical methodology to quantity the improvement in the model's performance.

4 Empirical results

4.1 Descriptive statistics and univariate analysis

Table 3 presents a summary of the descriptive statistics for all independent variables used in this study. On average, firms based in Mainland China tend to be larger, more profitable, exhibiting higher leverage and more capital expenditure than those in HK; whereas HK companies possess higher IR coverage ratios, more liquidity, and higher FC sales. In our sample, SOEs constitute a higher proportion among Mainland China corporations. The Pearson correlation coefficients and their significance among the independent variables are presented in Table A-2 of Appendix A. The absolute values of all correlations between paired variables are below 0.5, suggesting that multicollinearity is not likely to be a problem in our empirical analysis.

In Table 4 we present the results of a two-sample T-test and Wilcoxon rank-sum test which compare the characteristics of hedgers and non-hedgers. In the main our results show that in both Mainland China and HK, hedging firms are larger, have lower IR coverage ratios, higher leverage, lower liquidity, and higher FC sales, which is consistent with our a priori expectations It should be noted that this univariate analysis merely establishes a binary link and does not control for the potential effects arising from other independent variables. For this we need to conduct multivariate analysis which is presented in the following section.

4.2 Multivariate analysis

4.2.1 The determinants of corporate hedging

In this section we investigate the determinants of hedging for both Mainland China and HK firms. To the best of our knowledge, this study is the first to combine the usage of FC debt and derivatives in an all hedging dependent variable and examine its determinants in a Chinese context. Panel A of Table 5 reports the coefficient and marginal effect derived from the logit regression estimations for companies in Mainland China and Hong Kong.

The results show that of those firm level variables that proxy for the likelihood of financial distress only leverage and profitability are significant determinants of hedging for Mainland China firms. However, for HK firms, all four variables proxying for financial distress are statistically significant. These results clearly show that financial distress factors are less important determinants of hedging for Mainland China firms compared to HK firms. Our results suggests that higher levels of capital expenditure decreases the likelihood of hedging for both Mainland China and HK firms, which is opposite to our expectation. We find that firm size has a similar positive effect on the likelihood of hedging for both Mainland China and HK companies.

Based on the marginal effect, the impact of FC sales on hedging behaviour is greater for Mainland China firms compared to HK companies and is nearly twice as large. Our results suggest that a one percent increase in FC sales increases the probability of hedging in Mainland China firms by 66%, the corresponding increase in HK companies is only 36%. This finding aligns very closely with recent evidence by He et al. (2023) who report that as the RMB exchange rate becomes more flexible, Chinese enterprises are increasingly vulnerable to exchange rate risk. Furthermore, He et al. (2024) note that for Chinese firms managing their FX positions and hedging their exchange rate exposures is becoming increasingly necessary.

We find that state ownership has a greater influence on the likelihood of hedging for Mainland China firms than it does for HK companies. The marginal effects indicate that SOEs are 14% less likely to hedge in Mainland China compared to only 6% less likely in HK. This suggests that the negative effect of state ownership on the likelihood of hedging is more than twice the size for Mainland China firms compared to HK firms. Consistent with our expectations, our results suggest that state ownership is a stronger substitute for hedging in Mainland China compared to HK. In essence, our results suggest that state ownership provides firms with greater financial protection in Mainland China than it does in Hong Kong. This study is the first to show such an effect empirically. Finally, consistent with our expectations, we find that new regulation on derivatives transactions that came into force in 2010 reduces the likelihood of hedging among Mainland China firms, while it has no significant impact on HK companies.

Panel B of Table 5 displays the predicted classifications of the hedging models. For Mainland China firms, 76.2% of the observations are accurately predicted, while for our HK sample, 79.0% of the observations are accurately predicted. The proportions of correct classifications in our models are slightly higher than the 75% reported in Géczy et al. (1997) for their full sample. We also employ the ROC curve to assess our models' performance. In this instance, an Area Under the Curve (AUC) exceeding 0.8 is generally considered indicative of robust model performance (Fawcett, 2006). For Mainland China firms, the AUC is 0.8020, while for HK companies the AUC is 0.8520, indicating that our models perform well.

4.2.2 The determinants of corporate hedging: Derivatives hedging, FC debt hedging, FX derivatives hedging, IR derivatives hedging and FX hedging

In this section, we begin by assessing the performance of our hedging model before and after the removal of the bias caused by the inclusion of other hedging firms in the non-hedging sample as discussed in section 3.4.2. We use predicted classifications and ROC analysis to evaluate model performance. Figures 1 to 5 display the ROC curves of the pre-bias specification (Model A) and the post-bias specification (Model B). In Figures 1, 3, 4, and the HK firms in Figure 2, Model B generally lies above Model A, indicating that the model's discriminatory ability and overall performance improve after mitigating bias. However, in these figures, the ROC curves of Model A and Model B exhibit intersections and overlaps. For Mainland China in Figure 2 and in Figure 5, the ROC curves of Model A and Model B are nearly identical. This suggests that an accurate comparison of the models' performance cannot be made solely based on the ROC curves in Figures 1 to 5. Therefore, we further conduct a nonparametric analysis to assess the statistical significance of the differences between the AUC of the pre and post bias models. As shown in Table 6, we find that the AUC of the post bias specification is larger than that of pre-bias specification for all hedging categories and these differences are statistically significant at the 1% level, except for the two hedging categories related to FC debt and FX hedging for Mainland China firms. These results imply a statistically significant enhancement in a model's discriminatory ability and overall performance after removing the bias in the overwhelming majority of specifications. For the two hedging categories associated with FC debt and FX hedging for Mainland China firms, although ROC analysis indicates no significant difference in the performance of the hedging model before and after the removal of bias, according to predicted classifications, the discriminatory capability of the bias-removed model exhibits a noticeable improvement. Overall, this analysis shows that the discriminatory capability of our model improves significantly after the removal of the bias. Therefore, in the logit regression analysis that follows, we focus on the post bias model specification results.[15] Table 7 presents the marginal effects derived from the post bias logit regression results for non-financial companies in Mainland China and Hong Kong.

In line with our results for the determinants of all hedging, we find that leverage and profitability are significantly negatively related to the likelihood of derivatives use, FC debt use, FX derivatives use and FX hedging for Mainland China firms. These results contradict the findings obtained by Sun and Morley (2021) for FX derivatives use and Wen et al. (2021) for derivatives use. For HK firms, all four variables proxying for financial distress are statistically significant determinants of the likelihood of all 5 categories of hedging. Our results are in contrast to the findings of

[15] The results based on Model A with the original sample are shown in the Table A-3 in Appendix A.

Hu and Wang (2005) who find no evidence that that financial distress factors determine FX derivatives hedging. Our HK results confirm our earlier finding that financial distress factors are less important determinants of hedging for Mainland China firms compared to HK firms. It is noteworthy that, in contrast to other categories of hedging, the use of IR derivatives by Mainland China firms is significantly negatively related to the level of IR coverage, in addition to being influenced by leverage and profitability. This indicates that, compared to other categories of hedging, proxies for the likelihood of financial distress have a greater impact on the use of IR derivatives in Mainland China.

As shown earlier for all hedging, we find that firms with higher levels of capital expenditure are less likely to engage in each of the hedging categories for both Mainland China and HK firms. This result is consistent with Sun and Morley (2021) who also use capital expenditure, but opposite to that reported by Wen et al. (2021) who employ a R&D expenditure dummy to proxy for growth opportunities. Hu and Wang (2005) find no relationship between firm growth measured using the price-earnings ratio and HK firms' decision to use FX derivatives.

Consistent with our analysis of the determinants of all hedging, we find that firm size has a similar positive impact on the likelihood of each hedging category for both Mainland China and HK companies. This result is similar to that of previous Chinese studies such as Sun and Morley (2021) and Wen et al. (2021), but contradicts the result obtained by Hu and Wang (2005) who report that firm size has no significant impact on FX derivatives usage for HK firms.

In line with our all hedging results, we find that FC sales is an important driver of each hedging activity for both Mainland China and HK firms. This is consistent with the results of Sun and Morley (2021) but contradict the findings of Hu and Wang (2005) and Wen et al. (2021).

Our results show that state ownership plays a crucial role in the determinants of all the categories of corporate hedging in Mainland China, which contradicts the results of Wen et al. (2021) for derivatives use. In line with our all-hedging results, state ownership has a greater negative impact across all the different hedging categories displayed in Table 7 for Mainland China firms compared to HK firms. The negative impact of state ownership on the likelihood of the various hedging categories in Mainland China firms ranges from 1.4 to 3 times its impact on HK firms. These results confirm our earlier finding that state ownership is a stronger substitute for hedging in Mainland China compared to HK.

Interestingly, we find that state ownership has the greatest negative impact on the usage of IR derivatives when compared to other hedging categories for firms based in Hong Kong. Furthermore, if we focus on derivatives hedging, then our results show that state ownership is a much stronger substitute for IR derivatives hedging compared to FX derivatives hedging in both Mainland China and HK. These results are consistent with our expectations as the use of IR derivatives is designed to directly reduce a firm's default risk and given SOEs tend to experience a lower probability of financial distress due to the protection provided by government, this will give rise to a stronger substitutive relationship between state ownership and the use of IR derivatives. This study is the first to show this substitution effect.

Finally, in line with our earlier results for all hedging, we find that derivatives regulation reduces the likelihood of each hedging activity among Mainland China firms. As in section 4.2.1, we show this regulation has no impact on HK companies' hedging behaviour.

4.3 Robustness tests

As a robustness check, we incorporate lagged regressors for all independent variables, excluding state ownership and government policy, to address potential endogeneity concerns. In Table 8, we present the marginal effects derived from logit regression estimates of the models in Table 5 and 7 incorporating lagged regressors. The lagged results in Table 8 are entirely consistent with our prior findings, suggesting that endogeneity is not a serious concern in this study.

The usage of derivatives is concurrent with the choice of debt financing, which may lead to potential endogeneity issues (Géczy et al., 1997). Therefore, following Géczy et al. (1997), we employ a two-stage estimation technique to simultaneously estimate the determinants of corporate hedging and debt financing decisions. Moreover, we specify the capital structure model following Graham and Rogers (2002), and the structural equations are as follows:

Hedging equation:

$$Log\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \beta_0 + \beta_1 INT_{i,t} + \beta_2 LEV^*_{i,t} + \beta_3 LIQ_{i,t} + \beta_4 PRO_{i,t} + \beta_5 GRO_{i,t} + \beta_6 FXR_{i,t} + \beta_7 SIZ_{i,t} + \beta_8 SOE_i + \beta_9 POL_t + \sum Industry_i + \sum Year_t \qquad (2)$$

Capital structure equation:

$$LEV_{i,t} = \beta_0 + \beta_1 Hedg^*_{i,t} + \beta_2 NetPPE_{i,t} + \beta_3 Ln(sales)_{i,t} + \beta_4 MTB_{i,t} + \beta_5 Vol_{i,t} + \sum Industry_i + \sum Year_t + \varepsilon_{i,t} \qquad (3)$$

In equation (2), $LEV^*_{i,t}$ represents the predicted value of the leverage ratio for firm i at time t, derived from the first-stage estimation of the capital structure equation. In equation (3), $Hedg^*_{i,t}$ is the predicted value of each hedging activity for firm i at time t, derived from the first-stage estimation of the hedging equation. $NetPPE_{i,t}$ is the book value of property, plant, and equipment, net of depreciation over the book value of total assets for firm i at time t; $Ln(sales)_{i,t}$ is the natural logarithm of total sales for firm i at time t; $MTB_{i,t}$ is the sum of the book value of debt and the market value of equity over the book value of total assets for firm i at time t; $Vol_{i,t}$ is the equity volatility over 5 years for firm i at time t. In the first stage, the hedging equation is estimated using logit regression after mitigating the bias, whereas the capital structure equation is estimated using ordinary least squares (OLS) regression.

Subsequently, in the second stage, the predicted values of each hedging activity and leverage ratio from the first-stage regressions are incorporated into the structural equations as explanatory variables. Table 9 presents the results of structural models linking capital structure and each hedging activity. Panel A provides the marginal effects of the second-stage logit estimation of each hedging activity with the predicted value of the leverage ratio. The leverage ratio in each hedging activity is significantly positive, indicating that Chinese firms with higher leverage are more likely to hedge, consistent with our prior findings. On the other hand, Panel B demonstrates the results of the second-stage OLS estimation of the capital structure with the predicted value of each hedging activity. Each hedging activity has a significantly positive impact on capital structure, suggesting that hedging increases the leverage level of Chinese companies, aligning with the results of Graham and Rogers (2002). Hence, the potential endogeneity issues arising from the simultaneous choices of capital structure and corporate hedging in this study seem not to be severe. Furthermore, as illustrated in Panel A of Table 9, the determinants of each hedging activities and their differential effects between Mainland China and HK firms, as well as their varying impacts across different hedging instruments, are consistent with our previous results. These results further substantiate the robustness of our findings.

Although we develop a methodology in Section 3.4.2 to mitigate bias arising from the presence of firms employing alternative hedging instruments among the non-hedger cohort, it is important to note that the categorization of each hedging activity remains insufficiently nuanced owing to the simultaneous use of multiple hedging instruments within a particular hedging category. For instance, a company employing FX derivatives may concurrently use FC debt or IR derivatives. Therefore, as a robustness check, we subdivide hedging firms into four distinct groups, these are firms that only use FX derivatives, firms that only use IR derivatives, firms that only use FC debt and those who engage in more than one of the aforementioned hedging activities. We employ a multinomial logit model to explore the determinants of each of these hedging strategies with the results presented in Table 10. These results are consistent with our previous findings, further substantiating the robustness of our results.

Additionally, we also employ other methods to control for potential endogeneity issues, such as a fixed effects model and a Propensity Score Matching (PSM) approach. However, the results from the former are suboptimal, while the latter, although consistent with our previous findings, cannot pass the difference tests. Therefore, we place these results in Appendix A and provide some possible explanations. Specifically, to control for time-invariant unobservable factors that may be correlated with the independent variable, we use a fixed effects model to estimate equation (1), with the results presented in Table A-4 of Appendix A. However, these results are largely insignificant, and the SOE variable is even omitted. This may be due to the relatively stable ownership structure of Chinese non-financial firms. Although non-SOEs may potentially be acquired or controlled by SOEs, the likelihood of an SOE converting to a private firm is extremely low. In our sample, these cases are virtually non-existent, making the SOE dummy variable nearly time-invariant and thus leading to its omission. Furthermore, given the limited availability of notional principal data on derivatives and FC debt usage among Chinese firms, following Bartram (2019) and Wen et al. (2021), we construct dummy variables as proxies for various hedging activities. On the one hand, firms that use derivatives or FC debt for hedging may continue this behaviour over time, while firms that do not use these instruments may also persist in non-use due to barriers or lack of experience, both lending temporal consistency to their hedging behaviours. On the other hand, a dummy variable can only indicate whether firms engage in derivatives or FC debt hedging without capturing the extent of usage, which also limits variation over time. These limit temporal variation in our dependent variables may contribute to the suboptimal results of the fixed effects model.

Considering the potential financial characteristic differences between Mainland China and HK companies, we employ the PSM approach to achieve a matched sample. This approach facilitates a more rigorous examination of whether the coexistence of distinct economic systems in Mainland China and Hong Kong influences corporate hedging decisions. Specifically, we designate Mainland China firms as the treatment group and HK firms as the control group, employing a 1:1 nearest neighbour matching method to align companies from these regions. Using the matched sample, we then analyse the determinants of various hedging activities (all hedging, derivatives use, FC debt, FX derivatives, IR derivatives, and FX hedging) across Mainland China and HK firms, with the results shown in Table A-5 of Appendix A. These results are entirely consistent with our prior findings, suggesting that endogeneity is not a serious concern in this study. However, as shown in Table A-6, none of the six matched samples for the six types of hedging activities can pass the difference tests. The differences between the treatment and control groups in each matched sample have some significant factors, indicating substantial differences in variables between the treatment and control groups, leading to imbalanced matching. Moreover, the standardized bias, with differences exceeding 0.25 in absolute value, further highlights the poor quality of the match. Due to limitations in the number of firms disclosing hedging data in annual reports, our sample size may be insufficient, thus restricting the availability of suitable matches and causing weaker balance. This imbalance leads to failures in the difference tests and even causes instances of repeated matching.

5 Conclusion

This study presents one of the most comprehensive and robust examinations of the economic rationale for Chinese corporate hedging. Based on a large sample of 501 Chinese non-financial firms listed on the HKSE for a nine-year period from 2008 to 2016, we find that large Chinese firms, those with a higher likelihood of financial distress and those with greater FX risk exposure are more likely to hedge. We do not find that firms with higher growth opportunities as proxied by capital expenditure are more inclined to hedge, which is consistent with previous Chinese studies. In contrast to other types of hedging activity, we find that proxies for the likelihood of financial distress exert a larger impact on the usage of IR derivatives. This is not unexpected since IR derivatives hedging is the most effective way to avoid financial distress.

Our study is the first to compare the determinants of hedging between Mainland China and HK firms. We argue that this comparison is important given the different economic systems firms in Mainland China and HK operate under. Our results show that proxies for the likelihood of financial distress are more important drivers of the decision to hedge among HK firms compared to Mainland China firms. Moreover, we find that the negative impact of state ownership on the hedging decision is significantly much smaller for HK companies. In effect, state ownership is a more effective substitute for hedging among Mainland China firms than HK firms. These results are in line with the arms-length approach adopted by the Chinese state when it comes to rescuing firms such as SOEs in HK. We also find that state ownership is a more effective substitute for IR derivatives hedging than FX derivatives hedging for both Mainland China and HK firms. This result is consistent with our expectations, as both state ownerships and IR derivatives usage provide direct protection against credit default. We believe, to the best of our knowledge, this study is the first to show these differential impacts of state ownership in a Chinese corporate hedging context. This study is also the first to demonstrate that public policy intervention by way of derivatives markets regulation in 2010 decreased hedging activity among Mainland China firms. Furthermore, consistent with expectations, we find that the regulation has no significant impact on HK companies' derivatives use.

This research contributes to the extant literature on corporate hedging by offering novel and new insights into the determinants of hedging activities by Chinese non-financial firms, particularly for all hedging, IR derivatives use and FX hedging. Our study addresses a crucial research gap in this field and enhances our understanding of the impact of state ownership on the corporate hedging decision. Moreover, this study develops new methodologies to control for the bias caused by other types of hedgers in the non-hedging sample and introduces ROC curve analysis, which have important implications for future research in this field. Furthermore, the findings of this study are relevant for public policymakers, investors, and corporate risk managers, providing valuable insights into the hedging behaviours of Chinese firms. These insights can inform decision-making and risk management strategies in practice.

Table 1: Frequency distribution of corporate hedging

Table 1 presents corporate hedging activity among the sample of 501 Chinese non-financial firms listed on the HKSE over the period of 2008 to 2016. The sample comprises 2193 firm-year observations from Mainland China corporations and 2285 firm-year observations from Hong Kong corporations. Panel A demonstrates corporate derivatives activity. In Panel B, all hedgers include derivatives and FC debt users, and FX hedgers include FX derivatives and FC debt users. These data are hand-collected from annual reports.

Panel A. Derivative activity

	Mainland China		Hong Kong	
Derivative Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Derivative users	533	24.30%	718	31.42%
Derivative non-users	1660	75.70%	1567	68.58%
Total	2193	100.00%	2285	100.00%
FX derivatives users	432	19.70%	579	25.34%
FX derivatives non-users	1761	80.30%	1706	74.66%
Total	2193	100.00%	2285	100.00%
IR derivatives users	175	7.98%	403	17.64%
IR derivatives non-users	2018	92.02%	1882	82.36%
Total	2193	100.00%	2285	100.00%
CP derivatives users	131	5.97%	86	3.76%
CP derivatives non-users	2062	94.03%	2199	96.24%
Total	2193	100.00%	2285	100.00%

Panel B. Hedging activity

	Mainland China		Hong Kong	
Hedging Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
All hedgers	1318	60.10%	1250	54.70%
Non-hedgers	875	39.90%	1035	45.30%
Total	2193	100.00%	2285	100.00%
FC debt users	1206	54.99%	1051	46.00%
FC debt non-users	987	45.01%	1234	54.00%
Total	2193	100.00%	2285	100.00%
FX hedgers	1294	59.01%	1198	52.43%
FX non-hedgers	899	40.99%	1087	47.57%
Total	2193	100.00%	2285	100.00%

Table 2. Classification and method to mitigate bias of hedging activities

Table 2 illustrates the classification and definition of each corporate hedging activities. Furthermore, it outlines the approach employed to mitigate bias when examining the factors influencing derivatives, FC debt, FX derivatives, IR derivatives, and FX hedging, respectively.

Classification	Definition	Method to deal with bias
All hedger	Using derivatives or FC debt	No bias
Derivatives user	Using derivatives	Drop FC debt users among non-derivatives users
FC debt user	Using FC debt	Drop derivatives users among non-FC debt users
FX derivatives user	Using FX derivatives	Drop FC debt users or IR derivatives users among non-FX derivatives users
IR derivatives user	Using IR derivatives	Drop FC debt users or FX derivatives users among non-IR derivatives users
FX hedger	Using FX derivatives or FC debt	Drop IR derivatives users among non-FX hedgers

Table 3. Summary statistics

Table 3 provides summary information for the independent variables used in the analysis. The sample period is 2008-2016. Leverage, Liquidity, Profitability, Growth opportunity and Firm size are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers. IR coverage is right censored at 100 to mitigate the effects of outliers. FX risk exposure is a percentage variable. State ownership and Government regulation are dummy variables.

Variable	N	Min.	Mean (Mainland China)	Mean (HK)	Median (Mainland China)	Median (HK)	Max.	Std. Dev.
IR coverage	3249	0.001	22.579	27.291	8.038	10.386	100.000	32.520
Leverage	3894	0.149	71.805	58.644	46.817	35.663	583.177	84.606
Liquidity	4449	0.066	1.522	2.148	0.967	1.112	19.421	2.667
Profitability	4346	-29.536	5.949	3.144	4.791	2.844	32.100	8.715
Growth opportunity	4201	0.043	12.901	11.615	6.560	4.370	128.175	19.850
FX risk exposure	4409	0.000	0.108	0.217	0.000	0.020	1.000	0.275
Firm size	4200	2.379	6.371	6.332	6.252	6.371	11.114	1.947
State ownership	4478	0.000	0.303	0.193	0.000	0.000	1.000	0.431
Government regulation	4478	0.000	0.781	0.783	1.000	1.000	1.000	0.413

Table 4. Two sample T-test and Wilcoxon rank sum test between hedger and non-hedger

Table 4 presents the results for tests of the equality of means and Wilcoxon Rank Sum Test between hedger (including derivative and FC debt users) and non-hedger. Panel A exhibits results concerning non-financial firms in Mainland China, while Panel B presents results pertaining to non-financial firms in Hong Kong. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Mainland China Firms

	Non-hedger		Hedger		T-test Difference	Wilcoxon p-value
Variables	**N**	**Mean**	**N**	**Mean**	**H>NH**	**H>NH**
IR coverage	574	30.506	1106	18.508	-11.998***	0.000
Leverage	649	58.779	1278	78.437	19.658***	0.000
Liquidity	853	1.987	1311	1.227	-0.760***	0.000
Profitability	825	6.131	1307	5.77	-0.361	0.278
Growth opportunity	814	10.988	1304	14.102	3.114***	0.000
FX risk exposure	857	0.039	1305	0.153	0.114***	0.000
Firm size	732	5.533	1248	6.865	1.332***	0.000
State ownership	875	0.247	1318	0.34	0.093***	0.000
Government regulation	875	0.735	1318	0.812	-0.077***	0.000

Panel B. HK Firms

	Non-hedger		Hedger		T-test Difference	Wilcoxon p-value
Variables	**N**	**Mean**	**N**	**Mean**	**H>NH**	**H>NH**
IR coverage	526	41.935	1016	19.463	-22.472***	0.000
Leverage	782	46.049	1159	67.184	21.135***	0.000
Liquidity	1027	2.973	1229	1.469	-1.504***	0.000
Profitability	982	1.691	1209	4.233	2.542***	0.000
Growth opportunity	919	12.101	1135	11.3	-0.802	0.000
FX risk exposure	1011	0.181	1236	0.245	0.064***	0.000
Firm size	1000	5.445	1213	7.065	1.621***	0.000
State ownership	1035	0.189	1250	0.196	0.007	0.690
Government regulation	1035	0.757	1250	0.804	-0.047***	0.007

Table 5. The determinants of all hedging

Table 5 illustrates the incentives prompting Chinese non-financial firms to use derivatives or FC debt. Panel A reports the coefficient and marginal effect derived from the logit regression outcomes for non-financial companies in Mainland China and Hong Kong, respectively. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. Panel B and C shows the predicted classification and ROC curve measurement derived from the logit regression models for Mainland China and HK non-financial firms, respectively. Robust standard errors are chosen to control for heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Logit Regression Estimates

	Mainland China		HK	
Variable	**Coefficient**	**ME**	**Coefficient**	**ME**
IR Coverage	-0.0009	-0.0001	-0.0146***	-0.0021***
	(0.0030)	(0.0005)	(0.0028)	(0.0004)
Leverage	0.0048***	0.0007***	0.0059**	0.0008**
	(0.0018)	(0.0003)	(0.0024)	(0.0003)
Liquidity	-0.0697	-0.0108	-0.1427***	-0.0203***
	(0.0636)	(0.0099)	(0.0504)	(0.0071)
Profitability	-0.0705***	-0.0109***	-0.0342*	-0.0049*
	(0.0158)	(0.0024)	(0.0183)	(0.0026)
Growth Opportunity	-0.0152***	-0.0024***	-0.0108*	-0.0015**
	(0.0042)	(0.0006)	(0.0055)	(0.0008)
FX Risk Exposure	4.2532***	0.6597***	2.5342***	0.3604***
	(0.5263)	(0.0773)	(0.2825)	(0.0393)
Firm Size	0.7054***	0.1094***	0.6293***	0.0895***
	(0.0539)	(0.0068)	(0.0518)	(0.0062)
State Ownership	-0.8734***	-0.1355***	-0.4162**	-0.0592**
	(0.1723)	(0.0255)	(0.1926)	(0.0270)
Government Regulation	-1.2747***	-0.1977***	-0.0428	-0.0061
	(0.3510)	(0.0538)	(0.3301)	(0.0470)
Constant	-2.7363***		-1.8136***	
	(0.5014)		(0.6347)	
Observations	1359	1359	1315	1315
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Pseudo R^2	0.224	0.224	0.300	0.300
Chi-squared	297.7653	297.7653	344.5825	344.5825

Panel B. Predicted classification

	Mainland China			HK		
Number of Observations	**Predicted Dependent Variable**			**Predicted Dependent Variable**		
Actual dependent variable	0	1	Total	0	1	Total
0 (Discloses no hedging)	853	221	1074	785	165	950
1 (Discloses hedging)	103	182	285	111	254	365
Total	956	403	1359	896	419	1315
Correctly classified	76.16%			79.01%		

Panel C. ROC Curve

	Mainland China	HK
AUC	0.8020	0.8520

Table 6. The measurements of models' performance for various categories of corporate hedging

Table 6 exhibits the predicted classification, ROC curve measurements, and the outcomes of non-parametric testing conducted to evaluate the distinctions in performance between Model A and Model B, respectively. Model A is based on the original dataset, while Model B is constructed using a sample that mitigates bias by excluding other types of hedgers in the non-hedging sample.

Panel A. Derivatives				
	Mainland China		**HK**	
Measurement	**Model A**	**Model B**	**Model A**	**Model B**
Predicted Classification				
Correctly classified	75.63%	77.13%	73.92%	79.75%
ROC Curve				
AUC	0.8131	0.8406	0.8250	0.8569
P value for difference from AUC	0.0000		0.0000	
Panel B. FC debt				
	Mainland China		**HK**	
Measurement	**Model A**	**Model B**	**Model A**	**Model B**
Predicted Classification				
Correctly classified	72.26%	75.51%	76.35%	79.95%
ROC Curve				
AUC	0.7964	0.7949	0.8006	0.8187
P value for difference from AUC	0.6361		0.0000	
Panel C. FX derivatives				
	Mainland China		**HK**	
Measurement	**Model A**	**Model B**	**Model A**	**Model B**
Predicted Classification				
Correctly classified	80.49%	78.93%	76.05%	79.54%
ROC Curve				
AUC	0.7859	0.8350	0.8239	0.8495
P value for difference from AUC	0.0000		0.0005	
Panel D. IR derivatives				
	Mainland China		**HK**	
Measurement	**Model A**	**Model B**	**Model A**	**Model B**
Predicted Classification				
Correctly classified	90.70%	85.64%	82.05%	86.39%
ROC Curve				
AUC	0.8789	0.8996	0.8953	0.9185
P value for difference from AUC	0.0003		0.0000	
Panel E. FX hedging				
	Mainland China		**HK**	
Measurement	**Model A**	**Model B**	**Model A**	**Model B**
Predicted Classification				
Correctly classified	75.06%	75.79%	77.72%	78.52%
ROC Curve				
AUC	0.7759	0.7768	0.7948	0.7981
P value for difference from AUC	0.4495		0.0000	

Table 7. The marginal effects of various corporate hedging determinants

Table 7 presents the incentives prompting Chinese non-financial firms to employ derivatives, FC debt, FX derivatives, IR derivatives and FX hedging. Based on the bias-mitigated sample, the marginal effects derived from the logit regression results are demonstrated for non-financial companies in Mainland China and Hong Kong, respectively. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. Robust standard errors are chosen to control for heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	Derivatives		**FC debt**		**FX derivatives**		**IR derivatives**		**FX hedging**	
Variable	**Mainland China**	**Hong Kong**	**Mainland China**	**Hong Kong**	**Mainland China**	**Hong Kong**	**Mainland China**	**Hong Kong**	**Mainland China**	**Hong Kong**
IR Coverage	-0.0003	-0.0019***	-0.0001	-0.0024***	-0.0001	-0.0020***	-0.0017**	-0.0039***	-0.0001	-0.0023***
	(0.0006)	(0.0005)	(0.0005)	(0.0004)	(0.0006)	(0.0005)	(0.0008)	(0.0007)	(0.0005)	(0.0004)
Leverage	0.0010***	0.0007**	0.0008**	0.0009***	0.0010***	0.0007**	0.0011***	0.0005***	0.0008**	0.0008***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Liquidity	-0.0133	-0.0449***	-0.0133	-0.0159**	0.0044	-0.0390***	0.0253	-0.0295***	-0.0069	-0.0179***
	(0.0195)	(0.0074)	(0.0103)	(0.0073)	(0.0177)	(0.0076)	(0.0164)	(0.0058)	(0.0098)	(0.0069)
Profitability	-0.0100***	-0.0059*	-0.0125***	-0.0083***	-0.0075***	-0.0069**	-0.0118***	-0.0075**	-0.0114***	-0.0052**
	(0.0029)	(0.0031)	(0.0024)	(0.0028)	(0.0029)	(0.0034)	(0.0031)	(0.0032)	(0.0024)	(0.0026)
Growth Opportunity	-0.0055***	-0.0022**	-0.0024***	-0.0016**	-0.0071***	-0.0029***	-0.0022***	-0.0021***	-0.0025***	-0.0015*
	(0.0010)	(0.0009)	(0.0007)	(0.0008)	(0.0014)	(0.0010)	(0.0007)	(0.0006)	(0.0007)	(0.0008)
FX Risk Exposure	0.8714***	0.4905***	0.6444***	0.3522***	0.8831***	0.5027***	0.4925***	0.3901***	0.7032***	0.3511***
	(0.0847)	(0.0416)	(0.0799)	(0.0404)	(0.0816)	(0.0444)	(0.0767)	(0.0397)	(0.0801)	(0.0403)
Firm Size	0.1201***	0.1023***	0.1141***	0.0972***	0.1159***	0.1017***	0.1145***	0.1017***	0.1098***	0.0882***
	(0.0075)	(0.0063)	(0.0071)	(0.0067)	(0.0074)	(0.0064)	(0.0089)	(0.0053)	(0.0069)	(0.0062)
State Ownership	-0.0664*	-0.0388	-0.1598***	-0.0549**	-0.0608*	-0.0393	-0.1384***	-0.1017***	-0.1659***	-0.0560**
	(0.0346)	(0.0333)	(0.0266)	(0.0264)	(0.0349)	(0.0360)	(0.0469)	(0.0318)	(0.0262)	(0.0271)
Government regulation	-0.2381***	-0.0399	-0.2342***	-0.0400	-0.1727**	-0.0127	-0.1694**	-0.0443	-0.1909***	0.0040
	(0.0684)	(0.0567)	(0.0567)	(0.0471)	(0.0688)	(0.0590)	(0.0711)	(0.0509)	(0.0543)	(0.0475)
Observations	835	968	1270	1187	764	875	550	757	1355	1299
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.355	0.374	0.234	0.347	0.380	0.379	0.408	0.530	0.220	0.305
Chi-squared	231.6239	295.2087	301.2115	364.2288	218.8744	260.7923	155.5873	221.9219	288.3924	338.5126

Table 8. The marginal effects of corporate hedging determinants with lagged regressors

Table 8 exhibits the incentives behind the involvement of Mainland China and Hong Kong non-financial firms in various hedging activities, respectively. These activities encompass all hedging (derivatives and FC debt usage), derivatives usage, FC debt usage, FX derivatives usage, IR derivatives usage, and FX hedging (FX derivatives and FC debt usage). Specifically, Table 8 illustrates the marginal effects resulting from logit regression estimates with lagged regressors. Except for all hedging, the outcomes of other hedging activities are based on samples that have mitigated bias. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. Except state ownership and government policy, all other independent variables are lagged with one year. Robust standard errors are chosen to control for heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	All hedging		**Derivatives**		**FC debt**		**FX derivatives**		**IR derivatives**		**FX hedging**	
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
IR Coverage	-0.0001	-0.0019***	-0.0003	-0.0019***	-0.0001	-0.0022***	-0.0000	-0.0019***	-0.0018**	-0.0038***	0.0001	-0.0020***
	(0.0005)	(0.0004)	(0.0007)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0009)	(0.0007)	(0.0005)	(0.0004)
Leverage	0.0007**	0.0013***	0.0010***	0.0010***	0.0009**	0.0015***	0.0013***	0.0008**	0.0010***	0.0007***	0.0009***	0.0014***
	(0.0003)	(0.0005)	(0.0003)	(0.0004)	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0002)	(0.0002)	(0.0003)	(0.0005)
Liquidity	-0.0113	-0.0150*	-0.0031	-0.0432***	-0.0129	-0.0113	0.0156	-0.0382***	0.0195	-0.0279***	-0.0079	-0.0126
	(0.0100)	(0.0078)	(0.0193)	(0.0087)	(0.0104)	(0.0083)	(0.0166)	(0.0094)	(0.0143)	(0.0062)	(0.0099)	(0.0077)
Profitability	-0.0114***	-0.0042	-0.0108***	-0.0057*	-0.0127***	-0.0069**	-0.0074***	-0.0072**	-0.0129***	-0.0082***	-0.0115***	-0.0049*
	(0.0024)	(0.0027)	(0.0029)	(0.0033)	(0.0024)	(0.0029)	(0.0028)	(0.0036)	(0.0036)	(0.0032)	(0.0024)	(0.0028)
Growth Opportunity	-0.0022***	-0.0001	-0.0048***	-0.0005	-0.0023***	-0.0000	-0.0068***	-0.0008	-0.0020***	-0.0009	-0.0023***	0.0000
	(0.0007)	(0.0008)	(0.0009)	(0.0009)	(0.0007)	(0.0008)	(0.0014)	(0.0010)	(0.0007)	(0.0007)	(0.0007)	(0.0008)
FX Risk Exposure	0.6062***	0.3448***	0.9177***	0.4741***	0.6254***	0.3514***	0.9409***	0.5045***	0.6156***	0.3861***	0.6517***	0.3370***
	(0.0819)	(0.0404)	(0.0907)	(0.0429)	(0.0857)	(0.0431)	(0.0838)	(0.0454)	(0.1006)	(0.0433)	(0.0856)	(0.0418)
Firm Size	0.1122***	0.0844***	0.1234***	0.0977***	0.1157***	0.0928***	0.1148***	0.0998***	0.1185***	0.0978***	0.1111***	0.0844***
	(0.0072)	(0.0063)	(0.0084)	(0.0066)	(0.0074)	(0.0069)	(0.0081)	(0.0068)	(0.0113)	(0.0062)	(0.0072)	(0.0063)
State Ownership	-0.1261***	-0.0473	-0.0649*	-0.0249	-0.1472***	-0.0560**	-0.0433	-0.0151	-0.1585**	-0.1230***	-0.1572***	-0.0500*
	(0.0261)	(0.0290)	(0.0359)	(0.0377)	(0.0274)	(0.0277)	(0.0348)	(0.0367)	(0.0634)	(0.0370)	(0.0267)	(0.0285)
Government regulation	-0.1567***	0.0037	-0.1918***	-0.0299	-0.1867***	-0.0193	-0.1366**	-0.0018	-0.1506**	-0.0437	-0.1527***	0.0194
	(0.0532)	(0.0481)	(0.0663)	(0.0563)	(0.0566)	(0.0491)	(0.0665)	(0.0588)	(0.0759)	(0.0483)	(0.0533)	(0.0482)
Observations	1203	1169	665	820	1099	1026	602	726	388	623	1198	1146
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.223	0.309	0.395	0.391	0.244	0.370	0.435	0.417	0.440	0.562	0.221	0.325
Chi-squared	251.6095	316.3079	165.9191	274.4378	261.5615	317.8728	154.3738	225.7506	106.8993	201.3359	246.4037	303.1646

Table 9. The determinants of corporate hedging with two-stage estimation technique

Table 9 displays the outcomes derived from two-stage estimation technique linking the leverage ratio and various hedging activities. These activities encompass all hedging (derivatives and FC debt usage), derivatives usage, FC debt usage, FX derivatives usage, IR derivatives usage, and FX hedging (FX derivatives and FC debt usage). Panel A demonstrates the marginal effects resulting from the second-stage logit estimation for each hedging activity concerning the predicted leverage ratio. Meanwhile, Panel B presents the results from the second-stage OLS estimation, evaluating the impact of the predicted value of each hedging activity on the capital structure. IR coverage is the ratio of profit before interest and tax over interest expenses. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. Net PPE% is the book value of property, plant, and equipment, net of depreciation over the book value of total assets. Ln (Total sales) is the natural logarithm of total sales. Market to Book Ratio is the sum of the book value of debt and the market value of equity over the book value of total assets. Volatility is the equity volatility over 5 years. Robust standard errors are chosen to control for heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Marginal effects of logit regression estimates for each hedging activity

	All hedging		**Derivatives**		**FC debt**		**FX derivatives**		**IR derivatives**		**FX hedging**	
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
IR Coverage	-0.0025***	0.0003	-0.0034***	0.0005	-0.0025***	-0.0002	-0.0030***	0.0005	-0.0025***	-0.0008***	-0.0023***	0.0003
	(0.0006)	(0.0003)	(0.0009)	(0.0004)	(0.0006)	(0.0003)	(0.0009)	(0.0005)	(0.0007)	(0.0003)	(0.0006)	(0.0003)
Leverage*	0.0027***	0.0117***	0.0045***	0.0130***	0.0026***	0.0092***	0.0032***	0.0136***	0.0048***	0.0067***	0.0024***	0.0117***
	(0.0007)	(0.0004)	(0.0007)	(0.0005)	(0.0007)	(0.0004)	(0.0008)	(0.0007)	(0.0007)	(0.0010)	(0.0007)	(0.0004)
Liquidity	-0.0215	-0.0105**	-0.0325*	-0.0201***	-0.0223	-0.0078*	-0.0245	-0.0235***	0.0034	-0.0095**	-0.0198	-0.0093**
	(0.0134)	(0.0046)	(0.0196)	(0.0063)	(0.0137)	(0.0044)	(0.0160)	(0.0067)	(0.0149)	(0.0046)	(0.0138)	(0.0045)
Profitability	0.0007	-0.0053***	0.0065	-0.0068***	-0.0019	-0.0026	0.0046	-0.0068***	0.0042*	-0.0012	-0.0012	-0.0048***
	(0.0039)	(0.0016)	(0.0047)	(0.0020)	(0.0042)	(0.0020)	(0.0046)	(0.0023)	(0.0024)	(0.0024)	(0.0040)	(0.0016)
Growth Opportunity	-0.0028**	-0.0002	-0.0068***	-0.0006	-0.0029**	-0.0002	-0.0102***	-0.0006	-0.0022*	-0.0004	-0.0034**	-0.0001
	(0.0013)	(0.0006)	(0.0017)	(0.0007)	(0.0013)	(0.0004)	(0.0021)	(0.0007)	(0.0013)	(0.0007)	(0.0014)	(0.0006)
FX Risk Exposure	0.5622***	0.1819***	0.6481***	0.2703***	0.5600***	0.1011***	0.6853***	0.2524***	0.2878**	0.0344	0.5929***	0.1473***
	(0.0874)	(0.0339)	(0.1006)	(0.0452)	(0.0894)	(0.0299)	(0.0987)	(0.0520)	(0.1151)	(0.0304)	(0.0893)	(0.0339)
Firm Size	0.0925***	0.0381***	0.0966***	0.0428***	0.0989***	0.0334***	0.1012***	0.0473***	0.0483**	0.0269***	0.0938***	0.0356***
	(0.0079)	(0.0053)	(0.0085)	(0.0064)	(0.0083)	(0.0049)	(0.0092)	(0.0060)	(0.0217)	(0.0060)	(0.0081)	(0.0053)
State Ownership	-0.0703**	-0.0302	-0.0281	-0.0242	-0.1063***	-0.0251	-0.0709	-0.0152	-0.0882**	-0.0310**	-0.1133***	-0.0298
	(0.0340)	(0.0221)	(0.0435)	(0.0287)	(0.0371)	(0.0198)	(0.0476)	(0.0309)	(0.0384)	(0.0148)	(0.0358)	(0.0218)
Government Regulation	-0.1397*	-0.0874***	-0.1760*	-0.0100	-0.1791**	-0.0820***	-0.1372	0.0047	-0.1108**	0.0149	-0.1340	-0.0753**
	(0.0826)	(0.0312)	(0.0910)	(0.0372)	(0.0875)	(0.0307)	(0.0902)	(0.0433)	(0.0513)	(0.0304)	(0.0824)	(0.0320)
Observations	778	1106	490	809	726	990	449	728	304	629	777	1090
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.284	0.653	0.421	0.683	0.295	0.746	0.419	0.655	0.887	0.883	0.273	0.663
Chi-squared	187.5410	205.2322	134.6761	162.6453	196.7559	187.5620	130.2161	170.7350	36.1741	177.0072	189.5516	209.7694

Table 9. (Continued)

Panel B. OLS regression estimates of capital structure

	Leverage											
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
All Hedging*	84.8212***	131.1310***										
	(18.6921)	(15.7549)										
Derivatives*			89.0835***	90.7357***								
			(27.9358)	(11.3945)								
FC Debt*					81.4643***	136.5793***						
					(18.7185)	(15.9292)						
FX Derivatives*							63.8284**	85.8605***				
							(27.6195)	(11.8921)				
IR Derivatives*									185.9188***	80.4877***		
									(35.0721)	(10.9278)		
FX Hedging*											79.6898***	132.6063***
											(17.9541)	(15.8361)
Net PPE%	42.2240**	-23.4233***	48.6507*	-18.7923**	45.3894***	-27.9126***	24.7373	-27.2350***	4.3785	-19.0716*	41.0586**	-24.8116***
	(16.4292)	(8.6052)	(25.6133)	(9.4061)	(16.6126)	(9.1070)	(32.1849)	(10.1023)	(29.3604)	(10.5474)	(16.4680)	(8.8050)
Ln (Total sales)	-3.4111	-5.0503***	-7.1123	-3.0321*	-3.9322	-6.9231***	-4.6630	-2.9178*	-14.7159**	-2.7015	-2.8183	-5.2039***
	(2.9154)	(1.7561)	(5.1648)	(1.6277)	(3.1291)	(1.9253)	(5.4974)	(1.6496)	(6.0720)	(1.6799)	(2.8418)	(1.7587)
Market to Book Ratio	-9.0610***	-5.1413***	-8.6755***	-3.3001	-8.1596***	-5.9266***	-7.7169***	-2.5315	-12.3768***	-3.5841*	-8.7520***	-4.9827**
	(1.7894)	(1.9520)	(2.3806)	(2.2872)	(1.8841)	(2.2564)	(2.4361)	(2.4525)	(3.2814)	(2.0506)	(1.7753)	(1.9926)
Volatility	1.0950***	0.7703***	0.9707***	0.8738***	1.0021***	0.7271***	0.8458**	0.8116***	0.8021***	0.6621***	1.0598***	0.7397***
	(0.2509)	(0.1704)	(0.3205)	(0.1888)	(0.2522)	(0.1822)	(0.3619)	(0.1982)	(0.2814)	(0.1460)	(0.2518)	(0.1725)
Constant	-13.2716	-24.0178*	28.3286	-2.9617	-3.0857	-7.7429	30.3274	-5.5779	79.1173*	13.6772	-10.0480	-20.6366
	(23.9693)	(13.2851)	(42.1234)	(14.7637)	(24.3674)	(14.5313)	(47.1906)	(15.3496)	(45.4429)	(14.5493)	(24.0940)	(13.6651)
Observations	748	1073	485	786	698	962	444	705	317	612	747	1057
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R2	0.211	0.270	0.219	0.303	0.222	0.292	0.171	0.286	0.392	0.288	0.207	0.274

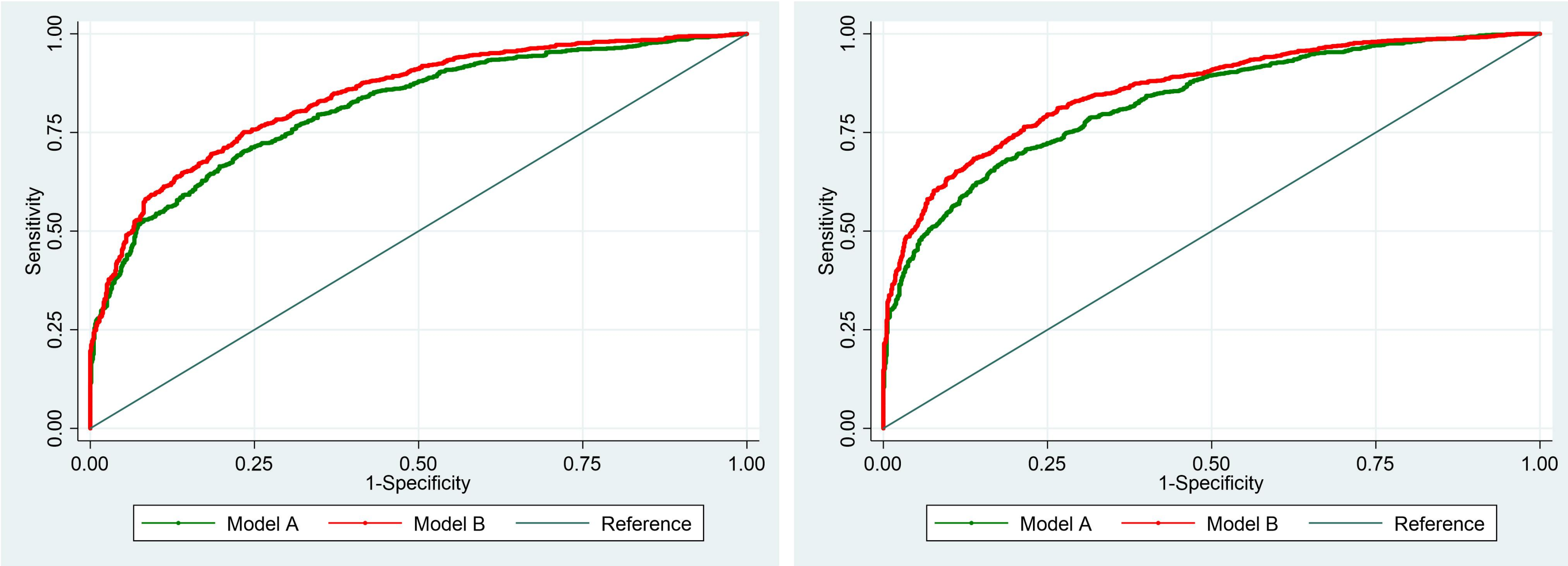
Table 10. The determinants of corporate hedging using multinomial logit estimation

Table 10 demonstrates the coefficient derived from the results of multinomial logit regression analysis regarding the motivations driving the participation of Mainland China and Hong Kong non-financial firms in corporate hedging, respectively. The dependent variable all hedgers are categorized into FX derivatives only users, IR derivatives only users, FC debt only users, and users concurrently using all three instruments. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. Robust standard errors are chosen to control for heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	FX derivatives only		IR derivatives only		FC debt only		FX&IR&FD	
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
IR Coverage	0.0053	-0.0060	-0.0310**	-0.0238***	-0.0020	-0.0149***	-0.0141**	-0.0243***
	(0.0040)	(0.0038)	(0.0129)	(0.0072)	(0.0032)	(0.0035)	(0.0067)	(0.0053)
Leverage	0.0044*	0.0034	0.0112***	0.0065**	0.0031	0.0057**	0.0103***	0.0089***
	(0.0024)	(0.0028)	(0.0026)	(0.0026)	(0.0020)	(0.0025)	(0.0027)	(0.0025)
Liquidity	-0.2078*	-0.3020***	0.0264	-0.6818***	-0.0733	-0.0754	0.1297	-0.1288**
	(0.1083)	(0.0853)	(0.1306)	(0.2340)	(0.0642)	(0.0545)	(0.1493)	(0.0577)
Profitability	-0.0720***	-0.0348	-0.1499***	-0.0630*	-0.0707***	-0.0215	-0.0409	-0.0764***
	(0.0211)	(0.0229)	(0.0527)	(0.0378)	(0.0168)	(0.0201)	(0.0288)	(0.0281)
Growth Opportunity	-0.0633***	-0.0165*	-0.0044	0.0174**	-0.0093**	-0.0060	-0.0245***	-0.0429***
	(0.0127)	(0.0095)	(0.0065)	(0.0087)	(0.0045)	(0.0064)	(0.0071)	(0.0089)
FX Risk Exposure	5.5940***	3.6121***	4.3368***	3.4202***	3.5351***	0.7532**	5.3950***	3.6065***
	(0.5893)	(0.3640)	(0.8388)	(0.4561)	(0.5511)	(0.3579)	(0.7128)	(0.4220)
Firm Size	0.8502***	0.5780***	1.0341***	0.7515***	0.6118***	0.4882***	1.0170***	1.1423***
	(0.0710)	(0.0724)	(0.1521)	(0.0918)	(0.0573)	(0.0577)	(0.0939)	(0.0876)
State Ownership	-0.4643**	-0.3171	-1.9450***	-0.2949	-1.0865***	-0.0229	-0.1122	-2.2019***
	(0.2271)	(0.2910)	(0.5163)	(0.3774)	(0.1886)	(0.2157)	(0.3195)	(0.3032)
Government Regulation	-1.3656***	0.0817	-1.8360**	-1.6095**	-1.3255***	0.3245	-0.9393	-0.9873**
	(0.4693)	(0.4639)	(0.8570)	(0.7839)	(0.3700)	(0.3765)	(0.6347)	(0.4747)
Constant	10.5757***	-2.9324***	-7.8142***	-4.1626***	14.4049***	-2.4773***	7.6549***	-5.3706***
	(0.9759)	(0.9532)	(1.3940)	(0.9097)	(0.5674)	(0.6851)	(1.2080)	(0.8675)
Observations	1429	1315	1429	1315	1429	1315	1429	1315
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.211	0.262	0.211	0.262	0.211	0.262	0.211	0.262

Figure 1 ROC curves for model A and B on derivatives usage

Figure 1 presents the ROC curves derived from the logit regression outcomes concerning the factors influencing the usage of derivatives among non-financial firms in Mainland China and Hong Kong, respectively. Model A is based on the original dataset, while Model B is constructed using a sample that mitigates bias by excluding FC debt users among non-derivatives users.

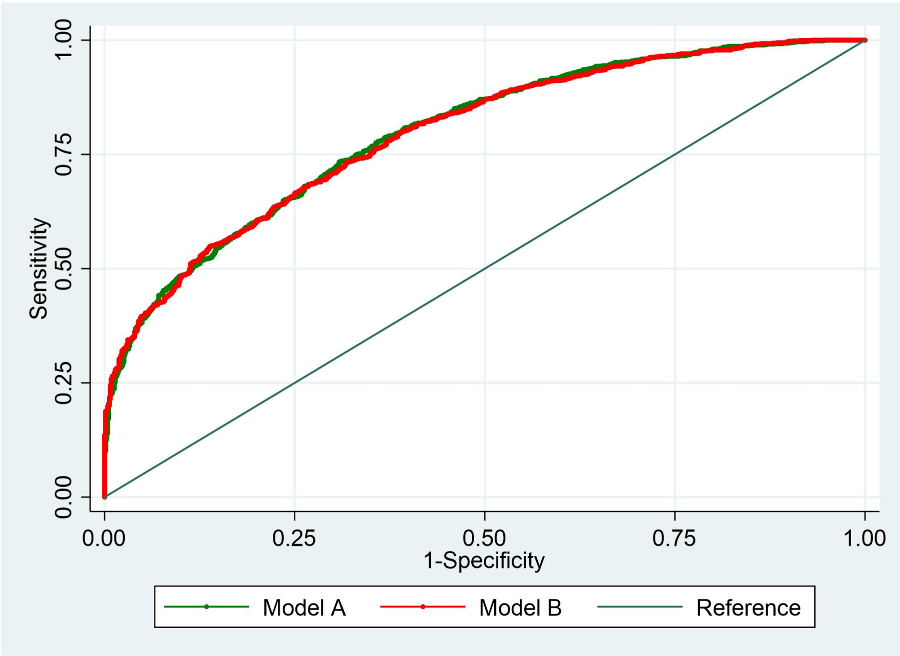


Mainland China firms

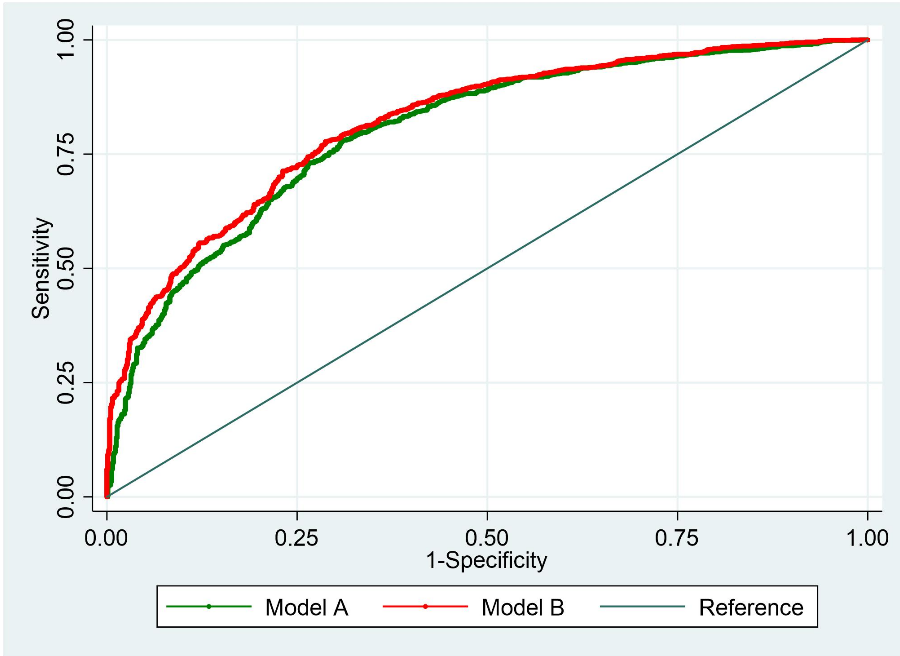
HK firms

Figure 2 ROC curves for model A and B on FC debt usage

Figure 2 displays the ROC curves derived from the logit regression outcomes concerning the factors influencing the usage of FC debt among non-financial firms in Mainland China and Hong Kong, respectively. Model A is based on the original dataset, while Model B is constructed using a sample that mitigates bias by excluding derivatives users among non-FC debt users.



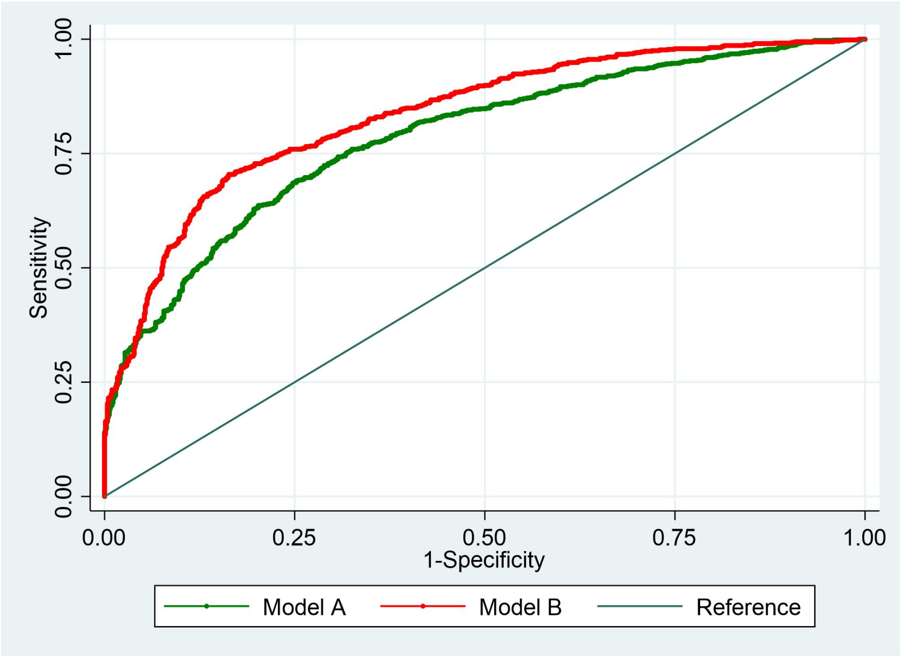
Mainland China firms



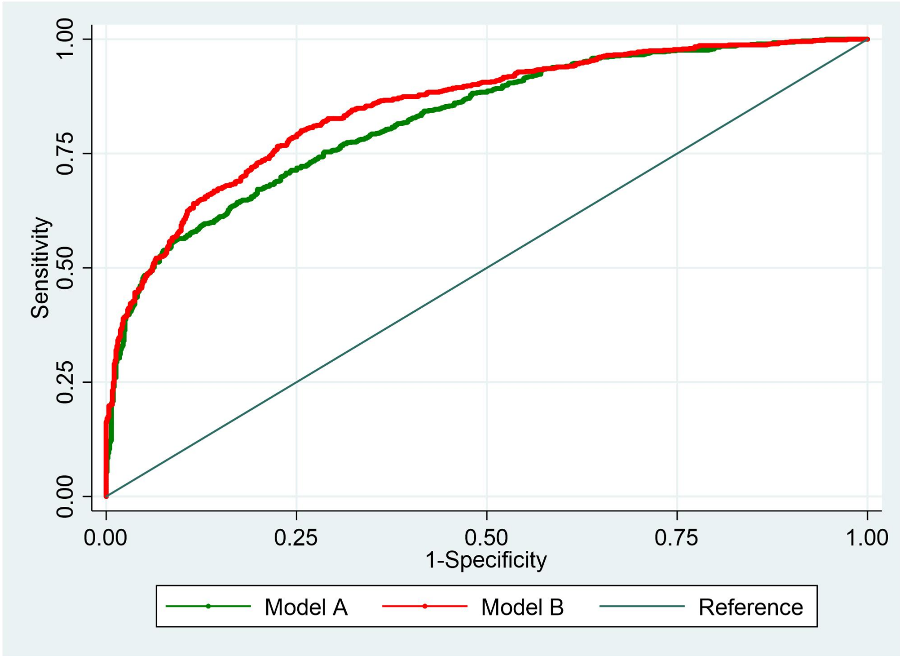
HK firms

Figure 3 ROC curves for model A and B on FX derivatives usage

Figure 3 demonstrates the ROC curves derived from the logit regression outcomes concerning the factors influencing the usage of FX derivatives among non-financial firms in Mainland China and Hong Kong, respectively. Model A is based on the original dataset, while Model B is constructed using a sample that mitigates bias by excluding FC debt or IR derivatives users among non-FX derivatives users.



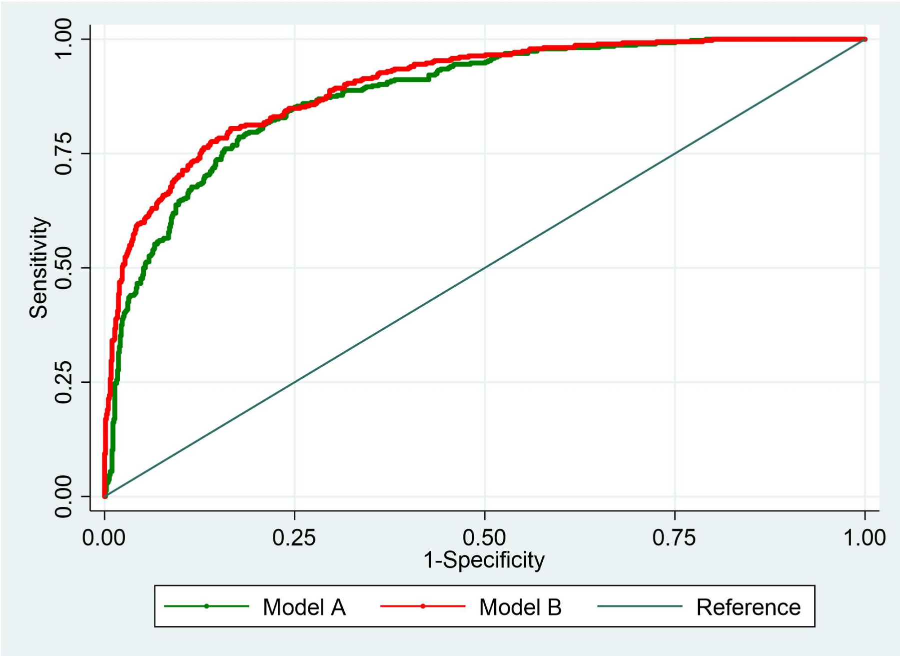
Mainland China firms



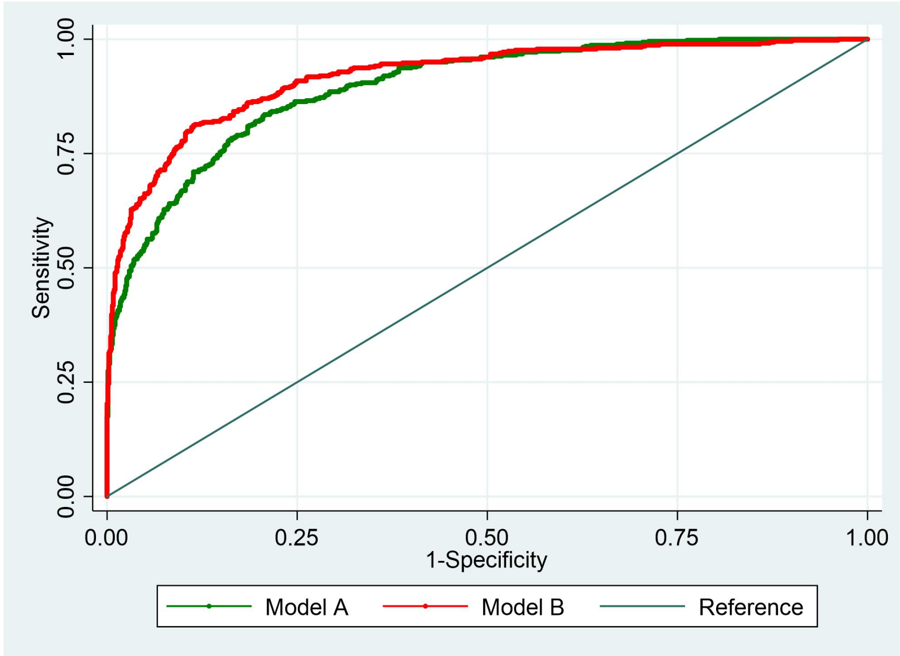
HK firms

Figure 4 ROC curves for model A and B on IR derivatives usage

Figure 4 shows the ROC curves derived from the logit regression outcomes concerning the factors influencing the usage of IR derivatives among non-financial firms in Mainland China and Hong Kong, respectively. Model A is based on the original dataset, while Model B is constructed using a sample that mitigates bias by excluding FC debt or FX derivatives users among non-IR derivatives users.



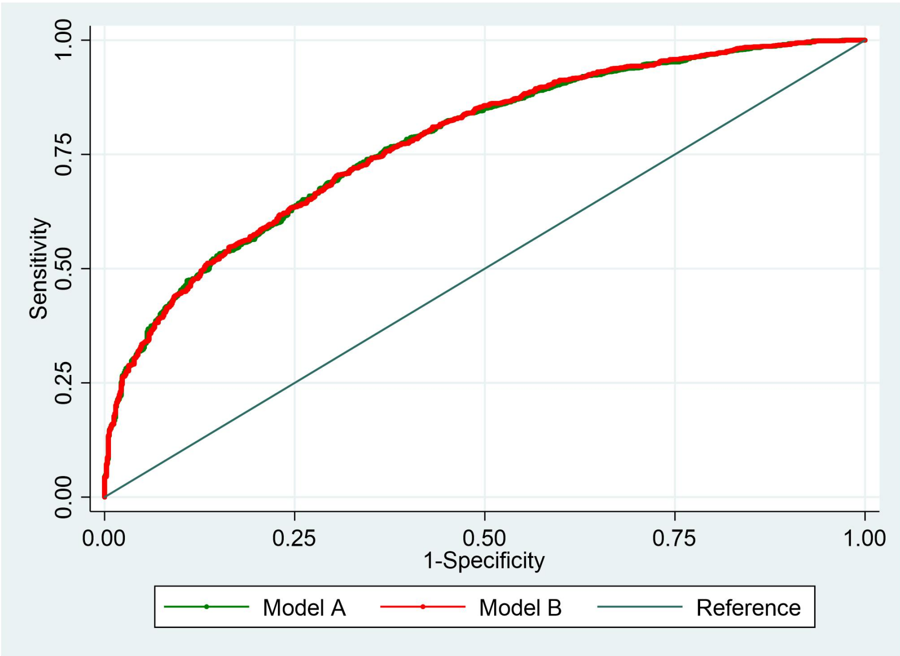
Mainland China firms



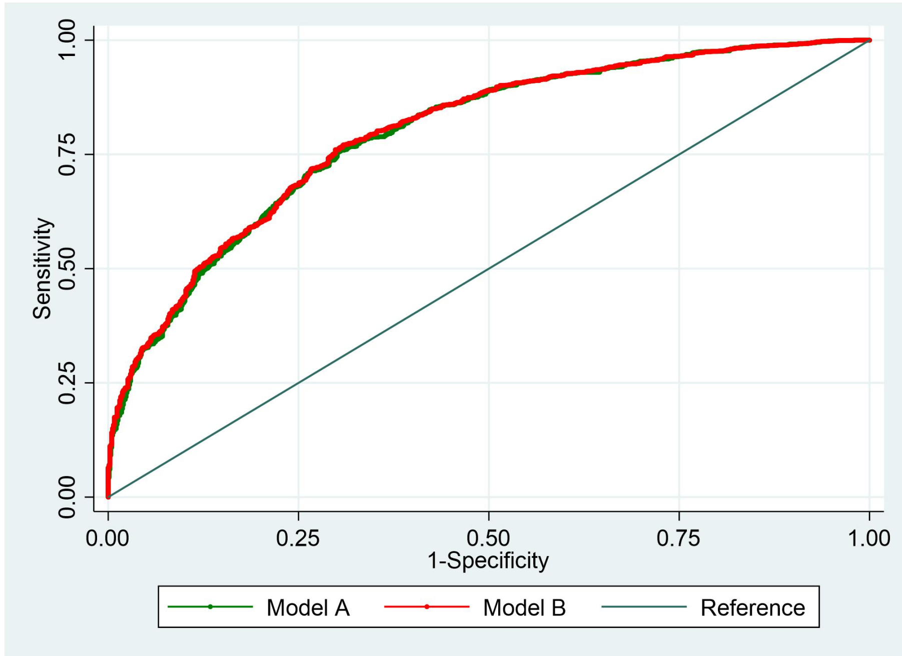
HK firms

Figure 5 ROC curves for model A and B on FX hedger

Figure 5 presents the ROC curves derived from the logit regression outcomes concerning the factors influencing the FX hedging among non-financial firms in Mainland China and Hong Kong, respectively. Model A is based on the original dataset, while Model B is constructed using a sample that mitigates bias by excluding IR derivatives users among non-FX hedgers.



Mainland China firms



HK firms

Online Appendix A

Table A-1. Variable definitions and the predicted sign

Table A-1 demonstrates the explanatory variables for the analysis. It presents the description and the predicted sign of the coefficient estimate of each variable.

Variables	Description	Predicted Sign
Interest rate coverage	Earnings before interest and tax (EBIT) over interest expenses.	–
Leverage	Total debt over total equity.	+
Liquidity	Quick ratio: total current assets less inventories divided by total current liabilities.	–
Profitability	Return on capital: net operating profit less adjusted taxes over book value of debt and equity less cash.	–
Growth opportunity	Capital expenditure divided by sales.	+
FX risk exposure	Total foreign sales over total sales.	+
Firm size	Natural log of market capitalisation.	+
State ownership	Indicator variable with value 1 for SOEs; 0 otherwise.	–
Government regulation	Indicator variable with value 0 in year 2008 and 2009; 1 otherwise.	–

Table A-2. Correlation matrix of independent variables

Table A-2 reports Pearson correlation coefficients for the independent variables used in the analysis. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	IR coverage	Leverage	Liquidity	Profitability	Growth opportunity	FX risk exposure	Firm size	State ownership	Government regulation
IR coverage	1								
Leverage	-0.3619***	1							
Liquidity	0.3186***	-0.2332***	1						
Profitability	0.448***	-0.1238***	-0.0502***	1					
Growth opportunity	-0.1028***	0.1395***	-0.0463***	-0.1088***	1				
FX risk exposure	-0.005	-0.0427***	0.0509***	-0.089***	-0.0123	1			
Firm size	0.0124	-0.0303*	-0.1662***	0.349***	0.1068***	-0.0939***	1		
State ownership	-0.0709***	0.0668***	-0.0445***	-0.0088	0.1151***	-0.0608***	0.2311***	1	
Government regulation	0.0063	0.0177	0.0076	-0.1023***	-0.0008	0.0073	0.0953***	-0.004	1

Table A-3. The marginal effects of various corporate hedging determinants before bias mitigation

Table A-3 presents the incentives prompting Chinese non-financial firms to employ derivatives, FC debt, FX derivatives, IR derivatives and FX hedging before bias mitigation. Based on the original data, the marginal effects derived from the logit regression results are demonstrated for non-financial companies in Mainland China and Hong Kong, respectively. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage denotes the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity represents the ratio of capital expenditure to sales. FX risk exposure reflects the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables.

	Derivatives		**FC debt**		**FX derivatives**		**IR derivatives**		**FX hedging**	
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
IR Coverage	0.0000	-0.0014***	-0.0001	-0.0028***	0.0003	-0.0013***	-0.0012**	-0.0033***	-0.0003	-0.0023***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0005)	(0.0004)
Leverage	0.0008***	0.0004**	0.0005*	0.0013***	0.0004***	0.0002	0.0007***	0.0006***	0.0004*	0.0009***
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0003)
Liquidity	-0.0139	-0.0335***	-0.0117	-0.0223**	-0.0024	-0.0167***	0.0194***	-0.0109**	-0.0092	-0.0173**
	(0.0160)	(0.0068)	(0.0103)	(0.0092)	(0.0140)	(0.0059)	(0.0075)	(0.0049)	(0.0099)	(0.0069)
Profitability	-0.0040	-0.0069**	-0.0143***	-0.0035	-0.0024	-0.0049	-0.0024	-0.0070***	-0.0116***	-0.0046*
	(0.0026)	(0.0032)	(0.0025)	(0.0027)	(0.0024)	(0.0031)	(0.0019)	(0.0027)	(0.0024)	(0.0027)
Growth Opportunity	-0.0048***	-0.0023***	-0.0020***	-0.0009	-0.0060***	-0.0047***	-0.0005	-0.0007	-0.0024***	-0.0015*
	(0.0009)	(0.0008)	(0.0007)	(0.0008)	(0.0012)	(0.0010)	(0.0004)	(0.0006)	(0.0007)	(0.0008)
FX Risk Exposure	0.4545***	0.5351***	0.4037***	0.2065***	0.4195***	0.4233***	0.1094***	0.2227***	0.7018***	0.3413***
	(0.0487)	(0.0391)	(0.0654)	(0.0403)	(0.0409)	(0.0368)	(0.0302)	(0.0350)	(0.0799)	(0.0402)
Firm Size	0.0744***	0.0881***	0.1129***	0.0861***	0.0663***	0.0794***	0.0408***	0.0795***	0.1115***	0.0858***
	(0.0067)	(0.0065)	(0.0072)	(0.0063)	(0.0063)	(0.0068)	(0.0057)	(0.0057)	(0.0069)	(0.0063)
State Ownership	0.0225	-0.1812***	-0.2035***	-0.0196	0.0280	-0.2008***	-0.0405*	-0.2040***	-0.1645***	-0.0585**
	(0.0271)	(0.0346)	(0.0282)	(0.0297)	(0.0244)	(0.0344)	(0.0216)	(0.0273)	(0.0264)	(0.0284)
Government regulation	-0.0732	-0.1005*	-0.2243***	-0.0005	-0.0316	-0.0549	-0.0024	-0.1331***	-0.1791***	0.0162
	(0.0552)	(0.0542)	(0.0569)	(0.0493)	(0.0508)	(0.0528)	(0.0401)	(0.0450)	(0.0548)	(0.0484)
Observations	1420	1315	1359	1315	1420	1315	1420	1315	1359	1315
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.185	0.224	0.175	0.277	0.201	0.193	0.169	0.292	0.216	0.286
Chi-squared	235.0624	299.8022	231.9073	349.2680	215.9281	242.4347	139.1736	275.5636	290.7387	344.4827

Table A-4. The determinants of corporate hedging with a fixed effect model

Table A-4 presents the incentives prompting Chinese non-financial firms to conduct all hedging, derivatives, FC debt, FX derivatives, IR derivatives and FX hedging, using a fixed effect model. Based on the bias-mitigated sample, the marginal effects are shown for non-financial firms in Mainland China and Hong Kong, respectively. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	All hedging		**Derivatives**		**FC debt**		**FX derivatives**		**IR derivatives**		**FX hedging**	
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
IR Coverage	-0.0000	-0.0000	0.0003	0.0014	-0.0000	-0.0000	0.0011	0.0008	0.0001	-0.0001	-0.0000	-0.0000
	(0.0002)	(0.0000)	(0.0007)	(0.0020)	(0.0002)	(0.0000)	(0.0024)	(0.0020)	(0.0003)	(0.0004)	(0.0002)	(0.0001)
Leverage	0.0001	0.0000	0.0002	0.0001	0.0001	0.0000	0.0005	-0.0004	0.0001	-0.0001	0.0001	0.0000
	(0.0001)	(0.0000)	(0.0005)	(0.0008)	(0.0001)	(0.0000)	(0.0010)	(0.0010)	(0.0003)	(0.0002)	(0.0001)	(0.0000)
Liquidity	0.0061	-0.0001	0.0112	-0.0065	-0.0008	0.0001	0.0335	0.0373	0.0031	0.0024	0.0060	0.0003
	(0.0090)	(0.0007)	(0.0246)	(0.0276)	(0.0073)	(0.0002)	(0.0682)	(0.0501)	(0.0167)	(0.0136)	(0.0087)	(0.0008)
Profitability	-0.0021	-0.0000	-0.0028	0.0038	-0.0025	-0.0002	-0.0065	0.0198	-0.0008	-0.0011	-0.0023	0.0002
	(0.0024)	(0.0003)	(0.0059)	(0.0086)	(0.0030)	(0.0003)	(0.0123)	(0.0216)	(0.0041)	(0.0051)	(0.0026)	(0.0004)
Growth Opportunity	0.0004	0.0001	-0.0002	-0.0103	0.0011	0.0000	-0.0015	-0.0039	-0.0001	-0.0013	0.0002	0.0001
	(0.0007)	(0.0002)	(0.0006)	(0.0125)	(0.0015)	(0.0000)	(0.0035)	(0.0069)	(0.0008)	(0.0062)	(0.0005)	(0.0002)
FX Risk Exposure	0.1067	0.0130	0.0466	-0.3669	0.1355	0.0049	0.2370	-0.2300	0.0131	-0.1473	0.0885	0.0128
	(0.1340)	(0.0164)	(0.1144)	(0.7897)	(0.1706)	(0.0068)	(0.5081)	(0.7348)	(0.0742)	(0.6790)	(0.1148)	(0.0175)
Firm Size	0.0179	0.0042	0.0110	0.0325	0.0184	0.0018	0.0192	-0.0121	0.0035	-0.0062	0.0172	0.0037
	(0.0112)	(0.0041)	(0.0163)	(0.0280)	(0.0135)	(0.0025)	(0.0159)	(0.0704)	(0.0157)	(0.0224)	(0.0112)	(0.0038)
State Ownership	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
Government Regulation	-0.0107	0.0111	-0.0094	0.2272	-0.0153	0.0014	0.0105	0.5600	-0.0064	-0.0010	-0.0108	0.0145
	(0.0228)	(0.0154)	(0.0243)	(0.3069)	(0.0263)	(0.0025)	(0.0600)	(0.6722)	(0.0356)	(0.0167)	(0.0213)	(0.0219)
Observations	456	341	200	175	382	227	164	152	82	68	455	331
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.098	0.190	0.155	0.156	0.155	0.340	0.215	0.359	0.307	0.249	0.108	0.238
Chi-squared	34.6541	50.8134	23.8851	20.9055	44.9349	59.7715	27.2130	42.5470	19.9916	13.7564	38.1213	62.2486

Table A-5. The determinants of corporate hedging with a PSM approach

Table A-5 presents the incentives prompting Chinese non-financial firms to conduct all hedging, derivatives, FC debt, FX derivatives, IR derivatives and FX hedging, using a 1:1 nearest neighbor PSM approach. Based on the bias-mitigated sample, the marginal effects are shown for non-financial firms in Mainland China and Hong Kong, respectively. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. Robust standard errors are chosen to control for heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	All hedging		**Derivatives**		**FC debt**		**FX derivatives**		**IR derivatives**		**FX hedging**	
Variable	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**	**Mainland China**	**HK**
IR Coverage	-0.0001	-0.0017**	-0.0003	-0.0009	-0.0001	-0.0024***	-0.0003	-0.0013	-0.0017**	-0.0054***	-0.0001	-0.0015**
	(0.0005)	(0.0007)	(0.0006)	(0.0009)	(0.0005)	(0.0006)	(0.0006)	(0.0008)	(0.0008)	(0.0018)	(0.0005)	(0.0006)
Leverage	0.0007***	0.0006	0.0011***	0.0009*	0.0008**	0.0006*	0.0009***	0.0004	0.0011***	0.0002	0.0008**	0.0006
	(0.0003)	(0.0004)	(0.0003)	(0.0005)	(0.0003)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Liquidity	-0.0108	-0.0259*	-0.0115	-0.0866***	-0.0133	-0.0153	0.0048	-0.0678***	0.0253	-0.0116	-0.0069	-0.0227*
	(0.0099)	(0.0135)	(0.0191)	(0.0261)	(0.0103)	(0.0105)	(0.0172)	(0.0150)	(0.0164)	(0.0163)	(0.0098)	(0.0125)
Profitability	-0.0109***	-0.0069*	-0.0094***	-0.0083*	-0.0125***	-0.0116***	-0.0067**	-0.0037	-0.0118***	0.0013	-0.0114***	-0.0099***
	(0.0024)	(0.0036)	(0.0029)	(0.0048)	(0.0024)	(0.0040)	(0.0028)	(0.0040)	(0.0031)	(0.0053)	(0.0024)	(0.0035)
Growth Opportunity	-0.0024***	-0.0003	-0.0053***	-0.0020	-0.0024***	0.0002	-0.0070***	-0.0021*	-0.0022***	-0.0013*	-0.0025***	-0.0008
	(0.0006)	(0.0012)	(0.0010)	(0.0014)	(0.0007)	(0.0012)	(0.0014)	(0.0012)	(0.0007)	(0.0007)	(0.0007)	(0.0012)
FX Risk Exposure	0.6597***	0.4617***	0.8744***	0.6105***	0.6444***	0.3422***	0.8804***	0.7554***	0.4925***	0.4946***	0.7032***	0.4399***
	(0.0773)	(0.0845)	(0.0852)	(0.0982)	(0.0799)	(0.0775)	(0.0805)	(0.0886)	(0.0767)	(0.0734)	(0.0801)	(0.0780)
Firm Size	0.1094***	0.0934***	0.1205***	0.0980***	0.1141***	0.1127***	0.1198***	0.1182***	0.1145***	0.0892***	0.1098***	0.1039***
	(0.0068)	(0.0100)	(0.0076)	(0.0136)	(0.0071)	(0.0107)	(0.0075)	(0.0105)	(0.0089)	(0.0124)	(0.0069)	(0.0096)
State Ownership	-0.1355***	-0.0634	-0.0665*	0.0534	-0.1598***	-0.0639	-0.0812**	0.0097	-0.1384***	-0.0753	-0.1659***	-0.0526
	(0.0255)	(0.0438)	(0.0359)	(0.0511)	(0.0266)	(0.0420)	(0.0349)	(0.0511)	(0.0469)	(0.0487)	(0.0262)	(0.0377)
Government Regulation	-0.1977***	-0.0895	-0.2256***	0.0305	-0.2342***	-0.0112	-0.1554**	0.1044	-0.1694**	-0.0299	-0.1909***	-0.0082
	(0.0538)	(0.0816)	(0.0684)	(0.0919)	(0.0567)	(0.0852)	(0.0687)	(0.0976)	(0.0711)	(0.0789)	(0.0543)	(0.0684)
Observations	1359	551	826	352	1270	540	754	335	550	222	1355	593
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R2	0.224	0.263	0.357	0.354	0.234	0.313	0.391	0.402	0.408	0.489	0.220	0.332
Chi-squared	297.7653	130.0131	230.9079	83.1300	301.2115	147.6855	213.8241	108.5761	155.5873	86.6150	288.3924	153.6001

Table A-6. Difference test of variable means after PSM approach

Table A-6 presents the results of the difference test for variable means following the PSM approach, using a 1:1 nearest neighbor matching method. Mainland China firms serve as the treatment group, while HK firms constitute the control group. Panels A to F respectively present the difference tests after matching Mainland China and HK firms based on samples of all hedging, derivatives, FC debt, FX derivatives, IR derivatives, and FX Hedging. IR coverage is the ratio of profit before interest and tax over interest expenses. Leverage is the ratio of total debt to total equity. Liquidity is total current assets minus inventories over total current liabilities. Profitability is net operating profit less adjusted taxes over book value of debt and equity less cash. Growth opportunity is the ratio of capital expenditure to sales. FX risk exposure is the proportion of total foreign sales over total sales. Firm size is natural log of market capitalization. State ownership and government regulation are dummy variables. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. All hedging

Variable	Treated Group	Control Group	Difference	%Bias
IR Coverage	19.361	23.103	-3.742***	-12.3
Leverage	68.205	73.238	-5.033	-7.3
Liquidity	1.255	1.300	-0.045	-3.0
Profitability	6.836	7.414	-0.578**	-10.9
Growth Opportunity	13.713	12.622	1.091	6.0
FX Risk Exposure	0.118	0.131	-0.014*	-5.3
Firm Size	6.662	6.515	0.147**	8.1
State Ownership	0.337	0.300	0.037**	8.4
Government Regulation	0.835	0.821	0.014	3.6

Panel B. Derivatives

Variable	Treated Group	Control Group	Difference	%Bias
IR Coverage	20.662	26.607	-5.945***	-19.4
Leverage	62.582	69.353	-6.771	-10.2
Liquidity	1.313	1.488	-0.176**	-12.0
Profitability	7.054	7.824	-0.769**	-14.0
Growth Opportunity	11.562	10.494	1.068	7.5
FX Risk Exposure	0.130	0.140	-0.010	-3.8
Firm Size	6.600	6.554	0.046	2.4
State Ownership	0.366	0.335	0.031	7.3
Government Regulation	0.825	0.825	0.000	0.0

Panel C. FC debt

Variable	Treated Group	Control Group	Difference	%Bias
IR Coverage	19.490	21.516	-2.026*	-6.7
Leverage	68.048	72.031	-3.983	-5.8
Liquidity	1.259	1.379	-0.121**	-8.4
Profitability	6.779	7.147	-0.368*	-7.2
Growth Opportunity	14.007	14.289	-0.282	-1.5
FX Risk Exposure	0.112	0.119	-0.007	-2.8
Firm Size	6.662	6.578	0.084	4.6
State Ownership	0.331	0.294	0.037**	8.5
Government Regulation	0.834	0.804	0.029**	7.5

Table A-6. (Continued)

Panel D. FX derivatives				
Variable	**Treated Group**	**Control Group**	**Difference**	**%Bias**
IR Coverage	21.986	24.842	-2.856*	-9.0
Leverage	57.015	59.275	-2.260	-3.6
Liquidity	1.365	1.340	0.026	1.7
Profitability	7.231	7.733	-0.502	-8.9
Growth Opportunity	11.082	10.943	0.139	1.0
FX Risk Exposure	0.131	0.156	-0.024**	-9.0
Firm Size	6.594	6.321	0.273***	14.3
State Ownership	0.372	0.334	0.038	9.0
Government Regulation	0.824	0.805	0.018	4.6
Panel E. IR derivatives				
Variable	**Treated Group**	**Control Group**	**Difference**	**%Bias**
IR Coverage	20.717	23.371	-2.654	-8.4
Leverage	68.453	79.513	-11.060*	-15.6
Liquidity	1.392	1.612	-0.220**	-13.7
Profitability	7.094	7.412	-0.319	-5.8
Growth Opportunity	13.344	13.110	0.234	1.5
FX Risk Exposure	0.076	0.073	0.003	1.4
Firm Size	6.259	6.111	0.148	8.1
State Ownership	0.345	0.270	0.075***	17.9
Government Regulation	0.825	0.816	0.009	2.2
Panel F. FX Hedging				
Variable	**Treated Group**	**Control Group**	**Difference**	**%Bias**
IR Coverage	19.413	22.522	-3.109***	-10.2
Leverage	66.984	71.331	-4.347	-6.5
Liquidity	1.259	1.334	-0.076*	-5.1
Profitability	6.847	6.874	-0.026	-0.5
Growth Opportunity	13.734	12.693	1.041	5.8
FX Risk Exposure	0.118	0.109	0.009	3.3
Firm Size	6.670	6.503	0.167**	9.2
State Ownership	0.338	0.307	0.031*	7.0
Government Regulation	0.834	0.804	0.031**	8.0

Online Appendix B: Examples of Annual Report Corporate Hedging Data Disclosures

Example 1 (Hong Kong company)

SITC International Holdings Company Limited Annual Report & Accounts 2016

Page 69 Valuation of derivative financial instruments

The Group uses derivative financial instruments, such as forward currency contracts and interest rate swaps, to manage its foreign currency risk and interest rate risk, which arise from its shipping service business and loan borrowings. These derivative financial instruments are state in the financial statements at fair value, the valuation of which is determined through the application of valuation techniques which involve the exercise of judgement and the use of assumptions and estimates. Any changes in the fair value of the derivative financial instruments will have an impact on the financial position, profit or loss and/or other comprehensive income of the Group.

At 31 December 2016, the carrying amounts of derivative financial instruments carried as assets and liabilities in the consolidated statement of financial position amounted to US$1,084,000 and US$1,000, respectively, and the Group recorded a net gain of US$1,433,000 in profit or loss during the year.

Related disclosures are included in notes 3, 5, 36, 37 and 38 to the financial statements.

We confirmed with counterparties the existence and completeness of the recorded derivative financial instruments, and the value of the derivative financial instruments as at the end of the reporting period.

Our procedures in relation to the valuation of derivative financial instruments included reviewing forward currency and interest rate swap contracts to verify the terms and underlying amounts that are relevant to the fair value valuation, and engaging our internal valuation specialist to evaluate the year end valuations of the Group's derivative financial instruments.

We also obtained the derivative contracts on the date of settlement to verify the realised gain or loss recognised for expired contracts on a sampling basis.

Finally, we assessed the adequacy of the related disclosures in notes to the financial statements.

Page 140 DERIVATIVE FINANCIAL INSTRUMENTS

19. DERIVATIVE FINANCIAL INSTRUMENTS

	Notes	2016 Assets US$'000	2016 Liabilities US$'000	2015 Assets US$'000	2015 Liabilities US$'000
Forward currency contracts	(b)	859	—	—	549
Interest rate swaps	(c)	225	1	156	120
		1,084	1	156	669
Portion classified as non-current:					
Interest rate swaps		(179)	—	(127)	(50)
Current portion		905	1	29	619

Notes:

(a) Derivative financial instruments of the Group were conducted with creditworthy banks.

(b) The Group has entered into other various forward currency contracts to manage its exchange rate exposures. These forward currency contracts are not designated for hedge purposes and are measured at fair value through profit or loss. A net gain in fair value changes in non-hedging forward currency contracts amounting to US$638,000 (2015: US$2,565,000) was recognised in profit or loss during the year.

(c) The Group has entered into various interest rate swap contracts to manage its interest rate exposures. These interest rate swap contracts are not designated for hedge purposes and are measured at fair value through profit or loss. A net gain on fair value changes in interest rate swaps amounting to US$116,000 (2015: loss of US$65,000) was recognised in profit or loss during the year.

Page 164 Interest rate risk

The Group's exposure to the risk of changes in market interest rates relates primarily to the Group's debt obligations with a floating interest rate.

The Group's policy is to manage its interest cost using a mix of fixed and variable rate debts. The Group's policy is to maintain between 5% and 50% of its borrowings at fixed interest rates. To manage this mix in a cost-effective manner, the Group enters into interest rate swaps, in which the Group agrees to exchange, at specified intervals, the difference between fixed and variable rate interest amounts calculated by reference to an agreed-upon notional principal amount. At 31 December 2016, after taking into account the effect of the interest rate swaps, approximately 7% (2015: 39%) of the Group's borrowings bore interest at fixed rates.

Page 165 Foreign currency risk

The Group has transactional currency exposures. These exposures arise from sales or purchases by operating units in currencies other than the units' functional currencies. In addition, certain bank loans were denominated in currencies other than the functional currencies of the entities to which they relate. Approximately 61% (2015: 73%) of the Group's sales were denominated in currencies other than the functional currencies of the operating units making the sale, whilst approximately 55% (2015: 38%) of costs were denominated in the units' functional currencies. The Group requires all its operating units to use forward currency contracts to manage the foreign currency exposures on transactions in excess of certain amounts of Japanese Yen and Renminbi for which receipts are anticipated in more than one month after the Group has entered into firm commitments for sales. The forward currency contracts must be in the same currency as that of the hedged item. It is the Group's policy not to enter into forward contracts until a firm underlying sales or purchases commitment is in place.

It is the Group's policy to negotiate the terms of the hedge derivatives to match the terms of the hedged item to maximise hedge effectiveness.

Example 2 (Hong Kong company)

MTR Corporation Limited Annual Report & Accounts 2016

Page 207 Treasury Management

The Company's Treasury Department operates within approved guidelines from the Board. It manages the Company's debt portfolio with reference to the Preferred Financing Model which defines the preferred mix of financing instruments, fixed and floating rate debt, maturities, interest rate risks, currency exposure and financing horizon. The model is reviewed and refined periodically to reflect changes in the Company's financing requirements and the market environment. Derivative financial instruments such as interest rate swaps and cross currency swaps are used only as hedging tools to manage the Group's exposure to interest rate and currency risks. Prudent guidelines and procedures are in place to control the Company's derivatives activities, including a comprehensive credit risk management system for monitoring counterparty credit exposure using the Valueat-Risk approach. There is also appropriate segregation of duties within the Company's Treasury Department.

Page 225 Derivative Financial Instruments and Hedging Activities

The Group uses derivative financial instruments such as interest rate swaps and currency swaps to manage its interest rate and foreign exchange exposure. Based on the Group's policies, these instruments are used solely for reducing or eliminating financial risks associated with the Group's investments and liabilities and not for trading or speculation purposes.

Page 263 Derivative Financial Assets and Liabilities

31 Derivative Financial Assets and Liabilities

A Fair Value

The contracted notional amounts, fair values and maturities based on contractual undiscounted cash flows of derivative financial instruments outstanding are as follows:

The Group and The Company

in HK$ million	Notional amount	Fair value	Contractual undiscounted cash flows maturing in Less than 1 year	1-2 years	2-5 years	Over 5 years	Total
2016							
Derivative Financial Assets							
Gross settled:							
Foreign exchange forwards							
– fair value hedges:	1,317	1					
– inflow			1,318	–	–	–	1,318
– outflow			(1,317)	–	–	–	(1,317)
Cross currency swaps							
– fair value hedges:	2,326	17					
– inflow			16	471	4	705	1,196
– outflow			(6)	(465)	–	(698)	(1,169)
– cash flow hedges:	4,699	81					
– inflow			128	130	391	5,402	6,051
– outflow			(118)	(119)	(356)	(5,344)	(5,937)
Net settled:							
Interest rate swaps							
– fair value hedges	600	27	20	22	–	–	42
– cash flow hedges	1,350	57	–	9	47	5	61
	10,292	183	41	48	86	70	245
Derivative Financial Liabilities							
Gross settled:							
Foreign exchange forwards							
– fair value hedges:	2,174	3					
– inflow			2,171	–	–	–	2,171
– outflow			(2,174)	–	–	–	(2,174)
– cash flow hedges:	324	15					
– inflow			158	53	76	22	309
– outflow			(167)	(55)	(79)	(23)	(324)
– not qualified for hedge accounting:	197	11					
– inflow			152	–	35	–	187
– outflow			(161)	–	(36)	–	(197)
Cross currency swaps							
– fair value hedges:	1,194	137					
– inflow			1,069	–	–	–	1,069
– outflow			(1,200)	–	–	–	(1,200)
– cash flow hedges:	2,670	366					
– inflow			75	75	227	3,017	3,394
– outflow			(100)	(100)	(300)	(3,282)	(3,782)
Net settled:							
Interest rate swaps							
– fair value hedges	2,701	32	5	(4)	(23)	(7)	(29)
– cash flow hedges	600	5	(5)	(6)	–	–	(11)
	9,860	569	(177)	(37)	(100)	(273)	(587)
Total	20,152						

31 Derivative Financial Assets and Liabilities *(continued)*

A Fair Value *(continued)*

in HK$ million	Notional amount	Fair value	Contractual undiscounted cash flows maturing in: Less than 1 year	1-2 years	2-5 years	Over 5 years	Total
2015							
Derivative Financial Assets							
Gross settled:							
Foreign exchange forwards							
– not qualified for hedge accounting :	60	–					
– inflow			60	–	–	–	60
– outflow			(60)	–	–	–	(60)
Cross currency swaps							
– fair value hedges :	2,326	10					
– inflow			34	405	466	306	1,211
– outflow			(23)	(399)	(465)	(310)	(1,197)
– cash flow hedges :	277	16					
– inflow			11	12	35	343	401
– outflow			(7)	(8)	(22)	(352)	(389)
Net settled:							
Interest rate swaps							
– fair value hedges	1,400	55	27	20	24	–	71
	4,063	81	42	30	38	(13)	97
Derivative Financial Liabilities							
Gross settled:							
Foreign exchange forwards							
– fair value hedges :	3,491	11					
– inflow			–	3,480	–	–	3,480
– outflow			–	(3,491)	–	–	(3,491)
– cash flow hedges :	313	21					
– inflow			132	49	74	35	290
– outflow			(147)	(51)	(76)	(37)	(311)
– not qualified for hedge accounting :	180	5					
– inflow			173	2	–	–	175
– outflow			(178)	(2)	–	–	(180)
Cross currency swaps							
– fair value hedges :	1,193	133					
– inflow			18	598	2	379	997
– outflow			(12)	(810)	–	(388)	(1,210)
– cash flow hedges :	2,437	623					
– inflow			67	67	199	2,490	2,823
– outflow			(92)	(92)	(277)	(3,091)	(3,552)
Net settled:							
Interest rate swaps							
– fair value hedges	2,200	17	1	3	(10)	(9)	(15)
– cash flow hedges	600	17	(9)	(6)	(7)	–	(22)
– not qualified for hedge accounting	100	3	(2)	(1)	(1)	1	(3)
	10,514	830	(49)	(254)	(96)	(620)	(1,019)
Total	14,577						

Page 266 Interest Rate Risk

The Group's interest rate risk arises principally from its borrowing activities at the parent company level (including its financing vehicles). Borrowings based on fixed and floating rates expose the Group to fair value and cash flow interest rate risk respectively due to fluctuations in market interest rates. The Group manages and controls its interest rate risk exposure at the parent company level by maintaining a level of fixed rate debt between 40% and 70% (2015: 55% and 75%) of total debt outstanding as specified by the Model. Should the actual fixed rate debt level deviate substantially from the Model, derivative financial instruments such as interest rate swaps would be procured to align the fixed and floating mix with the Model. As at 31 December 2016, 48% (2015: 56%) of the Company's (including financing vehicles) total debt outstanding was denominated either in or converted to fixed interest rate after taking into account outstanding cross currency and interest rate swaps. Interest rate risk at subsidiary and associate companies are managed separately based on their own borrowing requirement, circumstances and market practice.

Page 266 Foreign Exchange Risk

Foreign exchange risk arises when recognised assets and liabilities are denominated in a currency other than the functional currency of the Group's companies to which they relate. For the Group, it arises principally from its borrowing as well as overseas investment and procurement activities.

The Group manages and controls its foreign exchange risk exposure by maintaining a modest level of unhedged non-Hong Kong dollar debt at the parent company level as specified by the Model, and minimal foreign exchange open positions created by its investments and procurements overseas. Where the currency of a borrowing is not matched with that of the expected cash flows for servicing the debt, the Company would convert its foreign currency exposure resulting from the borrowing to Hong Kong dollar exposure through cross currency swaps. For investment and procurement in foreign currencies, the Group would purchase the foreign currencies in advance or enter into foreign exchange forward contracts to secure the necessary foreign currencies at pre-determined exchange rates for settlement.

The Company's exposure to US dollars due to its foreign currency borrowings is also offset by the amount of US dollar cash balances, bank deposits

and investments that it maintains.

As most of the Group's receivables and payables are denominated in the respective Group companies' functional currencies (Hong Kong dollars, Renminbi, Australian dollars, British Pound or Swedish Krona) or United States dollars (with which Hong Kong dollars are pegged) and most of its payment commitments denominated in foreign currencies are covered by foreign exchange forward contracts, management does not expect that there will be any significant currency risk associated with them.

Example 3 (Mainland China company)

Jiangxi Copper Company Limited Annual Report & Accounts 2016

Page 11 Items measured at fair value (prepared in accordance with the PRC GAAP)

V. Items measured at fair value (prepared in accordance with the PRC GAAP)

Unit: Yuan Currency: RMB

Item	Opening balance	Closing balance	Change during the period	Impact on profit of the current period
1. Investment in held-for-trading equity instruments				
Equity investments	27,931,358	27,284,608	-646,750	-1,100,318
2. Investment in held-for-trading debt instruments				
Bond investment	129,015,162	160,750,782	31,735,620	-13,154,403
3. Derivatives not designated as a hedge				
Forward foreign exchange contracts	25,412,025	-53,486,962	-78,898,987	-76,996,532
Interest rate swap contracts	-636,234	-12,841	623,393	641,791
Commodity option contracts	-39,703,764	-132,280,125	-92,576,361	-57,330,303
Commodity derivative contracts	332,410,844	-140,954,879	-473,365,723	-477,927,849
Gold forward contracts	-118,694,210	129,153,350	247,847,560	247,847,560
Currency swap contracts	-5,400,702	-3,664,397	1,736,305	1,736,305
4. Liabilities arising from the lease of gold measured at fair value	-1,758,823,082	-2,682,585,751	-923,760,669	-205,931,573

Page 162 Derivative financial instruments

The Group uses derivative financial instruments to hedge its commodity price risk, interest rate risk and foreign currency risk. The Group's derivative financial instruments mainly include commodity derivative contracts (mainly standardised copper cathode future contracts in Shanghai Futures Exchange ("SHFE") and London Metal Exchange ("LME"), foreign currency forward contracts and interest rate swaps and provisional price arrangement.

Page 198 DERIVATIVE FINANCIAL INSTRUMENTS

30. DERIVATIVE FINANCIAL INSTRUMENTS

	2016 Fair value		2015 Fair value	
	Assets	**Liabilities**	Assets	Liabilities
	RMB'000	***RMB'000***	*RMB'000*	*RMB'000*
Net settlement:				
Commodity derivative contracts	**297,690**	**(418,847)**	347,580	(169,963)
Provisional price arrangement	**–**	**(70,554)**	207,300	–
Foreign currency forward contracts and interest rate swaps	**–**	**(57,164)**	60,120	(40,745)
	297,690	**(546,565)**	615,000	(210,708)

	2016	2015
	RMB'000	*RMB'000*
Derivatives qualifying for hedge accounting:		
Cash flow hedges		
– Commodity derivative contracts	**3,300**	1,130
Fair value hedges		
– Provisional price arrangement	**(60,140)**	198,693
	(56,840)	199,823
Derivatives not qualifying for hedge accounting:		
– Commodity derivative contracts	**19,624**	2,474
– Provisional price arrangement	**(10,414)**	8,607
	9,210	11,081
Derivatives not under hedge accounting:		
– Commodity derivative contracts	**(144,081)**	174,013
– Foreign currency forward contracts and interest rate swaps	**(57,164)**	19,375
	(201,245)	193,388
	(248,875)	404,292

Page 199 Derivatives not under hedge accounting:

The Group utilises commodity derivative contracts to manage the commodity price risk of forecasted purchases of copper cathode as well as copper component within copper concentrate, and forecasted sales of copper wires and rods. These arrangements are designed to reduce significant fluctuations in the prices of copper concentrate, copper cathodes, copper wires and rods, and copper related products which move in line with the prevailing price of copper cathode.

The Group utilises gold commodity derivative contracts to manage the fair value change risk of the obligation to return gold with same quantity and quality to banks under gold lease contracts. These arrangements are designed to address significant fluctuation in the fair value of the obligation which move in line with the prevailing price of gold.

In addition, the Group has entered into various foreign currency forward contracts and interest rate swaps to manage its exposures on exchange rate and interest rate.

However, these commodity derivative contracts, foreign currency forward contracts and interest rate swaps are not designated as hedging instruments or not qualified for hedging accounting.

Example 4 (Mainland China company)

Fosun International Limited Annual Report & Accounts 2016

Page 154 Derivative financial instruments and hedge accounting

Initial recognition and subsequent measurement

The Group uses derivative financial instruments, such as forward currency contracts, interest rate swaps and commodity derivative contracts, to hedge its foreign currency risk, interest rate risk and commodity price risk, respectively. These derivative financial instruments are initially recognised at fair value on the date on which a derivative contract is entered into and are subsequently remeasured at fair value. Derivatives are carried as assets when the fair value is positive and as liabilities when the fair value is negative.

Page 223 DERIVATIVE FINANCIAL INSTRUMENTS

34. DERIVATIVE FINANCIAL INSTRUMENTS

As at 31 December 2016

	Fair value	
	Assets RMB'000	Liabilities RMB'000
Derivatives held for trading		
Currency derivatives		
Currency forwards and swaps, and cross-currency interest rate swaps	274,090	254,632
Currency options	3,810	3,810
Interest rate derivatives		
Interest rate swaps	359,275	416,181
Interest rate options	10,567	10,567
	647,742	685,190
Qualifying for hedge accounting		
Currency derivatives		
Currency forwards and swaps, and cross-currency interest rate swaps	166,367	81,676
Interest rate derivatives		
Interest rate swaps	10,925	530,307
Commodity derivatives and others	—	10,817
	177,292	622,800
	825,034	1,307,990
Portion classified as current assets/liabilities	(445,382)	(505,115)
Non-current portion	379,652	802,875

As at 31 December 2015

Example 5 (Mainland China company)

AAC Technologies Holdings Incorporated Annual Report & Accounts 2016

Page 9 FOREIGN EXCHANGE

Given our international operations and presence, the Group faces foreign exchange exposure including transaction and translation exposure.

It is the Group's consistent policy to centralize foreign exchange management to monitor total foreign currency exposure, to net off affiliate positions and to consolidate hedging transactions with banks. As far as possible, the Group aims to achieve natural hedging by investing and borrowing in the functional currencies. Where a natural hedge is not possible, the Group will mitigate foreign exchange risks via appropriate foreign exchange contracts.

The Group has not entered nor will it enter into any derivative transactions for speculative trading purposes.

Page 107 Currency risk – spot rates

With the Group's international operations and presence, the Group faces foreign exchange exposure including transaction and translation exposure.

It is the Group's policy to centralise foreign currency management to monitor the Group's total foreign currency exposure, to net off affiliate positions and to consolidate hedging transactions with banks. As far as possible, the Group aims to achieve natural hedging by investing and borrowing in the functional currencies. Where a complete hedge is not possible, the Group will consider to protect its anticipated foreign currency revenue and foreign currency monetary items with appropriate foreign exchange contracts.

The Group will not enter into derivative transactions for pure trading or speculative purposes.

The carrying amounts of the Group's and intra-Group's foreign currency denominated monetary assets and monetary liabilities at the reporting date are as follows:

	Assets		Liabilities	
	2016 RMB'000	2015 RMB'000	2016 RMB'000	2015 RMB'000
US$	**8,048,030**	1,769,306	**6,548,481**	3,200,037
Japanese Yen	**605,594**	183,203	**558,060**	127,644
Euro	**80,652**	103,495	**58,434**	73,132
HK$	**436,192**	445,767	**296,706**	41,473

Chapter 3: The effects of corporate hedging and state ownership on the probability of default: Evidence from Chinese non-financial firms

Abstract

Using hedging data for 501 Chinese non-financial firms listed on the Hong Kong Stock Exchange from 2008 to 2020, we reveal that corporate hedging results in an economically significant 36% reduction in the probability of default for non-state-owned enterprises (SOEs) but only 6% for SOEs. This difference is economically significant. Consistent with this, our analysis shows that state ownership significantly moderates the negative effect of corporate hedging on the probability of default, suggesting a substitution effect. Furthermore, we find that this substitution effect varies depending on firm size, such that state ownership is a more effective substitute for hedging among large SOEs, particularly in the case of derivatives hedging. However, more importantly, this substitution effect begins to weaken after 2017 and experiences a sharp decline in 2020 which coincides with a significant softening of the implicit Chinese government guarantee provided to SOEs. Moreover, we find that the moderating effect of state ownership is much stronger during periods of high economic policy uncertainty. Our analysis shows that interest rate derivatives hedging is three times more effective in mitigating default risk than FC derivatives or FC debt hedging. Overall, our findings are new for the corporate hedging literature.

Keywords: Default risk**;** corporate hedging; state ownership; derivatives; foreign currency debt; interest rate derivatives.

JEL codes: G3, G32, G33, G38.

1. Introduction

One of the most fundamental questions in corporate risk management is whether corporate hedging reduces a firm's likelihood of default. Of the few studies that have investigated this issue all are based on firms in developed countries, such as the US (Yi et al., 2008; Boyer and Marin, 2013; Magee, 2013; Marin, 2013; Anbil et al., 2019). As a result of globalization, companies in emerging economies are encountering greater financial risks and many of these firms are seen to be adopting a more proactive approach to mitigating these risks. As the largest emerging economy and the world's factory, Chinese risk management practices have garnered significant attention due to the remarkable growth of its derivatives market since 2005. In 2018, the total value of derivative contracts in the Chinese financial market amounted to approximately USD 15 trillion, surpassing China's GDP of about USD 13.9 trillion during the same year (Mao, 2019). By the end of the third quarter of 2021, more than 1,300 listed Chinese companies used derivatives for hedging, issuing a record-breaking 32,000 hedging announcements.[1] Despite this growth, some Chinese firms have incurred substantial losses from the use of derivatives. For instance, as recently as 2021, there have been some notable examples of derivative related losses in the corporate sector such as China Molybdenum Corporation Limited which suffered a loss of 3.292 billion yuan, Jiangxi Copper Corporation Limited incurred a loss of 2.718 billion yuan, and Xiamen ITG Group Corporation Limited faced a loss of 1.267 billion.[2] Given these losses and the subsequent call for tighter regulation of derivatives use by corporates, it is important to investigate the effect of derivatives use on the risk faced by Chinese firms. Our study sheds light on whether the corporate use of derivatives decreases firm credit risk, which is a significant area of interest for policy makers responsible for monitoring and promoting financial stability within an economy. Although some studies have examined the impact of derivatives on Chinese companies' cash flow risk, market risk, foreign exchange (FX), interest rate (IR) or commodity price (CP) risk (Xie and Yang, 2017; Shao et al., 2019; Zhang et al., 2020;

[1] News source: Securities Times. 2021-10-18. Website: https://news.stcn.com/sd/202110/t20211018_3768002.html.

[2] News source: China Business Network. 2021-09-01. Website: http://stock.caijing.com.cn/20210901/4797911.shtml.

Guo et al., 2021; Cheng and Cheung, 2021), to the best of our knowledge, no study has provided direct evidence on whether corporate hedging reduces the default risk of Chinese non-financial firms. Therefore, we conduct the first study to investigate the impact of corporate hedging on a firm's probability of financial distress in a Chinese context. We define firms as hedgers if they indicate the use of derivatives or foreign currency (FC) debt for risk mitigation purposes. We include FC debt as a hedging tool because a substantial number of Chinese firms disclose in their annual reports that they use FC debt for hedging purposes. Our research design allows us to construct several categories of hedging defined as all hedging (using derivatives or FC debt), derivatives hedging, FC debt hedging, FX derivatives hedging, IR derivatives hedging and FX hedging (using FX derivatives or FC debt). We find that the use of derivatives and or FC debt results in an economically significant decrease in the probability of default, around 30% for the average firm. Furthermore, all other categories of corporate hedging activity generate a significant reduction in a firm's likelihood of default.

It is important to note that the categorization of each hedging method is not nuanced enough due to the concurrent use of multiple hedging instruments among the hedging group. For example, a firm using FX derivatives may also employ FC debt or IR derivatives. Therefore, we develop an approach to address this issue by identifying all possible combinations of corporate hedging and constructing a distinct dummy variable for each combination. Subsequently, we provide unequivocal evidence that the mitigating effect of corporate hedging on a firm's likelihood of default is sensitive to the type of hedging method employed. Specifically, we discover that the use of IR derivatives is the most effective in reducing a firm's default risk, resulting in an economically significant 61% decrease in the probability of default for the average firm. The corresponding results for FX derivatives and FC debt hedging are significantly lower at 19% and 23%, respectively. Our results suggest that IR derivatives are three times as effective at reducing default risk compared to FX derivatives and FC debt hedging. To the best of our knowledge, these are new findings not just for the Chinese corporate hedging literature but the risk management literature in general.

As a typical emerging economy, Chinese financial market relies heavily on government intervention, and thus, state ownership plays a pivotal role in Chinese corporate behaviour (Opie et al., 2019; Jia et al., 2019). Therefore, we examine the relationship between state ownership and a firm's probability of default, and our findings reveal that state-owned enterprises (SOEs) exhibit a lower probability of default. Furthermore, we construct interaction variables between state ownership and each corporate hedging method to investigate the impact of state ownership on the relationship between corporate hedging and a firm's default risk. We find that state ownership significantly moderates the mitigating effect of each type of corporate hedging on a firm's probability of default. Our results show that hedging with derivatives and or FC debt by SOEs is 84% less effective in reducing a firm’s default probability compared to hedging by non-SOEs. This drop in effectiveness is economically significant and provides strong evidence to suggest that being a SOE is a substitute for hedging. These novel findings are crucial for the corporate hedging literature and enhance our current understanding of the role that state ownership can play in a firm’s risk management strategy.

Our results reveal that the role state ownership plays in the effect of corporate hedging on a firm’s likelihood of default varies with respect to firm size. We find that state ownership is a more effective substitute for hedging among large SOEs, particularly in the case of derivatives hedging. We believe this might be attributed to the Chinese government's reluctance to allow large SOEs to fail due to their significant implications for employment and their strategic importance for the economy.

Interestingly, we find that the substitute impact of state ownership starts to weaken after 2017, and experiences a very sharp decline in 2020, reaching its lowest point. The drop in the moderating impact of state ownership over this 3-year period very closely coincides with the period when the Chinese government started the gradual process of withdrawing the implicit government guarantees (IGG) provided to SOEs which resulted in a significant increase in the number and value of SOEs' defaulted bonds (Hotchkiss et al., 2023; Jin et al., 2023a; Li et al., 2023). Our findings imply that over time, state ownership has become a less effective substitute for corporate hedging in reducing the likelihood of SOEs' defaults. To the best of our knowledge, this study is the first to show this in the context of Chinese corporate hedging. A direct consequence of this is that corporate hedging has become increasingly pivotal in reducing Chinese SOEs default risk.

We find that the reducing impact of state ownership on firm's probability of financial distress is significant only under high economic policy uncertainty (EPU) while insignificant under low EPU. Furthermore, the moderating effect of SOE is much stronger under high EPU. This suggests that the Chinese government is more inclined to provide protection and support to SOEs when the economy experiences high macroeconomic risk and uncertainty. We believe these findings extend our understanding of the interplay between state ownership and the effectiveness of corporate hedging by introducing the dimension of macroeconomic uncertainty.

Finally, to address endogeneity concerns, we not only adopt lagged regressors, but also employ Heckman's two-step framework and a two-stage least squares (2SLS) approach. Our results remain qualitatively similar, suggesting that our findings may not be subject to a serious endogeneity issue.

The rest of the study is organised as follows. Section 2 reviews the extant literature and develops our hypotheses. Section 3 describes our sample selection, data collection and variable construction. Section 4 discusses our methodology. Sections 5 presents our empirical results and Section 6 concludes.

2. Literature review and hypothesis development

2.1 Literature review

In the past two decades, a significant amount of research has emerged to examine the impact of hedging on firms' risk. As a seminal paper, Smith and Stulz (1985) challenge the risk irrelevance view raised by Modigliani and Miller (1958) through a value maximising model and point out that corporate hedging can reducing firm's financial distress costs by alleviating the volatility of earnings. Subsequently, Leland (1998) and Kuersten and Linde (2011) further lend theoretical support to the risk-reducing effect of corporate hedging. From an empirical perspective, many studies have demonstrated that companies can economically alleviate their risks such as cash flow risk, market risk, FX risk, IR risk and CP risk through hedging (Guay, 1999; Allayannis and Ofek, 2001; Nguyen et al., 2007; Al-Shboul and Alison, 2009; Nguyen and Faff, 2010; Bartram et al., 2011; Bartram, 2019).

Most of the literature investigating the relationship between corporate hedging and a firm's risk focuses on firms in developed economies, while only a few studies examine this issue in a Chinese setting. Xie and Yang (2017) seem to be the first to investigate the impact of corporate hedging on Chinese non-financial firms' risk. They find that the use of FX derivatives can reduce firms' FX risk exposure, although the effect is relatively small. Subsequently, Shao et al. (2019) disaggregate the 269 CP futures users in their sample into hedgers and speculators, and find that the use of CP futures can significantly reduce firms' CP risk for hedgers while having no significant impact for speculators. Based on 264 multinational corporations (MNCs) listed on the Chinese A-share market between 2013 and 2017, Zhang et al. (2020) find that FX derivatives use reduces FX risk exposure for Chinese non-financial firms. Following Bartram (2019), Guo et al. (2021) calculate standard deviation, beta, net FX, IR and CP risk exposure as proxies for firm's risk and report that derivatives use reduces these measures of risk. Furthermore, Guo et al. (2021) divide derivatives users into

FX, IR or CP derivatives users and find their separate impacts on firm's standard deviation are similar, indicating that the risk-reducing effect of derivatives use is not dependent on the type of derivative. Using a large sample of all Chinese non-financial firms listed on the A-share market during 2008 to 2019, Cheng and Cheung (2021) show that the use of derivatives lowers the volatility of cash flows and profits.

The authors, research periods, samples, hedging instruments, risk measurements and key findings in Chinese studies are summarized in Table A-1 of Appendix A. Among these limited studies, most focus on FX derivatives (Xie and Yang, 2017; Shao et al., 2019; Zhang et al., 2020). Moreover, Xie and Yang (2017) and Zhang et al. (2020) only select Chinese MNCs to construct their samples, overlooking the fact that numerous non-MNCs also manage their risks through corporate hedging. Furthermore, although FC debt is a crucial hedging instrument (Erol et al., 2013; Boyer and Marin, 2013; Marin, 2013; Guo et al., 2018), there is currently no literature investigating the impact of FC debt use on a firm's risk in the Chinese context.

2.2 Hypothesis development

It is worth noting that most existing research on the impact of corporate hedging on firms' risk focuses on cash flow risk, market risk, and FX, IR or CP risk (Guay, 1999; Allayannis and Ofek, 2001; Nguyen et al., 2007; Al-Shboul and Alison, 2009; Nguyen and Faff, 2010; Bartram et al., 2011; Xie and Yang, 2017; Bartram, 2019; Shao et al., 2019; Zhang et al., 2020; Guo et al., 2021; Cheng and Cheung, 2021). Only recently have some studies attempted to examine the impact of corporate hedging on firms' default risk. By choosing credit rating as a proxy for bankruptcy probability, Yi et al. (2008) first report a firm's default risk is not affected by the use of derivatives. They further divide derivatives users into FX and IR derivatives users, and find neither of them has a significant impact on firms' credit ratings. However, the variations of credit rating are too small to capture the impact of corporate hedging on the likelihood of financial distress (Magee, 2013). Hence, Magee (2013) calculates a firm's one-year distance to default as a proxy for the probability of financial distress, and discovers that FX derivatives use can reduce a firm's default risk, although the effect is statistically rather weak. This might be attributed to not accounting for the use of FC debt as an FX hedging instrument. Boyer and Marin (2013) combine both FX derivatives and FC debt as tools for FX hedging, and report that FX hedging can effectively reduce a firm's default risk by increasing a firm's distance to default. Using data on actual bankruptcies of non-financial US firms during the period 1994 and 2004, Marin (2013) finds that the use of both FX derivatives and FC debt for hedging reduces the likelihood of bankruptcy. Anbil et al. (2019) employ credit default swap (CDS) spreads as a measure of credit risk. Based on non-financial firms listed on the S&P500 index from 2003 to 2011, they find that derivatives users with a hedging designation have lower credit risk, while those without have higher credit risk. They further divided derivatives users into FX derivatives users, IR derivatives users, and CP derivatives users. They find that regardless of hedging designation status, employment of IR derivatives significantly mitigates firms' credit risk. On the other hand, firms using FX derivatives with a hedging designation have lower credit risk, while those without exhibit higher credit risk. Additionally, they find that the usage of CP derivatives have no significant impact on firms' credit risk. Although Guo et al. (2021) use Z-score, financial slack, and the leverage ratio as proxies for a firm's financial distress and categorize them into high and low groups, they only investigate whether the reducing-effect of derivatives on a firm's total risk is influenced by financial distress. In other words, they do not examine the direct impact of derivatives use on a firm's likelihood of default. Moreover, their results indicate that the relationship between derivatives and a firm's total risk is not influenced by firm's financial distress. To the best of our knowledge, there is currently no study that investigates the impact of corporate hedging on the probability of default in a Chinese setting. Therefore, we test Hypothesis 1 for the first time in a Chinese setting:

Hypothesis 1: Corporate hedging reduces a firm's probability of default.

As a typical emerging economy, Chinese financial market relies heavily on governmental intervention, and thus, state ownership plays a vital role in Chinese corporate behaviour (Opie et al.,2019; Jia et al., 2019). Specifically, compared to Chinese private companies, SOEs have greater access to government subsidies, bank loans and other financial support because of the IGG, especially when they experience financial difficulties (Lin and Tan, 1999; Kornai et al., 2003; Brandt and Li, 2003; Chang and Boontham, 2017). Therefore, SOEs may possess a lower probability of default and state ownership may even act as a substitute for corporate hedging in reducing a firm's default risk. In this study, we examine the impact of state ownership on the link between corporate hedging and a firm's default risk, and test the following hypothesis:

Hypothesis 2: State ownership moderates the reducing effect of corporate hedging on a firm's probability of default.

3. Data

3.1 Sample description

Our sample consists of 501 non-financial Chinese firms[3] listed on the Hong Kong Stock Exchange (HKSE) between 2008 and 2020. An advantage of using firms listed on the HKSE is that they are bound by international accounting standards when it comes to financial policy disclosures like risk management in annual reports. In 2004, the Hong Kong Institute of Certified Public Accountants made an announcement stating that effective January 1st, 2005, the Hong Kong Accounting Standards would be restructured to align completely with the International Accounting Standards and

[3] Our sample selection process began with downloading a list of firms listed on the HKSE from the Capital IQ database. We assessed the operational status of each firm by verifying that its market capitalization was positive in 2008, resulting in 992 firms considered to be in normal operation. Next, we filtered these firms based on the location of their headquarters, excluding those located outside China (e.g., companies headquartered in Singapore or Australia), which left 982 firms. We then excluded financial firms, which reduced the sample to 882 firms. Next, we thoroughly reviewed the annual reports of these firms, excluding 381 firms that either did not disclose information on the use of derivatives or FC debt, provided insufficient detail to determine whether derivatives or FC debt were used for hedging or speculation, or indicated usage of these instruments explicitly for speculation. This left a final sample of 501 companies.

International Financial Reporting Standards. This resulted in more detailed risk management information being disclosed by firms listed on the HKSE. Furthermore, derivative market developments since 2005 have expanded the hedging toolkit for Chinese non-financial firms. For example, the FX forward transactions in the Chinese derivatives market were initiated in 2005, followed by the launch of FX swap and forward transactions in 2006. Subsequently, IR swaps were introduced as part of a pilot program in 2006 and was liberalised across the country from the beginning of 2008. We therefore choose 2008 as the first year of our sample since China had a relatively functional derivatives market from 2008 onwards. Following Bartram (2019) and Cheng and Cheung (2021), we exclude financial firms from our sample, given that they often sell derivatives to their corporate clients as well as using them for speculative purposes in addition to using them for risk mitigation.

3.2 Data collection

In this study, we employ a keyword search approach and manually collect corporate hedging data from audited financial statements. We follow the literature such as Bartram (2019) and search for the following keywords to identify hedging firms: 'hedging', 'derivative', 'foreign currency risk', 'interest rate risk', 'commodity price risk', 'foreign debt'. Some examples of the kind of corporate hedging information found in Chinese annual reports is presented in the Appendix B.

3.3 Variable construction

3.3.1 Default risk

In this study we employ a market-based measure of a firm's default risk, which is a firm's probability of default sourced from Capital IQ. As highlighted by Baldassarri et al. (2012), the probability of default in Capital IQ is calculated using the probability of default market signals (PDMS) model, which is a development of the Merton model[4]. Compared to the Merton model used by Magee (2013) and Boyer and Marin (2013), the PDMS model can offer more precise and dependable credit risk assessments by employing an iterative approach, incorporating market signals and eliminating outliers.[5]

We have refrained from using accounting-based measures of the probability of financial distress, such as Z-score, financial slack, and leverage ratio, as opposed to Guo et al. (2021). The rationale behind this decision is that such measures are derived from financial statements and predominantly reflect a firm's past performance rather than its future prospects. Accounting-based measures contain historical information, while market-based measures provide a forward-looking assessment (Hillegeist et al., 2004; Duffie et al., 2007). Therefore, the latter is deemed superior in predicting a company's likelihood of default in the future. Considering that corporate hedging can impact future cash flows, a forward-looking assessment is more likely to incorporate the effects of corporate hedging.

3.3.2 Corporate hedging

Following Bartram (2019) and Guo et al. (2021), we construct a binary variable to indicate whether a Chinese non-financial firm employs derivatives (FX or IR derivatives) or FC debt, where a value of 1 indicates usage and 0 otherwise. Our results, as shown in Panel A of Table 1, indicate that the percentage of derivatives

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[4] The Merton model is a structural framework that leverages the interplay between a corporation's assets and liabilities in order to gauge its probability of default. This model postulates that a firm's equity can be conceptualized as a call option on its assets, wherein the face value of its debt serves as the strike price. Utilizing the Black-Scholes equation, the model estimates the value of this call option, subsequently enabling the computation of the probability of default (Merton, 1974).

[5] The PDMS model employs an iterative approach to estimate asset value and asset volatility. These estimates are subsequently utilized to compute the probability of default. The iterative process has been designed to address and rectify the inconsistent and counterintuitive behaviour of default probability values that can be observed in cases where a company experiences significant fluctuations in leverage. Moreover, the PDMS model integrates market signals, including parameters like market capitalization and asset volatility. By assimilating these market signals, the model can effectively encapsulate shifts in market sentiment and convert them into a comprehensive evaluation of the probability of default. Additionally, the PDMS model includes a procedure for detecting and eliminating outliers, enhancing estimate accuracy. Outliers may result from data errors or unusual events not representative of typical company behaviour. By comparing estimated asset values and volatilities with historical data and removing deviating points, the model ensures estimates are based on reliable data. (Baldassarri et al., 2012)

users among Chinese non-financial firms is 28.82%, which is substantially higher than the 11.1% reported by Guo et al. (2021).

We further categorize derivatives users into those using FX, IR or CP derivatives. As depicted in Panel A of Table 1, FX derivatives users account for 23.5% among Chinese non-financial firms, which is lower than the proportions of 33% reported by Xie and Yang (2017) and 39% reported by Zhang et al. (2020). This can be attributed to their sample selection of only MNCs which face greater FX exposure and tend to employ FX derivatives more frequently. In our sample, FX derivatives are the most commonly used derivatives among Chinese non-financial firms, consistent with the findings of Guo et al. (2021). IR derivatives users account for 13.51% of our sample, this study is the first to report the extent of IR derivative usage in a Chinese setting. CP derivatives are the least used by firms in our sample, making up only 5.3% of firms.

An analysis of Chinese firms' annual reports reveals that FC debt plays a crucial role as an FX hedging instrument.[6] Panel B of Table 1 shows that FC debt users account for 49% of Chinese non-financial firms, which is higher than the proportion of 39% reported by Guo et al. (2018). Our hedging data in Panel B of Table 1 suggests that FC debt is the most popular hedging instrument for Chinese non-financial firms, possibly due to its lower transaction costs compared to FX derivatives in the Chinese financial market (Guo et al., 2018). Panel B of Table 1 shows that all hedgers, defined as firms using derivatives and or FC debt, account for 56.8% of Chinese non-financial firms, which is roughly twice the proportion of derivatives users. This reinforces the significant role of FC debt use in Chinese corporate hedging. FX hedgers, including FX derivatives and FC debt users, constitute 54.9% of Chinese non-financial firms.

[6] Cash inflows in FC can be matched with cash outflows of FC-denominated debt, which can mitigate a firm's FX risk exposures. Hence, we build a binary variable to measure a firm's FC debt use, which is equal to 1 if the firm uses FC debt and 0 otherwise.

3.3.3 State ownership

We develop a categorical variable to assess a firm's ownership structure, with a value of 1 indicating state ownership and 0 indicating otherwise. We obtained the data on SOEs from the China Stock Market & Accounting Research (CSMAR) database and the State-owned Assets Supervision and Administration of the State Council website.

3.3.4 Control variables

Following Shumway (2001), Campbell et al. (2008) and Magee (2013), we select a series of factors affecting a firm's probability of default as control variables. We measure leverage using the ratio of total debt to total capital and expect a positive relationship, as firms with higher leverage are more likely to default (Shumway, 2001). Shumway (2001) finds that larger firms have a lower probability of financial distress. Hence, we use the natural logarithm of total sales as a proxy for firm size and expect a negative relationship. Campbell et al. (2008) suggest that firms with greater liquidity have a lower probability of bankruptcy. As a result, we measure liquidity using the quick ratio, which is total current assets minus inventories divided by total current liabilities, and expect a negative relationship. Profitability is measured as the return on invested capital. Magee (2013) posits that profitable companies have a lower probability of default, leading to a negative prediction. Following Magee (2013), we compute equity volatility as the standard deviation of each firm's daily stock return throughout the fiscal year. We anticipate that equity volatility would be positively related to a company's default risk. We cumulate the monthly stock return to determine each firm's annual stock return and calculate excess return as the difference between the annual return and the value-weighted Hang Seng Index annual return. We anticipate a negative coefficient on excess return, as it is expected to have a diminishing impact on a firm's likelihood of bankruptcy (Campbell et al., 2008; Magee, 2013). All control variables except excess return are sourced from Capital IQ database. The stock returns and Hang Seng Index used to calculate excess returns are also sourced from Capital IQ database. All control variables are winsorized at the top and bottom 1 percent level to mitigate the effect of outliers. Table A-2 in Appendix A summarizes the definitions and predicted signs of all independent variables, including corporate hedging, SOE, interaction variables between SOE and corporate hedging and control variables.

4 Methodology

4.1 Estimation model

We use regression analysis to investigate the impact of corporate hedging on the probability of default, and the regression model takes the following specification:

$$Default\,risk_{i,t} = \beta_0 + \beta_1 Corporate\,hedging_{i,t} + \psi Control_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (1)$$

Where the dependent variable $Default\,risk_{i,t}$ is the expected default probability of firm i at time t; $Coproate\,hedging_{i,t}$ denotes all hedging, derivatives use, FC debt use, FX derivatives use, IR derivatives use and FX hedging, respectively; $Control_{i,t}$ denotes leverage, firm size, liquidity, profitability, volatility and excess return. We introduce industry and year dummies to control for the fixed effects of industry and time. Additionally, clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. Subsequently, taking the first derivative of equation (1) with respect to $Coproate\,hedging_{i,t}$, we get:

$$\frac{\partial Default\,risk_{i,t}}{\partial Corporate\,hedging_{i,t}} = \beta_1 \qquad (2)$$

β_1 measures the impact of corporate hedging on a firm's default risk, and a significantly negative β_1 lends support to Hypothesis 1. To examine Hypothesis 2, we add state ownership variable and its interaction variable with corporate hedging into equation (1), and the regression model takes the following specification:

$$Default\,risk_{i,t} = \beta_0 + \beta_1 Corporate\,hedging_{i,t} + \beta_2 SOE_{i,t} + \beta_3 SOE_{i,t} * Corporate\,hedging_{i,t} + \psi Control_{i,t} + Industry_i + Year_t + \varepsilon_{i,t} \quad (3)$$

Next, taking the first derivative of equation (3) with respect to $Coproate\ hedging_{i,t}$, we get:

$$\frac{\partial Default\ risk_{i,t}}{\partial Corporate\ hedging_{i,t}} = \beta_1 + \beta_3 SOE_{i,t} \qquad (4)$$

From the above expression, for non-SOEs, β_1 still measures the effect of corporate hedging on a firm's default risk. However, for SOEs, it is worth noting that the overall effect of corporate hedging on firm's default risk depends on both β_1 and β_3, which is (β_1+β_3). Therefore, if β_3 is significantly positive, Hypothesis 2 will hold.

4.2 Method to deal with bias

It is worth noting that some non-derivatives users may still use FC debt as a means of hedging their risks. Hence, defining these firms as non-hedgers could weaken the observed differences between hedgers and non-hedgers, and consequently introduce a bias into the analysis (Clark and Judge, 2008). To address this issue, firms that use FC debt among non-derivatives users are excluded from the analysis when investigating the impact of derivatives use on a firm's default risk. Similarly, the same methods are used to control for such bias in relation to FC debt use, FX derivatives use, IR derivatives use, and FX hedging. The steps taken to address this bias are summarized in Table A-3 of Appendix A. This study only reports the regression results after controlling for the bias.

5. Empirical results

5.1 Descriptive statistics and univariate analysis

Table 2 presents the summary statistics for the entire sample. The mean expected default probability for the Chinese non-financial firms in our sample is 2.96%, which is lower than the corresponding value of 6.19% for US non-financial firms reported by Brogaard et al. (2017). This suggests that, on average, Chinese non-financial firms may have lower expected default probabilities than their US counterparts. However, compared to the median value of zero percent reported by Brogaard et al. (2017), Chinese non-financial firms in our sample appear to have a higher default risk as the median expected default probability is 0.99%. In our sample, 24.6% of Chinese non-financial firms are SOEs. This is lower than the corresponding value of 42.7% reported by Guo et al. (2021), which is likely due to their focus on firms listed on the A-share market, where all firms are mainland Chinese, while we select firms listed on the HKSE with a mix of mainland Chinese and Hong Kong firms.

In table 3 we test for differences between hedgers and non-hedgers based on our all hedging definition using two sample T-tests and Wilcoxon rank sum tests. Table 3 shows that the mean expected default probability for hedgers is 2.09%, which is significantly smaller than the corresponding value of 4.18% for non-hedgers. We get a similar result using the Wilcoxon rank sum test.

Figure 1 illustrates the annual variation in the median expected default probabilities between hedgers and non-hedgers from 2008 to 2020. We find that the median expected default probability for hedgers is consistently lower than that of non-hedgers. This finding lends preliminary support to Hypothesis 1 that corporate hedging reduces a firm's probability of financial distress. We can also observe that the variability in the median default probability is smaller for hedgers than non-hedgers over this period. Moreover, we also plot the annual variation in the mean expected default probabilities between hedgers and non-hedgers, with 90% confidence intervals, from 2008 to 2020. As shown in Figure A-1 of Online Appendix A, the mean expected default probability for hedgers is consistently lower than that of non-hedgers. Additionally, the confidence intervals for hedgers are generally lower than those for non-hedgers, except for a period of overlap in 2009, indicating that the mean expected default probability for hedgers is significantly lower than that of non-hedgers at the 10% confidence level. This finding also provides preliminary support for Hypothesis 1.

The Pearson correlation coefficients and their significance among the variables are presented in Table A-4 of Appendix A. The expected default probability is found to be significantly negatively correlated with all hedging, derivatives use, FC debt use, FX derivatives use, IR derivatives use, and FX hedging, respectively. This suggests that each of these corporate hedging methods may help to reduce a firm's default risk. Furthermore, there is also a negative correlation between the expected default probability and state ownership, indicating that SOEs may have a lower probability of default. Except for the correlations between the various types of corporate hedging methods, the absolute value of all the correlations between paired variables is below 0.6, indicating that multicollinearity is not likely to be a problem.

Although these univariate analyses lend preliminary support to Hypothesis 1, they only establish a binary link and do not control for the potential effects of other independent variables. Therefore, we conduct multivariate analysis to further examine our hypotheses in the following section.

5.2 Multivariate analysis

5.2.1 Impact of corporate hedging on default probability

We use pooled ordinary least squares (OLS) to regress equation (1), with the results presented in Panel A of Table 4. We find that all hedging leads to a statistically significant reduction in the expected default probability of 0.892%. This result is also economically significant as it suggests that the use of derivatives or FC debt generates a fall of 30.1% (0.892/2.959*100%) in the average default probability. Our results show that not only the use of derivatives but also the use of FX or IR derivatives can result in a substantial reduction in the expected default probability, which contradicts the findings of Yi et al. (2008) that none of these three types of hedging methods has a significant impact on a firm's default risk. Consistent with expectations, IR derivatives use leads to the largest reduction in default risk.

We employ a one-year lag to all explanatory variables to control for the potential endogeneity by mitigating the issue of reverse causality (Chen and King, 2014). As illustrated in Panel B of Table 4, the reducing effect of each corporate hedging method on a firm's default risk remains statistically significant at the 1% level, which corroborates our previous findings. Cook et al. (2008) indicate that the estimators of a linear regression model may be biased and inconsistent when using a proportional dependent variable. Given that the expected default probability is a proportion, we address this concern by employing a beta regression model. The results of the beta regression model are presented in Panel C of Table 3 and are qualitatively similar to our findings in panel A and B.

For the control variables, our findings remain consistent across OLS, lagged, and beta regression models. As anticipated, leverage has a significantly positive impact on a firm's probability of financial distress. Firms with higher liquidity and higher profitability tend to have lower default risk. As expected, larger companies are less likely to default. Additionally, in line with expectations, we find that firms with higher excess return or those with lower volatility exhibit a lower probability of bankruptcy.

5.2.2 Impact of state ownership

Recent empirical evidence on the relationship between being a SOE and firm risk is mixed. Cheng and Cheung (2021) discover that SOEs exhibit lower levels of risk, while Shao et al. (2019) report no significant association between state ownership and a firm's risk. Guo et al. (2021) find that SOEs have lower standard deviation, net FX, IR, and CP risk exposures as proxies for firm risk, but higher market beta. In this study, we investigate the link between state ownership and a firm's default risk, which is particularly relevant in a Chinese context given the IGG. The results in panel A of Table 5 show that SOEs are less likely to default.

We use an interaction variable to explore whether state ownership has any impact on the reducing-effect of corporate hedging on a firm's default probability. Our results show that state ownership significantly moderates the reducing effect of corporate hedging on a firm's default risk, with all interaction variables between state ownership and each hedging method being significantly positive at the 1% level. Using all hedging as an example, our results show a significant reduction in non-SOEs' expected default probability, equivalent to a 36% (1.153/3.171*100%) decrease in the average default probability. However, for SOEs, all hedging only results in a 0.126% (-1.153%+1.027%) decrease in expected default probability, or equivalently, a 6% (0.126/2.151*100%) reduction in the average default probability. Thus, on average, the reducing effect of all hedging on a firm's expected default probability diminishes by 84% ((36.361%-5.858%)/36.361%) for SOEs compared to non-SOEs, which is highly significant in an economic sense.

As demonstrated in Panel B and C of Table 5, our findings remain valid when using lagged regressors and the beta regression model. Our results on control variables are consistent with our previous findings in Section 5.2.1 across OLS, lagged, and beta regression models.

5.3 Impact of corporate hedging types

Although FX derivatives and FC debt may mitigate a firm's probability of default by reducing the volatility of its FC cash flow, it is fair to say that a firm's probability of default is more closely aligned with a firm's IR risk, which can be managed directly via IR derivatives. The impact of IR derivatives stems from their ability to reduce the variability of debt expenses, thereby generating a greater impact on a firm's default risk. However, existing literature on the association between derivatives usage and a firm's likelihood of default predominantly focuses on FX derivatives (Magee, 2013) or FX hedging (Boyer and Marin, 2013; Marin, 2013). Although Yi et al. (2008) investigate the effect of IR derivatives on a firm's credit rating, they find there is no significant link between them. Given the paucity of evidence on the impact of IR derivatives, it is worthwhile to examine the isolated impact of IR derivatives on a firm's default risk. As shown in Tables 4 and 5, we find that the use of IR derivatives results in the largest reduction in the expected default probability, albeit the coefficients' magnitudes and statistical significance are similar across each hedging activity. However, it is important to note that the categorization of each hedging method may not be sufficiently refined due to the mixed use of multiple hedging instruments within a given hedging group. For instance, a firm using FX derivatives may simultaneously employ FC debt or IR derivatives. Therefore, we identify all possible combinations of corporate hedging, including firms who exclusively use FX derivatives, IR derivatives, or FC debt, firms who simultaneously employ FX derivatives and FC debt, firms who use both IR derivatives and FC debt, firms who use both FX and IR derivatives, and firms who simultaneously employ all three hedging instruments. Subsequently, we construct dummy variables for each corporate hedging combination and incorporate them into equation (1). This methodology not only accurately presents the isolated impact of IR derivatives usage on a firm's probability of financial distress, but also allows us to examine precisely whether the effect of corporate hedging on a firm's default risk is sensitive to the specific hedging type.

The results in Table 6 show that each category of corporate hedging has a significant reducing effect on a firm's expected default probability. We find that the use of IR-only derivatives produces the largest reduction in the average expected default probability of 61.1% (1.809/2.959*100%), with a significance level of 1%. This effect is approximately three times greater than that generated by FX derivatives-only use (18.8%) and by FC debt-only use (23.2%), and the differences are statistically significant at the 1% level. These results hold when using lagged regressors and the beta regression model. These results confirm in an unambiguous way our earlier finding that IR derivatives are the most effective in reducing a firm's default risk. Furthermore, our results show that the reduction in firm's default risk through the only use of IR derivatives is even significantly greater than the reduction achieved through the simultaneous use of FX derivatives and FC debt, as observed in both the OLS and beta regression models. We find that the impacts of FX derivatives-only use and FC debt-only use on reducing firm's expected default probability are similar. Moreover, hedging combinations that include IR derivatives generate greater reductions in a firm's default risk compared to those that do not include IR derivatives. Therefore, these results provide unequivocal evidence that the impact of corporate hedging on a firm's probability of financial distress is sensitive to the type of hedging instrument.

5.4 Robustness tests

The relationship between a firm's probability of bankruptcy and corporate hedging may be affected by endogeneity issues (Magee, 2013; Boyer and Marin, 2013; Marin, 2013). Magee (2013) reports that there is no significant relationship between a firm's probability of financial distress and the use of FX derivatives, which could be due to the presence of reverse causality, as the link becomes significant and marginally significant when 2SLS and generalized method of moments approaches are used to control for endogeneity. The probability of a firm's bankruptcy is not solely determined by its corporate hedging, but may also influence the firm's decision to engage in hedging, thus forming a feedback loop. On one hand, corporate hedging activities can decrease a firm's default risk. On the other hand, firms with higher default risk may be more inclined to engage in corporate hedging activities. Moreover, firms may assign themselves to hedge, leading to non-random sampling of each corporate hedging method, which may result in self-selection bias. Therefore, apart from the lagged regressors used in sections 5.2 and 5.3, we adopt Heckman's two-step approach and 2SLS approach to control for potential endogeneity.

We address concerns of self-selection bias and problems associated with omitted variables by adopting Heckman's two-step approach, as suggested by Jiang et al (2018) and Guo et al. (2021). In the first-stage model, a logit model is employed to predict the likelihood of engaging in corporate hedging activity. Following Bartram's

(2019), we select leverage, firm size, liquidity, profitability, FX risk exposure, and growth opportunity as the determinants in the first-stage model, which is as follows:

$$Log\left(\frac{P_{i,t}}{1-P_{i,t}}\right) = \beta_0 + \beta_1 LEV_{i,t} + \beta_2 SIZ_{i,t} + \beta_3 LIQ_{i,t} + \beta_4 PRO_{i,t} + \beta_5 FXR_{i,t} + \beta_6 GRO_{i,t} + Industry_i + Year_t \qquad (5)$$

$P_{i,t}$ is the likelihood of a firm engaging in each corporate hedging; $FXR_{i,t}$ is the FX risk exposure measured by foreign sales percentage of firm i at time t; $GRO_{i,t}$ is the growth opportunity of firm i at time t, calculated as capital expenditure over total sales; the definitions of leverage, firm size, liquidity, and profitability align with those provided in section 3.3.4. Table A-5 in Appendix A displays the outcomes of the first-stage regression. Consistent with Bartram's (2019) findings, larger firms with higher leverage, profitability and FX risk exposure are more likely to engage in hedging activities.

We include the inverse Mills ratio (Lambda), derived from the first-stage regression, in our second-stage model, examining the impact of corporate hedging on a firm's default risk and the moderating effect of state ownership on the risk-mitigating effects of corporate hedging. Panel A of Table 7 demonstrates that all hedging, derivatives, FC debt, FX derivatives, IR derivatives, and FX hedging exert a significant and negative influence on a firm's expected default probability at the 1% significance level. These results are consistent with our previous findings, indicating that each corporate hedging method can significantly diminish a firm's likelihood of default. Importantly, the inverse Mills ratio (Lambda) remains statistically insignificant even at a 10% confidence level, suggesting that this study may not be subject to serious self-selection bias.

Panel B of Table 7 presents the second-stage regression outcomes regarding the impact of corporate hedging on default risk net of state ownership. We find that SOEs are less likely to default, and the state ownership significantly moderates the risk-reducing effect of each corporate hedging method on a firm's likelihood of default. These findings algin with our earlier results. Furthermore, the statistically insignificant Lambdas at a 10% confidence level indicate the robustness of our results, suggesting that sample-selection bias and the omitted variable issue do not significantly influence our findings.

We use a 2SLS approach to further address the potential endogeneity issue. A valid instrument should relate to corporate hedging but have no direct impact on firm's probability of default. Following Géczy et al. (1997), Allayannis and Ofek (2001), Bartram et al. (2011), Gay et al. (2011), Allayannis et al. (2012), Magee (2013), Boyer and Marin (2013) and Marin (2013), we select foreign sales and growth opportunity as instrument variables.[7] Panel A of Table 8 illustrates that all hedging, derivatives, FC debt, FX derivatives, and FX hedging have a significant and negative impact on a firm's expected default probability at a 5% significance level. In particular, the use of IR derivatives generates the most substantial reduction and is statistically significant at the 1% level. These findings align with our previous results that each corporate hedging approach can significantly decrease a firm's likelihood of financial distress, with IR derivatives use generating the greatest impact. This suggests that our findings are robust and may not be affected by endogeneity.

We conduct several tests to assess the validity of our instrument variables. First, we employ the endogeneity test and find that we cannot reject the null hypothesis that the variables are exogenous for derivatives, FX, and IR derivatives groups. This suggests that there is no endogeneity issue present in these three groups. Even for all hedging, FC debt, and FX hedging groups, we are only able to marginally reject the null hypothesis. Second, we conduct the Sanderson-Windmeijer F test to assess whether our instrument variables are correlated with a firm's decision to hedge. Our results

[7] The selection of foreign sales percentage aligns with the findings of Géczy et al. (1997), Marin (2013), Gay et al. (2011), Allayannis et al. (2012), Boyer and Marin (2013) and Magee (2013), who observe its significantly positive impact on corporate hedging. We employ capital expenditure to sales as a proxy for firm growth, which is informed by Géczy et al. (1997) and Allayannis and Ofek (2001).

show that all F statistics are higher than 10 and significant at the 1% level. As a result, we can reject the null hypothesis that the instrument variables have no correlation with the endogenous explanatory variables. Third, we use the Hansen J test of overidentifying restrictions to evaluate whether our instrument variables are associated with the error term. Our results indicate that all J statistics are insignificant, and thus we cannot reject the null hypothesis that the instrument variables are uncorrelated with the error term. Therefore, the instrument variables used in this study are able to pass both the Sanderson-Windmeijer F and Hansen J tests, suggesting that they are valid. The regression results regarding the first stage of 2SLS approach are shown in Panel A of Table A-6 in Appendix A.

Then, we employ the 2SLS approach to assess the robustness of our findings concerning the impact of state ownership after controlling for endogeneity. As shown in Panel B of Table 8, SOEs are less likely to default, and state ownership significantly moderates the reducing effect of each corporate hedging method on a firm's probability of financial distress at the 5% significance level. These results are consistent with our previous findings and suggest that endogeneity does not pose a significant issue in our study. We conduct several tests to validate the instrument variables. Based on the results of endogeneity tests, we fail to reject the null hypothesis that variables are exogenous for derivatives, FX, and IR derivatives groups, indicating that no endogeneity issue exists in these three groups. Moreover, even for all hedging, FC debt, and FX hedging groups, we can only marginally reject the null hypothesis. Furthermore, we find that all F statistics exceed 10 at the 1% significance level, and all J statistics are insignificant. These results indicate that our instrument variables can pass both the Sanderson-Windmeijer F and Hansen J tests and are thus valid. The regression outcomes of the first stage of 2SLS approach are presented in Panel B of Table A-6 in Appendix A.

On June 12, 2015, China's A-share market, including the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE), experienced a significant market crash. Specifically, the SHSE index suffered a decline of more than 43% from its peak on June 12, 2015, to its lowest point on August 26, 2015, while the SZSC index lost 45% during the same period (Shu and Zhu, 2022). Although we select 501 Chinese non-financial firms listed on the HKSE to construct our sample and the HKSE did not experience a similar market crash, our sample includes 36 firms that are dual-listed on the Chinese A-share market, comprising 31 firms on the SHSE and 5 firms on the SZSE. On one hand, we use excess return and equity volatility, which are both market variables, as control variables, and these variables may be influenced by the market crash. On the other hand, there is a close relationship between a firm's default risk and the market crash (Andreou et al, 2021), especially since we adopt a market-based measure of a firm's default risk. Therefore, we exclude the 36 firms in our sample that are dual-listed on the HKSE and China's A-share market and re-examine the impact of corporate hedging on default risk, as well as the moderating effect of state ownership, with the results presented in Table 9. These results are consistent with our previous findings, further validating the robustness of our conclusions.

5.5 Firm size

Recent literature has acknowledged that governments may prioritize financial support towards larger firms because of their economic importance which may come in the guise of the employment opportunities they provide, their significance in terms of technological advancement of the economy, their overall strategic importance and their contribution to the economy’s tax take (Strahan, 2013; Bradshaw et al., 2019; Davila and Walther, 2020; Dong et al., 2021). Firms that receive this support are referred to as being systemically important or perhaps colloquially "too big to fail". In this section, we test for the existence of the "too big to fail" phenomenon using our corporate hedging framework by investigating whether the moderating effect of state ownership identified in section 5.2.2 is influenced by firm size.

We employ total sales as a measure of firm size and assign each corporate hedging user in our sample to firm size quartiles in each year. We do this for each of our six categories of hedging method, and construct hedging proxies referred to as Hedging Method Q1 to Hedging Method Q4 based on these quartiles.[8] Subsequently, by building interaction variables between our state ownership dummy variable and Hedging Method Q1 to Hedging Method Q4, we investigate whether the role state ownership plays in reducing the impact of corporate hedging on a firm's default risk varies with respect to firm size, with the results shown in Table 10.

For small SOEs, our results show that state ownership does not moderate the impact of corporate hedging on a firm's expected default probability, suggesting that the IGG for small SOEs is negligible. The implication of this result is that corporate hedging is important for small SOEs for the purpose of reducing their default risk. For SOEs in the second quartile, state ownership significantly moderates the reducing effect of FC debt use (all hedging, FC debt use, and FX hedging) on the firm's probability of financial distress, while having no impact on the relationship between derivatives use and firm's default risk. These results suggest that state ownership is a substitute for FC debt hedging but not generally for derivatives hedging for firms in quartile 2. Our results for SOEs in the third quartile show that state ownership moderates the risk reducing impact of FX derivatives and FC debt use on the firm's likelihood of default, while having no significant influence on the link between IR derivatives use and a firm's default risk. This suggests that IR derivatives hedging by these SOEs is still useful in reducing default risk. It follows that being a SOE in the third quartile does not provide full protection against default. For the largest SOEs, state ownership significantly moderates the risk reducing impact of all types of hedging on a firm's likelihood of default. Hence, for these SOEs, state ownership provides significant protection against default and therefore effectively substitutes for hedging to such an extent that hedging becomes unnecessary. Our findings suggest that the value of the

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[8] Hedging Method Q1 denotes the smallest 25% companies employing a particular hedging method in each year. Hedging Method Q2 comprises the companies in second quartile employing a particular hedging method in each year. Hedging Method Q3 denotes the firms in third quartile employing a particular hedging method in each year. Hedging Method Q4 comprises the largest 25% of companies using a particular hedging method in each year.

IGG varies depending on the size of the SOEs, with the largest SOEs afforded the greatest protection. Furthermore, this analysis demonstrates the existence of a "too big to fail" effect in China, with the very largest Chinese SOEs belonging to this category.

5.6 Variation over time in the moderating effect of SOE

The conventional perspective suggests that although SOEs often exhibit lower average productivity and financial performance, they have historically overcome financial difficulties through direct injections of capital and subsidies, extended debt repayment terms, as well as payment exemptions from state-owned banks (Lin and Tan, 1999; Kornai et al., 2003; Brandt and Li, 2003; Chang and Boontham, 2017). This financial support has provided in effect an IGG which has resulted in a very low default risk for SOEs up until recently. The first corporate bond default in China's onshore market took place in 2014 and prior to 2015, there were no bond defaults among Chinese SOEs.[9] Nevertheless, as shown in figure 2, the number of SOEs bond defaults increased sharply in 2016 although the number dropped off a little in the following three years, but remaining above 2015 levels. The data points to a substantial increase in the number of SOEs' bond defaults in 2020, depicting a fivefold increase from 2019. Jin et al. (2023a) note that the increase in the frequency of SOE bond defaults over this period is consistent with the Chinese government gradually withdrawing the IGG extended to SOEs. Hotchkiss et al. (2023) highlight that this trend is not notably evident in the two years following 2015, however, they note that after 2017, there is a clear softening of the IGG for SOEs, which is propelled by efforts to deleverage businesses, reduce excess capacity, and tighten regulatory oversight on financial products. Furthermore, Li et al. (2023) indicate that after 2019, there is a significant weakening in the government's stance on providing implicit guarantees to SOEs. They suggest this change is attributed to the limited resources and capabilities of the government, especially local governments, in aiding SOEs

9 News source: The New York Times. 2015-04-21. https://www.nytimes.com/2015/04/22/business/dealbook/chinese-state-owned-company-in-a-first-defaults-in-domestic-bond-market.html.

following the outbreak of the COVID-19 pandemic. As a result, the number and value of defaulted bonds issued by SOEs experience a significant increase and consequently reaching an all-time high in 2020 as shown in figure 2.[10]

We would argue that although state ownership moderates the reducing impact of corporate hedging on a firm's probability of financial distress, this moderating effect may not necessarily be constant, especially as SOEs' bond default data points to a softening of the IGG extended to SOEs in recent years and particularly in 2020. Therefore, we examine whether the moderating effect of state ownership changes over our sample period in a manner that is consistent with the perceived changes in the IGG and in the increase in the frequency of SOEs' bond defaults. Based on our analysis in Section 5.5, for small SOEs state ownership does not decrease the effect of corporate hedging on their default risk. For second quartile SOEs, the moderating effect of state ownership is limited to all hedging, FC debt and FX hedging. However, for third quartile and large SOEs, state ownership significantly moderates the negative impact of corporate hedging on their likelihood of default across all the hedging categories. In view of this, our examination of the time series variation in the moderating impact of state ownership focuses on SOEs in the 3rd and 4th firm size quartiles, which we refer to as large medium-sized and large SOEs. The results in Table 11 show that for both all hedging and FC debt, the moderating impact of state ownership becomes insignificant for the first time in 2018. This aligns with the observation in Hotchkiss et al (2023) that the Chinese government further withdrew the IGG provided to SOEs after 2017. Moreover, for derivatives, the moderating effect of state ownership becomes insignificant for the first time in 2015. Interestingly, this coincides with the timing of the first occurrence of SOE bond defaults as well as the period identified by Jin et al. (2023a) as the commencement of the government's withdrawal of IGG extended to SOEs. More importantly, our results show that the moderating impact of state ownership experienced a sharp decline in 2020. Not only does it become insignificant, but it is also approximately half the value observed in

[10] The data regarding the number and value of SOE defaulted bonds is sourced from Huang (2021).

2019. This finding is consistent with the assertion put forward by Li et al. (2023) that after 2019 there is a significant softening in the Chinese government's stance regarding providing implicit guarantees to SOEs. In figure 3 we plot the yearly coefficients of the state ownership and hedging interaction term as well as the number of SOE bond defaults.[11] Prior to 2015, the moderating effect of state ownership remains strong, coinciding with the absence of SOEs' bond defaults. In 2020, a sharp decline in the moderating effect of state ownership coincides with a significant increase in the number of defaulted bonds issued by SOEs. The moderating effect of state ownership reaches its lowest point at this time, while simultaneously, the quantity of SOEs' defaulted bonds reaches its peak. It follows from our analysis that state ownership in China has become a less effective substitute for hedging in reducing the likelihood of bankruptcy. Consequently, we would argue that corporate hedging is becoming increasingly important in the mitigation of default risk for Chinese SOEs.

5.7 Variation in the moderating effect of SOE under Economic Policy Uncertainty

Recently, an expanding body of literature has demonstrated a rising interest in diverse indicators of uncertainty, specifically focusing on the correlation between uncertainty and actual economic and financial activities (Pástor and Veronesi, 2013; Bretscher et al., 2018; Ludvigson et al., 2021). For example, Bretscher et al. (2018) find that under high IR uncertainty or EPU, firms tend to reduce investment activities. Inspired by prior literature, we examine whether EPU affects the moderating effect of state ownership on the reducing-impact of corporate hedging on a firm's default risk.

Based on the methodology of newspaper coverage frequency proposed by Baker et al. (2016), Davis et al. (2019) constructed China's EPU index based on the two most influential Chinese newspapers: the Renmin Daily and the Guangming Daily.

[11] The yearly coefficients of the state ownership and hedging interaction term as well as the value of SOE bond defaults are shown in figure A-2 in Appendix A.

Essentially, this proxy has the capacity to capture both short-term and long-term uncertainty related to Chinese economic policy decisions, and a higher value of this index indicates a higher level of EPU. Moreover, Davis et al. (2019) calculate this proxy on a monthly basis. In our study, we aggregate the monthly EPU index by taking the arithmetic mean to generate the annual index. For instance, the annual EPU index for the year 2020 will be calculated as the arithmetic average of the monthly EPU index from January to December 2020. Subsequently, following the approach in Bretscher et al. (2018), we divide the EPU into three categories based on magnitude and examine the moderating effect of state ownership under high and low EPU, with the results shown in Table 12.

We find that for non-SOEs, the mitigating effect of each corporate hedging activity on firm's probability of financial distress is not influenced by EPU. However, the reducing impact of state ownership on firm's likelihood of bankruptcy is significant only under high EPU while insignificant under low EPU. Furthermore, the moderating effect of state ownership on the reducing-impact of corporate hedging on a firm's default risk is much stronger under high EPU. This suggests that the Chinese government is more inclined to provide protection and support to SOEs when they face higher macroeconomic risk and uncertainty to prevent bankruptcy. In the process, this decreases the effectiveness of hedging in reducing default risk for SOEs.

6. Conclusion

This study investigates the impact of corporate hedging and its interaction with state ownership on a firm's probability of financial distress in a Chinese setting. Using a sample of 501 non-financial Chinese firms listed on the HKSE during the period from 2008 to 2020, we find that corporate hedging significantly reduces the probability of default for firms. Importantly, we provide unambiguous evidence that the effectiveness of corporate hedging in mitigating the likelihood of bankruptcy is contingent on the type of hedging method used, with IR derivatives demonstrating the most effective role in reducing default risk. We observe that SOEs are less likely to default, and that state ownership significantly moderates the impact of corporate hedging on the probability of financial distress. In essence, our results suggest that state ownership is a substitute for corporate hedging. To the best of our knowledge, our study is the first to demonstrate this important interplay between hedging and a firm's ownership status and their effect on the default risk. These findings contribute to the existing corporate hedging literature and provide new insights into the relationship between corporate hedging, state ownership and financial distress in a Chinese corporate context.

We find the role state ownership plays in the effect of corporate hedging on a firm's likelihood of bankruptcy varies with respect to firm size. Our findings suggest that state ownership serves as a more effective substitute for hedging among large SOEs, particularly in the case of derivatives hedging and especially so for IR derivatives hedging. This may be attributed to the Chinese government's stance of preventing the failure of large SOEs due to the potential implications on the wider economy and employment opportunities. However, we find that as the government gradually withdraws the IGG provided to SOEs, state ownership gradually loses its ability to substitute for the role of corporate hedging in mitigating the likelihood of bankruptcy of SOEs. This implies that corporate hedging has become increasingly crucial in managing SOEs' default risk. Interestingly, we find that the moderating effect of state ownership is much stronger under higher EPU, suggesting that the Chinese government tend to provide protection and support to SOEs during periods of high perceived macroeconomic risk and uncertainty.

This research contributes to the existing literature on corporate hedging by providing novel and significant insights into the effects and effectiveness of hedging by Chinese firms. It addresses an important research gap in this area and enhances our understanding of the role of state ownership in corporate risk management. Moreover, this study introduces new methodologies in the way it accounts for other types of hedger in the non-hedging sample, that can have implications for future research in this field. Furthermore, the findings of this study are relevant to public policy makers, central banks, investors, and corporate treasurers, as it provides valuable insights on the hedging behaviours of Chinese firms and the impact on the likelihood of firm failure, which can inform policy making and risk management strategies in practice. Additionally, for risk managers in SOEs, perhaps now is the time to acquire a strong understanding of how to effectively use corporate hedging for risk mitigation.

Table 1: Frequency distribution of corporate hedging

Table 1 presents corporate hedging activity among the sample of 501 Chinese non-financial firms listed on the HKSE over the period of 2008 to 2020. The sample has 6330 firm-year observations in total. Panel A demonstrates corporate derivatives activity. In Panel B, all hedgers include derivatives and FC debt users, and FX hedgers include FX derivatives and FC debt users. These data are hand-collected from annual reports.

Panel A. Derivative activity		
Derivative Categories	**Frequency**	**Percentage**
Derivative users	1,824	28.82 %
Non-users	4,506	71.18 %
Total	6,330	100.00%
FX derivatives users	1,490	23.54 %
FX derivatives non-users	4,870	76.46 %
Total	6,330	100.00%
IR derivatives users	855	13.51%
IR derivatives non-users	5,475	86.49 %
Total	6,330	100.00%
CP derivatives users	338	5.34%
CP derivatives non-users	5,992	94.66 %
Total	6,330	100.00%

Panel B. Hedging activity		
Hedging Categories	**Frequency**	**Percentage**
All hedgers	3,594	56.78%
Non-hedgers	2,736	43.22%
Total	6,330	100.00%
FC debt users	3,102	49.00%
FC debt non-users	3,228	51.00%
Total	6,330	100.00%
FX hedger	3,477	54.93%
FX non-hedgers	2,853	45.07 %
Total	6,330	100.00%

Table 2. Summary statistics

Table 2 provides summary information for the variables used in the analysis. The sample period is 2008-2020. Expected default probability is a firm's expected default probability from Capital IQ. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. All control variables (Leverage, Firm size, Liquidity, Profitability, Volatility and Excess return) are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers.

Variable	N	Minimum	Mean	Median	Maximum	Standard Deviation
Expected default probability	5668	0.0052	2.9590	0.9906	100.0000	5.9479
Leverage	5687	0.1326	32.5677	30.1597	168.1197	23.9239
Firm size	6257	-0.5694	8.5083	7.0070	23.9111	4.7748
Liquidity	6337	0.0396	1.7293	0.9891	19.4208	2.4733
Profitability	6193	-39.6476	3.7371	3.4796	32.1000	8.5763
Volatility	6094	0.0000	44.9411	40.0667	143.0034	23.8642
Excess return	6051	-1.0761	0.0376	-0.0175	1.8964	0.4806
SOE	6330	0	0.2463	0	1	0.4309
All hedging	6330	0	0.5678	1	1	0.4954
Derivatives	6330	0	0.2882	0	1	0.4529
FC debt	6330	0	0.4900	0	1	0.4999
FX derivatives	6330	0	0.2354	0	1	0.4243
IR derivatives	6330	0	0.1351	0	1	0.3418
FX hedging	6330	0	0.5493	1	1	0.4976

Table 3. Two sample T-test and Wilcoxon rank sum test

Table 3 presents the results for tests of the equality of means and Wilcoxon Rank Sum Test between hedger (including derivative and FC debt users) and non-hedger. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	Non-hedger		Hedger		T-test Difference	Wilcoxon p-value
Variables	**N**	**Mean**	**N**	**Mean**	**H>NH**	**H>NH**
Expected default probability	2193	4.184	3407	2.09	-2.093***	0.000
Leverage	2174	26.708	3444	36.145	9.437***	0.000
Firm size	2670	7.582	3558	9.229	1.648***	0.000
Liquidity	2702	2.337	3556	1.275	-1.062***	0.278
Profitability	2602	2.587	3523	4.615	2.028***	0.000
Volatility	2502	49.763	3433	41.667	8.095***	0.000
Excess return	2501	0.048	3465	0.032	-0.016	0.944
State ownership	2736	0.217	3594	0.269	0.052***	0.000

Table 4. Impact of corporate hedging on default risk

Panel A in Table 4 presents the OLS results of the impact of each corporate hedging method on the probability of default. As the robustness check, Panel B in Table 4 demonstrates the OLS results with lagged regressors, while Panel C shows the results under beta regression model. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives and FX hedging are dummy variables. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: OLS regression

Variable	Expected default probability					
All hedging	-0.8917***					
	(0.2081)					
Derivatives		-1.1853***				
		(0.2180)				
FC debt			-0.8693***			
			(0.2191)			
FX derivatives				-1.0635***		
				(0.2233)		
IR derivatives					-1.2829***	
					(0.2683)	
FX hedging						-0.8248***
						(0.2074)
Leverage	0.0255***	0.0285***	0.0250***	0.0288***	0.0317***	0.0253***
	(0.0056)	(0.0067)	(0.0059)	(0.0069)	(0.0077)	(0.0056)
Firm size	-0.2605***	-0.2062***	-0.2590***	-0.2092***	-0.1878***	-0.2656***
	(0.0428)	(0.0536)	(0.0450)	(0.0559)	(0.0692)	(0.0434)
Liquidity	-0.1579***	-0.1362**	-0.1766***	-0.1332**	-0.1290**	-0.1573***
	(0.0424)	(0.0549)	(0.0449)	(0.0550)	(0.0581)	(0.0424)
Profitability	-0.2709***	-0.2637***	-0.2815***	-0.2667***	-0.2933***	-0.2724***
	(0.0182)	(0.0216)	(0.0190)	(0.0221)	(0.0253)	(0.0182)
Volatility	0.0687***	0.0748***	0.0695***	0.0754***	0.0779***	0.0685***
	(0.0079)	(0.0103)	(0.0083)	(0.0106)	(0.0117)	(0.0079)
Excess return	-1.3271***	-1.4651***	-1.3358***	-1.5013***	-1.7003***	-1.3166***
	(0.2504)	(0.3249)	(0.2679)	(0.3420)	(0.3959)	(0.2520)
Constant	-0.1747	-0.7483	-0.2966	-0.7283	-1.1173	-0.1833
	(0.6937)	(0.8885)	(0.7459)	(0.9273)	(1.0587)	(0.7004)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4892	3365	4488	3113	2576	4847
R squared	0.414	0.400	0.415	0.400	0.404	0.413

Table 4 (Continued)

Panel B: OLS Regression with lagged regressors						
Variable	**Expected default probability**					
All hedging	-0.7302***					
	(0.2004)					
Derivatives		-1.2226***				
		(0.2237)				
FC debt			-0.7267***			
			(0.2156)			
FX derivatives				-1.0892***		
				(0.2299)		
IR derivatives					-1.4263***	
					(0.2846)	
FX hedging						-0.6609***
						(0.1988)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4470	2856	4004	2606	2106	4411
R squared	0.287	0.359	0.287	0.360	0.356	0.286

Panel C: Beta regression						
Variable	**Expected default probability**					
All hedging	-0.1332***					
	(0.0296)					
Derivatives		-0.2024***				
		(0.0434)				
FC debt			-0.1234***			
			(0.0306)			
FX derivatives				-0.1860***		
				(0.0421)		
IR derivatives					-0.2468***	
					(0.0516)	
FX hedging						-0.1209***
						(0.0290)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4892	3365	4488	3113	2576	4847
Chi-squared	721.7132	516.6095	688.8582	499.1360	460.2016	717.1258

Table 5. Impact of corporate hedging on default risk net of state ownership

Table 5 presents the OLS results of the impact of each corporate hedging method on the probability of default after controlling the effect of state ownership. As the robustness check, Panel B in Table 5 demonstrates the OLS results with lagged regressors, while Panel C shows the results under beta regression model. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: OLS regression						
Variable	**Expected default probability**					
All hedging	-1.1533***					
	(0.2398)					
Derivatives		-1.4308***				
		(0.2530)				
FC debt			-1.1227***			
			(0.2487)			
FX derivatives				-1.3790***		
				(0.2554)		
IR derivatives					-1.5727***	
					(0.3001)	
FX hedging						-1.1053***
						(0.2378)
Leverage	0.0251***	0.0277***	0.0246***	0.0278***	0.0305***	0.0250***
	(0.0056)	(0.0067)	(0.0060)	(0.0069)	(0.0077)	(0.0057)
Firm size	-0.2522***	-0.1840***	-0.2484***	-0.1928***	-0.1581**	-0.2576***
	(0.0464)	(0.0550)	(0.0490)	(0.0577)	(0.0710)	(0.0471)
Liquidity	-0.1526***	-0.1299**	-0.1710***	-0.1270**	-0.1215**	-0.1521***
	(0.0426)	(0.0547)	(0.0453)	(0.0549)	(0.0576)	(0.0426)
Profitability	-0.2711***	-0.2651***	-0.2820***	-0.2679***	-0.2956***	-0.2725***
	(0.0180)	(0.0215)	(0.0188)	(0.0220)	(0.0252)	(0.0180)
Volatility	0.0682***	0.0741***	0.0689***	0.0745***	0.0771***	0.0680***
	(0.0078)	(0.0102)	(0.0083)	(0.0105)	(0.0117)	(0.0078)
Excess return	-1.3246***	-1.4632***	-1.3332***	-1.4947***	-1.6984***	-1.3133***
	(0.2492)	(0.3238)	(0.2668)	(0.3407)	(0.3951)	(0.2508)
SOE	-0.9312***	-0.9892***	-0.9214***	-0.9849***	-1.0139***	-0.9421***
	(0.3157)	(0.3233)	(0.3167)	(0.3148)	(0.3270)	(0.3065)
SOE*hedging	1.0274***	0.8910**	0.9751**	1.1595***	0.9895**	1.0759***
	(0.3639)	(0.3691)	(0.3816)	(0.3794)	(0.4407)	(0.3647)
Constant	0.0530	-0.4941	-0.0647	-0.4579	-0.8825	0.0456
	(0.6868)	(0.8779)	(0.7360)	(0.9194)	(1.0394)	(0.6936)
Observations	4892	3365	4488	3113	2576	4847
R squared	0.416	0.403	0.417	0.403	0.407	0.415
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 5 (Continued)

Panel B: OLS Regression with lagged regressors						
Variable	**Expected default probability**					
All hedging	-0.9425***					
	(0.2309)					
Derivatives		-1.4504***				
		(0.2515)				
FC debt			-0.9306***			
			(0.2444)			
FX derivatives				-1.3778***		
				(0.2558)		
IR derivatives					-1.6975***	
					(0.3071)	
FX hedging						-0.8933***
						(0.2290)
SOE	-0.9007***	-0.9236***	-0.8936***	-0.9053***	-0.9459***	-0.9147***
	(0.3275)	(0.3265)	(0.3339)	(0.3143)	(0.3227)	(0.3147)
SOE*hedging	0.7653**	0.7827**	0.7180*	1.0258***	0.9088**	0.8185**
	(0.3724)	(0.3731)	(0.3911)	(0.3719)	(0.4354)	(0.3682)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4470	2856	4004	2606	2106	4411
R squared	0.288	0.362	0.289	0.363	0.359	0.288

Panel C: Beta regression						
Variable	**Expected default probability**					
All hedging	-0.1716***					
	(0.0315)					
Derivatives		-0.2353***				
		(0.0431)				
FC debt			-0.1610***			
			(0.0325)			
FX derivatives				-0.2303***		
				(0.0426)		
IR derivatives					-0.2991***	
					(0.0549)	
FX hedging						-0.1608***
						(0.0313)
SOE	-0.1368***	-0.1171***	-0.1334***	-0.1103***	-0.1044**	-0.1357***
	(0.0437)	(0.0423)	(0.0428)	(0.0407)	(0.0414)	(0.0420)
SOE*hedging	0.1622***	0.1259**	0.1565***	0.1728***	0.2369***	0.1639***
	(0.0531)	(0.0505)	(0.0528)	(0.0507)	(0.0588)	(0.0515)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4892	3365	4488	3113	2576	4847
Chi-squared	731.1949	523.3118	697.6574	505.5967	470.9283	726.7238

Table 6. Impact of corporate hedging types on default risk

Table 6 presents the results of OLS, lag and beta regressions of the impact of corporate hedging types on the probability of default. Dependent variable is a firm's expected default probability. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Expected default probability		
	OLS	**Lag**	**Beta**
FX derivatives only (1)	-0.5556**	-0.5391**	-0.0958**
	(0.2421)	(0.2433)	(0.0417)
IR derivatives only (2)	-1.8091***	-1.6732***	-0.3231***
	(0.3203)	(0.5010)	(0.0783)
FC debt only (3)	-0.6872***	-0.3748	-0.0591*
	(0.2310)	(0.2375)	(0.0315)
FX&FC (4)	-0.9780***	-0.9740***	-0.1424***
	(0.2490)	(0.2377)	(0.0377)
IR&FC (5)	-1.4560***	-1.4344***	-0.2677***
	(0.3864)	(0.3509)	(0.0534)
FX&IR (6)	-1.1872***	-1.3800***	-0.2061***
	(0.3343)	(0.3103)	(0.0665)
FX&IR&FC (7)	-1.0906***	-1.1169***	-0.3034***
	(0.2541)	(0.2506)	(0.0459)
Leverage	0.0260***	0.0241***	0.0040***
	(0.0057)	(0.0054)	(0.0011)
Firm size	-0.2583***	-0.2778***	-0.0744***
	(0.0430)	(0.0586)	(0.0085)
Liquidity	-0.1547***	-0.1566***	-0.0647***
	(0.0425)	(0.0476)	(0.0122)
Profitability	-0.2721***	-0.2206***	-0.0405***
	(0.0181)	(0.0177)	(0.0039)
Volatility	0.0676***	0.0608***	0.0126***
	(0.0080)	(0.0087)	(0.0018)
Excess return	-1.3139***	-0.9209***	-0.2775***
	(0.2517)	(0.2529)	(0.0481)
Constant	-0.0779	-0.1266	3.2327***
	(0.7039)	(0.7840)	(0.2343)
Observations	4892	4470	4892
R squared	0.415	0.289	
Chi-squared			721.2987
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Test (1) = (2) (p-value)	0.0003	0.0261	0.0057
Test (1) = (3) (p-value)	0.5920	0.5318	0.4018
Test (2) = (3) (p-value)	0.0002	0.0089	0.0007
Test (2) = (4) (p-value)	0.0070	0.1563	0.0164

Table 7. Regression results using Heckman's two-step approach

Panel A in Table 7 presents the results of the impact of each corporate hedging method on the probability of default with Heckman's two-step approach, while Panel B demonstrates the results after controlling the effect of state ownership. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The inverse Mills ratio (Lambda) is calculated based on the first-stage regression. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The impact of corporate hedging on the default risk with Heckman's two-step approach

Variable	Expected default probability					
All hedging	-0.8743***					
	(0.2184)					
Derivatives		-1.1667***				
		(0.2272)				
FC debt			-0.8557***			
			(0.2297)			
FX derivatives				-1.0495***		
				(0.2318)		
IR derivatives					-1.2760***	
					(0.2793)	
FX hedging						-0.8095***
						(0.2173)
Lambda	-0.0446	0.0578	-0.0762	0.0974	0.0082	-0.0564
	(0.0568)	(0.0510)	(0.0668)	(0.0673)	(0.1070)	(0.0599)
Leverage	0.0257***	0.0266***	0.0256***	0.0265***	0.0297***	0.0257***
	(0.0061)	(0.0069)	(0.0065)	(0.0071)	(0.0079)	(0.0062)
Firm size	-0.2529***	-0.2229***	-0.2447***	-0.2302***	-0.1879**	-0.2557***
	(0.0493)	(0.0609)	(0.0510)	(0.0637)	(0.0755)	(0.0494)
Liquidity	-0.1635***	-0.1460**	-0.1790***	-0.1448**	-0.1391**	-0.1621***
	(0.0451)	(0.0601)	(0.0475)	(0.0604)	(0.0635)	(0.0451)
Profitability	-0.2719***	-0.2662***	-0.2834***	-0.2696***	-0.2971***	-0.2734***
	(0.0187)	(0.0221)	(0.0195)	(0.0225)	(0.0259)	(0.0187)
Volatility	0.0647***	0.0698***	0.0649***	0.0702***	0.0724***	0.0645***
	(0.0079)	(0.0106)	(0.0085)	(0.0109)	(0.0123)	(0.0080)
Excess return	-1.2519***	-1.3716***	-1.2584***	-1.4020***	-1.6047***	-1.2412***
	(0.2453)	(0.3225)	(0.2634)	(0.3402)	(0.3990)	(0.2467)
Constant	0.2353	-0.3204	0.1876	-0.3142	-0.6139	0.2379
	(0.6934)	(0.8810)	(0.7444)	(0.9219)	(1.0614)	(0.7004)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	3174	4279	2934	2414	4621
R squared	0.404	0.387	0.406	0.387	0.390	0.403

Table 7 (Continued)

Panel B: The impact of corporate hedging on the default risk net of state ownership with Heckman's two-step approach

Variable	Expected default probability					
All hedging	-1.1164***					
	(0.2510)					
Derivatives		-1.3812***				
		(0.2642)				
FC debt			-1.0914***			
			(0.2603)			
FX derivatives				-1.3314***		
				(0.2661)		
IR derivatives					-1.5477***	
					(0.3173)	
FX hedging						-1.0731***
						(0.2490)
SOE	-0.8527**	-0.8916**	-0.8491**	-0.8892***	-0.9373***	-0.8737***
	(0.3394)	(0.3476)	(0.3417)	(0.3381)	(0.3537)	(0.3291)
SOE*hedging	0.9629**	0.7937**	0.9173**	1.0473***	0.9563**	1.0188***
	(0.3811)	(0.3887)	(0.3981)	(0.3986)	(0.4586)	(0.3798)
Lambda	-0.0515	0.0516	-0.0851	0.0834	-0.0213	-0.0655
	(0.0564)	(0.0512)	(0.0665)	(0.0666)	(0.1059)	(0.0595)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	3174	4279	2934	2414	4621
R squared	0.406	0.389	0.407	0.389	0.393	0.405

Table 8. Regression results using two-stage least squares (2SLS) approach

Panel A in Table 8 presents the results of the impact of each corporate hedging method on the probability of default with 2SLS approach, while Panel B demonstrates the results after controlling the effect of state ownership. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The impact of corporate hedging on the default risk with 2SLS approach

Variable	Expected default probability					
All hedging	-2.5085**					
	(1.0093)					
Derivatives		-2.1067**				
		(0.8415)				
FC debt			-2.5031**			
			(1.0565)			
FX derivatives				-2.1092**		
				(0.9569)		
IR derivatives					-2.8176***	
					(1.0626)	
FX hedging						-2.4950**
						(0.9994)
Leverage	0.0312***	0.0302***	0.0312***	0.0302***	0.0364***	0.0314***
	(0.0066)	(0.0072)	(0.0070)	(0.0075)	(0.0084)	(0.0067)
Firm size	-0.1908***	-0.1606**	-0.1851***	-0.1562**	-0.1208	-0.1921***
	(0.0598)	(0.0638)	(0.0646)	(0.0677)	(0.0857)	(0.0604)
Liquidity	-0.1885***	-0.1595**	-0.2056***	-0.1528**	-0.1377**	-0.1839***
	(0.0512)	(0.0634)	(0.0535)	(0.0628)	(0.0640)	(0.0500)
Profitability	-0.2638***	-0.2601***	-0.2768***	-0.2636***	-0.2954***	-0.2660***
	(0.0187)	(0.0222)	(0.0196)	(0.0228)	(0.0261)	(0.0187)
Volatility	0.0611***	0.0668***	0.0614***	0.0669***	0.0672***	0.0606***
	(0.0075)	(0.0100)	(0.0080)	(0.0104)	(0.0114)	(0.0075)
Excess return	-1.2366***	-1.3467***	-1.2493***	-1.3765***	-1.5504***	-1.2285***
	(0.2434)	(0.3136)	(0.2623)	(0.3307)	(0.3858)	(0.2453)
Constant	1.0221	0.1531	0.8916	0.1912	0.0571	1.0169
	(0.7835)	(0.8839)	(0.8128)	(0.9375)	(1.0488)	(0.7811)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	3174	4279	2934	2414	4621
R squared	0.385	0.381	0.387	0.380	0.380	0.383
Sanderson-Windmeijer F statistic	24.11***	42.04***	20.64***	39.26***	21.99***	24.28***
Hansen J statistic (p-value)	0.9792	0.8615	0.9592	0.6724	0.7619	0.9893
Endogeneity test (p-value)	0.0748	0.2226	0.0861	0.2296	0.1296	0.0631

Table 8 (Continued)

Panel B: The impact of corporate hedging on the default risk net of state ownership with 2SLS approach						
Variable	**Expected default probability**					
All hedging	-3.0443***					
	(1.1762)					
Derivatives		-2.5564***				
		(0.9563)				
FC debt			-3.0027**			
			(1.2276)			
FX derivatives				-2.5349**		
				(1.0416)		
IR derivatives					-3.5012***	
					(1.3124)	
FX hedging						-3.0776***
						(1.1789)
SOE	-2.0525**	-1.4486**	-1.9812**	-1.4094**	-1.5647***	-2.1068***
	(0.8057)	(0.5890)	(0.8055)	(0.5794)	(0.5801)	(0.7983)
SOE*hedging	2.6230**	1.7727**	2.5393**	2.0619**	2.4294**	2.7524**
	(1.0846)	(0.8626)	(1.1226)	(0.9430)	(1.1296)	(1.0934)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	3174	4279	2934	2414	4621
R squared	0.385	0.382	0.387	0.382	0.379	0.382
Sanderson-Windmeijer F statistic	18.36***	32.07***	16.39***	29.24***	15.29***	18.27***
Hansen J statistic (p-value)	0.8584	0.7519	0.7876	0.5557	0.6391	0.8196
Endogeneity test (p-value)	0.0681	0.1748	0.0842	0.2047	0.1104	0.0583

Table 9. Regression results excluding firms listed on the Chinese A-share markets

Panel A in Table 9 presents the results of the impact of each corporate hedging method on the probability of default without firms listed on the Chinese A-share markets, while Panel B shows the results after controlling the effect of state ownership. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: The impact of corporate hedging on the default risk without firms listed on the A-share markets						
Variable	**Expected default probability**					
All hedging	-0.9527***					
	(0.2115)					
Derivatives		-1.2433***				
		(0.2246)				
FC debt			-0.9260***			
			(0.2223)			
FX derivatives				-1.1295***		
				(0.2289)		
IR derivatives					-1.3464***	
					(0.2809)	
FX hedging						-0.8786***
						(0.2107)
Leverage	0.0275***	0.0290***	0.0270***	0.0289***	0.0314***	0.0273***
	(0.0057)	(0.0068)	(0.0061)	(0.0070)	(0.0079)	(0.0057)
Firm size	-0.2607***	-0.2023***	-0.2578***	-0.2045***	-0.1701**	-0.2662***
	(0.0491)	(0.0608)	(0.0517)	(0.0633)	(0.0733)	(0.0498)
Liquidity	-0.1551***	-0.1508***	-0.1732***	-0.1474***	-0.1334**	-0.1546***
	(0.0415)	(0.0560)	(0.0441)	(0.0560)	(0.0587)	(0.0414)
Profitability	-0.2679***	-0.2658***	-0.2783***	-0.2687***	-0.2956***	-0.2694***
	(0.0182)	(0.0222)	(0.0190)	(0.0227)	(0.0259)	(0.0183)
Volatility	0.0684***	0.0741***	0.0692***	0.0749***	0.0775***	0.0683***
	(0.0081)	(0.0105)	(0.0086)	(0.0108)	(0.0120)	(0.0081)
Excess return	-1.3918***	-1.4757***	-1.4090***	-1.5136***	-1.7043***	-1.3832***
	(0.2606)	(0.3382)	(0.2787)	(0.3563)	(0.4065)	(0.2623)
Constant	-0.1286	-0.5789	-0.2820	-0.4996	-1.1053	-0.1419
	(0.7095)	(0.9087)	(0.7659)	(0.9427)	(1.0746)	(0.7174)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4481	3114	4106	2888	2438	4440
R squared	0.416	0.401	0.417	0.400	0.404	0.415

Table 9 (Continued)

Panel B: The impact of corporate hedging on the default risk net of state ownership without firms listed on the A-share markets						
Variable	**Expected default probability**					
All hedging	-1.1588***					
	(0.2424)					
Derivatives		-1.4302***				
		(0.2586)				
FC debt			-1.1326***			
			(0.2519)			
FX derivatives				-1.3903***		
				(0.2622)		
IR derivatives					-1.5823***	
					(0.3051)	
FX hedging						-1.1112***
						(0.2406)
SOE	-0.8271**	-0.8587**	-0.8189**	-0.8913***	-0.9467***	-0.8652***
	(0.3403)	(0.3493)	(0.3424)	(0.3410)	(0.3454)	(0.3308)
SOE*hedging	0.9575**	0.8318**	0.9612**	1.2243***	1.0430**	1.0634***
	(0.3992)	(0.4205)	(0.4284)	(0.4437)	(0.5210)	(0.4042)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4481	3114	4106	2888	2438	4440
R squared	0.417	0.403	0.418	0.403	0.407	0.417

Table 10. Regression results across firm size

Table 10 presents the results of the impact of each corporate hedging method on the probability of default after controlling the effect of state ownership across firm size. Dependent variable is a firm's expected default probability. Hedging Method_Q1 to Hedging Method_Q4 are dummies equaling to 1 if the firms belong to the corresponding firm size quartile of companies that conduct hedging and 0 otherwise in each year. Q1 includes the smallest 25 percent firms, while Q4 includes the largest 25% firms. Hedging Method_Q1*SOE to Hedging Method_Q4*SOE are interaction variables between Hedging Method_Q1 to Hedging Method_Q4 and SOE. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Expected default probability					
	All hedging	Derivatives	FC debt	FX derivatives	IR derivatives	FX hedging
Hedging Method_Q1	-0.9230**	-1.8075***	-0.8469*	-1.6475***	-1.8652***	-0.8390**
	(0.3955)	(0.4890)	(0.4320)	(0.4968)	(0.5357)	(0.3985)
Hedging Method_Q2	-0.8705***	-1.0580***	-0.7305**	-1.0137***	-0.6544	-0.8074***
	(0.2865)	(0.3756)	(0.3113)	(0.3797)	(0.5961)	(0.2857)
Hedging Method_Q3	-1.5438***	-1.4750***	-1.5700***	-1.4547***	-1.7571***	-1.5128***
	(0.2717)	(0.2903)	(0.2813)	(0.2942)	(0.3340)	(0.2706)
Hedging Method_Q4	-1.3965***	-1.3422***	-1.4092***	-1.3215***	-1.5350***	-1.3702***
	(0.3297)	(0.3708)	(0.3406)	(0.3746)	(0.4013)	(0.3271)
SOE	-0.9942***	-0.9673***	-0.9927***	-0.9731***	-1.0116***	-1.0136***
	(0.3212)	(0.3302)	(0.3222)	(0.3230)	(0.3345)	(0.3129)
Hedging Method_Q1*SOE	2.0535	-0.7045	2.0974	-0.6481	-0.3556	1.9999
	(1.6425)	(0.9628)	(1.8269)	(1.0340)	(0.8184)	(1.6407)
Hedging Method_Q2*SOE	2.2728**	0.1781	2.6915**	0.5354	-1.1029	2.5780**
	(1.1238)	(0.8021)	(1.3052)	(0.9049)	(0.8787)	(1.1903)
Hedging Method_Q3*SOE	1.0087**	0.9481*	0.8258**	1.5195***	1.2647	1.0922***
	(0.3919)	(0.5092)	(0.4022)	(0.5708)	(0.8229)	(0.3944)
Hedging Method_Q4*SOE	0.8132**	0.9999**	0.7667**	1.1773***	1.0968**	0.8381**
	(0.3481)	(0.3935)	(0.3545)	(0.4038)	(0.4687)	(0.3428)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4892	3365	4488	3113	2576	4847
R squared	0.419	0.404	0.422	0.404	0.408	0.419

Table 11. The annual variation in the moderating effect of state ownership

Table 11 presents the annual variation in the moderating impact of state ownership on the risk-reducing effect of all hedging, derivatives and FC debt use from 2008 to 2020, respectively. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. This interaction variable reflects the moderating effect of state ownership, decomposed on an annual basis. Control variables are included. Specifically, leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	**Expected default probability**		
All hedging	-1.2189***		
	(0.4065)		
Derivatives		-1.2699***	
		(0.3686)	
FC debt			-1.2217***
			(0.4025)
State ownership	-1.3130***	-1.3703***	-1.2987***
	(0.4872)	(0.4502)	(0.4722)
SOE*hedging (by year)			
2008	1.8997**	2.0067*	2.1389**
	(0.8199)	(1.1322)	(0.8574)
2009	1.5949**	1.4585**	1.6914**
	(0.6886)	(0.6859)	(0.6994)
2010	1.1538**	1.3285**	0.9870*
	(0.5610)	(0.5946)	(0.5447)
2011	1.4025**	1.2088**	1.2903**
	(0.5566)	(0.5738)	(0.5396)
2012	1.3703**	1.2899**	1.3028**
	(0.5693)	(0.5650)	(0.5593)
2013	1.2946**	1.1369*	1.1650**
	(0.5630)	(0.6082)	(0.5451)
2014	1.3691**	1.4134**	1.2691**
	(0.5707)	(0.5844)	(0.5565)
2015	1.1614**	0.9602	0.9940*
	(0.5795)	(0.5963)	(0.5705)
2016	1.2119**	1.2077**	1.0635*
	(0.5700)	(0.5810)	(0.5679)
2017	1.5372**	1.8323***	1.5049**
	(0.6056)	(0.6162)	(0.5973)
2018	0.9437	1.0637	1.0011
	(0.6464)	(0.7445)	(0.6958)
2019	1.2047**	1.6028***	1.1243**
	(0.5638)	(0.5934)	(0.5688)
2020	0.6599	0.9105	0.6127
	(0.5075)	(0.6429)	(0.5754)
Constant	-0.8019	-1.3681	-0.9680
	(0.9743)	(1.2536)	(1.0748)
Control variables	Yes	Yes	Yes
Observations	2763	1935	2542
R squared	0.272	0.266	0.271
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes

Table 12. The variation in the moderating effect of state ownership under EPU

Table 12 presents the variation in the moderating impact of state ownership under high and low EPU. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. These interaction variables reflect the moderating effect of state ownership. The data related to EPU is sourced from Davis et al. (2019). Control variables are included. Specifically, leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	**Expected default probability**											
	Low EPU	High EPU	Low EPU	High EPU	Low EPU	High EPU	Low EPU	High EPU	Low EPU	High EPU	Low EPU	High EPU
All hedging	-1.1044***	-1.1973***										
	(0.4103)	(0.3550)										
Derivatives			-1.2217***	-1.4556***								
			(0.4083)	(0.3485)								
FC debt					-1.1290***	-1.1386***						
					(0.4260)	(0.3646)						
FX derivatives							-1.0701***	-1.4762***				
							(0.4111)	(0.3477)				
IR derivatives									-1.8048***	-1.3246***		
									(0.4969)	(0.3826)		
FX hedging											-1.0749***	-1.1737***
											(0.4087)	(0.3505)
SOE	-0.7854	-1.6191***	-0.7593	-1.6170***	-0.7895	-1.6236***	-0.7707	-1.6669***	-0.8691	-1.6732***	-0.8330	-1.6450***
	(0.6228)	(0.4231)	(0.6474)	(0.4435)	(0.6232)	(0.4323)	(0.6214)	(0.4388)	(0.6430)	(0.4725)	(0.6015)	(0.4179)
SOE*hedging	1.0547*	1.3745***	0.5316	1.7390***	1.0042	1.2293**	0.8145	2.1782***	0.9034	1.6577***	1.1313*	1.4855***
	(0.6163)	(0.4655)	(0.6928)	(0.5046)	(0.6227)	(0.4852)	(0.6732)	(0.5181)	(0.8406)	(0.5792)	(0.5958)	(0.4643)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1509	1619	969	1203	1402	1451	898	1133	719	943	1498	1598
R squared	0.495	0.431	0.469	0.414	0.503	0.430	0.470	0.415	0.485	0.415	0.496	0.430
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Figure 1 The annual variation in the median expected default probability

Figure 1 depicts the annual variation in median expected default probabilities, highlighting differences between hedgers and non-hedgers.

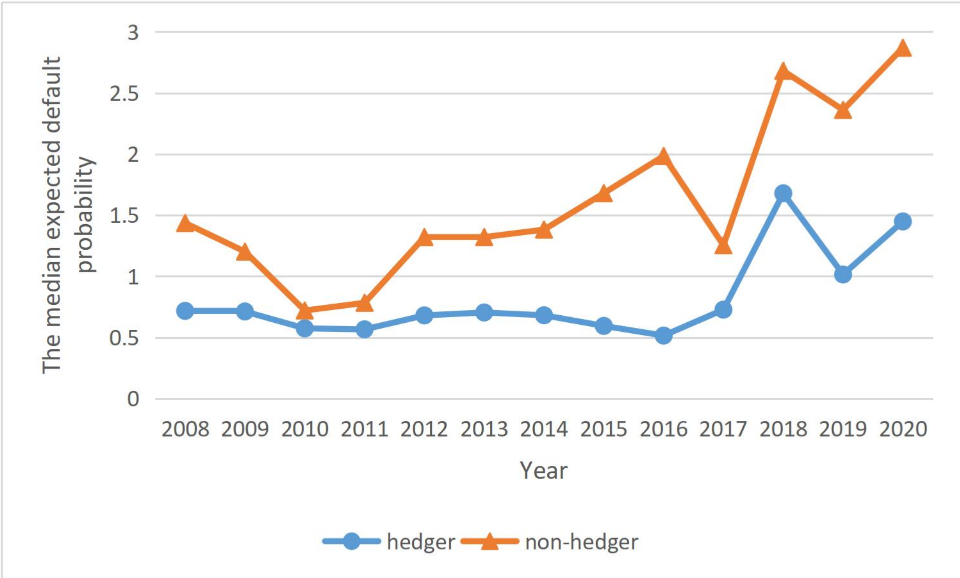
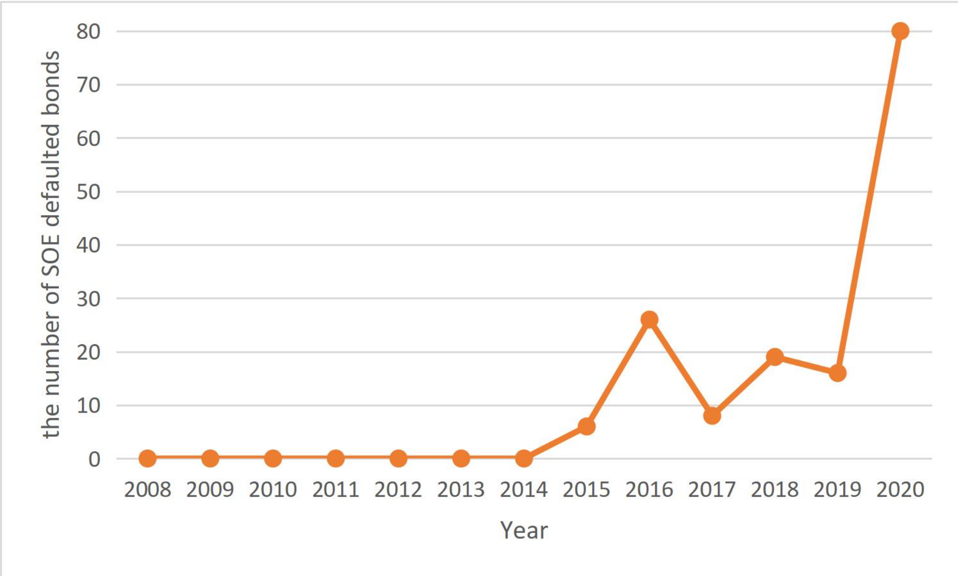


Figure 2 The annual variation in the number and value of SOE defaulted bonds

These figures demonstrate the annual variation in the number and value of SOE defaulted bonds. This data is sourced from Huang (2021).

A. The annual variation in the number of SOE defaulted bonds



B. The annual variation in the value of SOE defaulted bonds (RMBbn)

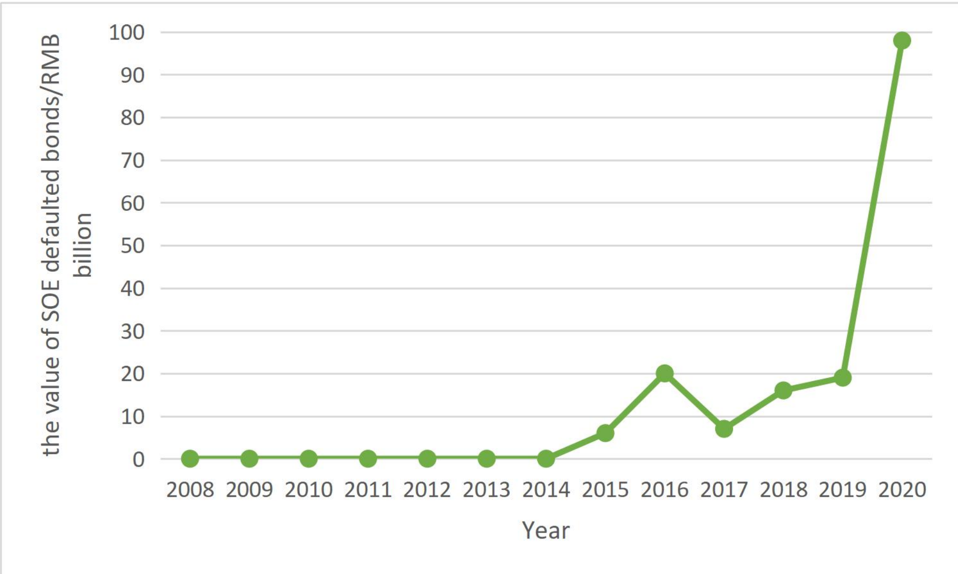
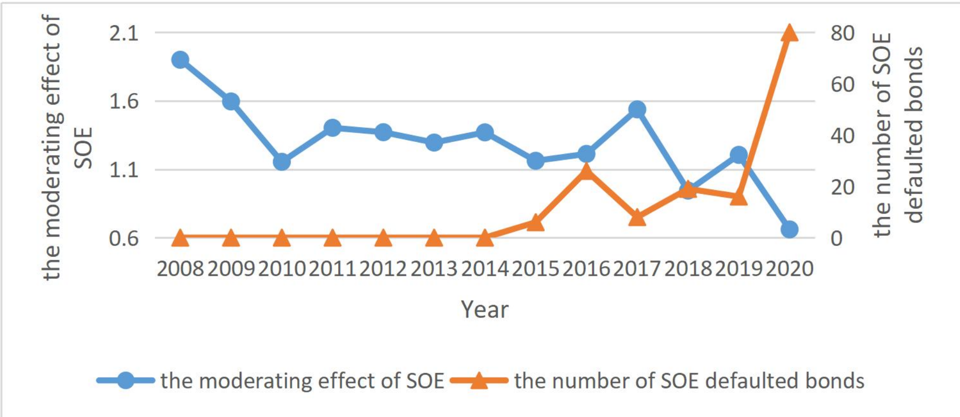


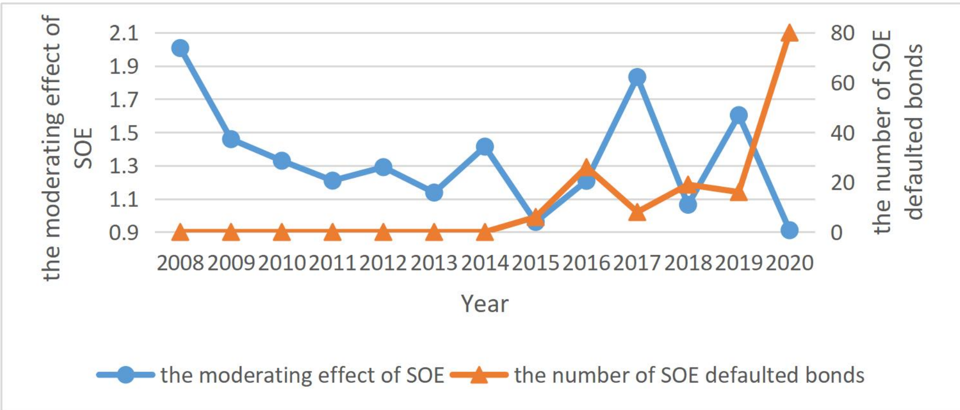
Figure 3 The annual variation in the moderating effect of state ownership

These figures illustrate the annual variation in the moderating impact of state ownership on the risk-reducing effect across different hedging activities. Chart A depicts the annual variation in the moderating effect of state ownership on the risk-reducing impact of all hedging. Chart B illustrates the annual variation in the moderating effect of state ownership on the risk-reducing impact of derivatives. Chart C showcases the annual variation in the moderating effect of state ownership on the risk-reducing impact of foreign debt. The annual fluctuation in the number of SOE defaulted bonds has been incorporated as a reference. The data regarding the number of SOE defaulted bonds is sourced from Huang (2021).

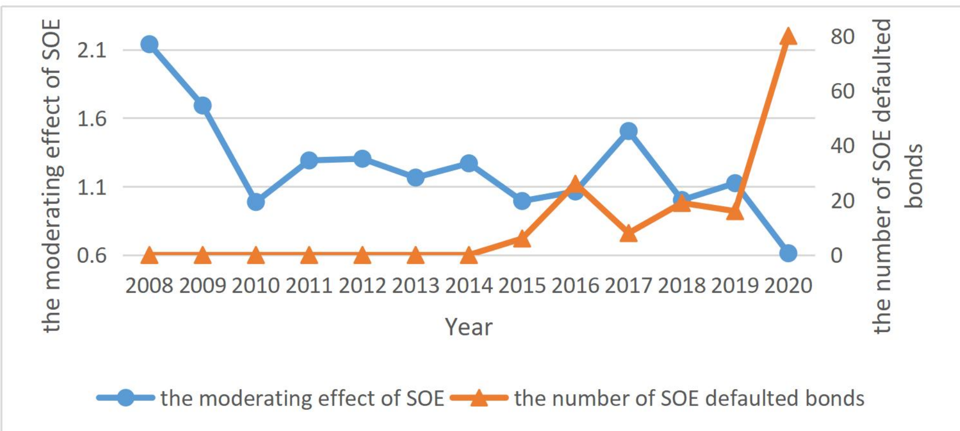
A. All hedging



B. Derivatives



C. Foreign debt



Online Appendix A

Table A-1. Empirical literature on the relationship between corporate hedging and Chinese firms' risk

Table A-1 shows a summary of empirical literature on the relationship between corporate hedging and Chinese firms' risk. It provides the authors, research periods, samples, hedging instruments, risk measurements and main findings.

Author(s)	**Period**	**Sample**	**Hedging Instrument**	**Risk Measurement**	**Main Findings**
Xie and Yang (2017)	2007-2015	221 non-financial MNCs	FX derivatives	FX risk exposure	FX derivatives use can alleviate FX risk exposure.
Shao et al. (2019)	2001-2014	269 non-financial firms	CP futures	The volatility of cost and revenue	CP futures use can significantly reduce firms' CP risk exposures for hedgers while have no economic impact for speculators.
Zhang et al. (2020)	2013-2017	264 non-financial MNCs	FX derivatives	FX risk exposure	The usage of FX derivatives can effectively reduce FX risk exposure.
Guo et al. (2021)	2007-2017	3476 non-financial firms	Derivatives, FX, IR and CP	Total risk, market risk, FX, IR and CP risk	Derivatives use has a significantly reducing effect on firms' risk, but this effect is less pronounced in SOEs than in non-SOEs, and these two conclusions are not
Cheng and Cheung (2021)	2008-2019	All non-financial firms	Derivatives	The volatility of cash flow and return on asset	Derivatives use has a significantly reducing effect on firms' risk, but this effect is weaker in firms with high-ability managers.

Table A-2. Variable description and the predicted sign

Table A-2 demonstrates the explanatory variables for the analysis. It presents the description and the predicted sign of the coefficient estimate of each variable.

Variables	Description	Predicted Sign
All hedger	Indicator variable with value 1 if a firm uses derivatives or FC debt, 0 otherwise.	−
Derivatives user	Indicator variable with value 1 if a firm uses derivatives, 0 otherwise.	−
FC debt user	Indicator variable with value 1 if a firm uses FC debt, 0 otherwise.	−
FX derivatives user	Indicator variable with value 1 if a firm uses FX derivatives, 0 otherwise.	−
IR derivatives user	Indicator variable with value 1 if a firm uses IR derivatives, 0 otherwise.	−
FX hedger	Indicator variable with value 1 if a firm uses FX derivatives or FC debt, 0 otherwise.	−
SOE	Indicator variable with value 1 if a firm is , 0 otherwise.	−
SOE*hedging	Interaction variable between SOE and each corporate hedging method.	+
Leverage	Total debt to total capital.	+
Firm size	Natural log of total sales.	−
Liquidity	Quick ratio: total current assets minus inventories over total current liabilities.	−
Profitability	Return on invested capital.	−
Volatility	The standard deviation of each firm's daily stock return over the entire fiscal year.	+
Excess return	Annual return minus the value weighted Hang Seng Index annual return.	−

Table A-3. Method to deal with bias of hedging activities

Table A-3 presents the methodology to deal with bias when focusing on derivatives, FC debt, FX derivatives, IR derivatives and FX hedging, respectively.

Classification	Method to deal with bias
All hedger	No bias
Derivatives user	Drop FC debt users among non-derivatives users
FC debt user	Drop derivatives users among non-FC debt users
FX derivatives user	Drop FC debt users or IR derivatives users among non-FX derivatives users
IR derivatives user	Drop FC debt users or FX derivatives users among non-IR derivatives users
FX hedger	Drop IR derivatives users among non-FX hedgers

Table A-4. Correlation matrix

Table A-4 reports Pearson correlation coefficients for the variables used in the analysis. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Expected default probability	1	1													
Leverage	2	0.1986***	1												
Firm size	3	-0.1161***	0.1137***	1											
Liquidity	4	0.0019	-0.3706***	-0.2020**	1										
Profitability	5	-0.4735***	-0.2011***	0.0265**	-0.0263**	1									
Volatility	6	0.3471***	0.0979***	-0.2370***	0.1025***	-0.2633***	1								
Excess return	7	-0.0729***	-0.0330**	-0.1452***	0.0322**	0.1214***	0.2144***	1							
SOE	8	-0.0786***	0.0247*	0.1395***	-0.0351***	0.0162	-0.0706***	-0.0156	1						
All hedging	9	-0.1806***	0.1937***	0.1706***	-0.2120***	0.1182***	-0.1703***	-0.0164	0.0598***	1					
Derivatives	10	-0.1756***	0.0589***	0.1676***	-0.1348***	0.1147***	-0.1685***	0.0004	0.0452***	0.5551***	1				
FC debt	11	-0.1374***	0.2096***	0.1297***	-0.1938***	0.0731***	-0.1353***	-0.0176	0.0528***	0.8553***	0.3057***	1			
FX derivatives	12	-0.1566***	0.0292**	0.1651***	-0.1040***	0.1099***	-0.164***	-0.0031	0.0285**	0.4841***	0.8721***	0.2867***	1		
IR derivatives	13	-0.1223***	0.1094***	0.1166***	-0.0928***	0.0294**	-0.1538***	0.0018	0.0005	0.3448***	0.6211***	0.2469***	0.4627***	1	
FX hedging	14	-0.1694***	0.1929***	0.1642***	-0.2007***	0.1122***	-0.1675***	-0.0196	0.0513***	0.9632***	0.4943***	0.8880***	0.5026***	0.3013***	1

Table A-5. Regression results of first stage using Heckman's two-step approach

Table A-5 delineates the first-stage outcomes derived from Heckman's two-step approach in examining the determinants of each corporate hedging method. The dependent variables are all hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging, respectively. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. FX exposure is the foreign sales percentage. Growth opportunity is the capital expenditure over total sales. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	**All hedging**	**Derivatives**	**FC debt**	**FX derivatives**	**IR derivatives**	**FX hedging**
Leverage	0.0159***	0.0127***	0.0175***	0.0118**	0.0212***	0.0165***
	(0.0037)	(0.0048)	(0.0039)	(0.0049)	(0.0057)	(0.0037)
Firm size	0.3058***	0.3610***	0.3125***	0.3638***	0.3676***	0.3055***
	(0.0460)	(0.0610)	(0.0487)	(0.0644)	(0.0736)	(0.0463)
Liquidity	-0.0502	-0.1159**	-0.0488	-0.0719	-0.0320	-0.0366
	(0.0396)	(0.0570)	(0.0436)	(0.0551)	(0.0658)	(0.0382)
Profitability	0.0252***	0.0425***	0.0197**	0.0435***	0.0335***	0.0239***
	(0.0081)	(0.0100)	(0.0084)	(0.0101)	(0.0121)	(0.0080)
FX exposure	1.9923***	2.8731***	1.9579***	2.8514***	2.8342***	2.0097***
	(0.2989)	(0.3459)	(0.3127)	(0.3556)	(0.3969)	(0.2984)
Growth opportunity	-0.0009	-0.0094**	0.0002	-0.0134**	-0.0014	-0.0007
	(0.0033)	(0.0046)	(0.0034)	(0.0054)	(0.0053)	(0.0033)
Constant	-1.2029**	-1.8667***	-1.4068**	-2.1511***	-2.9716***	-1.2817**
	(0.5693)	(0.6731)	(0.5907)	(0.7402)	(0.7785)	(0.5814)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5173	3555	4770	3308	2742	5135
R squared	0.176	0.246	0.185	0.244	0.277	0.174

Table A-6. Regression results of first stage using two-stage least squares (2SLS) approach

Panel A in Table A-6 presents the first-stage results of the impact of each corporate hedging method on the probability of default with 2SLS approach, while Panel B demonstrates the results of first stage after controlling the effect of state ownership. Dependent variable is a firm's expected default probability. All hedging, derivatives, FC debt, FX derivatives, IR derivatives, FX hedging and SOE are dummy variables. SOE*hedging are interaction variables between each corporate hedging method and SOE. FX exposure is the foreign sales percentage. Growth opportunity is the capital expenditure over total sales. Leverage is the ratio of total debt to total capital. Firm size is the natural log of total sales. Liquidity is total current assets minus inventories over total current liabilities. Profitability is the return on invested capital. Volatility is the standard deviation of each company's daily stock return over the entire fiscal year. Excess return is the annual return minus the value weighted Hang Seng Index annual return. The regressions include industry and year dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: First stage of 2SLS approach

Variable	All hedging	Derivatives	FC debt	FX derivatives	IR derivatives	FX hedging
FX exposure	0.3399***	0.5067***	0.3448***	0.5023***	0.4505***	0.3464***
	(0.0494)	(0.0575)	(0.0538)	(0.0604)	(0.0685)	(0.0501)
Growth opportunity	-0.0004	-0.0018**	-0.0002	-0.0023***	-0.0004	-0.0004
	(0.0006)	(0.0008)	(0.0007)	(0.0008)	(0.0008)	(0.0007)
Leverage	0.0037***	0.0033***	0.0040***	0.0029***	0.0041***	0.0038***
	(0.0007)	(0.0009)	(0.0008)	(0.0009)	(0.0009)	(0.0007)
Firm size	0.0452***	0.0485***	0.0473***	0.0491***	0.0399***	0.0461***
	(0.0067)	(0.0085)	(0.0072)	(0.0090)	(0.0096)	(0.0069)
Liquidity	-0.0148*	-0.0183**	-0.0138	-0.0121*	-0.0026	-0.0121
	(0.0079)	(0.0072)	(0.0084)	(0.0068)	(0.0060)	(0.0077)
Profitability	0.0060***	0.0078***	0.0048***	0.0068***	0.0032*	0.0053***
	(0.0017)	(0.0019)	(0.0018)	(0.0019)	(0.0018)	(0.0017)
Volatility	-0.0021***	-0.0030***	-0.0020***	-0.0029***	-0.0031***	-0.0022***
	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0007)	(0.0006)
Excess return	0.0054	0.0169	0.0017	0.0158	0.0253	0.0037
	(0.0148)	(0.0160)	(0.0157)	(0.0168)	(0.0154)	(0.0152)
Constant	0.4573***	0.4455***	0.4049***	0.3938***	0.3798***	0.4402
	(0.0899)	(0.1145)	(0.0970)	(0.1307)	(0.1251)	(0.0933)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	3174	4279	2934	2414	4621
R squared	0.212	0.298	0.226	0.289	0.312	0.211

Panel B: First stage of 2SLS approach after controlling the effect of state ownership

Variable	All hedging	Derivatives	FC debt	FX derivatives	IR derivatives	FX hedging
FX exposure	0.2893***	0.4442***	0.2937***	0.4431***	0.3735***	0.2905***
	(0.0478)	(0.0566)	(0.0518)	(0.0595)	(0.0676)	(0.0482)
Growth opportunity	0.0001	-0.0010*	0.0004	-0.0011*	0.0000	0.0003
	(0.0005)	(0.0006)	(0.0005)	(0.0006)	(0.0006)	(0.0005)
SOE	-0.5925***	-0.4125***	-0.5656***	-0.3710***	-0.2900***	-0.5870***
	(0.0265)	(0.0317)	(0.0275)	(0.0318)	(0.0305)	(0.0262)
SOE*hedging	0.8387***	0.7762***	0.8253***	0.7849***	0.6989***	0.8406***
	(0.0261)	(0.0350)	(0.0278)	(0.0371)	(0.0504)	(0.0258)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4659	3174	4279	2934	2414	4621
R squared	0.371	0.432	0.380	0.430	0.414	0.375

Figure A-1 The annual variation in the mean expected default probability

Figure A-1 depicts the annual variation in mean expected default probabilities with 90% confidence intervals, highlighting the differences between hedgers and non-hedgers.

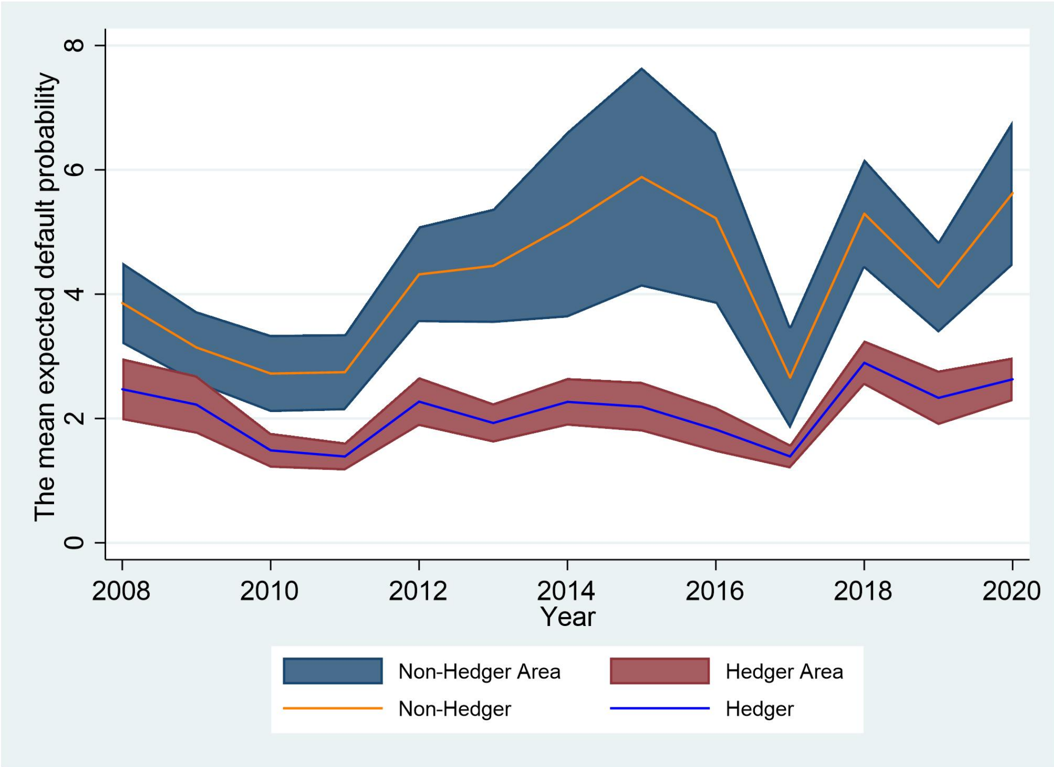
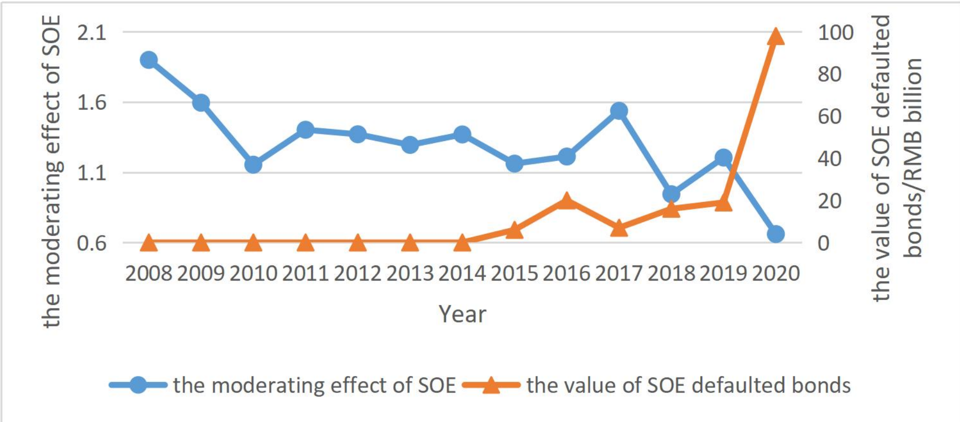


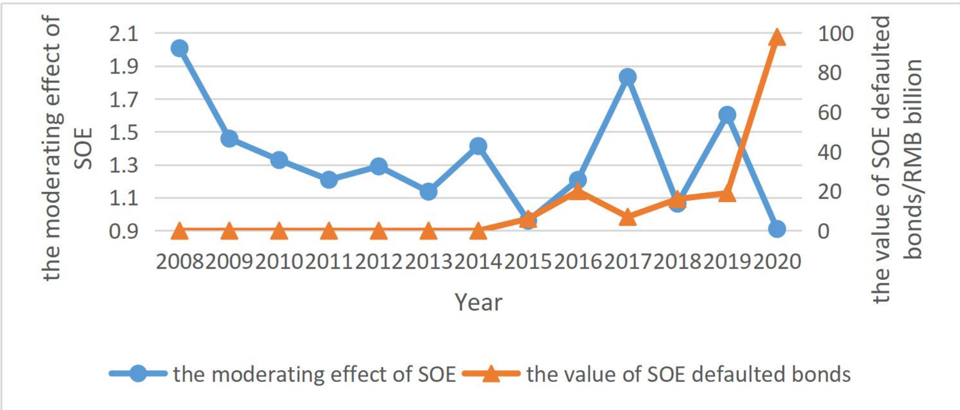
Figure A-2 The annual variation in the moderating effect of state ownership

These figures illustrate the annual variation in the moderating impact of state ownership on the risk-reducing effect across different hedging activities. Chart A depicts the annual variation in the moderating effect of state ownership on the risk-reducing impact of all hedging. Chart B illustrates the annual variation in the moderating effect of state ownership on the risk-reducing impact of derivatives. Chart C showcases the annual variation in the moderating effect of state ownership on the risk-reducing impact of foreign debt. The annual fluctuation in the value of SOE defaulted bonds has been incorporated as a reference. The data regarding the value of SOE defaulted bonds is sourced from Huang (2021).

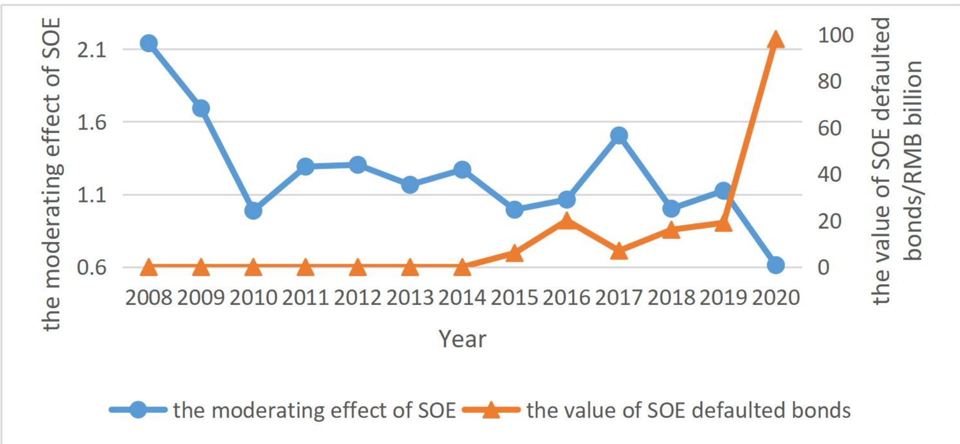
A. All hedging



B. Derivatives



C. Foreign debt



Online Appendix B: Examples of Annual Report Corporate Hedging Data Disclosures

Example 1

Chow Sang Sang Holdings International Limited Annual Report & Accounts 2010

Page 61 DERIVATIVE FINANCIAL INSTRUMENTS

The Group uses derivative financial instruments such as forward currency contracts, bullion contracts and interest rate swaps to hedge its foreign currency risk, bullion price risk and interest rate risk, respectively. Such derivative financial instruments are initially recognized at fair value on the date on which a derivative contract is entered into and are subsequently remeasured at fair value. Derivatives are carried as assets when the fair value is positive and as liabilities when the fair value is negative.

Any gains or losses arising from changes in fair value of derivatives are taken directly to the income statement.

Page 102 DERIVATIVE FINANCIAL INSTRUMENTS

28. Derivative financial instruments **28. 衍生金融工具**

		Group 本集團	
		2010	2009
		HK$'000	HK$'000
		千港元	千港元
Assets	**資產**		
Forward currency contracts	遠期外幣合約	–	180
Liabilities	**負債**		
Bullion contracts	貴金屬合約	**8,613**	14,096
Interest rate swaps	利率掉期	**895**	–
		9,508	14,096

The forward currency contracts, bullion contracts and interest rate swaps are stated at their fair values. The above transactions involving derivative financial instruments are conducted with financial institutions with obligations rated grade "A" or above.

遠期外幣合約、貴金屬合約及利率掉期按其公平價值列賬。上述涉及衍生金融工具之交易乃與信貸評級獲評定為「A」級或以上之金融機構進行。

The aggregate contractual amount of the bullion contracts was HK$277,074,000 (2009: HK$269,816,000) and the aggregate notional amount of the interest rate swaps was HK$128,000,000 (2009: Nil). As at 31 December 2009, the aggregate notional amount of the forward currency contracts was HK$23,150,000.

貴金屬合約之合約數額總值為277,074,000港元(二零零九年：269,816,000港元)及利率掉期之名義數額總值為128,000,000港元(二零零九年：零)。於二零零九年十二月三十一日，遠期外幣合約之名義數額總值為23,150,000港元。

The purpose of the above contracts and swaps entered into by the Group is to manage the Group's bullion price and interest rate exposures. Such contracts and swaps did not meet the criteria for hedge accounting.

本集團訂立上述合約旨在管理本集團之貴金屬價格及利率風險。該等合約及掉期並不符合對沖會計處理之條件。

Page 122 INTEREST RATE RISK

The Group is exposed to interest rate risk due to potential changes in interest rates of interest-bearing financial assets and liabilities. Interest-bearing financial assets are mainly loans to margin clients whereas interest-bearing financing liabilities are primarily bank borrowings with primarily floating interest rates which expose the Group to cash flow interest rate risk.

The Group's policy is to obtain the most favourable interest rates available without increasing its foreign currency exposure. In addition, the Group monitors the level of interest rate exposure and considers utilizing hedging instruments should the need arise.

Page 123 FOREIGN CURRENCY RISK

The Group has transactional currency exposures mainly arising from sales and purchases by operating units in currencies other than the units' functional currency. Management conducts periodical review of exposure and requirements of various currencies, and will consider hedging significant foreign currency exposures should the need arise. Management considers that the Group's exposure to foreign currency risk is not significant.

The Group's assets and liabilities are mainly denominated in Hong Kong dollar, Renminbi and United States dollar. Currency risk is managed partly by financing non-Hong Kong dollar assets with loans denominated in the relevant currencies.

Example 2

Far East Consortium International Limited Annual Report & Accounts 2016

Page 133 INTEREST RATE RISK

The Group is exposed to cash flow interest rate risk due to the fluctuation of the prevailing market interest rates on bank deposits, interest bearing receivables and variable-rate bank and other borrowings. The Group has entered into certain interest rate swaps contracts to mitigate the risk of the fluctuation of interest rate on its future interest payments on the bank borrowings which carry interest at Hong Kong Interbank Offered Rates ("HIBOR"), London Interbank Offered Rate ("LIBOR"), HK$ Prime Lending Rate, People's Bank of China ("PBOC") Prescribed Interest Rate, Singapore Swap Offered Rate ("S$ SOR"), Malaysia Base Lending Rates ("Malaysia BLR") and Australia Bank Bill Swap Reference Rate ("Australia BBSW"). It is the

Group's policy to keep its borrowings at floating rate of interest so as to minimise the fair value interest rate risk.

The Group's exposures to interest rates on financial liabilities are detailed in the liquidity risk management section.

Page 134 FOREIGN CURRENCY RISK

Certain group entities have transactions denominated in foreign currencies which expose the Group to foreign currency risk. The Group manages the foreign currency risk by entering certain forward foreign exchange contracts closely monitoring the movement of the foreign currency rate.

Page 170 DERIVATIVE FINANCIAL INSTRUMENTS

30. DERIVATIVE FINANCIAL INSTRUMENTS

	Assets		Liabilities	
	2016 HK$'000	2015 HK$'000	**2016 HK$'000**	2015 HK$'000
Designated under hedge accounting				
Cross currency swap contracts (note 1)	–	–	(76,680)	(81,832)
Designated not under hedge accounting				
Interest rate swap contracts (note 2)	–	–	(6,888)	(4,518)
Call/put options in listed equity securities and foreign currencies (note 3)	–	790	–	(3,737)
Forward foreign exchange contracts (note 4)	–	1,268	(2,016)	(394)
	–	2,058	(85,584)	(90,481)
Analysed for reporting purpose as:				
Current	–	2,058	(8,904)	(31,542)
Non-current	–	–	(76,680)	(58,939)
	–	2,058	(85,584)	(90,481)

Example 3

Capxon International Electronic Company Limited Annual Report & Accounts 2016

Page 10 FOREIGN EXCHANGE FLUCTUATIONS

The Group derives its revenue from operations principally in U.S. dollars and Renminbi, while its expenses are mainly denominated in Japanese Yen, Renminbi, U.S. dollars and New Taiwan dollars. As the revenue and expenses are denominated in different currencies, the exposure to exchange risks was mostly managed through natural hedges. However, where there is a relatively large fluctuation in the exchange rates of Renminbi and Japanese Yen, the Group will still be indirectly affected.

At present, Renminbi is not a freely convertible currency. The PRC government may adopt measures which could result in a material difference between the future and prevailing or historical exchange rates of Renminbi.

	Assets		Liabilities	
	2016 RMB'000	2015 RMB'000	**2016 RMB'000**	2015 RMB'000
Hong Kong Dollars ("HKD")	**26,007**	21,281	**946**	560
USD	**176,321**	91,179	**45,932**	90,657
New Taiwan Dollars ("NTD")	**292**	3,299	**197**	197
Euro ("EUR")	**4,230**	2,516	**–**	–
JPY	**143**	1,058	**20,064**	5,612

Chapter 4: The Determinants of Firms' Interest Rate Swap Usage and Interest Rate Debt Structure: The Role of Economic Policy Uncertainty

Abstract

Using the news-based UK economic policy uncertainty (EPU) index developed by Baker et al. (2016) and employing unique hand collected interest rate (IR) swaps data for a sample of UK non-financial listed firms from 1999 to 2021, we find that a one standard deviation increase in EPU decreases firms' usage of swapping to floating-rate debt by 16% and increases their usage of swapping to fixed-rate debt by 10%. Furthermore, we find that a one standard deviation increase in EPU reduces firms' final floating-rate debt by 3%. These results are both statistically and economically significant. Our findings show that firms that exhibit negative cash flow IR sensitivity, those faced with financial constraints and those dependent on bank debt, significantly decrease their usage of swapping to floating-rate debt and increase their usage of swapping to fixed-rate debt and as a result lower the amount of floating-rate debt when faced with elevated levels of EPU. On the other hand, we find that when facing high EPU, firms with positive cash flow IR sensitivity only reduce their usage of swapping to floating-rate debt while firms with high bond debt adopt alternative strategies other than IR swaps to reduce their floating-rate debt. Furthermore, we find that EPU has no significant impact on financially unconstrained firms' IR swap usage and floating-rate debt.

Keywords: Economic policy uncertainty**;** interest rate swap; final floating-rate debt; interest rate sensitivity; financial constraint; source of debt.

1. Introduction

Macroeconomic policy is a vital tool for governments to implement economic and financial management and regulation (McGrattan and Prescott, 2005). A smooth and predictable government policy making process contributes to businesses making more informed decisions, thereby promoting socio-economic and financial stability (Ashraf and Shen, 2019). However, in fact, the extent and manner in which governments implement various economic policies can potentially introduce inherent uncertainty, which has significant implications for market stability and corporate activity, thus attracting growing academic attention. Among them, the uncertainty of government regulation, fiscal, monetary, trade and import-export policies, commonly referred to as economic policy uncertainty (EPU), has recently been a particular focus. Specifically, an expanding body of literature investigates the impact of EPU on actual economic and financial activities. When facing higher EPU, evidence shows that stock price volatility increases (Pástor and Veronesi, 2013; Brogaard and Detzel, 2015; Bali et al., 2017; Liu et al., 2017; Witkowska et al., 2019; Luo and Zhang, 2020; Shaikh, 2020; Jing et al., 2023), firms tend to engage less in initial public offerings or new mergers and acquisitions activities (Çolak et al., 2017; Bonaime et al., 2018), corporate investment decreases (Julio and Yook, 2012; Baker et al., 2016; Jens, 2017; Azzimonti, 2018; Su et al., 2020), and finally research suggests there are economy wide effects such as a fall in employment and gross domestic product (GDP) (Baker et al., 2016; Bloom et al., 2018).

A parallel literature finds that heightened EPU worsens the external financing environment for firms, increasing their financial constraints. Zhang et al. (2015) report that under higher EPU, firms reduce their leverage to cope with tightening financing conditions. Çolak et al. (2018) and Gu et al. (2019) discover that higher EPU slows the speed at which firms adjust toward their target capital structure. Furthermore, Waisman et al. (2015) and Bradley et al. (2016) find that higher EPU leads to considerably higher spreads on corporate bonds. On the other hand, Francis et al. (2014), Ashraf and Shen (2019), and Ashraf (2021) show that under higher EPU, the average interest rate (IR) on total bank loans significantly increases. Given that a firm's debt financing primarily consists of either bank loans or corporate bonds or a mix of the two, this implies a significant increase in the cost of debt financing for firms when facing high EPU. Ashraf and Shen (2019) suggest this is due to firms facing higher default risk at elevated levels of EPU. It naturally follows that firms may attempt to mitigate the impact of higher EPU on their debt financing costs by adjusting the IR mix of their debt through the use of IR derivatives such as IR swaps.[1] However, to the best of our knowledge, this issue has been notably overlooked in the aforementioned strand of EPU related literature.

This question is crucial for several reasons: if firms can autonomously adjust their debt structure with IR swaps in response to high EPU thereby reducing firms' IR risks, then this may mitigate the adverse effects of EPU on corporate financing and investment and help promote economic and financial stability. Therefore, in this study, we explore the impact of EPU on firms' IR swap usage and firms' final IR mix of debt (after adjusting the original IR mix of the firms' debt for its IR swap activity). Using the news-based UK EPU index developed by Baker et al. (2016) and a large unique hand-collected dataset of UK non-financial listed firms use of IR swaps and their final floating-rate debt structure, we find that there is a significant negative relationship between EPU and firms' final floating-rate debt. However, we find that EPU has no significant impact on the overall usage of IR swaps. Faulkender (2005) points out that the assessment of firms' hedging behaviours should concentrate on their final IR exposure of debt rather than the intermediate measure of the quantity of IR swaps used by the firm. Under this rationale, most extant literature focuses only on the outcomes of IR swap usage, while neglecting the direction of IR swap usage (i.e., swapping to fixed or floating rate debt). However, considering the findings of Francis et al. (2014) and Ashraf and Shen (2019) who show that IR on bank-based debt

[1] Bartram (2019) find that firms massively use IR derivatives to reduce their IR exposure. Anbil et al. (2019) discover that IR derivatives users tend to have significantly lower credit default swap spreads. Judge and Wang (2024) find that firms' use of IR derivatives can significantly reduce their default risk.

increase during periods of elevated EPU, it could reasonably be argued that in order to avoid the hike in bank debt IR, firms might increase the use of swapping to fixed-rate debt and decrease the use of swapping to floating-rate debt. Our unique IR swap usage data allows us to test for this. Consistent with expectations, we observe that a one standard deviation increase in EPU significantly decreases firms' usage of swapping to floating-rate debt by 16% and increases their usage of swapping to fixed-rate debt by 10%. Furthermore, a one standard deviation increase in EPU significantly reduces firms' final floating-rate debt by 3%. Our findings are both statistically and economically significant. These results demonstrate that allowing for the direction of IR swaps is important. It follows that the lack of significance of the impact of EPU on the overall usage of IR swap may be attributed to the opposing effects resulting from the reduction in swapping to floating-rate debt and the increase in swapping to fixed-rate debt. To the best of our knowledge, our novel findings not only expand the research on the real effects of EPU on firms but also contribute to the literature that explores the determinants of firms' IR swap usage and firms' final floating rate debt structure.

Although the prevailing consensus in the majority of the literature is that having floating-rate debt increases a firm's risk (Faulkender, 2005; Chava and Purnanandam, 2007; Disatnik et al., 2014; Ippolito et al., 2018; Oberoi, 2018), some studies posit that for firms exhibiting a positive correlation between IR and cash flows, floating-rate debt serves as a means to naturally hedge IR exposure (Smith and Stulz, 1985; Froot et al., 1993; Servaes et al., 2006; Vickery, 2008; Chernenko and Faulkender, 2011). In this case, as IRs rise, the accompanying higher interest expenses are offset by the enhanced cash flows. Therefore, in this study, we explore whether IR sensitivity affects the impact of EPU on firms' IR swaps usage or final floating-rate debt. We construct a cash flow beta to reflect the relationship between a firm's cash flows and the 3-month London Interbank Offered Rate (LIBOR). We find that for firms with negative cash flow beta, EPU significantly decreases their usage of swapping to floating-rate debt and increases their usage of swapping to fixed-rate debt.

Furthermore, EPU significantly reduces these firms' final floating-rate debt. On the other hand, for firms with positive cash flow beta, we find that EPU only significantly reduces their usage of swapping to floating-rate debt, but has no significant impact on their usage of swapping to fixed-rate debt or their final floating-rate debt. This indicates that these firms do not need to excessively adjust their IR swap usage or final floating debt to cope with higher EPU. This validates that for firms with a positive link between IRs and cash flows, floating-rate debt can serve as a natural hedging instrument. These findings enhance our current understanding of the role that IR cash flow sensitivity plays in corporate risk management.

A significant body of literature investigates the interplay between levels of financial constraint and corporate risk management strategies. For instance, Oberoi (2018) finds that financial constraints influence a firm's IR mix of debt, with financially constrained firms generally holding higher floating-rate debt. Bretscher et al. (2018) reach a similar finding, and further show this leads these firms to employ more IR swaps to hedge. Floating-rate debt is subject to variable interest costs and thus carries higher risk (Faulkender, 2005; Chava and Purnanandam, 2007; Disatnik et al., 2014; Ippolito et al., 2018; Oberoi, 2018), particularly during periods of high EPU. Hence, financially constrained firms may engage in more risk management to cope with high EPU. Therefore, we investigate whether financial constraints affect the relationship between EPU and firms' IR swaps usage or floating-rate debt. Considering that financial constraints have a direct impact on a firm's IR exposure to floating-rate debt (Bretscher et al., 2018; Oberoi, 2018), we introduce initial floating-rate debt (the original IR mix of the firm's debt before the impact IR swap activity) to facilitate comparisons between the initial and final IR structure.[2] We find that EPU has no significant impact on the IR swap usage or floating-rate debt of financially unconstrained firms, suggesting that these firms do not need to adjust their IR swaps usage or floating-rate debt in response to high EPU. In contrast, when facing high

[2] The distinction between initial and final floating-rate debt lies in whether the use of IR swaps is considered. Hence, the impact of financial constraints, as well as the issuance of fixed-rate debt and other non-IR swap measures on a firm's floating IR exposure of debt, is reflected in the initial floating-rate debt; While the effects of IR swap usage are shown in the comparison between initial and final floating-rate debt.

EPU, financially constrained firms significantly reduce their use of swapping to floating-rate debt and increases their usage of swapping to fixed-rate debt, thereby lowering their floating IR exposure of debt to levels comparable to those of financially unconstrained firms. These findings enhance our current understanding of the role that financial constraints play in a corporate risk management context by examining the interplay between EPU and firms' IR swap usage and floating-rate debt.

Considering that EPU not only leads to higher spreads on corporate bonds (Waisman et al., 2015; Bradley et al., 2016), but also increases the IR on bank loans (Francis et al., 2014; Ashraf and Shen, 2019; Ashraf, 2021), we further disaggregate firms' debt into bank loans and corporate bonds to investigate whether the impact of EPU on a firm's IR swap usage and floating-rate debt is influenced by the source of debt. Given that the source of debt can directly influence a firm's floating IR exposure of debt (Dolde, 1993; Faulkender, 2005; Purnanandam, 2008; Vickery, 2008; Ippolito et al., 2018), we adopt a similar methodology to that used for financial constraints by introducing initial floating-rate debt as a basis for comparison. We find that firms with high bank debt significantly reduce their usage of swapping to floating-rate debt and increase their employment of swapping to fixed-rate debt to lower their floating IR exposure of debt in response to high EPU. On the other hand, we find that EPU has no significant impact on the IR swaps usage of firms with high bond debt. However, EPU significantly reduces their initial and final floating-rate debt. This indicates that these firms may employ alternative methods, such as issuing fixed-rate debt, rather than using IR swaps, to cope with high EPU. This may be because IR swaps usage involves costs and potential financing risks (Garleanu and Pedersen, 2007; Rampini et al., 2014; Bretscher et al., 2018), and firms with high bond debt may be unwilling or find it unnecessary to undertake these risks and costs, especially under high EPU. These new and important findings shed light on the role that the source of debt plays in the relationship between EPU and corporate risk management.

Finally, to address endogeneity concerns, we not only adopt lagged regressors, but also employ a fixed effect model and a two-stage least squares (2SLS) approach. Our results remain qualitatively similar, suggesting that our findings may not be subject to a serious endogeneity issue. Moreover, we also employ a series of methods such as time-weighted approach. This battery of additional tests demonstrates the robustness of our findings.

The remaining sections of the study are structured as follows. Section 2 provides a review of relevant literature and the formulation of our hypotheses. Section 3 outlines our sample, data collection, and variable construction. Section 4 describes our methodology. Section 5 presents our empirical findings and Section 6 concludes.

2. Literature review and hypothesis development

2.1 Literature review

Our study builds on two strands of recent literature in corporate finance, these are studies which explore the determinants of the IR mix of corporate debt including the use of IR swaps and studies which examine the impact of EPU on corporate external financing. In the first strand, existing studies employ both firm and country level factors to investigate the determinants of the IR structure of firms' debt. By combining the initial floating-rate debt with the use of IR swaps to build a firm's final IR exposure of debt, Faulkender (2005) is the first to investigate the determinants of a firm's final floating-rate debt. Based on 133 U.S. chemical companies, Faulkender (2005) finds that firms swap to floating-rate debt for market timing purposes rather than hedging. Moreover, Faulkender (2005) finds that larger and more profitable firms prefer fixed-rate debt, while factors such as IR sensitivity, financial distress costs (leverage), and growth opportunities have no significant impact on a firm's final IR exposure of debt. Based on 202 U.S. non-financial firms, Chava and Purnanandam (2007) report that managerial incentives are a significant driver of a firm's final floating-rate debt. Specifically, when Chief Financial Officers have incentives to increase firm risk, the firm tends to have a higher level of final floating-rate debt. Employing survey data comprising 3248 observations, Vickery (2008) observes that smaller firms exhibit a preference for using fixed-rate debt to manage their IR risk. Based on a sample of 59,710 U.S. firms' loans, Barry et al. (2009) examine the determinants of corporate debt issuance and provide evidence suggesting that market timing, rather than hedging, constitutes the primary motivation behind determining corporate debt structure. Antoniou et al. (2009) extend this inquiry to the UK market and find that a company's initial IR debt mix is primarily determined by market timing motives. However, it should be noted that Vickery (2008), Barry et al. (2009) and Antoniou et al. (2009) only focus on the initial IR mix of debt, which can be changed via the use of IR swaps to arrive at a firm’s final IR mix of debt. As argued by Chernenko and Faulkender (2011) , the overall IR exposure of a firm’s debt is determined by the combination of the initial debt's IR exposure and the company's IR swap activities. The use of IR swaps can therefore result in substantial differences between the initial and final IR mix of debt. Given the large scale of IR swap usage[3], assessing a firm’s IR exposure of debt solely based on the initial structure of floating and fixed rate debt is potentially inaccurate. Therefore, Chernenko and Faulkender (2011) employ a similar methodology to that of Faulkender (2005) and Chava and Purnanandam (2007) and find that firms' final floating-rate debt is influenced by both hedging and market timing purposes. Specifically, they find that for high-investment firms, the final floating-rate debt is determined by hedging motives, while for firms where executive compensation contracts are more sensitive to performance, speculative motives drive the final floating-rate debt. Moreover, unlike Faulkender (2005), Chernenko and Faulkender (2011) report that IR cash flow sensitivity, leverage, and growth opportunities are crucial drivers of firms' final floating-rate debt. Using a randomly selected sample of 100 firms from the S&P 500, Oberoi (2018) finds that firms tend to hold higher fixed-rate debt, particularly those with higher liquidity and lower operating income. Additionally, Oberoi (2018) reports that firms

[3] Based on a report provided by the Bank for International Settlements, in 2021, the scale of IR derivatives reached a staggering 963.37 trillion US dollars; and among these IR derivatives, IR swaps exhibited the highest level of usage, reaching 769.485 trillion US dollars, accounting for 79.9% of the total volume of IR derivatives employed.

with higher leverage have a lower probability of using fixed-rate debt, which contrasts with the findings of Chernenko and Faulkender (2011).

In the second strand, recent literature provides empirical evidence showing that EPU deteriorates the external financing conditions for firms, thereby exacerbating their financial constraints. For example, using the news-based EPU index developed by Baker et al. (2016) and data from publicly listed non-financial firms in China from 2003 to 2013, Zhang et al. (2015) find that EPU significantly reduces firms' leverage ratio. Using the same EPU index and a cross-national sample from 38 countries, Çolak et al. (2018) report that EPU slows down the speed of adjustment towards the target capital structure. Gu et al. (2019) further corroborate this finding using data from publicly listed non-financial firms in China, and similarly employ the EPU index developed by Baker et al. (2016). Focusing on corporate bond spreads, Qi et al. (2010) use the political rights index from Freedom House (2007) as a measure of political institutions and find that political rights negatively impact corporate bond spreads. Based on data from 39 countries, they report that a one standard deviation increase in political rights leads to an 18.6% decline in bond spreads. However, by using periods surrounding U.S. presidential elections as a proxy for EPU, Waisman et al. (2015) and Bradley et al. (2016) both find that political uncertainty significantly increases corporate bond spreads. The former even points out that a one standard deviation increase in political uncertainty leads to a 34-basis point increase in corporate bond spreads. On the other hand, the existing literature consistently finds that EPU significantly increases the IR on bank loans. Specifically, using the Baker et al. (2016), EPU index, Francis et al. (2014) and Ashraf and Shen (2019) show that a one standard deviation increase in EPU leads to an increase of 11.9 and 21.84 basis points in bank loan IR, respectively. Ashraf (2021) uses the World Uncertainty Index as a proxy for EPU and finds that it significantly increases bank loan IR.

2.2 Hypothesis development

The extant literature, which explores the impact of EPU on firms' bank loans and corporate bonds, provides empirical evidence that EPU tends to increase the cost of debt financing. Ashraf and Shen (2019) conjecture that this is due to firms facing higher default risk during periods of elevated EPU. Given that a firm's debt financing primarily comprises bank loans and corporate bonds, this would inevitably lead firms to adjust their debt structures and hedging strategies to mitigate the impact of EPU on firms' cost of debt financing. However, this issue has been notably overlooked in extant literature. Therefore, we complement these studies by examining the impact of EPU on corporate IR swap usage and the resulting final floating-rate debt.

Faulkender (2005) argues that the assessment of companies' hedging activities should focus on the final IR exposure of debt, rather than concentrating on the intermediate measure of the quantity of IR swaps used by the firm. However, Disatnik et al. (2014) distinguish between fair value hedging and cash flow hedging. They find that cash flow hedging, exemplified by swapping to fixed-rate debt, can mitigate the volatility of cash flows, consequently reducing corporate risk. Conversely, Disatnik et al. (2014) find that fair value hedging, characterized by swapping to floating-rate debt, is likely to augment cash flow volatility, thereby increasing corporate risk. These findings show the significance of distinguishing the direction of IR swap usage. Nonetheless, most extant literature focuses only on the outcomes of IR swap usage, while neglecting the direction. For example, although Bretscher et al. (2018) explore the relationship between economic uncertainty and IR swap usage, they focus on overall IR swap usage without accounting for IR swap direction. Most existing literature suggests that using floating-rate debt increases a firm's risk (Faulkender, 2005; Chava and Purnanandam, 2007; Disatnik et al., 2014; Ippolito et al., 2018; Oberoi, 2018), this risk could potentially be exacerbated during periods of high EPU. Therefore, EPU may have different impacts on the use of IR swaps depending on their direction, specifically whether firms are swapping to floating-rate debt or to fixed-rate debt.

These differing effects could potentially obscure the impact of EPU on overall IR swap usage. In light of this, we not only investigate the impact of EPU on overall IR swap usage but also distinguish between swapping to floating-rate debt and swapping to fixed-rate debt to explore the distinct effects of EPU on each type of IR swap strategy. From the above discussion we arrive at the following hypotheses:

Hypothesis 1: Firms reduce their final floating-rate debt in response to high EPU.

Hypothesis 2: Firms reduce the use of swapping to floating-rate debt and increase the use of swapping to fixed-rate debt in response to high EPU.

3. Data

3.1 Sample description

In this study we employ a sample comprising 6,840 firm-year observations of UK non-financial listed firms from 1999 to 2021. This 23-year time spread enables us to comprehensively capture a series of events that have exerted substantial influence on the UK economy, such as the global financial crisis, the Brexit referendum, and the COVID-19 pandemic. We exclude financial firms from the sample since they often act as counterparties on IR swaps with non-financial firms, facilitating hedging for the latter. Following Chernenko and Faulkender (2011), observations with zero levels of debt are eliminated from the sample.

Following the extant literature (Faulkender, 2005; Chava and Purnanandam, 2007; Chernenko and Faulkender, 2011; Bretscher et al., 2018; Oberoi, 2018), we meticulously hand collect IR swap usage[4] and final floating and fixed rate debt data from firms' annual reports. First, we employ a keyword search method to thoroughly

[4] IR Swap is a financial derivative contract in which two parties agree to exchange different types of interest payments over a specified period. IR swaps include fixed-to-floating and floating-to-fixed swaps, which are the primary focus of this study. Moreover, IR swaps encompass zero-coupon swaps, where the fixed-rate payer makes a lump-sum interest payment at the swap's maturity rather than at regular intervals, while the floating-rate payer makes payments periodically as agreed. IR swaps can also be categorized into single-currency IR swaps, where both parties use the same currency, and cross-currency IR swaps, where one party pays a fixed or floating rate in the domestic currency, and the other pays a floating or fixed rate in a foreign currency. The latter is widely employed by multinational corporations to hedge against both exchange rate and IR risks. Our sample includes many firms that use cross-currency IR swaps, typically paying in GBP, with the counterparty paying in euros or USD.

scan the footnotes within the financial statements, seeking any instances of the specified keywords such as “interest rate”, “swap”, “derivative”, “risk management” and so on. Second, we ascertain whether the firms have disclosed information regarding the direction of IR swap usage. If such disclosure exists, we subsequently categorize them into those that swap to floating-rate debt only, swap to fixed-rate debt only, and swap to both floating and fixed rate debt. As for companies employing IR swaps without disclosing their usage direction, they are classified as swap direction unknown. Third, enforced in March 1999, Financial Reporting Standard (FRS) 13 mandated firms to furnish both qualitative and quantitative disclosures explaining the influence of financial instruments, such as IR swaps, in shaping or modifying the risks inherent to a firm's operations. Consequently, UK firms are obligated to reveal the interest rate profile of their debt after the impact of IR derivatives, which enables us to determine a firm’s final floating-rate debt percentage as well as help quantify the extent of IR swap usage. A few examples showing the types of annual report disclosure are included in Appendix B.

3.2 Variable construction

3.2.1 IR swap usage and final floating-rate debt

In this study, we use two types of variables to proxy for the corporate use of IR swaps. The first is based on qualitative disclosures of direction of IR swap usage reported in companies’ annual report, termed IR swap choice. Specifically, it is a discrete variable taking the value of 0 for firms that do not employ IR swaps, 1 for firms that disclose they swap from fixed to floating rate debt only, 2 for firms that swap from floating to fixed rate debt only, 3 for firms that swap to both fixed and floating rate debt, and 4 for firms that use IR swaps without revealing the direction.

However, employing dummy variables as a proxy for IR swap usage fails to distinguish between firms that have extensive usage and those with limited usage. Therefore, we construct a continuous variable to measure a firm’s IR swap usage.

Following Faulkender (2005), Chernenko and Faulkender (2011) and Bretscher et al. (2018), we calculate the firm's final floating-rate debt as the percentage of floating-rate debt (after the impact of IR swaps) over total debt. Then, following Bretscher et al. (2018), we build a variable |Swap usage| as the absolute value of the difference between the percentage of initial[5] and final floating-rate debt (before and after the impact of IR swaps usage) over total debt. This variable measures a firm's extent of IR swap usage without considering the direction.

Although the swap usage variable constructed by Chernenko and Faulkender (2011) partly captures the direction of IR swap usage, the method of subtracting swapping to fixed-rate debt from swapping to floating-rate debt in constructing this variable has led to a substantial offsetting of the effects between these two approaches. This accounts for the non-significance of the majority of determining factors within their research. Therefore, we construct |Swap to floating| and |Swap to fixed| variables to measure both the extent and direction of IR swap usage for the first time. Specifically, for firms where the final floating-rate debt is greater than or equal to (less than or equal to) the initial floating-rate debt, we calculate the absolute value of the difference between the percentages of initial and final floating-rate debt as the |Swap to floating| (|Swap to fixed|). This extends the methodology used in Chernenko and Faulkender (2011), alleviating concerns about potential offsetting effects between swapping to floating-rate debt and swapping to fixed-rate debt. Additionally, in cases where the Capital IQ database lacks information regarding firms' initial floating-rate debt or when annual reports do not provide data on firms' final floating-rate debt, but it can be inferred from the annual reports that these firms do not employ IR swaps, we assign a value of zero to |Swap usage|, |Swap to floating| and |Swap to fixed|.

[5] The initial floating-rate debts (before the impacts of IR swaps use) data is sourced from the Capital IQ database. This has been corroborated by data analysts at Capital IQ. The firm's initial floating-rate debt is calculated as the percentage of floating-rate debt (before the impact of IR swaps) over total debt.

3.3.2 Economic Policy Uncertainty

Our measurement of EPU is sourced from Baker et al. (2016), who originally design this proxy based on newspaper articles regarding policy uncertainty. Specifically, they construct this EPU index based on 11 major UK newspapers: The FT, The Times and Sunday Times, The Telegraph, The Daily Mail, The Daily Express, The Guardian, The Mirror, The Northern Echo, The Evening Standard, and The Sun. They use the number of news articles containing the terms ‘uncertain’ or ‘uncertainty,’ ‘economic’ or ‘economy,’ as well as policy-relevant terms. For example, policy-relevant terms include: 'policy,' 'tax,' 'spending,' 'regulation,' 'Bank of England,' 'budget,' and 'deficit'. Then, they scale this by the smoothed total number of articles to get the EPU index. Essentially, this index has the capacity to capture both short-term and long-term uncertainty related to economic policy decisions, such as changes in policy rates and the impact of monetary policies. A higher EPU index indicates greater economic policy uncertainty in the UK. Moreover, Baker et al. (2016) calculate this proxy on a monthly basis. In our study, we derive the annual EPU index for a particular year by calculating the arithmetic average of the monthly EPU index from January to December of that year.

3.3.3 Control variables

We rely on Chernenko and Faulkender (2011) and Bretscher et al. (2018) to identify the control variables in our regression model, which are firm size, leverage, profitability, liquidity, capex/assets and market-to-book. Firm size is the natural logarithm of a firm’s total assets. Leverage is the ratio of total debt over the market value of total assets. Profitability is the ratio of earnings before interest, taxes, depreciation and amortization (EBITDA) over total assets. Liquidity is the ratio of cash and cash equivalent over total assets. Capex/assets is calculated as capital expenditure scaled by total assets. Market-to-book is the market value of total assets divided by the book value of total assets. Considering that EPU varies countercyclically to domestic business cycles (Bloom, 2014), we follow Ashraf and

Shen (2019) by including GDP growth as a control variable to eliminate the concern that our EPU variable is merely reflecting domestic business cycles. GDP growth is the annual percentage growth rate of GDP in UK. Financial data is sourced from Capital IQ database, while GDP data is collected form the website of Word Bank[6]. To mitigate the influence of outliers, all control variables, except for GDP growth, are winsorized at the 1st and 99th percentiles. The definitions of all variables used in our study are shown in Table A-1 of Appendix A.

4. Methodology

In order to mitigate potential interference among different types of currency derivatives, Géczy et al. (1997) subdivide them into three categories and employ a multinomial logit model to examine the rationales behind firms' usage of currency derivatives. In this study, the usage of IR swaps in different directions could also potentially introduce interference between one another, particularly in cases where firms employ both swapping to floating-rate and swapping to fixed-rate simultaneously. Therefore, following Géczy et al. (1997), we employ a multinomial logit model to investigate the impact of EPU on the direction of IR swaps usage. Specifically, we subdivide IR swap users into swapping from fixed to floating rate debt only, swapping from floating to fixed rate debt only, swapping to both fixed and floating rate debt, and IR swaps users that don't disclose swap direction. Based on this categorization, we construct the IR swap choice variable, which is discrete, and then use this variable as the dependent variable in the following multinomial logit model:

$$IR\ swap\ choice_{i,t} = \beta_0 + \beta_1 EPU_t + \psi Control_{i,t} \qquad (1)$$

Where $IR\ swap\ choice_{i,t}$ is the IR swap choice of firm i at year t: 0 for firms that do not use IR swaps, 1 for firms that only swap from fixed to floating rate debt, 2 for firms that only swap from floating to fixed rate debt, 3 for firms that swap to both fixed and floating rate debt, and 4 for IR swaps users without disclosing the direction. EPU_t denotes UK EPU at year t. $Control_{i,t}$ denotes a series of control variables

[6] Word Bank. Website: https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=GB.

discussed in Section 3.3.3. Moreover, we introduce industry dummies to control the fixed effects of industry. Additionally, clustering standard errors are chosen to control within-firm correlation and heteroskedasticity.

Next, we use the ordinary least squares (OLS) model and employ the continuous variables of IR swap usage and final floating-rate debt discussed in Section 3.3.1 as the dependent variables in the following equations:

$$IR\ swap_{i,t} = \beta_0 + \beta_1 EPU_t + \psi Control_{i,t} + \varepsilon_{i,t} \qquad (2)$$

$$Final\ floating\_rate\ debt_{\ i,t} = \beta_0 + \beta_1 EPU_t + \psi Control_{i,t} + \varepsilon_{i,t} \qquad (3)$$

Where $IR\ swap_{i,t}$ in Equation 2 denotes the |Swap usage|, |Swap to fixed| or |Swap to floating| of firm i at year t respectively, while $Final\ floating\_rate\ debt_{\ i,t}$ in Equation 3 is the final floating-rate debt of firm i at year t. Similarly, we introduce industry dummies and use clustering standard errors.

5. Empirical results

5.1 Floating-rate debt and IR swap usage summary statistics

Table 1 presents summary statistics for UK non-financial firms' floating-rate debt and IR swap usage from 1999 to 2021. As shown in Panel A, the data of a firm's initial floating-rate debt sourced from the Capital IQ database comprises 3,931 firm-year observations, while the data of a firm's final floating-rate debt collected from annual reports consists of 6,083 firm-year observations. This indicates a significant amount of missing data in the Capital IQ database, highlighting that annual reports remain the primary source for obtaining data on corporate derivatives usage and debt structure. Moreover, this also underscores the necessity of setting the variables |Swap usage|, |Swap to floating|, and |Swap to fixed| to zero for firms that have missing initial floating-rate debt data in the Capital IQ database but disclose in their annual reports that they do not use IR swaps.

Given the substantial difference in data volume between the initial and final floating-rate debt in Panel A, we select firms with available data for both the initial and final floating-rate debt to compare their initial and final debt structures. As Panel B of Table 1 shows, the mean value of firm's initial floating-rate debt is 54.55%, while the mean value of firm's final floating-rate debt is 54.48%. This suggests that, on average, firms tend to reduce their IR exposure to floating-rate debt. Similarly, based on U.S. non-financial firms, Chava and Purnanandam (2007) find that firms' floating-rate debt decreases from 58% to 57% on average, and Chernenko and Faulkender (2011) report that the average floating-rate debt of firms decreases from 42% to 38%. Moreover, the mean value of debt that has been swapped into floating-rate is -0.08%, suggesting that firms are swapping their debt into fixed-rate on average. This is consistent with the finding in Chernenko and Faulkender (2011) of a value of -3.4% for swapped to floating. Additionally, irrespective of direction, the average usage scale and the standard deviation of IR swaps in our sample are 24.83% and 30.46 respectively, which are significantly higher than the 6.84% and 16.79 reported by Chernenko and Faulkender (2011). This indicates that compared to their counterparts in the US, UK firms use more IR swaps, and there is greater variation in usage among different firms.

Next, we select IR swap users from the matched sample to build the sample for Panel C. It is noteworthy that Panel B comprises 3,428 observations, while Panel C consists of 2,229 observations, indicating that within the matched sample, there are 1,199 observations where IR swaps are not used. If firms do not use IR swaps, their initial and final floating-rate debt should be equal. Hence, we conduct a mean difference test between these two variables for IR swap non-users. In unreported results, we find no significant difference between them even at the 10% significance level, which further substantiates the reliability of our data. As panel C of Table 1 shown, the mean value of firm's initial floating-rate debt is 51.90%, while the mean value of firm's final floating-rate debt is 45.32%. This indicates a much larger decrease compared to the decline shown in Panel B, suggesting that IR swap users primarily swap their debt into fixed-rate on average. The mean value of -6.59% for the Swapped to floating variable further supports this. These findings are in line with Chernenko and Faulkender (2011) and Bretscher et al. (2018).[7] Moreover, irrespective of direction, the average usage scale in our IR swap users' sample is 25.34%, which is more than twice as large as the 12.29% in Chernenko and Faulkender (2011) and approximately four times larger than the 6.88% in Bretscher et al. (2018). Additionally, the standard deviation of |Swapped to floating| in our IR swap users' sample is 29.35, which is much higher than the 20.96 in Chernenko and Faulkender (2011) and 15.77 in Bretscher et al. (2018). This further demonstrates that compared to their counterparts in the US, UK firms use more IR swaps with a greater variation.

5.2 Summary statistics

Table 2 provides summary statistics of the variables used in this study spanning from 1999 to 2021. As Panel A of Table 2 shown, the mean value of debt transformed into floating-rate through swapping is 8.25%, while the mean value of debt converted into fixed-rate through swapping is 9.20%. This further suggests that firms exhibit a preference for swapping their debt into fixed-rate on average. Figure 1 illustrates the annual variation in the average value of swapping to floating-rate debt and swapping to fixed-rate debt from 1999 to 2021. Prior to 2005, the use of IR swaps is highly volatile, and no clear trends are observed in the extent or direction of IR swap activity. From 2005 onward, the use of IR swaps became relatively stable, maintaining consistent levels through to 2021. During this 17-year period of stability, except for the years 2005 to 2007, 2009, and the last two years, the use of swapping to fixed-rate debt exceeds that of swapping to floating-rate debt in the remaining 11 years. This further indicates that firms tend to convert their debt into fixed-rate debt on average.

Furthermore, Figure 1 also depicts the annual variation in the average value of final

[7] Chernenko and Faulkender (2011) find that the floating-rate debt of US firms in their IR swap users' sample decreases from 42.62% to 36.77%, while Bretscher et al. (2018) report a decrease from 37.42% to 35.82%. Moreover, the mean value of the Swapped to floating variable is -6.11% in the IR swap users' sample of Chernenko and Faulkender (2011) and -1.69% in Bretscher et al. (2018).

floating-rate debt from 1999 to 2021. Prior to 2007, final floating-rate debt remains at relatively high levels, then begins a significant decline through to 2013. From 2013 to 2015, there is a slight increase in final floating-rate debt, followed by another sharp decrease, reaching its lowest level in 2021. Moreover, despite the overall downward trend in final floating-rate debt from 2007 to 2017, it accounts for more than 50% of total corporate debt until it lost its dominant position after 2017. This shift indicates that final fixed-rate debt begins to play a leading role in corporate debt structures. These findings show the 23-year debt structure adjustment process among UK non-financial firms, with a general decrease in floating-rate debt on average.

As panel B of Table 2 shown, the mean value of UK EPU is 124.3 with the standard deviation of 57 suggesting substantial variation across years. Figures 2 illustrates the annual variation in the UK EPU from 1999 to 2021. Prior to 2007, the UK EPU remains at a relatively low level. The outbreak of the global financial crisis in 2008 causes a rapid increase in the UK EPU. Following the subsequent European crisis, UK EPU remains elevated until 2012. On June 23, 2016, the UK held a referendum on its departure from the European Union, with the results favoring Brexit. This leads to a sharp increase in the UK EPU in 2016, which subsequently declines. The COVID-19 pandemic then causes a significant rise in the UK EPU in 2019, with high levels persisting into 2020, before finally receding in 2021.

Figure 3 depicts the annual variation in the average value of swapping to floating-rate debt and swapping to fixed-rate debt alongside UK EPU, while Figure 4 illustrates the annual variation in the average value of final floating-rate debt alongside UK EPU. Prior to 2007, when UK EPU is at a low level, the use of swapping to floating-rate debt generally exceeds that of swapping to fixed-rate debt, and final floating-rate debt remains at a high level. The global financial crisis causes a rapid increase in UK EPU, accompanied by a rise in the use of swapping to fixed-rate debt exceeding that of swapping to floating-rate debt, as well as a decline in final floating-rate debt. Subsequently, due to a series of events including Brexit, the European debt crisis, and the COVID-19 pandemic, UK EPU remains elevated. Accompanying this is the use of swapping to fixed-rate debt consistently exceeding that of swapping to floating-rate debt (with the exception of 2009). It is not until 2020 that EPU decline, followed by a sharp decrease in 2021, at which point the use of swapping to floating-rate debt once again surpasses that of swapping to fixed-rate debt. On the other hand, during this period, the trend of final floating-rate debt is more sensitive to changes in UK EPU. The global financial crisis and the subsequent European crisis keep UK EPU elevated until 2012, during which time final floating-rate debt experiences a significant decline. As the effects of the European crisis weakens, UK EPU falls in 2013 and remains at a low level until 2015, coinciding with a slight increase in final floating-rate debt. The 2016 UK referendum on leaving the European Union, which resulted in a favorable outcome for Brexit, leads to a sharp increase in UK EPU in 2016, while final floating-rate debt begins to decline sharply. The COVID-19 pandemic causes a significant rise in UK EPU in 2019, accompanied by a further sharp decline in final floating-rate debt. It is not until 2021, as the impact of the COVID-19 pandemic begins to wane and UK EPU significantly decreases, that the rate of decline in final floating-rate debt also diminishes.

The LIBOR scandal refers to a series of fraudulent activities in which bankers from several major financial institutions colluded to manipulate the LIBOR, leading to subsequent investigations, lawsuits, and regulatory actions (Hou and Skeie, 2014). In 2012, it was revealed that banks were inflating or deflating IR to profit from transactions or to create a misleading impression of higher creditworthiness.[8] Despite the fact that many derivatives, particularly IR derivatives, are linked to LIBOR, as shown in Figure 1, the use of IR swaps by firms in our sample remains relatively stable from 2005 to 2021. Even during the revelation of the LIBOR scandal in 2012, the use of IR swaps by firms in our sample continues to be stable. This may be attributed to our focus on non-financial firms rather than financial institutions. The

[8] What Was the LIBOR Scandal? What Happened and Impacted Companies. Website: https://www.investopedia.com/terms/l/libor-scandal.asp.

latter may have significantly adjusted their use of IR swaps to profit from speculation amid the manipulation and fraud related to LIBOR, whereas non-financial firms primarily use IR swaps for hedging purpose and thus are not greatly affected by the LIBOR scandal.

Panel C of Table 2 presents summary statistics for the firm characteristic variables used in this study. The mean values for firm size, leverage, and capex/assets are 6.94, 0.24, and 0.05, respectively, which are comparable to the corresponding values of 6.96, 0.18, and 0.07 reported by Chernenko and Faulkender (2011). This indicates that the firms in our sample possess characteristics similar to those of the firms in previous literature sample.

5.3 Multivariate analysis

In this section, we investigate the impact of EPU on firm's IR swaps usage and their mix of floating and fixed rate debt (i.e., final floating-rate debt percentage). We use a multinomial logit model to examine whether the effect of EPU on IR swap usage varies across the direction of the IR swap. As shown in columns (1) and (2) of Table 3, in the presence of heightened EPU, firms significantly reduce the usage of swapping to floating-rate debt only and increase the employment of swapping to fixed-rate debt only. We conduct an intergroup difference analysis using the Wald test to further examine the difference between columns (1) and (2). We find that, in the face of high EPU, the differences in the usage of swapping to floating-rate debt only and swapping to fixed-rate debt only are statistically significant at the 1% level. These results suggest that firms tend to modify IR swaps usage strategies to reduce their exposure to floating-rate debt in response to high EPU. Moreover, based on columns (3) and (4) of Table 3, we observe a significant reduction in firms' usage of IR swaps to both floating and fixed-rate debt, along with swaps lacking direction disclosure, in response to high EPU.

Considering that using dummy variable as a proxy for IR swap usage cannot distinguish between firms with massive and limited usage, we also construct continuous variables to measure a firm's IR swap usage and final floating-rate debt, with the results shown in Panel A of Table 4. We find that EPU has no significant impact on the overall usage of IR swaps, which contrasts with the findings on the relationship between IR uncertainty and IR swaps of Bretscher et al. (2018). However, after distinguishing the direction of IR swap usage, we observe that EPU significantly decreases firms' usage of swapping to floating-rate debt and increases their usage of swapping to fixed-rate debt. This aligns with our findings using dummy variables as a proxy for IR swap usage in Table 3. Hence, the lack of significance of EPU on the overall usage of IR swap may be attributed to the opposing effects resulting from the reduction in swapping to floating-rate debt and the increase in swapping to fixed-rate debt. This further underscores the importance of distinguishing the direction of IR swap usage. Furthermore, we find that EPU significantly reduces firms' final floating-rate debt, which is consistent with the findings regarding the impact of IR uncertainty on final floating-rate debt in Bretscher et al. (2018).

To assess the economic significance of the impact of EPU on firms' IR swap usage and final floating-rate debt, we employ a standardized measure of EPU and present the results in Panel B of Table 4. Our findings show that a one-standard deviation increase in EPU on average decreases firms' usage of swapping to floating-rate debt by 16% (1.325/8.246 * 100) and increases their usage of swapping to fixed-rate debt by 10% (0.946/9.199 * 100). Furthermore, a one standard deviation increase in EPU on average reduces firms' final floating-rate debt by around 3% (1.468/54.310 * 100). These results indicate that the impact of EPU on firms' IR usage and final floating-rate debt is not only statistically significant but also more importantly significant in an economic sense.

For our control variables, we find that larger firms with higher leverage and lower liquidity tend to use more IR swaps. Specifically, larger firms display a preference for swapping to floating-rate debt, while firms with higher leverage are inclined towards swapping to fixed-rate debt. Moreover, firms with higher liquidity significantly reduce their use of swapping to fixed-rate debt. Furthermore, larger firms with higher leverage and higher market-to-book ratio exhibit a significant reduction in their final floating-rate debt. These findings are generally consistent with the existing literature such as Chernenko and Faulkender (2011) and Bretscher et al. (2018).

5.4 Robustness tests

5.4.1 Lagged regressors

To mitigate potential correlations between macroeconomic variables and firm financial variables, we lag all control variables, except for GDP, by one year. This approach serves the dual purpose of reducing concerns associated with reverse causality. Primarily, we use multinomial logit model to regress equation (1) including lag regressors, with the results presented in Table 5. We find that in the presence of high EPU, firms significantly reduce the usage of swapping to floating-rate debt only and increase the employment of swapping to fixed-rate debt only. Based on Wald test, their differences are statistically significant at the 1% level. Moreover, based on columns (3) and (4) of Table 5, there is a significant reduction in firms' usage of IR swaps to both floating and fixed rate debt, along with swaps lacking direction disclosure, in response to high EPU. These findings align with our previous results in Table 3, suggesting that our results are robust and may not be affected by the potential endogeneity.

Then, we use OLS model to regress equation (2) and (3) including lag regressors, with the results shown in Table 6. We find that EPU significantly decreases the usage of swapping to floating-rate debt and increases the usage of swapping to fixed-rate debt. Furthermore, EPU significantly reduces firms' final floating-rate debt. Additionally, EPU has no significant impact on the overall usage of IR swaps. These results are consistent with our prior findings in Table 4, indicating that our findings are robust and may not be subject to severe endogeneity issue.

5.4.2 Fixed effect model

To control for time-invariant unobservable factors that may be correlated with the independent variable, we use a fixed effects model to regress equation (2) and (3) respectively, with the results shown in Table 7. These results are entirely consistent with our prior findings in Table 4, suggesting that endogeneity is not a serious concern in this study. Furthermore, we conduct a Hausman test to assess the suitability of selecting a fixed effects model. As shown in Table 7, the p-values for the |Swap to floating| and Final floating-rate debt groups indicate that we can reject the null hypothesis, suggesting that the fixed effects model is more suitable. However, the p-values for the |Swap usage| and |Swap to fixed| groups suggest that we fail to reject the null hypothesis, indicating that the random effects model is more appropriate. Therefore, we further use a random effects model to regress equations (2) and (3) respectively, with the results shown in Table A-2 in Appendix A. These results are still in line with our previous findings, further indicating that our findings are robust.

5.4.3 Time-weighted approach

Baker et al. (2016) provide EPU data on a monthly basis. In our study, we aggregate the monthly EPU index by taking the arithmetic mean to obtain the annual index. Considering that the arithmetic mean method smooths data fluctuations and ignores recent trends, we recalculate the annual EPU index using a quarterly weighted average method and a monthly weighted average method. Following Gulen and Ion (2016), we assign weights to the months within the first, second, third, and fourth quarters as 1/30, 2/30, 3/30, and 4/30 respectively, to calculate the quarterly weighted average EPU. Furthermore, following Lian et al. (2023), we assign higher weights to months closer to the end of the year, with each month's weight being 1/78, 2/78, 3/78, ..., 11/78, 12/78, to get the monthly weighted average EPU. To control for time-invariant unobservable factors, we employ a fixed effects model to separately regress the quarterly and monthly weighted average EPU, with the results shown in Table 8. We find that whether based on the quarterly weighted average EPU or the monthly weighted average EPU, our results are still entirely consistent with our previous findings in Table 4. This further confirms the robustness of our results.

5.4.4 Matched sample

As shown in Panel A of Table 1, the data on a firm's initial floating-rate debt sourced from the Capital IQ database comprises 3,931 firm-year observations, while the data on a firm's final floating-rate debt collected from annual reports consists of 6,083 firm-year observations. This indicates a significant amount of missing data in the Capital IQ database. Therefore, we set the variables |Swap usage|, |Swap to floating|, and |Swap to fixed| to zero for firms that have missing initial floating-rate debt data in the Capital IQ database but disclose in their annual reports that they do not use IR swaps. To verify whether this method introduces bias, we match firms with available data for both initial and final floating-rate debt to construct the sample. The characteristics of this sample are presented in Panel B of Table 1 and discussed in Section 5.1. Based on the matched sample, we employ a fixed effects model to regress equations (2) and (3) respectively, with the results shown in Table 9. These results are in line with our earlier findings in Table 4, supporting the robustness of our findings.

5.4.5 2SLS approach

In this section, we employ 2SLS approach to address the potential endogeneity issue. A valid instrument should relate to UK EPU but have no direct impact on UK companies' IR swap usage and final floating-rate debt. Therefore, we select the EPU of vital trading partners of the U.K., such as the U.S. and France, as instrumental variables. As Table 10 shown, EPU significantly decreases the usage of swapping to floating-rate debt and increases the usage of swapping to fixed-rate debt, while it does not have a significant impact on the overall usage of IR swaps. Furthermore, EPU significantly reduces firms' final floating-rate debt. These results are in line with our prior findings in Table 4, suggesting that our findings are robust and may not be subject to the potential endogeneity. Then, we conduct several tests to assess the validity of our instrument variables. To examine whether our instrument variables are related to UK EPU, we employ the Kleibergen-Paap rk (KP) Wald F test and find that our instrument variables are strong. Furthermore, we conduct the Hansen J test of overidentifying restrictions to assess the potential association between our instrumental variables and the error term. As Table 10 shown, all J statistics are insignificant, thus leading to the inability to reject the null hypothesis that the instrumental variables are uncorrelated with the error term. Therefore, our instrumental variables successfully pass both the KP Wald F and Hansen J tests, confirming their validity.

5.5 Interest rate sensitivity

Although prevailing consensus in most literature that using floating-rate debt increases a firm's risk (Faulkender, 2005; Chava and Purnanandam, 2007; Disatnik et al., 2014; Ippolito et al., 2018; Oberoi, 2018), based on classic hedging theory, this notion is only valid for firms with a negative correlation between IR and cash flows (Smith and Stulz, 1985; Froot et al., 1993). Conversely, for firms with a positive link, a higher proportion of floating-rate debt is considered beneficial to mitigate costs caused by low cash flow states. In this case, as IR rise, the accompanying higher interest expenses are offset by the enhanced cash flows, which is termed as natural hedging by Servaes et al. (2006). Vickery (2008) further confirms the natural hedging and finds that for industries with a positive correlation between IR and industry output, the increase in borrowing costs resulting from IR hikes is partially offset by the concurrent rise in cash flows. By constructing the cash flow beta to estimate the IR exposure of a firm's cash flow, Chernenko and Faulkender (2011) find firms with higher cash flow beta tend to swap more to floating-rate debt and have higher final floating-rated debt.

Therefore, we investigate whether IR sensitivity affects the relationship between EPU and firms' IR swaps usage or final floating-rate debt. Following Chernenko and

Faulkender (2011), we construct cash flow beta as the proxy of a firm's IR sensitivity. Specifically, we calculate free cash flow as the operational income preceding depreciation, subtracted by capital expenditures, and normalize this disparity by book assets. Subsequently, we use OLS model to regress free cash flow on the average 3-month LIBOR[9] during the same year to estimate the cash flow beta for each individual firm with the following equation:

$$Free\ cash\ flow_{i,t}/Book\ asset_{i,t} = \beta_0 + \beta_{1,i}LIBOR_t + \varepsilon_{i,t} \qquad (4)$$

Where $Free\ cash\ flow_{i,t}$ and $Book\ asset_{i,t}$ denote free cash flow and book asset of firm i at time t respectively. $LIBOR_t$ is the average 3-month LIBOR at time t. $\beta_{1,i}$ is the cash flow beta of firm i. Moreover, following Chernenko and Faulkender (2011), we exclude cash flow betas with fewer than 5 observations during the estimation. It is noteworthy that the natural hedging effects shown in both Vickery (2008) and Chernenko and Faulkender (2011) are fairly weak, which may by caused by the discontinuous nature of the use of cash flows (Antoniou et al., 2009). Hence, we segment the cash flow beta into positive and negative groups and construct the CF beta dummy, which is a variable that takes the value of 1 if cash flow beta is positive, and 0 if cash flow beta is negative. For firms with positive cash flow beta, a higher proportion of floating-rate debt is considered beneficial to mitigate costs caused by low cash flow states, which is natural hedging (Servaes et al., 2006). On the other hand, for firms with negative cash flow beta, using floating-rate debt will increase their risk (Smith and Stulz, 1985; Froot et al., 1993; Faulkender, 2005; Chava and Purnanandam, 2007; Disatnik et al., 2014; Ippolito et al., 2018; Oberoi, 2018). Then, we construct the interaction variable between UK EPU and the CF beta dummy, and introduce it into equations (2) and (3) to investigate whether the IR sensitivity affects the impact of EPU on IR swaps usage and final floating-rate debt. The equations are as follows:

[9] The data for operational income preceding depreciation, capital expenditures, and book assets is sourced from the Capital IQ database. The data for 3-month LIBOR is obtained from the Bank of England: Website: https://www.bankofengland.co.uk/.

$$IR\ swap_{i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 EPU_t * CFbeta_{i,t} + \psi Control_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$Final\ floating\_rate\ debt_{\ i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 EPU_t * CFbeta_{i,t} + \psi Control_{i,t} + \varepsilon_{i,t} \quad (6)$$

Where $CFbeta_{i,t}$ denotes the CF beta dummy variable of firm i at year t. For firms with negative cash flow beta, β_1 still measures the effect of EPU on their IR swap usage and final floating-rate debt; While for firms with positive cash flow beta, it is worth noting that the overall effect of EPU on their IR swap usage or final floating-rate debt depends on both β_1 and β_2, which is (β_1+β_2).

Next, we use OLS model to regress equations (5) and (6) respectively, with the results shown in Table 11. We find that for firms with negative cash flow beta, EPU significantly decreases their usage of swapping to floating-rate debt and increases their usage of swapping to fixed-rate debt. Furthermore, EPU significantly reduces these firms' final floating-rate debt. On the other hand, for firms with positive cash flow beta, we find that EPU only significantly reduces their usage of swapping to floating-rate debt, but has no significant impact on their usage of swapping to fixed-rate debt or their final floating-rate debt. This indicates that these firms do not need to excessively adjust their IR swap usage or final floating-rate debt to cope with higher EPU. This validates the proposition by Servaes et al. (2006) that for firms with a positive link between IR and cash flows, floating-rate debt can serve as a natural hedging instrument.

5.6 Financial constraint

Financial constraint refers to the condition in which a firm is restricted in its investment, expansion, and operational activities due to insufficient funds or difficulty in obtaining external financing (Farre-Mensa and Ljungqvist, 2016). Oberoi (2018) finds that financial constraints impact a firm's debt structure between fixed and floating rates, with financially unconstrained firms typically holding a higher proportion of fixed-rate debt. Similarly, Bretscher et al. (2018) discover that financially constrained firms tend to have a higher proportion of floating-rate debt, which leads them to employ more IR swaps for hedging. Given that floating-rate debt is subject to variable interest costs and thus carries higher risk (Faulkender, 2005; Chava and Purnanandam, 2007; Disatnik et al., 2014; Ippolito et al., 2018; Oberoi, 2018), financially constrained firms may engage in more proactive risk management in the face of heightened EPU. Therefore, we investigate whether financial constraints affect the impact of EPU on firms' IR swaps usage and floating-rate debt.

Considering that financial constraints influence a firm's exposure to floating-rate debt (Bretscher et al., 2018; Oberoi, 2018), we introduce initial floating-rate debt, defined as the percentage of floating-rate debt (prior to the impact of IR swaps) relative to total debt, as a point of comparison. The distinction between initial and final floating-rate debt lies in whether the use of IR swaps is accounted for. Hence, the impact of financial constraints, as well as the issuance of fixed-rate debt on a firm's floating IR mix of debt, is reflected in the initial floating-rate debt. On the other hand, the effects of IR swap usage will be shown in the comparison between initial and final floating-rate debt. Due to the substantial missing data on firms' initial floating-rate debt sourced from the Capital IQ database, we construct the sample by including only those firms with available data on both initial and final floating-rate debt to accurately compare the impact of EPU on these two variables. Moreover, following a similar methodology as outlined in Section 3.3.1, in cases where the Capital IQ database lacks information on firms' initial floating-rate debt or annual reports do not provide data on firms' final floating-rate debt, but it can be inferred from annual reports that these firms do not use IR swaps, we use the available data on either initial or final floating-rate debt to impute the missing IR mix of debt. Following Bretscher et al. (2018), we use the Hadlock and Pierce (2010) (henceforth HP index)[10] as a proxy for a firm's financial constraint status. Firm is classified as being financially constrained if its value of the HP index is above the annual median for the sample as a whole, in

[10] The HP index is calculated based on Hadlock and Pierce (2010) as follows:-0.737Size+0.043Size2-0.04Age. Firm size is the natural logarithm of the book value of total assets. Age is the number of years the firm has been listed. The relevant data is sourced from the Capital IQ database. Firms with high HP index are often regarded as constrained.

which case the financial constraint dummy variable takes a value of 1. For our empirical analysis, we construct an interaction variable by taking the product of the EPU and the financial constraint dummy variables. We introduce this interaction variables into equations (2) and (3) to investigate whether financial constraints affect the link between EPU and IR swaps usage and a firms floating-rate debt. The equations are as follows:

$$IR\ swap_{i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 EPU_t * FC_{i,t} + \psi Control_{i,t} + \varepsilon_{i,t} \qquad (7)$$

$$Floating\_rate\ debt_{i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 EPU_t * FC_{i,t} + \psi Control_{i,t} + \varepsilon_{i,t} \qquad (8)$$

Where $Floating\_rate\ debt_{i,t}$ denotes the initial and final floating-rate debt of firm i at year t. $FC_{i,t}$ denotes the financial constraint dummy variable of firm i at year t. For financially unconstrained firms, β_1 measures the effect of EPU on their IR swap usage and floating-rate debt; While for financially constrained firms, the overall effect of EPU on their IR swap usage or floating-rate debt depends on both β_1 and β_2, which is (β_1+β_2).

We use an OLS model to regress equations (7) and (8) respectively, with the results shown in Table 12. We find that EPU has no significant impact on the IR swap usage or floating-rate debt of financially unconstrained firms. This suggests that these firms do not need to make substantial adjustments to their use of IR swaps or their floating-rate exposure of debt in response to high EPU. On the other hand, we find that for financially constrained firms, EPU significantly decreases their usage of swapping to floating-rate debt and increases their usage of swapping to fixed-rate debt. Furthermore, there is a significant positive relationship between EPU and these firms' initial floating-rate debt, while the relationship with their final floating-rate debt is insignificant and negative. This indicates that under higher EPU, financially constrained firms reduce their floating-rate debt through the adjustment of IR swaps usage. This may be because, due to financial constraints, these firms are unable to employ alternative strategies, such as issuing fixed-rate debt, to reduce their floating-rate debt under high EPU, aside from using IR swaps. Moreover, we find that the impact of EPU on the final floating-rate debt of financially constrained and unconstrained firms is similar. This implies that financially constrained firms adjust their IR swaps usage to reduce their floating-rate debt to levels comparable to those of financially unconstrained firms in the face of high EPU.

5.7 Source of debt

Given that EPU not only increases corporate bonds' spreads (Waisman et al., 2015; Bradley et al., 2016), but also raises bank loans' IR (Francis et al., 2014; Ashraf and Shen, 2019; Ashraf, 2021), we further disaggregate firms' debt into bank loans and corporate bonds to investigate whether the impact of EPU on a firm's IR swap usage and floating-rate debt is influenced by the source of debt. A substantial body of existing literature finds that bank loans are predominantly floating-rate debt (Faulkender, 2005; Vickery, 2008; Ippolito et al., 2018), while corporate bonds typically consist of fixed-rate debt (Dolde, 1993; Purnanandam, 2008). This indicates that the source of debt can directly influence a firm's floating IR mix of debt. Therefore, we adopt the methodology used in Section 5.6 by introducing initial floating-rate debt as a comparative measure and employing the same matched sample. Then, we construct bank debt (bond debt) variable as the percentage of the bank debt (bond debt) over total debt as the measure of source of debt[11]. Subsequently, we build a debt source dummy that takes the value of 1 if firms have more bond debt than bank debt and 0 otherwise. We create an interaction variable by taking the product of EPU and the debt source dummy and employ it in equations (2) and (3) to investigate whether the source of debt affects the relationship between EPU and IR swaps usage or floating-rate debt. The equations are as follows:

$$IR\ swap_{i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 EPU_t * Debt_{i,t} + \psi Control_{i,t} + \varepsilon_{i,t} \qquad (9)$$

$$Floating\_rate\ debt_{i,t} = \beta_0 + \beta_1 EPU_t + \beta_2 EPU_t * Debt_{i,t} + \psi Control_{i,t} + \varepsilon_{i,t} \qquad (10)$$

[11] The data for bank debt, bond debt, and total debt are sourced from the Capital IQ database.

Where $Debt_{i,t}$ denotes the debt source dummy variable of firm i at year t. For firms with higher bank debt, β_1 still measures the effect of EPU on their IR swap usage and floating-rate debt; While for firms with higher bond debt, the overall effect of EPU on their IR swap usage or floating-rate debt depends on both β_1 and β_2, which is (β_1+β_2).

We use an OLS model to regress equations (9) and (10), with the results shown in Table 13. We find that firms with more bank debt significantly reduce their usage of swapping to floating-rate debt and increase their employment of swapping to fixed-rate debt in response to high EPU. Furthermore, there is a significant positive link between EPU and these companies' initial floating-rate debt, while the link with their final floating-rate debt is insignificant. This suggests that under higher EPU, firms with high bank debt reduce their floating-rate debt through the use of IR swaps. On the other hand, we find that EPU has no significant impact on the usage of swapping to floating-rate debt and swapping to fixed-rate debt for firms with more bond debt. However, EPU significantly reduces their initial and final floating-rate debt. This suggests that firms with more bond debt may employ alternative methods, such as issuing fixed-rate debt, in addition to using IR swaps, to cope with high EPU.

Chava and Purnanandam (2007) and Chernenko and Faulkender (2011) find that firms with credit ratings tend to have higher levels of bond debt. Therefore, as a robustness test, we use the possession of a credit rating[12] as an indicator of the source of debt, with the results shown in Table A-3 of Appendix A. These results are consistent with the findings in Table 13.

6. Conclusion

Using a unique hand collected dataset of IR swap usage and IR structure of debt for UK non-financial listed firms from 1999 to 2021, we find that firms significantly decrease their use of swapping to floating-rate debt and increases their usage of

[12] Credit rating refers to whether a firm has a debt or commercial paper rating. The relevant data is sourced from the Capital IQ database.

swapping to fixed-rate debt to lower their final floating-rate debt in response to elevated levels of EPU. These findings have both statistical and economic significance. Interestingly, we find that EPU has no significant impact on the overall usage of IR swap, which may be attributed to the opposing effects resulting from the reduction in swapping to floating-rate debt and the increase in swapping to fixed-rate debt. This underscores the importance of considering the direction of IR swap strategies and our study is the first to show this.

We find that the magnitude of the impact of EPU on firms' IR swap strategies and their final floating-rate debt structure is amplified when firms exhibit negative cash flow IR sensitivity, are financially constrained, and are dependent on bank debt. These findings are new to the corporate risk management literature.

Our research not only extends recent studies which investigate the impact of EPU on firms but also contributes to the literature exploring the drivers of firms' IR swap usage and final IR exposure of debt. Our findings suggest that firms can adjust their debt structure through IR swap usage to cope with high EPU, which may mitigate the adverse influences of EPU, thereby reducing firms' IR risks and enhancing economic and financial stability. Moreover, our findings enhance the understanding of the roles of cash flow IR sensitivity, financial constraints, and sources of debt in firms' corporate risk management. Furthermore, the findings of this study are relevant to CFOs and corporate treasurers, as it provides valuable insights on employing IR swaps in response to high macroeconomic risk, which can inform risk management strategies in practice.

Table 1. Floating-rate debt and IR swaps usage summary statistics

Table 1 shows summary statistics for UK non-financial firms' floating-rate debt and IR swaps usage from 1999 to 2021. Initial and final floating-rate debt are the percentages of floating-rate debt over total debt before and after the impact of IR swaps, respectively. The matched sample includes firms for which there is no missing data relating to initial floating-rate debt from Capital IQ and final floating-rate debt from annual reports. We select IR swap users from the matched sample to build the sample for Panel C. Swapped to floating is calculated by subtracting the value of initial floating-rate debt from the value of final floating-rate debt. It is positive (negative) for firms that are overall swapping into floating (fixed) rate debt. |Swapped to floating| is the absolute value of Swapped to floating.

Variable	N	Mean	Median	Std. Dev.	Min	Max
Panel A: Full sample						
Initial floating-rate debt (%)	3931	53.50	56.45	41.01	0.00	100.00
Final floating-rate debt (%)	6083	54.31	52.00	36.04	0.00	100.00
Panel B: Matched sample						
Initial floating-rate debt (%)	3428	54.55	58.69	40.92	0.00	100.00
Final floating-rate debt (%)	3428	54.48	51.68	37.69	0.00	100.00
Swapped to floating (%)	3428	-0.08	0.00	39.30	-100.00	100.00
|Swapped to floating (%)|	3428	24.83	10.40	30.46	0.00	100.00
Panel C: IR swap users among matched sample						
Initial floating-rate debt (%)	2229	51.90	50.57	39.24	0.00	100.00
Final floating-rate debt (%)	2229	45.32	39.53	33.34	0.00	100.00
Swapped to floating (%)	2229	-6.59	-0.13	43.81	-100.00	100.00
|Swapped to floating (%)|	2229	25.34	13.46	29.35	0.00	100.00

Table 2. Summary statistics

Table 2 provides summary information for the variables used in the analysis. The sample period is 1999-2021. |Swap usage| is the absolute value of the difference between the final and the initial floating-rate debt percentage. For firms where the final floating-rate debt is greater than or equal to (less than or equal to) the initial floating-rate debt, the absolute value of the difference between the final and the initial floating-rate debt percentage is |Swap to floating| (|Swap to fixed|). For IR swap non-users without initial or final floating-rate debt data, |Swap usage|, |Swap to floating| and |Swap to fixed| are set to zero. Final floating-rate debt is the percentage of floating-rate debt (after the impact of IR swaps) over total debt. UK EPU is the economic policy uncertainty of the UK sourced from Baker et al. (2016). Control variables are as follows: GDP growth is the annual percentage growth rate of GDP in UK; Firm size is the natural logarithm of a firm's total assets; Leverage is the ratio of total debt over the market value of total assets; Profitability is the ratio of EBITDA over total assets; Liquidity is the ratio of cash and cash equivalent over total assets; Capex/assets is calculated as capital expenditure scaled by total assets; Market-to-book is the market value of total assets divided by the book value of total assets. All control variables, except the GDP growth, are winsorised at 1st and 99th percentile.

Variable	N	Minimum	Mean	Median	Maximum	Standard Deviation
Panel A. Dependent variables						
|Swap usage| (%)	4530	0.000	12.879	0.000	100.000	24.362
|Swap to floating| (%)	3503	0.000	8.246	0.000	100.000	19.845
|Swap to fixed| (%)	3202	0.000	9.199	0.000	100.000	22.013
Final floating-rate debt (%)	6083	0.00	54.310	52.000	100.000	36.040
Panel B. Macroeconomic variables						
UK EPU	6840	50.000	124.295	107.000	289.000	56.997
GDP growth	6840	-11.000	1.658	2.200	7.500	3.206
Panel C. Firm financial variables						
Firm size	6638	2.574	6.938	6.784	11.857	1.840
Leverage	6206	0.000	0.240	0.199	0.893	0.199
Profitability	6557	-0.320	0.116	0.116	0.378	0.094
Liquidity	6549	0.001	0.092	0.064	0.508	0.092
Capex/assets	6433	-0.248	-0.045	-0.033	-0.001	0.044
Market-to-book	6206	0.255	1.485	1.097	9.803	1.350

Table 3. The impact of EPU on IR swap direction

Table 3 presents the multinomial logit regression results of the impact of EPU on the direction of IR swap strategies. The dependent variable is a firm's IR swap choice, which is a discrete variable taking the value of 0 for firms that do not use IR swaps, 1 for firms that swap from fixed to floating rate debt only, 2 for firms that swap from floating to fixed rate debt only, 3 for firms that swap to both fixed and floating rate debt, and 4 for firms that use IR swaps without disclosing the direction. The independent variable is the UK EPU. The control variables include GDP growth, leverage, profitability, liquidity, Capex/assets, and market-to-book. Please refer to Table 2 or Table A-1 for the definitions of the variables. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Swap to floating only (1)	Swap to fixed only (2)	Difference (1)-(2):chi2 (Wald test)	Swap to both (3)	Swap direction unknown (4)
UK EPU	-0.0051***	0.0013*	18.63***	-0.0071***	-0.0162***
	(0.0015)	(0.0008)		(0.0020)	(0.0015)
GDP growth	0.0002	0.0135*	1.55	0.0155	0.0480***
	(0.0107)	(0.0082)		(0.0121)	(0.0118)
Firm size	0.9675***	0.1640***	75.26***	0.7939***	0.3281***
	(0.0939)	(0.0538)		(0.0942)	(0.0624)
Leverage	1.1850*	2.3871***	3.79**	2.7053***	1.9310***
	(0.6835)	(0.4316)		(0.6780)	(0.4455)
Profitability	3.7927**	1.4248*	1.72	0.4746	-1.3271*
	(1.7849)	(0.7662)		(1.9948)	(0.6782)
Liquidity	-1.6698	-3.4496***	1.55	-3.2929**	-2.6129***
	(1.3545)	(0.7955)		(1.5907)	(0.7626)
Capex/assets	4.6292	-2.0165	3.72	0.6773	-5.6452***
	(3.4483)	(1.6458)		(3.2527)	(1.5097)
Market-to-book	-0.2262	-0.0993	0.50	0.1513	0.1654***
	(0.1754)	(0.0630)		(0.1037)	(0.0434)
Constant	-9.0659***	-1.0818		-7.3938***	-1.3249
	(1.3761)	(0.8995)		(1.2042)	(0.9992)
Observations	6073	6073		6073	6073
Industry FE	Yes	Yes		Yes	Yes
Pseudo R-squared			0.160		

Table 4. The impact of EPU on the IR swaps usage and final floating-rate debt

Table 4 demonstrates the OLS results of the impact of EPU on the IR swaps usage and final floating-rate debt. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. Panel A presents the results using the original EPU, while Panel B shows the results using the standardized EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. EPU				
	|Swap usage|	**|Swap to floating|**	**|Swap to fixed|**	**Final floating-rate debt**
Variable	**(1)**	**(2)**	**(3)**	**(4)**
UK EPU	-0.0102	-0.0236***	0.0168*	-0.0261**
	(0.0089)	(0.0082)	(0.0093)	(0.0125)
GDP growth	0.0751	-0.0467	0.2395***	-0.1893
	(0.0736)	(0.0639)	(0.0738)	(0.1248)
Firm size	2.1290***	3.2738***	0.3492	-5.7495***
	(0.4355)	(0.4316)	(0.5118)	(0.5955)
Leverage	7.3992**	4.1803	10.1914**	-16.3728***
	(3.5110)	(2.9295)	(4.0502)	(4.9830)
Profitability	4.3522	-9.4602	12.3967*	21.8448*
	(6.1268)	(6.0452)	(7.0792)	(11.2303)
Liquidity	-18.2005***	-4.6784	-21.4957***	-4.4076
	(6.3658)	(4.6912)	(7.7134)	(11.5429)
Capex/assets	-25.1589	-9.9989	-34.5669*	31.7575
	(16.6415)	(14.6601)	(19.6431)	(19.8854)
Market-to-book	-0.7148*	0.2209	-1.1506***	-1.9695***
	(0.3918)	(0.3158)	(0.3782)	(0.6762)
Constant	8.3549	-12.6856*	1.3133	77.1490***
	(11.9041)	(6.8411)	(9.2160)	(7.2344)
Observations	4243	3279	2903	5507
Industry FE	Yes	Yes	Yes	Yes
R-squared	0.066	0.104	0.068	0.108

Panel B. Standardized EPU				
	|Swap usage|	**|Swap to floating|**	**|Swap to fixed|**	**Final floating-rate debt**
Variable	**(1)**	**(2)**	**(3)**	**(4)**
SD UK EPU	-0.5713	-1.3247***	0.9460*	-1.4678**
	(0.5015)	(0.4592)	(0.5234)	(0.7044)
Controls	Yes	Yes	Yes	Yes
Observations	4243	3279	2903	5507
Industry FE	Yes	Yes	Yes	Yes
R-squared	0.066	0.104	0.068	0.108

Table 5. The impact of EPU on the IR swaps direction with lagged regressors

Table 5 shows the multinomial logit regression results of the impact of EPU on the IR swaps direction with lagged regressors. The dependent variable is a firm's IR swap choice, which is a discrete variable taking the value of 0 for firms that do not use IR swaps, 1 for firms that swap from fixed to floating rate debt only, 2 for firms that swap from floating to fixed rate debt only, 3 for firms that swap to both fixed and floating rate debt, and 4 for firms that use IR swaps without disclosing the direction. The independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. Except for GDP growth, all other control variables are lagged by one year. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Swap to floating only (1)	Swap to fixed only (2)	Difference (1)-(2):chi2 (Wald test)	Swap to both (3)	Swap direction unknown (4)
UK EPU	-0.0038**	0.0023***	15.07***	-0.0055***	-0.0144***
	(0.0016)	(0.0008)		(0.0019)	(0.0016)
GDP growth	0.0136	0.0199**	0.36	0.0149	0.0343***
	(0.0105)	(0.0078)		(0.0118)	(0.0117)
Firm size	1.0076***	0.1749***	69.50***	0.8415***	0.3823***
	(0.1009)	(0.0552)		(0.0991)	(0.0669)
Leverage	0.9806	2.2714***	4.28**	2.5840***	1.9733***
	(0.6796)	(0.4280)		(0.6794)	(0.4548)
Profitability	5.7940***	1.4969*	4.32**	0.8604	-0.8585
	(2.0486)	(0.7689)		(2.0523)	(0.7353)
Liquidity	-1.5565	-2.8456***	0.79	-3.3378*	-2.1371**
	(1.3927)	(0.7923)		(1.8788)	(0.8556)
Capex/assets	5.8098	-2.9414*	6.26**	-0.5054	-6.6048***
	(3.5443)	(1.6244)		(3.6605)	(1.5938)
Market-to-book	-0.2669	-0.0875	0.94	0.1806*	0.1938***
	(0.1826)	(0.0596)		(0.1047)	(0.0460)
Constant	-9.7986***	-1.5374*		-8.4678***	-2.3583**
	(1.4038)	(0.8482)		(1.2246)	(1.0057)
Observations	5547	5547		5547	5547
Industry FE	Yes	Yes		Yes	Yes
Pseudo R-squared			0.156		

Table 6. The impact of EPU on the IR swaps usage and final floating-rate debt with lagged regressors

Table 6 presents the OLS results of the impact of EPU on the IR swaps usage and final floating-rate debt with lagged regressors. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. Except for GDP growth, all other control variables are lagged by one year. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	|Swap usage|	**|Swap to floating|**	**|Swap to fixed|**	**Final floating-rate debt**
Variable	**(1)**	**(2)**	**(3)**	**(4)**
UK EPU	-0.0077	-0.0208**	0.0202**	-0.0341***
	(0.0093)	(0.0087)	(0.0097)	(0.0129)
GDP growth	0.0999	-0.0606	0.2901***	-0.1844
	(0.0766)	(0.0660)	(0.0809)	(0.1226)
Firm size	2.1408***	3.3273***	0.4125	-6.0316***
	(0.4439)	(0.4351)	(0.5177)	(0.6283)
Leverage	9.2667**	4.8394	11.2903***	-19.5133***
	(3.6185)	(2.9482)	(4.1681)	(5.2477)
Profitability	2.9494	-9.8983*	11.4461	31.4532***
	(6.0995)	(5.7828)	(7.1212)	(11.6257)
Liquidity	-17.6727***	-5.2367	-19.2633**	2.0542
	(6.4151)	(4.3649)	(7.6087)	(13.2635)
Capex/assets	-33.2477**	-21.0122	-40.7985**	31.7418
	(16.5689)	(15.6393)	(19.7633)	(20.4606)
Market-to-book	-0.6420*	0.1742	-1.0094***	-2.0277***
	(0.3745)	(0.3031)	(0.3562)	(0.6962)
Constant	-6.9703	-13.6926*	-2.0898	83.4894***
	(8.0546)	(7.1235)	(7.8607)	(7.9201)
Observations	4043	3150	2782	4964
Industry FE	Yes	Yes	Yes	Yes
R-squared	0.068	0.103	0.070	0.122

Table 7. The impact of EPU on the IR swaps usage and final floating-rate debt under fixed effects model

Table 7 shows the results of the impact of EPU on the IR swaps usage and final floating-rate debt under a firm fixed effects model. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	|Swap usage| (1)	|Swap to floating| (2)	|Swap to fixed| (3)	Final floating-rate debt (4)
UK EPU	0.0004	-0.0103*	0.0180***	-0.0319***
	(0.0063)	(0.0060)	(0.0064)	(0.0084)
GDP growth	0.0913	0.0192	0.1202	-0.1557
	(0.0895)	(0.0783)	(0.0878)	(0.1330)
Firm size	-0.0406	0.8442	-1.0298	-5.6214***
	(0.7515)	(0.6976)	(0.7481)	(0.8867)
Leverage	7.3056***	5.2496**	5.6544**	-2.1641
	(2.7800)	(2.6345)	(2.8361)	(3.4910)
Profitability	7.2524	-4.9202	16.6356***	-0.2374
	(6.1103)	(5.5388)	(6.0392)	(7.9568)
Liquidity	-10.3257*	-9.0605*	-10.5357**	-25.6795***
	(5.3429)	(4.8569)	(5.3247)	(6.8085)
Capex/assets	6.9625	5.8750	-3.1698	-20.6145
	(12.8781)	(12.3154)	(12.9040)	(15.1243)
Market-to-book	-0.1304	1.0038**	-1.1000**	-0.2349
	(0.4753)	(0.4242)	(0.4484)	(0.5080)
Constant	12.3173**	3.5287	13.0231***	100.8701***
	(5.2971)	(4.8982)	(5.0342)	(6.5268)
Hausman test (P value)	0.1868	0.0268	0.2706	0.0002
Observations	4243	3279	2903	5507
R-squared	0.004	0.006	0.013	0.021

Table 8. The impact of EPU on the IR swaps usage and final floating-rate debt using a time-weighted approach

Table 8 presents the results of the impact of EPU on the IR swaps usage and final floating-rate debt using a time-weighted approach. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. The quarterly-weighted approach assigns different weights to the EPU for each quarter and then sums them to produce the annual EPU, while the monthly-weighted approach assigns different weights to the EPU for each month and then sums them to produce the annual EPU. A fixed effects model is used for the regression analysis. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	Quarterly-weighted				Monthly-weighted			
	|Swap usage|	|Swap to floating|	|Swap to fixed|	Final floating-rate debt	|Swap usage|	|Swap to floating|	|Swap to fixed|	Final floating-rate
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
UK EPU	-0.0021	-0.0111*	0.0149**	-0.0262***	-0.0027	-0.0112**	0.0143**	-0.0251***
	(0.0060)	(0.0057)	(0.0062)	(0.0081)	(0.0060)	(0.0057)	(0.0061)	(0.0080)
GDP growth	0.0822	0.0168	0.1084	-0.1357	0.0803	0.0165	0.1059	-0.1315
	(0.0893)	(0.0780)	(0.0875)	(0.1329)	(0.0892)	(0.0779)	(0.0875)	(0.1329)
Firm size	0.0251	0.8600	-0.9632	-5.7670***	0.0395	0.8642	-0.9525	-5.7919***
	(0.7503)	(0.6961)	(0.7472)	(0.8857)	(0.7504)	(0.6961)	(0.7473)	(0.8859)
Leverage	7.3028***	5.2676**	5.6448**	-2.1529	7.3025***	5.2680**	5.6477**	-2.1602
	(2.7799)	(2.6342)	(2.8373)	(3.4927)	(2.7798)	(2.6341)	(2.8376)	(3.4929)
Profitability	7.2336	-4.8202	16.5129***	-0.0182	7.2317	-4.8127	16.5154***	-0.0005
	(6.1096)	(5.5373)	(6.0426)	(7.9600)	(6.1095)	(5.5372)	(6.0432)	(7.9606)
Liquidity	-10.3292*	-9.1031*	-10.5546**	-25.7415***	-10.3292*	-9.1044*	-10.5649**	-25.7381***
	(5.3429)	(4.8565)	(5.3269)	(6.8111)	(5.3428)	(4.8564)	(5.3274)	(6.8116)
Capex/assets	7.3325	5.8201	-2.6527	-21.7242	7.4054	5.8076	-2.5595	-21.9134
	(12.8706)	(12.3065)	(12.9043)	(15.1206)	(12.8694)	(12.3053)	(12.9048)	(15.1205)
Market-to-book	-0.1280	0.9910**	-1.0752**	-0.2657	-0.1281	0.9888**	-1.0717**	-0.2725
	(0.4751)	(0.4240)	(0.4483)	(0.5080)	(0.4751)	(0.4239)	(0.4484)	(0.5081)
Constant	12.2462**	3.5545	12.9998***	101.1605***	12.2293**	3.5495	13.0141***	101.1986***
	(5.2966)	(4.8970)	(5.0367)	(6.5291)	(5.2967)	(4.8969)	(5.0371)	(6.5300)
Observations	4243	3279	2903	5507	4243	3279	2903	5507
R-squared	0.004	0.006	0.012	0.020	0.004	0.006	0.012	0.020

Table 9. The impact of EPU on IR swaps usage and final floating-rate debt using a matched sample

Table 9 presents the results of the impact of EPU on the IR swaps usage and final floating-rate debt using the matched sample. The matched sample includes firms for which there is no missing data related to initial floating-rate debt from Capital IQ and final floating-rate debt from annual reports. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. A fixed effects model is used for the regression analysis. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	**|Swap usage|** **(1)**	**|Swap to floating|** **(2)**	**|Swap to fixed|** **(3)**	**Final floating-rate debt** **(4)**
UK EPU	-0.0057	-0.0209***	0.0214**	-0.0210**
	(0.0078)	(0.0081)	(0.0094)	(0.0098)
GDP growth	0.1202	0.0314	0.1407	-0.0573
	(0.1146)	(0.1065)	(0.1333)	(0.1450)
Firm size	-2.0885**	-0.8388	-4.0800***	-5.7704***
	(1.0320)	(1.0811)	(1.2154)	(1.3057)
Leverage	6.7825*	8.1391**	1.9887	0.1324
	(3.5088)	(3.6242)	(4.1434)	(4.4395)
Profitability	7.0755	-5.1312	22.6847**	6.7254
	(8.7821)	(8.9027)	(10.5653)	(11.1115)
Liquidity	-7.3245	-11.9057	-15.6366*	-44.4471***
	(7.4895)	(7.3697)	(9.0728)	(9.4761)
Capex/assets	2.4311	9.5105	-24.1655	-34.0499
	(16.8752)	(18.2949)	(20.2339)	(21.3512)
Market-to-book	0.3228	2.2526***	-1.7545**	0.2231
	(0.7034)	(0.6888)	(0.8111)	(0.8900)
Constant	30.1190***	18.2374**	37.6038***	99.5308***
	(7.5593)	(7.9046)	(8.4050)	(9.5644)
Observations	3248	2284	1908	3248
R-squared	0.004	0.012	0.020	0.023

Table 10. The impact of EPU on the IR swaps usage and final floating-rate debt with 2SLS approach

Table 10 shows the results of the impact of EPU on the IR swaps usage and final floating-rate debt with 2SLS approach. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	|Swap usage|	**|Swap to floating|**	**|Swap to fixed|**	**Final floating-rate debt**
Variable	**(1)**	**(2)**	**(3)**	**(4)**
UK EPU	-0.0364	-0.0466***	0.0379***	-0.0869***
	(0.0236)	(0.0122)	(0.0113)	(0.0205)
GDP growth	-0.0411	-0.1516*	0.3523***	-0.5152***
	(0.1220)	(0.0775)	(0.0877)	(0.1386)
Firm size	2.2558***	3.3693***	0.1537	-5.5209***
	(0.4589)	(0.4335)	(0.5318)	(0.6007)
Leverage	7.1670**	3.8686	10.2282**	-16.5992***
	(3.5064)	(2.9283)	(4.0937)	(4.9612)
Profitability	4.0051	-9.8309	14.5111*	21.7108*
	(6.1274)	(6.0332)	(7.4624)	(11.1157)
Liquidity	-17.7955***	-4.4822	-23.1074***	-2.5042
	(6.3796)	(4.6819)	(8.0492)	(11.6260)
Capex/assets	-22.8351	-8.1005	-37.4224*	39.3744**
	(16.9135)	(14.4444)	(20.3763)	(20.0172)
Market-to-book	-0.6074	0.3131	-1.3765***	-1.9164***
	(0.3959)	(0.3161)	(0.4217)	(0.6723)
Constant	7.4025	0.7020	0.7373	110.4193***
	(7.6026)	(9.4942)	(6.9184)	(7.4756)
Observations	4243	3279	2844	5507
Industry FE	Yes	Yes	Yes	Yes
KP Wald F statistic	386.744	3984.561	986.529	1832.334
Hansen J test (p-value)	0.9241	0.2634	0.8871	0.5857
R-squared	0.063	0.100	0.066	0.100

Table 11. The impact of EPU on the IR swaps usage and final floating-rate debt across interest rate sensitivity

Table 11 demonstrates the OLS results of the impact of EPU on the IR swaps usage and final floating-rate debt across interest rate sensitivity. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variables are the UK EPU and the interaction of UK EPU and the CF beta dummy. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. The CF beta is computed by regressing the annual free cash flow against the average 3-month LIBOR for the same year. The CF beta dummy is a variable that takes the value of 1 if CF beta is positive, and 0 if CF beta is negative. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	|Swap usage| (1)	|Swap to floating| (2)	|Swap to fixed| (3)	Final floating-rate debt (4)
UK EPU	-0.0084	-0.0304***	0.0228*	-0.0496***
	(0.0126)	(0.0106)	(0.0136)	(0.0182)
UK EPU*	-0.0027	0.0082	-0.0074	0.0297*
CF beta dummy	(0.0112)	(0.0084)	(0.0128)	(0.0169)
GDP growth	0.0782	-0.0459	0.2411***	-0.1915
	(0.0740)	(0.0642)	(0.0743)	(0.1250)
Firm size	2.1314***	3.3072***	0.3308	-5.7505***
	(0.4453)	(0.4411)	(0.5333)	(0.6041)
Leverage	7.3289**	3.8297	10.3950**	-16.8074***
	(3.6068)	(2.9998)	(4.1775)	(5.1353)
Profitability	3.3979	-10.7877*	12.5213*	23.2291**
	(6.3558)	(6.4216)	(7.4398)	(11.6958)
Liquidity	-19.2834***	-4.7497	-22.8512***	-4.3652
	(6.5818)	(4.7482)	(8.0346)	(11.9111)
Capex/assets	-27.2282	-13.1416	-35.9707*	32.4420
	(17.4503)	(15.5189)	(20.2505)	(20.9642)
Market-to-book	-0.6747	0.2888	-1.1603***	-2.0697***
	(0.4227)	(0.3562)	(0.4100)	(0.7404)
Constant	-4.8815	0.6561	1.4041	77.3327***
	(8.3779)	(12.5479)	(9.3541)	(7.4037)
UK EPU+UK EPU* CF beta dummy	-0.0111	-0.0222***	0.0154	-0.0199
P-value	0.2378	0.0096	0.1222	0.1298
Observations	4144	3206	2827	5305
Industry FE	Yes	Yes	Yes	Yes
R-squared	0.065	0.103	0.070	0.109

Table 12. The impact of EPU on the IR swaps usage and floating-rate debt across financial constraint

Table 12 presents the OLS results of the impact of EPU on the IR swaps usage and floating-rate debt across financial constraint. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed|, Initial and Final floating-rate debt, while the independent variables are the UK EPU and the interaction of UK EPU and the FC dummy. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. Initial floating-rate debt is the percentage of floating-rate debt (before the impact of IR swaps) over total debt, sourced from Capital IQ. The HP index is calculated based on Hadlock and Pierce (2010). A firm with a high HP index indicates that it is financially constrained, and their corresponding FC dummy takes the value of 1. Otherwise, the FC dummy takes the value of 0. The regressions include industry dummies. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	|Swap usage| (1)	|Swap to floating| (2)	|Swap to fixed| (3)	Initial floating-rate debt (4)	Final floating-rate debt (4)
UK EPU	-0.0045	-0.0139	0.0167	0.0235	-0.0106
	(0.0106)	(0.0105)	(0.0119)	(0.0152)	(0.0167)
UK EPU*	-0.0085	-0.0213**	0.0065	0.0239	0.0046
FC dummy	(0.0106)	(0.0086)	(0.0137)	(0.0166)	(0.0159)
GDP growth	0.0815	-0.0581	0.2846***	0.3480***	-0.0302
	(0.0843)	(0.0770)	(0.0869)	(0.1258)	(0.1337)
Firm size	1.9267***	3.2135***	0.2211	-11.2721***	-7.2072***
	(0.4722)	(0.4645)	(0.6044)	(0.7535)	(0.7169)
Leverage	7.3644*	3.9934	11.0562**	-9.7294	-16.6764***
	(3.7941)	(3.2813)	(4.5113)	(6.1306)	(5.9873)
Profitability	6.7968	-7.1218	14.0735*	44.7213***	30.9181**
	(6.7538)	(6.8220)	(8.3889)	(16.7022)	(14.0699)
Liquidity	-19.1011***	-5.2399	-23.8981***	-51.9956***	-23.3988
	(7.3113)	(5.2584)	(9.2179)	(16.1625)	(14.3578)
Capex/assets	-23.7715	-9.7010	-35.0262*	29.4530	52.9383**
	(17.3775)	(15.5233)	(21.2174)	(29.0442)	(25.6074)
Market-to-book	-0.7896*	0.1969	-1.3206***	-2.7003**	-2.0784**
	(0.4623)	(0.3797)	(0.4750)	(1.0717)	(0.9961)
Constant	20.5407	10.3702	9.9314	95.4444***	91.8064***
	(18.4224)	(20.9956)	(11.8736)	(15.5238)	(14.8068)
UK EPU+UK EPU*					
FC dummy	-0.0130	-0.0352***	0.0232*	0.0474***	-0.0060
P-value	0.2767	0.0008	0.0816	0.0036	0.7122
Observations	3864	2919	2560	3864	3864
Industry FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.061	0.108	0.069	0.220	0.123

Table 13. The impact of EPU on the IR swaps usage and floating-rate debt across source of debt

Table 13 shows the OLS results of the impact of EPU on the IR swaps usage and floating-rate debt across source of debt. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed|, Initial and Final floating-rate debt, while the independent variables are the UK EPU and the interaction of UK EPU and the Debt dummy. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. Initial floating-rate debt is the percentage of floating-rate debt (before the impact of IR swaps) over total debt, sourced from Capital IQ. Bank debt is the percentage of the bank debt over the total debt, while bond debt is the percentage of the bond debt over the total debt. The Debt dummy is a variable that takes the value of 1 if firms have higher bond debt, and 0 if firms have higher bank debt. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	|Swap usage| (1)	|Swap to floating| (2)	|Swap to fixed| (3)	Initial floating-rate debt (4)	Final floating-rate debt (4)
UK EPU	-0.0049	-0.0331***	0.0323***	0.0918***	0.0178
	(0.0104)	(0.0092)	(0.0118)	(0.0132)	(0.0147)
UK EPU*	-0.0158*	0.0174*	-0.0472***	-0.2121***	-0.1176***
Debt dummy	(0.0096)	(0.0094)	(0.0100)	(0.0149)	(0.0134)
GDP growth	0.0461	-0.0137	0.1471	-0.1655	-0.3056**
	(0.0914)	(0.0872)	(0.0959)	(0.1243)	(0.1335)
Firm size	2.2097***	3.1358***	0.4409	-8.6607***	-5.6392***
	(0.4986)	(0.4882)	(0.6181)	(0.7599)	(0.7330)
Leverage	6.5598*	4.2632	9.7223**	-12.0502**	-17.7487***
	(3.8731)	(3.3640)	(4.7193)	(5.9441)	(6.0360)
Profitability	6.4695	-8.3171	17.4690*	39.7578**	28.6169**
	(7.7540)	(8.5548)	(9.4131)	(16.4810)	(14.2784)
Liquidity	-21.4177***	-12.2998**	-22.3531**	-28.6842*	-4.0943
	(8.0198)	(5.6952)	(10.2604)	(15.0506)	(14.3225)
Capex/assets	-20.9449	-7.6628	-29.7881	38.9306	56.5879**
	(18.4502)	(17.0392)	(21.8308)	(28.6685)	(25.0660)
Market-to-book	-0.6490	0.3769	-1.4018**	-2.0003**	-1.9860*
	(0.5711)	(0.5117)	(0.6092)	(0.9815)	(1.0526)
Constant	14.8890	8.0148	3.8078	79.1676***	79.4104***
	(15.6939)	(18.2062)	(8.5685)	(10.1388)	(11.0871)
UK EPU+UK EPU* Debt dummy	-0.0207*	-0.0157	-0.0149	-0.1203***	-0.0998***
P-value	0.0990	0.2411	0.2140	0.0000	0.0000
Observations	3795	2836	2463	3795	3795
Industry FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.057	0.100	0.078	0.332	0.166

Figure 1 The annual variation in IR swap usage and final floating-rate debt

Figure 1 depicts the annual variation in the mean value of swapping to floating-rate debt, swapping to fixed-rate debt and final floating-rate debt.

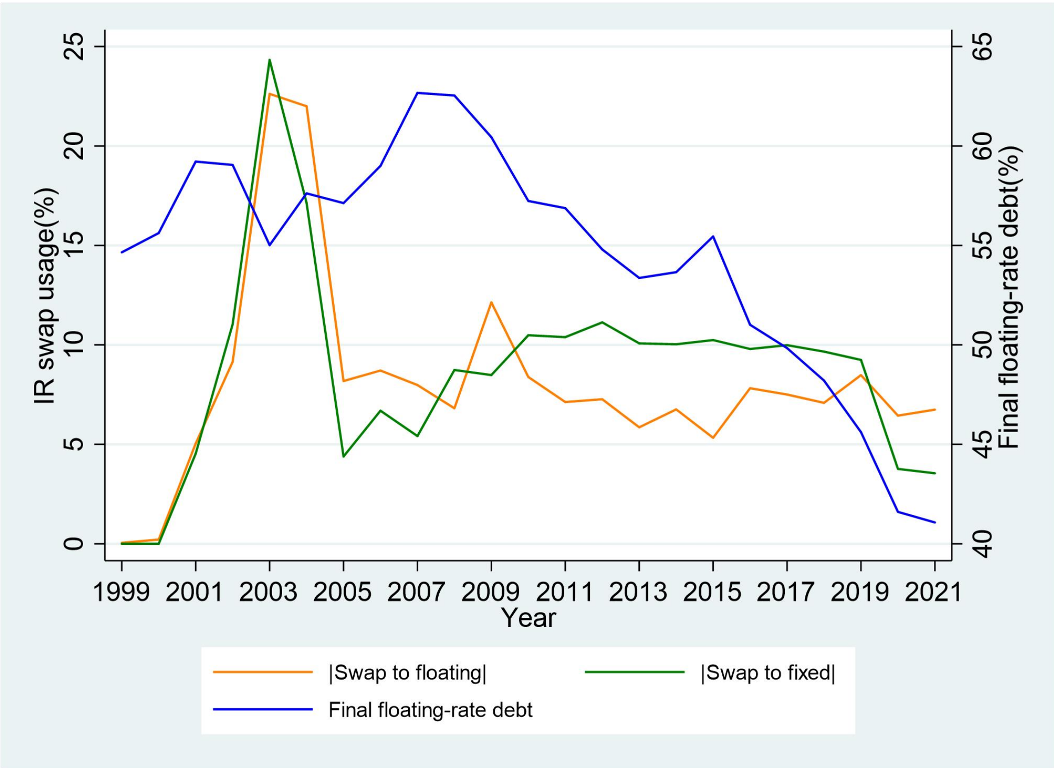


Figure 2 The annual variation in UK EPU

Figure 2 depicts the annual variation in UK EPU.

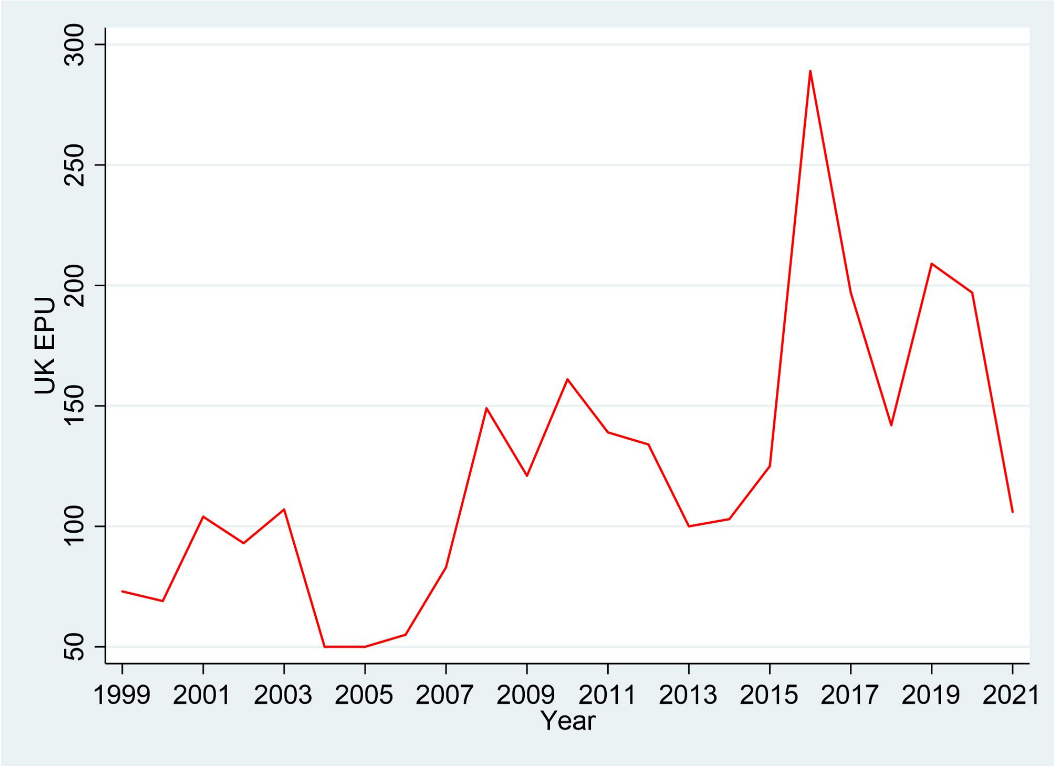


Figure 3 The annual variation in IR swap usage alongside UK EPU

Figure 3 depicts the annual variation in the mean value of swapping to floating-rate debt and swapping to fixed-rate debt alongside UK EPU.

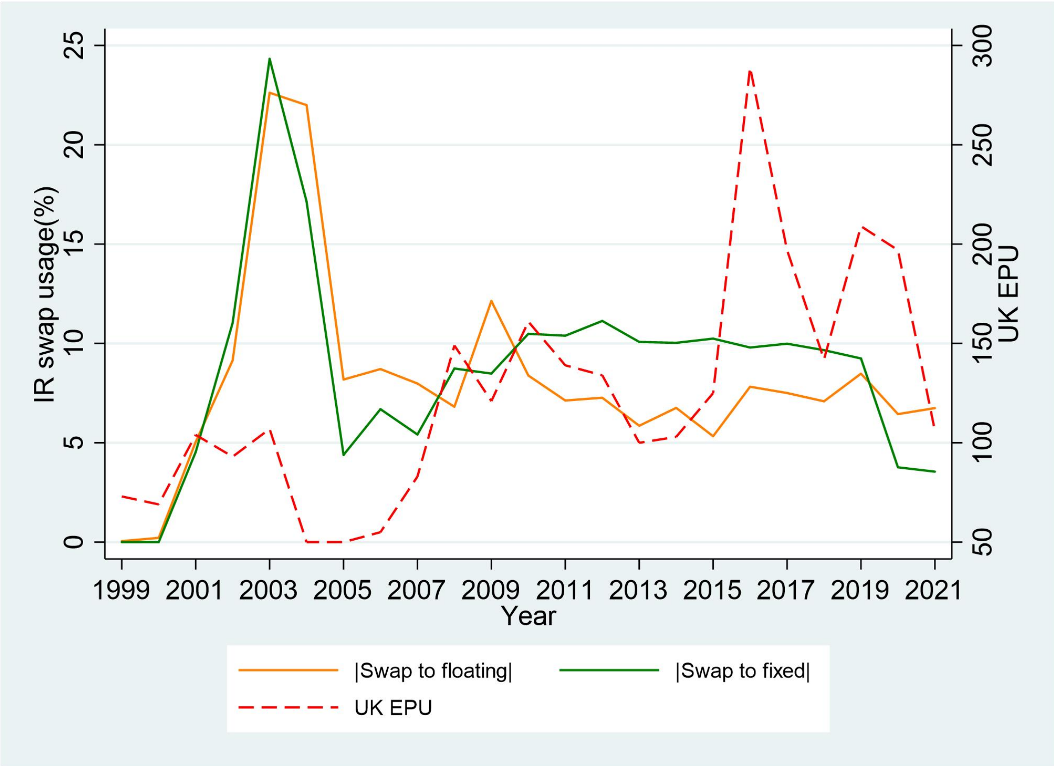
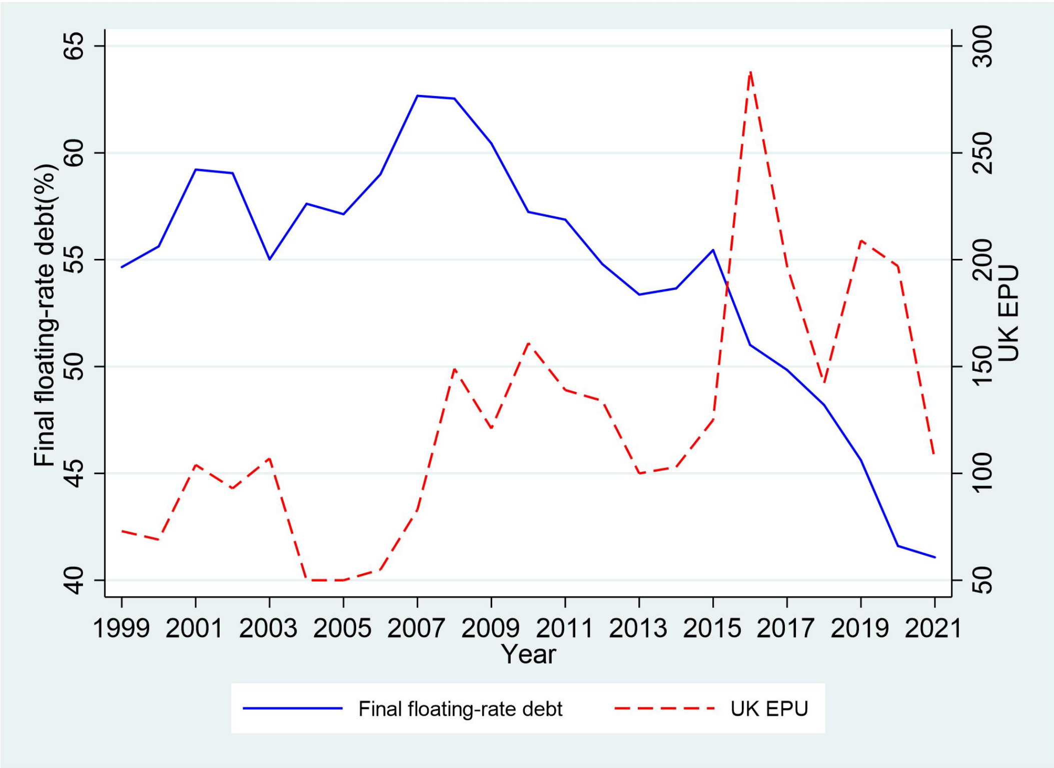


Figure 4 The annual variation in final floating-rate debt alongside UK EPU

Figure 4 depicts the annual variation in the mean value of final floating-rate debt alongside UK EPU.



Appendix A

Table A-1. Variable definition

Table A-1 demonstrates the definition and source of variables used in this study.

Variable	Definition	Sources
	Panel A. Interest rate swaps variables	
Interest rate swap choice	This is a discrete variable, taking the value of 0 for firms that do not use IR swaps, 1 for firms that only swap from fixed-rate to floating-rate debt, 2 for firms that only swap from floating-rate to fixed-rate debt, 3 for firms that swap to both fixed and floating rate debts, and 4 form firms that use IR swaps but we cannot determine the direction.	Annual report
|Swap usage|	The absolute value of the difference between the final floating-rate debt percentage and the initial floating-rate debt percentage. Zero for IR swap non-users.	Annual report and Capital IQ
|Swap to floating|	The absolute value of the swap usage variable but only for those firms that are in net terms swapping to floating-rate debt. Zero for IR swap non-users.	Annual report and Capital IQ
|Swap to fixed|	The absolute value of the swap usage variable but only for those firms that are in net terms swapping to fixed-rate debt. Zero for IR swap non-users.	Annual report and Capital IQ
Initial floating-rate debt	The percentage of floating-rate debt (before the impact of IR swaps) over total debt.	Capital IQ
Final floating-rate debt	The percentage of floating-rate debt (after the impact of IR swaps) over total debt.	Annual report
	Panel B. Macroeconomic variables	
UK EPU	Economic policy uncertainty in UK.	Baker et al. (2016)
GDP growth	Annual percentage growth rate of Gross Domestic Product in UK.	World Bank
	Panel C. Firm financial variables	
Firm size	Natural logarithm of book value of total assets.	Capital IQ
Leverage	The ratio of total debt to market value of total assets.	Capital IQ
Profitability	The ratio of EBITDA over total assets.	Capital IQ
Liquidity	The ratio of cash and cash equivalent over total assets.	Capital IQ
Capex/assets	The ratio of capital expenditure over total assets.	Capital IQ
Market-to-book	The ratio of market value of total assets over the book value of total assets.	Capital IQ

Table A-2. The impact of EPU on the IR swaps usage and final floating-rate debt under random effects model

Table A-2 shows the results of the impact of EPU on the IR swaps usage and final floating-rate debt under a firm random effects model. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed| and Final floating-rate debt, while the independent variable is the UK EPU. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. The regressions include industry dummies. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	|Swap usage|	**|Swap to floating|**	**|Swap to fixed|**	**Final floating-rate debt**
Variable	**(1)**	**(2)**	**(3)**	**(4)**
UK EPU	-0.0036	-0.0148***	0.0159***	-0.0292***
	(0.0060)	(0.0056)	(0.0061)	(0.0080)
GDP growth	0.0885	0.0093	0.1310	-0.1654
	(0.0888)	(0.0775)	(0.0870)	(0.1325)
Firm size	1.4178***	2.4872***	-0.3742	-5.5902***
	(0.4262)	(0.3588)	(0.4698)	(0.5407)
Leverage	7.1618***	5.0724**	6.4562**	-6.5484**
	(2.4586)	(2.2522)	(2.5149)	(3.1415)
Profitability	9.4632*	-4.0999	17.7282***	6.3457
	(5.2043)	(4.6140)	(5.1980)	(6.7117)
Liquidity	-12.7306***	-6.8082	-15.0714***	-18.8513***
	(4.7773)	(4.2388)	(4.7943)	(6.1411)
Capex/assets	-2.6091	0.2817	-10.4415	-0.8914
	(11.2916)	(10.4575)	(11.4934)	(13.3234)
Market-to-book	-0.4704	0.4938	-1.1775***	-0.7927*
	(0.3936)	(0.3392)	(0.3793)	(0.4442)
Constant	14.5696**	6.4822	6.6804	104.4267***
	(6.5360)	(5.3494)	(7.6907)	(7.7980)
Observations	4243	3279	2903	5507
Industry FE	Yes	Yes	Yes	Yes
R-squared	0.003	0.004	0.013	0.020

Table A-3. The impact of EPU on the IR swaps usage and floating-rate debt across credit rating

Table A-3 presents the OLS results of the impact of EPU on the IR swaps usage and floating-rate debt across credit rating. The dependent variables are |Swap usage|,|Swap to floating|, |Swap to fixed|, Initial and Final floating-rate debt, while the independent variables are the UK EPU and the interaction of UK EPU and the Rating dummy. We include the same control variables as those in Table 3. Please refer to Table 2 or Table A-1 for the definitions of the variables. Initial floating-rate debt is the percentage of floating-rate debt (before the impact of IR swaps) over total debt, sourced from Capital IQ. Credit rating refers to whether a firm has a debt or commercial paper rating. The Rating dummy is a variable that takes the value of 1 if a firm has a credit rating, and 0 otherwise. Clustering standard errors are chosen to control for within-firm correlation and heteroskedasticity. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

	|Swap usage|	**|Swap to floating|**	**|Swap to fixed|**	**Initial floating-rate debt**	**Final floating-rate debt**
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(4)**
UK EPU	-0.0018	-0.0241**	0.0288**	0.0470***	0.0020
	(0.0107)	(0.0100)	(0.0121)	(0.0144)	(0.0153)
UK EPU*	-0.0290*	0.0015	-0.0450**	-0.1198***	-0.0804***
Rating dummy	(0.0150)	(0.0165)	(0.0226)	(0.0236)	(0.0189)
GDP growth	0.0998	-0.0399	0.3002***	0.3914***	0.0462
	(0.0899)	(0.0794)	(0.0966)	(0.1383)	(0.1426)
Firm size	2.4415***	3.1220***	0.8150	-8.9362***	-5.6453***
	(0.5057)	(0.4943)	(0.6248)	(0.9185)	(0.8593)
Leverage	9.3013**	5.6729*	12.5558***	-6.9841	-13.0033**
	(3.8520)	(3.3378)	(4.6152)	(5.9429)	(6.0156)
Profitability	8.2266	-5.2516	17.6315**	45.6722***	29.0037**
	(7.1530)	(7.5142)	(8.3209)	(16.0698)	(13.7137)
Liquidity	-19.2456***	-7.9754	-22.2040**	-47.8725***	-23.4396*
	(7.3291)	(5.4254)	(9.1507)	(15.4791)	(13.7409)
Capex/assets	-24.9804	-4.9075	-36.7409*	17.6011	45.1178*
	(17.3622)	(16.0411)	(20.7039)	(28.2944)	(24.8091)
Market-to-book	-0.7323	0.1589	-1.2303**	-2.5486**	-2.2332**
	(0.4912)	(0.3937)	(0.5065)	(1.0990)	(1.0471)
Constant	12.3550	-11.6313	-3.8544	80.2682***	80.6796***
	(16.7805)	(7.0619)	(9.6476)	(12.5916)	(13.2384)
UK EPU+UK EPU* Rating dummy	-0.0308*	-0.0226	-0.0162	-0.0728***	-0.0784***
P-value	0.0567	0.1882	0.5022	0.0036	0.0001
Observations	3800	2884	2515	3800	3800
Industry FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.063	0.095	0.074	0.217	0.119

Appendix B: Examples of Annual Report Interest Risk Management Data Disclosures

Example 1

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Fair value of derivative positions

The fair value of the Group's open derivative positions at 31 December (excluding normal purchase and sale contracts held off balance sheet) recorded within 'Derivative financial assets' and 'Derivative financial liabilities', is as follows:

	Current				Non-current			
	2021		2020		2021		2020	
US$ million	Asset	Liability	Asset	Liability	Asset	Liability	Asset	Liability
Derivatives hedging net debt								
Fair value hedge								
Interest rate swaps	23	–	9	–	244	(77)	558	(26)
Held for trading								
Forward foreign currency contracts	–	–	–	(20)	–	–	–	–
Cross currency swaps	–	(88)	–	(19)	12	(240)	79	(166)
Debit valuation adjustment to derivative liabilities	–	5	–	–	–	–	–	–
	23	(83)	9	(39)	256	(317)	637	(192)
Other derivatives	164	(129)	96	(175)	–	–	–	–
Total derivatives	187	(212)	105	(214)	256	(317)	637	(192)

Other derivatives primarily relate to forward foreign currency contracts hedging capital expenditure, forward commodity contracts and other commodity contracts that are accounted for as 'Held for trading'. These marked to market valuations are not predictive of the future value of the hedged position, nor of the future impact on the profit of the Group. The valuations represent the cost of closing all hedge contracts at 31 December, at market prices and rates available at the time.

Page 212 Interest rate risk management

Interest rate risk arises due to fluctuations in interest rates which impact the value of short term investments and financing activities. The Group is principally exposed to US and South African interest rates.

USD LIBOR is expected to be replaced by an alternative risk-free rate by June 2023. The Group is managing the transition to alternative risk-free rates with respect to its hedging arrangements and any future transactions in the financial market. Please see note 39F for further details.

The Group's policy is to borrow funds at fixed rates of interest. The Group uses interest rate contracts to convert the majority of borrowings to floating rates of interest and manage its exposure to interest rate movements on its debt.

In respect of financial assets, the Group's policy is to invest cash at floating rates of interest and to maintain cash reserves in short term investments (less than one year) in order to maintain liquidity.

Analysis of interest rate risk associated with net debt balances and the impact of derivatives to hedge against this risk is included within the table below. Net other financial liabilities (excluding net debt related balances, variable vessel leases and cash in disposal groups, but including the debit valuation adjustment attributable to derivatives hedging net debt) of $2,470 million (2020 (restated (see note 22)): $1,950 million) are primarily non-interest bearing.

The table below reflects the exposure of the Group's net debt to currency and interest rate risk:

The table below reflects the exposure of the Group's net debt to currency and interest rate risk:

						2021
US$ million	Cash and cash equivalents	Floating rate borrowings	Fixed rate borrowings	Derivatives hedging net debt	Impact of currency derivatives	Total
US dollar	7,636	(1,847)	(7,265)	(126)	(3,097)	(4,699)
Euro	32	—	(2,681)	—	2,679	30
South African rand	695	(7)	(133)	—	—	555
Brazilian real	244	—	(24)	—	—	220
Australian dollar	108	—	(77)	—	—	31
Sterling	19	(7)	(753)	—	418	(323)
Other	323	—	(53)	—	—	270
Impact of interest rate derivatives	—	(8,542)	8,542	—	—	—
Total	9,057	(10,403)	(2,444)	(126)	—	(3,916)
Reconciliation:						
Variable vessel leases						74
Net debt						(3,842)

						2020
US$ million	Cash and cash equivalents	Floating rate borrowings	Fixed rate borrowings	Derivatives hedging net debt	Impact of currency derivatives	Total
US dollar	6,801	(1,102)	(7,732)	414	(3,722)	(5,341)
Euro	16	—	(3,276)	—	3,273	13
South African rand	206	(542)	(169)	1	—	(504)
Brazilian real	78	—	(29)	—	—	49
Australian dollar	151	—	(48)	—	—	103
Sterling	49	(7)	(549)	—	449	(58)
Other	207	—	(44)	—	—	163
Impact of interest rate derivatives	—	(8,953)	8,953	—	—	—
Total	7,508	(10,604)	(2,894)	415	—	(5,575)
Reconciliation:						
Variable vessel leases						45
Net debt						(5,530)

Example 2

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2020

	Nominal amounts in local currency	Carrying value $m	Other comprehensive income: Opening balance 1 January 2020 $m	Other comprehensive income: Fair value (gain)/loss deferred to OCI $m	Other comprehensive income: Fair value loss recycled to the income statement $m	Closing balance 31 December 2020 $m	Average maturity year	Average USD FX rate	Average pay interest rate
Fair value hedge – foreign currency and interest rate risk[1]									
Cross currency interest rate swap – Euro bond	EUR 300m	43	–	–	–	–	2021	1.09	USD LIBOR + 1.27%
Cash flow hedges – foreign currency and interest rate risk[2, 4, 6]									
Cross currency interest rate swaps – Euro bonds	EUR 2,200m	150	(30)	(163)	239	46	2025	1.14	USD 2.69%
FX Forwards – short term FX risk	USD 618m	5	–	(20)	15	(5)	2021	–	–
Net investment hedge – foreign exchange risk[3, 4]									
Transactions matured pre 2020		–	(565)	–	–	(565)	–	–	–
Cross currency interest rate swap – JPY investment	JPY 58.5bn	19	(4)	(15)	–	(19)	2029	108.03	JPY 1.53%
Cross currency interest rate swap – CNY investment	CNY 458m	(2)	1	1	–	2	2026	6.68	CNY 4.80%
Foreign currency borrowing – GBP investment	GBP 350m	(475)	(251)	18	–	(233)	2031	n/a	GBP 5.75%
Foreign currency borrowing – EUR investment	EUR 450m	(548)	34	51	–	85	2021	n/a	EUR 0.88%
Contingent consideration liabilities and Acerta Pharma put option liability – AZUK and AZAB USD investments	USD 5,252m	(5,252)	2,053	(642)	–	1,411	–	–	–

2021

	Nominal amounts in local currency	Carrying value $m	Other comprehensive income: Opening balance 1 January 2021 $m	Other comprehensive income: Fair value (gain)/loss deferred to OCI $m	Other comprehensive income: Fair value gain recycled to the income statement $m	Closing balance 31 December 2021 $m	Average maturity year	Average USD FX rate	Average pay interest rate
Fair value hedge – foreign currency and interest rate risk[1]									
Cross currency interest rate swap – Euro bond	–	–	–	–	–	–	–	–	–
Cash flow hedges – foreign currency and interest rate risk[2, 4, 6]									
Cross currency interest rate swaps – Euro bonds	EUR 1,700m	(43)	46	182	(201)	27	2026	1.14	USD 2.85%
FX Forwards – short term FX risk	USD 1,220m	12	(5)	–	(7)	(12)	2022	–	–
Net investment hedge – foreign exchange risk[3, 4]									
Transactions matured pre 2021		–	(565)	–	–	(565)	–	–	–
Cross currency interest rate swap – JPY investment	JPY 58.3bn	62	(19)	(43)	–	(62)	2029	108.03	JPY 1.53%
Cross currency interest rate swap – CNY investment	CNY 458m	(2)	2	–	–	2	2026	6.68	CNY 4.80%
Foreign currency borrowing – GBP investment	GBP 350m	470	(233)	(5)	–	(238)	2031	n/a	GBP 5.75%
Foreign currency borrowing – EUR investment[7]	EUR 450m	–	85	(47)	–	38	2021	n/a	EUR 0.88%
Foreign currency borrowing – EUR investment[8]	EUR 800m	898	–	(50)	–	(50)	2029	n/a	EUR 0.38%
Contingent consideration liabilities and Acerta Pharma share purchase liability – AZUK and AZAB USD investments	USD 2,658m	(2,658)	1,411	421	–	1,832	–	–	–

Page 183 Interest rate risk management

The Group maintains a Board approved mix of fixed and floating rate debt and uses underlying debt, interest rate swaps and forward rate agreements to manage this mix.

At 31 December 2021, interest rate swaps with a notional value of $288m are fair valued through profit or loss and this has effectively converted the 7% guaranteed debentures payable in 2023 to floating rates. No new interest rate swaps were entered into during 2021.

The majority of surplus cash is currently invested in US dollar liquidity funds and investment-grade fixed income securities.

The interest rate profile of the Group's interest-bearing financial instruments are set out below. In the case of current and non-current financial liabilities, the classification includes the impact of interest rate swaps which convert the debt to floating rate.

			2021			2020			2019
	Fixed rate $m	**Floating rate $m**	**Total $m**	Fixed rate $m	Floating rate $m	Total $m	Fixed rate $m	Floating rate $m	Total $m
Financial liabilities									
Interest-bearing loans and borrowings									
Current	**1,232**	**661**	**1,893**	1,357	1,029	2,386	1,785	225	2,010
Non-current	**23,985**	**4,903**	**28,888**	17,005	989	17,994	14,893	1,324	16,217
Total	**25,217**	**5,564**	**30,781**	18,362	2,018	20,380	16,678	1,549	18,227
Financial assets									
Fixed deposits	**53**	**–**	**53**	42	–	42	38	–	38
Cash and cash equivalents	**–**	**6,329**	**6,329**	–	7,832	7,832	–	5,369	5,369
Total	**53**	**6,329**	**6,382**	42	7,832	7,874	38	5,369	5,407

In addition to the financial assets above, there are $8,765m (2020: $6,328m; 2019: $6,765m) of other current and non-current asset investments and other financial assets. Of these, $nil receive floating rate interest (2020: $nil; 2019: $111m).

The Group is also exposed to market risk on equity securities, which represent non-controlling interests in third-party biotech companies.

	2021 $m	2020 $m	2019 $m
Equity securities at fair value through Other comprehensive income (Note 12)	**1,168**	1,108	1,339
Total	**1,168**	1,108	1,339

Example 3

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Page 193 Interest rate risk management

Interest rate risk is the risk that the fair value or future cash flows of a financial instrument will fluctuate because of changes in market interest rates. The Group's exposure to the risk of changes in market interest rates relates primarily to the Group's long-term debt obligations with floating interest rates.

Interest rate risk is managed through the maintenance of a mixture of fixed and floating rate debt and interest rate swaps, each being reviewed on a regular basis to ensure the appropriate mix is maintained. See note 23 for further detail.

The Group's risk management objective, policy and performance are as follows:

Objective	To manage exposure to interest rate fluctuations on borrowings by varying the proportion of fixed rate debt relative to floating rate debt to reflect the underlying nature of its commitments and obligations. As a result, the Group does not maintain a specific set proportion of fixed versus floating debt, but monitors the mix to ensure that it is compatible with its business requirements and capital structure.
Policy	Interest rate hedging and the monitoring of the mix between fixed and floating rates are the responsibility of the treasury department, and are subject to the policy and guidelines set by the Board.
Performance	As at 31 March 2021, the Group had 70% fixed rate debt (2020: 60%) and 30% floating rate debt (2020: 40%) based on gross debt including derivatives of £2,340.0 million (2020: £3,126.8 million). The percentages for the prior year included the fully drawn down revolving credit facility which if excluded would have resulted in 81% fixed rate debt and 19% floating rate debt. For further information see note 23.

The following table demonstrates the sensitivity to a reasonably possible change in interest rates on that portion of loans and borrowings affected, after the impact of hedge accounting. With all other variables held constant, the Group's profit before tax is affected through the impact on floating rate borrowings, as follows:

	Change in interest rate	Effect on profit before tax £m
GBP	0.5%	2.0
EUR	0.5%	1.2
ZAR	0.5%	0.1

Page 245&246 Interest rate exposure

Currency	2021 Total £m	2021 Floating rate £m	2021 Fixed rate £m
Sterling	**851.8**	**399.4**	**452.4**
Euro	**1,248.9**	**245.7**	**1,003.2**
US Dollar*	**123.9**	**18.8**	**105.1**
South African Rand	**23.0**	**14.8**	**8.2**
Canadian Dollar	**8.5**	**–**	**8.5**
Australian Dollar	**36.7**	**–**	**36.7**
Norwegian Krone	**0.7**	**–**	**0.7**
Swedish Krona	**18.5**	**–**	**18.5**
New Zealand Dollar	**0.8**	**–**	**0.8**
South Korean Won	**1.5**	**–**	**1.5**
Danish Krone	**0.5**	**–**	**0.5**
	2,314.8	**678.7**	**1,636.1**

Currency	2020 (restated) Total £m	2020 (restated) Floating rate £m	2020 (restated) Fixed rate £m
Sterling	1,800.4	1,238.6	561.8
Euro*	1,298.3	256.8	1,041.5
US Dollar*	528.2	251.0	277.2
South African Rand	23.1	15.6	7.5
Canadian Dollar	10.2	–	10.2
Australian Dollar	37.1	–	37.1
Norwegian Krone	1.4	–	1.4
Swedish Krona	20.8	–	20.8
Brazilian Real	5.8	5.8	–
South Korean Won	2.0	–	2.0
	3,727.3	1,767.8	1,959.5

Page 249&250 Interest rate swap usage

The Group maintains interest rate and cross-currency swap contracts as fair value hedges of the interest rate and currency risk on fixed rate debt issued by the Group.

These derivative contracts receive a fixed rate of interest and pay a variable interest rate. These are formally designated in fair value hedging relationships and are used to hedge the exposure to changes in the fair value of debt which has been issued by the Group at fixed rates.

The Group held the following interest rate hedges at 31 March 2021:

Hedged	Amount £m	Fixed payable %	Floating receivable %	Maturity
Interest rate swap	**3.9**	**4.745**	**6 month LIBOR**	**31/03/2029**

Hedged – EURO	Amount EURm	Amount at swapped rates £m	Swap %	Maturity
Cross currency and interest rate swap	**275.0**	**246.7**	**Fixed 1.375% EUR to fixed 2.931% GBP**	**13/09/2027**
Cross currency and interest rate swap	**275.0**	**246.7**	**Fixed 1.375% EUR to floating 3-month LIBOR + margin GBP**	**13/09/2027**
Total cross currency and interest rate swap – EURO	**550.0**	**493.4**		

Chapter 5: Thesis Conclusion

1. Summary

This thesis presents three essays that examine different but related topics in the corporate hedging. In brief, the first study examines the determinants of corporate hedging from a micro perspective, while the third study explores this issue from a macro level. On the other hand, the second study investigates the impact of corporate hedging.

Specifically, the first study presents one of the most comprehensive and robust examinations of the economic rationale for Chinese corporate hedging. Our results show that proxies for the likelihood of financial distress are more important drivers of the decision to hedge among HK firms compared to Mainland China firms. Moreover, we find that the negative impact of state ownership on the hedging decision is significantly much smaller for HK firms. In effect, state ownership is a more effective substitute for hedging among Mainland China firms than HK firms. These results are in line with the arms-length approach adopted by the Chinese state when it comes to rescuing firms such as state-owned enterprises (SOEs) in HK. We also find that state ownership is a more effective substitute for interest rate (IR) derivatives hedging than foreign exchange (FX) derivatives hedging for both Mainland China and HK firms. This result is consistent with our expectations, as both state ownership and IR derivatives usage provide direct protection against credit default. This study also shows that public policy intervention by way of derivatives markets regulation in 2010 decreased hedging activity among Mainland China firms. Furthermore, consistent with expectations, we find that the regulation has no significant impact on HK companies' derivatives use.

This study contributes to the extant literature on corporate hedging by offering novel and new insights into the determinants of hedging activities by Chinese non-financial firms, particularly for all hedging, IR derivatives use and FX hedging. This study addresses a crucial research gap in this field and enhances our understanding of the impact of state ownership on the corporate hedging decision. Moreover, this study develops new methodologies to control for the bias caused by other types of hedgers in the non-hedging sample and introduces Receiver Operating Characteristic (ROC) curve analysis, which have important implications for future research in this field. Furthermore, the findings of this study are relevant for public policymakers, investors, and corporate risk managers, providing valuable insights into the hedging behaviours of Chinese firms. These insights can inform decision-making and risk management strategies in practice.

The second study examines the impact of corporate hedging and its interaction with state ownership on a firm's probability of financial distress in a Chinese setting. We find that corporate hedging significantly reduces the probability of default for firms. Importantly, we provide unambiguous evidence that the effectiveness of corporate hedging in mitigating the likelihood of bankruptcy is contingent on the type of hedging method used, with IR derivatives demonstrating the most effective role in reducing default risk. We observe that SOEs are less likely to default, and that state ownership significantly moderates the impact of corporate hedging on the probability of financial distress. In essence, our results suggest that state ownership is a substitute for corporate hedging.

Moreover, we find the role state ownership plays in the effect of corporate hedging on a firm's likelihood of bankruptcy varies with respect to firm size. Our findings suggest that state ownership serves as a more effective substitute for hedging among large SOEs, particularly in the case of derivatives hedging and especially so for IR derivatives hedging. This may be attributed to the Chinese government's stance of preventing the failure of large SOEs due to the potential implications on the wider economy and employment opportunities. However, we find that as the government gradually withdraws the implicit government guarantees (IGG) provided to SOEs, state ownership gradually loses its ability to substitute for the role of corporate hedging in mitigating the likelihood of bankruptcy of SOEs. This implies that corporate hedging has become increasingly crucial in managing SOEs' default risk. Interestingly, we find that the moderating effect of state ownership is much stronger under higher economic policy uncertainty (EPU), suggesting that the Chinese government tend to provide protection and support to SOEs during periods of high perceived macroeconomic risk and uncertainty.

This study contributes to the existing literature on corporate hedging by providing novel and significant insights into the effects and effectiveness of hedging in the context of default risk among Chinese firms. It addresses an important research gap in this area and enhances our understanding of the role of state ownership in corporate risk management. Moreover, the findings of this study are relevant to public policy makers, central banks, investors, and corporate treasurers, as it provides valuable insights on the hedging behaviours of Chinese firms and the impact on the likelihood of firm failure, which can inform policy making and risk management strategies in practice. Additionally, for risk managers in SOEs, perhaps now is the time to acquire a strong understanding of how to effectively use corporate hedging for risk mitigation.

In the third study, we investigate the effect of EPU on firms' IR swaps usage and IR debt structure. Our results show that firms significantly decrease their use of swapping to floating-rate debt and increases their usage of swapping to fixed-rate debt to lower their final floating-rate debt in response to elevated levels of EPU. These findings have both statistical and economic significance. Interestingly, we find that EPU has no significant impact on the overall usage of IR swaps, which may be attributed to the opposing effects resulting from the reduction in swapping to floating-rate debt and the increase in swapping to fixed-rate debt. This underscores the importance of considering the direction of IR swap strategies. Furthermore, we find that the magnitude of the impact of EPU on firms' IR swap strategies and their final floating-rate debt structure is amplified when firms exhibit negative cash flow IR sensitivity, are financially constrained, and are dependent on bank debt.

Our final study not only extends recent studies which investigate the impact of EPU on firms but also contributes to the literature exploring the drivers of firms' IR swap usage and final IR exposure of debt. Our findings suggest that firms can adjust their debt structure through IR swap usage to cope with high EPU, which may mitigate the adverse influences of EPU, thereby reducing firms' IR risks and enhancing economic and financial stability. Moreover, our findings enhance the understanding of the roles of cash flow IR sensitivity, financial constraints, and sources of debt in firms' corporate risk management. Furthermore, the findings of this essay are relevant to CFOs and corporate treasurers, as it provides valuable insights on employing IR swaps in response to high macroeconomic risk, which can inform risk management strategies in practice.

2. Future research[1]

The first and second studies in this thesis use firms listed on the HKSE rather than those listed on Mainland China's A-share market to construct the sample. This choice is primarily due to the fact that firms listed on the HKSE generally exhibit a higher level of sophistication and possess extensive experience in risk management, thereby providing a richer dataset on corporate hedging practices compared to A-share-listed firms. This is closely related to the development of the derivatives market. Hong Kong already had a well-established derivatives market in the early 21st century, while Mainland China only began to offer more than one type of FX and IR derivative after 2008. Furthermore, the accounting standards on the HKSE are more closely aligned with international financial reporting standards (IFRS) than those applied to firms on the A-share market. This alignment enables HKSE-listed firms to disclose more accurate and detailed information on risk management practices. In contrast,

[1] We are deeply grateful to Professor Radu Tunaru and Dr Ahmed Barakat for providing valuable insights and suggestions for potential future research.

there are significant limitations in the hedging disclosure practices among firms listed on the A-share market (Guo et al., 2021). However, in 2014, China's Ministry of Finance made adjustments to the Chinese accounting standards, introducing and revising several standards, including those for financial instruments, revenue, and leasing, to further improve accounting disclosure requirements and align with IFRS.[2] These new standards mandate that Mainland China firms disclose information related to derivatives starting in 2014, leading to more accurate and detailed hedging data for these firms after this point and thus providing a solid data foundation for research on their hedging activities.

In the first study of this thesis, based on the location of corporate headquarters of HKSE-listed companies, we divide our sample into 245 Mainland China firms and 256 HK firms to examine the differential determinants influencing their respective hedging decisions. However, considering the differences between the A-share market and the Hong Kong market, such as the restrictions on foreign investors in the A-share market (Ding et al., 2018) and the more open and accessible trading environment for global investors in the HK market (Ho and Odhiambo, 2015), using Mainland China firms listed on the A-share market would provide an interesting comparison.

Including the HKSE, China has four stock exchanges, each with its own characteristics. Specifically, the Shanghai Stock Exchange (SHSE) primarily serves large firms and SOEs in China, while the Shenzhen Stock Exchange (SZSE) mainly caters to small and medium-sized firms (Tan et al., 2008). The newly established Beijing Stock Exchange mainly focuses on innovative firms in China[3], and the HKSE serves not only Chinese companies but also firms from around the world.[4] Therefore, investigating whether the determinants of hedging differ across stock exchanges would be an intriguing research direction, especially for firms that are listed on more

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[2] Decision of the Ministry of Finance on Amending the Accounting Standards for Business Enterprises – Basic Standards (Revised 2014 Edition). Website: https://www.moj.gov.cn/pub/sfbgw/flfggz/flfggzbmgz/201503/t20150306_145503.html.

[3] Beijing stock exchange. Website: https://www.bse.cn/index.html.

[4] Hong Kong stock exchange. Website: https://www.hkex.com.hk/?sc_lang=zh-HK.

than one stock exchange. For example, in our sample, there are 36 firms that are dual-listed on both the HKSE and China's A-share market. Considering the potential information flow between different stock exchanges, such as the volatility spill-over effect (Fabozzi et al., 2004), using dual-listed firms on more than one stock exchange as a comparison or investigating the impact of information flow on their hedging decisions would be a very interesting and promising research direction. In addition, the first study of this thesis develops new methodologies to control for the bias caused by other types of hedgers in the non-hedging sample and introduces ROC curve analysis. These methods can be applied in future research to examine the A-share market.

Lievenbrück and Schmid (2014) are the first to introduce the culture into the field of corporate hedging. They reveal that culture has a strong influence on corporate hedging, while other country-specific factors such as economic development or legal frameworks does not reflect this impact. Specifically, in countries with long-term orientation cultures, firms tend to significantly reduce both the likelihood and the magnitude of hedging activities. China is the birthplace of Confucian culture and is deeply influenced by it. The core of Confucian culture is long-term orientation (Hwang et al., 2013). Therefore, studying the impact of Confucian culture on corporate hedging is a very interesting direction. In particular, the influence of Confucian culture differs between Mainland China and Hong Kong (Lin and Ho, 2009). Hence, future research could explore whether the differential impact of Confucian culture on firms in Mainland China and Hong Kong is reflected in their corporate hedging decisions.

As the seminal paper, Knopf et al. (2002) firstly examine the impact of managerial compensation incentives on corporate hedging. Specifically, they find that the sensitivity of a manager's equity-linked compensation to stock price volatility increases a company's hedging activities, while the sensitivity of equity-linked compensation to earnings volatility reduces corporate hedging. Subsequently, based on a theoretical framework analysis, Akron and Benninga (2013) deduce that equity-linked compensation can lead to excessive hedging by management. However, in China, very few companies offer equity-linked compensation, and even when they do, the disclosed information is extremely limited (Firth et al., 2006). This greatly limits research on topics related to equity-linked compensation in Chinese companies. Until 2016, the Chinese government introduced policies to improve compensation incentive mechanisms and to strengthen the transparency and regulation of equity incentive plans[5]. Meanwhile, China Securities Regulatory Commission required listed companies to enhance information disclosure when implementing equity incentive plans. This led more Chinese firms to adopt equity-linked compensation and to disclose more accurate and richer information, providing data support for investigating equity-linked compensation in the Chinese market. Therefore, future research could explore the impact of managers’ equity-linked compensation on the hedging decision of Chinese firms. Moreover, Jin et al. (2023b) find that Confucian culture has a significant impact on CEO compensation in Chinese firms. Specifically, they observe that Chinese firms more strongly influenced by Confucianism tend to have lower CEO pay, smaller CEO pay gaps, and larger gender pay gaps. Hence, future research could integrate managerial compensation incentives and cultural factors to examine their combined impact on corporate hedging decisions-for instance, whether Confucian culture influences hedging decisions by shaping executives' equity-linked compensation in Chinese firms. This is a very interesting and valuable research direction.

From the iconic slogan "Women hold up half the sky" in the last century to the more recent "Her Era," women have been playing increasingly crucial roles in contemporary corporate development and governance. As women's influence expands across various sectors, substantial changes are taking place in the business environment. Lievenbrück and Schmid (2014) not only reveal that culture has a

[5] China Securities Regulatory Commission. Measures for the management of equity incentive of listed companies. Website: http://www.csrc.gov.cn/csrc/c106256/c1654022/content.shtml.

significant impact on corporate hedging, but also further categorize gender culture into male-dominated and female-dominated societies. They find that firms in male-dominated societies engage in less hedging activities. Given that Lievenbrück and Schmid (2014) address this issue from a macro perspective, future research could investigate this topic from a micro perspective, such as exploring the influence of female CEOs or female board members on corporate hedging decisions. Given that a substantial body of research indicates that female executives are more risk-averse than their male counterparts (Klenke, 2003; Krishnan and Park, 2005; Lyngsie and Foss, 2017), future research may draw similar conclusions to Lievenbrück and Schmid (2014) from a micro perspective.

The second study of this thesis also builds the sample using Chinese non-financial firms listed on the HKSE to examine the impact of corporate hedging on default risk and the moderating effect of state ownership on this relationship. Considering the "one country, two systems" framework, Mainland China firms, particularly those listed on the A-share market, are subject to stronger government regulation. This means that state ownership may play a more substantial role in reducing default risk, potentially acting as a stronger substitute for corporate hedging. Therefore, introducing Chinese firms listed on the A-share market and conducting a comparative analysis with those listed on the HKSE would be an intriguing research direction. Moreover, after 2015, the Chinese government began to reduce the IGG provided to SOEs. Our findings suggest that this diminished the substitutive role of state ownership, particularly in 2020. This phenomenon may be more pronounced for Mainland China firms listed on the A-share market. Future research could further explore this issue.

Furthermore, the SHSE is primarily composed of large Chinese firms and SOEs, while the SZSE mainly consists of Chinese small and medium-sized firms (Tan et al., 2008). The HKSE, on the other hand, is made up of global companies. Therefore, the substitutive role of state ownership in reducing firm risk through hedging may be influenced by the stock exchange. Moreover, the trend of this substitutive role weakening with the reduction of IGG may also vary across different stock exchanges. This is also a potential direction for future research.

Internationalization refers to the process by which a company gradually increases its involvement in foreign markets over time (Welch and Luostarinen, 1988). Forsgren (2002) and Tang and Yan (2010) find that internationalization helps firms gain access to a broader market, thereby providing additional revenue sources, which in turn improves their financial condition and reduces the default risk. Subsequently, by constructing a moderating model of the dynamic joint effects of internationalization, environmental dynamism, and marketing capability on the default vulnerability of global firms, Sun et al. (2020) show that high marketing capability helps globalized firms reduce default risk. Our sample is built on Chinese non-financial firms listed on the HKSE, which is an open and accessible trading environment for global investors in the international financial market (Ho and Odhiambo, 2015). In contrast, due to restrictions on foreign investors (Ding et al., 2018), the A-share market in Mainland China is primarily traded by local investors. As a result, firms listed on the A-share market tend to have a much lower level of internationalization compared to those listed on the HKSE. Therefore, future research could compare A-share listed firms with HKSE listed firms to examine the mechanism through which internationalization impacts corporate hedging and, in turn, affects default risk, as well as whether this mechanism is influenced by state ownership. Particularly, future research could focus on firms that are dual-listed on both the A-share market and the HKSE as a reference, comparing them with firms that are solely listed on the A-share market. This would more clearly highlight the impact of internationalization on corporate hedging, which is a very interesting potential research direction.

Considering that financial firms often sell derivatives to their corporate clients and use them for speculative purposes rather than employing them for controlling risk (Bartram, 2019; Cheng and Cheung, 2021), this study focuses on non-financial firms.

This leaves room for future research on financial firms such as banks. On one hand, future research could focus on banks instead of non-financial firms to investigate how corporate hedging affects default risk and whether this effect is influenced by state ownership. On the other hand, future research could continue to study non-financial firms while introducing bank oversight to explore the role it plays in corporate hedging. Yildirim (2020) find that bank oversight can reduce firms' default risk by enhancing their technical efficiency. Therefore, it would be interesting for future research to explore whether bank oversight can also influence firms' default risk by affecting corporate hedging activities. This is an open avenue for future research. The second study of this thesis finds that corporate hedging, particularly through IR derivatives, can significantly reduce firms' default risk. Therefore, if bank oversight, as Yildirim (2020) suggests, reduces default risk, firms obtaining new loans may increase their hedging activities. However, Garleanu and Pedersen (2007), Rampini et al. (2014) and Bretscher et al. (2018) indicate that the use of IR derivatives can incur high costs and potential financing risks, which in turn suggests that bank oversight might reduce firms' hedging activities to control their risk. Furthermore, due to the IGG for SOEs, Chinese banks, especially state-owned banks, tend to exercise less intensive and less stringent oversight on these firms compared to private companies (Bailey et al., 2011). Hence, future research could further incorporate ownership structure to examine whether it influences the mechanism through which bank oversight affects default risk by impacting corporate hedging activities. This is a potentially valuable research direction.

In the third study, we find that firms actively adjust their IR swap strategies and final floating-rate debt to cope with high EPU. Future research could further explore the effects of these adjustments, such as whether they lead to a reduction in firm risk, particularly default risk. This presents an interesting and important research direction. Furthermore, we find that EPU has no significant impact on the overall usage of IR swaps, which may be attributed to the opposing effects of the reduction in swapping to floating-rate debt and the increase in swapping to fixed-rate debt. This underscores the importance of considering the direction of IR swap usage. On one hand, this provides an important methodology for future IR swap-related research, specifically distinguishing between different directions of IR swap usage. On the other hand, investigating the impact of the direction of IR swap usage on firm risk is also a particularly promising area for future research.

Herding refers to the phenomenon in which investors disregard their private information and judgment, and instead make their investment decisions based on the actions of other participants (Yao et al., 2014). The prevailing consensus among the majority of the literature suggests that herding can increase market risk, lead to price bubbles, distort the efficient allocation of resources, and even trigger market turbulence (Shiller, 1981; Lee et al., 1991; Avery and Zemsky, 1998; Dong and Han, 2007). Duygun et al. (2021) and Hasan et al. (2023) find that herding is often closely associated with systemic risk, such as during the Eurozone crisis, China’s A-share market crash in 2015, and in the aftermath of the Brexit vote. Interestingly, the macroeconomic risk indicator EPU used in the third paper of this thesis includes events such as the Eurozone crisis and the Brexit vote, and it shows that EPU leads firms to significantly adjust their IR swap usage and final floating-rate debt. This suggests that the herding behaviour associated with systemic risk may further drive firms to hedge by influencing market risk. This presents an interesting and important research direction. Future research could examine the impact of herding on corporate hedging, potentially using market risk and default risk as intermediary mechanisms to address this question.

Furthermore, the third study of this thesis uses the continuous variable EPU to measure the macroeconomic and political uncertainty and risk faced by firms. Inspired by Hasan et al. (2023), future research could select specific events, such as the Eurozone crisis, China’s A-share market crash, and the Brexit vote, as shocks, and use a Difference-in-Differences approach to examine their impact on corporate hedging. This could be a potentially valuable research direction.

Moreover, we use the news-based UK EPU index developed by Baker et al. (2016) as a proxy for EPU, which is a national-level macroeconomic indicator. Although this is the EPU measure adopted in most of the prior literature (Francis et al., 2014 ; Zhang et al., 2015; Çolak et al., 2018 ; Ashraf and Shen, 2019 ; Gu et al., 2019), this macro-level indicator does not exhibit cross-sectional variations. Recently, Hassan et al. (2019) developed a firm-level Policy Uncertainty (PU) index, which has started to gain attention in some research (Hassan et al., 2023; Gad et al., 2024; Hassan et al., 2024). Similar to Baker et al. (2016), Hassan et al. (2019) construct their PU index using policy-relevant terms and textual analysis. The key difference is that the latter use quarterly earnings conference-call transcripts rather than newspapers, enabling the creation of a firm-level index. Specifically, Hassan et al. (2019) quantify a firm's PU at a given point in time by calculating the frequency of policy-relevant terms and dividing it by the total length of the conference call transcript. A higher firm-level PU index indicates greater PU for the firm. It is an interesting direction for future research to use this firm-level PU index sourced from Hassan et al. (2019) to investigate its impact on the IR swaps usage and IR debt structure.[6] Additionally, the methodology for distinguishing the direction of IR swaps, as proposed in the third paper of this thesis, can be applied to these studies.

In addition, the third study examines the determinants of corporate IR swap usage and IR debt structure from a macroeconomic perspective. However, within the control variables, we only include one macro-level variable, which is GDP growth rate, while the others are firm-level variables. Lang et al. (1998) and Azad et al. (2012) find that the spread and volatility of IR swaps are related to several macroeconomic factors, such as the unemployment rate and consumer price index (CPI). This suggests that we may need to incorporate additional macro-level factors as control variables.

[6] Our sample starts from 1999, while the data from Hassan et al. (2019) begins in 2002, with limited data available in the earlier years. On the other hand, Hassan et al. (2019) select quarterly earnings conference-call transcripts as the basis for their calculations, which is based on the practices of U.S. firms. Specifically, the majority of publicly listed U.S. firms regularly hold earnings calls with analysts and other stakeholders, where management discusses the company's past and future performance and answers questions from conference call participants (Hassan et al., 2019). However, this practice may not be applicable to many UK firms, which could prevent Hassan et al. (2019) from calculating the firm-level PU for these firms. These factors result in only 36% of the observations in our sample being matched with the UK firm-level PU sourced from Hassan et al. (2019). Therefore, we did not use this measure as a proxy for EPU.

Nevertheless, extensive literature indicates that EPU significantly raises unemployment rates (Caggiano et al., 2017; Ahmed et al., 2022; Haldar and Sethi, 2022; Zaria and Tuyon, 2023). On the other hand, Athari et al. (2022) discover that EPU is closely associated with inflation and can be used to predict inflationary risk. Therefore, to avoid multicollinearity, we do not introduce unemployment rate and CPI as control variables. However, future research could further explore the mechanism by which EPU affects corporate IR swap usage and IR debt structure. Specifically, whether EPU affects corporate IR swap usage and IR debt structure through influencing unemployment and CPI. This intriguing direction could enrich the literature on the real impact of EPU and the determinants of corporate hedging.

References

Adam, T. R. (2002). Do firms use derivatives to reduce their dependence on external capital markets?. *Review of Finance*, *6*(2), 163-187.

Adler, M., & Dumas, B. (1984). Exposure to currency risk: definition and measurement. *Financial Management*, 41-50.

Ahmed, A., Granberg, M., Troster, V., & Uddin, G. S. (2022). Asymmetric dynamics between uncertainty and unemployment flows in the United States. *Studies in Nonlinear Dynamics & Econometrics, 26*(1), 155-172.

Akron, S., & Benninga, S. (2013). Production and hedging implications of executive compensation schemes. *Journal of Corporate Finance, 19*, 119-139.

Al-Shboul, M., & Alison, S. (2009). The Effects of the Use of Corporate Derivatives on the Foreign Exchange Rate Exposure. *Journal of Accounting, Business & Management*, *16*(1).

Allayannis, G., & Ofek, E. (2001). Exchange rate exposure, hedging, and the use of foreign currency derivatives. *Journal of International Money and Finance*, *20*(2), 273-296.

Allayannis, G., & Weston, J. P. (2001). The use of foreign currency derivatives and firm market value. *The Review of Financial Studies*, 14(1), 243-276.

Allayannis, G., Lel, U., & Miller, D. P. (2012). The use of foreign currency derivatives, corporate governance, and firm value around the world. *Journal of International Economics, 87*(1), 65-79.

Anbil, S., Saretto, A., & Tookes, H. (2019). How does hedge designation impact the market's perception of credit risk?. *Journal of Financial Stability, 41*, 25-42.

Andreou, C. K., Andreou, P. C., & Lambertides, N. (2021). Financial distress risk and stock price crashes. *Journal of Corporate Finance, 67*, 101870.

Antoniou, A., Zhao, H., & Zhou, B. (2009). Corporate debt issues and interest rate risk management: hedging or market timing?. *Journal of Financial markets, 12*(3), 500-520.

Ashraf, B. N., & Shen, Y. (2019). Economic policy uncertainty and banks' loan pricing. *Journal of Financial Stability, 44*, 100695.

Ashraf, B. N. (2021). Is Economic uncertainty a risk factor in bank loan pricing decisions? international evidence. *Risks, 9*(5), 81.

Athari, S. A., Kirikkaleli, D., Yousaf, I., & Ali, S. (2022). Time and frequency co-movement between economic policy uncertainty and inflation: evidence from Japan. *Journal of Public Affairs, 22*, e2779.

Avery, C., & Zemsky, P. (1998). Multidimensional uncertainty and herd behavior in financial markets. *American economic review*, 724-748.

Azad, A. S., Fang, V., & Hung, C. H. (2012). Linking the interest rate swap markets to the macroeconomic risk: the UK and US evidence. *International Review of Financial Analysis, 22*, 38-47.

Azzimonti, M. (2018). Partisan conflict and private investment. *Journal of Monetary Economics, 93*, 114-131.

Bae, S. C., Kim, H. S., & Kwon, T. H. (2018). Currency derivatives for hedging: New evidence on determinants, firm risk, and performance. *Journal of Futures Markets*, 38(4), 446-467.

Bailey, W., Huang, W., & Yang, Z. (2011). Bank loans with Chinese characteristics: Some evidence on inside debt in a state-controlled banking system. *Journal of Financial and Quantitative Analysis, 46*(6), 1795-1830.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The Quarterly Journal of Economics, 131*(4), 1593-1636.

Baldassarri, G., Chen, A., & Heinrichs, M. (2012). PD Model—Market Signals: An Enhanced Structural Probability of Default Model. *Standard & Poor's*.

Bali, T. G., Brown, S. J., & Tang, Y. (2017). Is economic uncertainty priced in the cross-section of stock returns?. *Journal of Financial Economics, 126*(3), 471-489.

Bartram, S. M., Brown, G. W., & Fehle, F. R. (2009). International evidence on financial derivatives usage. *Financial Management, 38*(1), 185-206.

Bartram, S. M., Brown, G. W., & Minton, B. (2010). Resolving the exposure puzzle: The many facets of foreign exchange exposure. *Journal of Financial Economics*.

Bartram, S. M., Brown, G. W., & Conrad, J. (2011). The effects of derivatives on firm risk and value. *Journal of Financial and Quantitative Analysis*, *46*(4), 967-999.

Bartram, S. M., Brown, G. W., & Waller, W. (2015). How important is financial risk?. *Journal of Financial and Quantitative Analysis*, *50*(4), 801-824.

Bartram, S. M. (2019). Corporate hedging and speculation with derivatives. *Journal of Corporate Finance*, *57*, 9-34.

Barry, C. B., Mann, S. C., Mihov, V., & Rodríguez, M. (2009). Interest rate changes and the timing of debt issues. *Journal of Banking & Finance, 33*(4), 600-608.

Bessembinder, H. (1991). Forward contracts and firm value: Investment incentive and contracting effects. *Journal of Financial and Quantitative Analysis, 26*(4), 519-532.

Bloom, N. (2014). Fluctuations in uncertainty. *Journal of Economic Perspectives, 28*(2), 153-176.

Bloom, N., Floetotto, M., Jaimovich, N., Saporta-Eksten, I., & Terry, S. J. (2018). Really uncertain business cycles. *Econometrica, 86*(3), 1031-1065.

Bodnar, G. M., Giambona, E., Graham, J. R., & Harvey, C. R. (2019). A view inside corporate risk management. *Management Science*, *65*(11), 5001-5026.

Bonaime, A., Gulen, H., & Ion, M. (2018). Does policy uncertainty affect mergers and acquisitions?. *Journal of Financial Economics, 129*(3), 531-558.

Boubakri, N., Cosset, J. C., & Saffar, W. (2013). The role of state and foreign owners in corporate risk-taking: Evidence from privatization. *Journal of Financial Economics*, *108*(3), 641-658.

Boyer, M. M., & Marin, M. (2013). Financial distress risk and the hedging of foreign currency exposure. *The Quarterly Journal of Finance, 3*(01), 1350002.

Bradley, D., Pantzalis, C., & Yuan, X. (2016). Policy risk, corporate political strategies, and the cost of debt. *Journal of Corporate Finance, 40*, 254-275.

Bradshaw, M., Liao, G., & Ma, M. S. (2019). Agency costs and tax planning when the government is a major shareholder. *Journal of Accounting and Economics, 67*(2-3), 255-277.

Brandt, L., & Li, H. (2003). Bank discrimination in transition economies: ideology, information, or incentives?. *Journal of Comparative Economics*, *31*(3), 387-413.

Breeden, D. T., & Viswanathan, S. (2015). Why do firms hedge? An asymmetric information model. *The Journal of Fixed Income*, *25*(3), 7-25.

Bretscher, L., Schmid, L., & Vedolin, A. (2018). Interest rate risk management in uncertain times. *The Review of Financial Studies*, *31*(8), 3019-3060.

Brogaard, J., & Detzel, A. (2015). The asset-pricing implications of government economic policy uncertainty. *Management Science, 61*(1), 3-18.

Brogaard, J., Li, D., & Xia, Y. (2017). Stock liquidity and default risk. *Journal of Financial Economics*, *124*(3), 486-502.

Caggiano, G., Castelnuovo, E., & Figueres, J. M. (2017). Economic policy uncertainty and unemployment in the United States: A nonlinear approach. *Economics Letters, 151*, 31-34.

Campbell, J. Y., Hilscher, J., & Szilagyi, J. (2008). In search of distress risk. *The Journal of Finance*, *63*(6), 2899-2939.

Carroll, A., O'Brien, F., & Ryan, J. (2017). An examination of European firms' derivatives usage: The importance of model selection. *European Financial Management, 23*(4), 648-690.

Carter, D. A., Rogers, D. A., & Simkins, B. J. (2006). Does hedging affect firm value? Evidence from the US airline industry. *Financial Management, 35*(1), 53-86.

Chang, S. C., & Boontham, W. (2017). Post-privatization speed of state ownership relinquishment: Determinants and influence on firm performance. *The North American Journal of Economics and Finance*, *41*, 82-96.

Chava, S., & Purnanandam, A. (2007). Determinants of the floating-to-fixed rate debt structure of firms. *Journal of Financial Economics, 85*(3), 755-786.

Chen, J., & King, T. H. D. (2014). Corporate hedging and the cost of debt. *Journal of Corporate Finance*, *29*, 221-245.

Cheng, L., & Cheung, A. W. (2021). Is there a dark side of managerial ability? Evidence from the use of derivatives and firm risk in China. *Journal of Contemporary Accounting & Economics*, *17*(2), 100258.

Chernenko, S., & Faulkender, M. (2011). The two sides of derivatives usage: Hedging and speculating with interest rate swaps. *Journal of Financial and Quantitative Analysis*, *46*(6), 1727-1754.

Clark, E. and Judge, A. (2008). The determinants of foreign currency hedging: Does foreign currency debt induce a bias? *European Financial Management*, *14* (3), 445-469.

Çolak, G., Durnev, A., & Qian, Y. (2017). Political uncertainty and IPO activity: Evidence from US gubernatorial elections. *Journal of Financial and Quantitative Analysis, 52*(6), 2523-2564.

Çolak, G., Gungoraydinoglu, A., & Öztekin, Ö. (2018). Global leverage adjustments, uncertainty, and country institutional strength. *Journal of Financial Intermediation, 35*, 41-56.

Cook, D. O., Kieschnick, R., & McCullough, B. D. (2008). Regression analysis of proportions in finance with self selection. *Journal of Empirical Finance*, *15*(5), 860-867.

Davis, S. J., Liu, D., & Sheng, X. S. (2019). Economic policy uncertainty in China since 1949: The view from mainland newspapers. In *Fourth Annual IMF-Atlanta Fed Research Workshop on China's Economy Atlanta* (Vol. 19, pp. 1-37).

Dávila, E., & Walther, A. (2020). Does size matter? Bailouts with large and small banks. *Journal of Financial Economics, 136*(1), 1-22.

Ding, R., Hou, W., Liu, Y. L., & Zhang, J. Z. (2018). Media censorship and stock price: Evidence from the foreign share discount in China. *Journal of International Financial Markets, Institutions and Money, 55*, 112-133.

Disatnik, D., Duchin, R., & Schmidt, B. (2014). Cash flow hedging and liquidity choices. *Review of Finance, 18*(2), 715-748.

DeLong, E. R., DeLong, D. M., & Clarke-Pearson, D. L. (1988). Comparing the areas under two or more correlated receiver operating characteristic curves: a nonparametric approach. *Biometrics*, 837-845.

Dolde, W. (1993). The trajectory of corporate financial risk management. *Journal of Applied Corporate Finance, 6*(3), 33-41.

Dong, Z. Y., & Han, X. (2007). Detection Method of Herd Behavior Based on GCAPM and Empirical Evidence in the Chinese Stock Market. *Financial Research, (05A)*, 108-117.

Dong, Y., Hou, Q., & Ni, C. (2021). Implicit government guarantees and credit ratings. *Journal of Corporate Finance, 69*, 102046.

Duffie, D., Saita, L., & Wang, K. (2007). Multi-period corporate default prediction with stochastic covariates. *Journal of financial economics*, *83*(3), 635-665.

Duygun, M., Tunaru, R., & Vioto, D. (2021). Herding by corporates in the US and the Eurozone through different market conditions. *Journal of International Money and Finance, 110*, 102311.

Erol, T., Algüner, A., & Üçükkocaoğlu, G. (2013). Exchange Rate Exposure of Real Sector Firms in an Emerging Economy. *Journal of Finance and Accounting*, *1*(1), 1-12.

Fabozzi, F. J., Tunaru, R., & Wu, T. (2004). Modeling volatility for the Chinese equity markets. *ANNALS OF ECONOMICS AND FINANCE., 5*, 79-92.

Farre-Mensa, J., & Ljungqvist, A. (2016). Do measures of financial constraints measure financial constraints?. *The Review of Financial Studies, 29*(2), 271-308.

Faulkender, M. (2005). Hedging or market timing? Selecting the interest rate exposure of corporate debt. *The Journal of Finance, 60*(2), 931-962.

Fawcett, T. (2006). An introduction to ROC analysis. *Pattern Recognition Letters, 27*(8), 861-874.

Firth, M., Fung, P. M., & Rui, O. M. (2006). Corporate performance and CEO compensation in China. *Journal of Corporate Finance, 12*(4), 693-714.

Forsgren, M. (2002). The concept of learning in the Uppsala internationalization process model: a critical review. *International business review, 11*(3), 257-277.

Francis, B. B., Hasan, I., & Zhu, Y. (2014). Political uncertainty and bank loan contracting. *Journal of Empirical Finance, 29*, 281-286.

Friberg, R., & Seiler, T. (2017). Risk and ambiguity in 10-Ks: An examination of cash holding and derivatives use. *Journal of Corporate Finance, 45,* 608-631.

Froot, K. A., Scharfstein, D. S., & Stein, J. C. (1993). Risk management: Coordinating corporate investment and financing policies. *The Journal of Finance, 48*(5), 1629-1658.

Gad, M., Nikolaev, V., Tahoun, A., & van Lent, L. (2024). Firm-level political risk and credit markets. *Journal of Accounting and Economics, 77*(2-3), 101642.

Garleanu, N., & Pedersen, L. H. (2007). Liquidity and risk management. *American Economic Review, 97*(2), 193-197.

Gay, G. D., Lin, C. M., & Smith, S. D. (2011). Corporate derivatives use and the cost of equity. *Journal of Banking & Finance, 35*(6), 1491-1506.

Géczy, C., Minton, B. A., & Schrand, C. (1997). Why firms use currency derivatives. *The Journal of Finance, 52*(4), 1323-1354.

Géczy, C. C., Minton, B. A., & Schrand, C. M. (2007). Taking a view: Corporate speculation, governance, and compensation. *The Journal of Finance*, *62*(5), 2405-2443.

Geyer-Klingeberg, J., Hang, M., Rathgeber, A. W., Stöckl, S., & Walter, M. (2018). What do we really know about corporate hedging? A meta-analytical study. *Business Research, 11*(1), 1-31.

Geyer-Klingeberg, J., Hang, M., & Rathgeber, A. W. (2019). What drives financial hedging? A meta-regression analysis of corporate hedging determinants. *International Review of Financial Analysis, 61*, 203-221.

Gonzalez, L. O., Bua, M. V., Lopez, S. F., & Santomil, P. D. (2010). Foreign debt as a hedging instrument of exchange rate risk: a new perspective. *The European Journal of Finance, 16*(7), 677-710.

Graham, J. R., & Rogers, D. A. (2002). Do firms hedge in response to tax incentives?. *The Journal of Finance, 57*(2), 815-839.

Gu, X., Hasan, I., & Zhu, Y. (2019). Political influence and financial flexibility: Evidence from China. *Journal of Banking & Finance, 99*, 142-156.

Gu, X., Lian, Z., Peng, L., & Zhao, Q. (2023). A comparative study of bank efficiency in three Chinese regions: Mainland China, Hong Kong, and Macao. *Journal of Financial Research, 46*(2), 547-571.

Guay, W. R. (1999). The impact of derivatives on firm risk: An empirical examination of new derivative users. *Journal of Accounting and Economics*, *26*(1-3), 319-351.

Guay, W., & Kothari, S. P. (2003). How much do firms hedge with derivatives?. *Journal of Financial Economics*, *70*(3), 423-461.

Gul, F. A., Khedmati, M., Lim, E. K., & Navissi, F. (2018). Managerial ability, financial distress, and audit fees. *Accounting Horizons*, *32*(1), 29-51.

Gulen, H., & Ion, M. (2016). Policy uncertainty and corporate investment. *The Review of Financial Studies, 29*(3), 523-564.

Guo, F. (2012). Foreign exchange risk hedging and firm value: Evidence from the MNCs in China. *Economic Research Journal*, *9*, 18-31.

Guo, F., Wang, X. N., & Ma, R. (2013). Financial hedging, operational hedging and corporate value (in Chinese). *Journal of Zhongnan University of Economics and Law*, (3), 88-93.

Guo, F., You, H., & Guo, H. (2018). Why do firms raise foreign currency denominated debt? Evidence from Chinese listed companies (in Chinese). *Journal of Financial Research*, *453*(3), 137-154.

Guo, H., Pan, Z., & Tian, G. G. (2021). State ownership and the risk-reducing effect of corporate derivative use: Evidence from China. *Journal of Business Finance & Accounting*, *48*(5-6), 1092-1133.

Hadlock, C. J., & Pierce, J. R. (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies, 23*(5), 1909-1940.

Haldar, A., & Sethi, N. (2022). The economic effects of Covid-19 mitigation policies on unemployment and economic policy uncertainty. *Bulletin of Monetary Economics and Banking, 25*, 61-84.

Hassan, T. A., Hollander, S., Van Lent, L., & Tahoun, A. (2019). Firm-level political risk: Measurement and effects. *The Quarterly Journal of Economics, 134*(4), 2135-2202.

Hasan, I., Tunaru, R., & Vioto, D. (2023). Herding behavior and systemic risk in global stock markets. *Journal of Empirical Finance, 73*, 107-133.

Hassan, T. A., Hollander, S., Van Lent, L., Schwedeler, M., & Tahoun, A. (2023). Firm-level exposure to epidemic diseases: Covid-19, SARS, and H1N1. *The Review of Financial Studies, 36*(12), 4919-4964.

Hassan, T. A., Hollander, S., Lent, L. V., & Tahoun, A. (2024). The global impact of Brexit uncertainty. *The Journal of Finance, 79*(1), 413-458.

Haushalter, D., Klasa, S., & Maxwell, W. F. (2007). The influence of product market dynamics on a firm's cash holdings and hedging behavior. *Journal of Financial Economics, 84*(3), 797-825.

He, Q., Liu, J., & Zhang, C. (2021). Exchange rate exposure and its determinants in China. *China Economic Review*, *65*, 101579.

He, Q., Wang, W., & Yu, J. (2023). Exchange rate co-movements and corporate foreign exchange exposures: A study on RMB. *International Review of Financial Analysis, 90*, 102831.

He, Q., Liang, B., & Liu, J. (2024). RMB internationalization and exchange rate exposure of Chinese listed firms. *Journal of International Money and Finance*, 103098.

Hentschel, L., & Kothari, S. P. (2001). Are corporations reducing or taking risks with derivatives?. *Journal of Financial and Quantitative Analysis*, *36*(1), 93-118.

Hillegeist, S. A., Keating, E. K., Cram, D. P., & Lundstedt, K. G. (2004). Assessing the probability of bankruptcy. *Review of Accounting Studies*, *9*(1), 5-34.

Ho, S. Y., & Odhiambo, N. M. (2015). Stock market performance in Hong Kong: an exploratory review. *Asian-Pacific Economic Literature, 29*(1), 47-61.

HON Tai Yuen, K., Yin, W. K., & Shum, P. (2015). Behavioral study of financial derivatives investments in Hong Kong. *Asian Profile.*

Hotchkiss, E., John, K., Li, B., Ponticelli, J., & Wang, W. (2023). Default and Bankruptcy Resolution in China. *Annual Review of Financial Economics, 15*, 369-385.

Hou, D., & Skeie, D. R. (2014). LIBOR: Origins, economics, crisis, scandal, and reform. *FRB of New York Staff Report,* (667).

House, F. (2007). Annual freedom in the world survey: political rights and civil liberties rating 1972-2006.

Hu, C., & Wang, P. (2005). The determinants of foreign currency hedging–evidence from HK non-financial firms. *Asia-Pacific Financial Markets, 12*(1), 91-107.

Huang, T. (2021). Rising SOE defaults alarm investors but could benefit the Chinese economy. From https://www.piie.com/blogs/china-economic-watch/rising-soe-defaults-alarm-investors-could-benefit-chinese-economy.

Hutson, E., & Laing, E. (2014). Foreign exchange exposure and multinationality. *Journal of Banking & Finance*, *43*, 97-113.

Hwang, J., Chung, J. E., & Jin, B. (2013). Culture matters: The role of long-term orientation and market orientation in buyer-supplier relationships in a Confucian culture. *Asia Pacific Journal of Marketing and Logistics, 25*(5), 721-744.

Ippolito, F., Ozdagli, A. K., & Perez-Orive, A. (2018). The transmission of monetary policy through bank lending: The floating rate channel. *Journal of Monetary Economics, 95*, 49-71.

Jens, C. E. (2017). Political uncertainty and investment: Causal evidence from US gubernatorial elections. *Journal of Financial Economics, 124*(3), 563-579.

Jenson, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics*, *3*(4), 305-360.

Jia, N., Huang, K. G., & Man Zhang, C. (2019). Public governance, corporate governance, and firm innovation: An examination of state-owned enterprises. *Academy of Management Journal*, *62*(1), 220-247.

Jiang, F., Cai, W., Wang, X., & Zhu, B. (2018). Multiple large shareholders and corporate investment: Evidence from China. *Journal of Corporate Finance, 50*, 66-83.

Jin, S., Wang, W., & Zhang, Z. (2023a). The real effects of implicit government guarantee: evidence from Chinese state-owned enterprise defaults. *Management Science, 69*(6), 3650-3674.

Jin, Z., Li, Y., & Liang, S. (2023b). Confucian culture and executive compensation: Evidence from China. *Corporate Governance: An International Review, 31*(1), 33-54.

Jing, Z., Lu, S., Zhao, Y., & Zhou, J. (2023). Economic policy uncertainty, corporate investment decisions and stock price crash risk: Evidence from China. *Accounting & Finance, 63*, 1477-1502.

Jorge, M. J., & Augusto, M. G. (2016). Is hedging successful at reducing financial risk exposure?. *Applied Economics, 48*(39), 3695-3713.

Judge, A. (2006). Why and how UK firms hedge. *European Financial Management*, *12*(3), 407-441.

Judge, A., & Wang, Z (2024). The effects of corporate hedging and state ownership on the probability of default: Evidence from Chinese non-financial firms. *Available at SSRN 4833082*.

Judge, A., Finavker, V., Tran, L., & Wang, Z. K. (2024). The Effects of Derivative Use on the Probability of Default. *Working Paper. Nottingham University Business School.*

Julio, B., & Yook, Y. (2012). Political uncertainty and corporate investment cycles. *The Journal of Finance, 67*(1), 45-83.

Klenke, K. (2003). Gender influences in decision-making processes in top management teams. *Management Decision, 41*(10), 1024-1034.

Knopf, J. D., Nam, J., & Thornton Jr, J. H. (2002). The volatility and price sensitivities of managerial stock option portfolios and corporate hedging. *The Journal of Finance, 57*(2), 801-813.

Kornai, J., Maskin, E., & Roland, G. (2003). Understanding the soft budget constraint. *Journal of Economic Literature*, *41*(4), 1095-1136.

Krishnan, H. A., & Park, D. (2005). A few good women-on top management teams. *Journal of business research, 58*(12), 1712-1720.

Kuersten, W., & Linde, R. (2011). Corporate hedging versus risk-shifting in financially constrained firms: The time-horizon matters!. *Journal of Corporate Finance*, *17*(3), 502-525.

Lang, L. H., Litzenberger, R. H., & Liu, A. L. (1998). Determinants of interest rate swap spreads. *Journal of Banking & Finance, 22*(12), 1507-1532.

Lau, C. K. (2016). How corporate derivatives use impact firm performance?. *Pacific-Basin Finance Journal, 40*, 102-114.

Lee, C. M., Shleifer, A., & Thaler, R. H. (1991). Investor sentiment and the closed-end fund puzzle. *The journal of finance, 46*(1), 75-109.

Leland, H. E. (1998). Agency costs, risk management, and capital structure. *The Journal of Finance*, *53*(4), 1213-1243.

Li, B., Li, M., Li, S., & Liu, L. X. (2023). The Value of Bankruptcy Court in Financial Distress: Evidence from Chinese Bond Market. *Available at SSRN 4285149*.

Lian, Y., Huang, J., & Gao, J. (2023). Economic Policy Uncertainty and Bank Herding: Based on the Perspective of Similarity of Bank Loans'Industrial Structure. *Journal of Central University of Finance and Economics,* (5), 35-49.

Lien, D., & Zhang, M. (2008). A survey of emerging derivatives markets. *Emerging Markets Finance and Trade*, *44*(2), 39-69.

Lievenbrück, M., & Schmid, T. (2014). Why do firms (not) hedge?-Novel evidence on cultural influence. *Journal of Corporate Finance, 25*, 92-106.

Lin, J. Y., & Tan, G. (1999). Policy burdens, accountability, and the soft budget constraint. *American Economic Review*, *89*(2), 426-431.

Lin, C. M., Phillips, R. D., & Smith, S. D. (2008). Hedging, financing, and investment decisions: Theory and empirical tests. *Journal of Banking & Finance, 32*(8), 1566-1582.

Lin, L. H., & Ho, Y. L. (2009). Confucian dynamism, culture and ethical changes in Chinese societies-a comparative study of China, Taiwan, and Hong Kong. *The international journal of human resource management, 20*(11), 2402-2417.

Lins, K. V., Servaes, H., & Tamayo, A. (2011). Does fair value reporting affect risk management? International survey evidence. *Financial Management*, *40*(3), 525-551.

Liu, L. X., Shu, H., & Wei, K. J. (2017). The impacts of political uncertainty on asset prices: Evidence from the Bo scandal in China. *Journal of Financial Economics, 125*(2), 286-310.

Ludvigson, S. C., Ma, S., & Ng, S. (2021). Uncertainty and business cycles: exogenous impulse or endogenous response?. *American Economic Journal: Macroeconomics, 13*(4), 369-410.

Luo, H. R., & Wang, R. (2018). Foreign currency risk hedging and firm value in China. *Journal of Multinational Financial Management*, *47*, 129-143.

Luo, Y., & Zhang, C. (2020). Economic policy uncertainty and stock price crash risk. *Research in International Business and Finance, 51*, 101112.

Lyngsie, J., & Foss, N. J. (2017). The more, the merrier? Women in top‐management teams and entrepreneurship in established firms. *Strategic management journal, 38*(3), 487-505.

Magee, S. (2013). The effect of foreign currency hedging on the probability of financial distress. *Accounting & Finance*, *53*(4), 1107-1127.

Manconi, A., Massa, M., & Zhang, L. (2018). The informational role of corporate hedging. *Management Science*, *64*(8), 3843-3867.

Mao, W.F. 2019. The report on comparing China's derivatives market with global derivatives markets (in Chinese). *China Futures*. November 28.

Marin, M. (2013). Can financial risk management help prevent bankruptcy?. *Journal of Finance and Accountancy*, *12*, 1.

McGrattan, E. R., & Prescott, E. C. (2005). Taxes, Regulations, and the Value of US and UK Corporations. *The Review of Economic Studies, 72*(3), 767-796.

Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of finance*, *29*(2), 449-470.

Ministry of Finance of the People's Republic of China. (2009) 'Notice on Further Strengthening the Regulation of Financial Derivatives Business of Central Enterprises'. *http://sx.mof.gov.cn/bszn/zhengcefagui/200904/t20090427_137351.htm.*

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, *48*(3), 261-297.

Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics*, *5*(2), 147-175.

Nam, J., Wang, J., & Zhang, G. (2008). Managerial career concerns and risk management. *Journal of Risk and Insurance*, *75*(3), 785-809.

Nguyen, H., Faff, R., & Marshall, A. (2007). Exchange rate exposure, foreign currency derivatives and the introduction of the euro: French evidence. *International Review of Economics & Finance*, *16*(4), 563-577.

Nguyen, H., & Faff, R. (2010). Are firms hedging or speculating? The relationship between financial derivatives and firm risk. *Applied Financial Economics*, *20*(10), 827-843.

Oberoi, J. (2018). Interest rate risk management and the mix of fixed and floating rate debt. *Journal of Banking & Finance, 86*, 70-86.

Opie, W., Tian, G. G., & Zhang, H. F. (2019). Corporate pyramids, geographical distance, and investment efficiency of Chinese state-owned enterprises. *Journal of Banking & Finance*, *99*, 95-120.

Pástor, Ľ., & Veronesi, P. (2013). Political uncertainty and risk premia. *Journal of financial Economics, 110*(3), 520-545.

Purnanandam, A. (2008). Financial distress and corporate risk management: Theory and evidence. *Journal of Financial Economics, 87*(3), 706-739.

Qi, Y., Roth, L., & Wald, J. K. (2010). Political rights and the cost of debt. *Journal of Financial Economics, 95*(2), 202-226.

Rampini, A. A., Sufi, A., & Viswanathan, S. (2014). Dynamic risk management. *Journal of Financial Economics, 111*(2), 271-296.

Servaes, H., Tufano, P., Ballingall, J., Crockett, A., & Heine, R. (2006). The theory and practice of corporate debt structure. *Global Survey of Corporate Financial Policies and Practices, Deutsche Bank.*

Shaikh, I. (2020). Does policy uncertainty affect equity, commodity, interest rates, and currency markets? Evidence from CBOE's volatility index. *Journal of Business Economics and Management, 21*(5), 1350-1374.

Shao, L., Shao, J., Sun, Z., & Xu, H. (2019). Hedging, speculation, and risk management effect of commodity futures: Evidence from firm voluntary disclosures. *Pacific-Basin Finance Journal*, *57*, 101084.

Shiller, R. J. (1981). Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends?. *American Economic Review, 71*(3), 421-436.

Shu, M., & Zhu, W. (2022). Dissecting the 2015 Chinese stock market crash. *Stat, 11*(1), e460.

Shumway, T. (2001). Forecasting bankruptcy more accurately: A simple hazard model. *The Journal of Business*, *74*(1), 101-124.

Smith, C. W., & Stulz, R. M. (1985). The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis*, *20*(4), 391-405.

State-Owned Assets Supervision and Administration Commission. (2009). 'Several Opinions on Strengthening Corporate Financial Management in Response to the Current Financial Crisis'. *http://www.sasac.gov.cn/n2588025/n2588119/c2703670/content.html.*

Strahan, P. E. (2013). Too big to fail: Causes, consequences, and policy responses. *Annu. Rev. Financ. Econ., 5*(1), 43-61.

Stulz, R. M. (1996). RETHINKING RISK MANAGEMENT. *Journal of Applied Corporate Finance*, *9*(3), 8-25.

Su, X., Zhou, S., Xue, R., & Tian, J. (2020). Does economic policy uncertainty raise corporate precautionary cash holdings? Evidence from China. *Accounting & Finance, 60*(5), 4567-4592.

Sun, W., Ding, Z., Xu, X., & Cui, K. (2020). Internationalization and firm default risk: The roles of environmental dynamism and marketing capability. *Journal of business research, 121*, 142-153.

Sun, Y., & Morley, B. (2021). The Dynamics of Foreign Exchange Derivative Use in China. *Journal of Risk and Financial Management*, *14*(7), 291.

Tan, L., Chiang, T. C., Mason, J. R., & Nelling, E. (2008). Herding behavior in Chinese stock markets: An examination of A and B shares. *Pacific-Basin finance journal, 16*(1-2), 61-77.

Tang, D. Y., & Yan, H. (2010). Market conditions, default risk and credit spreads. *Journal of Banking & Finance, 34*(4), 743-753.

Tunaru, R., Fabozzi, F., & Wu, T. (2006). Chinese equity market and the efficient frontier. *Applied Financial Economic Letters, 2*(02), 87-94.

Vickery, J. (2008). How and why do small firms manage interest rate risk?. *Journal of Financial Economics, 87*(2), 446-470.

Waisman, M., Ye, P., & Zhu, Y. (2015). The effect of political uncertainty on the cost of corporate debt. *Journal of Financial Stability, 16*, 106-117.

Welch, L. S., & Luostarinen, R. (1988). Internationalization: Evolution of a concept. *Journal of general management, 14*(2), 34-55.

Wen, Y., Kang, Y., Qin, Y., & Kennedy, J. C. (2021). Use of Derivative and Firm Performance: Evidence from the Chinese Shenzhen Stock Exchange. *Journal of Risk and Financial Management, 14*(2), 83.

Witkowska, D., Kompa, K., & Mentel, G. (2019). The effect of government decisions on the efficiency of the investment funds market in Poland. *Journal of Business Economics and Management, 20*(3), 573-594.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data.* MIT press.

Xie, F., & Yang, H. (2017). Research on the influence of the foreign currency derivatives on the foreign exchange rate exposure: An empirical analysis of multinational corporations in China (in Chinese). *Journal of Chongqing University (Social Science Edition)*, *23*(6): 21-29.

Yao, J., Ma, C., & He, W. P. (2014). Investor herding behaviour of Chinese stock market. *International Review of Economics & Finance, 29*, 12-29.

Yi, B., Lin, J. B., & Chen, C. W. (2008). Does derivative use help reduce the cost of debt. *Review of Business Research*, *8*(3), 196-204.

Yildirim, A. (2020). The effect of relationship banking on firm efficiency and default risk. *Journal of Corporate Finance, 65*, 101500.

Yip, W. H., & Nguyen, H. (2012). Exchange rate exposure and the use of foreign currency derivatives in the Australian resources sector. *Journal of Multinational Financial Management*, *22*(4), 151-167.

Zaria, Y. B., & Tuyon, J. (2023). Relationship between unemployment and policy uncertainty in Nigeria: ARDL evidence from 1990 to 2020. *International Journal of Social Economics, 50*(6), 800-820.

Zhang, H. (2009). Effect of derivative accounting rules on corporate risk-management behavior. *Journal of Accounting and Economics*, *47*(3), 244-264.

Zhang, G., Han, J., Pan, Z., & Huang, H. (2015). Economic policy uncertainty and capital structure choice: Evidence from China. *Economic Systems, 39*(3), 439-457.

Zhang, H. L., Mei, M., & Qi, L. (2020). How can enterprises avoid foreign exchange risks under the Belt and road initiative-Based on the comparison of operational hedging and financial Hedging (in Chinese). *Journal of International Trade*, (3).

Zhou, X. (2005). Thoughts on financial system reforms in the period of the eleventh five-year plan. *Study Times, 311*, 2005-11.