LIQUIDITY, CORPORATE POLICY, AND CORPORATE GOVERNANCE

by

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(Due to my changing institution as part of my doctoral studies, earlier versions of Chapter 2 were also submitted to the plagiarism software Turnitin whilst studying at University of Southampton.)

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ABSTRACT

Liquidity is closely related to risk estimation. Therefore liquidity has a potential impact on investment and financing strategies which can affect or be affected by the risk perspective. The purpose of this thesis is to establish a linkage between liquidity and three outstanding risk-related issues in the finance literature. First, we inspect the impact of market liquidity on feedback trading. Our results suggest that market liquidity should be included in the feedback traders' demand function for shares in East Asian stock markets. The explanatory power of market liquidity on feedback trading tends to be stronger in the bull market regime than in the bear market regime. We then analyse listed US firms to test the impact of financial flexibility on a firm's Corporate Social Responsibility (CSR). We find that financial flexibility is negatively correlated with CSR, which indicates that the two are substitutes for each other in hedging the financing risk. Furthermore, we find that the negative relationship between financial flexibility and CSR is affected by both CEO conservatism and the lifecycle stage of a firm. Finally, we investigate the impact of CEO inside debt compensation on the adjustment speed of cash holding of the US-listed firms. We find that CEOs with high inside debt compensation accelerate the adjustment speed of cash holding when the actual cash ratio is below the target and decelerate the adjustment speed of cash holding when the cash level is above the target. We also find that the major channel for inside debt compensation to exert an impact on cash holding is through *the* reduced dissipation rather than the increased accumulation of cash.

DEDICATION

I dedicate my work to my parents, for all their love and support.

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CHAPTER 1: INTRODUCTION

1.1. Background and motivation

Research into liquidity constitutes a major issue in the finance literature. In a perfect capital market without financing frictions, a firm can freely adjust its capital structure to optimise its investment level and to finance unexpected needs (Miller and Modigliani, 1961). However, in a world of friction and conflict, neither individual investors nor institutional investors can trade without restrictions. On the one hand, the difference between the bid price and the ask price incurs a trading cost for investors in financial markets. On the other hand, financing frictions introduce a financing cost for firms which prevents them from investing at their first-best level.

Market liquidity and corporate liquidity are two major parts of liquidity. Market liquidity is defined as the ability for investors to trade large amounts quickly at low cost without substantially influencing the price. Although stock price acts as the primary indicator of a firm's market performance, Harvey (1988) points out that the information implied in the stock price is so complex that it can blur the signals sent by stock returns. NÆS *et al.* (2011) further suggest that the information covered by stock market liquidity on the real economy is more than the stock return can capture. Given the advisory role of liquidity in predicting market performance, liquidity has a potential impact on the investment decision-making process. Existing literature has established a link between stock liquidity and the stock return. Greene and Smart (1999) prove that the relationship between stock liquidity and temporary abnormal returns is positive and significant. Liu (2006) further confirms liquidity's role as a risk premium which remains robust after controlling for the CAPM model and Fama-French three factors. These findings indicate that excess return in the stock market can be partly ascribed to the liquidity premium. In addition to stock liquidity's informative role in stock market performance, it also plays an advisory role in predicting the performance of both individual firms and the macroeconomy. Existing literature documents a positive and significant effect of liquidity on both firm performance and economic growth (Fang *et al.*, 2014; Levine and Zervos, 1998). Given the substantial influence of liquidity on both the micro and the macroeconomy, Ibbotson *et al.* (2013) suggest that liquidity should be treated as an investment style on a par with trading styles, based on size, value (growth), and momentum.

Corporate liquidity policies can affect a firm's investment ability. Denis (2011) summarises the literature on corporate liquidity policies and points out that the main motivation for managers to adjust their liquidity policy is to acquire financial flexibility. Once they have acquired financial flexibility, this enables firms to fund their investment opportunity set promptly or to respond quickly to unexpected changes in cash flow. Collectively, the existing literature emphasises the importance of financial flexibility and cash as two primary concerns in managing corporate liquidity.

Graham and Harvey (2001) suggest that financially flexible firms should have the following desirable features when facing future liquidity risk. First, financially flexible firms have sufficient liquidity to react to unexpected changes in cash flow. Second, financially flexible firms can access external funds easily, which enables them to meet investment needs in a timely manner. Finally, financially flexible firms are unlikely to be restricted by insurance decisions. These features of financially flexible firms contribute to a lower probability of encountering adverse financial shocks and thus investment distortions. Existing literature highlights the determining role of financial flexibility in a firm's investment and funding policy, given the substantial impact of financial flexibility on the risk perspective of a firm. According to de Jong *et al.* (2012), firms with financial flexibility are more likely to make higher future investments compared with financially inflexible firms. Arslan-Ayaydin *et al.* (2014) further disclose that financial flexibility outperforms traditional measures of financial constraints in determining the investment success and performance of a corporation.

Firms are increasingly holding larger amounts of cash. The average value of cash held by public firms in the US was higher than the debt holding in 2006 (Bates *et al.*, 2009a). By the end of the third quarter of 2016, the cash held by non-financial firms listed in the S&P500 had reached 1.54 trillion dollars.[1] Clearly, cash reserves are now far above the requisite level for transactional needs. As illustrated by Opler *et al.* (1999), stronger growth opportunities and higher cash flow risk are two primary reasons for firms to hold a greater proportion of their assets in cash. Cash holding, alongside lines of credit, is a vital source of corporate liquidity which reduces a firm's

1 Please see the official FACTSET website for more details:

https://insight.factset.com/cashinvestment_12.21.16?utm_source=hs_email&utm_medium=email&utm_content=39676383&_hse

nc=p2ANqtz--lLUjMhs9n5HgnP6iKK_c3tSVUBFqli5kO8OgvrNA29fnAtpwh2Kg6MAW1Pe1e5MvLbIL9O-

IZILVkkvHHmqpapy1ZK1jQNpiRgT6pxx_TJ55IIGY&_hsmi=39676383

concern about the liquidity risk. Both empirical and theoretical evidence supports the insurance role played by cash holding in hedging the liquidity risk. According to a survey carried out by Lins *et al.* (2010) on CFOs from 29 countries, firms use cash holding to hedge against cash flow risks, especially in times of adversity. Likewise, Acharya *et al.* (2007) and Denis and Sibilkov (2009) suggest that cash holding can help a firm to hedge the financing and predation risks. Han and Qiu (2007) introduce a precautionary perspective on cash holding. Due to financial constraints, a firm has to make a trade-off between current investment and future investment. Accordingly, under-diversified firms have a greater motivation to save more cash as a precaution against their future liquidity risk. Similarly, it is documented that diversified firms hold much less cash than focused firms (Subramaniam *et al.*, 2011). The negative relationship between capital structure diversification and cash holding confirms the hedging role of cash since capital structure diversification can act as a substitute for cash reserves in hedging risk.

Although existing studies have well established the linkage between liquidity and risk, there is a scarcity of literature on the relationship between liquidity and behavioural (corporate) finance. Unlike classical financial theories, behavioural (corporate) finance highlights the irrationality of the individual. In 2002, Kahneman and Smith were awarded the Nobel Prize in Economics for their contribution to behavioural finance theory. A major assumption of the classical financial theory is the hypothesis of the rational man, which suggests that decision-makers follow an optimal path to maximise their utility. However, the gap between the ideal scenario and reality should not be overlooked since both firm managers and individual investors show an estimation bias regarding risk. Our study focuses on three issues in the finance literature which are closely related to risk estimation bias in general, and liquidity risk in particular.

The first issue we look into is feedback trading behaviour. Feedback traders buy shares when the stock price increases and sell shares when the stock price decreases. This trading style is counter-intuitive since the golden trading rule of thumb is "buy low and sell high". Market inspectors pay considerable attention to feedback trading since it contributes to the destabilisation of the financial market. Identifying the factors that have an influence on feedback trading, therefore, helps to eliminate the adverse impact of feedback trading on market destabilisation. Existing studies have documented some of the key factors behind the phenomenon including extraordinary profit, margin requirements, market inefficiency and investor sentiment (Antoniou *et al.*, 2005; Chau *et al.*, 2011; Jegadeesh and Titman, 1993; Watanabe, 2002). Sentana and Wadhwani (1992) introduce the most widely applied feedback trading model which stresses the importance of ex-post returns in the demand function of feedback traders. Since the demand for shares is closely related to the risk factors, it is necessary to examine whether dominant risk factors in the financial market, such as market liquidity, should be included in the demand function of feedback traders.

The second issue we examine is investment in corporate social responsibility. The Financial Times calculates that the expenditure of Fortune 500 companies on corporate responsibility reached $15bn in 2014.[2] From a neoclassical economic

2 Please see the official Financial Times website for more details: https://www.ft.com/content/95239a6e-4fe0-11e4-a0a4-

viewpoint, heavy investment in CSR can be a result of the agency problem. Friedman (1970) points out that CSR investment cannot only be associated with managers' self-serving behaviour, but it can also unnecessarily increase a firm's costs. Stakeholder theory partly explains the heavy investment in CSR. As a part of society, a firm has to serve the interest of both stockholders and other parties of interest, including workers, customers, suppliers, and community organisations (Donaldson and Davis, 1991; Freeman, 1984). When the firm performs in a socially responsible way, society rewards the firm not only by enhancing its reputation but also by giving it priorities in terms of financing. Therefore, corporate social responsibility plays an insurance role when firms face moral hazards and financial distress. Goss and Roberts (2011) ascribe CSR investment to a firm's risk management perspective. They find that firms with a high level of CSR can get bank loans at lower costs than firms who are less socially responsible. Similarly, El Ghoul *et al.* (2011) find that a strong corporate social performance can substantially reduce the cost of equity. Given the positive impact of CSR investment in hedging a firm's financing risk, we suppose that the CSR policy of a firm and its corporate policy on liquidity management are closely correlated. More specifically, previous studies document an increase in socially responsible engagement, and a decrease in the cost of capital and capital constraints after firms adopt strategic CSR (Baron, 2001; Cheng et al., 2014; El Ghoul et al., 2011). The findings indicate that CSR investment can reduce financing risk. Therefore, keeping financial flexibility and CSR investment is a substitute to each other in hedging financing risk, and thus we expect that firms with high financial flexibility are less likely to invest in CSR.

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The third issue we investigate is CEO inside debt compensation. The CEO, as the primary decision-maker, has a direct impact on a firm's investment and financing strategies. Existing studies have established a linkage between the CEO's attitude towards risk and his/her compensation contract, since compensation directly affects the CEO's wealth (Jiang and Lie, 2016). Inside debt, which is comprised of pension and deferred compensation, makes up a crucial part of a CEO's compensation package. The impact of CEO inside debt on a firm's risk preference has attracted closer scrutiny since 2006 when public data on CEO inside debt compensation became available. Unlike equity compensation, which aligns the interests of CEOs and shareholders, inside debt compensation aligns the interests of CEOs and debt holders. Like debt holders, CEOs with high inside debt compensation care more about the firm's long-term survival than its current performance and thus have a lower tolerance of risk (Edmans and Liu, 2011; Sundaram and Yermack, 2007). Existing literature documents that CEOs with high inside debt compensation prefer less risky financing and investment policies (Liu *et al.*, 2014; Srivastav *et al.*, 2014). We conjecture that CEO inside debt compensation, as a measure for CEO's risk preference, should influence corporate policies relating to liquidity management.

Our thesis aims at establishing a linkage between liquidity, which is closely connected to the estimation of risk, and investment and financing policies, which may lead either individual investors or firm managers to make suboptimal decisions. It is, therefore, necessary to examine the interactions between liquidity, investment, and financing policies in more detail as they are all closely correlated with the risk perspective of either individuals or firms. Existing studies have established an association between liquidity and decision-making. However, the relationship between liquidity and three other important issues remains neglected in the finance literature. The "liquidity" mentioned above is referred to "stock market liquidity", "financial flexibility" and "adjustment speed of cash holding" respectively in our three topics. The three important issues refer to feedback trading behaviour, CSR investments and CEO inside debt compensation. More specifically, we inspect the impact of market liquidity on feedback trading, the impact of financial flexibility on a firm's CSR investment, and the impact of CEO inside debt compensation on the adjustment speed of cash holding. In sum, our thesis highlights the role of liquidity in estimating risk and thus influencing corporate policy. From a corporate governance perspective, our study can help investors and corporate inspectors to make more precise predictions about the actions taken by individual investors and managers in relation to liquidity risk.

1.2. Structure and scope of the thesis

The thesis consists of five chapters: an introductory chapter which explains the background to our work and states its aim; three independent chapters which provide empirical studies on three liquidity-related issues; and a chapter offering conclusions and suggestions for future research. The remainder of the thesis is organised as follows.

Chapter 2 presents the first empirical study. We investigate the role of stock market liquidity in investors' feedback trading behaviour in the East Asian stock markets where individual investors dominate the trading accounts and activities.[3] Consistent with our expectations, we find the presence of feedback trading behaviour in all six East Asian stock markets. More importantly, using our augmented model with three different liquidity measures, our results indicate that stock market liquidity drives feedback traders' demand function. To be more specific, the intensity of feedback trading is conditional on the level of stock market liquidity, in particular, the following two dimensions: trading speed and trading volume. Furthermore, we show that market liquidity has an asymmetric impact on feedback trading behaviour under different market regimes.

Chapter 3 presents the second empirical study. We attempt to investigate the impact of financial flexibility on a firm's CSR performance (investment). The detailed information on the cost of CSR investment of individual firms is not available. Generally, the CSR performance is positively correlated with CSR investment. Therefore, we conjecture that the firms with better CSR performance invest more in CSR. Existing literature indicates that good CSR performance can reduce two types of firm risks. The first risk is the risk of moral hazard. A firm can lower the risk of facing moral hazard if it can act in a socially responsible way and can serve the interest of the public. The second risk is regarding the financing risk. Existing studies find that firms with high CSR performance have a lower cost of both equity financing and debt financing. Accordingly, firms with higher CSR performance are more likely to overcome the difficulty of financing risk. From the standpoint that CSR is related

3 Contrary to Antoniou et al. (2005), who document that feedback trading becomes eliminated after the introduction of index futures in western countries, all six Asian markets retain the feedback trading effect after the introduction of index futures.

to firm risk, our analysis reveals that firms that use debt conservatively are less likely to achieve a good CSR performance. This result supports the view that firms whose shareholders consider financial flexibility more valuable are less likely to engage in CSR activities. These firms tend to use resources more conservatively and reduce their luxury investments, which includes CSR activities. Furthermore, the substitution effect between financial flexibility and CSR for risk management purposes implies that financially flexible firms have less motivation to conduct CSR activities. It is important to be aware that the association between financial flexibility and CSR is stronger in firms with conservative CEOs. This result provides further support for the view that conservative CEOs prioritise the value of financial flexibility for CSR. Additionally, we show that the association between financial flexibility and CSR varies according to the different stages of the business cycle. Our findings are robust to alternative measures and model specifications.

Chapter 4 presents the third empirical study. We aim to discover whether the CEO risk preference, measured by CEO inside debt compensation, can affect a firm's cash policy in general, and the adjustment speed of cash holding in particular. Since cash policy is closely related to the risk perspective of a firm, we suggest that CEO risk preference, which results in the biased evaluation of risk, has a potential impact on a firm's cash policy. After analysing US-listed companies from 2006 to 2014, we document a positive relationship between CEO inside debt holding and a firm's cash ratio. We further find that CEOs with high inside debt compensation accelerate the adjustment of cash holding when the actual cash ratio is below the target. In contrast, CEOs with high inside debt compensation reduce the adjustment speed of cash holding when the cash level is above the target. The impact of CEOs with high inside debt compensation on the adjustment speed of cash is more (less) pronounced in firms with a high level of institutional ownership than those with a low level of institutional ownership when the actual cash level is below (above) the target. With respect to the channels through which CEO compensation incentives can exert such an impact, we find that the major channel for inside debt compensation to exert an impact on the cash ratio is through reduced dissipation rather than the increased accumulation of cash. These findings combined indicate that risk-averse CEOs with high inside debt compensation are also conservative with regard to cash policy.

Chapter 5 provides the conclusions drawn from the previous three chapters by highlighting the research questions, summarising the main findings, and discussing their implications. We also point out the limitations of our study as well as making suggestions for future research.

CHAPTER 2:LIQUIDITY AND FEEDBACK TRADING: EVIDENCE FROM ASIAN STOCK MARKETS

2.1. Introduction

Feedback traders are investors who believe that stock prices follow a trend and thus adjust their demands for a financial asset based on previous prices. Feedback trading behaviour has long been documented in a variety of financial markets such as stock markets, futures markets, forex markets, and ETF (Exchange-traded Funds) markets. Sentana and Wadhwani (1992) indicate that there was a clear association between feedback trading and the US equity market crash in 1987. Other recent studies on feedback trading include those by Koutmos (1997), Sentana and Wadhwani (1992), Antoniou *et al.* (2005), Laopodis (2005), Salm and Schuppli (2010), Chau *et al.* (2011), Charteris *et al.* (2014), Hou and Li (2014), among many others. Long *et al.* (1990) point out that while feedback trading drives the stock price away from its fundamental level and results in market destabilisation, this practice can improve market liquidity. They further explain that investors' heterogeneous beliefs have the effect of boosting the liquidity of the financial market and providing arbitrage opportunities. However, the question of whether the investment strategies of feedback traders are conditional on market liquidity has not received much attention in the literature. Market liquidity is not only an essential element in describing the financial market but also a pricing factor which can affect investors' investment strategies. Therefore, our study represents the first attempt to address the research gap in the literature.

Existing studies suggest that the liquidity premium can be partly attributed to the excess returns in the stock market. Amihud and Mendelson (1986) document a positive correlation between the bid-ask spread and stock returns. Similarly, Amihud (2002) proposes an illiquidity measure and reveals a positive relationship between illiquidity and the ex-ante excess stock return. Liu (2006) theoretically proves that liquidity is a pricing factor after controlling for CAPM model factors and Fama-French three factors. His two-factor model highlights the role of liquidity as a risk premium in the pricing model. Given the significant role of liquidity as a pricing factor, feedback traders may decide on which trading strategies to pursue, based on the level of liquidity in the stock market. Sentana and Wadhwani (1992) specify the feedback traders' demand for shares as a function of lagged return and volatility only, and thus it is necessary to control for the impact of market liquidity when examining the behaviour of feedback traders.

This chapter aims to investigate the role of stock market liquidity in the trading behaviour of feedback traders, and we focus on East Asian stock markets due to Asia's increasing influence in the global financial market. It is notable that the trading activities in East Asian stock markets are dominated by individual investors who are more likely to engage in feedback trading behaviour than institutional investors. We conjecture that feedback traders may also take market liquidity into account when making investment decisions, given that liquidity plays an important role in pricing. Chau *et al.* (2011) extend the most widely applied model for feedback trading proposed by Sentana and Wadhwani (1992) using a proxy for sentiment in the feedback traders' demand function for shares. Motivated by Chau *et al.* (2011), we extend Sentana and Wadhwani (1992)'s feedback trading model (hereafter the SW Model) by including market liquidity in the demand function of feedback traders to examine the role of liquidity in feedback trading behaviour. Koutmos (2012) points out that low-frequency data is insufficient to base short-term investment strategies on, and hence this is the case for feedback trading. Stock market participants have to consider the liquidity risk in the short-run computerised strategy-making process, and thus we construct liquidity measures using daily data instead of the monthly observations employed by Liu (2006) and Amihud (2002).

Our study contributes to the literature in a number of ways. First, to our knowledge this paper represents the first attempt to examine whether stock market liquidity exacerbates or mitigates positive feedback trading (an especially destabilizing form of noise trading). We make several extensions to the standard feedback trading model to allow the demand of feedback traders to be influenced not solely by price but also by liquidity. Our results could provide a deeper understanding of the question why noise trading takes place. Although a number of reasons have been put forward in explaining the presence of feedback trading, such strategies are usually associated with noise or uninformed traders whose demand for shares are more likely to be driven by the overall market liquidity and trading activity. Broadly speaking, this paper also adds to the growing number of studies examining the role of market liquidity in asset pricing and investor behaviour.

Second, as further analysis, we examine the potential asymmetry in the role of liquidity with respect to stock market conditions (bull vs bear markets). This appears to be another novelty in the literature on the subject. Assuming that liquidity is a contributing factor in inducing noise trading activity, the liquidity-induced trading is likely to be more pronounced in the good market conditions and rising stock prices. This may result from noise traders' excessive liquidity and their ability to engage with trend-chasing investment strategies. Such a scenario can push prices away from fundamentals in the short run, further exacerbating investors' irrationality. Consistent with this conjecture, Cooper et al. (2004) find that momentum trading activity by noise traders tend to increase during the bull market periods.

Third, unlikely many previous studies which focus primarily on the major industrialised markets, this paper conducts analysis using data from the six South East Asia countries that have received relatively little attention in the literature (namely China, Japan, Hong Kong, Singapore, South Korea and Taiwan). These markets were chosen to ensure that our sample represents a spectrum of markets from the region. Given the growing importance of Asian countries in the world economy and the global financial system, there is a pressing need for rigorous research to better understand the price dynamics and speculative trading behaviour in these fastest growing markets. Additionally, given the vast majority of investors trading in these Asian markets are individual investors, our results could be particularly relevant in enhancing our understanding of retail investors' trading strategy and philosophy. Intuitively speaking, since individual investors have scarce resources and limited access to information, it is natural to expect greater feedback trading activity in the Asian stock markets as they are dominated by individual investors who trade on the basis of noises rather than information. The findings of Chuang and Susmel (2011) and Colwell et al. (2008) support the notion that individual investors are more susceptible to behaviourally biased trading than institutional investors, but they are in contrast with the evidence of Nofsinger and Sias (1999) who conclude that institutional investors positive-feedback trade more than individual retail investors.

Finally, from a methodological standpoint, we also carry out extensive model specification tests to determine the appropriate volatility model and then test the robustness of our results using an alternative GARCH specification. The search and application of an appropriate volatility model are important to ensure the 'non-convergence' problem is reduced to minimal. Most univariate GARCH models should encounter few convergence problems if the model is well-specified and fits data reasonably well (Alexander, 2001). More importantly, if a certain assumption is made about the volatility dynamics of a market but is not true, then econometric results may be subject to bias. Thus if only to investigate the robustness of empirical results, conducting a detailed search of appropriate model is warranted.

The remainder of this chapter is organised as follows. Section 2.2 reviews the existing literature on feedback trading and liquidity. In addition, this section gives a brief introduction to the Asian stock market. Section 2.3 introduces the methodology and gives the summary statistics for our sample. Sections 2.4 and 2.5 present the empirical results and the robustness check. Section 2.6 summarises the findings and provides a conclusion.

2.2. Research Background

2.2.1. Feedback trading

To explore the primary cause of feedback trading behaviour, Jegadeesh and Titman (1993) test the profitability of feedback trading strategies. They reveal an average excess return of 1% per month for 3–12 months after investors implement feedback trading strategies. Shiller *et al.* (1984) point out that the heterogeneous beliefs shared by investors can trigger some anomalies in the financial market. They highlight the influence of social dynamics on asset pricing. They also propose some alternative explanations for feedback trading, including herding behaviour, market inefficiency, order flow, and compensation for time-varying unsystematic risks (Daníelsson and Love, 2006; Jegadeesh and Titman, 2001; Li *et al.*, 2008; Shu, 2009). Mendel and Shleifer (2012) presume that feedback trading behaviour is motivated by information asymmetry. There are three types of investors in their behavioural finance model: the insiders; the noise traders; and the outsiders. The insiders make rational decisions using full inside information while the outsiders only subtract information from the changes in price. Unlike the insiders and outsiders who trade on the information, the noise traders trade on sentiment shocks. The feedback traders are classified as those outsiders who have to analyse the relative impact of the insiders and noise traders when there is a change in price. The outsiders follow a positive feedback trading strategy by chasing the trend if they believe that the dominant investors are the insiders. Otherwise, the outsiders adopt a negative feedback trading strategy to bet against the noise traders.

Since feedback trading activities weaken financial market stability, it is interesting and useful to try to further understand the formulation and framework of this phenomenon by inspecting the behaviour of feedback traders under different market regimes. Feedback trading partly explains why financial crises occur. The financial crisis in the early 1990s, the Asian economic turmoil in 1997, the internet bubble in 2002, and the financial crisis in 2008 all offer researchers observable data to analyse. Koutmos and Saidi (2001) find that positive feedback trading is more pronounced during periods of market decline than during market booms, especially in emerging capital markets.

Empirical studies have noted that following the introduction of index derivatives, the feedback trading effect is alleviated or even disappears in some financial markets. Antoniou *et al.* (2005) find that the feedback trading effect in the stock market was mitigated after the initiation of index futures. Chau *et al.* (2008) observe that the feedback trading behaviour for USF (Universal Stock Futures) listed stocks was alleviated to a greater extent since the launch of the USF than for its controlled counterparts. These findings further confirm the influence of market inefficiency on feedback trading behaviour. The improvement in market efficiency squeezes out arbitrage opportunities thus making investors less inclined to adopt feedback trading strategies.

Although the existence of feedback trading is well documented in the literature, the demand function of feedback traders is still inconclusive and needs further investigation. Some previous studies have extended Sentana and Wadhwani (1992) by adding explanatory variables other than the price in the demand function. For instance, Watanabe (2002) finds that the autocorrelation in stock returns is determined by the margin requirement. Kurov (2008) and Chau *et al.* (2011) reveal the influence of investor sentiment on feedback trading in the futures and ETF markets respectively by applying the VAR model and the augmented SW Model. Dean and Faff (2011) focus on the interaction between different financial markets. Using a bivariate ICAPM model, they find that the covariance of the equity market and the bond market can be an influential factor in feedback trading in the equity market and vice versa. Chau *et al.* (2015) apply augmented feedback trading models to examine the trading style in major European energy markets. They find significant feedback trading effects in coal and electric markets which are not dominated by institutional investors.

2.2.2. Liquidity and Asian stock markets

Existing literature has recognised liquidity as another essential pricing factor and shown that feedback trading boosts market liquidity. Black (1986) ascribes the high trading volume in the financial market to noise-trading, where noise is regarded as information. Similarly, Long *et al.* (1990) indicate that the divergence between the actual price and its fundamental, which is driven by the existence of heterogeneous beliefs, contributes to the market liquidity. Market liquidity is an essential element in describing market conditions and a determinant in making the investment and trading decisions. As pointed out by Ibbotson *et al.* (2013), liquidity should be treated as an investment style on a par with trading styles based on size, value (growth), and momentum. Hong and Rady (2002) show that through a learning effect, market statistics can reflect the impact of past prices and liquidity (trading volume) on future strategic trades. Similarly, Ziemba (2007) highlights the role of liquidity as a determinant in executing trading strategies. They argue that traders who exploit strategies related to the January effect prefer stock indexes with greater liquidity.

Liquidity is generally described as the ability to trade large quantities quickly at low cost without substantially influencing the price. The measures for liquidity are based on four main dimensions (i.e. trading volume, trading speed, trading cost, and price impact) in order to quantify the liquidity. Because liquidity measures do not measure liquidity directly, it has been questioned whether low-frequency measures can capture the liquidity of high-frequency trading. The empirical study by Goyenko *et al.* (2009) concludes that liquidity measures based on daily data, such as the effective spread and the Amihud illiquidity measure, are good measures of high-frequency transaction cost benchmarks (i.e. liquidity measures do measure liquidity).

Over the last three decades, literature has proliferated which has established connections between liquidity and various fields of empirical finance using different types of liquidity measures. A rich body of literature documents the relationship between liquidity and temporary abnormal returns. For example, the quoted bid-ask spread, the amortised effective spread (constructed by quotes and subsequent transactions), and the price impact (the response of the price to the order size or fixed trading cost) are all positively correlated with risk-adjusted stock returns (Amihud and Mendelson, 1986; Brennan and Subrahmanyam, 1996; Chalmers and Kadlec, 1998; Eleswarapu, 1997). Liu (2006) also shows the robustness of the liquidity premium after considering the CAPM and the Fama–French three factors. This finding has prompted researchers in the field of asset pricing research to take liquidity into account as a substantial risk factor. As well as the stock market, it has been found that the corporate bond market's expected returns can also be explained by liquidity (Lin *et al.*, 2011).

In addition, liquidity can be used to forecast stock prices and their distribution. Bekaert *et al.* (2007) document that liquidity plays a significant part in predicting future returns by looking at 18 emerging and Asian stock markets. Chen *et al.* (2001) show that negative skewness in daily returns is more pronounced in stocks with a higher trading volume compared with the trend over the prior six months. Moreover, Rubia and Sanchis-Marco (2013) report that market-wide liquidity proxies, as well as trading conditions, are capable of forecasting the quantiles of the conditional distribution using several representative market portfolios.

Given the forecasting ability of liquidity for asset returns, it is of interest to examine whether liquidity can affect trading activities. Chordia *et al.* (2001) study the aggregate market spreads, depth and trading activity for US equities over an extended period. They find high volatility and negative serial dependence between daily changes in the market liquidity and trading activities. Suominen (2001) indicates that trading volume plays an advisory role in predicting volatility and making predictions about the limits and market order of traders' placement strategies. Moreover, the study documents a highly volatile and negatively serially dependent relationship between the market averages of liquidity and trading activities.

Accordingly, investors may set up a trading strategy based upon ex-post liquidity. As pointed out by Hong and Rady (2002), strategic traders are believed to learn about market liquidity based on ex-post return and liquidity if they do not know the pattern distribution of liquidity trades. Therefore, past market outcomes such as liquidity have a path-dependent relationship with market trades. Similarly, in their study of asset allocation portfolio decisions, Xiong *et al.* (2013) confirm that changes in market liquidity can act as an indicator with which to inform the dynamic decision-making process. Cao *et al.* (2013) highlight the importance of understanding and incorporating market liquidity conditions in investment decision making. They find that hedge fund managers are able to time market liquidity accurately. More specifically, hedge fund managers increase (decrease) their portfolios' market exposure when the liquidity of the equity market is high (low).

Despite the well-documented role of liquidity as a risk premium, the literature on the impact of liquidity on feedback trading is relatively scant. The importance of liquidity in asset pricing suggests that it has an influence on the investment decision-making process, and thus it may also influence investors' trading behaviour, of which feedback trading is a part. We conjecture that market liquidity may drive feedback traders' demand for shares via the following sequence. First, an initial purchase by rational speculators boosts liquidity by triggering feedback traders to buy shares. Second, as the number of forward-looking speculators increases, volatility further departs from its fundamentals. As more traders hold the same beliefs in relation to the price trend, the liquidity level falls. Finally, as the market becomes less liquid, feedback traders' demand for shares is determined by both systematic risk and liquidity risk. In other words, the need to compensate for liquidity risk becomes a major concern for feedback traders when adopting such strategies. Amihud (2002) observes that an unexpected decrease in market liquidity leads to a contemporaneous drop in stock prices. It is plausible that feedback traders may react to the changes in market liquidity to seize the profits generated by their investment portfolios.

Moreover, the potential impact of liquidity on feedback trading is ascribed to the close relationship between liquidity and some other factors that have been shown to influence feedback trading. Chau and Deesomsak (2015) examine the relationship between feedback trading and the business cycle. They find feedback trading strategies to be more significant and pronounced during expansionary economic phases. Stock liquidity contributes to the asymmetric impact of different stages of the business cycle on investment decisions. NÆS et al. (2011) indicate that market liquidity has a close relationship with the changes in investors' portfolios during different business cycles. Chau et al. (2015) document a more prevalent feedback trading effect in the coal and electricity sector when there is a high arbitrage opportunity. Existing literature has established the linkage between arbitrage opportunities and liquidity. On the one hand, the increase in stock liquidity measured by the bid-ask spread is a result of informational efficiencies achieved via index arbitrage trading (Erwin and Miller, 1998). On the other hand, market liquidity can increase the incorporation of private information into prices (Chordia et al., 2008).

Finally, and most importantly, market liquidity covers information which cannot be easily abstracted from the stock price. Existing studies find that the information implied in stock price is so complex that it blurs signals which cover valuable information (Harvey, 1988). In addition, the information covered by stock market liquidity on the real economy is more than the stock return series can capture (NÆS et al., 2011). Unlike smart money investors who have full access to inside information, feedback traders as the outsiders do not have access to inside information. In order to make better decisions, they have to analysis easy accessible information, such as the stock price. Market liquidity can be easily measured by accessible data; therefore, the outsiders are likely to use the information applied in the market liquidity to adjust their demand for shares. It is reasonable that feedback traders can include market liquidity in their equity valuation model. Taking altogether the analysis presented above, we can conclude that feedback traders' demand for shares may be influenced by market liquidity.

Emerging markets face a more severe liquidity problem than the stock markets in developed countries. Chuhan (1992) documents a survey on developed markets by World Bank and finds that liquidity can limit the investment of foreign institutional investors. Lesmond (2005) illustrates that while the spectacular returns on investment in emerging markets can easily exceed 90% in any given year, they are accompanied by a higher level of risk and liquidity costs. Bekaert *et al.* (2007) further argue that emerging markets undergo a structural break known as equity market liberalisation which is likely to have an impact on market liquidity. Moreover, there is evidence of more pronounced positive feedback trading in emerging markets (Bohl and Siklos, 2008).

The constituent members of Asian stock markets are a combination of developing countries and developed countries. Although Asian equity markets are in various stages of development, they share similar features and risks with regard to liquidity as the level of market integration rises. Based on examining a set of common factors contributing to liquidity variations in twelve Asian equity markets, Wang (2013) points out that common factors increasingly drive the liquidity of Asian stock markets. The findings indicate that regional factors have a strong effect on local market liquidity while the impact of US- and UK-related factors is very minor. Similarly, Charoenwong *et al.* (2013) document the comovement of liquidity among Asian stock markets in relation to the financial crisis. They examined the market liquidity in 11 Asian countries during the 1997-1998 Asian crisis and the 2007-2008 global financial crisis and revealed a sharp decline in liquidity, measured by turnover, among all the Asian countries after a massive market decline.

Asian stock markets share many features with more developed markets, but they have the following distinctive characteristics. First, Asian markets consist of dynamic economies with a high gross economic growth rate and a high rate of financial market capitalisation. With a GDP growth rate of 5.3 forecast for 2016-2017, Asian markets appeal to both finance researchers and practitioners.[4] According to the IMF, Asian stock markets had reached a capitalisation of almost $15 trillion by the end of 2012 (Ong and Lipinsky, 2014). This figure is approximately the same as the combined capitalisation of Europe, the Middle East, and Africa.

4 Please see the official IMF website for the Regional Economic Report for Asia and the Pacific for more details: http://www.imf.org/en/Publications/REO/APAC/Issues/2017/03/06/Building-on-Asia-s-Strengths-during-Turbulent-Times

Second, Asian stock markets have multiple participants with different levels of financial market experience. The majority of Asian countries are developing countries. Compared with Europe and North America, the relatively primitive financial systems in Asia are inefficient, which results in predictability in stock returns. Although the EMH assumes a random walk in price series, Wang *et al.* (2014) document a mean-reverting pattern in prices for all the Asian equity markets after adding a trend term. This result suggests that the trend followed by Asian stock prices is predictable since shocks in the stock price are only temporary.

Third, Asian investors appear to suffer from cognitive biases to a greater extent than investors in western cultures (Yates *et al.*, 1997; Yates *et al.*, 1996; Yates *et al.*, 1989). Based on theoretical evidence from research by psychologists and sociologists, culture plays a crucial role in developing varying levels of behavioural biases. People raised in Asian cultures are more likely to show behavioural bias than people raised in US culture (Yates *et al.*, 1997; Yates *et al.*, 1989). Similarly, Yates *et al.* (1996) find that Asians are more likely to exhibit overconfidence than Westerners. Chen *et al.* (2007) document overconfidence and representativeness bias among Chinese investors, meaning that they appear to regard past returns an indicator for future returns. These cognitive biases can cause Chinese investors to make poor investment decisions. A study on cultural difference reveals that some cultures are individualist while others are collectivist (Hofstede, 1980). Asian cultures show more features of social collectivism. The behavioural bias of Asian investors is argued to be a result of living in collective-oriented societies. Collectivism can lead to overconfidence and herding behaviour.

Finally and most importantly, the contribution of individual investors to feedback trading behaviour is well documented in the literature. Colwell *et al.* (2008) distinguish between different types of investors and document that in the short term (up to 1 month), only individual investors adopt a feedback trading strategy. Chuang *et al.* (2014) indicate that, compared with institutional investors, individual investors are more likely to trade as a response to market gains. Moreover, existing studies suggest that individual investors are more likely to engage in positive feedback trading. Kim *et al.* (2005) find that while Japanese individual investors are positive feedback traders, there is no compelling evidence that Japanese institutions engage in positive feedback trading. Bange (2009) further confirms that small individual investors adopt a positive feedback trading strategy when making decisions with regard to portfolio allocation. In contrast to individual investors, institutional investors either make little contribution to feedback trading or engage in negative feedback trading. Chau *et al.* (2015) ascribe the insignificant feedback trading found in the carbon and natural gas markets to the dominant role of institutional investors in these markets. Likewise, Ülkü and Weber (2013) suggest that the while individual traders in the Korean stock market are intraday positive feedback traders, institutional investors are intraday negative feedback traders.

In contrast to the equity markets of developed Western countries, domestic individual investors play an important role in East-Asian equity markets (Coakley *et al.*, 2012). While institutional investors account for over half of the total U.S. equity ownership, individual investors in Asian stock markets hold a higher proportion of the outstanding tradeable shares (Bennett *et al.*, 2003). For example, more than 90% of the 60 million investor accounts of the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) belonged to individual investors by the end of 2004 (Li *et al.*, 2016). Similarly, Hung and Banerjee (2014) report that the ownership percentage of domestic individual investors (40.37%) in Taiwan was around eight times that of domestic financial institutions (4.99%) in 2011. In addition, the total number (as well as the total percentage) of Hong Kong's retail investors among the adult population, reached its highest recorded level (35.7%) in 2011.

Moreover, individual investors account for a major proportion of the market trading activities in the Asian stock markets. According to Hung and Banerjee (2014), individual investors in Taiwan contributed to between 62.7% and 84.41% of the total trading volume from 2001 to 2011. More specifically, domestic individual investors were responsible for 71% of the transactions on the Taiwanese stock market from 8 October 2007 to 30 September 2008 (Kuo and Lin, 2013). Li *et al.* (2016) document that individual accounts made up 97.23% of the 37.82 million accounts traded on the Shanghai Stock Exchange by the end of 2004, accounting for 86.3% of its trading value. In 2011, the trading activity of domestic individual investors comprised 79.5% of the total shares traded on the Korean stock exchange (Hung and Banerjee, 2014). Coakley *et al.* (2012) reveal that the trading volume of individual investors in the Hong Kong Stock Exchange ranged from 25% to 45% between 1999 and 2009. It is worth noting that in 2001 the proportion of total shares traded on the U.S. stock market by individuals was 14.4%, which is much lower than the proportion of shares traded by individual investors in Asia (Griffin *et al.*, 2003). As the behavioural bias theory suggests, more financial anomalies are documented in Asian stock markets. For example, significant day-of-the-week effects are reported in three out of the five South-east Asian equity markets (Brooks and Persand, 2001). Given the dominant role of individual investors in Asian stock markets and the contribution of individual investors to feedback trading, we investigate the feedback trading activities in the main Asian stock markets.

If all the evidence is taken together, previous studies on feedback trading have the following limitations. First, the majority of existing studies only examine market volatility and ex-post returns. Second, only a limited amount of literature extends the feedback trading models to incorporate factors other than price-related variables. Third, although the existence of feedback trading in stock markets is well documented in the literature, there is a lack of up to date studies covering the economic crisis of 2008 onwards. This chapter aims to fill the research gap by examining the connection between feedback trading and liquidity. Motivated by Chau *et al.* (2011), we extend the demand function of feedback traders by incorporating liquidity into our augmented SW model. We employ the SW Model as our baseline model because it highlights the influence of volatility on feedback trading. A feature of the SW Model is its cross product of ex-post return and volatility which reflects the impact of feedback trading on the autocorrelations in the return series. It is assumed that the coefficients of the cross-section term are negative and significant if positive feedback traders dominate the market. Existing literature has documented a positive correlation between trading volume, as a measure of liquidity, and volatility, finding it to be negatively correlated with non-synchronous trading (Koutmos, 1997).

2.2.3. Feedback trading models

Feedback trading is a widely documented type of trading behaviour among investors. Although the trading rule of thumb is 'buy low and sell high', some investors still apply a momentum trading strategy. Feedback traders buy when the price goes up and sell when the price goes down. The effect of this behaviour first attracted attention in the early 1980s. Pioneer research put forward a 'fads' model and a 'noise trading' model respectively to try to capture the behaviour of investors who hold different beliefs (Long *et al.*, 1990; Shiller *et al.*, 1984). The models revealed a positive correlation with equity returns. Later, Cutler *et al.* (1991) confirmed the impact of feedback traders on the serial correlation pattern in a variety of assets. Since then, scholars have proposed various feedback trading models to capture the autocorrelation pattern in asset returns. A major assumption in modelling feedback trading is that investors hold different beliefs. Trying to determine how many types and what kind of investors are the major participants in the market represents a problem which has formed the subject of much debate. The strategic trading framework introduced by Kyle (1985) divides investors into three subgroups: the fully-informed risk-neutral insider, the random noise trader with no inside information; and the rational but uninformed market maker. Long *et al.* (1990) also suppose there are three groups of investors in the market. In their study, the three subgroups are categorised as rational speculators, positive feedback traders, and passive traders. Their theoretical model shows a close relationship between the momentum of stock returns and positive feedback traders. Under the basic assumption of heterogeneous beliefs among market participants, Rossi and Tinn (2010) extend Kyle (1985) framework to model positive feedback trading by market makers. They find that positive feedback trading will be an optimal strategy if private information is of high value. In the case where private information is of low value, negative feedback trading proves to be the optimal trading strategy. A more recent study by Guo and Ou-Yang (2014) introduces a monopolistic investor to Kyle (1985) strategic model and finds that various types of investors react differently to fundamental and non-fundamental information. Some researchers have derived feedback trading models from other aspects. For instance, Antoniou *et al.* (2005) emphasise the complexity of autocorrelation patterns in stock returns and prove the existence of an inverse relationship between autocorrelation and volatility.

2.2.3.1. SW feedback trading model

Despite the proliferation of new feedback trading models, the model introduced by Sentana and Wadhwani (1992) is still the most widely applied. Similarly to Kyle (1985), the underlying assumption in Sentana and Wadhwani (1992) model is that investors hold heterogeneous beliefs. Apart from the group of rational investors who aim to maximise their expected utility (smart money investors), the other groups of investors follow the trend-chasing strategy (feedback traders). The SW Model highlights the importance of volatility in feedback trading behaviour. When the market is highly volatile, smart money investors face a greater risk when trying to make precise predictions about stock returns. In this case, feedback traders may have a greater influence on stock prices. Smart money investors could take advantage of the higher autocorrelation in price series resulting from feedback trading to make a profit. According to the framework of the SW Model, volatility has a positive correlation with stock returns. It is worth noting that, under certain circumstances, the autocorrelation in the stock return series can become neutral or negative. Sentana and Wadhwani (1992) suggest that the first-order autocorrelation can be negative under the joint effect of feedback traders and smart money investors when the stock volatility is high enough.

The SW Model has attractive properties. First, the assumptions made by the SW Model are testable. The existence of positive or negative feedback traders can easily be discerned from the coefficient. Second, the SW Model takes the two most frequently cited explanations for serial correlation in the index return into account, namely non-synchronous trading and feedback trading. Third, the SW Model is capable of detecting momentum behaviour, especially during periods of downturn.

Following Sentana and Wadhwani (1992), we only allow for risk-return considerations (i.e. maximising expected utility) to affect smart money investors' demand for shares, $Q_{1,t}$:

$$Q_{1,t} = \frac{E_{t-1}\left(R_t\right) - \alpha}{\mu_t} \tag{2.1}$$

where $E_{t-1}\left(R_t\right)$ is the expectation of return at time t given the information available at time $t-1$, α is the risk-free return when smart money investors hold zero shares and μ_t is the risk premium when investors with expected maximised utility own all the shares. If we take the conditional variance as a proxy for risk, the risk premium

$\mu(\cdot)$ becomes an increasing function of conditional variance:

$$\mu_t = \mu(\sigma_t^2) \tag{2.2}$$

Investors require a higher level of compensation for greater risk (conditional volatility). It is worth noting that if all the shares are held by smart money investors ($Q_{1,t} = 1$), the function becomes:

$$E_{t-1}(R_t) - \mu(\sigma_t^2) = \alpha \tag{2.3}$$

Equation (2.3) is a fundamental form of the Capital Asset Pricing Model (CAPM). The demand for shares by the second group of investors or the feedback trading investors, $Q_{2,t}$, is determined by the previous return:

$$Q_{2,t} = \gamma R_{t-1} \tag{2.4}$$

where $\gamma > 0$. The key factor for positive feedback traders is the ex-post return, R_{t-1}. This group of investors bets on the stock return trend to continue. They expect positive trends to follow positive returns and negative trends to follow negative returns. On the contrary, if the market is dominated by negative feedback traders who bet on the negative correlation between returns, the signal of the capital asset returns is reversed, i.e. $\gamma < 0$. To meet the requirement of market equilibrium the following must hold:

$$Q_{1,t} + Q_{2,t} = 1 \tag{2.5}$$

By substituting Equation (2.1), (2.2) and (2.4) into Equation (2.5), we get:

$$E_{t-1}\left(R_t\right) - \alpha = \mu\left(\sigma_t^2\right) - \gamma\mu\left(\sigma_t^2\right) R_{t-1} \tag{2.6}$$

If we assume that the smart money investors have rational expectations of future returns:

$$R_t = E_{t-1}\left(R_t\right) + \varepsilon_t \tag{2.7}$$

where ε_t is an identically independently distributed error term. We then substitute Equation (2.6) into Equation (2.7):

$$R_t = \alpha + \mu\left(\sigma_t^2\right) - \gamma\mu\left(\sigma_t^2\right) R_{t-1} + \varepsilon_t \tag{2.8}$$

It can be observed from Equation (2.8) that in an equity market with feedback trading behaviour, the appearance of the additional term, R_{t-1}, in the return function implies a first-order autocorrelation in the return series. The sign of the coefficient of R_{t-1} depends on the market volatility. As market volatility changes, the relative percentage of the two types of investors also varies. When there is a rise in market instability, feedback traders rather than smart traders dominate the market. As a result, there is a stronger autocorrelation in stock returns. It is worth noting that, as Chau and Deesomsak (2015) point out, positive feedback trading results in a negative autocorrelation in returns while negative feedback trading causes a positive autocorrelation in returns.

The term $-\gamma\mu\left(\sigma_t^2\right)R_{t-1}$ suggests that negative returns introduce a positive correlation in the return series while positive returns introduce a negative correlation in the return series. The serial correlation is stronger when there is higher volatility. It is worth noting that Equation (2.8) does not take into account the impact of non-synchronous trading and market imperfections on the serial correlation. To allow for the influence of these omitted factors on feedback trading behaviour, Sentana and Wadhwani (1992) derive the empirical version of the feedback trading model as follows:

$$R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \varepsilon_t \quad (2.9)$$

where: γ_0 is the coefficient on the pure ex-post return term which measures the impact of non-synchronous trading and market imperfections, γ_1 is the coefficient on the feedback trading term and $\gamma_1 = -\gamma\mu$. Therefore, as specified by Equation (2.9), a positive and significant γ_1 indicates the presence of negative feedback trading while a negative and significant γ_1 indicates the presence of positive feedback trading.

If the market volatility is low enough, feedback trading is mainly reflected by a significant γ_0 on the first lag of the return. In the case of high market volatility, the growing influence of feedback traders is reflected by the significant γ_1 . In the case of positive feedback trading, high market volatility results in a negative correlation between stock returns. Thus, if there are positive (negative) feedback trading investors in a market, the coefficient γ_1 should be negative (positive) and statistically significant. In general, with market volatility acting as a predictor for constituents of market participants, the SW Model shows that in a market with positive (negative) feedback traders, returns have negative (positive) autocorrelations (Sentana and Wadhwani (1992) documented statistically significant $\gamma_0 = 0.11$, $\gamma_1 = -0.019$). The negative autocorrelation becomes stronger in the case of higher volatility. The SW Model also takes non-synchronous trading into account by including an AR(1) term. When two independent stocks are trading at an equal frequency in a market, they have different adjustment speeds to news which has an impact on both of them. The delay in reflecting news by one of the stocks results in a positive cross-correlation pattern between the two stocks. Since the index is a combination of various stocks, there is a pattern of positive autocorrelation in a stock index. Lo and Craig MacKinlay (1990) verify that the correlation in the index caused by non-synchronous trading could be measured by an AR(1) procedure. In the SW Model, the coefficient γ_0 on the lagged return term captures the degree of non-synchronous probability.

2.2.3.2. Augmented feedback trading models with liquidity measures

To test whether liquidity can explain feedback trading, we add a liquidity term to the demand function of feedback traders. First, we assume that the demand for shares by feedback traders is a linear combination of ex-post return and liquidity:

$$Q_{2,t} = \gamma R_{t-1} + \delta liq_{t-1} \tag{2.10}$$

where liq_{t-1} is the market liquidity measured by the bid-ask spread, the turnover rate and the Amihud illiquidity measure on day $t-1$. A positive (negative) δ on a liquidity measure suggests that the demand for shares increases (decreases) when the liquidity measure becomes higher. As the equilibrium in Equation (2.5) holds, we can substitute Equations (2.1) (2.2) and (2.10) into (2.5) and rearrange it, which gives:

$$E_{t-1}\left(R_t\right) - \alpha = \mu\left(\sigma_t^2\right) - \gamma\mu\left(\sigma_t^2\right) R_{t-1} - \delta\mu\left(\sigma_t^2\right) liq_{t-1} \tag{2.11}$$

Following Sentana and Wadhwani (1992), we assume that the smart money investors have rational expectations of future returns and the non-synchronous trading effect, and thus if we further set $\gamma_2 = -\delta\mu$, Equation (2.10) becomes:

$$R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right) R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t \tag{2.12}$$

which is our augmented SW Model I. As illustrated in the model, the return in period *t* is determined by an additional term derived as the cross-product of liquidity and volatility. The model indicates that the dependence of the return on liquidity varies with conditional volatility σ_t^2. The coefficient γ_2 is significant if market liquidity can explain feedback trading. If market liquidity is the primary reason for investors adopting a feedback trading strategy, the significance of coefficient γ_1 on the feedback trading term is reduced while the coefficient γ_2 on the liquidity term $liq_{t-1}\sigma_t^2$ remains significant. A positive γ_2 (where $\gamma_2 = -\delta\mu$) suggests that a feedback trader is more likely to sell shares when the value of the liquidity measure is higher during the last period, while a negative γ_2 suggests that a feedback trader is more likely to buy shares when the value of the liquidity measure is greater during the last period.

If market liquidity has an effect on the feedback traders' demand function for shares, not as an additional linear term but in a multiplicative way, then the feedback traders' demand function, $Q_{2,t}$, can be re-parameterised as follows:

$$Q_{2,t} = \left(\gamma + \delta liq_{t-1}\right) R_{t-1} \qquad (2.13)$$

Equations (2.1) (2.2) and (2.13) are substituted into, and it is rearranged, which gives:

$$E_{t-1}\left(R_t\right) - \alpha = \mu\left(\sigma_t^2\right) - \left(\gamma + \delta liq_{t-1}\right)\mu\left(\sigma_t^2\right) R_{t-1} \qquad (2.14)$$

Following the empirical approximation used by Sentana and Wadhwani (1992) and setting $\gamma_3 = -\delta\mu$, Equation (2.14) can be re-parameterised as:

$$R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right) R_{t-1} + \varepsilon_t \qquad (2.15)$$

The above model is our augmented SW Model II. The model allows for the collective impact of ex-post return, conditional volatility and market liquidity on feedback trading. The coefficient of γ_3 is significant if the intensity of feedback trading is conditional upon the level of stock market liquidity. If market liquidity plays a determinant role in feedback traders' demand function, the significance of coefficient γ_1 on the feedback trading term is reduced while the coefficient γ_3 on the liquidity term $\gamma_3 liq_{t-1}\sigma_t^2 R_{t-1}$ remains significant. When the lagged return is positive, a positive γ_3 (recalling that $\gamma_3 = -\delta\mu$) suggests that a feedback trader is more likely to sell shares when the value of the liquidity measure is higher during the last period. A negative γ_3 suggests that a feedback trader is more likely to buy shares when the value of the liquidity measure is greater during the last period. On the contrary, when the lagged return is negative, a positive γ_3 suggests that a feedback trader is more likely to buy shares when the value of the liquidity measure is higher during the last period. A negative γ_3 suggests that a feedback trader is more likely to sell shares when the value of the liquidity measure is greater during the last period.

Please note that to illustrate the difference between augmented SW model I and model II, we define γ_2 as the coefficient on the interaction between lagged liquidity and volatility, $liq_{t-1}\sigma_t^2$, and define γ_3 as the coefficient on the three-way interaction between lagged liquidity, lagged return and volatility, $liq_{t-1}\sigma_t^2 R_{t-1}$. Therefore, γ_2 and γ_3 are only included in the augmented SW models I and II to capture the impact of liquidity respectively, which are Equation (2.12) and Equation (2.16) respectively.

2.2.3.3. Specification of conditional variance

The development of GARCH models introduces various proxies for conditional volatility, σ_t^2. The SW Model assumes that GARCH type models are capable of capturing conditional volatility and applies three proxies for volatility, drawing on the Exponential GARCH model in particular. Some recent studies, including those by Antoniou *et al.* (2005) and Chau *et al.* (2011), apply the GJR-GARCH specification proposed by Glosten *et al.* (1993) to capture the asymmetrical effect in conditional variance. In this study we adopt the GJR-GARCH (1, 1) specification:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \delta I_{t-1} \varepsilon_t^2 \qquad (2.16)$$

Where σ_t^2 represents the conditional volatility in period *t*, ε_{t-1} stands for innovation in period $t-1$ and I_{t-1} is an indicator of the asymmetric response of volatility to good and bad news. If there is bad news ($\varepsilon_{t-1} < 0$), I_{t-1} takes a value of 1 and a value of 0 otherwise. A positive and significant δ implies that negative shocks have a greater influence on future volatility than positive shocks of the same size. The news coefficient α_1 indicates the impact of the most recent innovation; β measures the persistence of volatility, and α_0 stands for unconditional volatility. We also apply the GJR-GARCH model as the variance equation for the SW Model and two augmented SW Models.

Leptokurtosis and non-normality in the distribution of daily stock returns series have been well documented. We follow Sentana & Wadhwani (1992a), Koutmos (1997), and Chau *et al.* (2011) in assuming a Generalised Error Distribution (GED) for stock returns to capture non-normality and leptokurtosis. We estimate the coefficients of the mean equation and variance equation simultaneously using the maximum likelihood method. The maximum likelihood method is conducted using the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm to achieve convergence (Chau *et al.*, 2011).

2.2.4. Liquidity measures

Because liquidity is an elusive concept, it is difficult for researchers to observe it directly. Therefore, liquidity measures have been developed to quantify various aspects of liquidity. A single liquidity measure cannot reveal the whole picture when exploring the effect of liquidity on expected stock returns. A rich body of literature applies liquidity measures as a risk premium in asset pricing models. We augment the SW Model by using three liquidity measures to examine the relationship between feedback trading and market liquidity. We apply the two most traditional liquidity measures – the turnover rate and the bid-ask spread – together with the Amihud illiquidity measure, a composite liquidity measure, first developed by Amihud (2002). Our measures of liquidity are also the primary liquidity measures applied by Lesmond (2005) to examine liquidity in emerging markets. We adjust his quarterly measure to a daily measure to allow for investors rapidly changing their demand for shares.

Our first measure, the Amihud illiquidity measure, was proposed by Amihud (2002). Based on the findings of Goyenko et al. (2009), the Amihud (2002) measure turns out to be a good proxy for the price impact after running horse races between a number of liquidity proxies. The Amihud illiquidity measure is a price impact measure which captures the "daily price response associated with one dollar of trading volume". In his article, Amihud defines the illiquidity measure as the average ratio of the absolute daily return of stock j to its trading volume on year y: $Illiq_{j,y} = \frac{1}{D_{j,y}} \sum_{j=1}^{D_{j,y}} \left| R_{j,y,d} \right| \Big/ VA_{j,y,d}$,

$D_{j,y}$ is the number of days with available data for stock j in year y ; $R_{j,y,d}$ is the return of stock j on day d of year y; and $VA_{j,y,d}$ is the trading volume measured by value on day d of year y of stock j .

We notice that the original Amihud illiquidity measure cannot reflect the daily change in market liquidity. To measure the daily illiquidity measure for the stock market as a whole, we add together the illiquidity measure for each stock traded on day t and divide it by the number of shares traded (n) on day t :

$$Illiq_t = \frac{1}{n_t} \sum_{j=1}^{n_t} Illiq_{j,t} \tag{2.17}$$

where: $Illiq_{j,t} = \frac{\left| R_{j,t} \right|}{VA_{j,t}}$. Please note that $Illiq_{j,t} = \frac{\left| R_{j,t} \right|}{VA_{j,t}}$ also reflects the general definition of the Amihud illiquidity measure. The Amihud (2002) defines the illiquidity measure as a price impact measure which captures the "daily price response associated with one dollar of trading volume. We apply the first equation to explain the form of the annual Amihud illiquidity measure and use the second equation in calculating our daily Amihud illiquidity measures as we use daily data.

Our second measure of liquidity is the quoted percentage spread (PS). The spread between the bid and the ask price is a natural measure of liquidity since it combines the premium and the concession from both sides to finish the trade. The ask price accounts for the premium for immediate buying while the bid price reflects the concession given for immediate sale. In order to take into consideration the percentage change in liquidity, we apply a quoted percentage spread, the Q-spread (PS). The Q-spread for stock j at day t is defined as the quoted bid-ask spread scaled by the bid-ask midpoint, where $m_{j,t} = \frac{Ask_{j,t} + Bid_{j,t}}{2}$. We apply the following function to measure the percentage Q-spread of the whole market:

$$Qspread = 100 * \frac{1}{n_t} \sum_{j=1}^{n} \frac{Ask_{j,t} - Bid_{j,t}}{m_{j,t}} \quad (2.18)$$

where $Qspread_{j,t} = \frac{Ask_{j,t} - Bid_{j,t}}{m_{j,t}}$. We total up the Q-spread of individual stocks and scale it by the number of stocks n traded on day t.

Our third measure of liquidity is the turnover rate. Using the turnover rate as a liquidity measure has strong theoretical appeal. In a situation of market equilibrium, market liquidity is correlated with trading frequency. Intuitively, if the liquidity itself is not directly observable, the turnover rate is a good proxy for liquidity. We define the turnover rate (Tov) as the volume of shares (Vol) of stock j traded on day t

scaled by the number of shares outstanding ($Nosh$). To capture the turnover rate of the market as a whole, we apply the equally weighted percentage market turnover rate which is given below:

$$Tov_t = \frac{1}{n}\sum_{j=1}^{n} Tov_{j,t} \tag{2.19}$$

where $Tov_{j,t} = \frac{Vol_{j,t}}{Nosh_{j,t}}$. We apply equal-weighted portfolio instead of value-weighted portfolio for the following reasons: First, Amihud illiquidity measure is the primary measure in our study. Amihud (2002) also applies the equal-weighted return in deriving the Amihud illiquidity measure. Second, Liu (2006) includes liquidity in the asset pricing model and applies turnover rate, bid-ask spread and Amihud illiquidity measure as the measures for market liquidity. In his study, he focuses on the equally weighted portfolio. He explains that the liquidity premium generated by value-weighting is weaker than the one generated by equal-weighting. His analysis further shows value-weighting tends to underestimate the liquidity premium especially when the illiquid stocks tend to be small. Therefore, we follow Amihud (2002) and Liu (2006) and apply equally weighted portfolio in deriving the liquidity measures. We winsorize the upper and bottom 1% of the distribution following Lesmond (2005) and Amihud (2002) to eliminate the impact of extreme values.

2.3. Data and descriptive statistics

Our sample includes the major stock indices of the top six stock exchanges ranked by market value in East Asia. The capital market valuation ranges from 4910 to 639 billion dollars, and covers those in Japan, China, Hong Kong, South Korea, Taiwan and Singapore.[5] Kim and Shamsuddin (2008) apply multiple variance ratio tests to examine the market efficiency of Asian stock markets. They find that Hong Kong, Japanese, Korean and Taiwanese markets are efficient in the weak form while Malaysia and Philippines show no sign of efficiency. The stock markets in Singapore and Thailand become more efficient after the financial crisis in 1997. Their findings show that while Asian stock markets are not efficient, they are becoming more efficient as they develop. Our study is inspired by Kim and Shamsuddin (2008), which highlights the impact of the market development on the market efficiency, in selecting our sample markets. Our sample includes the top six Asian stock markets ranked by market value and covers countries at different development stages. In addition, our study takes the biggest developing market, China's stock market, into account. We collected the daily closing prices of the main stock index in these countries from Data Stream. More specifically, the following stock indices are examined: Shanghai A Share (China); Hang Seng Index (Hong Kong); Taiwan Weighted Stock Index (Taiwan); Nikkei 225 (Japan); KOSPI Index (Korea); and Straits Times Index STI (Singapore). Data for all the stock indices spans from 01/01/2000 to 31/12/2016. To measure the stock market liquidity, we obtained the number of shares outstanding ($Nosh$), the closing price (P), the bid price (PB), the ask price (PA), the turnover by volume (Vol) and the turnover by value (VA) from Datastream.

5 Please see the official The Money Project website for more details: http://money.visualcapitalist.com/all-of-the-worlds-stock-exchanges-by-size/

The economic crisis which began in 2007-2008 is often regarded as the turning point in the market regime. As shown in Figure 2-1, the price of the six equity market indices reached their peak in October 2007, after which they fell substantially. We also noticed that the stock indices recovered after 2013. To check whether the interaction between liquidity and the feedback trading effect exists under different market regimes, we apply the method implemented by Chen (2011) to specify the market regime. We use the market regime dummy variable where 1 denotes a bull market, and 0 denotes a bear market. Daily closing stock returns for individual stocks and stock indices are calculated as the percentage of natural logarithmic difference of daily closing prices., i.e., $R_t = 100 * \ln\left(\frac{P_t}{P_{t-1}}\right)$.

[Insert Figure 2-1 around here]

Panel A of Table 2-1 provides the summary statistics of the daily stock returns of the six equity indices for our sample markets. It is evident that all six stock return series are negatively skewed and highly leptokurtic. The significant JB statistics of all six indices imply a departure from the normal distribution. All of the sample countries show a significant ARCH (12) effect according to the Lagrange multiplier test. The return series have significant Ljung-Box statistics with lags of up to 12 in all markets except for South Korea and Japan. All the indices show a temporal dependence in squared returns given by significant Ljung-box statistics. To test whether there is an asymmetrical response to the conditional volatility, we apply the Engle and Ng (1993) signal bias test. The significant statistics imply the existence of significant asymmetry in all the return series except that of China. In sum, these significant statistics support the adoption of the GARCH type models to gauge the autocorrelation, leptokurtosis and asymmetry in the conditional variance. It is also worth noting that all the stock indices have a positive correlation with each other (near or above 0.5), which suggests co-movement of the East Asian stock markets.

[Insert Table 2-1 around here]

In Panel C of Table 2-1, we estimate a simple AR (5) model for each stock index to test whether the stock return has significant autocorrelations with its lags. None of the six indices shows significant autocorrelations with its lags up to 5. We only find a significant autocorrelation between a stock index and its lags up to 4 for China, Taiwan and Singapore. These significant correlations imply that feedback trading may exist in Asian stock markets. As pointed out by Chau *et al.* (2011), the interaction between smart money investors and feedback trading investors can lead to very complex models, and thus further empirical investigation is implemented using the SW Model.

2.4. Empirical results

2.4.1. Results of SW Models

Table 2-2 presents the results of the SW Model for our six Asian stock markets based on the maximum likelihood method.

Before giving the result of Table 2-2, we first introduce the items and their implications in the Panel B. Each of our following tables which give the empirical result on the SW and augmented SW models include two to three panels. Panel B of each table gives the estimation results of the conditional variance equation. We pay attention to the coefficients to confirm that it is proper to apply GARCH type models. α_1 is the coefficient of the moving-average term. If α_1 is close to zero, there is pronounced temporal dependence. β is the coefficient on the autoregressive term. If β is close to unity, there is persisting conditional volatility process. If δ in the variance equation is significant, the past squared residuals have an asymmetric effect on conditional variance. The leverage effect or the volatility feedback effect is used to explain the asymmetry. Antoniou et al. (2005) indicate that the asymmetry is partly induced by the asymmetric response of feedback traders to good and bad news. Feedback traders are inclined to react more strongly to bad news than to good news. If the estimated parameter ν is well below 2 and is close to unity, the empirical distribution of returns is close to the Laplace distribution. Most of our empirical results show that our variance terms have the following features: temporal dependence and persisting volatility; asymmetric respond to good and bad news; distribution is close to the Laplace distribution, and thus the GJR-GARCH models are suitable for most of our sample markets.

As shown in Panel B of Table 2-2, for each index, all the coefficients of the variance equation are significant at the 1% level. The coefficient of the moving-average term, α_1, is close to zero while the coefficient of the autoregressive term, β, is close to unity, implying that there are pronounced temporal dependencies and that the conditional volatility process persists. The significant δ in the variance equation shows that past squared residuals have an asymmetric effect on conditional variance, indicating that feedback traders are inclined to react more strongly to bad news than to good news. The estimated parameter ν is well below 2 and is close to unity, indicating that the empirical distribution of returns is close to the Laplace distribution. Our empirical result shows that our variance terms have the following features: temporal dependence and persisting volatility; asymmetric respond to good and bad news; distribution is close Laplace distribution. Therefore, the GJR-GARCH models are suitable for most of our sample markets.

[Insert Table 2-2 around here]

Panel A of Table 2-2 shows the estimated coefficients of the mean equation. To describe the autocorrelation pattern in the return series, we focus on the coefficients of two parameters: the constant component of return autocorrelation, γ_0, and the cross-product of ex-post return and level of volatility γ_1. The autocorrelation coefficients γ_0 on simple ex-post return terms are all positive and significant at least at the 10% level. It is worth noting that, as argued by Sentana and Wadhwani (1992), the significance of γ_0 implies the existence of non-synchronous trading in part of the Asian equity market. However, the coefficients, γ_1, which capture the presence of feedback trading in the SW Model, are all negative and statistically significant at least at the 5% level. The results show the existence of positive feedback trading in all six of the Asian stock markets. The impact of feedback trading is stronger in periods of high volatility. As the level of volatility increases, positive feedback trading leads to a negative autocorrelation in the stock return series. The increase in autocorrelation strengthens the predictability of stock returns which results in higher profitability. As pointed out by Jegadeesh and Titman (2011), the momentum strategy (feedback trading) performs best over a three- to twelve-month period. Therefore, our findings provide more evidence that feedback trading can be a profitable strategy. The original SW feedback trading model does not allow for the possible impact of market liquidity on feedback trading behaviour. We now turn to the main focus of this chapter: examining the presence and intensity of feedback trading, taking into account the influence of market liquidity.

2.4.2. Results for augmented SW Models with Amihud illiquidity measure

In this section, we explore the role of market liquidity in feedback trading behaviour and include a liquidity term in the feedback traders' demand function. We employ the Amihud illiquidity measure, the bid-ask spread and the turnover rate as proxies for liquidity level. We reason the empirical results of augmented SW models as follows: firstly, we look at the significance and sign on γ_1. Positive (negative) and significant γ_1 indicates that the negative (positive) feedback trading effect is presented in the market. We then look at the significance of γ_2 and γ_3. Significant γ_2 and γ_3 indicate that the market liquidity can influence the feedback trading behaviour by affecting the feedback trader's demand function for shares. Positive (negative) and significant γ_2 in Model I implies that investors sell (buy) their shares when market liquidity increases. If the lagged return and lagged liquidity are both positive, the positive (negative) and significant γ_3 in Model II indicates that the feedback traders will sell (buy) more shares when the market liquidity increases. The market liquidity can be a primary driver for feedback trading, if the γ_1 turns insignificant after controlling for the impact of market liquidity while γ_2 or γ_3 remains significant.

We first provide the summary statistics of the liquidity measures for the six Asian markets which show significant feedback trading. Panel A of Table 2-3 shows the summary statistics for the three liquidity measures for each index. All three measures show highly significant JB statistics for each of the equity indices, implying a departure from normality. A few of the models do not reject the null hypothesis of the joint test, but the rest reject each diagnostic test. The significant test statistics indicate that the liquidity measures not only have an ARCH effect but also have temporal dependence in the first and second moment.

[Insert Table 2-3 around here]

b1 to b5 are the coefficients on the autoregressive regression $R_t = b_0 + \sum_{i=1}^{5} b_i R_{t-1} + u_t$. The aim of the autoregressive regression is to see whether the variable has a correlation with its lags. If any of b1 to b5 is significant, there is autocorrelation between the tested variable and its lags. If this is the case, it is proper to apply GARCH type models to gauge the autocorrelation. It is not required that all the coefficients are significant or are equal. Therefore, we do not test the null hypothesis "b1=b2=b3=b4=b5". A similar approach is also applied in several studies feedback trading (Charteris et al., 2014; Chau et al., 2011; Chau et al., 2015). The autocorrelation figures displayed in Panel C show a highly significant autocorrelation between market liquidity measures up to lag five. The combined results suggest that in the regressions with liquidity measures, the diagnostic tests may be influenced by the ARCH effect introduced by the liquidity measures. Since the sample involves daily data which covers a period of 16 years, the regression coefficients given by the maximum likelihood method are reliable.

We then consider the estimation based on the augmented SW Model with the Amihud illiquidity measure. Table 2-4 reports the results using the maximum likelihood method. As shown in Panel A of Table 2-4, all the models except augmented SW Model II for Hong Kong and augmented SW Model I for Singapore have a significant liquidity term. The results indicate that liquidity should be included in the demand function of feedback traders. It is worth noting that after allowing for the market liquidity as an additional factor in determining feedback trading investors' demand for shares, the coefficient γ_1 of Model I for China, South Korea and Singapore, as well as Model II for China, become insignificant. This result suggests that in some countries, concerns about market liquidity can be a dominant factor in feedback traders' decision-making process. The difference in the significance of γ_2 and γ_3 between countries may be a result of the impact from western countries. US exerts a significant economic impact on Japan, Korea, Singapore and Taiwan, while the financial system in Hong Kong was constructed under the direction of UK. In our six sample markets, only Chinese stock market is policy oriented and thus relatively free from the influence of western countries. In addition, the different percentage of individual investors in the stock market may also contribute to the change of significance level among the sample markets. As mentioned in the literature review, the contribution of individual investors to feedback trading behaviour is well documented in the literature. While all our sample markets are dominated by individual investors, the percentage of shares traded by individual investors varies significantly from market to market. Li et al. (2016) document that individual accounts made up 97.23% of the 37.82 million accounts traded on the Shanghai Stock Exchange by the end of 2004, accounting for 86.3% of its trading value. In 2011, the trading activity of domestic individual investors comprised 79.5% of the total shares traded on the Korean stock exchange (Hung and Banerjee, 2014). Coakley et al. (2012) reveal that the trading volume of individual investors in the Hong Kong Stock Exchange ranged from 25% to 45% between 1999 and 2009. The individual investor affects the intensity of feedback trading, and thus the significance of the coefficient on liquidity measures. Both two augmented feedback trading models perform well in capturing the impact of market liquidity on feedback trading in China. Given that Chinese market has the highest percentage of individual investors, the result suggests that the individual investors abstract information from market liquidity when setting up feedback trading strategy. It is also of interest that most models, except Model I for China, Japan and Singapore, still have a significant γ_0, which is evidence of the existence of non-synchronous trading in some Asian equity markets. In sum, the good performance of both models with the Amihud illiquidity measure as a proxy for liquidity suggests that feedback traders in Asian stock markets base their demand for shares upon market liquidity.

[Insert Table 2-4 around here]

Instead of focusing solely on the ex-post stock return, feedback trading investors have an incentive to choose stocks based on their liquidity. It is worth noting that the signals of the liquidity terms in Model I and Model II are mixed. As the Amihud illiquidity measure is a measure of illiquidity, the results show that, given the level of previous returns, higher volatility and lower liquidity lead to either more or less pronounced feedback trading depending on the undocumented biases among investors. If we recall the demand function of feedback traders given by Equation (2.12), the positive (negative) and significant γ_2 in Model I implies that investors buy (sell) their shares when market liquidity increases.

According to the definition of the demand function given by Equation (2.13), the results of Model II can be analysed as follows: If the ex-post return is positive and the coefficient γ_3 is positive, feedback traders are more likely to buy shares when market liquidity increases. If the ex-post return is negative and the coefficient γ_3 is positive, feedback traders are more likely to buy shares when market liquidity decreases. If the ex-post return is positive and the coefficient γ_3 is negative, feedback traders are more likely to buy shares when market liquidity decreases. Finally, if the ex-post return is negative and the coefficient γ_3 is negative, feedback traders are more likely to buy shares when market liquidity increases. In general, as the level of liquidity increases, feedback traders are inclined to buy (sell) shares when the sign of the ex-post return and coefficient γ_3 are the same (different). Therefore, as reported in Panel A of Table 2-4, we should expect feedback traders in China and Hong Kong to buy more shares when the market liquidity decreases since there is a negative and significant γ_2 in Model I. On the contrary, feedback traders in Taiwan, South Korea and Japan will be likely to buy more shares when the market liquidity increases, since there is a positive and significant γ_2 in Model I. The asymmetric impact of market liquidity on feedback traders' demand function for the various countries suggests that investors in different countries have different demands for market liquidity. Colwell et al. (2008) point out that the individual investors are the key participant in feedback trading. The percentage of account opened by individual investors is quite high in these East Asian countries. Unlike institutional investors, who can focus on certain trading strategies, individual investors in different countries make investment decisions based on different demand or standard regarding the market liquidity. The difference may contribute to the difference in the sign on the γ_2.

In Panel B of Table 2-4, the coefficients of the variance equation are all significant for each index. The significance of the coefficients on the variance terms suggests that our variance terms share the following features: Firstly, there is temporal dependence and persisting volatility in the volatility series; Secondly, the variance term make asymmetric respond to good and bad news; Finally, the distribution of the variance is close Laplace distribution. This result is consistent with the results of the SW Model which confirms that the volatility is asymmetric and highly persistent. It confirms that it is proper to apply the GJR-GARCH model to capture the features of the variance for the augmented SW feedback trading models. As shown in Panel C of Table 2-4, most models passed either the ARCH test or the LB test, indicating that the model is correctly defined. If we consider that the liquidity measures are highly autocorrelated, the estimated coefficient is reliable in a large sample. To further compare the performance of the two augmented SW models we apply two additional measures for liquidity.

2.4.3. Results of alternative measures of liquidity

The results obtained so far suggest that liquidity has an additional effect on the feedback trading strategy. Moreover, in some models with significant liquidity terms, the coefficient of γ_1 becomes insignificant, which indicates that market liquidity can play a substitutive role in feedback trading behaviour. To test the robustness of the models, we apply two additional liquidity measures, namely the bid-ask spread and the turnover rate.

Panel A of Table 2-5 displays the maximum likelihood estimation of the augmented SW Models with the bid-ask spread. Both augmented SW Models capture the significant impact of market liquidity on feedback trading given the significant liquidity terms in each model. The results show that both models perform well when we apply the bid-ask spread as the measure of market liquidity. The signal on the liquidity terms in Model I and Model II varies between the countries, which suggests that investors in different countries have differing demands for market liquidity. We also notice that most of the signals of the liquidity terms in Model I using the bid-ask spread remain the same as those given in Table 2-4. The consistency in the signals suggests that the impact of liquidity on feedback trading, which is captured by Model I, holds true under the two specifications of market liquidity. When examining the robustness of Model II, we notice that the signal on the liquidity terms has changed for three of the six countries. The change in signal reflects the asymmetric impact of different dimensions of liquidity on the feedback traders' demand for shares. Moreover, the change in the signal can be affected by the signal of the lagged return.

Therefore, it is harder to explain the impact of market liquidity on feedback trading using Model II than Model I.

[Insert Table 2-5 around here]

As revealed in Panel B of Table 2-5, most of the coefficients on the variance equation terms are highly significant for each model, suggesting that the volatility is asymmetric and highly persistent. It is proper to adopt the GJR_GARCH model to capture the asymmetry in the variance term. As the case of the augmented SW Model with the Amihud illiquidity measure, Panel C of Table 2-5 shows that the coefficients estimated are reliable in a large sample.

Panel A of Table 2-6 shows the explanatory power of the augmented SW Models with the turnover rate as the proxy for market liquidity. Most models have highly significant liquidity terms except those in Model I for Japan and Model II for South Korea. The results confirm the impact of market liquidity on feedback trading. When examining the robustness of the signals on the liquidity terms in Model I, we notice that the signal for the liquidity terms for two of the six countries has changed, namely China and Hong Kong.

[Insert Table 2-6 around here]

It is worth noting that the correlation between the turnover rate and the Amihud illiquidity measure is negative for China and Hong Kong, as reported in Panel B of

Table 2-3. Thus, the findings given by the estimation using the turnover rate are consistent with those of the estimation using the Amihud illiquidity measure. As summarised in Panel B of Table 2-6, the variance equations all have significant coefficients. The conditional variance is highly persistent since α_1 approximates to zero while β approximates to unity. The significance of δ in each variance equation implies that conditional variance is asymmetrically affected by the past squared residuals. Panel C of Table 2-6 provides evidence that all the models are correctly specified in a large sample. In sum, the robustness of the augmented SW models with different specifications of liquidity measures suggests that the explanatory power of liquidity for feedback trading holds for all six markets, since each country has at least one efficient model.

The findings indicate that concerns about market liquidity should be taken into account when setting the demand function for feedback traders. Since both models perform similarly in terms of capturing the impact of market liquidity on feedback trading, the specification of the demand function of feedback traders can be either a linear combination of ex-post return and liquidity or a cross-product of ex-post return and liquidity.

2.4.4. The effect of liquidity on feedback trading under different market regimes

We observed the following findings: First, there is significant feedback trading in all six equity markets in East Asia. Second, the feedback trading strategy can be determined by the liquidity of the market. Third, the impact of market liquidity on feedback trading holds under different liquidity measures. Finally, the demand function for feedback traders can be estimated by either a linear combination of ex-post return and liquidity or by a cross-product of ex-post return and liquidity.

Since all the findings so far are based on the sample as a whole, it is worth testing whether these results remain unchanged under different market regimes. Chau et al. (2011) and Chau et al. (2015) tell apart the impact of bull market regime and bear market regime when studying the feedback trading strategy, especially when the data covers the financial crisis periods. Chau et al. (2015) point out that it is interesting and informative to further investigate whether the impact of arbitrage opportunity on the feedback traders is condition on the market regimes. We suppose that the market regime may affect the relationship between market liquidity and feedback trading for the following reasons: Firstly, the market regime may exert an impact on feedback trading behaviour. Chen et al. (2007) find out that individuals' attitudes and preference towards risk and past returns are strikingly different between bull and bear market. Given that feedback trading strategy is mainly adopted by individual investors and that feedback traders set up trading strategies based on their attitude towards past return and risk, it is necessary to examine whether there is a significant difference in the feedback trading effect from the bull market regime to the bear market regime. Secondly, different market regimes are associated with the different level of market volatility. As Sentana and Wadhwani (1992) suggest, the market volatility is a determinant factor in feedback trader's demand function. Controlling for the impact of the market regime can control for the change in market risk (volatility) when examining the market liquidity's impact on feedback trading behaviour. To control for the impact of various market regimes on the relationship between market liquidity and feedback trading, we include a regime dummy variable, D_t, in our augmented SW Models. Following Chen (2011), we use the moving average approach to define the market regime dummy. The market regime dummy, D_t, equals one (bull market) when the moving average of the return over the past 90 days is positive and zero otherwise (bear market). When we include the regime dummy, Model I, given by Equation (2.12), becomes:

$$\begin{aligned} R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2^{bull} liq_{t-1}\sigma_t^2 * \left(D_t\right) \\ + \gamma_2^{bear} liq_{t-1}\sigma_t^2 * \left(1 - D_t\right) + \varepsilon_t \end{aligned} \tag{2.20}$$

Similarly, Model II given by Equation (2.15), becomes:

$$\begin{aligned} R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_3^{bull} liq_{t-1}\sigma_t^2 R_{t-1} * \left(D_t\right) \\ + \gamma_3^{bear} liq_{t-1}\sigma_t^2 R_{t-1} * \left(1 - D_t\right) + \varepsilon_t \end{aligned} \tag{2.21}$$

The variance equations for the market regime controlled augmented SW Models adopt the GJR-GARCH specifications given by Equation (2.16).

Table 2-7, Table 2-8 and Table 2-9 show the maximum likelihood estimation for the two augmented SW Models with the market regime dummy using the three liquidity measures respectively. For Model I, we mainly focus on the coefficients of the feedback trading term γ_1 and the liquidity terms γ_2^{bull} and γ_2^{bear}. For Model II, we mainly concentrate on the coefficients of the feedback trading term γ_1 and the liquidity terms γ_3^{bull} and γ_3^{bear}. The significance of the variance terms in Panel B of Table 2-7, Table 2-8 and Table 2-9 suggest that there exist temporal dependence and the volatility in the conditional variance is persistent. The asymmetric respond of conditional variance to good and bad news is reflected by the significant δ. The estimated parameter ν is well below 2 and is close to unity, which indicates that the distribution of the variance is close to Laplace distribution. Overall, the results given by Panel B suggest that it is adequate to apply GJR-GARCH models to gauge the features of variance terms in our augmented SW models with market regime dummy.

[Insert Table 2-7 around here]

Table 2-7 gives the regression results for the augmented SW Models using the Amihud illiquidity measure. As reported in Panel A of Table 2-7, under Model I, all the countries have statistically significant liquidity terms under the bull market regime while only China and Hong Kong have statistically significant liquidity terms under the bear market regime. To further explore whether there is a significant difference in the coefficient on the bear market regime and that of the bull market regime, we apply the likelihood ratio test (LR Test). The null hypothesis of our LR Test is $\gamma_2^{bull} = \gamma_2^{bear}$ for augmented SW Model I and $\gamma_3^{bull} = \gamma_3^{bear}$ for augmented SW Model II. The Likelihood Ratio test statistics reported in Panel C of Table 2-7 confirm that the asymmetric impact of liquidity on feedback trading is significant in all the countries except Singapore. The results of Model I suggest that the impact of market liquidity on feedback trading is more pronounced under a bull market than under a bear market regime.

Under Model II, China, Hong Kong and Singapore have statistically significant liquidity terms under the bull market regime, while China, Hong Kong, South Korea and Japan have statistically significant liquidity terms under the bear market regime. The LR test shows that the differing impact of market liquidity on feedback trading between the two market regimes is only significant for China and Hong Kong. The findings show that Model II fails to reveal the asymmetric impact of liquidity on feedback trading under the two market regimes.

Table 2-8 gives the regression results for the augmented SW Models using the bid-ask spread measure for liquidity. As reported in Panel A of Table 2-8, under Model I, all countries have statistically significant liquidity terms under the bull market regime while China, Hong Kong, South Korea and Singapore have statistically significant liquidity terms under the bear market regime. As shown in Panel C of Table 2-8, all of the countries rejected the null hypothesis of the LR Test which confirms the asymmetric impact of liquidity on feedback trading.

[Insert Table 2-8 around here]

Under Model II, none of the sample countries has significant liquidity terms under the bull market regime, while China, Taiwan and Singapore have statistically significant liquidity terms under the bear market regime. The LR Test fails to reject the null hypothesis in all the countries, indicating that Model II cannot identify the change in the impact of market liquidity on feedback trading from one market regime to another. The findings given in Table 2-8 indicate that market liquidity has an asymmetric impact on feedback trading under the two market regimes.

The regression results for the augmented SW Models with the turnover rate as the measure of liquidity are reported in Table 2-9. Under Model I, all the countries have statistically significant liquidity terms under both bull market and bear market regimes. As Panel C of Table 2-9 shows, all the countries rejected the null hypothesis of the LR Test and confirmed the asymmetric impact of liquidity on feedback trading.

[Insert Table 2-9 around here]

For Model II, only Japan and Singapore have significant liquidity terms during the bull market regime while China and Hong Kong have statistically significant liquidity terms under the bear market regime. The LR Test fails to reject the null hypothesis for all the countries except China which indicates that Model II fails to capture the asymmetric impact of market liquidity on feedback trading between the two market regimes. The results based on the turnover rate indicate that liquidity has an asymmetric impact on feedback trading under the two market regimes.

Overall, the results given by the augmented SW Models with the market regime dummy imply that the impact of liquidity on the feedback trading strategy under the bull market regime is significantly different from the impact on the bear market regime. While both models can identify the impact of liquidity on feedback trading, Model I can better capture the asymmetric impact of the market regime on the relationship between liquidity and feedback trading.

2.5. Robustness Checks

2.5.1. Other specifications of variance term

Generalised autoregressive conditional heteroscedastic (GARCH) type models are applied in numerous studies to capture the heteroscedasticity in the variance term. As previously discussed, we assumed the variance term to be a GJR-GARCH process with a GED distribution. We noticed that the baseline research conducted by Sentana and Wadhwani (1992) assumes an exponential GARCH (EGARCH) in their study. To check our model's robustness under EGARCH distribution, we examine our augmented SW Model I with EGARCH specifications. The EGARCH equation is as follows:

$$\ln\left(\sigma_t^2\right) = \alpha_0 + \alpha_1 G_{t-1} + \beta\sigma_{t-1}^2 \tag{2.22}$$

where $G_{t-1} = \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}} + \delta\frac{\varepsilon_{t-1}}{\sigma_{t-1}}$, σ_t^2 is the conditional variance at time t, and ε_{t-1} is the innovation at time t-1.

2.5.2. Improved Amihud illiquidity measure

Our primary measure of liquidity, the Amihud illiquidity measure, is based on the accumulated weight of return scaled by trading volume. Although Amihud's measure has certain advantages, its specifications also have several drawbacks. First, according to Florackis *et al.* (2011), the Amihud illiquidity measure does not eliminate size bias since the market capitalisation is not compatible. Second, as highlighted by Cochrane (2005), due to the return to trading volume specification, the firm size becomes a factor which is taken into account in determining a stock's liquidity. The small-cap stocks are automatically characterised as 'illiquid' due to their size. Third, Amihud's ratio does not take the holding horizon into account which results in an implicit assumption of similar trading frequencies across stocks.

We then apply a modified Amihud illiquidity ratio based on that used by Florackis *et al.* (2011) to examine whether our models can survive the new measure. The expression for the adjusted Amihud illiquidity ratio is defined as follows:

$$RtoTR_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{|R_{i,t,d}|}{TR_{i,t,d}} \tag{2.23}$$

where $TR_{i,t,d}$ is the turnover ratio of stock i at day d. $D_{i,t}$ and $R_{i,t,d}$ are the number of valid observation days in month t for stock i and return of stock i on day d at month t respectively.

2.5.3. Alternative index for Asian markets

In this section, we test the influence of liquidity on feedback trading behaviour using an alternative index: the total market index, provided by the DataStream database. The total market index is comprehensive, representing all the stocks trading in a country's stock market. We apply this to the augmented SW Models to check their robustness.

[Insert Table 2-10 around here]

Table 2-10 presents the results of the augmented SW Models under EGARCH specifications for the variance term. As shown in Panel A of Table 2-10, both models withstand the EGARCH specifications for four out of the six markets which have a significant coefficient on liquidity terms. The substitutive effect of market liquidity in explaining feedback trading is given by the insignificant γ_1 for China in Model II.

[Insert Table 2-11 around here]

We then use the adjusted Amihud measure for market liquidity. As reported in Table 2-11, when we use the adjusted Amihud illiquidity measure to capture stock liquidity, all six East Asian countries have significant liquidity terms according to Model I. Model II is capable of identifying the impact of liquidity on feedback trading in four out of the six countries. The substitutive effect of market liquidity in explaining feedback trading is given by the insignificant γ_1 for South Korea in Model I.

[Insert Table 2-12 around here]

Finally, we use the total stock index as an alternative measure of stock market performance. As reported in Table 2-12, all the countries except Hong Kong have significant liquidity terms using Model I. All the countries except Hong Kong and

Singapore have significant liquidity terms using Model II. Model I documents an insignificant γ_1 for China and Singapore while Model II documents an insignificant γ_1 for China and South Korea which indicates a substitutive impact of market liquidity on feedback trading behaviour. Taken all together, we find the performance of Model I is more robust than Model II in capturing the impact of market liquidity on feedback trading. The findings which are given in Table 2-10, Table 2-11, and Table 2-12 are similar to the results presented in Table 2-4, confirming the robustness of the relationship between market liquidity and feedback trading under these three alternative specifications.

2.6. Conclusion

This chapter uses liquidity as an explanatory factor for the feedback trading effect. To examine the explanatory power of liquidity on feedback trading, we augmented the feedback trading model proposed by Sentana and Wadhwani (1992) by including a liquidity term in the demand function of feedback traders. The two augmented SW Models use the diverse approximation approach to allow the demand function to be either a linear form of lagged return and market liquidity or a cross product of lagged return and market liquidity. We applied these augmented models to the most fundamental and largest financial market, the stock market. We used the six East Asian stock markets based on market value as our sample indices. Our results confirm that all six of the equity markets (China, Hong Kong, Taiwan, South Korea, Japan and Singapore) have a significant feedback trading effect. The results show that although feedback trading is weak in major western equity markets such as the US, it is still pronounced in Asian stock markets. The results of the two augmented feedback trading models with the Amihud illiquidity measure shows the explanatory power of liquidity in all six Asian stock markets and suggests that the demand function of feedback traders should be a combination of both the previous return and a liquidity term. We also noticed that in some countries the featured SW Model's feedback trading term, γ_1 , become insignificant under the two augmented SW Model specifications. The findings suggest that liquidity may be a primary concern of feedback traders when deciding on an investment strategy. When examining the asymmetric impact of market liquidity on feedback trading in relation to bull and bear market regimes, we document that the impact of liquidity is stronger under a bull market regime than under a bear market regime. The robustness of the augmented SW Models with the alternative specifications of liquidity measures, in variance form as well as with market performance measures, provides further evidence that liquidity plays a substantial role in the feedback trading effect.

If all these findings are taken together, it seems that the approach followed by many of the studies in the existing literature, which formulates the demand for shares by feedback traders as a simple function of the previous returns, is too narrow. The good performance of both augmented SW Models implies that the feedback traders' demand function for shares can be approximated by either a linear combination of ex-post return and liquidity or by a cross-product of ex-post return and liquidity. Therefore, as a pricing factor, market liquidity plays a determinant role in the 'following the trend' strategy pursued by feedback traders. The findings highlight the importance of liquidity in determining investment strategies, which is consistent with the findings of Ibbotson et al. (2013). Finally, our study helps to understand how heterogeneous investors make investment decisions under different market regimes. The significant but asymmetric correlation between market liquidity and feedback trading under different market regimes suggests that market regulators should pay more attention to feedback trading when the market is under a bull regime.

Figure 2-1: Graph for price of stock indices

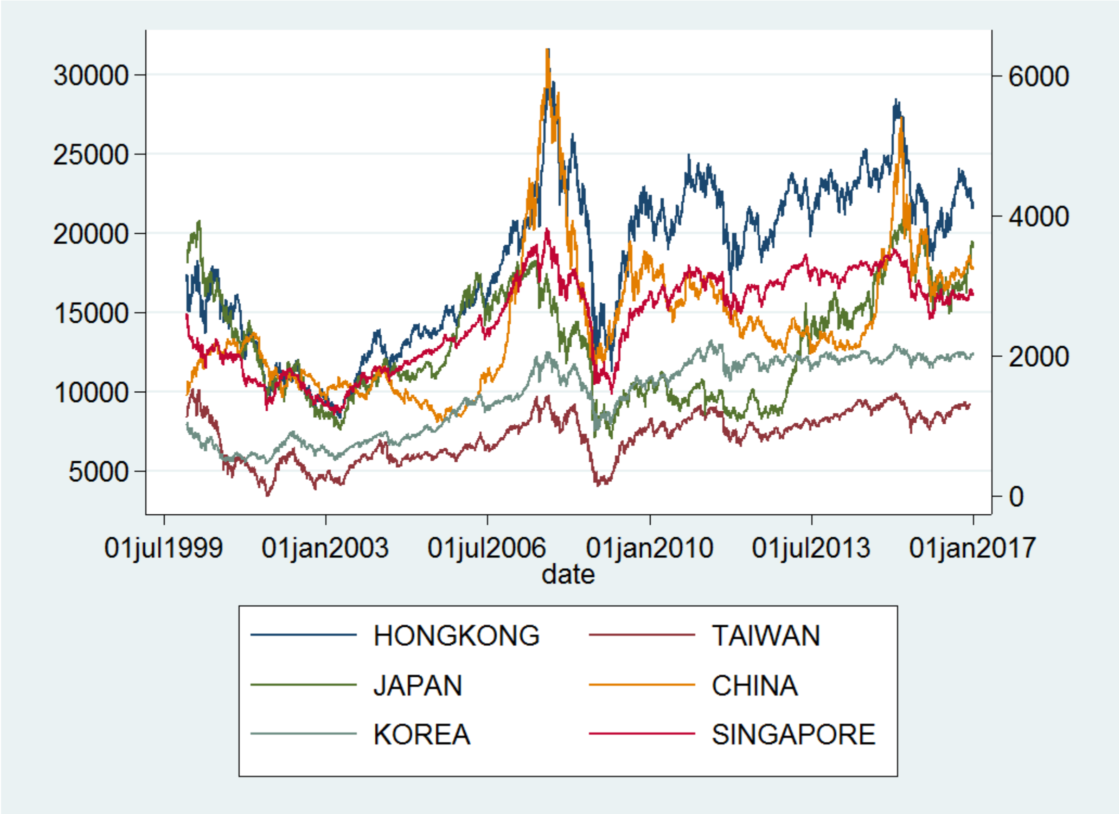

Table 2-1: Descriptive statistics of stock markets return

	CHINA	HONG KONG	TAIWAN	SOUTH KOREA	JAPAN	SINGAPORE
Panel A: summary statistics						
μ	0.017	0.005	0.004	0.023	0.005	0.003
σ	1.465	1.343	1.300	1.402	1.371	1.058
SKEWNESS	-0.395***	-0.186***	-0.161***	-0.237***	-0.204***	-0.167***
KURTOSIS	1.927***	1.308***	1.494***	1.754***	0.772***	1.344***
JB	801.404***	341.519***	429.628***	609.987***	140.872***	354.158***
LB(12)	35.821***	19.974*	37.138***	13.059	10.859	23.949**
$LB^2(12)$	1488.541***	2905.402***	1899.481***	2418.599***	1437.411***	2634.037***
ARCH(12)	553.711***	875.645***	648.009***	742.713***	534.987 ***	786.686***
JOINT	5.295	41.696***	37.766***	49.016***	39.050***	23.940***
Panel B: correlation coefficients						
CHINA	**1.000**					
HONG KONG	**0.358**	**1.000**				
TAIWAN	**0.192**	**0.487**	**1.000**			
SOUTH KOREA	**0.191**	**0.587**	**0.550**	**1.000**		
JAPAN	**0.201**	**0.535**	**0.432**	**0.538**	**1.000**	
SINGAPORE	**0.222**	**0.679**	**0.464**	**0.540**	**0.484**	**1.000**
Panel C: autocorrelation						
b0	0.013	0.007	0.003	0.025	0.007	0.003
	(0.590)	(0.328)	(0.142)	(1.189)	(0.317)	(0.197)
b1	0.011	0.008	0.032**	0.012	-0.034**	0.024
	(0.738)	(0.532)	(2.156)	(0.766)	(-2.259)	(1.599)
b2	-0.007	-0.017	0.031**	-0.022	0.000	-0.005
	(-0.496)	(-1.134)	(2.047)	(-1.484)	(-0.006)	(-0.343)
b3	0.034**	0.019	0.022	0.004	-0.015	0.021
	(2.254)	(1.264)	(1.439)	(0.237)	(-0.982)	(1.399)
b4	0.055***	-0.003	-0.056***	-0.017	-0.014	0.026*
	(3.679)	(-0.174)	(-3.730)	(-1.112)	(-0.962)	(1.705)
b5	-0.013	-0.015	0.010	-0.020	0.015	0.011
	(-0.870)	(-1.003)	(0.657)	(-1.329)	(0.996)	(0.701)

This table provides the descriptive statistics of the six major stock indices in East Asia. JB is the Jarque–Bera test for normality. LB(12) & $LB^2(12)$ are the Ljung–Box Q test of serial correlation for the level & squared variables, and the test statistics report the χ^2 distribution with n degree of freedom. ARCH(12) is the Lagrange Multiplier LM test for ARCH effect. The JOINT is Engle and Ng (1993) test for the potential asymmetries in conditional volatility where the null hypothesis is $b_1 = b_2 = b_3$ for the following regression: $Z_t^2 = a + b_1 S_t^- + b_2 S_t^- \varepsilon_{t-1} + b_3 S_t^+ \varepsilon_{t-1} + v_t$

Where Z_t^2 is squared standard residuals; S_t^- is a dummy variable which takes a value of 1 when ε_{t-1} is negative and 0 otherwise; S_t^+ is a dummy variable which takes a value of 1 when ε_{t-1} is positive and 0 otherwise. The unconditional autocorrelation (b_i) estimates are obtained using the following autoregressive equation: $R_t = b_0 + \sum_{i=1}^{5} b_i R_{t-1} + u_t$. * Statistically significance at 10%, ** statistically significance at 5%, and *** statistically significance at 1%.

Table 2-2: Result for SW Model

	CHINA	HONG KONG	TAIWAN	SOUTH KOREA	JAPAN	SINGAPORE
Panel A: conditional mean equation						
α	-0.018	0.006	0.074***	0.013	0.030	0.018***
	(-0.841)	(0.235)	(17.223)	(0.688)	(0.944)	(6.193)
ρ	0.037***	0.011	-0.015**	0.025*	0.001	-0.001***
	(4.568)	(0.590)	(-2.033)	(1.950)	(0.069)	(-2.743)
γ_0	0.038***	0.062***	0.122***	0.028***	0.040*	0.023***
	(5.687)	(2.980)	(5.919)	(8.826)	(1.732)	(8.445)
γ_1	-0.010***	-0.019**	-0.037***	-0.004***	-0.026***	-0.008***
	(-3.328)	(-1.974)	(-5.774)	(-21.137)	(-3.118)	(-5.193)
Panel B: conditional variance equation						
α_0	0.021***	0.017***	0.031***	0.015***	0.041***	0.008***
	(6.218)	(3.357)	(5.138)	(3.864)	(6.791)	(688.929)
α_1	0.062***	0.018***	0.065***	0.031***	0.029***	0.036***
	(343.240)	(25.082)	(15.380)	(867.084)	(68.838)	(1361.922)
β	0.924***	0.940***	0.875***	0.918***	0.899***	0.920***
	(568.972)	(131.105)	(99.865)	(275.933)	(266.855)	(524.770)
δ	0.010***	0.062***	0.078***	0.084***	0.100***	0.073***
	(3.765)	(6.794)	(5.521)	(34.467)	(29.833)	(100.948)
ν	1.538***	1.277***	1.204***	1.322***	1.169***	1.156***
	(35.217)	(28.213)	(28.822)	(24.067)	(24.817)	(111.186)
Panel C: diagnostic tests						
$E(Z_t)$	-0.031	-0.016	-0.030	-0.026	-0.019	-0.011
$E(Z_t^2)$	1.000	1.002	1.002	1.001	1.003	1.002
LB(12)	44.436***	15.006	11.007	10.523	4.014	17.513
$LB^2(12)$	7.308	34.108***	18.690*	31.769***	18.226	17.418
ARCH(12)	7.990	37.240***	17.532	26.943***	17.303	15.701

The table provides the maximum likelihood estimation for the SW model for the six East Asian stock indices.

The conditional mean equation for the SW model is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \varepsilon_t$

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & $LB^2(N)$ are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. ARCH(12) is the Lagrange Multiplier LM test for ARCH effect. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-3: Summary statistics for liquidity measures

	CHINA			HONG KONG			TAIWAN		
	ILLIQ	*PS*	*TOV*	*ILLIQ*	*PS*	*TOV*	*ILLIQ*	*PS*	*TOV*
Panel A: summary statistics									
μ	2.377	0.257	2.276	1.872	0.419	0.331	34.991	1.974	0.809
σ	3.169	0.112	1.427	5.697	0.201	0.138	40.071	3.018	0.420
skewness	2.296***	0.923***	1.306***	5.011***	0.634***	1.266***	2.440***	2.537***	1.345***
kurtosis	5.552***	0.000	1.481***	27.626***	-0.970***	1.724***	6.847***	6.290***	2.049***
JB	8895.243***	584.038***	1544.224***	150886.300***	445.550***	1638.564***	10204.470***	9427.202***	1650.640***
LB(12)	25158.854***	43070.001***	33187.906***	6568.055	43597.301***	16349.271***	9657.545***	35025.367***	28014.249***
LB2(12)	13157.088***	41986.359***	30051.557***	1452.095	41578.038***	13742.541***	4556.558***	29956.189***	23962.225***
ARCH(12)	2028.749***	3821.204***	3544.853***	512.894***	3779.677***	2251.161***	1048.195***	3164.557***	2808.856***
JOINT	1.285	21.218***	6.212	0.870	5.630	22.816***	3.059	5.018	2.209
Panel B: correlation coefficients									
ILLIQ	1.000			1.000			1.000		
PS	0.745	1.000		0.472	1.000		0.090	1.000	
TOV	-0.344	-0.310	1.000	-0.081	0.096	1.000	0.102	0.411	1.000
Panel C: autocorrelation									
b0	0.171***	0.004***	0.093***	0.472***	0.006***	0.043***	6.510***	0.032**	0.034***
	(4.842)	(3.614)	(6.411)	(5.705)	(3.012)	(10.597)	(8.467)	(2.252)	(5.618)
b1	0.276***	0.523***	0.746***	0.174***	0.314***	0.483***	0.274***	0.616***	0.614***
	(17.775)	(33.517)	(47.787)	(11.422)	(20.711)	(31.369)	(16.157)	(36.336)	(36.170)
b2	0.245***	0.176***	0.089***	0.121***	0.185***	0.103***	0.171***	0.277***	0.146***
	(15.413)	(10.021)	(4.586)	(7.915)	(11.702)	(6.043)	(9.778)	(13.953)	(7.331)
b3	0.130***	0.160***	0.062***	0.121***	0.166***	0.094***	0.167***	-0.011	0.056***
	(7.993)	(9.123)	(3.168)	(7.927)	(10.484)	(5.488)	(9.542)	(-0.538)	(2.823)
b4	0.159***	0.072***	0.044**	0.166***	0.132***	0.102***	0.137***	0.093***	0.075***
	(10.031)	(4.113)	(2.281)	(10.849)	(8.383)	(5.984)	(7.833)	(4.710)	(3.767)
b5	0.118***	0.053***	0.018	0.162***	0.186***	0.088***	0.065***	0.007	0.067***
	(7.597)	(3.419)	(1.146)	(10.612)	(12.297)	(5.703)	(3.855)	(0.402)	(3.957)

This table provides the descriptive statistics of the liquidity measures for the six major stock indices in East Asia. JB is the Jarque–Bera test for normality. LB(12) & LB²(12) are the Ljung–Box Q test of serial correlation for the level & squared variables, and the test statistics report the χ^2 distribution with n degree of freedom. ARCH(12) is the Lagrange Multiplier LM test for ARCH effect. The JOINT is Engle and Ng (1993) test for the potential asymmetries in conditional volatility where the null hypothesis is $b_1 = b_2 = b_3$ for the following regression: $Z_t^2 = a + b_1 S_t^- + b_2 S_t^- \varepsilon_{t-1} + b_3 S_t^+ \varepsilon_{t-1} + v_t$. Where Z_t^2 is squared standard residuals; S_t^- is a dummy variable which takes a value of 1 when ε_{t-1} is negative and 0 otherwise; S_t^+ is a dummy variable which takes a value of 1 when ε_{t-1} is positive and 0 otherwise. The unconditional autocorrelation (b_i) estimates are obtained using the following autoregressive equation: $R_t = b_0 + \sum_{i=1}^{5} b_i R_{t-1} + u_t$. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-3 (Continue): Summary statistics for liquidity Measures

	SOUTH KOREA			JAPAN			SINGAPORE		
	ILLIQ	*PS*	*TOV*	*ILLIQ*	*PS*	*TOV*	*ILLIQ*	*PS*	*TOV*
Panel A: summary statistics									
μ	0.555	0.759	2.612	0.017	0.376	14.075	175.140	0.752	0.232
σ	0.628	0.245	2.526	0.020	0.155	22.087	874.843	0.433	0.099
skewness	2.651***	1.146***	2.150***	2.464***	1.379***	3.924***	7.207***	0.826***	1.365***
kurtosis	7.825***	1.693***	4.744***	5.998***	1.675***	19.826***	53.874***	-0.541***	2.447***
JB	15635.366***	1420.479***	7174.111***	9725.128***	1680.256***	73372.841***	526005.093***	511.158***	2272.627***
LB(12)	18016.157***	37532.854***	43199.432***	34090.746***	35414.955***	23411.809***	1006.151***	42424.234***	10645.375***
LB2(12)	8986.935***	33254.198***	38146.856***	24368.270***	31972.711***	9140.002***	253.887***	38465.717***	7859.679***
ARCH(12)	1579.612***	3591.374***	3799.918***	2757.916***	3146.178***	2178.588***	190.375***	3569.026***	1705.741***
JOINT	1.893	13.407***	15.169***	6.900*	5.297	13.346	0.081	3.593	19.510***
Panel B: correlation coefficients									
ILLIQ	1.000			1.000			1.000		
PS	0.643	1.000		0.804	1.000		0.250	1.000	
TOV	0.096	0.260	1.000	0.523	0.642	1.000	-0.060	0.135	1.000
Panel C: autocorrelation									
b0	0.063***	0.026***	0.042***	0.000***	0.012***	1.031***	99.545***	0.011***	0.042***
	(6.753)	(6.253)	(3.194)	(2.817)	(4.784)	(4.863)	(7.114)	(2.851)	(12.136)
b1	0.239***	0.631***	0.584***	0.140***	0.333***	0.686***	0.181***	0.316***	0.445***
	(15.666)	(40.938)	(37.859)	(8.868)	(20.880)	(43.120)	(11.544)	(20.380)	(28.459)
b2	0.182***	0.150***	0.235***	0.247***	0.189***	-0.001	0.044***	0.223***	0.101***
	(11.674)	(8.244)	(13.158)	(15.644)	(11.332)	(-0.055)	(2.746)	(13.878)	(5.892)
b3	0.187***	0.099***	0.117***	0.258***	0.177***	0.014	0.136***	0.119***	0.092***
	(12.019)	(5.405)	(6.462)	(16.412)	(10.584)	(0.716)	(8.579)	(7.305)	(5.375)
b4	0.119***	0.034*	-0.007	0.130***	0.129***	0.074***	0.026	0.157***	0.091***
	(7.675)	(1.874)	(-0.407)	(8.243)	(7.723)	(3.870)	(1.625)	(9.743)	(5.338)
b5	0.158***	0.051***	0.054***	0.194***	0.139***	0.151***	0.044***	0.170***	0.091***
	(10.363)	(3.285)	(3.499)	(12.305)	(8.754)	(9.549)	(2.795)	(10.993)	(5.841)

This table provides the descriptive statistics of the liquidity measures for the six major stock indices in East Asia. JB is the Jarque–Bera test for normality. LB(12) & $LB^2(12)$ are the Ljung–Box Q test of serial correlation for the level & squared variables, and the test statistics report the χ^2 distribution with n degree of freedom. ARCH(12) is the Lagrange Multiplier LM test for ARCH effect. The JOINT is Engle and Ng (1993) test for the potential asymmetries in conditional volatility where the null hypothesis is $b_1 = b_2 = b_3$ for the following regression: $Z_t^2 = a + b_1 S_t^- + b_2 S_t^- \varepsilon_{t-1} + b_3 S_t^+ \varepsilon_{t-1} + v_t$ Where Z_t^2 is squared standard residuals; S_t^- is a dummy variable which takes a value of 1 when ε_{t-1} is negative and 0 otherwise; S_t^+ is a dummy variable which takes a value of 1 when ε_{t-1} is positive and 0 otherwise. The unconditional autocorrelation (b_i) estimates are obtained using the following autoregressive equation: $R_t = b_0 + \sum_{i=1}^{5} b_i R_{t-1} + u_t$. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-4: Result for augmented SW models with Amihud illiquidity measure

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	-0.016**	-0.016	0.004	0.006	0.039	0.029	0.025***	0.012	0.032	0.030	0.018	0.018
	(-2.381)	(-0.494)	(0.198)	(0.288)	(1.198)	(1.302)	(3.050)	(0.690)	(1.405)	(0.897)	(1.140)	(1.225)
ρ	0.042***	0.034*	0.016	0.011	-0.008	0.014	-0.002	0.025**	-0.002	0.002	-0.001	-0.001
	(12.898)	(1.945)	(1.224)	(0.646)	(-0.238)	(1.044)	(-0.181)	(2.209)	(-0.363)	(0.105)	(-0.056)	(-0.077)
γ_0	0.035	0.040**	0.061***	0.062***	0.064***	0.066***	0.026*	0.033***	0.040	0.043**	0.023	0.023***
	(1.480)	(2.157)	(3.283)	(2.983)	(3.285)	(3.341)	(1.824)	(6.065)	(1.452)	(2.409)	(0.982)	(8.058)
γ_1	-0.010	-0.004	-0.019***	-0.019*	-0.018**	-0.020***	-0.003	-0.012***	-0.026***	-0.031***	-0.008	-0.008***
	(-1.163)	(-0.508)	(-2.700)	(-1.832)	(-2.045)	(-6.274)	(-0.962)	(-10.957)	(-2.731)	(-9.448)	(-0.504)	(-6.412)
γ_2	-0.002***		-0.002***		0.000***		0.027***		0.092***		0.000	
	(-3.104)		(-2.677)		(3.055)		(3.236)		(2.657)		(-0.049)	
γ_3		-0.003***		0.000		0.000**		0.007***		0.129*		0.000***
		(-2.604)		(0.037)		(2.158)		(2.857)		(1.899)		(3.119)
Panel B: conditional variance equation												
α_0	0.021***	0.021***	0.016***	0.017***	0.013***	0.014***	0.015***	0.015***	0.041***	0.041***	0.008***	0.008***
	(91.236)	(9.030)	(91.540)	(61.566)	(15.588)	(2.795)	(3.484)	(23.211)	(49.173)	(4.299)	(6.486)	(6.422)
α_1	0.063***	0.062***	0.018***	0.018***	0.011***	0.012	0.031***	0.031***	0.028***	0.029***	0.036***	0.036***
	(372.176)	(207.406)	(215.031)	(155.961)	(21.751)	(1.560)	(61.836)	(205.956)	(23.394)	(70.794)	(233.262)	(127.451)
β	0.924***	0.925***	0.940***	0.940***	0.942***	0.941***	0.918***	0.918***	0.899***	0.899***	0.920***	0.920***
	(572.084)	(464.948)	(571.441)	(374.818)	(214.129)	(69.603)	(100.188)	(443.291)	(326.564)	(77.066)	(534.088)	(433.008)
δ	0.010***	0.009***	0.061***	0.062***	0.067***	0.067***	0.083***	0.083***	0.101***	0.100***	0.073***	0.073***
	(122.031)	(10.915)	(186.861)	(13.497)	(6.318)	(4.221)	(5.349)	(288.668)	(212.047)	(5.823)	(16.254)	(218.759)
ν	1.543***	1.541***	1.281***	1.277***	1.425***	1.433***	1.324***	1.323***	1.169***	1.171***	1.156***	1.156***
	(29.859)	(25.149)	(61.151)	(26.257)	(25.898)	(26.614)	(37.329)	(28.511)	(29.073)	(25.994)	(52.070)	(35.771)
Panel C: diagnostic tests												
$E(Z_t)$	-0.031	-0.031	-0.016	-0.016	-0.029	-0.030	-0.027	-0.026	-0.019	-0.020	-0.011	-0.011
$E(Z_t^2)$	1.000	1.000	1.002	1.002	1.002	1.002	1.001	1.001	1.003	1.003	1.002	1.002
LB(12)	42.780***	46.085***	14.925	15.007	11.009	11.063	10.575	10.489	4.003	4.021	17.512	17.588
$LB^2(12)$	7.446	7.549	34.036***	34.113***	18.923*	18.667*	32.349***	31.444***	18.229	18.023	17.427	17.693
ARCH(12)	8.094	8.190	36.986***	37.232***	17.795	17.509	27.542***	26.535***	17.315	17.176	15.707	15.969

The table provides the maximum likelihood estimation for the augmented SW models for the six East Asian stock indices using Amihud illiquidity measure as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t$.

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right)R_{t-1} + \varepsilon_t$.

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$.

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB²(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-5: Result for augmented SW models with bid-ask spread

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	-0.016*	-0.010	0.006**	0.006	0.029	0.028	0.035*	0.013	0.038***	0.029	0.019***	0.018
	(-1.869)	(-0.398)	(2.006)	(0.249)	(1.378)	(0.697)	(1.681)	(0.696)	(3.591)	(1.535)	(14.157)	(0.525)
ρ	0.049***	0.030**	0.010***	0.011	-0.002	0.015	-0.042	0.024*	-0.017***	0.002	-0.006***	-0.001***
	(8.545)	(2.299)	(14.625)	(0.652)	(-0.118)	(0.437)	(-1.248)	(1.828)	(-3.374)	(0.161)	(-6.390)	(-3.439)
γ_0	0.036*	0.040*	0.062***	0.065***	0.067***	0.067***	0.024	0.026**	0.039*	0.047***	0.024	0.023
	(1.691)	(1.927)	(3.148)	(3.558)	(3.972)	(2.977)	(1.340)	(2.255)	(1.770)	(8.917)	(0.969)	(1.308)
γ_1	-0.010	0.012	-0.019**	-0.029***	-0.020***	-0.012***	-0.002	-0.001	-0.026***	-0.037***	-0.008	-0.002*
	(-1.219)	(1.240)	(-2.421)	(-13.266)	(-3.302)	(-7.897)	(-0.235)	(-0.874)	(-3.314)	(-14.837)	(-0.612)	(-1.880)
γ_2	-0.049**		0.001***		0.008**		0.062**		0.036***		0.005***	
	(-2.302)		(5.019)		(2.038)		(2.062)		(2.870)		(6.934)	
γ_3		-0.092***		0.019**		-0.004**		-0.002***		0.017***		-0.006***
		(-2.626)		(2.312)		(-2.494)		(-6.446)		(4.203)		(-3.040)
Panel B: conditional variance equation												
α_0	0.021***	0.021***	0.017***	0.017***	0.013**	0.013*	0.015***	0.015***	0.041***	0.041***	0.008***	0.008***
	(6.520)	(6.260)	(6.887)	(4.846)	(2.158)	(1.806)	(3.722)	(5.891)	(10.281)	(12.714)	(5.315)	(13.714)
α_1	0.063***	0.062***	0.018***	0.018***	0.007	0.012	0.030***	0.031***	0.028***	0.029***	0.036***	0.036***
	(242.577)	(49.470)	(954.592)	(34.503)	(0.877)	(1.546)	(4.619)	(177.370)	(4.445)	(86.192)	(173.732)	(58.050)
β	0.924***	0.925***	0.940***	0.940***	0.944***	0.942***	0.918***	0.918***	0.899***	0.899***	0.920***	0.920***
	(389.012)	(446.556)	(1279.483)	(360.491)	(62.299)	(55.557)	(88.586)	(309.419)	(254.150)	(2102.238)	(459.451)	(98.955)
δ	0.010***	0.010**	0.062***	0.062***	0.070***	0.066***	0.084***	0.084***	0.101***	0.100***	0.073***	0.073***
	(2.632)	(1.983)	(118.987)	(22.882)	(4.410)	(4.187)	(6.306)	(64.844)	(14.216)	(53.314)	(30.490)	(29.627)
ν	1.542***	1.537***	1.277***	1.277***	1.424***	1.440***	1.324***	1.322***	1.169***	1.169***	1.156***	1.156***
	(32.212)	(29.066)	(114.473)	(24.834)	(25.779)	(29.240)	(34.892)	(27.091)	(31.852)	(28.313)	(43.243)	(19.859)
Panel C: diagnostic tests												
$E(Z_t)$	-0.031	-0.030	-0.016	-0.016	-0.030	-0.030	-0.026	-0.026	-0.019	-0.019	-0.011	-0.011
$E(Z_t^2)$	1.000	1.000	1.002	1.002	1.002	1.002	1.001	1.001	1.003	1.003	1.002	1.002
LB(12)	44.165***	46.354***	15.009	14.898	11.081	11.168	10.452	10.526	3.995	3.990	17.488	17.523
$LB^2(12)$	7.433	7.247	34.103***	34.304***	19.135*	18.781*	31.747***	31.796***	18.309	17.990	17.413	17.334
ARCH(12)	8.083	7.999	37.240***	37.302***	18.083	17.635	27.258***	26.981***	17.410	17.158	15.694	15.614

The table provides the maximum likelihood estimation for the augmented SW models for the six East Asian stock indices using the bid-ask spread as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t$.

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right)R_{t-1} + \varepsilon_t$.

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$.

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB^2(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-6: Result for augmented SW models with turnover rate

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	0.059	-0.017	0.020	0.006	0.029	0.027	0.004	0.013	0.028***	0.030	0.027**	0.019
	(1.631)	(-0.774)	(1.298)	(0.403)	(1.272)	(1.500)	(1.143)	(0.718)	(2.708)	(1.308)	(2.257)	(1.168)
ρ	-0.083***	0.037***	-0.024***	0.011	-0.052	0.016	0.040***	0.025*	0.005	0.001	-0.047**	-0.002
	(-2.744)	(2.685)	(-4.083)	(1.468)	(-1.288)	(1.085)	(8.589)	(1.873)	(1.134)	(0.084)	(-2.350)	(-0.117)
γ_0	0.032	0.039***	0.057***	0.062***	0.068***	0.067***	0.028	0.029	0.040***	0.040***	0.023	0.027***
	(1.286)	(5.005)	(3.203)	(36.433)	(2.748)	(6.191)	(1.498)	(1.639)	(3.405)	(73.773)	(1.112)	(2.649)
γ_1	-0.013	-0.013***	-0.017**	-0.018***	-0.022*	-0.014***	-0.004	-0.006	-0.026***	-0.028***	-0.008	-0.019***
	(-1.560)	(-3.430)	(-2.309)	(-192.208)	(-1.844)	(-5.042)	(-0.761)	(-0.810)	(-15.874)	(-92.188)	(-0.839)	(-8.197)
γ_2	0.032***		0.075***		0.081**		-0.003**		0.000		0.140***	
	(10.860)		(2.928)		(2.295)		(-2.124)		(-0.782)		(4.214)	
γ_3		0.001**		-0.001***		-0.008***		0.000		0.000***		0.027*
		(2.205)		(-4.060)		(-3.010)		(0.362)		(3.745)		(1.805)
Panel B: conditional variance equation												
α_0	0.023***	0.021***	0.016***	0.017***	0.013**	0.014***	0.015***	0.015***	0.040***	0.041***	0.008***	0.008***
	(17.277)	(3.868)	(6.980)	(41.188)	(2.112)	(12.056)	(28.485)	(3.346)	(180.365)	(16.494)	(6.183)	(3.921)
α_1	0.055***	0.062***	0.017***	0.018***	0.003	0.012*	0.032***	0.031***	0.029***	0.029***	0.035***	0.036***
	(8.555)	(28.943)	(51.238)	(9.156)	(0.335)	(1.920)	(62.474)	(5.809)	(79.196)	(14.373)	(64.569)	(4.700)
β	0.926***	0.924***	0.941***	0.940***	0.947***	0.941***	0.917***	0.918***	0.898***	0.899***	0.920***	0.920***
	(203.338)	(217.803)	(365.768)	(696.221)	(55.403)	(180.527)	(454.441)	(86.626)	(208.830)	(201.158)	(335.987)	(117.744)
δ	0.018**	0.010***	0.062***	0.062***	0.072***	0.067***	0.082***	0.084***	0.100***	0.100***	0.074***	0.073***
	(2.011)	(8.092)	(12.350)	(15.266)	(4.353)	(18.229)	(87.972)	(6.355)	(15.992)	(17.124)	(95.402)	(31.300)
ν	1.581***	1.539***	1.283***	1.277***	1.426***	1.432***	1.323***	1.323***	1.169***	1.169***	1.156***	1.156***
	(31.466)	(36.049)	(34.597)	(40.370)	(24.425)	(26.593)	(37.688)	(29.517)	(30.804)	(32.800)	(33.184)	(29.754)
Panel C: diagnostic tests												
$E(Z_t)$	-0.032	-0.031	-0.015	-0.016	-0.030	-0.030	-0.027	-0.026	-0.019	-0.019	-0.011	-0.011
$E(Z_t^2)$	1.000	1.000	1.002	1.002	1.002	1.002	1.001	1.001	1.003	1.003	1.002	1.002
LB(12)	31.857***	44.499***	15.074	15.010	11.891	10.982	10.680	10.532	4.039	4.003	17.451	17.357
$LB^2(12)$	7.360	7.244	33.649***	34.089***	18.945*	18.611*	31.477***	31.840***	18.234	18.069	17.375	17.469
ARCH(12)	7.791	7.923	36.754***	37.221***	17.798	17.431	26.668***	27.010***	17.241	17.221	15.645	15.744

The table provides the maximum likelihood estimation for the augmented SW models for the six East Asian stock indices using turnover rate as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t$.

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right)R_{t-1} + \varepsilon_t$.

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$. ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & $LB^2(N)$ are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-7: Result for augmented SW models with market regime dummy using Amihud illiquidity measure

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	-0.019***	-0.010	0.005	0.008	0.007	0.026	0.004	0.010	0.029	0.031	0.014	0.017*
	(-5.649)	(-0.408)	(0.236)	(0.352)	(0.369)	(1.178)	(0.241)	(1.172)	(0.788)	(1.212)	(1.375)	(1.733)
ρ	0.034***	0.029**	0.016	0.011	0.017	0.022	0.010	0.029***	-0.010	0.003	0.003	0.002
	(6.940)	(2.147)	(1.075)	(0.936)	(1.309)	(1.088)	(0.602)	(3.278)	(-0.407)	(0.208)	(0.411)	(0.119)
γ_0	0.031*	0.039***	0.059***	0.060***	0.069***	0.063***	0.027	0.028***	0.040	0.045***	0.027	0.023***
	(1.877)	(3.664)	(3.016)	(4.463)	(3.410)	(2.593)	(1.461)	(7.109)	(1.584)	(7.760)	(1.224)	(3.179)
γ_1	-0.010	-0.003	-0.020**	-0.019***	-0.021**	-0.018	-0.005	-0.013***	-0.028***	-0.030***	-0.008	-0.007
	(-1.315)	(-0.457)	(-2.127)	(-4.801)	(-2.119)	(-1.301)	(-0.832)	(-17.644)	(-5.005)	(-19.057)	(-0.733)	(-0.942)
γ_2^{bull}	0.019***		0.006**		0.001***		0.083***		2.689***		0.000*	
	(7.544)		(2.184)		(4.204)		(3.752)		(4.324)		(1.727)	
γ_2^{bear}	-0.006***		-0.004*		0.000		0.012		-0.293		0.000	
	(-18.118)		(-1.663)		(-0.675)		(0.809)		(-0.584)		(-0.203)	
γ_3^{bull}		-0.005***		0.001*		0.000		0.019		-0.104		0.000*
		(-5.486)		(1.744)		(0.132)		(1.317)		(-0.356)		(1.774)
γ_3^{bear}		-0.003***		-0.001***		0.000		0.007***		0.138***		0.000
		(-4.701)		(-10.544)		(-0.034)		(2.767)		(3.412)		(-0.071)
Panel B: conditional variance equation												
α_0	0.019***	0.019***	0.017***	0.017***	0.015***	0.016**	0.015***	0.016***	0.040***	0.042***	0.008***	0.008***
	(24.259)	(3.467)	(26.061)	(15.346)	(14.841)	(1.999)	(4.879)	(13.846)	(3.189)	(85.859)	(3.666)	(6.350)
α_1	0.059***	0.058***	0.019***	0.019***	0.017**	0.019***	0.030***	0.032***	0.030***	0.029***	0.036***	0.036***
	(374.344)	(64.384)	(32.306)	(36.857)	(2.260)	(3.003)	(120.864)	(16.447)	(2.945)	(73.198)	(43.166)	(30.812)
β	0.930***	0.929***	0.939***	0.939***	0.936***	0.934***	0.918***	0.916***	0.899***	0.897***	0.919***	0.919***
	(494.666)	(146.039)	(711.684)	(508.631)	(183.639)	(54.980)	(299.290)	(363.303)	(72.773)	(290.455)	(239.170)	(447.677)
δ	0.006***	0.011	0.061***	0.062***	0.063***	0.064***	0.083***	0.083***	0.098***	0.102***	0.074***	0.074***
	(18.077)	(1.103)	(146.155)	(53.442)	(28.295)	(3.305)	(67.143)	(11.135)	(5.148)	(249.178)	(11.936)	(24.405)
ν	1.549***	1.537***	1.283***	1.280***	1.433***	1.439***	1.351***	1.347***	1.170***	1.168***	1.156***	1.155***
	(32.644)	(31.779)	(125.876)	(32.269)	(29.183)	(25.155)	(35.426)	(26.401)	(23.623)	(25.369)	(37.026)	(34.857)
Panel C: diagnostic tests												
$E(Z_t)$	-0.033	-0.031	-0.015	-0.016	-0.030	-0.028	-0.029	-0.027	-0.019	-0.019	-0.012	-0.012
$E(Z_t^2)$	0.975	0.974	0.980	0.980	0.977	0.976	0.981	0.981	0.979	0.979	0.980	0.980
LB(12)	42.900***	51.200***	15.569	14.559	11.147	10.750	9.389	8.944	5.657	5.207	19.465*	19.621*
$LB^2(12)$	14.196	13.375	38.699***	40.029***	21.709**	20.186*	28.150***	26.570***	17.637	18.030	24.076**	24.199**
ARCH(12)	12.971	12.196	37.305***	38.625***	21.211**	19.905*	27.675***	26.268***	17.313	17.594	22.929**	23.092**
LR-TEST	103.497***	5.856**	7.833***	6.941***	17.880***	0.020	9.449***	0.716	22.311***	0.629	1.475	2.628

The table provides the maximum likelihood estimation for the augmented SW models with market regime dummy for the six East Asian stock indices using Amihud illiquidity measure as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2^{bull} liq_{t-1}\sigma_t^2 * \left(D_t\right) + \gamma_2^{bear} liq_{t-1}\sigma_t^2 * \left(1 - D_t\right) + \varepsilon_t$.

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_3^{bull} liq_{t-1}\sigma_t^2 R_{t-1} * \left(D_t\right) + \gamma_3^{bear} liq_{t-1}\sigma_t^2 R_{t-1} * \left(1 - D_t\right) + \varepsilon_t$

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$.

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB²(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. The null hypothesis of LR-TEST is $\gamma_2^{bull} = \gamma_2^{bear}$ for augmented SW Model I and $\gamma_3^{bull} = \gamma_3^{bear}$ for augmented SW Model II, the table reports the chi-squared statistic and significance level. The models with red headings are with significant liquidity terms. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-8: Result for augmented SW models with market regime dummy using bid-ask spread measure

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	-0.032***	-0.004	-0.042	0.008	0.016	0.026**	0.014	0.011	0.009	0.030	-0.005***	0.018
	(-3.071)	(-0.145)	(-1.253)	(0.305)	(0.914)	(2.046)	(0.588)	(0.596)	(0.705)	(1.018)	(-6.743)	(1.190)
ρ	0.028***	0.024	0.018***	0.011	0.020	0.023*	-0.114***	0.029**	-0.029***	0.004	0.002	0.000
	(3.864)	(1.538)	(2.952)	(0.641)	(1.328)	(1.853)	(-2.796)	(2.034)	(-5.941)	(0.208)	(1.587)	(0.025)
γ_0	0.018	0.036	0.059	0.061***	0.064***	0.065***	0.022	0.024	0.041	0.055***	0.024	0.016
	(0.765)	(1.606)	(0.998)	(2.628)	(5.385)	(3.278)	(1.166)	(1.079)	(1.603)	(2.751)	(1.226)	(0.852)
γ_1	-0.009	0.011	-0.021	-0.025	-0.018***	-0.012	-0.001	-0.004	-0.030***	-0.035***	-0.009	-0.003
	(-1.122)	(1.108)	(-0.870)	(-1.557)	(-19.538)	(-1.611)	(-0.164)	(-0.231)	(-3.041)	(-4.290)	(-0.661)	(-0.317)
γ_2^{bull}	0.362***		0.199**		0.010**		0.250***		0.247***		0.107***	
	(6.376)		(2.469)		(2.226)		(5.667)		(8.559)		(11.321)	
γ_2^{bear}	-0.169***		-0.047*		-0.002		0.109***		-0.002		-0.026**	
	(-31.886)		(-1.748)		(-0.541)		(3.252)		(-0.052)		(-1.992)	
γ_3^{bull}		-0.068		0.016		-0.003		0.004		-0.015		0.023
		(-1.372)		(0.393)		(-1.192)		(0.222)		(-0.487)		(1.012)
γ_3^{bear}		-0.095***		0.010		-0.004***		-0.001		0.017		-0.006**
		(-3.016)		(0.365)		(-5.655)		(-0.065)		(0.710)		(-2.104)
Panel B: conditional variance equation												
α_0	0.020***	0.019***	0.017***	0.017***	0.015***	0.016***	0.015***	0.016***	0.040***	0.042***	0.008***	0.008***
	(10.331)	(6.917)	(14.207)	(3.147)	(41.121)	(193.265)	(3.320)	(3.341)	(69.747)	(4.780)	(84.011)	(3.175)
α_1	0.059***	0.058***	0.016***	0.019***	0.016***	0.019***	0.029***	0.032***	0.030***	0.029***	0.034***	0.036***
	(39.019)	(15.592)	(3.134)	(3.418)	(87.827)	(145.661)	(4.412)	(4.988)	(52.584)	(49.670)	(83.217)	(4.497)
β	0.931***	0.929***	0.941***	0.939***	0.936***	0.934***	0.920***	0.916***	0.899***	0.897***	0.921***	0.920***
	(259.313)	(723.051)	(135.330)	(102.568)	(494.420)	(498.657)	(84.609)	(80.609)	(353.441)	(90.117)	(473.132)	(81.706)
δ	0.003	0.011	0.061***	0.062***	0.066***	0.063***	0.082***	0.084***	0.095***	0.102***	0.074***	0.073***
	(0.604)	(1.583)	(5.156)	(5.226)	(129.597)	(75.846)	(5.634)	(4.823)	(59.051)	(7.045)	(213.405)	(5.249)
ν	1.573***	1.536***	1.278***	1.279***	1.435***	1.446***	1.355***	1.346***	1.171***	1.167***	1.160***	1.155***
	(34.943)	(33.781)	(20.290)	(26.515)	(26.020)	(29.892)	(27.783)	(26.234)	(28.323)	(26.843)	(81.460)	(17.971)
Panel C: diagnostic tests												
$E(Z_t)$	-0.032	-0.030	-0.014	-0.015	-0.029	-0.028	-0.030	-0.026	-0.019	-0.019	-0.013	-0.012
$E(Z_t^2)$	0.975	0.975	0.980	0.980	0.976	0.976	0.981	0.981	0.979	0.979	0.980	0.980
LB(12)	38.103***	50.939***	15.501	14.390	10.860	11.074	9.375	9.081	5.958	5.153	18.860*	19.734*
$LB^2(12)$	15.949	12.597	39.702***	39.707***	21.298**	20.369*	28.211***	27.002***	17.709	18.192	24.265**	24.314**
ARCH(12)	14.420	11.526	38.301***	38.312***	20.866*	20.062*	27.700***	26.731***	17.316	17.752	23.145**	23.174**
LR-TEST	89.957***	0.509	5.410**	0.038	5.292**	0.071	42.599***	0.327	32.403***	2.332	35.280***	1.377

The table provides the maximum likelihood estimation for the augmented SW models with market regime dummy for the six East Asian stock indices using the bid-ask spread as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2^{bull} liq_{t-1}\sigma_t^2 * \left(D_t\right) + \gamma_2^{bear} liq_{t-1}\sigma_t^2 * \left(1 - D_t\right) + \varepsilon_t$

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_3^{bull} liq_{t-1}\sigma_t^2 R_{t-1} * \left(D_t\right) + \gamma_3^{bear} liq_{t-1}\sigma_t^2 R_{t-1} * \left(1 - D_t\right) + \varepsilon_t$

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$.

v is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB²(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. The null hypothesis of LR-TEST is $\gamma_2^{bull} = \gamma_2^{bear}$ for augmented SW Model I and $\gamma_3^{bull} = \gamma_3^{bear}$ for augmented SW Model II, the table reports the chi-squared statistic and significance level. The models with red headings are with significant liquidity terms. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-9: Result for augmented SW models with market regime dummy using turnover rate measure

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	0.016	-0.012	-0.030*	0.007	-0.018***	0.025	-0.007	0.010	0.016*	0.033	-0.005	0.018
	(0.790)	(-0.606)	(-1.725)	(0.239)	(-4.228)	(1.196)	(-0.524)	(0.514)	(1.883)	(1.502)	(-0.451)	(1.316)
ρ	-0.006	0.032***	0.020**	0.012	0.065***	0.024	0.040***	0.029**	0.011**	0.001	0.014***	0.001
	(-0.314)	(4.357)	(2.512)	(0.685)	(8.852)	(1.243)	(4.924)	(2.111)	(2.429)	(0.092)	(3.098)	(0.049)
γ_0	0.020	0.025	0.059***	0.071***	0.060***	0.063***	0.027	0.028***	0.037**	0.032	0.026	0.020***
	(1.196)	(1.279)	(3.104)	(4.461)	(3.061)	(5.727)	(1.339)	(5.881)	(2.161)	(1.317)	(1.014)	(13.383)
γ_1	-0.009	0.002	-0.022**	-0.031***	-0.016*	-0.010	-0.006	-0.007	-0.027***	-0.024**	-0.011	-0.005
	(-1.185)	(0.255)	(-2.539)	(-13.075)	(-1.953)	(-1.112)	(-0.966)	(-1.298)	(-3.782)	(-2.562)	(-0.784)	(-0.578)
γ_2^{bull}	0.025***		0.174***		0.046***		0.009***		0.001***		0.274***	
	(4.699)		(5.447)		(3.158)		(2.994)		(4.280)		(17.107)	
γ_2^{bear}	-0.016*		-0.081*		-0.109***		-0.007**		-0.001***		-0.140**	
	(-1.915)		(-1.864)		(-3.423)		(-2.100)		(-3.323)		(-2.492)	
γ_3^{bull}		-0.001		0.005		-0.007		0.000		0.000**		0.038***
		(-0.310)		(0.296)		(-0.834)		(0.212)		(2.006)		(4.408)
γ_3^{bear}		-0.006**		0.020**		-0.014		0.000		0.000		-0.013
		(-2.005)		(2.040)		(-0.619)		(0.453)		(-0.530)		(-0.261)
Panel B: conditional variance equation												
α_0	0.022***	0.019***	0.017***	0.017***	0.015***	0.016***	0.016***	0.016***	0.041***	0.042***	0.008***	0.008***
	(4.834)	(3.343)	(5.932)	(3.384)	(2.826)	(4.615)	(12.244)	(9.661)	(17.895)	(45.165)	(6.993)	(143.690)
α_1	0.054***	0.059***	0.014***	0.018***	0.016***	0.019***	0.030***	0.032***	0.031***	0.029***	0.033***	0.036***
	(42.034)	(8.128)	(29.714)	(30.659)	(10.975)	(4.510)	(9.433)	(127.367)	(19.085)	(170.352)	(45.907)	(540.755)
β	0.930***	0.929***	0.943***	0.938***	0.939***	0.934***	0.917***	0.916***	0.897***	0.896***	0.921***	0.919***
	(247.405)	(125.768)	(140.449)	(228.570)	(95.719)	(206.782)	(327.596)	(369.296)	(393.222)	(296.346)	(673.015)	(503.833)
δ	0.013***	0.010	0.062***	0.062***	0.062***	0.063***	0.084***	0.083***	0.099***	0.103***	0.075***	0.073***
	(14.314)	(1.213)	(5.873)	(81.143)	(4.764)	(12.593)	(10.375)	(40.967)	(24.480)	(51.907)	(34.951)	(31.031)
ν	1.578***	1.544***	1.276***	1.278***	1.455***	1.439***	1.344***	1.347***	1.169***	1.166***	1.160***	1.156***
	(34.168)	(35.635)	(31.801)	(23.284)	(40.991)	(22.713)	(45.214)	(31.605)	(22.700)	(29.001)	(24.820)	(41.905)
Panel C: diagnostic tests												
$E(Z_t)$	-0.030	-0.030	-0.014	-0.015	-0.028	-0.028	-0.027	-0.027	-0.019	-0.019	-0.013	-0.012
$E(Z_t^2)$	0.975	0.974	0.981	0.980	0.976	0.976	0.981	0.981	0.979	0.979	0.980	0.980
LB(12)	35.946***	47.991***	13.880	14.343	11.298	10.812	9.135	9.088	5.414	5.198	18.303	19.701*
$LB^2(12)$	15.319	12.464	41.984***	40.125***	23.717**	20.177*	27.292***	27.135***	16.595	17.758	24.960**	24.195**
ARCH(12)	14.022	11.384	40.350***	38.772***	23.076**	19.888*	26.854***	26.869***	16.255	17.295	23.735**	23.070**
LR-TEST	28.907***	4.867**	33.234***	0.444	17.847***	0.110	11.825***	0.000	15.005***	2.503	34.607***	1.393

The table provides the maximum likelihood estimation for the augmented SW models with market regime dummy for the six East Asian stock indices using turnover rate as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2^{bull} liq_{t-1}\sigma_t^2 * \left(D_t\right) + \gamma_2^{bear} liq_{t-1}\sigma_t^2 * \left(1 - D_t\right) + \varepsilon_t$.

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_3^{bull} liq_{t-1}\sigma_t^2 R_{t-1} * \left(D_t\right) + \gamma_3^{bear} liq_{t-1}\sigma_t^2 R_{t-1} * \left(1 - D_t\right) + \varepsilon_t$.

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$.

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB²(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. The null hypothesis of LR-TEST is $\gamma_2^{bull} = \gamma_2^{bear}$ for augmented SW Model I and $\gamma_3^{bull} = \gamma_3^{bear}$ for augmented SW Model II, the table reports the chi-squared statistic and significance level. The models with red headings are with significant liquidity terms. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-10: Robust check for the augmented SW Models with EGARCH specification

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: mean equation												
α	-0.016***	-0.016***	0.018***	0.022***	0.044**	0.032***	0.023	0.008	0.019	0.019*	0.009	0.009
	(-2.672)	(-4.639)	(2.983)	(12.364)	(1.961)	(7.016)	(1.140)	(0.424)	(1.134)	(1.801)	(0.567)	(0.578)
ρ	0.042***	0.035***	0.006***	0.000	-0.020	0.010	-0.003	0.026**	0.002	0.002	0.006	0.006
	(5.982)	(35.583)	(6.359)	(0.139)	(-1.453)	(0.808)	(-0.198)	(2.047)	(0.148)	(0.186)	(0.323)	(0.428)
γ_0	0.032***	0.036*	0.068***	0.068***	0.062***	0.064***	0.021*	0.029***	0.043	0.047***	0.034	0.034*
	(14.839)	(1.765)	(3.281)	(3.313)	(2.762)	(9.516)	(1.646)	(9.720)	(1.628)	(627.168)	(1.513)	(1.921)
γ_1	-0.010***	-0.004	-0.022***	-0.022**	-0.018*	-0.021***	-0.003***	-0.012***	-0.029***	-0.034***	-0.013	-0.014
	(-3.560)	(-0.450)	(-2.634)	(-2.194)	(-1.772)	(-32.604)	(-2.764)	(-8.026)	(-2.741)	(-134.968)	(-0.909)	(-1.149)
γ_2	-0.002***		-0.002***		0.000***		0.029***		-0.024		0.000	
	(-3.324)		(-4.423)		(24.284)		(7.542)		(-0.090)		(-0.095)	
γ_3		-0.003**		0.000		0.000***		0.007**		0.112***		0.000
		(-2.546)		(0.198)		(3.605)		(2.087)		(2.881)		(1.240)
Panel B: variance equation												
α_0	-0.107***	-0.107***	-0.079***	-0.079***	-0.082***	-0.083***	-0.112***	-0.112***	-0.110***	-0.110***	-0.120***	-0.120***
	(-10.917)	(-8.918)	(-66.326)	(-25.963)	(-21.987)	(-55.677)	(-8.521)	(-345.971)	(-22.728)	(-852.461)	(-10.677)	(-36.298)
α_1	0.986***	0.986***	0.986***	0.986***	0.987***	0.987***	0.987***	0.987***	0.965***	0.965***	0.987***	0.987***
	(277.158)	(260.003)	(409.668)	(457.101)	(252.979)	(251.827)	(239.375)	(350.362)	(218.571)	(274.038)	(354.728)	(389.141)
β	-0.013***	-0.012	-0.052***	-0.052***	-0.068***	-0.066***	-0.066***	-0.066***	-0.090***	-0.090***	-0.062***	-0.062***
	(-3.374)	(-1.301)	(-6.814)	(-6.448)	(-6.484)	(-6.026)	(-5.127)	(-7.858)	(-6.225)	(-7.627)	(-7.799)	(-12.449)
δ	0.154***	0.154***	0.108***	0.108***	0.108***	0.109***	0.151***	0.150***	0.162***	0.162***	0.148***	0.149***
	(10.492)	(9.152)	(63.746)	(22.794)	(37.816)	(58.085)	(8.349)	(101.931)	(42.160)	(392.834)	(10.542)	(83.098)
ν	1.542***	1.539***	1.287***	1.284***	1.417***	1.429***	1.322***	1.322***	1.164***	1.166***	1.154***	1.154***
	(33.386)	(30.930)	(29.737)	(22.556)	(26.085)	(32.434)	(26.492)	(31.238)	(27.092)	(94.237)	(30.647)	(24.325)
Panel C: diagnostic tests												
$E(Z_t)$	-0.032	-0.032	-0.014	-0.014	-0.027	-0.028	-0.024	-0.024	-0.012	-0.013	-0.009	-0.009
$E(Z_t^2)$	1.001	1.001	1.004	1.004	1.003	1.002	1.001	1.002	1.004	1.004	1.002	1.002
LB(12)	42.860***	46.117***	14.848	14.862	12.047	12.006	11.278	11.299	4.009	4.035	18.627*	18.714*
$LB^2(12)$	8.848	8.752	39.282***	39.343***	18.992*	18.585*	39.107***	37.741***	25.949*	25.843**	22.866**	23.103**
ARCH(12)	9.225	9.159	44.097***	44.332***	17.964	17.553	33.155***	31.560***	24.764**	24.751**	20.389*	20.623*

The table provides the maximum likelihood estimation for the augmented SW Models with EGARCH variance for the six East Asian stock indices using Amihud illiquidity measure as the measure of market liquidity.

The conditional mean equation for the augmented SW model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t$

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right)R_{t-1} + \varepsilon_t$

The variance equation with EGARCH specification is: $\ln\left(\sigma_t^2\right) = \alpha_0 + \alpha_1 G_{t-1} + \beta\sigma_{t-1}^2$, where $G_{t-1} = \left|\varepsilon_{t-1}/\sigma_{t-1}\right| - \sqrt{2/\pi} + \delta*\left(\varepsilon_{t-1}/\sigma_{t-1}\right)$

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB^2(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-11: Robust check for the augmented SW Models with adjusted Amihud illiquidity measure

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	-0.020	-0.011	0.006***	0.007	0.027***	0.028	0.030**	0.015	0.032***	0.029	0.019***	0.018**
	(-1.099)	(-0.738)	(8.368)	(0.576)	(21.912)	(1.473)	(2.061)	(0.936)	(14.750)	(1.096)	(3.414)	(2.178)
ρ	0.050***	0.030***	0.013***	0.011	0.019***	0.015	-0.011***	0.023**	-0.001	0.002	-0.004	-0.001
	(5.004)	(6.258)	(8.709)	(1.199)	(10.395)	(0.960)	(-5.477)	(2.085)	(-1.226)	(0.145)	(-0.305)	(-0.109)
γ_0	0.036**	0.028**	0.062***	0.060***	0.066***	0.068***	0.024**	0.021	0.040***	0.045***	0.024***	0.023
	(2.335)	(2.074)	(4.406)	(3.590)	(4.224)	(5.666)	(2.332)	(1.340)	(3.256)	(36.371)	(14.488)	(1.358)
γ_1	-0.011**	0.009***	-0.019***	-0.015***	-0.019**	-0.023**	-0.001	0.003***	-0.026***	-0.035***	-0.008*	-0.009
	(-2.567)	(3.708)	(-2.654)	(-6.739)	(-2.430)	(-2.464)	(-0.294)	(3.852)	(-21.515)	(-125.672)	(-1.759)	(-0.757)
γ_2	-0.307*		-0.010***		-0.004***		0.078***		0.021**		0.005**	
	(-1.874)		(-2.632)		(-76.433)		(32.349)		(2.073)		(2.024)	
γ_3		-0.316***		-0.026**		0.005		-0.011***		0.065***		0.002
		(-3.890)		(-2.469)		(0.553)		(-4.913)		(34.887)		(0.278)
Panel B: conditional variance equation												
α_0	0.021***	0.021***	0.017***	0.016***	0.014***	0.014***	0.015***	0.015***	0.041***	0.041***	0.008***	0.008***
	(4.436)	(3.070)	(619.290)	(133.639)	(262.917)	(87.185)	(5.666)	(55.673)	(77.899)	(18.599)	(15.809)	(6.758)
α_1	0.063***	0.062***	0.018***	0.018***	0.012***	0.012***	0.030***	0.030***	0.029***	0.029***	0.036***	0.036***
	(164.194)	(7.067)	(98.137)	(484.934)	(56.206)	(738.198)	(28.023)	(300.028)	(305.629)	(33.346)	(122.002)	(150.136)
β	0.924***	0.925***	0.940***	0.940***	0.941***	0.941***	0.918***	0.918***	0.899***	0.899***	0.920***	0.920***
	(366.948)	(99.754)	(825.847)	(402.644)	(615.010)	(526.414)	(504.056)	(380.184)	(500.722)	(408.314)	(368.510)	(495.401)
δ	0.010***	0.009	0.062***	0.062***	0.067***	0.067***	0.084***	0.084***	0.100***	0.100***	0.073***	0.073***
	(3.880)	(1.267)	(676.691)	(180.710)	(474.938)	(146.405)	(63.125)	(193.207)	(62.902)	(40.482)	(208.057)	(42.970)
ν	1.544***	1.542***	1.278***	1.278***	1.433***	1.433***	1.320***	1.323***	1.169***	1.171***	1.155***	1.156***
	(31.724)	(28.569)	(34.761)	(32.934)	(38.915)	(58.922)	(46.341)	(34.368)	(158.447)	(27.647)	(53.353)	(35.694)
Panel C: diagnostic tests												
$E(Z_t)$	-0.031	-0.031	-0.016	-0.016	-0.030	-0.030	-0.025	-0.026	-0.019	-0.020	-0.011	-0.011
$E(Z_t^2)$	1.000	1.000	1.002	1.002	1.002	1.002	1.001	1.001	1.003	1.003	1.002	1.002
LB(12)	40.738***	46.698***	14.995	15.056	11.061	11.064	10.685	10.544	4.015	4.039	17.520	17.542
$LB^2(12)$	7.329	7.447	34.104***	33.965***	18.672*	18.617*	32.292***	31.910***	18.221	18.022	17.437	17.486
ARCH(12)	7.977	8.051	37.221***	37.202***	17.508	17.443	27.670***	27.130***	17.304	17.247	15.735	15.770

The table provides the maximum likelihood estimation for the augmented SW Models for the six East Asian stock indices using adjusted Amihud illiquidity measure as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t$.

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right)R_{t-1} + \varepsilon_t$.

The variance equation with GJR-GARCH specification is given by: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$.

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & $LB^2(N)$ are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. *, **, and *** indicate significance level at 10%, 5% and 1% respectively.

Table 2-12: Robust check for the augmented SW Models with total market index

	CHINA		HONG KONG		TAIWAN		SOUTH KOREA		JAPAN		SINGAPORE	
	I	II	I	II	I	II	I	II	I	II	I	II
Panel A: conditional mean equation												
α	-0.051***	-0.048	0.018	0.018	0.011	0.012	0.010	0.008*	0.010*	0.016	0.031***	0.033***
	(-9.137)	(-1.530)	(0.546)	(0.756)	(0.559)	(0.768)	(0.617)	(1.797)	(1.658)	(1.023)	(2.834)	(9.640)
ρ	0.043***	0.042**	0.010	0.010	0.024***	0.019*	0.017***	0.021**	0.012***	0.002	0.005	-0.007**
	(15.884)	(2.347)	(0.488)	(0.584)	(4.634)	(1.662)	(8.243)	(2.104)	(7.209)	(0.106)	(0.489)	(-2.124)
γ_0	0.033	0.037*	0.099***	0.099***	0.049**	0.075***	0.015***	0.013	0.119***	0.126***	0.034	0.034
	(1.372)	(1.691)	(3.126)	(4.541)	(2.427)	(2.718)	(35.378)	(1.182)	(48.769)	(10.036)	(1.404)	(1.323)
γ_1	-0.009	-0.005	-0.026**	-0.027***	-0.022**	-0.050***	-0.001***	0.001	-0.041***	-0.049***	-0.014	-0.017
	(-1.252)	(-0.706)	(-2.065)	(-2.593)	(-2.346)	(-2.888)	(-3.786)	(0.211)	(-6.035)	(-13.755)	(-0.844)	(-0.874)
γ_2	0.001***		0.000		-0.014*		0.195***		-0.007***		0.000**	
	(2.849)		(0.018)		(-1.921)		(3.282)		(-11.336)		(-2.378)	
γ_3		-0.003***		0.000		0.033**		-0.085***		0.004***		0.000
		(-4.194)		(0.419)		(2.421)		(-2.662)		(4.685)		(0.777)
Panel B: conditional variance equation												
α_0	0.019***	0.019**	0.017**	0.017***	0.018***	0.018***	0.016***	0.016***	0.048***	0.047***	0.008***	0.008***
	(3.308)	(2.394)	(2.259)	(3.834)	(231.773)	(20.791)	(6.360)	(73.218)	(53.481)	(7.601)	(11.682)	(31.611)
α_1	0.061***	0.061***	0.020***	0.020***	0.008***	0.008***	0.026***	0.026***	0.026***	0.025***	0.041***	0.040***
	(160.343)	(14.281)	(48.948)	(4.521)	(68.454)	(11.122)	(178.278)	(29.065)	(30.761)	(3.388)	(241.017)	(231.476)
β	0.928***	0.928***	0.932***	0.932***	0.940***	0.940***	0.925***	0.925***	0.879***	0.880***	0.913***	0.914***
	(278.209)	(87.561)	(86.788)	(215.342)	(476.359)	(355.013)	(384.516)	(456.193)	(368.421)	(211.493)	(385.778)	(382.280)
δ	0.007***	0.008	0.069***	0.069***	0.070***	0.070***	0.080***	0.079***	0.122***	0.123***	0.071***	0.072***
	(11.865)	(0.730)	(5.207)	(6.093)	(360.099)	(16.349)	(433.248)	(245.754)	(132.192)	(16.747)	(74.377)	(32.110)
ν	1.553***	1.555***	1.282***	1.283***	1.354***	1.352***	1.303***	1.303***	1.100***	1.100***	1.186***	1.185***
	(27.844)	(26.560)	(25.742)	(27.958)	(31.462)	(27.316)	(36.620)	(39.409)	(29.808)	(26.130)	(25.050)	(54.960)
Panel C: conditional diagnostic tests												
$E(Z_t)$	-0.025	-0.024	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.015	-0.016	-0.018	-0.018
$E(Z_t^2)$	1.000	1.000	1.002	1.002	1.000	1.000	1.001	1.001	1.003	1.003	1.002	1.002
LB(12)	40.558***	40.857***	14.621	14.541	20.225*	18.979*	11.709	11.701	6.926	6.934	25.539**	25.459**
$LB^2(12)$	5.953	5.809	26.007**	25.987**	15.343	15.580	25.813**	25.846**	23.045**	22.795**	12.634	12.477
ARCH(12)	6.271	6.185	28.183***	28.067***	15.293	15.495	22.001**	21.976**	20.640*	20.438*	11.335	11.180

The table provides the maximum likelihood estimation for the augmented SW Models for the total market indices in the six East Asian countries using Amihud illiquidity measure as the measure of market liquidity.

The conditional mean equation for the augmented SW Model I with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2\right)R_{t-1} + \gamma_2 liq_{t-1}\sigma_t^2 + \varepsilon_t$

The conditional mean equation for the augmented SW Model II with liquidity measures is: $R_t = \alpha + \rho\sigma_t^2 + \left(\gamma_0 + \gamma_1\sigma_t^2 + \gamma_3 liq_{t-1}\sigma_t^2\right)R_{t-1} + \varepsilon_t$

The variance equation with GJR-GARCH specification is: $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta I_{t-1}\varepsilon_t^2$

ν is a scale parameter which indicates that the error terms are following the Generalised Error Distribution(GED). The t-statistics reported are robust to autocorrelation and heteroscedasticity using the standard errors introduced in Bollerslev and Wooldridge (1992). LB(N) & LB^2(N) are the Ljung–Box Q test of serial correlation for the level & squared variables, ARCH(N) is the Lagrange Multiplier LM test for ARCH effects and distributed as a χ^2 with N degree of freedom. *, **, and *** indicate significance level at 10%, 5% and 1% respectively

CHAPTER 3: FINANCIAL FLEXIBILITY, CEO CONSERVATISM, AND CORPORATE SOCIAL RESPONSIBILITY: A LIFECYCLE APPROACH

3.1. Introduction

A growing number of practitioners have come to allocate a greater amount of time and resources to CSR engagement. It is reported that 90 percent of the listed Fortune 500 companies now pursue explicit CSR initiatives (Kotler and Lee, 2004). The Financial Times calculated that the expenditure of Fortune 500 companies on corporate responsibility reached $15bn in 2014. Previous studies suggest that firms are "doing well by doing good", which suggests that firms can benefit from following sound CSR practices (Servaes and Tamayo, 2013). In addition to an enhanced reputation, socially responsible firms also enjoy a healthy business environment rooted in a favourable social environment. The consensus in the literature is that when firms are required to serve the growth and development of the community, they receive a social sanction from society. In line with stakeholder theory, previous studies document that companies who lead the way in terms of CSR activities have increased chances of long-term survival, a lower probability of future bankruptcy, and lower firm risk (Cheng *et al.*, 2014; Kim *et al.*, 2014; Orlitzky *et al.*, 2003). Unlike previous literature which mostly focuses on the impact of CSR on a firm's performance, our study contributes to the literature by shifting the focus to the determinants of a firm's CSR performance. In this chapter, we attempt to explore the impact of financial flexibility on a firm's CSR performance.

Extensive research offers comprehensive theories on the determinants of CSR performance (Feddersen and Gilligan, 2001; Freeman, 1984; Jennings and Zandbergen, 1995; McWilliams and Siegel, 2001). Campbell (2007) provides a substantial review on why corporations are increasingly likely to be socially responsible. According to his study, a firm's financial performance, economic environment, industry competitiveness and legal environment could all contribute to its CSR performance. However, as mentioned by Zu and Song (2009), the more likely motivation for a firm to engage in CSR activities links back to entrepreneurs' instincts for gaining economic benefits. Therefore this chapter attempts to extend the literature by examining the association between a firm's financial flexibility and CSR performance. We employ financial flexibility as our main measurement for financial conditions, other than direct measurements such as leverage and free cash level. Because financial flexibility is regarded as one of the most important determinants of a firm's financing policy and strategy, the majority of corporate managers prioritise financial flexibility when they make capital structure decisions (Bancel and Mittoo, 2004; Brounen *et al*., 2006). The implications of financial flexibility for firms' decision-making have been documented and developed by Gamba and Triantis (2008), who argue that financially flexible firms suffer a less severe impact as a result of external shocks. In a similar vein, Rapp *et al*. (2014) argue that financial flexibility can shape firms' payout policies and decisions on capital structure. Motivated by the fact that financial flexibility serves as a critical determinant of a firm's decision-making, it is worthwhile exploring the impact of a firm's financial flexibility on CSR activities, which in turn serves as a valuable measure of risk management investment.

Our study makes a threefold contribution to the literature: Firstly, to the best of our knowledge, it is the first attempt to show direct evidence of the impact of financial flexibility on a firm's CSR activities. By using firm-level data for the US market between 1994 and 2014, we find that measures of financial flexibility are negatively correlated with a firm's CSR performance. This result is in line with the view that firms that conservative use of debt is more likely to neglect the value of CSR. The nature of financial flexibility is that it enhances a firm's ability to cope with financial friction and lower associated costs. In other words, firms that have a conservative approach to debt build up financial flexibility as insurance against the future financing risk. In recent years, CSR engagement has also been recognised as an alternative form of risk management investment. As a consequence, it is important to investigate the relationship between financial flexibility and CSR for managing firm risk. In line with stakeholder theory, by mitigating conflict between stakeholders, a higher CSR performance could lead to a lower level of firm risk. However, along with the benefits of CSR engagement, the costs associated with CSR are impossible to ignore. CSR-related projects tend to be long-term investments that do not have an immediate payoff. Therefore, in the case of those firms that pursue a conservative leverage policy, it is possible for them to reserve their debt capacity and prepare for future investment opportunities or negative news or shocks. In other words, these firms tend to be more conservative in terms of resource allocation and thus reduce their CSR investment, which is a costly and long-term investment without an immediate payoff. Furthermore, the nature of financial flexibility indicates that it can reduce the risk of bankruptcy by absorbing the impact of future negative shocks. The substitution effect of financial flexibility and CSR engagement for risk management purposes suggests that financially flexible firms are less motivated to engage in socially responsible activities.

Secondly, in line with McCarthy *et al*. (2017), our results provide further evidence of the positive effect of CEO conservatism on firms' CSR performance. More importantly, this chapter examines the impact of CEO conservatism on the relationship between financial flexibility and CSR performance. Conservative CEOs affect the relationship between financial flexibility and CSR due to their cognitive bias. Heaton (2002) documents that conservative CEOs have a tendency to underestimate both their ability to invest, and the profit generated from their projects, but to overestimate the probability and risk of adverse events. Consequently, conservative CEOs tend to make biased financing decisions. Malmendier and Tate (2005) document that less conservative executives are more likely to fund their investments by increasing debt rather than issuing equity. Equity financing is too expensive for less conservative CEOs since they believe that their firms are undervalued. Therefore, conservative CEOs have a tendency to overestimate the leverage risk and the impact of future negative shocks and, thus, reserve debt capacity. This leads these firms to use resources more conservatively and reduce their engagement with CSR, which is a costly investment without an immediate payoff.

Finally, based on the fact that firms have to adopt distinct growth and capital capacity strategies as they move from one lifecycle stage to another (Anthony and Ramesh, 1992). Jenkins *et al*. (2004) show that strategic actions vary across the different stages in the lifecycle of a firm. We attempt to investigate the impact of the lifecycle stages on CSR performance and the association between financial flexibility and a firm's CSR performance. While growing and mature firms focus more on sales growth, firms in the later stages of the lifecycle may emphasise profitability instead. We posit that declining firms prioritise maintaining the return on existing investments. Therefore, they are unlikely to put more resources into CSR. Younger firms are focused on increasing their profits and have a strong desire to build up a good reputation as well as to serve the interests of wider stakeholders. Our study confirms that lifecycle theory holds true when corporations consider CSR expenditure.

The remainder of Chapter 3 proceeds as follows. Section 3.2 discusses the existing literature and charts the development of our hypotheses. Section 3.3 outlines the data and methodology used. Section 3.4 presents our empirical results. Section 3.5 describes and shows the robustness checks employed, and Section 3.6 presents our conclusions.

3.2. Literature Review and Hypothesis Development

In line with stakeholder theory, CSR performance helps to mitigate the conflicts between stakeholders, e.g., consumers, suppliers and the government (Freeman 2010; Huseynov and Klamm 2012). Specifically, firms engage in socially responsible activities to attract and retain high-quality employees, mitigate political and legal risks, increase customer loyalty and, ultimately enhance their long-term sustainability and reduce the probability of future bankruptcy. Therefore CSR serves as an essential risk management tool for firms with a conservative approach to future risk. The risk-controlling role of CSR has been investigated by some recent studies. Jo and Na (2012) find that there is an inverse relationship between CSR engagement and firm risk after controlling for various firm characteristics. Similarly, Husted (2005) finds that CSR has a negative impact on the ex-ante downside business risk of a firm. Goss and Roberts (2011) posit that CSR activities help a firm to avoid penalties imposed by society when they externalise a proportion of their production costs as a result of their irresponsible behaviour. Similarly, Jo and Na (2012) find that society praises and rewards firms for good CSR engagement after controlling for various firm characteristics. Oikonomou *et al*. (2012) attempt to investigate the impact of CSR on financial risk by determining the impact of corporate social responsibility and corporate social irresponsibility. Their study reveals that corporate social responsibility is negatively but weakly correlated with systematic firm risk, while corporate social irresponsibility is positively and confidently correlated with financial risk. [6] Additionally, as confirmed by Johnson and Greening (1999), there is a lower level of information asymmetry among socially responsible firms. Meanwhile, CSR

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6 MSCI database is a rating service which assesses a great number of firms with regard to their strengths and concerns on a series of dimensions. Once a firm performs well in a category, it gets one score for the strength, otherwise, it gets one score for the concern. The Instead of getting the corporate social responsibility score by calculating the difference between the summed score for strength and the summed score for concerns, Oikonomou et al. (2012) applied the summed strength score as the proxy for socially responsible performance and the summed concern score as the proxy for socially irresponsible performance to examine two opposite aspects of CSR. They have the following findings: firstly, the corporate social responsible score is negatively but weakly related to systematic firm risk; secondly, the corporate social irresponsible score is positively and strongly related to financial risk. As pointed out in their study, their findings indicate that "…in times of small or moderate levels of volatility, firms that engage in socially responsible behaviour are characterized by lower levels of market risk, while during times of high volatility, firms that are socially irresponsible are associated with higher levels of financial risk" which both highlights the importance of CSR in reducing firm risk and the adverse impact of socially irresponsible behaviour on firm risk.

activities can reduce firm risk by lowering firms' financing costs. Empirical studies document an increase in the number of socially responsible customers, and a decrease in the cost of capital and capital constraints after firms adopt strategic CSR (Baron, 2001; Cheng *et al*., 2014; El Ghoul *et al*., 2011). Thus, a good level of engagement with CSR is expected to lower both the firm risk and the cost of capital.

Despite these appealing features of firms with a high level of CSR engagement, it remains debatable whether CSR investments are value-creating or value-destroying. Critics argue that investment in CSR is costly since it diverts a firm's scarce resources away from more pressing priorities. From the perspective of neoclassical economics, Friedman (1970) argues that CSR is a result of the agency problem. On the one hand CSR investment can be motivated by managers' self-serving behaviour[7], but on the other hand, such investments unnecessarily increase a firm's costs. The higher costs may put the firm in a relatively disadvantaged position which contradicts the idea of shareholder wealth maximisation. Those who support Friedman (1970) emphasise that the maximisation of productivity and profit can best serve the interests of the collective good. As reasoned by Porter and Kramer (2006), successful companies can

7 Schaefer et al. (2004) document a close association between overconfidence and narcissistic personality traits. Petrenko et al. (2016) provide three reasons to link CSR with narcissistic CEOs. Firstly, CSR is value-loaded initiatives that appear to further some social good. Secondly, CSR engages sets of value sensitive audiences in adulation, media attention, and praise. Finally, CSR offers a variety of avenues to change the status quo, supplying continuity and variety to the opportunities that narcissistic CEOs have to exhibit themselves to attentive and responsive audiences. In a similar vein, McCarthy et al. (2017) argue that it is possible that overconfidence as a personality trait can result in higher CSR investment. Therefore, we point out that CSR investment can be derived by self-serving behaviours, such as the desire to exhibit themselves to responsive audiences.

best serve a healthy society by creating job opportunities, innovating to increase living standards, and increasing wealth. If the government or other social participants sacrifice productivity by imposing overly demanding CSR requirements on companies, the benefits derived from CSR will be more than wiped out. These include weakened regional competitiveness, followed by a decrease in wages and the loss of jobs, which will finally lead to the stagnation of taxation and wealth. As a result, the nonprofit organisations aimed at maximising social benefits will not survive.

The benefits derived from CSR investment have limitations. One such limitation is that CSR-related projects tend to be long-term investments which involve little short-term cash flow. Although citizenship might bring potential advantages, it is recognised that such benefits cannot materialise over a short time span. A long-term focused citizenship strategy, therefore, is not sufficient to meet the complex needs of multiple stakeholders. Another restriction is that the benefits from CSR are estimated under ideal conditions. For example, the idiosyncratic risk reduction role of CSR is not guaranteed, especially for firms with high levels of financial leverage (Mishra and Modi, 2013). Similarly, Ammann *et al.* (2011) point out that the positive evaluation influence of CSR is restricted to firms with good corporate governance. They argue that CSR spending motivated by managers' personal ambition may dominate the CSR expenditure, rather than profit-oriented CSR expenditure when the quality of corporate governance is poor. Finally, it is hard for managers to capture the vague demands of CSR advocates precisely enough. As Gioia (1999) explains, while there is a demand for CSR, the failure to fully take into account the daily realities faced by managers harms its managerial credibility. In addition, the high priority given to CSR in business decision-making has been questioned (Crook, 2005),

The literature on the determinants of CSR performance suggests that firms' engagement with CSR can be influenced by both firm characteristics and managers' attributes. With respect to firm characteristics, Liang and Renneboog (2017) posit that a firm's legal origin plays an essential role in explaining its CSR performance. Specifically, they argue that firms in civil law countries have a better CSR performance than firms in common law countries. Contrafatto (2014) and Pondevile *et al*. (2013) suggest that pressure from the public, the market, and the community motivates firms to engage in socially responsible activities. In a similar vein, Lys *et al*. (2015) point out that firms that anticipate a stronger future financial performance are more likely to engage in CSR activities. Furthermore, in order for CSR to be successfully implemented, managers' motivations are also critical. It is likely that CEOs' own beliefs and ethical ideals, together with their personal values, exert a substantial influence on their decisions. Duarte (2010) contends that the 'CSR cultures' within an organisation are created and maintained under the influence of managers' personal values. The general public represents an important external factor which may also affect CSR performance. As the public benefits directly from favourable corporate social performance, it is logical that there will be a strong correlation between CSR and public pressure, a view which is supported by Pamela Barton Roush *et al*. (2012). Survey evidence gathered from firms' decision-makers suggests that there is another factor which is considered to be of first-order importance for firms' financial and investment policies and has so far received little attention in the academic literature: financial flexibility. Therefore, it is intriguing and useful to investigate the impact of financial flexibility on firms' CSR policy.

3.2.1. The Impact of Financial Flexibility on CSR

Before introducing existing literature on financial flexibility, we first look into three closely related concepts in our study: the leverage, the debt capacity and the financial flexibility. Though financial flexibility, the leverage and the debt capacity are closely linked with each other, they are different concepts and have different implications. Leverage is the measure of capital structure derived as the debt to equity ratio. The higher leverage, the more debt a firm uses. High leverage does not necessarily result in the difficulty of raising debt as long as a firm has debt capacity. Debt capacity is defined as the difference between the actual leverage and the predicted value of leverage. A firm has unused debt capacity if its predicted value of leverage is higher than the actual leverage. The unused debt allows a firm to have quick access to external debt funds. Keeping financial flexibility is a conservative financing strategy, which requires a firm to keep unused debt capacity for at least three consecutive years. According to a survey by Graham and Harvey (2001), financial flexibility is regarded as the most critical concern in capital structure decisions. Financial flexible firms have more liquidity to act quickly to cash flow shocks and fund their investment opportunities in a timely manner. Therefore, the financial flexibility can act as insurance against financing risk.

Survey evidence gathered from decision-makers indicates that financial flexibility considerations shape corporate financial and investment policies. Existing literature confirms that the CFOs' choices of leverage are primarily driven by financial flexibility (Bancel and Mittoo, 2004; Graham and Harvey, 2001). According to the survey by Gamba and Triantis (2008), American and European CFOs' desire to gain and retain financial flexibility plays a decisive role in a firm's capital structure. Similarly, Ang and Smedema (2011) confirm that financial flexibility is a critical policy for managers in times of recession. Rapp *et al*. (2014) posit that firms with greater flexibility have lower dividend payouts, exhibit lower leverage ratios and accumulate more cash.

The nature of financial flexibility explains its dominant role in a firm's decision-making process. Graham and Harvey (2001) provide the most common definition of financial flexibility, according to which a firm is categorised as financially flexible if it meets three conditions. Firstly, it should have sufficient liquidity to react to cash flow shocks. Secondly, it should have easy access to external funds to allow it to pursue investment opportunities in a timely manner. Thirdly, it should not be restricted by insurance decisions. In other words, financial flexibility is extremely valuable when a firm is experiencing financial friction, and also mitigates the problem of underinvestment. Firms with sufficient liquidity and easy access to external funds are less vulnerable to the impact of future negative shocks and therefore reduce their chances of future bankruptcy. According to Graham and Harvey (2001), firms whose shareholders consider financial flexibility to be more valuable are more prepared to fund profitable investment opportunities. While information asymmetry and agency problems may cause a firm to miss out on profit opportunities, financial flexibility can increase their ability to take them. The reserved substantial borrowing power implied in a conservative leverage policy will allow companies to access the capital market when there is a positive shock to their investment opportunity set. de Jong *et al*. (2012) find that, compared with financially inflexible firms, financially flexible firms have higher future investments. Their findings suggest that there are reduced investment distortions among more financially flexible companies.

As the primary influencing factor in determining financing and investment strategies, financial flexibility should affect a firm's CSR performance. We propose that firms whose shareholders consider financial flexibility more valuable have lower incentives to engage in CSR activities.

CSR engagement is valuable to firms because of its hedging feature, i.e. it helps to reduce firm risk. More specifically, a high CSR performance implies that a firm is likely to have some underlying desirable features. Corporate socially responsible firms are more likely to produce high-quality financial reports. It is reasonable to assume that firms which are managed by those with a high standard of ethical concerns are apt to have a strong CSR performance. Accordingly, Kim et al. (2012) point out that socially responsible firms are less likely to engage in earnings management through discretionary accruals. Their study also documents that it is less likely that high CSR firms will be involved in real operating manipulation or to be under the investigation of the SEC. Furthermore, empirical studies document an increase in socially responsible engagement, and a decrease in the cost of capital and capital constraints after firms adopt strategic CSR (Baron, 2001; Cheng et al., 2014; El Ghoul et al., 2011). Following these arguments, research shows that CSR provides firms with insurance-like protection and reduces the effects of future external impacts

(Godfrey et al., 2009).

However, the benefits of CSR engagement have their limitations. For example, the idiosyncratic risk reduction role of CSR is not guaranteed, especially for firms with high levels of financial leverage (Mishra and Modi, 2013). Similarly, Ammann et al. (2011) point out that the positive evaluation influence of CSR is restricted to firms with good quality corporate governance. They argue that CSR spending which is led by managers' personal ambition may dominate the CSR expenditure, rather than profit-oriented CSR expenditure, when the quality of corporate governance is poor. Finally, it is hard for managers to capture the vague demands of CSR advocates precisely enough. As Gioia (1999) explains, although there is a demand for CSR, the failure to fully acknowledge and take into account the daily realities faced by managers harms its managerial credibility. In addition, the high priority given to CSR in business decision-making has been questioned (Crook, 2005).

It is worth noting that CSR engagement as a long-term investment strategy may cause conflict with conservative shareholders who want to maintain a high level of financial flexibility. In line with the shareholder expenses view, CSR commitments expend a firm’s valuable resources in order to create a strong socially responsibly image without generating immediate profit (Bénabou and Tirole, 2010). Another stream of literature argues that CSR engagement is associated with CEOs’ personal self-serving behaviour (Fabrizi et al., 2014; Petrenko et al., 2016). Specifically, CEOs invest in socially responsible practices to further their own reputation and career prospects. The long-term costs associated with CSR have also been recognised by the market:

Renneboog et al. (2008) document that CSR investments have been undervalued by stock markets in the short run even though they could create value for shareholders in the long term.

As a result, we propose that firms that consider financial flexibility to be more valuable are less likely to have a strong CSR performance. First, firms that pursue conservative financial strategies are likely to be more conservative in terms of resource allocation for CSR investments. In particular, firms whose shareholders consider financial flexibility more valuable are more likely to reserve debt capacity to prepare for future investment opportunities or negative shocks. This will cause these firms to spend their resources more conservatively and, consequently, to avoid luxury investments such as CSR activities. Furthermore, CSR is considered to be a risk management investment, while financial flexibility can also reduce the chances of future bankruptcy by absorbing future negative shocks. The substitution effect for the purpose of risk-management indicates that financially flexible firms are less motivated to engage in CSR activities.

H1: *Firms with higher financial flexibility are more likely to have lower CSR performance.*

3.2.2. The Role of CEO conservatism

The CEO, as the primary decision-maker, plays a determinant role in a firm's operation and performance. Therefore, the impact of CEO characteristics on a firm's investment and financial decisions constitutes a crucial issue in the corporate finance literature (Croci and Petmezas, 2015; Duellman *et al*., 2015; Hirshleifer *et al*., 2012).

Motivated by the proposal that CEO personal preference has a significant impact on a firm's decision-making, we examine the incremental effect of CEO conservatism on the association between financial flexibility and CSR engagement. A prominent cognitive bias shown by conservative (overconfident) CEOs is that they are inclined to underestimate (overestimate) both their own ability to invest and the profit from their projects, but overestimate (underestimate) the probability and risk of adverse events (Heaton, 2002; Malmendier and Tate, 2005). Similarly, conservatism is also linked with distortions in other costly investment policies, as well as financing and accounting policies (Ben-David *et al*., 2010; Malmendier and Tate, 2005, 2008). Cumulative evidence has revealed the impact of CEO personal preference on every aspect of a firm's decisions, including corporate policies, investment strategy, financing methods and dividend payments (Cordeiro, 2009; Deshmukh *et al*., 2013; Hirshleifer *et al*., 2012; Malmendier and Tate, 2008; Malmendier *et al*., 2011).

CEO conservatism affects CSR performance through two channels. Firstly, the incentives for conservative CEOs to be risk-averse make them overestimate the actual level of risk. Specifically, when firms face moral hazards, a strong corporate social performance can act as insurance against them. Risk-averse CEOs overestimate the probability of moral hazards and the losses that they will incur and are thus less likely to undertake insurance activities such as CSR investment. Therefore, we expect that there should be a positive relationship between CEO conservatism and CSR.

In addition to examining the direct effect of CEO conservatism on corporate socially responsible activities, we test the incremental effect of CEO conservatism on the relationship between financial flexibility and CSR policy. We propose that the association between financial flexibility and CSR is likely to be stronger in firms run by conservative CEOs. That is, conservative CEOs will overestimate the leverage risk and impact of future negative shocks (Lewellen, 2006) and, consequently, increase the firm's financial flexibility instead of spending valuable resources on costly and long-term CSR investment. Therefore, we expect the impact of CEO conservatism on the relationship between financial flexibility and CSR policy to be negative.

H2: *The negative relationship between CEO financial flexibility and CSR is stronger for companies with conservative CEOs.*

3.2.3. The Role of Lifecycle

The lifecycle theory illustrates that firms at different lifecycle stages adopt different growth strategies (Anthony and Ramesh, 1992). From the moment they come into existence, firms move from one corporate lifecycle stage to another (Miller and Friesen, 1984). There are four major lifecycle phases, namely birth, growth, maturity, and decline. As firms evolve, they have to face and deal with changing internal and external factors. A firm's financial resources, managerial ability, business and macro economy all exert a substantial impact on its chances of survival. Dickinson (2011) defines firm lifecycles as distinct phases resulting from changes in internal and external factors. The circumstances faced by a firm, its organisational strategy, capital structure and style of decision-making all significantly vary between lifecycle stages

(Adizes, 2004; Miller and Friesen, 1984; Pashley and Philippatos, 1990).

Existing studies have confirmed the validity of lifecycle theory in several fields of corporate finance. For example, Maug (2001) claims that as a firm moves through different stages of the lifecycle, there are varying optimal ownership structures. After examining the impact of lifecycle stages on firms' payout policy, DeAngelo et al. (2006) document that mature and established firms have a greater tendency to pay dividends. The lower dividends paid by young firms can be partly ascribed to the relatively abundant investment opportunities available to them and their relatively limited resources. In addition to struggling to generate sufficient internal cash, young firms also encounter substantial hurdles to raising capital from external sources. In order to fund investment opportunities efficiently, they are more likely to reserve cash by decreasing dividend payments to shareholders. As argued by Bulan and Subramanian (2009), firms at the maturity stage have a diminished set of investment opportunities, flattened growth and profitability, and a decline in systematic risk. Therefore, the cash generated is more than mature firms can profitably invest. Eventually, mature firms with higher profitability and fewer attractive investment opportunities become better candidates for dividend payments.

We assume that firms should adopt different CSR strategies during different phases of their lifecycle. We predict that, generally, as a firm develops it will have a higher CSR rating. While firms are still at the birth stage, they share the following features: simple, structurally informal, and undifferentiated. They have few financial resources and focus mainly on innovation and sales expansion. Barnea and Rubin (2010) point out that CSR-related expenses account for a substantial part of their operating costs. Young firms are, therefore, less likely to pay much attention to CSR investments since they have to use the scarce financial resources that they have as efficiently as possible. As firms grow, additional funds will become available for them to invest in CSR. Growth firms are therefore likely to have a better corporate social performance than those at the birth stage. When firms reach the mature stage, they have a steady cash flow and fewer opportunities for expansion. Thus, mature firms have a higher propensity to invest in projects to improve their social responsibility performance. Declining firms which are struggling to survive care more about the pay-offs for their existing capital investments, resulting in a poor CSR performance.

The investment strategy pursued by more mature (pre-decline stage of the lifecycle) corporations is in line with the evidence provided by Renneboog et al. (2008). Their study showed that, over the long-term, firms’ investment in CSR creates value for their shareholders, although stock markets underestimate the value over the short-term. Mature firms can build up a favourable reputation as good citizens by investing in CSR. The sound CSR performance attracts further investments for the firm and lowers the cost of debt financing. Firms at a more mature stage are subject to stricter monitoring from the general public than firms at earlier stages of the lifecycle. Therefore mature firms face greater pressure and higher expectations to perform in a socially responsible way. We assume that CSR investments will maintain momentum as long as there is a balance between the costs and benefits of CSR investments.

Also, we would expect younger firms to have better CSR performance than the decline firms. We define "younger firms" as the firms which have not moved to the decline stage of life cycle. CSR investment is a long-term and costly investment which does not generate an immediate return. Therefore, decline firms focusing on the harvest strategy have the least desire to invest in CSR. If young firms have spare financial resources, they will invest more in CSR than the decline firms. On the one hand, the younger firms may expect the benefit from their sound CSR practice as they move to later stages. On the other hand, behaving in a socially responsible way can attract investment from socially responsible investors. Also, existing studies document that firms with higher CSR performance have easier access to external funds. Unlike firms at decline stage, younger firms have more investment opportunities, and thus the young firms may consider the benefit of having cheaper financing resulting from CSR activities and put more resources into CSR.

H3a*: Compared with earlier lifecycle stages, firms have the poorest CSR performance at the decline stage of the lifecycle.*

H3b*: The CSR performance of firms is improving from birth stage to mature stage of the lifecycle.*

Lifecycle stage, as a comprehensive description of a firm's status, is closely associated with its financing and investment decisions. We assume that the impact of financial flexibility on CSR is more pronounced during the later stages of the lifecycle. For instance, firms at the birth stage are less likely to be influenced by it because they have fewer choices available to them and face more constraints than at other stages of the lifecycle. These firms have to seize profit opportunities and accept demanding requirements from investors to survive in a competitive environment. In addition to attracting investment, birth stage firms have two major concerns. On the one hand, birth stage firms are primarily focused on innovation to try to differentiate themselves from their competitors. On the other hand, birth stage firms have to obtain a competitive advantage by expanding sales. These concerns for firms at the birth stage should not be influenced by the desire to reserve debt capacity. We suppose that at the birth stage of the lifecycle, the effects of constraints will take precedence over other factors that have an influence on CSR, i.e. financial flexibility. We also take into account the severe financing problem as well as the agency problem faced by firms in the decline stage. We thus assume that financial flexibility will exert a more negative impact on the CSR rating of those firms in the decline stage.

***H3c**: Compared with firms at earlier stages, the negative relationship between financial flexibility and CSR is most pronounced at the decline stage of the lifecycle.*

***H3d:** The negative relationship between financial flexibility and CSR becomes more pronounced from birth stage to mature stage of the lifecycle.*

3.3. Data and Sample

3.3.1. Measure of Corporate Social Responsibility

CSR scores can quantify the extent of CSR engagement. Following Deng et al. (2013), we construct two adjusted CSR scores to control for the impact of firm size. The CSR score we construct is based on the MSCI database (formerly known as

KLD) which is widely applied in most of the literature on CSR in relation to the US market.[8] The MSCI database starts from 1991 and covers approximately 650 companies, including the Domini 400 Social SM Index as well as Standard & Poor's (S&P) 500. *Since July 2003* over three thousand firms that are listed in the Russell 3000 have also been included.

There are seven major dimensions of the MSCI database relating to firms' CSR, namely community, corporate governance, diversity, employee relations, environment, human rights, and product quality and safety. All the dimensions are classified into two categories: "strength" and "concern." If a firm performs well in a "strength" indicator, it will get one point. However, if a firm follows bad practice in relation to the "concern" indicators, it will lose one point. The raw CSR score comprises the total points accumulated by a firm in relation to all the strengths and concerns. Intuitively, the higher a firm's CSR score, the better its social performance. However, Manescu (2009) points out that the raw CSR score lacks comparability across years and dimensions due to the varying numbers of indicators over time. To minimise these potential drawbacks associated with the raw CSR score, we employ the adjusted CSR score measure, developed by Deng *et al*. (2013), as follows:

$$\mathrm{CSR}_t^i = \frac{\sum_{p=1}^{n_t^i} STRENGTH_p^i}{n_t^i} - \frac{\sum_{q=1}^{m_t^i} CONCERN_q^i}{m_t^i} \qquad (3.1)$$

8 The full name for MSCI is Morgan Stanley Capital International. It is the name of an American provider of equity, fixed income, hedge fund stock market indexes, and equity portfolio analysis tools. The full name for KLD is KLD Research & Analytics, Inc. (KLD). It is the leading authority on social research for institutional investors.

where CSR_t^i denotes the CSR score for dimension i at time t; $STRENGTH_p^i$ represents the p^{th} strength indicator for dimension i at time t; $CONCERN_q^i$ represents the q^{th} concern indicator for dimension i at time t. Both indicators are equal to one if a firm meets strength p or concern q, and equal to zero otherwise; and n_t^i and m_t^i are the total numbers of strength and concern indicators, respectively, in dimension i at time t. Each dimension's strength and concern scores are scaled by the respective number of strength and concern indicators to derive the adjusted strength and concern scores for that dimension. The adjusted CSR score is computed as the difference between the adjusted total strength score and the adjusted total concern score. The bias in the original CSR score resulting from comparing indicators from relatively irrelevant industries is mitigated since equal weight is given to each dimension, rather than to individual indicators. We adopt the adjusted CSR score, including the corporate governance section, as the principal measure of corporate social performance. We also use the adjusted CSR score, excluding the corporate governance section, to check the robustness of our findings.

3.3.2. Measure of Financial Flexibility

Corporate debt capacity as a proxy for financial flexibility is defined as the maximum amount a firm can borrow under a given level of investment if the capital market is perfect. As illustrated by Denis and McKeon (2012), unused debt capacity, which takes factors such as firm size and economy into account, is considered to be the crucial source of financial flexibility. They reason that only if a firm has adequate unused debt capacity can it have quick access to external debt funds. To measure the financial flexibility of a firm we have to compare the actual leverage with the predicted value of leverage. We adopt the regression model specified by Marchica and Mura (2010) to obtain the predicted value of firm leverage.[9] The regression model has the following specification:

$$\begin{aligned} LEV_{it} &= \alpha_1 LEV_{it\text{-}1} + \beta_1 Industry\ Leverage_{it} + \beta_2 MTB_{it\text{-}1} + \beta_3 SIZE_{it\text{-}1} \\ &+ \beta_4 Tangibility_{it\text{-}1} + \beta_5 \Pr ofitability_{it\text{-}1} + \beta_6 Inflation_{it\text{-}1} \\ &+ Firm\ fixed\ effects + Year\ fixed\ effects + u_{it} \end{aligned} \quad (3.2)$$

To control for potential endogeneity problems, the independent variables in the model are in their lags. According to the model, firms are believed to have unused debt capacity if the difference between the actual and the predicted leverage is negative. Following Marchica and Mura (2010), a firm has to retain unused debt for a minimum of three consecutive years to be categorised as financially flexible. The financial flexibility measure *FLEX_DUMMY1* (abbreviate as *FF1*) derived from Equation (3.2) is also the primary financial flexibility measure applied in our research. Specifically, *FF1* is a dummy variable which takes a value of 1 if the firm has unused debt capacity for at least three consecutive years, and 0 otherwise.

As Ferrando *et al*. (2013) claim, cash holding introduces the agency problem as well

9 We also employ an augmented model based on the one used by Yung et al. (2015), which adjusted the measure applied in Marchica and Mura (2010), as an alternative measure of financial flexibility. The results are materially unchanged. For brevity, the results are available upon request. The augmented regression model is specified as follows:

$$\begin{aligned} LEV_{it} &= \alpha_1 LEV_{it\text{-}1} + \beta_1 Industry\ Leverage_{it} + \beta_2 MTB_{it\text{-}1} + \beta_3 SIZE_{it\text{-}1} + \beta_4 Tangibility_{it\text{-}1} + \beta_5 \Pr ofitability_{it\text{-}1} + \beta_6 Inflation_{it\text{-}1} \\ &+ \beta_7 Cash_{it\text{-}1} + \beta_8 Maturity_{it\text{-}1} + \beta_9 Dividends_{it\text{-}1} + \beta_{10} Tax_{it\text{-}1} + \beta_{11} Ndts_{it-1} + Firm\ fixed\ effects + Year\ fixed\ effects + u_{it} \end{aligned}$$

as credit rationing. It is reasonable to control for the impact of cash holding when examining the impact of financial flexibility on CSR. Therefore, we also apply the leverage net of cash as specified by Bates *et al.* (2009b) to derive our second financial flexibility measure *FLEX_DUMMY2* (abbreviate as *FF2*) based on Equation (3.2).

3.3.3. Measure of CEO Conservatism[10]

Following McCarthy *et al*. (2017), we derive our proxy for CEO conservatism from the timing of exercising options. CEOs are exposed to idiosyncratic risk because they have a less diversified portfolio. To minimise the risk, CEOs have to try to seize the perfect moment to exercise their options and sell the shares gained from doing so. Overconfident CEOs believe that the firm value will continue to increase. They therefore tend to hold on and delay exercising their options. We believe that

10 In the previous version of my thesis used in the VIVA, I applied three measures for CEO overconfidence. The three measures are also applied in Ahmed and Duellman (2013), which examine the impact of CEO overconfidence on the accounting conservatism. The first measure, *Holder67*, is based on the timing of exercising options. *Holder67* is a dummy variable which is set to one when the option-in-the-money is over 0.67 at least twice over the sample period and zero otherwise. When CEOs expect that the firm value will increase, they are unlikely to exercise their options. Therefore, the higher the percentage of exercisable unexercised options relative to the exercise price, the more confident a CEO is regarding their firm's performance. The option-based measure for CEO overconfidence is the primary measure for CEO's overconfidence. The other two measures for CEO overconfidence, *Over-invest* and *CAPEX,* are based on the firm's investment and capital expenditure decisions. Compared with *Holder67*, the two expenditure-based measures might interact with CSR in two ways. First, overconfident CEOs are less likely to invest in CSR as insurance since they are likely to underestimate risk and overestimate profit. Second, CSR as an investment may have positive linkage with the capital expenditure and over-investment. Thus, the correlation between *Over-invest*, *CAPEX* and CSR may be positive before controlling for other factors.

overconfident CEOs will have higher options in-the-money (OPIM) than rational or conservative CEOs. We calculate OPIM as follows: We first obtain the mean of each option ($\bar{C}$) as the exercisable unexercised options scaled by the number of exercisable unexercised options:

$$\bar{C} = \frac{Exercisable\ unexercised\ options}{Number\ of\ exercisable\ unexercised\ options} \tag{3.3}$$

We then obtain the mean of each option's exercise price ($\bar{X}$) as the difference between the stock price at the fiscal year end ($\bar{S}$) and the mean of each option ($\bar{C}$):

$$\bar{X} = \bar{S} - \bar{C} \tag{3.4}$$

The options in-the-money is defined as the mean of each option ($\bar{C}$) scaled by the mean of each option's exercise price ($\bar{X}$):

$$Options\ in\text{-}the\text{-}money\ (OPIM) = \bar{C} / \bar{X} \tag{3.5}$$

We define dummy variable "*HOLDER10*" as our first the measure for CEO conservatism. The dummy variable *HOLDER10* takes a value of 1 if *OPIM* is less than 10% at least twice over the entire sample period, and zero otherwise. A CEO is more likely to be ascribed as conservative when *HOLDER10* equals 1.

McCarthy *et al.* (2017) and Banerjee *et al.* (2015a and 2015b) point out that a dichotomous variable is not capable in telling the level of CEO confidence. Therefore, we construct a continuous measure of CEO confidence, *CONSERV* based on the Option-in-the-money (*OPIM*). The *CONSERV* is the negative standardised value of *OPIM* based on firms in the same industry i in the year t. The higher value of *CONSERV*, the more conservative a CEO is.

3.3.4. Identify Lifecycle

We classify the lifecycle stages of firms based on the method introduced by Anthony and Ramesh (1992). To identify the lifecycle stage of a firm we consider four dimensions, which are: dividend payment, sales growth, capital expenditure and firm age. As illustrated by Koh *et al*. (2015), a firm's lifecycle stage is determined by the sum of the score of the four dimensions. We obtained the data from the COMPUSTAT database and then derive the measures for the four firm-specific dimensions as follows:

We calculate the dividend payment dimension (*DP*) as the annual dividend scaled by the income:

$$DP_{it} = \left(DIV_{it} / IBED_{it}\right)*100 \qquad (3.6)$$

We calculate the sales growth rate dimension (*SG*) as the annual percentage sales growth:

$$SG_{it} = \left(SALES_{it} / SALES_{it\text{-}1}\right)*100 \quad (3.7)$$

We derive the Capital expenditure dimension (*CEV*) as the capital expenditure scaled by total firm value:

$$CEV_{it} = \left(CE_{it} / VALUE_{it}\right)*100 \quad (3.8)$$

The last dimension, the age of the firm (*AGE*), is the number of years for which information is available for the firm on COMPUSTAT.

Where: AGE_t is the number of years for which information on the firms is available on COMPUSTAT, CE_t is the capital expenditure in year t, DIV_t is the common dividend in year t, $IBED_t$is the income before extraordinary items and discontinued operations in year t, $SALES_t$ is net sales in year t, and $VALUE_t$ is the market value of equity plus book value of long-term debt at the end of year t.

	DP	SG	CEV	AGE
Birth	1	4	4	1
Growth	2	3	3	2
Mature	3	2	2	3
Decline	4	1	1	4

Firstly the value of each of the lifecycle dimensions is derived based on a firm-year level. Secondly, we use data collected over a five-year period from year t to year t-4 to compute each of the firm-year descriptors' median values. Thirdly, the median values of descriptors for each firm in the same industry (based on Fama and French's 49 industry classification) are split into quartiles. More specifically, using the five-year median of each dimension for each firm, we can get the 25%, 50% and 75% percentile of the median values of each dimension for the firms in the same Fama-French industry. We then categorise the firms by lifecycle stage: each firm-year is put into a category and labelled with a mark based on the quartiles (Q1 = 1, Q2 = 2, Q3 = 3 and Q4 = 4). The marks for each firm-year are then totalled and split into quartiles again. Then we categorise the lifecycle stage of firms based on the final quartiles.

3.3.5. Control Variables

To control for correlated omitted variables, we augment our regression equations with control variables motivated by prior research (e.g., McCarthy *et al*. (2017), McWilliams *et al*. (2006), and Nelling and Webb (2009)) We include firm size (*FIRM SIZE*) based on the natural log of market value, since firm size is related to a firm's lifecycle and may lead to variations in CSR practice (McWilliams and Siegel, 2001). We control for firms' investment and growth opportunities by including market-to-book ratio (*MTB*) (Gaud *et al.*, 2005; Karuna, 2007; Roychowdhury, 2006). Lie (2001) indicates that the market to book ratio embeds information about the expectations of the capital market in relation to scaled earnings in the future. We control for firms' profitability by including sales-to-assets ratio (*SALES_AT*) estimated as the sales figure scaled by the total assets. Since past performance and stock volatility could have implications for a firm's CSR policy (Nelling and Webb, 2009), we also include stock market performance based on stock return (*STOCK*

RETURN) and risk-based volatility (*VOLATILITY*). A number of studies, such as McWilliams *et al*. (2006), Servaes and Tamayo (2013), and Jiraporn *et al*. (2014) suggest that R&D and advertising expenditures are associated with a firm's investment strategy which will influence its future performance, and, in turn, affect CSR expenditure decisions. In addition, Jiraporn and Chintrakarn (2013) and Cai *et al*. (2012) postulate that firms with higher cash flow are inclined to conduct more CSR activities. Consequently, we use research and development expenditure (*XRD*), advertising expenditure (*XAD*) and free cash flow as control variables. We also control for ownership structure and market competition by using the percentage of institutional ownership (*INSTOWN_PERC*) and *HHI*. We noticed the critical role of concentration ratios in the life-cycle related papers. Herfindahl-Hirschman index (*HHI*) and the concentration ratios (*CR(n)*) are two standard tools of competition economists and competition authorities to measure market concentration. The concentration of firms in an industry is of interest to economists, business strategists and government agencies. Therefore, we include *HHI* to control for market competition. Finally, we include the dummy variables *LN_TENURE*, *FEMALE* and *AGE* in our analysis. We take the natural log of the tenure because the natural log form of tenure has a lower level of skewness. More specifically, we control for the impact of CEO tenure, gender, and age for the following reasons. First, investment in CSR as a strategy can be affected by executive's demographic factors. Wiersema and Bantel (1992) assert age and tenure as primary demographic variables affecting strategic choice. In addition, Anderson (2003) highlights the importance of executives' gender in a company's strategic outcome. Arora and Dharwadkar (2011) examine the impact of corporate governance on CSR and they control for the impact of CEO age and tenure. They pointed out in their study that "CEO Age and Tenure have been shown to be significant in determining CEO power, which is an important predictor of a CEO's owning responsibility for strategic change, especially in a high discretion environment." Second, many empirical studies into the relationship between CEO characteristics and CSR have controlled for the three factors. For example, McCarthy et al. (2017), Petrenko et al. (2016) and Borghesi et al. (2014) argue that CEO characteristics including tenure, gender and age can influence CSR performance.

3.3.6. Data and Descriptive Statistics

We selected a sample of North American firms which have accessible information available from COMPUSTAT, EXECUCOMP, and MSCI from 1994-2014.[11] We removed financial services and insurance firms (Sector 45, 46, 47 and 48 based on the Fama French 49 industry classification) and utility firms (Sector 49 based on the Fama-French 49 industry classification) from the sample as these firms have relatively unique financial structures and are subject to regulatory constraints that may affect their reporting. To estimate a firm's lifecycle stage, we need at least five years' data available for each firm. We exclude firms with less than five years' information listed on COMPUSTAT. When calculating CEO conservatism measures, we disregard firms with no information on the number of options held by the CEO when using the option measure *HOLDER10*.

11 I have excess to EXECUCOMP. I studies in Southampton University for nearly three years and transferred to University of Birmingham since September, 2016. Southampton University has access to the WRDs database which incorporates the EXECUCOMP. The data collection work was finished before I transferred to Birmingham.

[Insert Table 3-1 around here]

Table 3-1 displays the descriptive statistics for the variables applied in our regressions. The table shows that the adjusted CSR measure which includes the corporate governance section (*CSR_INC*) has a mean of -0.1323 and a standard deviation of 0.8055, while the adjusted CSR measure excluding the corporate governance section (*CSR_EXC*) has an average of -0.0748 and a standard deviation of 0.7373. The lower score for *CSR_INC* indicates that the average corporate governance score is negative. The medians for *CSR_INC* and *CSR_EXC* are -0.1667 and -0.0833 respectively. The negative means and medians of both CSR measures show that the firms, in general, are skewed towards having a negative CSR score. When the strength score offsets the concerns score, firms' CSR performances are above average. The primary CEO confidence measure, *HOLDER10*, has a mean of 0.2926 and a standard deviation of 0.4550. The 50^{th} percentile of *HOLDER10* is 0, indicating that less than half of the CEOs in our sample can be categorised as conservative. The financial flexibility measure *FF1* has a mean of 0.2220 which is lower than that of *FF2* (0.2251); this is in line with their specifications.

Table 3-2 presents the Pearson correlations between the dependent, independent and control variables. As can be seen from Table 3-2, the two CSR measures are highly positively correlated, showing that the two CSR measures follow similar trends. When we examine the correlation between CSR and the two CEO conservative measures, we find that the correlation between *CSR_INC* and *HOLDER10* is negative but insignificant; the correlation between *CSR_EXC* and *HOLDER10* is negative but insignificant; the correlation between *CSR_INC* and *CONSERV* is positive and significant; the correlation between *CSR_EXC* and *CONSERV* is positive and significant. In addition, we find the correlation between the two CEO conservative measures is positive and significant. The findings show that CEO conservative may exert a positive impact on a firm's CSR performance before controlling for influencing factors. We control for other influencing factors to further examine the impact of CEO conservatism on CSR in Section 3.4.2. When it comes to financial flexibility, both the financial flexibility measures *FF1* and *FF2* are negatively correlated with CSR measures, which is consistent with our expectation that firms with greater financial flexibility are less likely to have a strong CSR performance. The two financial flexibility measures are highly positively correlated, indicating that the two measures co-move with each other.

[Insert Table 3-2 around here]

The number of firm-year observations within each lifecycle stage is illustrated in Table 3-3. There are no significant differences between the populations of the four lifecycles. There are more firm-year observations under the birth (2998) and decline (5633) stages of the lifecycles than under the growth (3487) and mature (3336) stages of the lifecycles.

[Insert Table 3-3 around here]

3.4. Empirical Results

3.4.1. Financial Flexibility and CSR

We first investigate the impact of financial flexibility on corporate CSR performance. Our hypothesis H1 predicts that firms that value financial flexibility are less likely to engage in CSR activities. To test this hypothesis, we empirically estimate the following equation[12]:

$$CSR_{it} = \alpha_0 + \alpha_1 Flexibility_{it} + Control\ \text{var} iables_t + \varepsilon_{it} \qquad (3.9)$$

We adopt two financial flexibility measures, *FF1* and *FF2*, as well as two measures of a firm's CSR rating, *CSR_INC*, and *CSR_EXC*. The results are presented in Table 3-4.

[Insert Table 3-4 around here]

We can see that the estimated coefficients on the financial flexibility measures are all negative and significant at least at the 5% level, indicating a negative and robust relationship between financial flexibility and CSR rating.[13] The results support our

12 Standard errors in all the regressions are adjusted for heteroscedasticity (White, 1980). To control for the unobserved firm heterogeneity, we add firm fixed effects in all the regressions. Since lifecycle is identified based on the year and industry, year and industry fixed effects are not included in the regressions.

13 We also employ an OLS regression with firm fixed effects and year fixed effects to examine the relationship between financial flexibility and CSR performance. The results remain the same as reported in Table 3-4. More details are available upon request.

first hypothesis that firms whose shareholders consider financial flexibility more valuable have a lower CSR performance. Regarding the control variables, we find that *ROE* has a negative and significant relationship with the adjusted *CSR_INC* measure, which is in line with Wright and Ferris' (1997b) finding that CSR and financial performance are negatively correlated. The gender dummy *FEMALE* retains a positive and highly significant relationship with CSR ratings, indicating that firms with female CEOs have a better CSR performance than those with male CEOs. The positive association between firm age and CSR ratings suggests that firms with older CEOs have a higher CSR score. The institutional ownership measure *INSTOWN_PERC* has a negative and highly significant effect on the CSR rating. This is consistent with Zahra *et al.'s* (1993) finding that institutional ownership and CSR are negatively related. We also find a positive correlation between firm size and CSR, a negative relationship between sales and CSR, a negative relationship between stock market risk and CSR, a negative relationship between advertising expenditure and CSR, and, finally, a positive correlation between market competition and CSR, findings which are in line with those of Becchetti *et al*. (2015), McWilliams *et al*. (2006), and Flammer (2015).

3.4.2. Financial Flexibility, CSR and CEO Conservatism

To test hypothesis H2, which assumes that the negative relationship between financial flexibility and CSR is stronger in firms with conservative CEOs, we estimate the following equation:

$$CSR_{it} = \alpha_0 + \alpha_1 Flexibility_{it} + \alpha_2 Overconfident_{it} + \alpha_3 Flexibility_{it} * Overconfident_{it} + Control\ variables_t + \varepsilon_{it} \quad (3.10)$$

We measure CEO conservatism using *HOLDER10* and *CONSERV*, financial flexibility using *FF1* and *FF2*, and CSR performance using the adjusted CSR score including/excluding the corporate governance section. The results are presented in Table 3-5. Columns (1), (2), (5) and (6) of Table 3-5 report the estimations when we use the adjusted CSR measure with the corporate governance section as the dependent variable, and Columns (3), (4), (7) and (8) report the results when the adjusted CSR measure excluding the corporate governance section is used as the dependent variable.

[Insert Table 3-5 around here]

All the estimated coefficients of CEO conservatism, including *HOLDER10* and *CONSERV*, are significantly positive at the 1% level. The findings are consistent with the empirical result given by Table 3-2. The results indicate that conservative CEOs are more likely to invest in CSR activities, which is in line with the findings of McCarthy *et al*. (2017).

When we focus on the interaction terms between CEO conservatism and financial flexibility, we find that they are all negative at the 1% level of significance. This implies that the negative relationship between financial flexibility and CSR performance is stronger in firms with conservative CEOs. The results support the proposal put forward in H2 that conservative CEOs would overestimate the impact of future negative shocks and use debt more conservatively to prepare for negative shocks. Consequently, they would be expected to allocate valuable resources more conservatively and avoid spending on luxury investments such as CSR activities.

3.4.3. Financial Flexibility, CSR, and Lifecycle

In this section, we first investigate whether firms at different lifecycle stages follow different practices in relation to their CSR score. To test hypothesis H3a, which assumes that firms at the decline stage of the lifecycle have a relatively lower CSR score than those at the earlier stages of the lifecycle, and H3b, which assumes that the CSR score becomes higher as firms move from birth stage to mature stage of the lifecycle, we estimate the equation below:

$$CSR_{it} = \alpha_0 + \alpha_1 Birth_{it} + \alpha_2 Growth_{it} + \alpha_3 Mature_{it} + Control\ \mathrm{var}iables_t + \varepsilon_{it} \quad (3.11)$$

If hypothesis H3a holds, we should expect that the constant term, which reflects the impact of decline stage of lifecycle on the CSR engagement, should be lower than the coefficients on the earlier lifecycle stages, given by coefficients α_1 on birth, α_2 on growth, and α_3 on mature. If hypothesis H3b holds, we should expect that the coefficients on the birth, growth and mature stage of lifecycle stages become less negative as the firm grows. The results are presented in Table 3-6.

[Insert Table 3-6 around here]

We show the results of the adjusted *CSR_INC* in column (1) of Table 3-6. When we compare firms at the decline stage (given by the constant term α_0) with firms at the other three lifecycle stages, we observe that the decline stage has a significantly stronger negative effect on the CSR score. When comparing the three earlier stages of the lifecycle, we find that as firms move from earlier stages to later stages of the lifecycle (except for the decline stage) the negative impact of the lifecycle on CSR performance diminishes, and finally the impact of the lifecycle stage on the CSR rating becomes insignificant for mature firms. This is consistent with the lifecycle theory, which states that birth stage firms lack financial resources. When firms are under severe pressure to survive, it is reasonable for them to spend less on CSR and thus they will have a lower CSR score. Although growth stage firms benefit from profitability, they are still in a competitive environment and thus have to focus more on investment opportunities. As a result, although firms at the growth stage will invest more in CSR than those at the birth stage, they are more concerned with generating investment opportunities and profit than firms at the mature stage of the lifecycle. We find that the negative relationship between the lifecycle and CSR is stronger for firms at the earlier stages of the lifecycle than those at other stages (except for decline stage firms). In other words, firms' CSR performance generally improves as they grow into mature firms. It is interesting that although firms at the decline stage are less positively correlated with CSR, the correlation nonetheless remains positive. Although a firm's CSR strategy tends to gain momentum and firms can use CSR as a signal of good performance or expectations of good performance, we also documented that firms have the worst CSR performance during the decline stage. This suggests that decline stage firms may significantly reduce CSR expenditure in an effort to survive.

When we use the adjusted *CSR_EXC* as the dependent variable in regression (2), we observe a negative and significant constant term, which provides further evidence for the negative relationship between the decline stage of the lifecycle and CSR. The other three phases of the lifecycle have a negative and significant association with CSR except for the mature stage, which is consistent with the findings shown in column (1). We also observed a less negative coefficient on the lifecycle stages as a firm grows. This result implies that the relationship between lifecycle and CSR is less negative during the later stages, except for firms at the decline stage. It is worth noting that there is also a significant increase in the coefficients (from -0.0670 to -0.0066). This result is consistent with the findings of regression (1). We also observe positive and significant coefficients on gender, firm size, CEO age, market competition and free cash flow on the CSR rating. Meanwhile, the *MTB* ratio, institutional ownership, sales and stock volatility exert a negative and significant impact on the CSR rating, which is consistent with the findings presented in Table 3-4.

To further investigate whether the relationship between financial flexibility and CSR varies at different stages of the lifecycle, we test H3c and H3d using the following equation:

$$\begin{aligned} CSR_{it} = {} & \alpha_0 + \alpha_1 Birth_{it} + \alpha_2 Growth_{it} + \alpha_3 Mature_{it} + \alpha_4 Flexibility_{it} \\ & + \alpha_5 Birth_{it} * Flexibility_{it} + \alpha_6 Growth_{it} * Flexibility_{it} \\ & + \alpha_7 Mature_{it} * Flexibility_{it} + Control\ \text{var}\,iables_t + \varepsilon_{it} \end{aligned} \tag{3.12}$$

If hypothesis H3c holds, we should expect the coefficient α_4 on financial flexibility, which reflects the impact of financial flexibility on the CSR engagement in the decline stage of lifecycle to be more negative and significant than the sum of α_4 and coefficient on the interaction terms between the other three lifecycle stages and financial flexibility, i.e. α_5, α_6 and α_7. If hypothesis H3d holds, we should expect the sum of α_4 and coefficient on the interaction terms between the other three lifecycle stages and financial flexibility, i.e. α_5, α_6 and α_7 to become more negative and significant as firms move from birth stage to mature stage of the lifecycle. The results are presented in Table 3-7.

Columns (1) and (3) report the results when *FF1* is used as the financial flexibility measure, and Columns (2) and (4) present the results when *FF2* is used as the measure of financial flexibility. We find that the coefficients on both *FF1* and *FF2* are negative and significant. We observe negative and significant coefficients on the birth and growth dummies as well as negative but insignificant maturity dummies. The coefficients on the birth, growth and mature dummies further confirm that as firms move through lifecycle stages, the negative relationship between the lifecycle and CSR become weaker. The highly negative and significant constant term suggests that firms have the poorest CSR performance during the decline stage.

[Insert Table 3-7 around here]

The interaction terms of financial flexibility and birth dummy, as well as the interaction terms of financial flexibility and growth dummy, are all positive and significant, suggesting that firms at the birth and growth stages of the lifecycle experience a reduced negative impact of financial flexibility on CSR performance comparing with firms at the birth stage of the lifecycle. It is also worth noting that the sum of the coefficient on financial flexibility and the coefficient on the interaction terms between the other three lifecycle stages and financial flexibility is becoming more negative as firms grow. The findings indicate that the negative impact of financial flexibility on CSR is becoming stronger as firms move from birth stage to mature stage of the lifecycle. The interaction terms on the mature stage of the lifecycle are all insignificant, indicating that the negative impact of financial flexibility on CSR does not change significantly from the mature stage of the lifecycle to the decline stage of the lifecycle. These overall results suggest that lifecycle stages do affect the impact of financial flexibility on CSR. The findings also confirm hypothesis H3c and H3d, which assumes that the negative relationship between financial flexibility and CSR is most pronounced at the decline stage of the lifecycle, and that the negative effect of financial flexibility on CSR becomes more pronounced as firms move from birth stage to mature stage of the lifecycle.

3.5. Robustness Checks

3.5.1. Financial Flexibility and Future CSR

Thus far we have examined the impact of financial flexibility on CSR under different measures of CSR and financial flexibility. Tobin (1958) finds that ordinary least-square estimation (OLS) parameter estimations will be biased if the endogeneity problem is not taken into consideration. As pointed out by Duchin *et al*. (2010), financial constraints have been criticised since they are derived from firm-level variables. Therefore, financial constraints measures are influenced by endogenous firm choices in general and by unobserved endogenous variations in investment opportunities in particular. Since financial flexibility is the opposite of financial constraints, it is essential to control for the underlying endogeneity problem when applying financial flexibility measures. We apply a lagged OLS regression where the dependent variable is measured at time t while the independent variables, as well as the control variables, are measured at time t-1. A similar approach is also applied by Duchin *et al*. (2010) and Arslan-Ayaydin *et al*. (2014) in order to reduce the effect of endogeneity. We also control for industry and year fixed effects to examine whether the relationship between financial flexibility and CSR still holds after controlling for endogeneity.

[Insert Table 3-8 around here]

As shown in columns (1) to (4) in Table 3-8, both financial flexibility measures have a negative and significant impact on CSR performance, which is consistent with the findings displayed in Table 3-4.

3.5.2. Robustness test under alternative measures for financial flexibility

Following Marchica and Mura (2010), we apply two groups of additional measures for financial flexibility. The first group of measures control for the impact of noise when calculating the debt capacity. More specifically, we consider a firm to have debt capacity in year t if the negative deviation between the actual leverage and the predicted value of leverage is above a certain threshold, i.e. 10% or 25%. Accordingly, we define two new financial flexibility measures: *FLEXIBILITY_P10* and *FLEXIBILITY_P25*. *FLEXIBILITY_P10* is a dummy variable which equals one if the deviation between actual leverage and the predicted value of leverage is higher than 10% for at least three consecutive years and zero otherwise. *FLEXIBILITY_P25* is a dummy variable which equals one if the deviation between actual leverage and the predicted value of leverage is higher than 25% for at least three consecutive years, and zero otherwise.

The second group of additional measures for financial flexibility require a firm to have debt capacity with more than three consecutive years to be ascribed as financially flexible. The new financial flexibility measures, *FLEXIBILITY_C5* and *FLEXIBILITY_C6*, require a firm to have debt capacity for at least five years and six years respectively.

[Insert Table 3-9 &Table 3-10 around here]

As shown in columns (1) to (4) in Table 3-9 and Table 3-10, all four new measures for financial flexibility are negative and significant at least at 5% level. The result further confirms the negative relationship between financial flexibility and CSR performance, which is displayed in Table 3-4.

3.5.3. Robustness test under alternative specification for CSR

We applied the adjusted CSR score proposed by Deng *et al.* (2013) as our primary measure for a firm's CSR performance. In addition to the adjusted CSR score, we also apply the unadjusted CSR score to eliminate the bias in selecting CSR measures.

Unlike the adjusted CSR score which controls for the weights of each dimension, the unadjusted CSR score (raw CSR score) comprises merely the total points accumulated by a firm in relation to all the strengths and concerns.

[Insert Table 3-11around here]

As shown in columns (1) to (4) in Table 3-11 the coefficients on *FF1* and *FF2* are all negative and significant at 1% level. The result is consistent with the findings displayed in Table 3-4, which apply adjusted CSR score as the measure for CSR performance.

3.5.4. Heckman two-step treatment effect model

The endogenous treatment effect, as well as the sample selection bias, hampers the explanatory power of our models in testing the relationship between CSR and financial flexibility. Heckman (1976) addresses the endogeneity bias problem by introducing a two-stage estimation procedure. The inverse Mills' ratio, derived from the probit model in the first step, is included as an additional explanatory variable in the second step OLS regression. The Heckman two-step procedure is applied in many studies in the literature since it is particularly helpful in addressing the problem of endogeneity when the independent variable is a dummy (Bonaimé *et al*., 2014; Evgeniou and Vermaelen, 2017; Faccio *et al*., 2016). We now apply the Heckman two-stage estimation to control for endogeneity in our model specification to examine whether the negative relationship between financial flexibility and CSR engagement still holds. In the first stage probit model, we regress the financial flexibility dummy against two instrumental variables (*L.IND_LEVERAGE* and *L.TANGIBILITY*) and all the control variables. The two instrumental variables are also the additional factors controlled for by Yung *et al*. (2015) in estimating the target leverage level. In the second stage OLS model, we regress the CSR score against the inverse Mills' ratio derived from the first step probit model and all the control variables.

[Insert Table 3-12 around here]

The estimations of the second-stage analysis are reported in Panel A of Table 3-12. We find that there is a significant and negative impact of financial flexibility on CSR engagement after correcting for the endogenous treatment effect. The findings are consistent with the findings presented in Table 3-4 which support our hypothesis that financial flexibility reduces CSR engagement.

3.5.5. Robustness test under different credit rating groups

The survey carried out by Graham and Harvey (2001) indicates that corporate managers consider financial flexibility to be the most important concern when deciding on financing strategies, following the desire to maintain a good credit rating. Ang and Smedema (2011) suggest that lines of credit are a source of financial flexibility on a par with cash flow and debt capacity. To examine whether the relationship between financial flexibility and CSR performance is affected by credit rating, we divide our firm-year observations into three categories following Almeida *et al*. (2009). Our credit rating categories are based on the S&P Domestic Long Term Issuer Credit Rating (*SPLTICRM*) from the COMPUSTAT database. The three subsamples are defined as follows: if a firm's *SPLTICRM* is rated from AAA to BBB- it is categorized as an investment grade rating; if a firm's *SPLTICRM* is rated from SD to BB+ it is categorized as a speculative rating; and if a firm's *SPLTICRM* is missing it is categorized as unrated.

[Insert Table 3-13 around here]

Table 3-13 reports the OLS estimations of our model (3.9) with firm fixed effects and year fixed effects under the three credit rating categories as defined above. The coefficients on financial flexibility are significant and negative across all columns which confirms the robustness of the negative relationship between financial flexibility and CSR performance under different levels of credit ratings. Overall our findings that financial flexibility has a negative impact on CSR performance remain robust under various specifications, including the Lagged OLS, alternative specifications for financial flexibility measures, alternative specifications for CSR measures, the Heckman two-stage regressions, and the subsample regression based on credit rating.

3.6. Conclusion

Motivated by survey evidence that financial flexibility is one of the primary factors in firms' decision-making, this study investigates the relationship between financial flexibility and CSR performance. Consistent with the conservative shareholder view, our results show that highly financially flexible firms are less likely to invest their precious financial resources in CSR activities That is, firms whose shareholders consider financial flexibility more valuable have a preference for reserving debt capacity rather than investing in costly CSR activities. Furthermore, we document that the negative association between financial flexibility and CSR engagement is stronger in firms operated by conservative CEOs. The results support our hypothesis that conservative CEOs use debt more conservatively and thus, in turn, avoid engaging in costly and long-term CSR investment. Finally, we find that, before decline stage of life cycle, firms at the later stages have a stronger CSR performance. In addition, the negative impact of financial flexibility on CSR is stronger as a firm moves from the birth stage of the lifecycle to mature stage of the lifecycle.

Our research contributes to the literature on CSR in three ways. Firstly, we explore a new dimension of research into CSR and capital structure by detecting the negative effect of financial flexibility on CSR. Secondly, we reveal that CEO conservatism, an important CEO characteristic, has a significant influence not only on firms' CSR but also on the relationship between financial flexibility and CSR. Finally, our results confirm the explanatory power of the lifecycle theory in a firm's CSR strategy. The findings portray a clearer pattern of the motivation behind CSR investments, including their financial expectations, executives' behaviour, and the lifecycle stage of the firm, which sheds light on the causes and effects of corporate social performance, thus pointing the way for further study.

Appendix 3-1: Definition of variables in Chapter 3

Dependent variables	
CSR_INC	Adjusted corporate social responsibility measure CSR score including governance section
CSR_EXC	Adjusted corporate social responsibility measure excludes monitors CSR score excluding governance section
Independent variables	
FF1	Dummy variable where equals one if the firm has, at least, three consecutive years of unused debt capacity based on equation (2)
FF2	Dummy variable where equals one if the firm has, at least, three consecutive years of unused debt capacity adjusted for cash holding based on equation (2)
HOLDER10	Dummy variable where equals one if CEO's option in the money is smaller than 0.10 at least twice, and zero otherwise
CONSERV	Continuous variable which is the negative value of the industry-year standardised option in the money (*OPIM*)
BIRTH	Dummy variable where equals one if the firm is under lifecycle stage "birth"
GROWTH	Dummy variable where equals one if the firm is under lifecycle stage "growth"
MATURE	Dummy variable where equals one if the firm is under lifecycle stage "mature"
Control variables	
LN_AGE	The natural log of the CEO's age during the fiscal year
LN_MKVALT	The natural log of market value
FEMALE	Dummy variable where equals one if the gender of CEO is female
LN_TENURE	The natural log of the CEO's tenure
ROE	Return on equity
STOCK RETURN	Stock return
LN_MKVALT	Firm size measured by natural log of market value
MTB	Market to book value
SALES_AT	Total sales scaled by total asset
XRD_SALE	Research and development expense scaled by total sales
XAD_SALE	Advertising expense scaled by total sales
HHI	Herfindahl-Hirschman Index for market competition
FREE_CASH_FLOW	A measure of a company's financial performance based on operating cash flow and expenditure
VOLATILITY	The annualised stock return volatility based on daily stock return
INSTOWN_PERC	Total Institutional Ownership (Percentage of Shares Outstanding)

Table 3-1: Summary statistics

	MEAN	SD	P25	P50	P75	N
Dependent variables						
CSR_INC	-0.1323	0.8055	-0.5333	-0.1667	0.1417	15855
CSR_EXC	-0.0748	0.7373	-0.4500	-0.0833	0.1667	15855
FINANCIAL FLEXIBILITY MEASURES						
FF1	0.2220	0.4156	0.0000	0.0000	0.0000	14838
FF2	0.2251	0.4176	0.0000	0.0000	0.0000	14836
CEO confidence measures						
HOLDER10	0.2926	0.4550	0.0000	0.0000	1.0000	13775
CONSERV	-0.0170	0.9378	-0.1373	0.2052	0.4772	13763
Control variables						
ROE	0.0091	0.4741	0.0245	0.0462	0.0652	15855
MTB	3.9973	49.5893	1.5722	2.3993	3.8145	15855
LN_TENURE	1.7853	0.8773	1.0986	1.7918	2.3979	15855
LN_AGE	4.0147	0.1306	3.9318	4.0254	4.1109	15855
FEMALE	0.0272	0.1628	0.0000	0.0000	0.0000	15855
XRD_SALE	0.0577	0.4028	0.0000	0.0051	0.0545	15855
XAD_SALE	0.0127	0.0301	0.0000	0.0000	0.0107	15855
HHI	0.0693	0.0604	0.0411	0.0554	0.0758	15855
INSTOW_PERC	0.7532	0.1838	0.6428	0.7672	0.8767	15855
RETURN	0.0364	0.4669	-0.1663	0.0714	0.2751	15855
VOLATILITY	0.0254	0.0122	0.0171	0.0226	0.0304	15855
FREE_CASH_FLOW	328.6063	1678.8420	-5.4236	44.1970	210.0676	15855
SALE_AT	1.1262	0.6955	0.6447	0.9608	1.4135	15855
LN_MKVALT	7.7297	1.5123	6.6143	7.5741	8.7126	15855

CSR_INC and *CSR_EXC* are the adjusted CSR measure include corporate governance section and exclude corporate governance section respectively; *FF1 (FLEX_DUMMY1)* is the financial flexibility measures as defined Marchica and Mura (2010) while *FF2(FLEX_DUMMY2)* is the financial flexibility measure controlling the impact of cash holding (net leverage); *HOLDER10* is the CEO confidence dummy based on timing of option; *CONSERV* is a standardised continuous variable which measures the level of CEO confidence based on the negative value of option in the money (*OPIM*); *ROE* is the return on equity; *MTB* is the market to book ratio; *LN_TENURE* is the natural log of tenure of CEO derived as the financial year differenced by the start year as CEO; *LN_AGE* is the natural log of the age of CEO. *FEMALE* is a dummy variable which takes 1 if the CEO is female; *XRD_SALE* is the research and development expenditure scaled by total sales; *XAD_SALE* is the advertisement expenditure scaled by total sales; *HHI* is the Herfindahl-Hirschman Index for market competition; *INSTOWN_PERC* is the total institutional ownership (percentage of shares outstanding) for ownership concentration; *RETURN* is the annualized stock return; *VOLATILITY* is the annualized stock return volatility based on daily stock return; *FREE_CASH_FLOW* is a measure of a company's financial performance based on operating cash flow and expenditure; *SALE_AT* is the sales scaled by total asset; *LN_MKVALT* is the natural log of market value measuring the firm size.

Table 3-2: Pairwise correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1)	**1.0000**																			
(2)	**0.9650**	**1.0000**																		
(3)	**-0.0864**	**-0.1112**	**1.0000**																	
(4)	**-0.0804**	**-0.1016**	**0.9245**	**1.0000**																
(5)	-0.0016	-0.0078	0.0085	0.0044	**1.0000**															
(6)	**0.0305**	**0.0371**	**-0.0869**	**-0.0823**	**0.2131**	**1.0000**														
(7)	**0.0196**	0.0144	-0.0090	-0.0107	**0.0212**	**-0.0402**	**1.0000**													
(8)	0.0063	0.0057	-0.0087	-0.0077	**0.0184**	-0.0140	0.0015	**1.0000**												
(9)	**-0.0222**	**-0.0324**	**0.1238**	**0.1199**	**0.4669**	**-0.0721**	0.0120	**0.0161**	**1.0000**											
(10)	**-0.0261**	**-0.0298**	**-0.0660**	**-0.0682**	**0.1696**	**0.0223**	0.0150	0.0022	**0.3735**	**1.0000**										
(11)	**0.0896**	**0.0941**	0.0029	0.0086	**-0.0592**	**0.0182**	**-0.0188**	-0.0073	**-0.0458**	**-0.0553**	**1.0000**									
(12)	0.0024	0.0062	**0.0855**	**0.1016**	-0.0079	0.0107	**-0.0215**	-0.0008	0.0000	**-0.0212**	-0.0050	**1.0000**								
(13)	**0.0841**	**0.0938**	0.0009	0.007	**0.0214**	**-0.0233**	-0.0030	0.0100	**-0.0230**	**-0.0600**	**0.0545**	**-0.0156**	**1.0000**							
(14)	**-0.0653**	**-0.0738**	-0.0122	-0.0011	-0.0028	-0.0016	-0.0042	0.0116	-0.0012	0.0002	**0.0327**	-0.0094	**0.0584**	**1.0000**						
(15)	**-0.0634**	**-0.0587**	**0.0340**	**0.0541**	**0.0909**	**-0.0322**	**0.0362**	-0.0069	-0.0142	**-0.0698**	0.0124	**0.0245**	-0.0145	**-0.0210**	**1.0000**					
(16)	**0.0314**	**0.0170**	0.0121	0.0074	-0.0089	**-0.1420**	**0.2523**	**0.0276**	-0.0041	0.0029	-0.0083	**-0.0227**	-0.0063	0.0014	**0.0316**	**1.0000**				
(17)	**-0.1493**	**-0.1396**	**0.1706**	**0.1762**	0.0091	**-0.0219**	**-0.2508**	-0.0018	-0.0031	**-0.1121**	0.0068	**0.0869**	**-0.0217**	**-0.0251**	**0.0207**	**-0.2022**	**1.0000**			
(18)	**0.1182**	**0.1179**	**-0.0978**	**-0.0998**	**-0.0296**	**0.0294**	**0.0684**	0.0064	**-0.0364**	**0.0349**	0.0097	-0.0099	**0.0607**	**0.0309**	**-0.1195**	**0.0218**	**-0.1781**	**1.0000**		
(19)	**-0.0283**	**-0.0314**	**-0.0416**	**-0.07**	0.0010	**-0.0325**	-0.0050	0.0044	**-0.0264**	**0.0201**	**0.0400**	**-0.1148**	**0.0283**	**-0.0427**	**-0.0223**	-0.0123	-0.0059	**-0.0272**	**1.0000**	
(20)	**0.1746**	**0.2169**	**-0.4218**	**-0.4108**	**0.0642**	**-0.0348**	**0.1262**	**0.0177**	**-0.0631**	**0.0589**	**-0.0248**	**-0.0245**	**0.0806**	**0.0202**	**-0.0811**	**0.1140**	**-0.4172**	**0.3779**	**-0.1284**	**1.0000**

Variables (1) to (20) are *CSR_INC, CSR_EXC, FF1, FF2, HOLDER10, CONSERV, ROE, MTB, LN_TENURE, LN_AGE, FEMALE, XRD_SALE, XAD_SALE, HHI, ISTOWN_PERC, RETURN, VOLATILITY, FREE_CASH_FLOW, SALE_AT and LN_MKVALT* respectively. Please see Appendix 3-1 for definitions of variables. The numbers in Bold are significant at 5% level.

Table 3-3: Firm-year observations under lifecycle categories (with available control variables)

	Number
Birth	2998
Growth	3487
Mature	3336
Decline	5633
Total	15454

The *Birth*, *Growth*, *Mature* and *Decline* are lifecycle stages dummy which takes the value of 1 if the firm is in the stage and 0 otherwise, as defined in Koh *et al.* (2015) and Anthony and Ramesh (1992)

Table 3-4: Financial flexibility and CSR

Variables	(1)	(2)	(3)	(4)
FF1	-0.2153***		-0.1317***	
	(-5.8246)		(-3.9345)	
FF2		-0.1566***		-0.0803**
		(-3.7466)		(-2.1196)
ROE	-0.0539***	-0.0539***	-0.0425***	-0.0425***
	(-3.1581)	(-3.1542)	(-3.1727)	(-3.1694)
MTB	0.0001	0.0001	0.0000	0.0000
	(0.7637)	(0.7683)	(0.5183)	(0.5121)
LN_TENURE	0.0006	0.0011	0.0034	0.0036
	(0.0576)	(0.0939)	(0.3398)	(0.3669)
LN_AGE	0.1899**	0.1827**	0.1710**	0.1659**
	(2.2951)	(2.2095)	(2.3122)	(2.2443)
FEMALE	0.4484***	0.4501***	0.3934***	0.3946***
	(6.0791)	(6.0943)	(5.6496)	(5.6587)
XRD_SALE	-0.0043	-0.0044	-0.0088	-0.0088
	(-0.7614)	(-0.7686)	(-1.4961)	(-1.5001)
XAD_SALE	-1.2985**	-1.3030**	-1.3413***	-1.3392***
	(-2.1926)	(-2.2010)	(-2.6154)	(-2.6088)
HHI	1.7117***	1.6829***	1.4219***	1.4014**
	(2.8474)	(2.8022)	(2.5882)	(2.5533)
INSTOWN_PERC	-0.4513***	-0.4506***	-0.3210***	-0.3202***
	(-8.2546)	(-8.2398)	(-6.7836)	(-6.7666)
RETURN	0.0053	0.0055	-0.0048	-0.0047
	(0.4419)	(0.4542)	(-0.4603)	(-0.4475)
VOLATILITY	-8.6882***	-8.6653***	-6.3951***	-6.3777***
	(-15.1567)	(-15.1185)	(-13.0248)	(-12.9902)
FREE_CASH_FLOW	0.0000***	0.0000***	0.0000***	0.0000***
	(3.6560)	(3.6592)	(2.7440)	(2.7469)
SALE_AT	-0.1868***	-0.1865***	-0.1611***	-0.1609***
	(-6.2110)	(-6.1951)	(-6.0505)	(-6.0408)
LN_MKVALT	0.0741***	0.0738***	0.0638***	0.0635***
	(5.5138)	(5.4910)	(5.3638)	(5.3441)
Constant	-0.7732**	-0.7550**	-0.7407**	-0.7300**
	(-2.2413)	(-2.1899)	(-2.4089)	(-2.3754)
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	14,838	14,836	14,838	14,836
R-squared	0.4226	0.4223	0.4656	0.4655

Where column (1) and (2) report the relationship between financial flexibility and adjusted CSR score including governance section. Column (3) and (4) report the relationship between financial flexibility and adjusted CSR score excluding governance section See Appendix 3-1 for definitions of variables. All the estimations have been carried out using panel data regression with firm fixed effect. All regressions are with variance-covariance estimation (vce) specified standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-5: The impact of CEO conservatism on the relationship between financial flexibility and CSR

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
FF1	-0.1698***		-0.0873**		-0.2121***		-0.1246***	
	(-3.8149)		(-2.2136)		(-5.1832)		(-3.4241)	
FF2		-0.1026**		-0.0250		-0.1472***		-0.0678
		(-1.9928)		(-0.5532)		(-3.0647)		(-1.6146)
HOLDER10	0.1410***	0.1421***	0.1167***	0.1191***				
	(5.8532)	(5.8647)	(5.5001)	(5.5832)				
CONSERV					0.0580***	0.0585***	0.0533***	0.0541***
					(5.6962)	(5.6915)	(5.9028)	(5.9454)
*FF1*HOLDER10*	-0.1357***		-0.1176***					
	(-3.8489)		(-4.0082)					
*FF2*HOLDER10*		-0.1438***		-0.1317***				
		(-4.0910)		(-4.4520)				
*FF1*CONSERV*					-0.0660***		-0.0560***	
					(-4.9679)		(-4.9218)	
*FF2*CONSERV*						-0.0641***		-0.0560***
						(-4.7746)		(-4.8647)
ROE	-0.0453***	-0.0452***	-0.0342***	-0.0340***	-0.0477***	-0.0477***	-0.0360***	-0.0360***
	(-2.9157)	(-2.9085)	(-2.9573)	(-2.9467)	(-3.0608)	(-3.0551)	(-3.1258)	(-3.1190)
MTB	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(1.0628)	(1.0618)	(0.9290)	(0.9236)	(0.9968)	(0.9996)	(0.9065)	(0.9059)
LN_TENURE	-0.0063	-0.0057	-0.0006	-0.0002	0.0167	0.0169	0.0185	0.0186*
	(-0.4767)	(-0.4311)	(-0.0538)	(-0.0137)	(1.3039)	(1.3136)	(1.6417)	(1.6512)
LN_AGE	0.1379	0.1302	0.1308	0.1252	0.1577*	0.1516	0.1480*	0.1437*
	(1.4615)	(1.3814)	(1.5441)	(1.4788)	(1.6695)	(1.6065)	(1.7480)	(1.6979)
FEMALE	0.4299***	0.4306***	0.3700***	0.3708***	0.4240***	0.4245***	0.3638***	0.3644***
	(5.5440)	(5.5515)	(5.0996)	(5.1123)	(5.5511)	(5.5538)	(5.0785)	(5.0856)
XRD_SALE	-0.0034	-0.0037	-0.0080	-0.0082	-0.0033	-0.0033	-0.0078	-0.0079
	(-0.7186)	(-0.7676)	(-1.4683)	(-1.4824)	(-0.6842)	(-0.6965)	(-1.4078)	(-1.4147)
XAD_SALE	-0.9696	-0.9722	-1.0191**	-1.0143*	-0.9502	-0.9626	-1.0010*	-1.0069*
	(-1.6020)	(-1.6051)	(-1.9765)	(-1.9592)	(-1.5748)	(-1.5977)	(-1.9471)	(-1.9567)
HHI	2.4620***	2.4228***	2.0769***	2.0454***	2.6423***	2.6090***	2.2480***	2.2228***
	(4.3363)	(4.2721)	(3.9572)	(3.9015)	(4.4810)	(4.4289)	(4.1667)	(4.1237)
INSTOWN_PERC	-0.4742***	-0.4720***	-0.3357***	-0.3343***	-0.4597***	-0.4572***	-0.3250***	-0.3230***
	(-7.8837)	(-7.8537)	(-6.3371)	(-6.3174)	(-7.6396)	(-7.6001)	(-6.1314)	(-6.0969)
RETURN	-0.0093	-0.0091	-0.0156	-0.0155	0.0056	0.0056	-0.0026	-0.0027
	(-0.7098)	(-0.6969)	(-1.3668)	(-1.3551)	(0.4336)	(0.4300)	(-0.2303)	(-0.2396)
VOLATILITY	-8.2607***	-8.2288***	-5.9560***	-5.9339***	-7.9653***	-7.9166***	-5.6673***	-5.6303***
	(-13.4833)	(-13.4352)	(-11.4186)	(-11.3827)	(-13.0451)	(-12.9746)	(-10.9064)	(-10.8449)
FREE_CASH_FLOW	0.0001***	0.0001***	0.0000***	0.0000***	0.0001***	0.0001***	0.0000***	0.0000***
	(5.8193)	(5.8250)	(4.6866)	(4.6919)	(5.8485)	(5.8507)	(4.6971)	(4.6991)
SALE_AT	-0.1983***	-0.1977***	-0.1681***	-0.1675***	-0.1995***	-0.1990***	-0.1675***	-0.1672***
	(-5.9438)	(-5.9200)	(-5.7030)	(-5.6775)	(-5.9783)	(-5.9585)	(-5.6906)	(-5.6768)
LN_MKVALT	0.0926***	0.0917***	0.0785***	0.0777***	0.0905***	0.0907***	0.0785***	0.0787***
	(6.3213)	(6.2647)	(6.0263)	(5.9730)	(6.1462)	(6.1560)	(6.0123)	(6.0250)
Constant	-0.7887**	-0.7660**	-0.7708**	-0.7561**	-0.8817**	-0.8734**	-0.8676**	-0.8643**
	(-2.0204)	(-1.9642)	(-2.2013)	(-2.1619)	(-2.2513)	(-2.2306)	(-2.4750)	(-2.4669)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,925	12,925	12,925	12,925	12,914	12,914	12,914	12,914
R-squared	0.4500	0.4497	0.4915	0.4914	0.4496	0.4492	0.4914	0.4913

The table gives the impact of CEO conservatism on the relationship between financial flexibility and CSR when the option in the money is lower than 10% at least twice of the firms in the same industry. Columns (1) ,(2),(5) and (6) report the impact of CEO conservatism on the relationship between financial flexibility and the adjusted CSR score including governance section. Columns (3), (4), (7) and (8) report the impact of CEO conservatism on the relationship between financial flexibility and the adjusted CSR score excluding governance section. See Appendix 3-1 for definitions of variables. *CONSERV* is a continuous conservative measure for CEO conservatism which is the negative value of standardized *OPIM*. All the estimations have been carried out using panel data regression with firm fixed effect. All regressions are with variance-covariance estimation (vce) specified standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. T statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-6: Lifecycle and CSR

Variables	(1)	(2)
BIRTH	-0.0955***	-0.0832***
	(-3.3283)	(-3.2939)
GROWTH	-0.0693***	-0.0670***
	(-2.8607)	(-3.1450)
MATURE	-0.0041	-0.0066
	(-0.1915)	(-0.3462)
ROE	-0.0536***	-0.0426***
	(-3.1275)	(-3.1411)
MTB	0.0001	0.0001
	(0.8600)	(0.6402)
LN_TENURE	0.0060	0.0066
	(0.5502)	(0.6968)
LN_AGE	0.1524*	0.1508**
	(1.8942)	(2.1042)
FEMALE	0.4540***	0.3928***
	(6.2528)	(5.7728)
XRD_SALE	-0.0060	-0.0104*
	(-1.0378)	(-1.6949)
XAD_SALE	-0.7663	-0.8619**
	(-1.5467)	(-2.0198)
HHI	1.1184**	0.8985*
	(2.1073)	(1.8473)
INSTOWN_PERC	-0.4291***	-0.3061***
	(-8.2479)	(-6.7685)
RETURN	0.0030	-0.0078
	(0.2564)	(-0.7677)
VOLATILITY	-8.1259***	-5.9176***
	(-14.9370)	(-12.6866)
FREE_CASH_FLOW	0.0000***	0.0000***
	(3.7581)	(2.7719)
SALE_AT	-0.1894***	-0.1630***
	(-6.4390)	(-6.2624)
LN_MKVALT	0.0833***	0.0739***
	(6.4487)	(6.4427)
Constant	-0.7124**	-0.7340**
	(-2.1197)	(-2.4562)
Firm fixed effects	Yes	Yes
Observations	15,454	15,454
R-squared	0.4202	0.4630

Where column (1) report the relationship between firm lifecycles and adjusted CSR score including governance section. Column (2) is the relationship between firm lifecycles and adjusted CSR score excluding governance section. See Appendix 3-1 for definitions of variables. All the estimations have been carried out using panel data regression with firm fixed effect. All regressions are with variance-covariance estimation (vce) specified standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-7: The impact of lifecycle on the relationship between financial flexibility and CSR

Variables	(1)	(2)	(3)	(4)
BIRTH	-0.1346***	-0.1259***	-0.1108***	-0.1054***
	(-3.7567)	(-3.5114)	(-3.4731)	(-2.8191)
GROWTH	-0.0801***	-0.0842***	-0.0771***	-0.0767***
	(-2.7759)	(-2.8931)	(-3.0224)	(-2.5943)
MATURE	0.0033	0.0051	0.0001	0.0034
	(0.1328)	(0.2035)	(0.0049)	(0.1359)
FF1	-0.2746***		-0.1759***	
	(-6.2480)		(-4.4537)	
*FF1*BIRTH*	0.1935***		0.1510***	
	(3.7358)		(3.3734)	
*FF1*GROWTH*	0.1173***		0.0965**	
	(2.6506)		(2.5394)	
*FF1*MATURE*	0.0155		0.0053	
	(0.3802)		(0.1529)	
FF2		-0.1980***		-0.1094**
		(-3.9055)		(-2.3541)
*FF2*BIRTH*		0.1532***		0.1101**
		(2.8630)		(2.3713)
*FF2*GROWTH*		0.1146**		0.0958**
		(2.5325)		(2.4343)
*FF2*MATURE*		-0.0031		-0.0101
		(-0.0753)		(-0.2824)
ROE	-0.0526***	-0.0525***	-0.0414***	-0.0413***
	(-3.1596)	(-3.1498)	(-3.1625)	(-3.1445)
MTB	0.0001	0.0001	0.0001	0.0001
	(0.8356)	(0.8497)	(0.5979)	(0.5913)
LN_TENURE	0.0020	0.0024	0.0045	-0.0033
	(0.1788)	(0.2124)	(0.4552)	(-0.2819)
LN_AGE	0.1824**	0.1749**	0.1648**	0.2343***
	(2.1957)	(2.1064)	(2.2190)	(2.5963)
FEMALE	0.4507***	0.4532***	0.3958***	0.4635***
	(6.1019)	(6.1268)	(5.6773)	(5.1632)
XRD_SALE	-0.0038	-0.0038	-0.0087	-0.0104
	(-0.6601)	(-0.6638)	(-1.4510)	(-1.2132)
XAD_SALE	-1.2874**	-1.2818**	-1.3385***	-2.0266**
	(-2.1677)	(-2.1605)	(-2.6035)	(-2.5678)
HHI	1.6026***	1.5729***	1.3112**	1.2692**
	(2.6709)	(2.6238)	(2.3916)	(2.0813)
INSTOWN_PERC	-0.4490***	-0.4467***	-0.3188***	-0.3886***
	(-8.1874)	(-8.1506)	(-6.7167)	(-6.7235)
RETURN	0.0053	0.0054	-0.0046	-0.0012
	(0.4412)	(0.4460)	(-0.4440)	(-0.0990)
VOLATILITY	-8.5811***	-8.5563***	-6.3016***	-6.7144***
	(-14.9951)	(-14.9629)	(-12.8734)	(-11.6488)
FREE_CASH_FLOW	0.0000***	0.0000***	0.0000***	0.0000**
	(3.6257)	(3.6270)	(2.7079)	(2.5312)
SALE_AT	-0.1858***	-0.1847***	-0.1601***	-0.2072***
	(-6.1655)	(-6.1262)	(-6.0073)	(-6.4375)
LN_MKVALT	0.0723***	0.0723***	0.0620***	0.0592***
	(5.3801)	(5.3793)	(5.2205)	(4.2386)
Constant	-0.6971**	-0.6829**	-0.6715**	-0.8080**
	(-2.0050)	(-1.9654)	(-2.1651)	(-2.1257)
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	14,821	14,819	14,821	12,026
R-squared	0.4234	0.4231	0.4663	0.4706

Where column (1) and (2) report the impact of firm lifecycle on the relationship between financial flexibility and adjusted CSR score including governance section. Column (3) and (4) report the impact of firm lifecycle on the relationship between financial flexibility and adjusted CSR score excluding governance section. See Appendix 3-1 for definitions of variables. All the estimations have been carried out using panel data regression with firm fixed effect. All regressions are with variance-covariance estimation (vce) specified standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-8: Relationship between financial flexibility and future CSR performance

Variables	(1)	(2)	(3)	(4)
FF1	-0.1671***		-0.1562***	
	(-5.7027)		(-5.8008)	
FF2		-0.1551***		-0.1420***
		(-5.1610)		(-5.1283)
ROE	0.0049	0.0038	-0.0063	-0.0075
	(0.2321)	(0.1792)	(-0.3215)	(-0.3827)
MTB	0.0001	0.0001	0.0001	0.0001
	(0.7330)	(0.7415)	(0.6005)	(0.6043)
LN_TENURE	-0.0025	-0.0030	-0.0088	-0.0094
	(-0.1855)	(-0.2199)	(-0.7023)	(-0.7514)
.LN_AGE	-0.2926***	-0.2891***	-0.2580**	-0.2539**
	(-2.7664)	(-2.7289)	(-2.5745)	(-2.5289)
FEMALE	0.3888***	0.3913***	0.3779***	0.3802***
	(4.2351)	(4.2639)	(4.6255)	(4.6604)
XRD_SALE	0.0057	0.0057	0.0045	0.0043
	(0.4848)	(0.4699)	(0.4755)	(0.4502)
XAD_SALE	1.3028***	1.3125***	1.2740***	1.2810***
	(2.5814)	(2.5957)	(2.7108)	(2.7194)
HHI	-0.8363	-0.8295	-0.6171	-0.6084
	(-1.0102)	(-1.0013)	(-0.7643)	(-0.7530)
INSTOWN_PERC	-0.1371*	-0.1276	-0.0787	-0.0696
	(-1.6906)	(-1.5739)	(-1.0455)	(-0.9249)
RETURN	-0.0805***	-0.0814***	-0.0832***	-0.0841***
	(-5.5529)	(-5.6162)	(-6.2648)	(-6.3316)
VOLATILITY	-2.9584***	-2.9768***	-1.9447*	-1.9669*
	(-2.6120)	(-2.6197)	(-1.8563)	(-1.8702)
FREE_CASH_FLOW	0.0000	0.0000	0.0000	0.0000
	(1.2349)	(1.2194)	(0.8333)	(0.8121)
SALE_AT	-0.0251	-0.0257	-0.0193	-0.0198
	(-1.1528)	(-1.1799)	(-0.9396)	(-0.9652)
LN_MKVALT	0.0784***	0.0802***	0.0978***	0.0999***
	(6.0621)	(6.2467)	(8.2413)	(8.4685)
Constant	0.5313	0.4949	0.1862	0.1454
	(1.1300)	(1.0535)	(0.4163)	(0.3254)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	13,067	13,065	13,067	13,065
R-squared	0.2254	0.2248	0.2267	0.2258

Where column (1) and (2) report the relationship between financial flexibility and adjusted CSR score including governance section. Column (3) and (4) report the relationship between financial flexibility and adjusted CSR score excluding governance section See Appendix 3-1 for definitions of variables. All the estimations have been carried out using panel data regression industry and year fixed effect. All regressions are with firm clustered standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-9: Relationship between financial flexibility and adjusted CSR after controling for noise

VARIABLES	(1)	(2)	(3)	(4)
FLEXIBILITY_P10	-0.2312***		-0.1491***	
	(-4.1388)		(-2.9042)	
FLEXIBILITY_P25		-0.1986***		-0.1319**
		(-3.3590)		(-2.4417)
ROE	-0.0553***	-0.0553***	-0.0434***	-0.0434***
	(-3.0986)	(-3.0953)	(-3.1310)	(-3.1284)
MTB	0.0001	0.0001	0.0001	0.0001
	(0.9081)	(0.9212)	(0.7077)	(0.7200)
LN_TENURE	-0.0115	-0.0115	-0.0064	-0.0064
	(-0.8679)	(-0.8697)	(-0.5480)	(-0.5494)
LN_AGE	0.3115***	0.3092***	0.2711***	0.2698***
	(3.1108)	(3.0888)	(3.0147)	(3.0000)
FEMALE	0.5246***	0.5250***	0.4545***	0.4548***
	(5.6259)	(5.6295)	(5.1268)	(5.1292)
XRD_SALE	-0.0118	-0.0118	-0.0121	-0.0121
	(-1.3466)	(-1.3479)	(-1.3545)	(-1.3552)
XAD_SALE	-2.3258**	-2.3026**	-2.3208***	-2.3077***
	(-2.5590)	(-2.5258)	(-2.8902)	(-2.8691)
HHI	1.7522***	1.7488***	1.4350**	1.4330**
	(2.6434)	(2.6381)	(2.3652)	(2.3618)
INSTOWN_PERC	-0.5628***	-0.5616***	-0.4163***	-0.4156***
	(-8.6484)	(-8.6306)	(-7.2323)	(-7.2210)
RETURN	0.0055	0.0055	-0.0008	-0.0008
	(0.3932)	(0.3947)	(-0.0649)	(-0.0639)
VOLATILITY	-9.0907***	-9.0627***	-6.8014***	-6.7837***
	(-13.3968)	(-13.3561)	(-11.7316)	(-11.7004)
FREE_CASH_FLOW	0.0001***	0.0001***	0.0000**	0.0000**
	(3.3273)	(3.3282)	(2.5542)	(2.5549)
SALE_AT	-0.2422***	-0.2414***	-0.2057***	-0.2052***
	(-6.6634)	(-6.6410)	(-6.3760)	(-6.3606)
LN_MKVALT	0.0788***	0.0788***	0.0623***	0.0623***
	(4.9976)	(4.9931)	(4.4554)	(4.4540)
Constant	-1.1447***	-1.1425***	-0.9909***	-0.9895***
	(-2.7156)	(-2.7108)	(-2.6224)	(-2.6191)
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	12,102	12,102	12,102	12,102
R-squared	0.4348	0.4346	0.4721	0.4720

Where column (1) to (3) report the relationship between financial flexibility and adjusted CSR score including governance section. Column (4) to (6) report the relationship between financial flexibility and adjusted CSR score excluding governance section. A firm has debt capacity in year t if the negative deviation between the actual leverage and predicted value of firm leverage is above certain threshold, i.e. 10% or 25%, to control for the impact of noise. *FLEXIBILITY_P10* is a dummy variable which equals one if the deviation between actual leverage and the predicted vale of leverage is higher than 10% for at least 3 consecutive years, and otherwise zero. *FLEXIBILITY_P25* is a dummy variable which equals one if the deviation between actual leverage and the predicted vale of leverage is higher than 25% for at least 3 consecutive years, and otherwise zero. See Appendix 3-1 for definitions of control variables. All the estimations have been carried out using panel data regression industry and year fixed effect. All regressions are with firm clustered standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-10: Relationship between financial flexibility and adjusted CSR wth financial flexibility measures under higher standard

VARIABLES	(1)	(2)	(3)	(4)
FLEXIBILITY_C5	-0.1649***		-0.1081***	
	(-3.8488)		(-3.0108)	
FLEXIBILITY_C6		-0.2195***		-0.1326***
		(-4.6158)		(-3.3881)
ROE	-0.0558***	-0.0553***	-0.0436***	-0.0434***
	(-3.1798)	(-3.1309)	(-3.1991)	(-3.1487)
MTB	0.0001	0.0001	0.0000	0.0000
	(0.7353)	(0.8057)	(0.5173)	(0.5694)
LN_TENURE	-0.0032	-0.0044	0.0001	-0.0012
	(-0.2680)	(-0.3586)	(0.0100)	(-0.1128)
LN_AGE	0.2071**	0.2237**	0.1799**	0.1941**
	(2.3356)	(2.4203)	(2.2713)	(2.3486)
FEMALE	0.4878***	0.5242***	0.4305***	0.4590***
	(6.2528)	(6.4041)	(5.8252)	(5.8799)
XRD_SALE	-0.0046	-0.0048	-0.0092	-0.0094
	(-0.7573)	(-0.7599)	(-1.4446)	(-1.4080)
XAD_SALE	-1.2474**	-1.1139*	-1.2709**	-1.1925**
	(-1.9623)	(-1.6695)	(-2.3266)	(-2.0909)
HHI	2.2488***	2.7564***	1.8364***	2.2885***
	(3.2842)	(3.9946)	(2.9268)	(3.5882)
INSTOWN_PERC	-0.4702***	-0.4898***	-0.3395***	-0.3495***
	(-7.9328)	(-7.8152)	(-6.6306)	(-6.5412)
RETURN	0.0135	0.0162	0.0050	0.0076
	(1.0542)	(1.2296)	(0.4512)	(0.6633)
VOLATILITY	-9.0570***	-9.2785***	-6.7630***	-6.8850***
	(-14.6598)	(-14.4624)	(-12.7911)	(-12.5532)
FREE_CASH_FLOW	0.0000***	0.0000***	0.0000***	0.0000**
	(3.5686)	(3.3495)	(2.6180)	(2.4140)
SALE_AT	-0.1790***	-0.1673***	-0.1504***	-0.1408***
	(-5.5609)	(-5.0124)	(-5.2868)	(-4.7690)
LN_MKVALT	0.0676***	0.0648***	0.0520***	0.0508***
	(4.7013)	(4.3880)	(4.1236)	(3.9232)
Constant	-0.8300**	-0.8993**	-0.7111**	-0.7892**
	(-2.2328)	(-2.3252)	(-2.1495)	(-2.2906)
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	13,742	13,149	13,742	13,149
R-squared	0.4291	0.4331	0.4709	0.4734

Where column (1) to (3) report the relationship between financial flexibility and adjusted CSR score including governance section. Column (4) to (6) report the relationship between financial flexibility and adjusted CSR score excluding governance section. We require a firm to have debt capacity for more than 3 years, i.e. 5 or 6 years, to be ascribed as financially flexible. *FLEXIBILITY_C5* is a dummy variable which equals one if a firm has debt capacity for at least 5 consecutive years, and otherwise zero. *FLEXIBILITY_C6* is a dummy variable which equals one if a firm has debt capacity for at least 6 consecutive years, and otherwise zero. See Appendix 3-1 for definitions of control variables. All the estimations have been carried out using panel data regression industry and year fixed effect. All regressions are with firm clustered standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-11: Relationship between financial flexibility and unadjusted CSR

VARIABLES	(1)	(2)	(3)	(4)
FF1	-0.6495***		-0.3997***	
	(-5.8231)		(-3.9666)	
FF2		-0.5128***		-0.2890***
		(-4.3667)		(-2.7876)
ROE	-0.1303***	-0.1303***	-0.1238***	-0.1239***
	(-2.9428)	(-2.9389)	(-3.2130)	(-3.2101)
MTB	0.0003	0.0003	0.0002	0.0002
	(1.0671)	(1.0815)	(0.8028)	(0.8082)
LN_TENURE	0.0124	0.0139	0.0235	0.0245
	(0.3714)	(0.4150)	(0.7942)	(0.8284)
LN_AGE	0.2362	0.2143	0.2262	0.2110
	(0.9364)	(0.8503)	(1.0070)	(0.9395)
FEMALE	0.9617***	0.9685***	0.8237***	0.8285***
	(4.8816)	(4.9119)	(4.5829)	(4.6053)
XRD_SALE	-0.0265	-0.0266	-0.0389*	-0.0389*
	(-1.2823)	(-1.2881)	(-1.8792)	(-1.8818)
XAD_SALE	-2.6883	-2.7148	-2.7251*	-2.7331*
	(-1.4857)	(-1.5024)	(-1.7874)	(-1.7930)
HHI	4.5773***	4.4977***	4.1752***	4.1215***
	(2.7443)	(2.6993)	(2.7537)	(2.7207)
INSTOWN_PERC	-1.4726***	-1.4709***	-0.5324***	-0.5308***
	(-9.0313)	(-9.0194)	(-3.8663)	(-3.8536)
RETURN	-0.0217	-0.0214	-0.0774**	-0.0771**
	(-0.5675)	(-0.5580)	(-2.2400)	(-2.2307)
VOLATILITY	-24.7271***	-24.6719***	-17.1326***	-17.0942***
	(-13.5379)	(-13.5081)	(-10.4658)	(-10.4436)
FREE_CASH_FLOW	0.0001***	0.0001***	0.0001***	0.0001***
	(3.7041)	(3.7079)	(3.1920)	(3.1952)
SALE_AT	-0.4544***	-0.4532***	-0.3877***	-0.3870***
	(-4.9817)	(-4.9673)	(-4.7994)	(-4.7903)
LN_MKVALT	0.2732***	0.2725***	0.2620***	0.2616***
	(6.8166)	(6.7987)	(7.2812)	(7.2669)
Constant	-1.1580	-1.0953	-1.7498*	-1.7098*
	(-1.1122)	(-1.0524)	(-1.8868)	(-1.8445)
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	14,838	14,836	14,838	14,836
R-squared	0.5650	0.5649	0.6133	0.6132

Where column (1) and (2) report the relationship between financial flexibility and unadjusted CSR score including governance section. Column (3) and (4) report the relationship between financial flexibility and unadjusted CSR score excluding governance section. See Appendix 3-1 for definitions of control variables. All the estimations have been carried out using panel data regression industry and year fixed effect. All regressions are with firm clustered standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-12: Relationship between financial flexibility and CSR with Heckman two-step treatment effect model

Panel A: Second-stage regressions

Dependent variable	(1)	(2)	(3)	(4)
	CSR_INC	*CSR_INC*	*CSR_EXC*	*CSR_EXC*
FF1	-0.6207***		-0.5426***	
	(-12.9628)		(-12.4516)	
FF2		-0.5842***		-0.5166***
		(-12.4314)		(-12.0691)
ROE	0.0099	0.0083	0.0004	-0.0008
	(0.7365)	(0.6190)	(0.0316)	(-0.0685)
MTB	0.0001	0.0001	0.0001	0.0001
	(0.6805)	(0.7394)	(0.5864)	(0.6376)
LN_TENURE	0.0226***	0.0202**	0.0130*	0.0111
	(2.8440)	(2.5537)	(1.7898)	(1.5341)
LN_AGE	-0.3963***	-0.3807***	-0.3375***	-0.3246***
	(-7.4466)	(-7.1892)	(-6.9760)	(-6.7347)
FEMALE	0.3659***	0.3763***	0.3665***	0.3754***
	(9.6314)	(9.9351)	(10.6116)	(10.8912)
XRD_SALE	0.0191	0.0194	0.0145	0.0149
	(1.2514)	(1.2734)	(1.0446)	(1.0771)
XAD_SALE	1.5293***	1.6047***	1.3717***	1.4418***
	(6.3712)	(6.6766)	(6.2867)	(6.5914)
HHI	-1.0127***	-0.9743**	-0.7467**	-0.7156**
	(-2.5831)	(-2.4922)	(-2.0953)	(-2.0114)
INSTOWN_PERC	-0.2111***	-0.1774***	-0.1369***	-0.1078***
	(-5.3213)	(-4.5136)	(-3.7960)	(-3.0129)
RETURN	-0.0232	-0.0281*	-0.0394***	-0.0435***
	(-1.5130)	(-1.8392)	(-2.8259)	(-3.1280)
VOLATILITY	-1.2811*	-1.3420*	-0.1224	-0.1752
	(-1.6936)	(-1.7788)	(-0.1780)	(-0.2552)
FREE_CASH_FLOW	0.0000***	0.0000***	0.0000***	0.0000***
	(8.2297)	(7.8950)	(6.1937)	(5.8696)
SALE_AT	-0.0351***	-0.0376***	-0.0300***	-0.0322***
	(-2.9975)	(-3.2124)	(-2.8130)	(-3.0260)
LN_MKVALT	0.0040	0.0101	0.0362***	0.0409***
	(0.5076)	(1.3264)	(5.0963)	(5.8881)
LAMBDA	0.3098***	0.2935***	0.2638***	0.2552***
	(10.6645)	(10.2664)	(9.9683)	(9.7941)
Constant	1.6404***	1.5039***	1.1356***	1.0264***
	(5.9002)	(5.4670)	(4.4931)	(4.0993)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	14,838	14,836	14,838	14,836

Panel B: First stage PROBIT model

Dependent variable	(1)	(2)	(3)	(4)
	FF1	*FF2*	*FF1*	*FF2*
ROE	0.2711***	0.2779***	0.2711***	0.2779***
	(6.1670)	(6.3495)	(6.1670)	(6.3495)
MTB	-0.0001	-0.0001	-0.0001	-0.0001
	(-0.3550)	(-0.2239)	(-0.3550)	(-0.2239)
LN_TENURE	0.2568***	0.2533***	0.2568***	0.2533***
	(13.8761)	(13.5945)	(13.8761)	(13.5945)
LN_AGE	-0.9914***	-0.9276***	-0.9914***	-0.9276***
	(-8.3210)	(-7.7528)	(-8.3210)	(-7.7528)
FEMALE	-0.1559*	-0.1201	-0.1559*	-0.1201
	(-1.7608)	(-1.3503)	(-1.7608)	(-1.3503)
XRD_SALE	0.2104**	0.3361***	0.2104**	0.3361***
	(2.3095)	(3.3401)	(2.3095)	(3.3401)
XAD_SALE	1.0827*	2.0377***	1.0827*	2.0377***
	(1.9077)	(3.6168)	(1.9077)	(3.6168)
HHI	-3.4490**	-3.0219**	-3.4490**	-3.0219**
	(-2.3589)	(-2.0547)	(-2.3589)	(-2.0547)
INSTOWN_PERC	-0.0966	0.1248	-0.0966	0.1248
	(-1.0701)	(1.3671)	(-1.0701)	(1.3671)
RETURN	0.1752***	0.1466***	0.1752***	0.1466***
	(5.2453)	(4.3773)	(5.2453)	(4.3773)
VOLATILITY	0.0921	0.6830	0.0921	0.6830
	(0.0536)	(0.3964)	(0.0536)	(0.3964)
FREE_CASH_FLOW	-0.0000	-0.0001***	-0.0000	-0.0001***
	(-0.6112)	(-2.8882)	(-0.6112)	(-2.8882)
SALE_AT	-0.0880***	-0.1048***	-0.0880***	-0.1048***

	(-3.1397)	(-3.6251)	(-3.1397)	(-3.6251)
LN_MKVALT	-0.6916***	-0.6696***	-0.6916***	-0.6696***
(Continue)				
	(-41.4116)	(-40.9562)	(-41.4116)	(-40.9562)
L.IND_LEVERAGE	-1.0837*	-1.4567**	-1.0837*	-1.4567**
	(-1.7897)	(-2.3653)	(-1.7897)	(-2.3653)
L.TANGIBILITY	-1.2574***	-1.3099***	-1.2574***	-1.3099***
	(-11.2426)	(-11.4970)	(-11.2426)	(-11.4970)
Constant	7.7158***	7.2039***	7.7158***	7.2039***
	(10.7360)	(10.0014)	(10.7360)	(10.0014)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	14,838	14,836	14,838	14,836

Where column (1) and (2) report the relationship between financial flexibility and adjusted CSR score including governance section. Column (3) and (4) report the relationship between financial flexibility and adjusted CSR score excluding governance section See Appendix 3-1 for definitions of variables. All the estimations have been carried out using panel data regression industry and year fixed effect. All regressions are with robust standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. The *LAMBDA* used in the second stage regression is the inverse mills ratio from the PROBIT regression. *L.IND_LEVERAGE* and *L.TANGIBILITY* are the instrument variables applied in the first stage PROBIT model where *L.IND_LEVERAGE* is the lagged industry leverage, and *L.TANGIBILITY* is the lagged tangibility. *T* statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

Table 3-13: Relationship between financial flexibility and CSR under different credit rating groups

	Investment grade rating				Speculative rating				Unrated			
Variables	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
FF1	-0.3560**		-0.3721**		-0.1989***		-0.1841***		-0.0795***		-0.0818***	
	(-1.9709)		(-2.3112)		(-4.6849)		(-4.7059)		(-5.7871)		(-6.4633)	
FF2		-0.4482**		-0.4793***		-0.1590***		-0.1522***		-0.0725***		-0.0720***
		(-2.5698)		(-3.0957)		(-3.6981)		(-3.8203)		(-5.1703)		(-5.5634)
ROE	-0.1177	-0.1168	-0.1370	-0.1361	0.0057	0.0056	-0.0010	-0.0011	-0.0368*	-0.0380**	-0.0504***	-0.0520***
	(-1.2955)	(-1.2854)	(-1.5966)	(-1.5855)	(0.4543)	(0.4420)	(-0.0986)	(-0.1103)	(-1.9472)	(-2.0129)	(-2.7574)	(-2.8358)
MTB	0.0010	0.0010	0.0008	0.0008	0.0000	0.0000	0.0000	0.0000	0.0003	0.0003	0.0001	0.0001
	(1.0024)	(1.0009)	(0.9447)	(0.9430)	(1.2124)	(1.2560)	(1.0104)	(1.0529)	(0.7379)	(0.7341)	(0.2718)	(0.2397)
LN_TENURE	0.0133	0.0127	0.0148	0.0141	-0.0154	-0.0171	-0.0238*	-0.0252*	0.0001	-0.0004	-0.0100	-0.0107
	(0.7720)	(0.7356)	(0.9268)	(0.8836)	(-0.9857)	(-1.0945)	(-1.6644)	(-1.7652)	(0.0160)	(-0.0503)	(-1.5021)	(-1.5999)
LN_AGE	-0.1035	-0.1002	-0.1071	-0.1033	-0.5275***	-0.5177***	-0.4402***	-0.4314***	-0.3453***	-0.3434***	-0.2916***	-0.2887***
	(-0.8112)	(-0.7851)	(-0.9023)	(-0.8702)	(-5.0190)	(-4.9344)	(-4.6007)	(-4.5166)	(-7.2736)	(-7.2237)	(-6.6642)	(-6.5887)
FEMALE	0.5058***	0.5069***	0.4567***	0.4579***	0.3298***	0.3294***	0.3344***	0.3340***	0.2578***	0.2594***	0.2796***	0.2814***
	(4.0717)	(4.0782)	(3.8489)	(3.8565)	(4.1034)	(4.1096)	(4.7368)	(4.7429)	(6.3319)	(6.3458)	(7.0016)	(7.0221)
XRD_SALE	2.6905***	2.7224***	2.7975***	2.8340***	0.6782***	0.6713***	0.6566***	0.6499***	-0.0088***	-0.0089***	-0.0109***	-0.0111***
	(5.8652)	(5.9076)	(6.2916)	(6.3363)	(3.9762)	(3.8479)	(3.5225)	(3.4229)	(-2.6385)	(-2.6790)	(-3.2131)	(-3.2737)
XAD_SALE	3.2193***	3.2623***	2.8415***	2.8865***	1.5680***	1.5811***	1.2430***	1.2560***	-0.0023	0.0049	0.1170	0.1221
	(5.5459)	(5.6602)	(5.3759)	(5.5413)	(3.0261)	(3.0364)	(2.5925)	(2.6081)	(-0.0123)	(0.0260)	(0.6814)	(0.7082)
HHI	-1.8641**	-1.8783**	-1.4304*	-1.4461*	0.6909	0.7207	0.6898	0.7175	0.0705	0.0857	0.2748	0.2948
	(-2.3814)	(-2.4002)	(-1.9211)	(-1.9430)	(0.9111)	(0.9498)	(0.9315)	(0.9670)	(0.1526)	(0.1853)	(0.6405)	(0.6862)
INSTOWN_PERC	-0.3868***	-0.3867***	-0.3413***	-0.3409***	0.0135	0.0223	-0.0047	0.0034	-0.0601*	-0.0547*	0.0088	0.0143
	(-3.3717)	(-3.3713)	(-3.2342)	(-3.2308)	(0.1563)	(0.2576)	(-0.0594)	(0.0435)	(-1.8427)	(-1.6802)	(0.2843)	(0.4621)
RETURN	-0.0296	-0.0294	-0.0464	-0.0461	-0.0251	-0.0263	-0.0280	-0.0290	-0.0238*	-0.0247*	-0.0420***	-0.0430***
	(-0.7289)	(-0.7234)	(-1.2452)	(-1.2377)	(-0.9884)	(-1.0336)	(-1.2479)	(-1.2935)	(-1.7926)	(-1.8690)	(-3.4912)	(-3.5840)
VOLATILITY	-7.7634***	-7.8180***	-5.8845***	-5.9451***	-0.2586	-0.2582	0.6366	0.6389	-1.9590***	-1.9891***	-0.9201	-0.9604
	(-3.5047)	(-3.5275)	(-2.8816)	(-2.9094)	(-0.2030)	(-0.2019)	(0.5246)	(0.5248)	(-3.1126)	(-3.1490)	(-1.5610)	(-1.6214)
FREE_CASH_FLOW	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0000	-0.0000	0.0000***	0.0000***	0.0000***	0.0000***
	(1.1499)	(1.1357)	(0.5845)	(0.5664)	(0.1594)	(0.1576)	(-0.0027)	(-0.0020)	(2.8375)	(2.8091)	(2.6869)	(2.6515)
SALE_AT	-0.0007	-0.0007	0.0110	0.0110	0.0094	0.0113	0.0119	0.0136	-0.0243**	-0.0243**	-0.0220**	-0.0220**
	(-0.0312)	(-0.0313)	(0.4880)	(0.4870)	(0.4027)	(0.4844)	(0.5511)	(0.6294)	(-2.2017)	(-2.2072)	(-2.1468)	(-2.1459)
LN_MKVALT	0.0256*	0.0244*	0.0480***	0.0468***	0.0088	0.0114	0.0378***	0.0400***	0.0448***	0.0465***	0.0760***	0.0781***
	(1.8016)	(1.7209)	(3.7079)	(3.6079)	(0.5659)	(0.7328)	(2.6374)	(2.7874)	(6.1419)	(6.4112)	(11.1836)	(11.5590)
Constant	0.3231	0.3208	0.0715	0.0684	1.2694**	1.1853**	0.8198*	0.7466	0.8801***	0.8554***	0.4228**	0.3902*
	(0.5214)	(0.5175)	(0.1206)	(0.1152)	(2.4285)	(2.2791)	(1.7238)	(1.5774)	(3.6567)	(3.5503)	(1.9664)	(1.8128)
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
Observations	4,758	4,758	4,758	4,758	2,853	2,853	2,853	2,853	7,188	7,186	7,188	7,186
R-squared	0.3973	0.3977	0.3859	0.3864	0.2453	0.2433	0.2218	0.2200	0.2060	0.2053	0.1943	0.1932

Where column (1) ,(2) and column (3), (4) in each credit rating group report the relationship between financial flexibility and adjusted CSR score including governance section and excluding governance section respectively. See Appendix 3-1 for definitions of variables. All the estimations have been carried out using panel data regression industry and year fixed effect. All regressions are with variance-covariance estimation (vce) specified standard errors, which are asymptotically robust to both heteroscedasticity and serial correlation. T statistics in parentheses: *** Significance at the 1% level** Significance at the 5% level * Significance at the 10% level.

CHAPTER 4: CEO INSIDE DEBT AND THE ADJUSTMENT SPEED OF CASH HOLDING

4.1. Introduction

Due to the separation of ownership and control, managers have incentives to set up corporate strategies that are in their own interests. Compensation contracts are designed to align the interests of the CEO and the shareholders, given the direct impact of compensation on the CEO's wealth, and thus the CEO's attitude towards corporate risk (Jiang and Lie, 2016). Inside debt compensation refers to the sum of deferred compensation and pension. Those CEOs with high inside debt compensation are more inclined to derive certain gains from this and thus have fewer incentives to take risks. Therefore, they may care more about the firm's long-term solvency than about short-term opportunities for growth. On the contrary, those CEOs with high equity compensation may prefer value-increasing projects such as R&D, which can involve greater risks (Cheng, 2004). In other words, CEOs with greater inside debt compensation are more likely to align their interests with debt holders while CEOs with high equity compensation are more likely to align their interests with equity holders.

Although inside debt compensation is recognised as a crucial part of the CEO's compensation contract, its impact has only attracted attention since 2006 when public data on CEO inside debt compensation became available. Existing studies have taken the percentage of inside debt in CEOs' compensation packages as a measure of managers' preference for risk (Caliskan and Doukas, 2015; Campbell *et al.*, 2016;

Srivastav *et al.*, 2014). The higher the percentage of inside debt in the CEO's compensation contract, the lower the CEO's appetite for risk in relation to corporate policy.

CEOs with high inside debt compensation prefer less risky corporate policies. For example, *Caliskan and Doukas (2015)* reveal a positive influence of high CEO inside debt compensation on dividend payment. Their work also finds that firms with CEOs who are paid with more convex components, such as options, in the contracts are more likely to cut the dividend payments. They explain that dividend payout as a conservative strategy caters to risk-averse CEO's appetite. Caliskan and Doukas (2015) explain the relationship between CEO inside debt compensation and dividend policy from the perspective of risk. Caliskan and Doukas (2015), DeAngelo et al. (2006) and Grullon et al. (2002) consider higher dividend payout a conservative policy as opposed to investing in value-increasing projects which involve risk-taking. Therefore, CEOs with high inside debt should be inclined to pay excess cash as dividends (or buy back stocks) rather than investing in the projects which may increase firm risk and reduce the value of their inside debt. These findings are consistent with van Bekkum (2016), who suggests that debt-based compensation limits both risk and risk-taking behaviour by encouraging CEOs to make more conservative decisions.

The impact of CEO risk preference on corporate policy is well documented in the literature. On the one hand, CEO inside debt holdings, as a proxy for CEO risk preference, are negatively associated with expenditure on R&D, a firm's financial leverage, risky decisions regarding pension funding, the refinancing risk associated with corporate debt maturity, and earnings management using discretionary accruals (Bergstresser and Philippon, 2006; Cassell *et al.*, 2012; Dang and Phan, 2016; Yu-Thompson *et al.*, 2015). On the other hand, CEO inside debt holdings are positively associated with the extent of diversification, asset liquidity, conservative payout policies by banks, conservative balance sheet management, and hedging activities using derivatives (Belkhir and Boubaker, 2013; Cassell *et al.*, 2012; Srivastav *et al.*, 2014; van Bekkum, 2016).

Existing studies have also established a link between CEO risk preference and firm performance, given the significant impact of inside debt on corporate policy. van Bekkum (2016) finds a negative relationship between the percentage of inside debt in CEOs' compensation packages and the loss of stock market value, volatility, tail risk, and the probability of financial distress. Similarly, Bennett *et al.* (2015) identify a lower default risk and better firm performance among firms which have CEOs with inside debt based compensation during a period of crisis.

The importance of corporate cash policy is being increasingly recognised as cash stockpile has become the main component of a firm's assets. According to the research report by Birstingl (2016), the cash held by S&P500 companies (excluding financial firms) reached 1.54 trillion dollars by the end of the third quarter of 2016, which is the largest total cash holding recorded over the last ten years.[14]

14 We referred to a quarterly report called "Cash and Investment", which is published on December 21, 2016. The report is written by analyst Andrew Birstingl who worked for "Factset". The "Cash & Investment Quarterly" is one part of three reports

Existing studies have concluded that there are several detailed motivations for CEOs to hold cash (Bates *et al.*, 2009a; Opler *et al.*, 1999). Firstly, cash financing involves much lower transaction costs than other methods of funding, including equity financing and debt financing. External funds can be particularly expensive given the adverse selection problem (Drobetz *et al.*, 2010), whereas cash is free from the adverse selection problem. Therefore, cash financing is cheaper than external financing methods, and the marginal value of a dollar of cash should be higher when there is a higher degree of information asymmetry.

Second, having an abundant cash holding can act as insurance against adverse shocks and liquidation needs. Opler *et al.* (1999) point out that managers tend to accumulate cash even if the accumulated cash is above the optimised level. They ascribe the phenomenon to managers' risk aversion or managers' desire to achieve personal targets with more flexibility. This reasoning is aligned with the agency theory which indicates that managers can waste corporate resources such as cash to benefit themselves (Jensen and Meckling, 1976).

Third, US firms facing high repatriation taxes have an incentive to keep a high level

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("Dividend Quarterly" and "Buyback Quarterly") analyzing cash and discretionary spending within the S&P 500. Please see the official website of FACTSET for more details:

https://insight.factset.com/cashinvestment_12.21.16?utm_source=hs_email&utm_medium=email&utm_content=39676383&_hsenc=p2ANqtz--lLUjMhs9n5HgnP6iKK_c3tSVUBFqli5kO8OgvrNA29fnAtpwh2Kg6MAW1Pe1e5MvLbIL9O-IZILVkkvHHmqpapy1ZK1jQNpiRgT6pxx_TJ55IIGY&_hsmi=39676383

of cash (Fritz Foley *et al.*, 2007). US multinationals have a motivation to retain earnings abroad in order to avoid the tax burdens incurred by the foreign operations of domestic firms. In addition, multinational firms are likely to hold the retained earnings as cash when there is a lack of attractive investment opportunities.

Finally, cash is something that is at the discretion of executives and receives little scrutiny from outside investors, which can give managers who are so inclined the opportunity to engage in power enhancing activities and empire building. Dittmar and Mahrt-Smith (2007) indicate that cash is a resource at considerable risk because managers have easy access to cash reserves. Since excess cash is free from the external financing obligations associated with monitoring, it is possible for managers to engage in projects with a negative net present value (NPV) or to extract rents from excess cash. The value destruction associated with excess cash flow can be enormous. This rent extraction view argues that CEOs have the power to influence their own pay, and they use such power to extract rents (Dechow, 2006). The rent extraction theory posits that the effectiveness of boards is questionable given their tendency for passivity, their dependence on the CEO for information, and their lack of exposure to firms' share returns enabling CEOs to extract compensation in excess of the optimal compensation for shareholders (Bebchuk et al., 2002). Less effective governance practices (e.g., inside directors, grey directors and CEO duality) magnify the potential agency problem with an adverse impact on firm value. In addition, empirical evidence shows that rent extraction through CEO compensation is pervasive, economically significant and persistent (Core et al., 1999). Cash is vulnerable to extraction by both external parties (e.g., the government, shareholders) and entrenched managers in the company (Chen et al., 2014; Myers and Rajan, 1998). Therefore, Excess cash offers managers the opportunity to extract rents for their private interests.

In addition to the various motivations for CEOs to hold cash, existing studies find that the CEO risk preference has a significant impact on the cash policy (Liu *et al.*, 2014; Tong, 2010). CEOs whose compensation package includes equity, options, and inside debt, tie their wealth to the firm's risk, which is then directly affected by the cash policy. Therefore, CEOs with different risk preferences may set up different cash policies to maximise their interests. Liu *et al.* (2014) find a positive relationship between inside debt compensation and a firm's cash level which supports the view that inside debt compensation can help firms to balance the competing interest of bondholders and stockholders by tilting managerial incentive towards bondholders.

It is worth noting that there is a trade-off between liquidity needs and the risk of overinvestment when a firm has excess cash (Bates *et al.*, 2009b; Fritz Foley *et al.*, 2007). Firms have to weigh up the benefits and costs when deciding what level of cash holding is appropriate. On the one hand, cash is a cheap way of financing investment opportunities since funding by cash does not incur costly external capital transaction fees; on the other hand, excessive cash can be easily squandered especially when there is no disciplinary mechanism present (Jiang and Lie, 2016). In other words, either holding excess cash or holding insufficient cash can be expensive. On the one hand, excess cash can be wasted easily and incurs the risks of over-investment and empire building. On the other hand, inadequate cash result in loss of investment opportunity and high liquidity risk. The trade-off mechanism indicates that there is an optimal level of cash holding, referred to as the target cash ratio, *which minimises the cost of holding cash.*

Cook and Tang (2010) argue that firms have a motivation for reducing the deviations between actual leverage and the target amount, since the deviation from optimal leverage may result in a decrease in firm value. Similarly, firms have an incentive to adjust their cash ratio towards the target, given the underlying cost when the cash balance departs from the optimal level. Existing studies have documented the target-adjustment behaviours in relation to cash holding using either partial or straightforward target-adjustment models (Jiang and Lie, 2016; Opler et al., 1999; Ozkan and Ozkan, 2004; Venkiteshwaran, 2011).

There are three major concerns which may affect the adjustment speed of cash holding (Jiang and Lie, 2016). First, when adjusting the cash ratio towards the target, a manager has to consider whether departing from the target cash ratio will be costly. Both underinvestment due to insufficient cash and overinvestment due to excess cash can be costly. Second, when adjusting the cash ratio towards the target, a manager has to consider whether the policy of adjusting the cash ratio will be expensive. For example, although cutting investments and raising new capital can help to narrow the gap between the actual cash ratio and the target when there is a lack of cash, they also impose nontrivial costs on the firm. In contrast, although dividend payments and share repurchasing can help to reduce the gap between the actual cash ratio and the target when the cash level is above the target, they also impose an extra cost on the shareholders by way of the taxed capital gains. Finally, managers have to consider whether the cash adjustment could harm their interests. Jiang and Lie (2016) find that self-interested managers prefer high cash levels and are reluctant to disburse excess cash.

Motivated by Jiang and Lie (2016) which focus on the role of managerial entrenchment in the adjustment speed of cash holding, and Caliskan and Doukas (2015) which emphasise the influence of CEO risk preference on corporate policy, we examine the impact of CEO risk preference on the adjustment speed of cash holding. CEOs with high inside debt compensation align their interests with bondholders which leads them to be risk-averse in estimating the cost of both departing from the target and adjusting the amount of cash towards the target. In addition, the cash policy is closely related to firm risk, which in turn is closely linked to the claims of CEOs with high inside debt on the firm's assets. Accordingly, the risk preference of a CEO has a potential impact on all three major concerns identified by Jiang and Lie (2016) regarding the adjustment speed of cash. Therefore, we conjecture that CEOs with high inside debt compensation can have an effect on the cash adjustment.

Our study extends the existing research on cash policy in the following respects. First, although existing literature has established a link between CEO incentive compensation and a firm's cash holding level, as well as the value of the cash holding, to the best of our knowledge, no previous research has investigated the relationship between CEO risk preference and the adjustment speed of cash. We notice that pioneer studies including Liu et al. (2014) and Tong (2010) have explored the impact of CEO incentive on the cash level. Their study has the following drawbacks. Firstly, they did not identify the asymmetric impact of CEO compensation incentive on cash holding under different conditions of being above or below the target level. Secondly, they omit the cost and the duration of non-optimal cash level, which is directly determined the adjustment speed of cash. Our study extends Liu et al. (2014) and Tong (2010) by explaining why firms with different CEOs compensation incentive have different levels of cash holding: the adjustment speed of cash holding is asymmetric conditioning on the relative relationship between actual cash level and the target. Also, our study confirms for the first time that it is possible for firms to reduce the cost of holding cash by adjusting the CEO's compensation basket. For example, in firms which face high cost of holding insufficient cash, inside debt compensation motivates CEOs to make quicker respond to cash shortage. Second, Dittmar and Mahrt-Smith (2007) highlight the importance of corporate governance in relation to the cash policy and find that firms with weak corporate governance tend to dissipate cash quickly. We investigate the impact of institutional ownership, as a critical concern in corporate governance, on the relationship between CEO risk preference and the cash adjustment. Third, we identify that reduced dissipation rather than increased accumulation is the primary channel through which CEO inside debt compensation can exert an impact on the cash holding adjustment speed. Fourth, existing studies find an inconclusive relationship between CEO inside debt and cash holding using limited inside debt measures. We apply four inside debt measures as a proxy for CEO risk preference in order to examine the relationship in greater detail. Finally, we examine three channels through which the CEO inside debt compensation incentive may influence the adjustment speed of cash to give a better understanding of how the compensation incentive affects the speed of cash adjustment.

Using a large sample of US-listed firms between 2006 and 2014, we find that those firms which have CEOs with a lower risk preference also have a higher level of cash reserves, which is consistent with Liu *et al.* (2014). The asymmetry in cash adjustment partly explains this phenomenon. On the one hand, when the actual cash ratio is below the target, firms with high CEO inside debt compensation may increase the adjustment speed of cash holding by up to 40.21%. On the other hand, when the actual cash ratio is above the target, firms with high CEO inside debt compensation may decrease the adjustment speed of cash holding by up to 12.84%. When we divide our sample based on institutional ownership, we find a more intense impact of CEO risk preference on cash adjustment in the subsample with a higher level of institutional ownership when the actual cash level is below the target. When the cash level is below the target, firms with a high level of institutional ownership and CEOs with a low risk preference accelerate the adjustment speed of cash holding by up to 38.05%. On the opposite, we find a more intense impact of CEO risk preference on cash adjustment in the subsample with a lower level of institutional ownership when the actual cash level is above the target. When the cash level is above the target, firms with a high level of institutional ownership and CEOs with a low risk preference decelerate the adjustment speed of cash holding by up to 7.17%. Since institutional ownership is positively associated with the quality of corporate governance, the change in the impact of CEO inside debt compensation on the of cash adjustment under different levels of institutional ownership is consistent with the view that firms with high corporate governance level are more likely to make swifter respond to the deviation between actual cash level and the target to reduce the associated cost. While

CEOs can affect the adjustment speed of cash by pursuing cash policies based on either cash accumulation or cash dissipation, we find that CEOs with high inside debt compensation prefer to decelerate the dissipation of cash. Our results also suggest that investment and debt-retirement are two primary channels through which CEO inside debt compensation has an impact on the dissipation of cash.

The remainder of Chapter 4 is organised as follows. Section 4.2 provides a review of existing literature on CEO risk incentives and cash policy. Section 4.3 explains the development of our hypothesis. Section 4.4 defines the measures of risk preference that we use and specifies the models with which we test our hypothesis. Section 4.5 describes the data and the regression variables. Section 4.6 reports our empirical results and the robustness tests. Finally, Section 4.7 provides the conclusion to our study.

4.2. Literature review

4.2.1. Cash holding and firm risk

Firms' cash reserve levels have been increasing rapidly, especially in non-financial firms. Birstingl (2016) indicates that the cash held by S&P500 companies (excluding financial firms) had achieved its highest level for ten years of 1.54 trillion dollars by the third quarter of 2016. An outstanding example of the firms which hold abundant cash is the Apple Inc. Apple holds $216bn cash by the end of 2015 (Times financial). Bates *et al.* (2009a) find that on average public firms in the US held more cash than debt in 2006. The fact that US firms are holding too much cash has been called into question as the excess cash should really be used for job creation and investment

(Kim and Bettis, 2014). Baum et al. (2006) point out that non-financial firms "hold cash far in excess of transactions needs". Also, as mentioned by Azar *et al.* (2016), since the surplus cash incurs a rate of interest lower than the risk-free interest rate, the cost of capital associated with a liquid-asset portfolio is higher than the return.

Existing literature has identified several motivations for excess cash holding. The earliest explanations offered by academic research are based on trade-offs motivated by transactions costs. These theories suggest that firms hold cash to avoid the cost of being short liquid assets (Baumol, 1952; Karni, 1973; Meltzer, 1963; Miller and Orr, 1966; Tobin, 1956). Opler et al. (1999) point out that stronger growth opportunities and higher cash flow risk are two primary reasons why firms choose to hold a greater proportion of their assets in cash. Accordingly, large firms or high-credit firms with easy access to capital markets are more likely to have a lower ratio of cash assets to total assets. Likewise, Han and Qiu (2007) indicate that financial constraints greatly affect a firm's cash policy. Firms have to make an intertemporal trade-off between current investment and future investment. They suggest that the precautionary motive for under-diversified firms to keep more cash is as a response to the future liquidity risk. Acharya *et al.* (2007) and Denis and Sibilkov (2009) suggest that cash holding can hedge the financing and predation risks faced by a firm. Subramaniam *et al.* (2011) further confirm the hedging role of cash by identifying the impact of capital structure on cash holding and argue that the cash level of diversified firms is much lower than that of focused firms. They reason that the substitutive role of capital structure diversification in hedging risk reduces the value of a high cash reserve. In sum, the consensus is that the primary motivation for firms to hold more cash is from the perspective of risk.

A rich body of literature investigates the adjustment of capital structure (Elsas and Florysiak, 2015; Huang and Ritter, 2009; Öztekin, 2015). A primary reason for firms to make adjustments towards the target leverage is that the deviation from optimal leverage may result in a decrease in firm value (Cook and Tang, 2010). Similarly, firms have a motivation to adjust their cash ratio towards the target since it can be costly when the cash balance departs from the optimal level. Firms have to balance their liquidity needs and the risk of overinvestment when they have excess cash since operating with either insufficient cash or abundant cash can be costly (Bates *et al.*, 2009b; Fritz Foley *et al.*, 2007). The benefit of holding cash is obvious. Jiang and Lie (2016) point out that cash offers a cheap method of financing that does not incur costly external capital transactions. Therefore, funding with cash provides a firm with more flexibility when investment opportunities are available to it. However, they also indicate that the excess cash can be easily squandered especially in the absence of a disciplinary mechanism. The trade-off mechanism implies that an optimal target cash ratio can be set to minimise the cost of holding cash.

Both partial and straightforward target-adjustment models identify the target-adjusting behaviour of firms in relation to the cash policy (Jiang and Lie, 2016; Opler *et al.*, 1999; Ozkan and Ozkan, 2004; Venkiteshwaran, 2011). Jiang and Lie (2016) indicate that CEOs have three major concerns which may affect the adjustment speed of cash holding. The first concern is about the cost of departing from the target cash ratio. On the one hand, underinvestment due to insufficient cash is expensive since it means foregoing profit opportunities. On the other hand, overinvestment with excess cash is also expensive since the CEOs may put their cash into investments with negative NPVs. The second concern focuses on the cost of the adjustment. Jiang and Lie (2016) point out that there are non-trivial costs associated with policies which may narrow the gap between the actual and the target cash ratio, including cutting investments and raising new capital when there is a lack of cash. When the cash level is above the target, policies which can narrow the gap between the actual and the target cash ratio can also be expensive. For example, shareholders have to pay tax on the dividend payment gains and share repurchasing. The third concern is related to the self-interest of the CEO. A manager has to estimate whether a change in the speed of cash adjustment can harm his or her own interests. Jiang and Lie (2016) find that it is more difficult for self-interested managers to disburse excess cash since cash holding can act as a means of protecting their power.

4.2.2. CEO inside debt compensation

Inside debt compensation is the sum of the CEO’s pension and deferred compensation. The theoretical framework proposed by Jensen and Meckling (1976) considers inside debt to constitute an integral part of CEO compensation since it can mitigate the conflict between debt holders and CEOs with high equity compensation. The agency cost of debt is also known as “risk-shifting”. The payoff of debt is an asymmetric function in relation to a company’s net assets (Watts, 2003). As a consequence, debt holders prefer firms to adopt a more conservative firm policy. When CEOs with more equity compensation take excessive risks which incur a greater risk of default, the interests of debt holders are harmed due to the shift in risk. The importance of inside debt compensation in reducing firm risk has become more widely recognised due to the instability in financial markets. Edmans and Gabaix (2009) point out that inside debt yields a positive payoff in bankruptcy, proportional to the recovery value. Thus it renders the manager sensitive to firm value in bankruptcy, and not just the incidence of bankruptcy exactly as desired by creditors. Indeed, debt-aligned managers reduce firm risk, as measured by the firm's distance to default (Sundaram and Yermack, 2007) or its credit rating (Gerakos, 2007). Inside debt can thus reduce the cost of raising external debt, to the benefit of shareholders. As documented by Wei and Yermack (2010), following the financial crisis which took place in 2007-2008 there is now a widespread belief that option and equity led compensation contracts result in excessive risk-taking behaviour by the executives of certain firms, especially in the financial industry." Consequently, top executives' compensation contracts should include deferred compensation from the risk-reducing perspective.

Cassell *et al.* (2012) illustrate the risk preferences of CEOs with high inside debt compensation in more detail. The obligations implied by inside debt are neither guaranteed nor funded and can only be paid in the future. CEOs with high inside debt compensation have to face the same default risk as that faced by external creditors. Therefore, they become debt holders whose claim on the firm is tied to the firm's long-term survival rather than its current performance (Edmans and Liu, 2011; Sundaram and Yermack, 2007). The firm's risk of bankruptcy and its liquidation value in case of bankruptcy or reorganisation, therefore, becomes the major concern for

CEOs with high inside debt compensation (Edmans and Liu, 2011). Accordingly, CEOs with inside debt-led compensation make more conservative financing or investment decisions in favour of a firm's debt holders.

Existing literature has established a link between a firm's conservative policy and CEO inside debt compensation. Srivastav *et al.* (2014) examine the impact of CEO inside debt holdings and risk-shifting of banks and point out that firms with highly leveraged (inside debt to inside equity ratio) CEOs are more likely to opt for conservative payout policies. If CEO compensation is held in the form of inside debt, it is unsecured from the firm's obligations. A high payout policy of dividend may result in a higher bank default risk which decreases the value of inside debt. Therefore, payouts are more likely to be reduced and to be more significantly reduced by CEOs with high inside debt compensation. Similarly, Liu *et al.* (2014) find a positive relationship between cash holdings and CEO inside debt compensation. The relationship between cash balances and CEOs' inside debt is nonlinear due to the different leverage levels of firms. Collectively, the findings suggest that CEOs with high inside debt compensation prefer less risky financing and investment policy.

4.2.3. CEO equity compensation

CEOs are expected to work according to the best interests of shareholders and make profits for them. The CEOs invest their entire intellectual capital in the firm and make only a proportion of the firm's profits as a return for their efforts. CEOs typically hold a large percentage of their portfolio in their firms and thus are less diversified than the outside shareholders (Jin, 2002). In the case of possible financial distress, they may, therefore, suffer a loss not only in wealth but also in terms of their annuities and reputation. Jensen and Meckling (1976) suggest that there is a trade-off between providing incentives and optimal risk-sharing for CEOs and shareholders. To mitigate the conflict of interests between CEOs and shareholders and to reduce the costs arising from the agency problem, a rich body of literature exists which encourages compensation mechanisms including equity-led compensation (Coles *et al.*, 2006; Guay, 1999; Low, 2009). As the percentage of equity in the total CEO compensation package increases, the interests of risk-averse CEOs become more closely aligned with those of the shareholders.

4.2.4. CEO cash compensation

The cash compensation element that a CEO can expect is composed of both his/her salary and bonus. As pointed out by Caliskan and Doukas (2015), although cash compensation does not have an effect on CEO risk preference, it may result in the abuse of a firm's resources. Cash holding as an essential financing resource may be influenced by the level of a CEO's cash compensation. Therefore, we control for the impact of cash compensation when examining the role of CEO inside debt compensation in a firm's cash policy.

4.2.5. CEO Delta and Vega

Delta measures the change in the value of a CEO's stock option in response to the change in stock price. Delta motivates CEOs to adjust both the systematic risk and the idiosyncratic risk of the firm. John and John (1993) suggest that Delta has a mixed impact on the CEO's attitude towards risk. On the one hand, CEOs with high Delta compensation have magnified exposure to the firm's risk. Therefore, these CEOs are more likely to take actions to reduce both the systematic and the idiosyncratic risk. Accordingly, the high Delta will encourage CEOs to hedge the risk by holding more cash, especially when the CEO is risk-averse and under-diversified. On the other hand, CEOs with high Delta compensation tend to invest in risky investments which may lead to an increase in the firm's value. When the increase in the value of the firm is high enough, CEOs benefit from the transfer of wealth from creditors to shareholders. Accordingly, the high Delta should have an adverse impact on the level of cash holding when the interests of managers and shareholders are more closely aligned.

Vega measures the change in the value of a CEO's stock option in response to the change in stock return volatility. Armstrong and Vashishtha (2012) find that CEOs with high Vega compensation are motivated to increase the systematic risk rather than the idiosyncratic risk, which increases the total risk of a firm. Compared with a rise in idiosyncratic risk, an equivalent rise in systematic risk leads to a greater increase in the subjective value of the stock and options in the compensation portfolio of a CEO, given that the Vega remains the same. Existing literature documents a mixed relationship between Vega and a firm's cash holding. While Tong (2010) examines the influence of the CEO incentive on cash policy over the time span from 1993 to 2000 and finds that high Vega compensation has a negative impact on cash holding, Liu and Mauer (2011), whose study covers the period from 1992 to 2006, demonstrate that high Vega compensation has a positive influence on cash holding. On the one hand, as is argued by the literature above, the increase in Vega motivates the CEO to adopt riskier financing policies and to undertake riskier types of investment. Since retaining a high level of cash holding is regarded as a conservative financing policy, CEOs with high Vega compensation may exert an adverse impact on the level of cash holding. On the other hand, high Vega compensation implies that the firm may not have easy access to external funds or that the cost of external financing is high. Liu and Mauer (2011) point out that bondholders anticipate that firms with high Vega should have higher risk-taking behaviour and thereby require greater liquidity. Thus, firms with high Vega CEO compensation may hedge their future liquidity risk by building up cash reserves. Therefore the hedging perspective predicts that Vega has a positive impact on cash holding.

Undiversified compensation portfolios tie a major part of a CEOs' wealth to the value of the firms they serve. Therefore, under-diversified CEOs who are risk averse are more likely to forgo profitable but risky projects. Including stock options in the CEO compensation package can solve the problem to an extent (Haugen and Senbet, 1981; Smith and Stulz, 1985). The value of the options granted to managers rises with an increase in the volatility of stock returns. The increased payoff induces risk-averse CEOs to undertake more risks. An alternative perspective on the role of CEO compensation in risk-taking behaviour claims that executives will value their options based on their own preferences if they are unable to diversify the risk implied in their options(Carpenter, 2000; Lambert *et al.*, 1991; Lewellen, 2006; Ross, 2004). Consequently, a risk-averse manager does not necessarily have a greater appetite for risk if more employee stock options (ESOs) are granted. Although the manager's wealth is more sensitive to the volatility of the stock price (Vega) with more stock options, which results in a higher convexity payoff, the manager's wealth is also more sensitive to the movement of stock prices (Delta) with more stock options. Therefore managers are affected by both the increase in Vega which results in more risk-taking behaviour and the increase in Delta which magnifies a firm's risk aversiveness. Thus, the relationship between option compensation and the CEOs' appetite for risk is inconclusive.

4.3. Hypothesis development

Due to competing hypotheses, research into the impact of CEO inside debt compensation on the cash holding level remains inconclusive (Liu *et al.*, 2014). The risk-aversion hypothesis points out that the level of cash holding may increase if CEOs hold a higher percentage of their compensation in the form of inside debt since cash can reduce the asset volatility of a firm. The spending hypothesis suggests that firms with CEOs having high inside debt compensation are likely to have lower cash level. The spending hypothesis is developed by Harford et al. (2008), that "For a given set of firms with high levels of cash, all else equal, the firms with weaker governance will spend that cash more quickly than those with stronger governance." The low cash reserve in firms with weak corporate governance is ascribed to the managers' desire to spend the cash flows and cash accumulated. This is why the hypothesis is called "spending" hypothesis. Secondly, Lee and Tang (2011) indicate that high CEO inside debt compensation can be negatively related to the strength of corporate governance. Therefore, the firms which have CEOs with high inside debt compensation are more likely to have a lower quality of corporate governance, and thus have a lower cash reserve.

It is worth noting that firms in countries with weak shareholder protection hold twice as much cash as those firms in countries with strong shareholder protection (Dittmar *et al.*, 2009). Accordingly, poor level of corporate governance does not necessarily result in a decrease in cash level from the perspective of shareholder protection. In other words, the reasoning given by the spending hypothesis may not stand. In this study, we follow the risk-aversion hypothesis and conjecture that CEOs with high inside debt compensation will have a positive impact on the cash level for the following reasons. First, risk-averse CEOs are more likely to hold more cash to meet unexpected financing needs, since they tend to take out insurance against adverse shocks. Second, Low (2009) points out that risk-averse CEOs have difficulty reducing risk in the presence of a takeover threat. It is easier for the risk-averse CEOs to adopt risk-reducing firm policies when they are entrenched or are free from takeover threat. Jiang and Lie (2016) indicate that cash holding is closely linked to power protection. Therefore, holding more cash can benefit risk-averse CEOs in the following ways. On the one hand, when the cash holding is higher, the risk-averse CEOs are under stronger protection from the takeover threat. On the other hand, it easier for the risk-averse CEOs to adopt risk-reducing strategies when they are better protected from takeover threat. Third, Caliskan and Doukas (2015) find that CEOs with high inside debt compensation are more likely to pay dividends. Caliskan and Doukas (2015) examine whether risk aversion-inducing CEO compensation motivates managers to pay more dividends regardless of investor preferences. Using inside debt (i.e., pensions and deferred compensation) and the sensitivity of CEO equity compensation to stock price changes (i.e., high CEO delta), as proxies of CEO risk aversion, they document that inside debt induces CEOs to pay dividends while convex CEO compensation decreases dividend payout. Higher payouts is considered as a conservative policy comparing to investing in value-increasing projects, which may increase firm risk (DeAngelo et al., 2006; Grullon et al., 2002). The high firm default risk can endanger the value of CEOs inside debt. Therefore, instead of investing in projects, CEOs with high inside debt compensation should be inclined to pay dividends when the actual cash ratio is above the target. Accordingly, we conjecture that CEOs with high inside debt are risk averse and are likely to hold more cash. The excess cash held by those CEOs is more likely to be used for payout purposes than for investment purposes (Please note that this does not necessarily indicate that CEOs with high inside debt compensation must reduce excess cash by increasing payout. Investment and payout are two primary channels for firms to spend cash. Though risk-averse CEOs prefer dividend payment, they may use the cash holding for investment purposes). Therefore, in order to meet stockholders' expectations, CEOs with high inside debt compensation may need larger cash holdings with which to make dividend payments.

H1*: Firms that have CEOs with high inside debt compensation have a greater level of cash holding.*

Jiang and Lie (2016) document that managerial entrenchment has an adverse impact on the adjustment speed of cash holding based on the point of view that cash can act as insurance against shocks. They reason that the insurance role of cash is more important for firms with greater risk and conjecture that managers of firms with high operating and financial risk will be quicker to take action to remedy any cash shortfall than managers of other firms. They find that as firms become more insulated from the threat of takeovers, they decelerate their cash adjustment at high cash ratios. The finding suggests that self-interested managers are reluctant to disburse excess cash, and they will allow cash levels to remain high unless the firms are subject to external pressure.

Jiang and Lie (2016) propose three major concerns when CEOs adjust the cash holding towards the target level, including the cost of departing from the target cash ratio, the cost of adjustment towards the target ratio and whether or not the cash adjustment will damage their interests. Having CEOs with high inside debt compensation has a potential impact on these concerns. First, debt compensation aligns the interests of CEOs with bondholders which results in risk-aversion in estimating the cost of departing from the target cash level. Jiang and Lie (2016) conjecture that it is more expensive to operate with insufficient cash than with abundant cash, since operating with insufficient cash incurs higher costs in the case of both underinvestment and financial distress. CEOs with high inside debt may overestimate the cost of operating with a cash shortage and thus accelerate the adjustment of cash when there is insufficient cash. Second, Jiang and Lie (2016) propose that it is more expensive for firms to increase the cash ratio than to decrease it. It is worth noting that decreasing the cash ratio harms the interests of CEOs since cash can act as insurance against adverse shocks and protect the power of CEOs. In addition, the cash policy is closely related to the firm's level of risk which is in turn closely connected to the claims of CEOs with high inside debt on the firm's assets.

Therefore, the underlying cost of adjusting the cash ratio towards the target may be higher for a risk-averse CEO when the cash level is above the target than when the cash level is below the target. Accordingly, we conjecture that CEOs with high inside debt compensation may reduce the adjustment speed of cash holding when the cash level is above the target. We thus have the following hypothesis regarding the impact of CEO inside debt compensation on the adjustment speed of cash holding:

H2a: *Firms that have CEOs with high inside debt compensation have higher cash holding adjustment speed when the actual cash holding is below its target.*

H2b: *Firms that have CEOs with high inside debt compensation have lower cash holding adjustment speed when the actual cash holding is above its target.*

The impact of corporate governance on cash policy is well documented in the literature (Dittmar and Mahrt-Smith, 2007; Dittmar *et al.*, 2009; Harford *et al.*, 2012). More specifically, corporate governance has a substantial impact on the value of cash. (Dittmar and Mahrt-Smith, 2007). For example, while $1.00 of cash in a poorly governed firm is valued at only $0.42 to $0.88, good governance approximately doubles this value. Intuitively, it is more expensive for CEOs to disgorge excess cash of high value than to disgorge cash of low value. Since high institutional ownership is positively correlated with the quality of corporate governance, the value of cash should be higher when the institutional ownership is high. Therefore, institutional ownership may exert a negative impact on the adjustment speed of cash holding when there is excess cash. However, the possible negative impact of institutional ownership has to compromise with the increased cost of holding cash.

As institutional investors are increasing fast, they are not only shareholders but also active participants in the governance of their corporate holdings (Gillan and Starks, 2000). In addition, existing studies have well documented that institutional ownership increases the quality of a firm's governance structure (Aggarwal et al., 2011; Chung and Zhang, 2011; Li et al., 2006). Therefore, the firms with higher level of institutional ownership have more effective monitoring mechanism and will adjust their cash level towards the target to reduce the cost associated with the deviation of cash level from the target. Accordingly, firms with high institutional ownership will accelerate the adjustment towards target cash ratio regardless of the relative relationship between actual cash ratio and the target. We have already found that CEOs with high inside debt compensation accelerate the adjustment speed of cash when when the actual cash ratio is below the target and decelerate the adjustment speed of cash when the actual cash ratio is above the target. When the actual cash level is below the target, the interest of CEOs with high inside debt compensation and the institutional investors are aligned, since they both wish to reduce the cost of operating with insufficient cash. Accordingly, when the cash level is below the target, the impact of CEOs with high inside debt compensation should be stronger under high institutional ownership than under low institutional ownership. When the actual cash level is above the target, the desire of CEOs with high inside debt to accumulate cash has confliction with the institutional investors desire to reduce the cost of operating with excess cash. Besides, high institutional investors, as effective monitors, can lower the agency cost by reducing the impact of compensation incentive when there is a confliction of the interest between CEOs and shareholders. Bratten and Xue (2016) show that when firms' CEOs have abnormally high equity incentives, higher institutional ownership is associated with a larger reduction in the incentives. Ning et al. (2015) find that institutional ownership concentration, measured by the top five to total institutional holdings and institutional Herfindahl index, is negatively related to option related CEO compensation risk. In addition, Khan et al. (2005) find that higher institutional ownership is associated with lower ratios of options to total compensation. Given that inside debt is a major source of CEO incentive compensation, the institutional investors as effective monitors should affect the relationship between CEO inside debt compensation and cash policies. Accordingly, we conjecture that the effective monitoring of institutional investors will reduce the negative impact of CEOs with high inside debt compensation on the adjustment speed of cash holding when the cash level is above the target.

Based on the analysis above, the hypothesis H3 should be modified into two sub-hypothesis：

When the cash level is below the target, high institutional ownership will allow the CEOs with high inside debt compensation to accelerate the adjustment speed of cash holding, either from the standpoint of cost reduction or the standpoint of conservatism.

H3a*: When the actual cash holding is below its target, the positive impact of high CEO inside debt compensation on the adjustment speed of cash holding is stronger under high institutional ownership.*

When the cash level is above the target, high institutional ownership will reduce the negative impact of CEOs with high inside debt compensation on the adjustment speed of cash holding from the standpoint of cost reduction and the standpoint of effective monitoring.

H3b*: When the actual cash holding is above its target, the negative impact of high CEO inside debt compensation on the adjustment speed of cash holding is weaker under high institutional ownership.*

4.4. Methodology

4.4.1. CEO's incentive compensation

4.4.1.1. CEO inside debt compensation

Jensen and Meckling (1976) and Edmans and Liu (2011) suggest that the risk preference of CEOs can be measured by the value of a CEO's leverage (CEO debt-based compensation scaled by equity-based compensation) relative to the firm's leverage. When the value of the relative leverage ratio is one, there is a perfect alignment between the incentive of CEOs and that of both debt and equity holders. When the relative leverage ratio is above unity, the incentive of CEOs is more closely aligned with the incentive of the debt holders than with the equity holders.

As inside debt compensation can provide a better measure of CEO risk preference when taking firm leverage into account, we apply four inside debt-related risk preference measures based on the relative value of CEO leverage and firm leverage

(Cassell *et al.*, 2012; Jensen and Meckling, 1976; Sundaram and Yermack, 2007). The first measure is the CEO relative leverage (*REL_LEV*), which is derived from the CEO leverage scaled by firm leverage. The second measure is a dummy variable which takes a value of one if the CEO relative leverage is higher than unity and zero otherwise. The dummy variable is referred to as the high CEO relative leverage dummy (*HIGH_LEV_DUM*) in our analysis. We expect that firms with high CEO relative leverage (or high CEO relative leverage dummy equals one) are less likely to make risky investments and are more likely to hold more cash. The third measure is the CEO relative incentive ratio (*REL_INC*) which is proposed by Wei and Yermack (2011). This measure compares the change in a CEO's claim to inside debt over inside equity and the change in a firm's claim to external debt over external equity when there is a unit increase in the firm's value. The CEO's mixed claim on debt and equity is perfectly matched with the capital structure of the firm when the relative incentive ratio equals one. Therefore, when the CEO relative incentive ratio is unity, a CEO has little motivation for adopting strategies which may change the firm's risk policies by transferring value between firm debt and firm equity. A CEO relative incentive ratio which is higher than unity motivates CEOs to adopt conservative strategies, while a CEO relative incentive ratio which is lower than unity motivates CEOs to take risks. We suggest that the CEO relative incentive ratio has a positive impact on cash holding. Cassell *et al.* (2012) assert that it is essential to control for the impact of future cash compensation when analysing the impact of the CEO relative incentive ratio and a firm's investment and financing policy. Therefore, our fourth measure, the CEO relative incentive ratio adjusted for cash compensation (*REL_INC_CA*), controls for the present value of an executive's expected cash compensation. The present value of future cash compensation is closely linked to the expected decision horizon which is derived from the difference between the industry median level of CEO tenure and the CEO's actual tenure plus the difference between the industry median level of a CEO's age and the CEO's actual age. If the expected decision horizon of the CEO is positive, we multiply the expected decision horizon by the most recent year's cash compensation to get the present value of future cash payments. If the expected decision horizon of the CEO is negative, we use the most recent year's cash compensation as the proxy for the present value of future cash compensation. It is worth noting that when using the approximation, we assume that the growth rate of the CEO's cash compensation is the same as the discount rate. We adjust for the impact of cash compensation on the CEO relative incentive ratio by adding the present value of cash compensation to the CEO inside debt holding before calculating the CEO relative incentive ratio.

4.4.1.2. CEO equity compensation

When examining the relationship between CEO inside debt compensation and cash holding level and the adjustment speed of cash holding, we control for other components in the compensation basket including equity compensation, cash compensation, Vega and the Delta-Vega ratio. We control for the impact of CEO equity holding by including *CEO_EQUITY_HOLDINGS_TC*, which is the equity-related compensation scaled by the total compensation. The stock options' value of CEOs is calculated based on the Black–Scholes option pricing model (Black and Scholes, 1973). Core and Guay (2002) introduce an approximation method to calculate the value of the stock option when there are missing variables. Since the

EXECUCOMP database provides full information on CEO compensation, including inside debt compensation, from 2006 onwards, we apply the method proposed by Coles *et al.* (2006) to get the value of the stock option portfolio of a CEO by adding the value of each tranche together.

4.4.1.3. CEO Delta and Vega

In this study, we derive the option-based CEO incentive measures, namely Delta and Vega, following Core and Guay (1999) and Guay (1999) method, which extended the option pricing models. To estimate the values for the current grant of stock options, we assume 1st July as the grant date. To estimate the approximate value of Delta and Vega for the previous grants, we follow the procedure developed by Core and Guay (2002) which is also applied in a recent study by Caliskan and Doukas (2015).

The variables required to derive the option value as well as *Delta* and *Vega* are defined as follows. S_t is the market price of stocks at the fiscal year end of time t. We use the fiscal year end stock price since stock options are valued at the same time. $\mathrm{d_t}$ is the average dividend yield over the past three years (including time t) where $d_t = \frac{1}{3}(D_t + D_{t-1} + D_{t-2})$, and $\mathrm{r_t}$ is the risk free rate based on the return of T-Bonds corresponding to the actual maturity of the option. We downloaded the annual Treasury rates from 2006-2014 from the Federal Reserve Bank's website. We noted that only 1, 2, 3, 5, 7 and 10 year rates are available on the FED website, so we interpolated the numbers for 4, 6, 8 and 9 years. The derived risk-free rate is scaled by 100 to transform the percentage value to a fraction. $\mathrm{T_t}$ is the time from t to the maturity of the option. In our calculation we suppose the general life of the option is

10 years, so we do not use the hair-cut method applied by EXECUCOMP which multiplies the term of the option by 0.7.[15] σ_t^2 is the estimated volatility based on a rolling standard deviation with a window of 5 years, where $\sigma_t = \sqrt{\sum_{i=-60}^{-1} (r_i - \bar{r})^2 \Big/ 59} * \sqrt{12}$.

X is the strike price (*EXPRIC*). N is the cumulative probability function for the normal distribution. N' is the normal density function. $Z_t = \left[\ln\left(\frac{S_t}{X_t}\right) + T_t\left(r_t - d_t + \frac{\sigma_t^2}{2}\right) \right] \Big/ \sigma_t T_t^{(1/2)}$.

Given the specifications above, the CEO option values, Delta and Vega, are derived as follows:

$$Value_t = S_t e^{-d_t t} N\left(Z_t\right) - X e^{-r_t T_t} N\left(Z_t - \sigma_t T_t^{(1/2)}\right) \tag{4.1}$$

$$Delta_t = \frac{\partial V}{\partial S} = e^{-d_t t} N\left(Z_t\right) * \left(S_t / 100\right) \tag{4.2}$$

$$Vega_t = \frac{\partial V}{\partial \sigma} = e^{-d_t t} N'\left(Z_t\right) S_t T_t^{(1/2)} * 0.01 \tag{4.3}$$

4.4.1.4. Cash Compensation

We measure the cash compensation of executives (*CEO_CASH_COMP_TC*) as the

15 EXECUCOMP database applies a hair-cut method in calculating the for option value using Black–Scholes option pricing model. The database assumes that executives do not hold their options till the end of the maturity. Therefore, they added 0.7, a discount factor, to the option-holding period, which suggest that the general life of option is 7 years. It is not necessary to set the discount factor as 0.7 or to set a discount factor. In our study, we follow Coles et al. (2006) which suppose that the general life of the option is 10 years in calculating option's *Delta* and *Vega*.

sum of their salary and bonus at the fiscal year end scaled by the total compensation. According to the theoretical framework developed by Jensen and Meckling (1976), CEOs with high cash compensation (salary and bonus) do not have an incentive to make profitable long-term investments since firm performance does not affect their salary. Although the award of a bonus is intended to encourage CEOs to achieve certain goals, most bonuses are based on fulfilling the firm's target in the short term. In other words, cash compensation does not motivate CEOs to undertake value-increasing projects in the long run. However, as pointed out by Jensen (1986), CEOs with high cash compensation tend to abuse free cash flows, resulting in a decrease in the cash balance. On the one hand, although reduced investment in value-increasing projects reduces positive NPV, it does not guarantee a higher cash balance. On the other hand, the abuse of free cash flow results in an immediate decrease in cash holding.

4.4.2. The impact of CEO inside debt on cash level

To examine the relationship between CEO inside debt compensation and the cash level we specify the regression model as similar to that specified by Gao *et al.* (2013), controlling for the variables used in the regression model for predicting the target cash ratio. We take the impact of year- and industry-specific features into account by including dummy variables. To control for the impact of heteroscedasticity in the error term, we apply the standard errors clustered by firm.

$$
\begin{aligned}
Cash\_ratio_t = \alpha &+ \beta_1 CEO\ Inside\ Debt_t + \beta_2 Ln\_at_t \\
&+\beta_3 Cash\_flow_t + \beta_4 Industry\_sigma_t \\
&+\beta_5 Leverage_t + \beta_6 Sales\_growth_t \\
&+\beta_7 MtB_t + \beta_8 NWC_t + \beta_9 Capex_t \\
&+\beta_{10} Aquisition_t + \beta_{11} RND_t + \beta_{12} Div\_dummy_t \\
&+\beta_{13} MNC_t + \beta_{14} Dummy\_rating_t \\
&+\beta_{15} Ln\_firm\_age_t + Year\_dummy \\
&+Industry\_dummy + \varepsilon_{i,t}
\end{aligned} \tag{4.4}
$$

Cash ratio as the primary dependent variable is defined as the cash holding scaled by the firm's total assets. The independent variable is the CEO inside debt which is specified in Section 4.4.1.1. Detailed definitions of the control variables are given in Section 4.5. It is worth noting that we include three additional control variables in the model specification, including the natural algorism of firm age (*LN_FIRM_AGE*), the public debt issuance right (*DUMMY_RATING*) and the foreign sales percentage indicator (*MNC*). The three additional control variables are added for the following reasons: first, similar as Jiang and Lie (2016) and Dittmar and Duchin (2010), we include the firm age to control for the effect of firm life cycle on the cash policy; second, Jiang and Lie (2016) reason that firms that lack a debt rating face a constraint in accessing the debt markets compared to other firms. Given the risk introduced by higher cost of debt financing, the unrated firms may adopt different cash policy comparing with rated firms. Therefore the *DUMMY_RATING* is included regarding the lack of a debt rating as an additional financial risk factor; third, Foley et al. (2007) find that U.S. companies which would incur tax consequences associated with repatriating foreign earnings hold higher levels of cash. Accordingly, it is necessary to control for foreign sales using *MNC* when examining influencing factors on cash policy (see, e.g. Gao et al. (2013)). All the control variables are similar to those specified by Jiang and Lie (2016).

4.4.3. The impact of CEO inside debt on adjustment speed of cash holding

We use the predicted values from the contemporaneous regressions as firms' target ratios.

$$Cash^{*}_{i,t} = \alpha_0 + \alpha_i Basic\ Independent\ Variables_{i,t} + \varepsilon_{i,t} \qquad (4.5)$$

The predicted values from the regressions (4.5) are set as the target cash ratios. The basic independent variables are *LN_AT*, *CASH_FLOW*, *INDUSTRY_SIGMA*, *LEVERAGE*, *SALES_GROWTH*, *MTB*, *NWC*, *CAPEX*, *ACQUISITION*, *RND*, *DIV_DUMMY*, *DUMMY_RATING*, *MNC*, and *LN_FIRM_AGE*. We then regress the changes in the cash ratio from the previous year to the current year on the difference between the current year's cash-ratio target and the previous year's cash ratio to examine whether the cash holding is adjusting towards the target.

$$Cash_{i,t} - Cash_{i,t-1} = \lambda\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) + \varepsilon_{i,t} \qquad (4.6)$$

Where the λ estimated above is the adjustment speed of cash holding.

To test whether the adjustment speed of cash holding is affected by CEO inside debt compensation, we use the following specification:

$$Cash_{i,t} - Cash_{i,t-1} = \lambda\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) + \gamma_1\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) * CEO\ Inside\ Debt_{i,t} + \varepsilon_{i,t} \tag{4.7}$$

The equation (4.7) is the same as the model applied in Jiang and Lie (2016) which examine whether the relative relationship between cash level and the target has an asymmetric impact on the adjustment speed of cash holding. The model Jiang and Lie (2016) applied is called the Speed of Adjustment model (SOA). SOA is an extension of the partial adjustment model and has been applied wildly when testing the influencing factors on the speed of capital structure adjustment (also called the dynamic of capital structure) (Brisker and Wang, 2017; Liao et al., 2015; Öztekin and Flannery, 2012).

Jiang and Lie (2016) propose the following specification of SOA when testing whether the adjustment speed is asymmetric given the relative relationship between actual cash level and the target:

$$Cash_{i,t} - Cash_{i,t-1} = \lambda\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) + \gamma_1\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) * Highcash_{i,t} + \varepsilon_{i,t}$$

The *Highcash* is a dummy variable which takes 1 when the actual cash holding is above the target and takes 0 otherwise. It is worth noting that there is also no individual *Highcash* term. The coefficient γ_1 measures the partial impact of high cash level on the adjustment speed of cash holding. If individual *Highcash* term is included in the SOA model, the SOA model will become:

$$Cash_{i,t} - Cash_{i,t-1} = \lambda\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right)$$
$$+\gamma_1\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right) * Highcash_{i,t} + \beta Highcash_{i,t} + \varepsilon_{i,t}$$

The new model has the following drawbacks: First, the impact of high cash level will be divided into two parts; second, the coefficient β on the individual *Highcash* term does not stand for the change in the adjustment speed and is difficult to explain. Therefore, we follow Öztekin and Flannery (2012), Liao et al. (2015), Jiang and Lie (2016) and Brisker and Wang (2017), and only include the interaction term in the partial adjustment model. As applied by Jiang and Lie (2016), we also include interaction terms between the control variables and $\left(Cash^{*}_{i,t} - Cash_{i,t-1}\right)$ to control for possible impact on the adjustment speed of cash holding.

To further study the impact of CEO risk preference on the change in excess cash (or negative excess cash), we first examine the aim of the CEO when the firm has excess cash. There are two broad aims for CEOs to store excess cash, namely, dissipation and accumulation. We test which aim is dominant among CEOs with high inside debt compensation based on the following models:

$$\Delta Excess\ Cash\left(Dissipation\right) = \alpha + \beta\left(CEO\ Inside\ debt_t\right) + \gamma\left(Industry\ Average\ Change\ in\ Excess\ Cash_t\right) + \varepsilon_{i,t} \quad (4.8)$$

Where:

$$\Delta Excess\ Cash\left(Dissipation\right) = \left(Cash^{*}_{i,t+1} - Cash_{i,t}\right) - \left(Cash^{*}_{i,t} - Cash_{i,t-1}\right)$$

$$\Delta Excess\ Cash\left(Accumulation\right) = \alpha + \beta\left(CEO\ Inside\ debt_t\right) \\ +\gamma\left(Industry\ Average\ Change\ in\ Excess\ Cash_t\right) + \varepsilon_{i,t}$$

(4.9)

Where:

$$\Delta Excess\ Cash\left(Accumulation\right) = \left(Cash^*_{i,t} - Cash_{i,t-1}\right) - \left(Cash^*_{i,t-1} - Cash_{i,t-2}\right)$$

To test the asymmetric impact of the negative and positive deviation of the actual cash holding from the target cash holding we separate the sample into two subsamples based on the relative magnitude of the actual cash level and the target. Therefore, there are four groups of regressions based on model (4.8) and model (4.9): dissipation of excess cash when the actual cash level is above the target; dissipation of excess cash when the actual cash level is below the target; accumulation of excess cash when the actual cash level is above the target; and accumulation of excess cash when the actual cash level is below the target.

4.5. Data and summary statistics

Our firm-year observations for the accounting variables are collected from the COMPUSTAT database, the variables for measuring stock market performance are taken from the Centre for Research in Security Prices (CRSP), and the CEO compensation and variables related to CEO characteristics are obtained from EXECUCOMP. The EXECUCOMP database provides detailed information on top executives' salary, bonus, stock holdings and new grants and stock options, as well as the deferred compensation plans and pension benefits for Standard and Poor (S&P)

1500 listed firms (including S&P 500, S&P Mid-cap 400 and S&P Small-cap 600). Our study covers the time span from 2006 to 2014. The sample is taken from 2006 since US firms have been required by the Securities and Exchange Commission to report information on top executives' deferred compensation plans and pension benefits since 2006. Following Jiang and Lie (2016) study, we use the following criteria for our firm-level data. First, the financial firms (SIC code 6000-6999) and utility firms (SIC codes 4900-4999) are excluded from our sample due to their specific capital structures. Second, we require non-missing data for all the financial variables applied. Third, following Bates *et al.* (2009a), we also eliminate firm-years with negative assets or negative sales.

The primary dependent variable, the cash ratio (CASH_RATIO), is defined as the firm's cash holding divided by firm's total asset (#1/#6), where all cash and marketable securities are considered as cash. The list of control variables applied in the regression to determine target cash ratio is summarised as follows. LN_AT is the natural log of the book value of total assets (#6). The market-to-book ratio (*MTB*) is the difference between the total book value of assets and the book value of equity plus the market value of equity divided by the total book value of assets ((#6 – #60 + #199 * #25)/#6).[16] The #6, #60, #199 and #25 are the order of listed items in the

16 Our calculation for *MTB* follows Bates at al. (2009), which gives the following definition for the MTB: "Market-to-book ratio. Firms with better investment opportunities value cash more since it is costly for these firms to be financially constrained. We use the book value of assets (#6) minus the book value of equity (#60) plus the market value of equity (#199 * #25) as the numerator of the ratio and the book value of assets (#6) as the denominator."

COMPUSTAT database, where #6 is the book value of assets; #60 is the book value of equity, #199 is the stock price, and #25 is the common shares outstanding, #199*#25 is the market value of equity. As Bates et al. (2009a) suggest, the market to book ratio measures investment opportunities. They believe that firms which have better investment opportunities place a higher value on cash reserves. Therefore, the relationship between *MTB* and cash reserves is positive. The dividend dummy (*DIV_DUMMY*) is set to one if the firm pays a common dividend (#21) and zero otherwise. Since the dividend payout reduces the cash holding, we suggest that the *DIV_DUMMY* is negatively correlated with the *CASH_RATIO*. The definition of the industry cash flow risk (*INDUSTRY_SIGMA*) is similar to the one used by Bates et al. (2009a). First, we categorised all firms into different industry groups based on the Fama-French 48 industry classification. The Industry Sigma (*INDUSTRY_SIGMA*) is the mean of the ten-year standard deviation of the *CASH_RATIO* for each industry. *INDUSTRY_SIGMA* measures the cash flow risk which may affect the cash ratio. Most of the existing studies on the influencing factors on cash holding control for the impact of *INDUSTRY_SIGMA* (Jiang and Lie, 2016; Opler et al., 1999; Ozkan and Ozkan, 2004; Venkiteshwaran, 2011). Jiang and Lie (2016) point out that, generally, firms retain more financial flexibility in the form of more cash if they face greater risk (as measured by industry cash flow volatility). Opler et al. (1999) and Ozkan and Ozkan (2004) find a positive coefficient on the cash flow volatility (*INDUSTRY_SIGMA*). Following the previous study, we control the cash flow risk when calculating the target cash ratio and when testing influencing factors on the cash ratio. The *INDUSTRY_SIGMA* is assumed to be positively correlated with the *CASH_RATIO*. Asset beta (*BETA*) is defined as unleveraged beta. Non-Rated

(*RATING_DUMMY*) is a dummy variable which indicates whether a firm has public debt. Cash flow (*CASH_FLOW*) is measured as the earnings after interest, taxes and common dividends but before depreciation divided by the total book value of assets ((#13 – #15 – #16 – #21) / #6). [17] Bates et al. (2009a) indicate that a high cash flow increases a firm's ability to accumulate cash reserves, controlling for other factors. The capital expenditure (*CAPEX*) is defined as the proportion of capital expenditures (#128) as a fraction of the total book assets (#6). Higher capital expenditure can be correlated with a temporary increase in investment which reduces the cash reserves in the short run, as illustrated by Riddick and Whited (2009). We assume a negative relationship between capital expenditure and cash ratio.

We derive leverage as the total of long-term debt (#9) and current debt (#34) scaled by total book assets (#6). The relationship between leverage and cash reserves is mixed. Bates *et al.* (2009a) propose the idea of the deleverage role of cash and assume a negative relationship between cash and leverage. However, the hedging argument highlighted by Acharya *et al.* (2007) indicates that leverage has a positive impact on cash holding. It is recognised that leverage plays a significant role in shaping firms'

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17 On Page 1999 of Bates et al (2009), *CASH_FLOW* is defined as "…Cash flow to assets. We measure cash flow as earnings after interest, dividends, and taxes but before depreciation divided by book assets ((#13 –#15 – #16 – #21) / #6). Firms with higher cash flow accumulate more cash, all else equal. Such firms might have better investment opportunities, but we control for these through other variables." In the table descriptions of Jiang and Lie (2016), cash flow is defined as "Cash flow is (EBITDA–interest–taxes–common dividends) scaled by total assets." *EBITDA* is short for earnings before interest, tax, depreciation and amortization and is listed as the item 13 (#13) in the COMPUSTAT database.

cash policies. The role of cash is well illustrated in . The relationship between cash and leverage can be either positive or negative. On the one hand, to the extent that the leverage of a firm acts as a proxy for the firm's ability to issue debt, we may expect a negative relation between leverage and cash holdings. That is, firms can use borrowing as a substitute for holding cash (John, 1993). Further, firms can maintain financial flexibility through having large cash reserves and/or unused debt capacity (low leverage) suggesting a negative relationship between firms' cash reserves and leverage (see, e.g., Graham Graham and Harvey (2001)). On the other hand, at high levels of leverage firms are more likely to experience financial distress and, thus, accumulate larger cash reserves in order to minimise the risk of bankruptcy. It is also argued that financially constrained firms have more incentives to hold large cash balances (see, e.g., Hovakimian and Titman (2003) and Fazzari et al. (1988)). In addition, to the extent that firms with high leverage are more likely to be constrained in raising external finance, they would increase their cash balances as a precautionary motive. These arguments suggest that the relationship between cash holdings and leverage can become positive when the level of leverage is high.

Sales growth (*SALES_GROWTH*) is derived as the change in sales (#12) from the past year to the current year divided by the past year's sales. As a part of the revenue, we suggest that there is a positive relationship between sales growth and cash reserves. The measure for acquisition activity (*ACQUISITION*) is derived from acquisitions (#129) scaled by total assets (#6).We assume a negative relationship between acquisitions and cash levels since acquisitions is a net cash outflow. Net working capital (*NWC*) is defined as the working capital net of cash scaled by the total book assets ((#179-#1)/#6). Research and development (*RND*) is derived as *XRD* (#46) scaled by total assets (#6) and measures a firm's growth opportunities. We replace the missing values in *XRD* with zeros to give more observations. We also run the regressions without replacing *XRD* with zeros which gives a similar result. Firm age is defined as the total listed years starting from the firm's IPO (we specify the birth date of the firm as the first date of a firm with an available share price (#199) in the COMPUSTAT database). The influence of extreme values is eliminated by winsorizing all of the continuous variables in the top and bottom 1%.

[Insert Table 4-1 around here]

Table 4-1 presents the descriptive statistics of the variables applied in our regressions. Our primary dependent variable is the level of cash (*CASH_RATIO*). Similarly to Opler *et al.* (1999), we divide the total dollar value of cash and marketable securities by a firm's net assets to get our cash holding ratio. CEO incentive measures are applied as the independent variables. The CEO inside debt compensation measures applied include the CEO relative leverage to firm leverage ratio (*REL_LEV*), the CEO high leverage dummy (*HIGH_LEV_DUM*), the CEO relative incentive ratio (*REL_INC*) and the CEO relative incentive ratio adjusted for cash compensation (*REL_INC_CA*). To control the impact of other compensation incentives, including CEO cash compensation and CEO equity compensation, on the cash holding policy, we include four compensation-related control variables in our regression models. Where *CEO_CASH_COMP_TC* is the fraction of cash compensation out of the total compensation of CEOs, *CEO_EQUITY_HOLDINGS_TC* is the fraction of equity compensation out of the total compensation of CEOs, *DV* is the Delta to Vega ratio, and *VEGA_TC* is Vega divided by the total compensation of CEOs.

As presented in Table 4-1, our sample includes 10,953 firm years which have complete data for our firm-related control variables. In other words, 10953 firm years have full information to calculate the independent variables and the "basic control variables". The basic independent variables are *LN_AT*, *CASH_FLOW*, *INDUSTRY_SIGMA*, *LEVERAGE*, *SALES_GROWTH*, *MTB*, *NWC*, *CAPEX*, *ACQUISITION*, *RND*, *DIV_DUMMY*, *DUMMY_RATING*, *MNC*, and *LN_FIRM_AGE*. The dependent variables are derived from the cash balance relative to the net assets (*CASH_RATIO*) and target cash ratio (*TCASH_RATIO*). The median of the *CASH_RATIO* over the period from 2006 to 2014 is 0.1053, which is below the median level of 0.1411 of the target cash-ratio (*TCASH_RATIO*). This result suggests that the majority of our sample firms have not achieved their target cash level.

Jensen and Meckling (1976) indicate that the optimal leverage for executives should mimic that of the firm, while Edmans and Liu (2011) argue that the relative leverage of the CEOs should be lower than unity. Higher equity compensation results in risk-taking behaviour while higher inside debt compensation results in risk-averse behaviour. Intuitively, when the compensation leverage of a CEO mimics the firm leverage, the interest of the CEO and the firm should be perfectively aligned. The goal of setting different compensation contracts is to motivate a CEO to take risks or to avoid risky investments. Edmans and Liu (2011) show that granting the manager equal proportions of debt and equity is typically inefficient to achieve the goal. In most cases, an equity bias is desired to induce effort. However, if the effort is productive in increasing liquidation value, or if bankruptcy is likely, a debt bias can improve effort as well as alleviate the agency costs of debt. In line with Edmans and Liu (2011), the majority of CEOs in our sample have relative leverage below unity. The high CEO relative leverage dummy has a median value of zero, indicating that less than half of the CEOs have higher leverage than the firm. We also noticed that the 75th percentile of CEO relative leverage is below unity, while the mean of CEO relative leverage is 2.2563. This finding suggests that inside debt compensation accounts for a much greater proportion of the total compensation package of less than a quarter of the CEOs than the other CEOs in the sample. Similarly, the other two inside debt derived measures, the relative incentive ratio and the CEO incentive ratio adjusted for cash compensation, have a mean of 2.2370 and 41.0060 respectively.

When we look at the control variables derived from CEO compensation, we find that equity compensation accounts for over *80%* percent of a CEO's total average compensation, given a mean value of 0.81, while CEO cash compensation accounts for only 7.86% of the total average compensation. The high percentage of CEO equity compensation in a CEO's total compensation package indicates that the CEOs' compensation basket is under-diversified in general. The mean of the *DV* ratio is 22.5482 while the 75th percentile of the *DV* ratio is 6.1726, indicating that those CEOs who fall into the fourth quarter are most likely to have a compensation incentive related to equity. Similarly, the mean of Vega to total compensation ratio shows that the CEO's total compensation package changes by 0.37% on average, due to a one percent change in stock return volatility.

[Insert Table 4-2 around here]

Table 4-2 presents the pair-wise correlation coefficients between dependent variables, independent variables and control variables. Cash ratio has a positive correlation with all four of our CEO inside debt compensation measures, as shown in column (1) of Table 4-2. CEO Vega, equity compensation and CEO cash compensation have a positive correlation with cash ratio. According to Table 4-1, equity-related compensation accounts for over 80% of the total compensation, which suggests a high level of under-diversification in CEOs' compensation packages. This lack of diversification results in excessively risk-averse behaviour which leads to the adoption of risk-reducing policies such as building up cash reserves. The positive correlation between inside debt compensation and the cash ratio suggests that CEOs with high inside debt compensation have an incentive to hold more cash. Cash compensation is positively correlated with the cash ratio, which is consistent with the analysis by Jensen and Meckling (1976). Jensen and Meckling (1976) point out that cash compensation does not motivate CEOs to undertake long-term value increasing investments, and thus retain a higher level of cash holding. It is worth noting that the correlation between dividend dummy, capital expenditure, and acquisition and cash ratio is negative. This negative relationship highlights the role of the payout policy in determining the cash holding level.

4.6. Empirical results

4.6.1. CEO inside debt compensation and cash ratio

We report the results of testing the relationship between CEOs inside debt compensation and the level of cash holding in Table 4-3. As shown in Regressions (1) to (4) in Table 4-3, we find positive and highly significant coefficients on all four CEO inside debt compensation measures, indicating that CEO inside debt compensation has a positive impact on the level of cash holding. As illustrated by Edmans and Liu (2011), the relative leverage as a measure based on inside debt compensation is a comprehensive measure of CEO risk preference since it takes CEO equity compensation into account as well as the firm's financial leverage. Risk-averse CEOs regard cash as the firm's most liquid asset, which can lower the asset volatility. The positive relationship between inside debt holdings and cash ratio supports the risk-aversion hypothesis of inside debt.

[Insert Table 4-3 around here]

The level of cash holding is indifferent to the CEO's cash compensation. Only the coefficient on CEO cash compensation given by Regression (4) is negative and significant. The finding is consistent with previous literature which indicates that cash compensation does not motivate CEOs to invest in value-increasing projects and may cause CEOs to abuse free cash flow. We also find that the coefficient on CEO equity compensation is positive and significant at the 1% level for all four regressions. This result shows that under-diversified CEOs with high equity compensation are risk averse, which has a positive impact on the level of cash holding. We also observed a non-significant coefficient on *Vega* and the *DV* Ratios. The neutral impact of a CEO's wealth sensitivity to stock return volatility on cash ratio suggests that the alignment hypothesis reconciles with the costly financing hypothesis. It is worth noting that control variables related to cash dissipation channels including acquisition, R&D, and dividend dummy are all significant at the 1% level, indicating a strong relationship between the cash payment and level of cash holding. The coefficient on *MTB* which controls for the over-pricing of stock is positive and significant at 1% level. The finding is consistent with the those by John (1993), which finds that firms with high *MTB* ratios and low tangible asset ratios tend to hold more cash. John (1993) ascribes the positive relationship between *MTB* and cash holding to the cost of financial distress, where high *MTB* ratio is a proxy for financial distress costs.

The results in Table 4-3 suggest that CEOs' inside debt compensation as a measure of CEO risk preference has a positive impact on a firm's cash holding level, which is in line with our hypothesis H1. The CEO equity compensation incentive has a positive relationship with the level of cash holding, while there is no strong correlation between CEO cash compensation and the level of cash holding.

4.6.2. CEO inside debt compensation and adjustment speed of cash holding

We now focus on the impact of CEO inside debt compensation on the adjustment of cash towards the target ratio. Table 4-4 reports the general relationship between the adjustment speed of cash holding and CEO inside debt compensation (all the interaction terms are expressed in the 00s (hundreds) to provide a better overview of the results). Estimations provided by Regressions (1) to (4) are models with four individual inside debt measures respectively. The models are specified as baseline Equation (4.7), which gives the relationship between the deviations from the target cash ratio (*DIF_TCASH*) and the change in cash holding (*DIF_CASH*). The coefficient on *DIF_TCASH* measures the adjustment speed of the cash holding. Regression (5) gives the regression result for the model without considering the impact of CEO inside debt compensation.

[Insert Table 4-4 around here]

We find positive and significant coefficients on *DIF_TCASH* in all five models. This result indicates that firms generally adjust their cash ratio towards their target. The coefficient on *DIF_TCASH* in Regression (5) is 0.2334, indicating that the sample firms closed up 23.34% of the gap between the actual cash ratio and the target without considering the impact of CEO inside debt compensation. We noticed that the significance of some control variables had changed significantly from the regression result given by Table 4-3. For instance, the coefficient on *MTB* becomes insignificant. Existing studies on the adjustment speed of cash holding also fails to document a significant impact of *MTB* on the adjustment speed of cash. Jiang and Lie (2016) find that the Tobins'Q has a positive and significant impact on the adjustment speed when the actual cash holding is below the target while a negative and insignificant impact on the adjustment speed when the actual cash holding is above the target. Given that high *MTB* ratio is a proxy for financial distress costs, high *MTB* ratio may motive firms to accumulate cash regardless of the relative relationship between actual cash level and the target. Therefore, it is possible that the impact of *MTB* on the adjustment speed of cash is neutral before dividing the sample into subgroups based on the target cash level. Most of the compensation-based control variables including *CEO_CASH_COMP_TC*, *DV* ratio and *VEGA_TC* do not exert a significant impact on the adjustment speed of cash holding under the whole sample. Section 4.2 points out that cash compensation does not affect CEO risk preference. We also find that part of our regression results shows a negative impact of *CEO_EQUITY_HOLDINGS_TC*, *DV* ratio and *VEGA_TC* on the adjustment speed of cash holding. Existing studies documents a mixed impact of CEO equity compensation on the risk-taking behaviour of CEOs. (Caliskan and Doukas, 2015; John and John, 1993). The findings show that high equity or high Vega compensated CEOs are likely to take risks regarding the cash policy when there is a deviation between the actual cash level and the target.

When examining the impact of CEO inside debt on the adjustment speed of cash holding, we document insignificant coefficients on the interaction terms between the difference from the target cash ratio and the CEO inside debt based measures. The overall results show that although CEO inside debt may accelerate the adjustment speed of cash holding, the relationship is not strong. Since CEOs with high inside debt compensation are risk averse and thus favour having cash, they may implement an asymmetric cash adjustment policy in respect to the different relationships between the actual cash holding and the target cash holding. As illustrated in our hypothesis development, we assume that the relationship between CEO inside debt and cash holding adjustment speed is positive when the actual cash holding is below the target but negative when the actual cash holding is above the target. According to our assumptions, we separate our whole sample into two sub-samples based on the relationship between the lagged cash ratio and the target cash ratio.

Table 4-5 illustrates the relationship between CEO inside debt compensation and the adjustment speed of cash holding when the actual cash level is below the target cash level. The baseline regression reported in Regression (5) shows that the estimated adjustment speed of cash holding when the actual cash ratio is below the target is 12.31% each year. Regressions (1) to (4) all report the positive and significant impact of CEO inside debt compensation on the adjustment speed of cash holding. Given a one unit increase in CEO relative leverage, CEO relative incentive ratio or CEO relative incentive ratio adjusted for cash compensation, the adjustment speed of cash holding increases by 40.21%, 27.61% and 2.45% respectively. As shown in Regression (2), compared with firms that have a low level of CEO relative leverage, firms with a high level of CEO relative leverage increase their adjustment speed of cash holding by 16.95%.

[Insert Table 4-5 around here]

This result conforms to our hypothesis that CEOs with high inside debt compensation have a low risk preference which motivates them to reject riskier investment and financing policies. When the actual cash holding is below the target, these risk-averse CEOs prefer to have a higher level of cash holding and therefore accelerate the adjustment speed of cash.

We then investigate the relationship between CEO risk preference and the adjustment speed of cash holding when the actual cash level is above the target cash level. As shown in Regression (5) in Table 4-6, the estimated adjustment speed of the cash ratio is 21.31% each year when the actual cash ratio is above the target cash ratio. The adjustment speed of high cash ratio firms is much higher than the coefficient on *DIF_TCASH* (12.31%) given by Regression (5) in Table 4-5, where the actual cash holding is below the target. This indicates that it is much easier for firms to adjust their cash ratio towards the target when the cash level is above the target than when the cash level is below the target. The result is consistent with common sense phenomenon and is in line with the findings by Jiang and Lie (2016), which shows that across all sample firms, the adjustment speed is faster if the cash level is above the target than if it is below. Jiang and Lie (2016) conjecture that the costs of increasing the cash ratio exceed the costs of lowering it, in which case the adjustment speed of cash would be faster when the cash ratio is above the target, all else equal. In other words, it is cheaper to disgorge cash than it is to raise cash. When examining the coefficients on the compensation based control variables, we find that the coefficients on the *VEGA_TC* are all negative and significant. The finding indicates that Vega compensation motive CEOs to reduce the adjustment speed of cash when the cash level is below the target. Given that a firm is facing the risk of underinvestment when the cash level is below the target, the finding is consistent with the risk increasing role of *Vega* in the CEO's compensation.

[Insert Table 4-6 around here]

As reported in Regressions (1) to (4), the results show that the coefficients on the interaction terms between the difference in actual cash from the target and the CEO inside debt measures are negative and significant. These negative coefficients imply that when the actual cash holding is above the target, CEO inside debt compensation decelerates the adjustment of cash towards the target. These figures confirm the asymmetric impact of CEO inside debt compensation on the adjustment speed of cash holding, which provides evidence to support our hypotheses H2a and H2b. To further examine the impact of inside debt compensation on the adjustment speed of cash holding in more detail, we focus on the coefficient on the interaction term. Given a one unit increase in CEO relative leverage, CEO relative incentive ratio or CEO relative incentive ratio adjusted for cash compensation, the adjustment speed of cash holding decreases by 12.84%, 16.49% and 0.75% respectively. As shown in Regression (2), compared with firms with a low level of CEO relative leverage, those firms with a high level of CEO relative leverage decrease their adjustment speed of cash holding by 6.95%. Although the impact of CEO inside debt compensation on the adjustment speed remains significant when the cash level is above the target, the absolute value of the coefficients are lower than those shown in Table 4-5, indicating a more pronounced impact of CEO inside debt compensation on the adjustment speed of cash holding when there is insufficient cash. Though Table 4-5 documents negative and significant impact of *VEGA_TC* on the adjustment speed of cash holding, Table 4-6 shows that the impact becomes insignificant when the actual cash level is above the target. This relationship between *VEGA_TC* and the adjustment speed of cash holding can be explained as follows: High Vega compensation motive CEOs to take risks. When the cash level is above the target, firms face the risk of overinvestment and the high cost of holding cash. High Vega compensation reduces CEOs' incentive to reduce these risks. The higher adjustment speed of cash holding, together with the reduced impact of CEO inside debt compensation, suggests that when the cash level is above the target, the desire of CEOs with high inside debt compensation to accumulate or reduce the dissipation of cash has to be compromised due to other factors, such as the pressure from shareholders. In other words, it is likely that the negative impact of CEOs with high inside debt compensation is reduced when the cash level is above the target due to the confliction of interest between the CEO and the shareholders. It does not necessarily mean that CEOs with high inside debt compensation have to accelerate the adjustment speed of cash holding under the pressure of shareholders.

The results reported in Table 4-6 confirm our hypothesis that having CEOs with high inside debt compensation accelerates the adjustment towards the target when the actual cash ratio is below the target, while it decelerates the adjustment towards the target when the actual cash ratio is above the target. We also noticed that the extent of the impact of CEO inside debt on the cash holding adjustment speed is reduced when the cash level is above the target. As explained above, when the cash level is above the target, CEOs face pressure from parties of interest to make investments or implement a payout policy. From common sense phenomenon, parties of interest, such as shareholders, expect a firm to make better use of the cash reserve when the cash level is above the target. Therefore, there is a confliction in the interest between CEOs with high inside debt compensation and the shareholders when the cash level is above the target. On the one hand, CEOs with high inside debt compensation wish to accumulate cash regardless of the relative relationship between actual cash level and the target. On the other hand, parties of interest, especially the shareholders, wish to adjust the cash level towards the target to reduce the cost associated with holding either insufficient cash or with excess cash. Regarding the possible pressure from shareholders, we expect that the negative impact of CEOs with high inside debt compensation on the adjustment speed of cash holding will be reduced when the cash level is above the target. Therefore, our hypothesis is consistent with our hypothesis H2b, "Firms with high inside debt compensation CEO have lower adjusting speed of cash holding when the actual cash holding is above its target.

To examine our hypothesis H3 that CEO inside debt compensation has an asymmetric impact on the adjustment speed of cash holding under different levels of institutional ownership, we divided our sample into two subgroups based on the firm's level of institutional ownership. A firm has high institutional ownership if its institutional ownership is among the top 25% of the firms in the same industry-year.

Table 4-7 shows the impact of institutional ownership on the relationship between CEO inside debt compensation and the cash holding adjustment speed when the actual cash holding is below the target. Regressions (1) to (5) report the results of the subgroup with a high level of institutional ownership. Similarly to the results shown in Table 4-5, all four interaction terms are positive. Three of the interactions are significant at the 10% level. The findings indicate that a high level of institutional ownership reduces the adjustment speed of cash holding. Regressions (6) to (10) report the results for the subgroup with a low level of institutional ownership. Only two out of four coefficients on the interaction terms are positive and significant. In addition, we find that CEOs with accelerate the adjustment speed of cash more under high institutional ownership than under low institutional ownership, when comparing the corresponding coefficients on the interaction terms between the two subsamples. The findings indicate that when the actual cash level is below the target, institutional investors will encourage risk-averse CEOs to increase cash holding. It is worth noting that three out of five coefficients on *VEGA_TC* are negative and significant at 5% level when the actual cash holding is below the target under low institutional ownership. The results indicate that given the lower quality of monitoring given by institutional investors, the CEOs with higher Vega compensation are more likely to decrease the adjustment speed of cash when there is a negative deviation between the actual cash level and the target. From the standpoint of risk reduction, a firm should adjust towards its target to avoid the risk of operating with insufficient cash. Therefore, the finding confirms the view of Armstrong and Vashishtha (2012) that CEOs with high Vega compensation are motivated to increase the total risk of a firm.

[Insert Table 4-7 & Table 4-8 around here]

Table 4-8 displays the results of testing the impact of institutional ownership on the relationship between CEO inside debt compensation and the cash holding adjustment speed when the cash level is above the target. Regressions (1) to (5) present the results for the subgroup with a high level of institutional ownership while Regressions (6) to (10) show the results for the subgroup with a low level of institutional ownership. Similarly to the results presented in Table 4-6, most of the coefficients on the interaction terms are negative. None of the interactions between DIF_TCASH and

CEO inside debt measures provided by Regressions (1) to (4) are significant, indicating that the adverse impact of high inside debt compensation on the adjustment speed of cash holding is eliminated under high institutional ownership. Two of the interaction terms in models (6) to (9) are negative and significant. The results indicate that the negative impact of CEO inside debt compensation on the adjustment speed of cash holding is weaker when institutional ownership is higher. In addition, we notice that the adjustment speed of cash holding decreases more when institutional ownership is low by comparing the results of the model (2) and (4) with those of model (7) and (9). The results support our hypothesis H3b that the negative impact of CEO inside debt compensation on the adjustment speed of cash holding is weaker under the condition of high institutional ownership when the actual cash level is above the target. As discussed in the hypothesis development, when the actual cash ratio is above the target, the lower impact of CEO inside debt compensation on the adjustment speed of cash under high institutional ownership can be explained as followings: The percentage of institutional ownership is positively correlated with the quality of corporate governance. Since the difference between actual cash level and the target induces high cost of holding cash, the institutional investors have an incentive to adjust the firm’s cash level towards the target to reduce such cost. Therefore, firms with high institutional ownership may accelerate the adjustment speed of cash holding which reduces the adverse impact of CEO inside debt compensation on the cash holding adjustment.

We also find that the significance level of coefficients on CEO compensation-based control variables, such as *CEO_CASH_COMP_TC*, *CEO_EQUITY_HOLDINGS_TC*, *DV* and *VEGA_TC*, change significantly under the two subgroups. For example, the coefficients on *CEO_CASH_COMP_TC* are mostly positive and significant under high institutional ownership while it is insignificant under low institutional ownership. On the opposite, the coefficients on *DV* are insignificant under high institutional ownership while it is negative and significant under low institutional ownership. The findings further confirm that institutional investors may enhance the positive impact while reducing the negative impact of CEO compensation incentives on the adjustment speed of cash holding regardless of the relative relationship between the actual cash level and the target.

4.6.3. The impact of CEO inside debt compensation on inadequate and excess cash

Given the significant impact of the CEO inside debt compensation incentive on the adjustment speed of cash holding, we tried to find out whether the accumulation of cash or dissipation of cash is the main way in which CEOs can affect the adjustment speed of cash holding. Our model is specified as in Equation (4.8), whereby we regress the difference between the excess cash ratio from the current year to the next year against the current year's industry trend and the current year's CEO inside debt proxy. Table 4-9 reports the influence of CEO inside debt on the dissipation of negative excess cash (actual cash ratio below target level).

The coefficients on the inside debt compensation measures in Regressions (1) to (4) in Table 4-9 are all negative and significant except for the coefficient on the CEO incentive ratio. The negative sign suggests that CEOs with high inside debt compensation decelerate the dissipation of negative excess cash. First, the dependent variable is the difference between the negative excess cash at time t+1 and the negative excess cash at time t. On the one hand, the dissipation of negative excess cash is accelerated, if the difference is exaggerated. On the other hand, the dissipation of negative excess cash is decelerated, if the difference is reduced. Our regression result shows that three out of four measures for CEO compensation incentive show a negative relationship between inside debt compensation and the dependent variable. The result suggests that there is a negative impact of CEO inside debt compensation on the dissipation of cash when the actual cash holding is below the target.[18]

[Insert Table 4-9 & Table 4-10 around here]

Table 4-10 presents the results for the regressions which test the impact of CEO inside debt on the dissipation of excess cash (actual cash ratio above target level). The coefficients on the inside debt measures through Regressions (1) to (4) are all negative and significant, which indicates that CEO inside debt compensation adversely affects the dissipation of excess cash. This finding shows that risk-averse CEOs with high inside debt are reluctant to spend both excess cash and negative excess cash.

18 The method we applied to examine the impact of inside debt compensation on the dissipation of excess cash is the same as the one applied by Jiang and Lie (2016), which examines the impact of CEO entrenchment on the dissipation of cash. In the Table 5 of Jiang and Lie (2016), they regress changes in the excess cash ratio from year t to t + 1 for those firm-years that have positive excess cash in year t against an industry trend variable and their entrenchment measures. They reasoned that "since the coefficients on BCL dummy and Delaware × After95 are both positive with p-values of 0.007 and 0.013, respectively, the exogenous entrenchment shocks decelerate the dissipation of excess cash." Please note that Opler et al (1999), a key paper on cash holding, also use "negative excess cash" to show that the actual cash level is below the target.

Table 4-11 and Table 4-12 give the regression results of Equation (4.9) which measures the impact of CEO risk preference on the accumulation of cash. Equation (4.9) regresses the difference between the excess cash ratio of the current year and the previous year against the previous year's industry trend and the previous year's CEO inside debt proxy.

[Insert Table 4-11 & Table 4-12 around here]

As reported in Table 4-11 and Table 4-12, most coefficients on the CEO inside debt measures are insignificant. This result shows that CEO inside debt compensation does not affect the accumulation of cash, regardless of the relative relationship between the actual cash ratio and the target cash ratio. The results displayed in Table 4-9 to Table 4-12 suggest that the major channel for CEOs with high inside debt compensation to exert an influence on cash policy is through reduced dissipation of cash rather than accumulation of cash.

4.6.4. CEO inside debt compensation and dissipation channels of cash

To further examine how CEO inside debt compensation affects the way in which firms dissipate cash, we examine the main methods of cash dissipation through which CEOs with high inside debt compensation may exert an influence. As described by Gao *et al.* (2013), there are three major ways for firms to dissipate cash: investment (*INVESTMENT*), which is the total value of capital expenditure, research and development expenses and expenditure on acquisitions; payout (*PAYOUT*), which is the sum of dividend payments and share repurchasing; and long-term debt retirement (*DLTR_AT*). We estimate the impact of CEO inside debt compensation on the change in dissipation by regressing the difference between the dissipation and the forward value of dissipation on CEO inside debt measures. The differences between the current value and the forward value of the three methods of dissipation are shorthand for *FDINVESTMENT*, *FDPAYMENT,* and *FDDLTR_AT* respectively.

Table 4-13 and Table 4-14 report the impact of CEO inside debt on the forward change in investment. The results produced by Regressions (1) to (4) in Table 4-13 show a positive and significant relationship between CEO inside debt compensation and the forward change in investment when the cash ratio is below the target. This finding is worth noting since most existing literature assumes that there is a negative relationship between inside debt compensation and firm investments such as R&D. Lee *et al.* (2016) argue that the risk-reducing incentive of CEOs with inside debt compensation does not necessarily reduce the capital expenditure. CEO inside debt reduces both marginal demand for risky investments and the cost of external debt financing. Therefore, while risky investments are reduced, inside debt can motivate CEOs to adopt safer investments to compensate. Lee *et al.* (2016) highlight the positive impact of CEO inside debt on investment when the firm has cash constraints and external funding requirements. Therefore, our finding that CEO inside debt has a positive effect on investment when there is a lack of cash (cash constraints) is consistent with the findings of Lee *et al.* (2016).

[Insert Table 4-13 & Table 4-14 around here]

The coefficients on the measures for CEO inside debt compensation are only significant and positive as shown in Regression (2) in Table 4-14. This result does not support the positive impact of CEO inside debt on the forward change in investment when the cash ratio is above the target. We also note that the significance of the coefficient on some control variables has changed significantly between results reported in Table 4-13 and Table 4-14. While *CASH_FLOW* shows a positive and significant impact on the firms' change in investment when the cash level is below the target, its impact becomes insignificant for three out of four regressions when the cash level is above the target. The results confirm that cash plays a determent role in firms' investment policy. Cash flow affects a firm's potential to make a future investment when the firm's cash holding level is below the target. The positive cash flow partly alleviates the concern in investment decisions when there is cash shortage. However, when the firm has abundant cash, the impact of the positive cash flow on a firm's future investment policy becomes weaker. Intuitively, the firm can make use of its cash stockpile for future investments rather than use the cash generated by the cash flow.

Table 4-15 and Table 4-16 show the results of the tests on the impact of CEO inside debt compensation on the forward change in payout. Table 4-15 reveals mixed signs for the coefficients on CEO inside debt measures. Although we find the coefficient on the CEO relative incentive ratio adjusted for cash compensation to be negative and significant at the 5% level, all the other measures are insignificant. The overall result is too weak to reveal a negative impact of CEO inside debt compensation on a firm's payout when the actual cash ratio is below the target.

[Insert Table 4-15 & Table 4-16 around here]

Table 4-16 illustrates the relationship between CEO inside debt compensation and the forward change in payout when the actual cash ratio is above the target. Two CEO inside debt measures, CEO relative leverage, and CEO relative incentive ratio are positive and significant at the 10% and 5% level respectively. These results partly confirm the notion that when the cash level is above the target, CEO inside debt compensation has a positive impact on the payout. It is worth noting that the significance level of the coefficient on *VEGA_TC* is negative and significant at 5% level. Using cash holding for dividend payment is considered as a conservative and less risky strategy compared with other investments. The finding is consistent with the view that high Vega compensation motive CEOs to take more risks..

[Insert Table 4-17 & Table 4-18 around here]

Table 4-17 and Table 4-18 show the impact of CEO inside debt on the forward change in debt retirement. While only the coefficient on CEO relative leverage is negative and significant at the 10% level, as reported in Table 4-17, three out of the four measures in Table 4-18 are negative and significant. This result suggests that the impact of CEO inside debt compensation on the forward change of debt retirement is only pronounced when the actual cash ratio is above the target.

The overall result shows that CEOs' inside debt compensation mainly affects the investment channel of dissipation when there is inadequate cash, while it primarily has an impact on the debt retirement channel of dissipation when the cash level is above the target.

4.6.5. Robustness check with cash target generated by GMM estimated target cash ratio

To test the robustness of the relationship between CEO inside debt compensation and the adjustment speed of cash holding, we adopt the dynamic panel regression derived by Faulkender *et al.* (2012):

$$Cash^{*}_{i,t} = \beta X_{i,t-1} + \varepsilon_{i,t} \tag{4.10}$$

As is suggested by Blundell and Bond (1998) and Flannery and Hankins (2013), who derive the alternative cash target level using the GMM specification, we repeat the regressions to test our hypotheses H2a and H2b on the relationship between CEO inside debt and the adjustment speed of cash holding. We adopt the following equation to give the GMM estimated target cash ratio[19]:

$$Cash_{i,t} = \lambda\beta X_{i,t-1} + (1-\lambda)Cash_{i,t-1} + \varepsilon_{i,t} \tag{4.11}$$

Table 4-19 and Table 4-20 report the relationship between CEO inside debt and the

19 Detailed information on the specification of our GMM model for cash-target is available upon request.

adjustment speed of cash holding with the GMM derived target cash ratio. The *DIF_TCASH* is the difference between the target cash ratio derived from the GMM model and the actual cash ratio. We observe a positive and significant *DIF_TCASH* in all models which indicates that the firms are adjusting their cash ratio towards the target. The coefficients on the interaction terms are all positive and highly significant at least at the 5% level, which further confirms the results shown in Table 4-5 to the effect that a higher level of inside debt compensation is correlated with a higher adjustment speed of cash holding when there is inadequate cash.

[Insert Table 4-19 & Table 4-20 around here]

The coefficients on the interaction terms given in Table 4-20 are all negative while two of them are significant. This result partly supports the result shown in Table 4-6 which indicates that CEOs with high inside debt compensation are less likely to accelerate the adjustment speed of cash holding when the cash level is above the target. This result indicates that the documented influence of CEO inside debt compensation on the adjustment speed of cash holding is consistent under both model specifications.

4.7. Conclusion

Existing studies have examined the relationship between the CEO compensation incentive and firm cash holding. They have generated fruitful but mixed results on the relationship between CEO incentive (measured by Vega, Delta, inside debt compensation and equity compensation) and the level of cash holding, as well as the value of cash holding. Our study focuses on the CEO risk preference measured by inside debt compensation and extends the existing literature on the relationship between the CEO risk preference and cash holding by examining two new dimensions, namely the adjustment speed of cash holding and the channels through which CEO compensation may exert such an impact. Our updated study, which covers the period from 2006 to 2014, contributes to the research on inside debt, information about which has only been available since 2006.

Our results show that, in general, high inside debt compensation exerts a positive impact on the level of cash holding. This finding is in accord with the hypothesis that the risk bias introduced by the compensation incentive can exert an effect on the cash holding policy. When analysing the relationship between CEO inside debt compensation and the adjustment speed of cash holding, we found that CEO inside debt compensation did not exert a significant impact on the adjustment speed of cash holding before we examined the relationship between the actual cash holding and the target. When the actual cash holding is below the target, we found that high inside debt compensation accelerates the adjustment speed of cash holding but decelerates the adjustment speed when the actual cash holding is above the target. We further concluded that regardless of the difference between the actual cash level and the target, CEO inside debt compensation has an impact on the adjustment speed of cash holding mainly by adjusting the dissipation, rather than the accumulation, of cash. These findings confirm that CEOs with a low risk preference are reluctant to spend cash both when there is a lack of cash, and when there is sufficient cash. Having CEOs with high inside debt affects the dissipation of cash through increasing investment when there is inadequate cash, and through reducing debt retirement when the cash level is above the target. In addition, we documented the asymmetric impact of CEO inside debt on the adjustment speed of cash holding under different levels of institutional ownership. On the one hand, the influence of CEO inside debt compensation on the cash holding adjustment speed is more pronounced under high institutional ownership than under low institutional ownership when the actual cash level is below the target; On the other hand the influence of CEO inside debt compensation on the cash holding adjustment speed is more pronounced with a low level of institutional ownership than with a high level of institutional ownership when the actual cash level is above the target This result provides evidence that institutional owners inherently wish to accelerate the adjustment speed of cash holding regardless of the relative relationship between the actual cash level and the target.

Appendix 4-1: Definition of variables in Chapter 4

Dependent variables	
CASH_RATIO	Actual cash ratio
DIF_CASH	The difference between actual cash ratio and the target
F.D_DIF_TCASH	Factor which examines the dissipation of cash
D_DIF_TCASH	Factor which examines the accumulation of cash
FDINVESTMENT	Forward change in investment
FDPAYOUT	Forward change in payout
FDDLTR_AT	Forward change in debt retirement
Independent variables	
REL_LEV	The ratio of the CEO leverage to the firm leverage
HIGH_LEV_DUM	CEO high leverage dummy which takes one if CEO leverage is higher than firm leverage
REL_INC	CEO's relative incentive ratio
REL_INC_CA	CEO's relative incentive ratio adjusted for cash compensation
Control variables on compensation incentives	
CEO_CASH_COMP_TC	CEO's cash compensation scaled by total compensation
CEO_EQUITY_HOLDINGS_TC	CEO's equity compensation scaled by total compensation
DV	CEO's Delta to Vega ratio
VEGA_TC	CEO's Vega scaled by total compensation
Other control variables	
LN_AT	Firm size defined as the natural logarithm of total asset
CASH_FLOW	Cash flow
INDUSTRY_SIGMA	Industry cash flow risk
LEVERAGE	Firm leverage
SALES_GROWTH	Sales growth rate
MTB	Market to book ratio
NWC	Net working capital
CAPEX	Capital expenditure
ACQUISITION	Acquisition
RND	Research and development
DIV_DUMMY	Dividend dummy which takes one if the firm pays the dividend
DUMMY_RATING	Rating dummy which takes one if the firm has public debt issuance
MNC	Foreign sales percentage indicator
LN_FIRM_AGE	Natural logarithm of firm age

Table 4-1: Descriptive statistics

Statistics	Mean	Std. dev.	P25	P50	P75	N
CASH_RATIO	0.1603	0.1610	0.0400	0.1053	0.2279	10953
TCASH_RATIO	0.1606	0.0952	0.0981	0.1411	0.2035	10953
REL_LEV	2.2563	9.5458	0.0000	0.1368	0.9740	9093
HIGH_LEV_DUM	0.3747	0.4841	0.0000	0.0000	1.0000	10953
REL_INC	2.2370	10.4245	0.0000	0.1376	0.8662	6528
REL_INC_CA	41.0060	245.6567	0.3700	1.3053	4.0328	6231
CEO_CASH_COMP	0.0786	0.1241	0.0176	0.0386	0.0820	10600
CEO_EQUITY_HOLDINGS_TC	0.8194	0.1978	0.7465	0.8912	0.9601	10600
DV	22.5482	97.5679	1.5476	2.6608	6.1726	9353
VEGA_TC	0.0037	0.0040	0.0005	0.0025	0.0054	10600
LN_AT	7.4652	1.5658	6.3737	7.3857	8.5134	10953
CASH_FLOW	0.0818	0.0801	0.0536	0.0853	0.1194	10953
INDUSTRY_SIGMA	0.3462	0.3643	0.0807	0.1876	0.4864	10953
LEVERAGE	0.2213	0.1912	0.0547	0.2001	0.3274	10953
SALES_GROWTH	0.0857	0.2253	-0.0175	0.0632	0.1551	10953
MTB	1.8958	1.1225	1.2068	1.5636	2.1769	10953
NWC	0.0654	0.1432	-0.0217	0.0611	0.1526	10953
CAPEX	0.0492	0.0510	0.0180	0.0328	0.0596	10953
AQUISITION	0.0300	0.0643	0.0000	0.0008	0.0250	10953
RND	0.0310	0.0545	0.0000	0.0023	0.0392	10953
DIV_DUMMY	0.4735	0.4993	0.0000	0.0000	1.0000	10953
RATING_DUMMY	0.4977	0.5000	0.0000	0.0000	1.0000	10953
MNC	0.3354	0.4722	0.0000	0.0000	1.0000	10953
FIRM_AGE	3.0308	0.6988	2.6391	3.0910	3.6889	10953

The table gives the summary statistics for our main dependent variables, independent variables and control variables. See Appendix 4-1 for definitions of variables.

Table 4-2: Correlations matrix

	Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	*CASH_RATIO*	**1.0000**											
(2)	*TCASH_RATIO*	**0.6862**	**1.0000**										
(3)	*REL_LEV*	**0.0949**	**0.0822**	**1.0000**									
(4)	*HIGH_LEV_DUM*	**0.2023**	**0.2119**	**0.3823**	**1.0000**								
(5)	*REL_INC*	**0.0890**	**0.0697**	**0.9681**	**0.3411**	**1.0000**							
(6)	*REL_INC_CA*	**0.1748**	**0.1709**	**0.3346**	**0.0366**	**0.3448**	**1.0000**						
(7)	*CEO_CASH_COMP*	**0.0402**	**0.0930**	-0.0066	**-0.0284**	0.0118	**0.1729**	**1.0000**					
(8)	*CEO_EQUITY_HOLDINGS_TC*	**0.1463**	**0.1444**	**-0.2107**	**-0.3154**	**-0.1794**	**-0.0689**	**-0.6005**	**1.0000**				
(9)	*DV*	-0.0038	-0.0051	**-0.0312**	**-0.0337**	-0.0217	-0.0201	**-0.0617**	**0.0901**	**1.0000**			
(10)	*VEGA_TC*	**0.0574**	**0.0569**	0.0001	0.0125	**-0.0249**	0.0032	**0.0290**	**-0.0208**	**-0.2269**	**1.0000**		
(11)	*LN_AT*	**-0.3218**	**-0.4926**	**-0.0441**	**-0.0868**	**-0.0496**	**-0.1835**	**-0.2887**	**-0.0452**	**-0.0389**	**0.1333**	**1.0000**	
(12)	*CASH_FLOW*	**-0.1155**	**-0.2237**	**0.0319**	**0.0481**	**0.0317**	-0.0241	**-0.2656**	**0.2092**	0.0139	**-0.0484**	**0.1375**	**1.0000**
(13)	*INDUSTRY_SIGMA*	**0.2078**	**0.3086**	-0.0032	-0.0065	-0.0243	**0.0508**	**0.0209**	**0.0573**	-0.0095	**0.0292**	**-0.0886**	**-0.0633**
(14)	*LEVERAGE*	**-0.3340**	**-0.4323**	**-0.2299**	**-0.3969**	**-0.2113**	**-0.2128**	**0.0627**	**-0.1437**	-0.0109	0.0090	**0.2690**	**-0.1281**
(15)	*SALES_GROWTH*	**0.0510**	**0.0942**	**-0.0334**	**-0.0328**	**-0.0264**	-0.0180	**-0.1275**	**0.1766**	**0.0371**	**-0.0974**	**-0.0210**	**0.1864**
(16)	*MTB*	**0.3424**	**0.4919**	**0.0569**	**0.1656**	**0.0434**	**0.0320**	**-0.1749**	**0.2482**	**0.0426**	**-0.0819**	**-0.1330**	**0.2122**
(17)	*NWC*	**-0.2135**	**-0.3103**	**0.0877**	**0.0986**	**0.0914**	**0.0363**	-0.0067	**-0.0216**	**0.0232**	**-0.0879**	**-0.1952**	**0.0692**
(18)	*CAPEX*	**-0.2111**	**-0.3220**	**-0.0404**	**-0.0698**	**-0.0392**	**-0.0359**	**-0.0539**	**0.0682**	**0.0592**	**-0.1115**	**0.0631**	**0.1943**
(19)	*AQUISITION*	**-0.1230**	**-0.1484**	**-0.0453**	**-0.0856**	**-0.0388**	-0.0238	**-0.0601**	**0.0679**	-0.0160	0.0001	0.0145	**0.0238**
(20)	*RND*	**0.5418**	**0.7282**	0.0094	**0.1146**	0.0049	**0.0718**	**0.0537**	**0.0886**	**-0.0354**	**0.1826**	**-0.2499**	**-0.2341**
(21)	*DIV_DUMMY*	**-0.2249**	**-0.2951**	**0.0694**	**0.1314**	**0.0336**	**-0.1032**	**-0.1542**	**-0.1249**	0.0001	**0.0353**	**0.3504**	**0.0363**
(22)	*RATING_DUMMY*	**-0.3409**	**-0.4790**	**-0.0864**	**-0.1458**	**-0.0845**	**-0.1557**	**-0.1357**	**-0.1254**	**-0.0340**	**0.0811**	**0.6669**	**0.0330**
(23)	*MNC*	**-0.0417**	-0.0108	**-0.0456**	**-0.0638**	**-0.0400**	0.0126	**0.0772**	**0.0317**	**0.0597**	**-0.1228**	**-0.1850**	0.0159
(24)	*FIRM_AGE*	**-0.1632**	**-0.2586**	**0.0547**	**0.0925**	**0.0307**	**-0.0669**	**-0.0068**	**-0.2212**	**-0.0562**	**0.0738**	**0.2942**	**-0.0474**

	Variable	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(13)	*INDUSTRY_SIGMA*	**1.0000**											
(14)	*LEVERAGE*	**-0.0680**	**1.0000**										
(15)	*SALES_GROWTH*	**0.0431**	**-0.0296**	**1.0000**									
(16)	*MTB*	**0.1198**	**-0.1092**	**0.2064**	**1.0000**								
(17)	*NWC*	**-0.1445**	**-0.2044**	-0.0172	**-0.1354**	**1.0000**							
(18)	*CAPEX*	**-0.1404**	**0.0545**	**0.0934**	-0.0001	**-0.1303**	**1.0000**						
(19)	*AQUISITION*	**0.0673**	**0.0842**	**0.2178**	**-0.0242**	-0.0023	**-0.1343**	**1.0000**					
(20)	*RND*	**0.2498**	**-0.1810**	**0.0476**	**0.2668**	**-0.1429**	**-0.1878**	0.0128	**1.0000**				
(21)	*DIV_DUMMY*	**-0.1444**	**0.0268**	**-0.1160**	0.0056	**0.0472**	0.0040	**-0.0331**	**-0.2341**	**1.0000**			
(22)	*RATING_DUMMY*	**-0.1234**	**0.4297**	**-0.0550**	**-0.1808**	**-0.1359**	**0.0743**	0.0060	**-0.2516**	**0.2447**	**1.0000**		
(23)	*MNC*	**-0.0835**	**0.0603**	**0.0641**	**0.0222**	**-0.0900**	**0.2142**	**-0.0447**	**-0.1466**	**-0.0843**	**-0.0976**	**1.0000**	
(24)	*FIRM_AGE*	**-0.1033**	**0.0220**	**-0.1504**	**-0.1363**	**0.0931**	**-0.0724**	**-0.0572**	**-0.0885**	**0.3203**	**0.2320**	**-0.1345**	**1.0000**

The table gives the pairwise correlation for our main dependent variables, independent variables and control variables. See Appendix 4-1 for definitions of variables. The numbers in Bold are significant at 5% level.

Table 4-3: The impact of CEO inside debt on firm cash holding

CASH_RATIO	(1)	(2)	(3)	(4)
REL_LEV	0.0980***			
	(4.7356)			
HIGH_LEV_DUM		0.0369***		
		(6.4971)		
REL_INC			0.0914***	
			(3.8632)	
REL_INC_CA				0.0058***
				(5.9671)
CEO_CASH_COMP_TC	-0.0003	0.0280	-0.0318	-0.0719**
	(-0.0131)	(1.0456)	(-1.1482)	(-2.4676)
CEO_EQUITY_HOLDINGS_TC	0.0530***	0.0868***	0.0546***	0.0407***
	(4.3129)	(5.1435)	(3.8026)	(2.8576)
DV	-0.0000	0.0000	-0.0000	-0.0000
	(-0.5530)	(0.1160)	(-0.6781)	(-0.8315)
VEGA_TC	0.6717	0.1492	1.0044	0.9131
	(1.1454)	(0.2601)	(1.5413)	(1.3790)
LN_AT	-0.0118***	-0.0170***	-0.0106***	-0.0095***
	(-4.5402)	(-6.4402)	(-3.5573)	(-3.2035)
CASH_FLOW	-0.0673*	-0.1077***	-0.0893*	-0.0898*
	(-1.6868)	(-3.0465)	(-1.9011)	(-1.8594)
INDUSTRY_SIGMA	0.0049	0.0014	-0.0001	-0.0008
	(0.8534)	(0.2552)	(-0.0210)	(-0.1177)
LEVERAGE	-0.1133***	-0.1388***	-0.1266***	-0.1168***
	(-6.7393)	(-8.0205)	(-6.7976)	(-6.2301)
SALES_GROWTH	0.0116	0.0153*	0.0160	0.0192*
	(1.3642)	(1.9097)	(1.5959)	(1.8757)
MTB	0.0215***	0.0215***	0.0204***	0.0200***
	(6.0026)	(7.1641)	(5.3909)	(5.1627)
NWC	-0.2798***	-0.3169***	-0.2748***	-0.2653***
	(-11.2658)	(-13.1949)	(-10.4641)	(-9.9939)
CAPEX	-0.4704***	-0.5472***	-0.4879***	-0.4776***
	(-9.5405)	(-10.7435)	(-8.4726)	(-8.8719)
AQUISITION	-0.2921***	-0.3348***	-0.2945***	-0.2902***
	(-14.4574)	(-16.3997)	(-13.0800)	(-12.7070)
RND	0.6636***	0.5515***	0.6926***	0.6883***
	(7.7922)	(6.9861)	(7.6259)	(7.4557)
DIV_DUMMY	-0.0189***	-0.0204***	-0.0204***	-0.0183***
	(-3.5967)	(-3.8123)	(-3.4311)	(-3.0377)
DUMMY_RATING	-0.0106*	-0.0075	-0.0132**	-0.0137**
	(-1.7650)	(-1.2332)	(-1.9753)	(-2.0502)
MNC	-0.0046	-0.0037	-0.0017	-0.0017
	(-0.7573)	(-0.5956)	(-0.2454)	(-0.2416)
LN_FIRM_AGE	-0.0026	-0.0066*	-0.0049	-0.0056
	(-0.7772)	(-1.8245)	(-1.2210)	(-1.3966)
Constant	0.1931***	0.2267***	0.1724***	0.1859***
	(4.9030)	(5.6755)	(5.0102)	(5.0666)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	7,932	9,127	6,171	5,911
R-squared	0.4921	0.5557	0.5045	0.5091

This table reports impact of CEO inside debt on cash holdings. The dependent variable is the cash ratio; the independent variables are measures for CEO inside debt compensation; We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-4: The impact of CEO inside debt on adjustment speed of cash holding

DIF_CASH	(1)	(2)	(3)	(4)	(5)
DIF_TCASH	0.2348***	0.2255***	0.2400***	0.2387***	0.2334***
	(12.5946)	(11.8937)	(11.0422)	(10.7336)	(13.7268)
*DIF_TCASH*REL_LEV*	0.0640				
	(0.8122)				
*DIF_TCASH*HIGH_LEV_DUM*		0.0194			
		(0.8760)			
*DIF_TCASH*REL_INC*			-0.0130		
			(-0.1767)		
*DIF_TCASH*INC_RATIO_CA*				0.0022	
				(0.6800)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.1149	0.1398	0.0643	0.0379	0.1131
	(1.0411)	(1.2419)	(0.4518)	(0.2538)	(1.0433)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	-0.1396**	-0.0422	-0.1545**	-0.1771**	-0.0702
	(-2.1126)	(-0.6097)	(-2.1234)	(-2.4646)	(-1.1770)
*DIF_TCASH*DV*	-0.0002**	-0.0001**	-0.0002	-0.0001	-0.0001**
	(-2.0127)	(-2.2453)	(-1.6073)	(-1.2874)	(-2.2314)
*DIF_TCASH*VEGA_TC*	-4.6131**	-4.5728**	-3.4534	-3.1949	-4.4787**
	(-1.9887)	(-2.0853)	(-1.3680)	(-1.2106)	(-2.0547)
*DIF_TCASH*LN_AT*	-0.0054	-0.0066	-0.0015	-0.0022	-0.0074
	(-0.5967)	(-0.8070)	(-0.1443)	(-0.2097)	(-0.8853)
*DIF_TCASH*CASH_FLOW*	0.1281	0.0375	0.0848	0.1110	0.0385
	(1.0838)	(0.3242)	(0.6328)	(0.8147)	(0.3306)
*DIF_TCASH*INDUSTRY_SIGMA*	0.0192	0.0260*	0.0132	0.0157	0.0257*
	(1.1393)	(1.6656)	(0.6562)	(0.7686)	(1.6474)
*DIF_TCASH*LEVERAGE*	-0.1109*	-0.0727	-0.1853***	-0.1787**	-0.0940*
	(-1.9116)	(-1.1822)	(-2.7260)	(-2.5782)	(-1.6885)
*DIF_TCASH*SALES_GROWTH*	-0.0021	0.0176	0.0031	-0.0031	0.0170
	(-0.0496)	(0.4347)	(0.0703)	(-0.0655)	(0.4199)
*DIF_TCASH*MTB*	0.0012	-0.0017	0.0039	0.0048	-0.0005
	(0.1115)	(-0.1762)	(0.3507)	(0.4236)	(-0.0527)
*DIF_TCASH*NWC*	0.2154***	0.2817***	0.2475***	0.2283***	0.2865***
	(2.9826)	(3.9236)	(2.9918)	(2.7425)	(3.9768)
*DIF_TCASH*CAPEX*	1.4067***	1.5176***	1.3734***	1.3138***	1.5260***
	(6.5985)	(6.1033)	(5.0253)	(4.4292)	(6.1046)
*DIF_TCASH*ACQUISITION*	2.4464***	2.4528***	2.4594***	2.4398***	2.4509***
	(25.4878)	(26.4184)	(23.3215)	(22.6421)	(26.4356)
*DIF_TCASH*RND*	0.5170**	0.5066**	0.6128**	0.6211**	0.5094**
	(2.2119)	(2.4008)	(2.2594)	(2.2511)	(2.4077)
*DIF_TCASH*DIV_DUMMY*	-0.0293	-0.0231	-0.0269	-0.0265	-0.0222
	(-1.4027)	(-1.1991)	(-1.1682)	(-1.1087)	(-1.1430)
*DIF_TCASH*DUMMY_RATING*	0.0387*	0.0371*	0.0426*	0.0401*	0.0369*
	(1.9526)	(1.9109)	(1.8236)	(1.6553)	(1.9009)
*DIF_TCASH*MNC*	-0.0130	-0.0174	-0.0251	-0.0262	-0.0189
	(-0.6844)	(-0.9705)	(-1.1594)	(-1.1750)	(-1.0697)
*DIF_TCASH*LN_FIRM_AGE*	-0.0134	0.0006	-0.0306*	-0.0312*	0.0004
	(-0.8697)	(0.0437)	(-1.6906)	(-1.6783)	(0.0322)
Constant	-0.0232***	-0.0213***	-0.0324***	-0.0293***	-0.0212***
	(-4.0493)	(-3.8418)	(-6.7680)	(-4.2319)	(-3.7446)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	7,677	8,799	5,983	5,726	8,799
R-squared	0.3652	0.3501	0.3598	0.3547	0.3499

This table reports the impact of the CEO inside debt on the cash adjustment speed. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV, REL_INC*, and *REL_INC_CA*) are centred by their industry-year median; the control variables include firm characteristics. Year and industry dummies (based on 48 industries categories) are included to control for year and industry fixed effects. T-values based on standard errors robust to clustering by the firm are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4-5: The impact of CEO inside debt on adjustment speed of cash holding when actual cash is below target

DIF_CASH	(1)	(2)	(3)	(4)	(5)
DIF_TCASH	0.1386***	0.0792**	0.1354***	0.1531***	0.1231***
	(4.5801)	(2.4752)	(4.0261)	(4.6000)	(3.6955)
*DIF_TCASH*REL_LEV*	0.4021***				
	(2.7325)				
*DIF_TCASH*HIGH_LEV_DUM*		0.1695***			
		(4.3150)			
*DIF_TCASH*REL_INC*			0.2761*		
			(1.8126)		
*DIF_TCASH*REL_INC_CA*				0.0245***	
				(4.1686)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.0827	0.1826	0.0505	-0.0743	-0.0437
	(0.7776)	(1.3697)	(0.4082)	(-0.5875)	(-0.3749)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	0.0521	0.2263**	0.1129	0.0488	-0.0236
	(0.8137)	(2.4888)	(1.4563)	(0.6214)	(-0.3546)
*DIF_TCASH*DV*	-0.0000	0.0000	0.0000	0.0000	0.0000
	(-0.1594)	(0.6085)	(0.0255)	(0.1946)	(0.2598)
*DIF_TCASH*VEGA_TC*	-7.8922***	-9.9005***	-6.3532**	-6.0425**	-9.1149***
	(-3.1096)	(-3.4049)	(-2.3137)	(-2.2421)	(-3.0670)
*DIF_TCASH*LN_AT*	0.0088	-0.0074	0.0106	0.0149	-0.0119
	(0.9124)	(-0.7499)	(0.9976)	(1.4367)	(-1.1598)
*DIF_TCASH*CASH_FLOW*	0.2672*	0.0263	0.3494**	0.3675**	0.0518
	(1.8623)	(0.1831)	(2.3012)	(2.4447)	(0.3463)
*DIF_TCASH*INDUSTRY_SIGMA*	-0.0065	0.0076	-0.0249	-0.0193	-0.0015
	(-0.3285)	(0.3413)	(-1.1690)	(-0.8820)	(-0.0704)
*DIF_TCASH*LEVERAGE*	-0.0618	-0.1196	-0.0544	-0.0038	-0.2868***
	(-0.6248)	(-1.1419)	(-0.4578)	(-0.0320)	(-2.8001)
*DIF_TCASH*SALES_GROWTH*	-0.0930*	-0.1037*	-0.0560	-0.0752	-0.1285**
	(-1.8421)	(-1.7332)	(-1.0652)	(-1.4923)	(-2.0547)
*DIF_TCASH*MTB*	0.0122	0.0070	-0.0005	0.0016	0.0186
	(0.9984)	(0.5959)	(-0.0432)	(0.1474)	(1.5764)
*DIF_TCASH*NWC*	-0.1237	-0.1550*	-0.0883	-0.0918	-0.1285
	(-1.5072)	(-1.6974)	(-0.9102)	(-0.9430)	(-1.3166)
*DIF_TCASH*CAPEX*	-1.0867***	-1.2265***	-1.0916***	-0.9914***	-1.1352***
	(-3.3958)	(-3.1696)	(-3.0161)	(-2.8802)	(-2.8749)
*DIF_TCASH*ACQUISITION*	-1.4811***	-1.7919***	-1.5488***	-1.4936***	-1.8552***
	(-7.6502)	(-8.5887)	(-6.5559)	(-6.3377)	(-8.5449)
*DIF_TCASH*RND*	-0.0802	-0.3172	0.0475	-0.0329	-0.2732
	(-0.2295)	(-0.8019)	(0.1202)	(-0.0903)	(-0.6938)
*DIF_TCASH*DIV_DUMMY*	-0.0667***	-0.0775***	-0.0585**	-0.0604**	-0.0635***
	(-3.2960)	(-3.7277)	(-2.2882)	(-2.3189)	(-3.1129)
*DIF_TCASH*DUMMY_RATING*	0.0099	0.0221	0.0028	-0.0148	0.0277
	(0.3854)	(0.8465)	(0.0986)	(-0.5077)	(1.0406)
*DIF_TCASH*MNC*	-0.0190	-0.0012	-0.0069	-0.0184	-0.0075
	(-0.8478)	(-0.0472)	(-0.2630)	(-0.7243)	(-0.2828)
*DIF_TCASH*LN_FIRM_AGE*	-0.0020	-0.0174	-0.0186	-0.0142	-0.0148
	(-0.1382)	(-1.0960)	(-1.0447)	(-0.8029)	(-0.8942)
Constant	-0.0098**	-0.0088**	-0.0092	-0.0086	-0.0082**
	(-2.5024)	(-2.5225)	(-1.5326)	(-0.9021)	(-2.0171)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	4,754	5,160	3,700	3,536	5,160
R-squared	0.0981	0.1194	0.0930	0.0995	0.1087

This table reports the impact of the CEO inside debt on the cash adjustment speed. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV*, REL_INC, and *REL_INC_CA*) are centred by their industry-year median; We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-6: The impact of CEO inside debt on adjustment speed of cash holding when actual cash is above target

DIF_CASH	(1)	(2)	(3)	(4)	(5)
DIF_TCASH	0.2395***	0.2440***	0.2585***	0.2556***	0.2131***
	(8.0716)	(8.2198)	(7.7073)	(7.2214)	(8.3204)
*DIF_TCASH*REL_LEV*	-0.1284***				
	(-2.7016)				
*DIF_TCASH*HIGH_LEV_DUM*		-0.0695**			
		(-2.5652)			
*DIF_TCASH*REL_INC*			-0.1649**		
			(-2.1382)		
DIF_TCASH REL_INC_CA*				-0.0075**	
				(-2.2187)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.3450*	0.2393	0.3278	0.4634	0.3283**
	(1.8173)	(1.3881)	(1.1940)	(1.5589)	(2.0175)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	-0.2321**	-0.1311	-0.2854***	-0.2475**	-0.0349
	(-2.2869)	(-1.3800)	(-2.7187)	(-2.3465)	(-0.4519)
*DIF_TCASH*DV*	-0.0002	-0.0002**	-0.0003*	-0.0003*	-0.0002***
	(-1.4594)	(-2.3039)	(-1.7774)	(-1.7067)	(-2.5855)
*DIF_TCASH*VEGA_TC*	-4.1681	-3.3993	-4.5648	-4.8081	-3.7284
	(-1.2987)	(-1.1511)	(-1.2370)	(-1.2102)	(-1.2770)
*DIF_TCASH*LN_AT*	-0.0103	-0.0087	-0.0049	-0.0080	-0.0057
	(-0.8055)	(-0.7529)	(-0.3325)	(-0.5228)	(-0.4884)
*DIF_TCASH*CASH_FLOW*	0.0966	0.0679	-0.0317	-0.0048	0.0704
	(0.5758)	(0.4223)	(-0.1665)	(-0.0244)	(0.4425)
*DIF_TCASH*INDUSTRY_SIGMA*	0.0742**	0.0753***	0.0817**	0.0853**	0.0739***
	(2.1091)	(2.7528)	(1.9862)	(2.0278)	(2.7099)
*DIF_TCASH*LEVERAGE*	-0.2234***	-0.1448*	-0.3206***	-0.3498***	-0.0618
	(-2.9667)	(-1.7252)	(-3.7151)	(-3.9154)	(-0.8956)
*DIF_TCASH*SALES_GROWTH*	0.0162	0.0313	0.0030	0.0052	0.0297
	(0.3010)	(0.6371)	(0.0506)	(0.0809)	(0.6014)
*DIF_TCASH*MTB*	0.0145	0.0025	0.0308*	0.0331*	-0.0027
	(0.9151)	(0.1950)	(1.7917)	(1.9178)	(-0.2096)
*DIF_TCASH*NWC*	0.4937***	0.5405***	0.5122***	0.4945***	0.5143***
	(4.2485)	(4.8414)	(3.6824)	(3.4855)	(4.7577)
*DIF_TCASH*CAPEX*	2.1738***	2.2037***	2.2756***	2.2067***	2.1781***
	(8.0753)	(6.7473)	(6.3433)	(5.4731)	(6.7596)
*DIF_TCASH*ACQUISITION*	2.6859***	2.6695***	2.7077***	2.7037***	2.6842***
	(24.1756)	(24.8430)	(21.9716)	(21.1422)	(24.7675)
*DIF_TCASH*RND*	0.9592***	0.9692***	0.8707**	0.8282**	0.9626***
	(3.2936)	(4.1614)	(2.5592)	(2.4109)	(4.1838)
*DIF_TCASH*DIV_DUMMY*	0.0212	0.0339	0.0144	0.0213	0.0317
	(0.7331)	(1.2333)	(0.4703)	(0.6637)	(1.1726)
*DIF_TCASH*DUMMY_RATING*	0.0098	0.0087	0.0222	0.0183	0.0092
	(0.3397)	(0.3115)	(0.6431)	(0.5052)	(0.3259)
*DIF_TCASH*MNC*	-0.0008	-0.0377	-0.0224	-0.0316	-0.0348
	(-0.0273)	(-1.5709)	(-0.6712)	(-0.9300)	(-1.4040)
*DIF_TCASH*LN_FIRM_AGE*	-0.0348	-0.0077	-0.0550**	-0.0546**	-0.0066
	(-1.5322)	(-0.3866)	(-2.0365)	(-1.9761)	(-0.3276)
Constant	-0.0167	-0.0157	-0.0812***	-0.0823***	-0.0203
	(-0.7028)	(-0.7246)	(-10.5818)	(-10.2739)	(-1.0292)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	2,923	3,639	2,283	2,190	3,639
R-squared	0.4732	0.4404	0.4752	0.4666	0.4387

This table reports the impact of the CEO inside debt on the cash adjustment speed when the actual cash ratio is above the target. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV*, *REL_INC*, and *REL_INC_CA*) are centred by their industry-year median. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-7: The impact of institutional ownership on the relationship between CEO inside debt compensation incentive and adjustment speed of cash holding when actual cash ratio is below target

	High Institutional Holdings					Low Institutional Holdings				
DIF_CASH	(1)	(2)	(3)	(4)	(5)	（6）	（7）	（8）	（9）	（10）
DIF_TCASH	0.1642***	0.1051	0.1373*	0.0959	0.1604**	0.0997***	0.0549	0.1096***	0.1377***	0.0989***
	(2.6439)	(1.6083)	(1.9080)	(1.3662)	(2.2992)	(2.8726)	(1.5706)	(2.8396)	(3.6599)	(2.6746)
*DIF_TCASH*REL_LEV*	0.3805*					0.3051				
	(1.8071)					(1.3146)				
*DIF_TCASH*HIGH_LEV_DUM*		0.1644**					0.1505***			
		(2.3705)					(3.4567)			
*DIF_TCASH*REL_INC*			0.2031					0.1486		
			(0.8318)					(0.5221)		
*DIF_TCASH*REL_INC_CA*				0.0324***					0.0231*	
				(2.6235)					(1.7688)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.2648	0.2635	0.6079	0.2957	-0.0403	0.0550	0.1640	-0.1369	-0.2140	-0.0587
	(0.6825)	(0.5743)	(1.2898)	(0.6469)	(-0.0983)	(0.4052)	(1.0889)	(-0.9305)	(-1.4365)	(-0.4527)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	0.4454**	0.6173**	0.5676**	0.5621**	0.3096	-0.0478	0.1580	-0.0158	-0.0690	-0.0998
	(2.3803)	(2.1644)	(2.3997)	(2.3761)	(1.3296)	(-0.5720)	(1.4830)	(-0.1901)	(-0.8834)	(-1.3624)
*DIF_TCASH*DV*	-0.0002	-0.0003*	-0.0001	-0.0001	-0.0003*	0.0000	0.0001	0.0000	0.0000	0.0001
	(-1.1064)	(-1.7642)	(-0.8474)	(-0.6197)	(-1.7367)	(0.1597)	(1.0913)	(0.0401)	(0.3241)	(0.8929)
*DIF_TCASH*VEGA_TC*	-10.0874	-7.9842	-9.6424	-6.2783	-8.9772	-7.3291**	-8.7583**	-4.8775	-4.2725	-7.4507**
	(-1.6025)	(-1.2801)	(-1.4288)	(-0.9194)	(-1.4367)	(-2.4052)	(-2.5231)	(-1.5977)	(-1.3989)	(-2.0999)
*DIF_TCASH*LN_AT*	-0.0189	-0.0251	0.0081	0.0096	-0.0326	0.0014	-0.0081	-0.0004	0.0034	-0.0117
	(-0.6737)	(-0.7964)	(0.2637)	(0.3081)	(-1.0385)	(0.1270)	(-0.7150)	(-0.0354)	(0.2843)	(-1.0504)
*DIF_TCASH*CASH_FLOW*	-0.2337	0.0289	-0.3881	-0.3930	0.0794	0.3260**	-0.0001	0.3892**	0.3923**	0.0315
	(-0.7592)	(0.0816)	(-1.2007)	(-1.1843)	(0.2294)	(2.0953)	(-0.0007)	(2.3903)	(2.5015)	(0.1907)
*DIF_TCASH*INDUSTRY_SIGMA*	-0.0093	-0.0201	-0.0285	0.0212	-0.0450	-0.0030	0.0077	-0.0244	-0.0236	0.0023
	(-0.1294)	(-0.2648)	(-0.3455)	(0.2567)	(-0.6049)	(-0.1340)	(0.3170)	(-1.0498)	(-1.0032)	(0.1003)
*DIF_TCASH*LEVERAGE*	0.2592	0.2400	0.2043	0.2362	0.0692	-0.2067***	-0.2320***	-0.1768*	-0.1291	-0.3967***
	(0.9979)	(0.9213)	(0.6250)	(0.7367)	(0.3006)	(-2.6451)	(-2.9051)	(-1.8876)	(-1.3577)	(-5.1690)
*DIF_TCASH*SALES_GROWTH*	-0.1010	-0.1341	-0.1477	-0.1569	-0.1493	-0.0854	-0.1179*	-0.0485	-0.0721	-0.1415**
	(-0.8395)	(-1.1598)	(-1.1711)	(-1.2087)	(-1.2693)	(-1.4295)	(-1.7460)	(-0.8143)	(-1.3187)	(-1.9928)
*DIF_TCASH*MTB*	-0.0140	0.0056	0.0081	0.0053	0.0094	0.0195	0.0072	-0.0011	0.0018	0.0203*
	(-0.5399)	(0.1970)	(0.3080)	(0.2004)	(0.3249)	(1.5040)	(0.5704)	(-0.0990)	(0.1646)	(1.6704)
*DIF_TCASH*NWC*	0.0921	0.1621	0.1323	0.0272	0.2256	-0.1714*	-0.1199	-0.1212	-0.0991	-0.1176
	(0.4958)	(0.8060)	(0.6157)	(0.1188)	(1.0874)	(-1.6596)	(-1.0308)	(-1.0308)	(-0.8742)	(-0.9869)
*DIF_TCASH*CAPEX*	-1.5472**	-2.2165***	-1.0880	-0.9383	-2.1150***	-0.7979**	-0.6281	-0.6416*	-0.5181	-0.5401
	(-2.1921)	(-3.1902)	(-1.3031)	(-1.1229)	(-3.0683)	(-2.3630)	(-1.4244)	(-1.8246)	(-1.5640)	(-1.2025)
*DIF_TCASH*ACQUISITION*	-1.4343***	-1.6370***	-1.5347***	-1.4538***	-1.6735***	-1.5154***	-1.8164***	-1.7781***	-1.7634***	-1.8383***
	(-4.0060)	(-4.2499)	(-3.5309)	(-3.1550)	(-4.1409)	(-6.7374)	(-7.6395)	(-6.4088)	(-6.2987)	(-7.6014)
*DIF_TCASH*RND*	-0.3663	-0.5486	-0.7564	-0.7043	-0.4057	-0.0694	-0.3203	0.0444	-0.1351	-0.3276
	(-0.5465)	(-0.9267)	(-0.9714)	(-0.8925)	(-0.6934)	(-0.2068)	(-0.7690)	(0.1176)	(-0.4220)	(-0.7770)
*DIF_TCASH*DIV_DUMMY*	-0.0723*	-0.0498	-0.0815*	-0.0685	-0.0526	-0.0268	-0.0391	-0.0285	-0.0348	-0.0285
	(-1.7120)	(-1.1352)	(-1.7039)	(-1.3939)	(-1.2325)	(-1.0548)	(-1.4730)	(-0.9263)	(-1.0999)	(-1.0815)
*DIF_TCASH*DUMMY_RATING*	0.0640	0.0749	0.0247	0.0239	0.0873	0.0056	0.0139	0.0078	-0.0077	0.0182
	(1.0307)	(1.1462)	(0.4036)	(0.3878)	(1.3385)	(0.2000)	(0.4743)	(0.2313)	(-0.2295)	(0.6217)

*DIF_TCASH*MNC*	-0.0243	-0.0377	0.0062	-0.0086	-0.0553	-0.0042	0.0096	-0.0037	-0.0191	0.0033
	(-0.4356)	(-0.6980)	(0.0881)	(-0.1137)	(-0.9901)	(-0.1578)	(0.3358)	(-0.1248)	(-0.6679)	(0.1170)
(Continue)										
*DIF_TCASH*LN_FIRM_AGE*	0.0198	0.0015	0.0035	0.0286	0.0007	-0.0122	-0.0204	-0.0284	-0.0248	-0.0197
	(0.5476)	(0.0392)	(0.0740)	(0.6982)	(0.0190)	(-0.7011)	(-1.1598)	(-1.4115)	(-1.2418)	(-1.0792)
Constant	-0.0245***	-0.0202**	-0.0178	-0.0180*	-0.0219**	-0.0096**	-0.0104**	-0.0113*	-0.0074	-0.0098**
	(-2.8681)	(-2.1367)	(-1.6113)	(-1.6793)	(-2.3633)	(-2.2773)	(-2.5214)	(-1.9583)	(-0.7171)	(-2.3157)
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
Observations	966	1,042	757	718	1,042	3,253	3,558	2,540	2,443	3,558
R-squared	0.1731	0.1807	0.1716	0.2012	0.1729	0.1013	0.1198	0.1009	0.1043	0.1112

This table reports the impact of the CEO inside debt on the cash adjustment speed when the actual cash ratio is below the target. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV*, *REL_INC*, and *REL_INC_CA*) are centred by their industry-year median. t We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-8: The impact of institutional ownership on the relationship between CEO inside debt compensation incentive and adjustment speed of cash holding when actual cash ratio is above target

	High Institutional Holdings					Low Institutional Holdings				
DIF_CASH	(1)	(2)	(3)	(4)	(5)	（6）	（7）	（8）	（9）	（10）
DIF_TCASH	0.2645***	0.2227***	0.2829***	0.2787***	0.2054***	0.2253***	0.2331***	0.2452***	0.2516***	0.2004***
	(6.0712)	(4.2883)	(5.9554)	(5.6285)	(4.6983)	(5.4806)	(6.1335)	(5.0817)	(4.8899)	(5.7715)
*DIF_TCASH*REL_LEV*	-0.1555					0.0227				
	(-1.4999)					(0.2151)				
*DIF_TCASH*HIGH_LEV_DUM*		-0.0371					-0.0717**			
		(-0.6825)					(-2.1994)			
*DIF_TCASH*REL_INC*			-0.0957					-0.1249		
			(-0.9270)					(-1.0367)		
*DIF_TCASH*REL_INC_CA*				0.0014					-0.0119**	
				(0.3398)					(-2.1841)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.6726**	0.4653	0.7340*	0.8830**	0.5089	0.1887	0.0745	0.1993	0.3609	0.1920
	(1.9833)	(1.2890)	(1.8199)	(2.2468)	(1.4472)	(0.7438)	(0.3484)	(0.5279)	(0.8840)	(0.9473)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	-0.0329	0.1508	-0.0384	0.0355	0.1957**	-0.3353**	-0.2429*	-0.2952*	-0.2964*	-0.1253
	(-0.2487)	(1.3026)	(-0.2083)	(0.2114)	(1.9796)	(-2.2971)	(-1.8663)	(-1.7559)	(-1.7510)	(-1.1570)
*DIF_TCASH*DV*	-0.0005	-0.0004	0.0002	0.0003	-0.0004	-0.0002	-0.0001**	-0.0004*	-0.0004*	-0.0002**
	(-0.8923)	(-1.2806)	(0.1683)	(0.2936)	(-1.3156)	(-1.3860)	(-2.2025)	(-1.7373)	(-1.8131)	(-2.5509)
*DIF_TCASH*VEGA_TC*	6.3933	4.8160	10.0602*	9.5668	4.2404	-7.0522*	-4.7215	-9.0428**	-9.3723*	-4.9553
	(1.2588)	(1.0271)	(1.7763)	(1.6390)	(0.9144)	(-1.9131)	(-1.3066)	(-2.0722)	(-1.9330)	(-1.3938)
*DIF_TCASH*LN_AT*	0.0142	0.0025	0.0055	0.0045	0.0040	-0.0218	-0.0228	-0.0142	-0.0151	-0.0193
	(0.6326)	(0.1170)	(0.2238)	(0.1904)	(0.1931)	(-1.2653)	(-1.6416)	(-0.7223)	(-0.7438)	(-1.3674)
*DIF_TCASH*CASH_FLOW*	0.2018	0.1042	0.0931	0.1427	0.1199	0.0203	0.0503	-0.2534	-0.2736	0.0356
	(0.8241)	(0.4083)	(0.3436)	(0.5271)	(0.4707)	(0.0838)	(0.2443)	(-0.9440)	(-0.9510)	(0.1717)
*DIF_TCASH*INDUSTRY_SIGMA*	0.0420	0.0797	-0.0081	-0.0174	0.0829	0.0685	0.0524	0.0844	0.0905	0.0485
	(0.6278)	(1.2809)	(-0.1104)	(-0.2343)	(1.3303)	(1.5023)	(1.5185)	(1.4605)	(1.5423)	(1.3938)
*DIF_TCASH*LEVERAGE*	-0.2249**	-0.2670**	-0.2084*	-0.1798	-0.2257**	-0.2400**	-0.0789	-0.4087***	-0.4920***	0.0089
	(-2.1319)	(-2.5669)	(-1.7973)	(-1.5683)	(-2.4467)	(-2.2532)	(-0.6795)	(-3.6614)	(-4.1507)	(0.0907)
*DIF_TCASH*SALES_GROWTH*	-0.0372	-0.0365	-0.0632	-0.0800	-0.0401	0.0458	0.0766	0.0467	0.0517	0.0800
	(-0.6180)	(-0.6537)	(-0.9794)	(-1.2457)	(-0.7267)	(0.4815)	(0.8904)	(0.4332)	(0.4664)	(0.9181)
*DIF_TCASH*MTB*	0.0110	0.0030	0.0123	0.0048	0.0006	0.0219	0.0025	0.0431	0.0495*	-0.0037
	(0.5412)	(0.1616)	(0.5741)	(0.2207)	(0.0303)	(0.8835)	(0.1396)	(1.6146)	(1.8483)	(-0.2114)
*DIF_TCASH*NWC*	0.7922***	0.8233***	0.7811***	0.7444***	0.8044***	0.4509***	0.5038***	0.5036**	0.4930**	0.4793***
	(4.2274)	(4.9878)	(3.5514)	(3.4526)	(4.8222)	(2.6195)	(3.3142)	(2.4577)	(2.3081)	(3.2344)
*DIF_TCASH*CAPEX*	1.8555***	1.8862***	2.6743***	2.8310***	1.8829***	2.5088***	2.2912***	2.6043***	2.5480***	2.2815***
	(4.0369)	(4.6083)	(2.9718)	(2.7302)	(4.6428)	(6.2241)	(4.9305)	(5.0288)	(4.9019)	(4.8893)
*DIF_TCASH*ACQUISITION*	2.6794***	2.6840***	2.7571***	2.7328***	2.7007***	2.6934***	2.7266***	2.7579***	2.7537***	2.7393***
	(15.8281)	(17.8404)	(14.3102)	(13.7462)	(17.9863)	(15.3218)	(17.8454)	(13.8431)	(13.4138)	(17.9242)
*DIF_TCASH*RND*	1.5601***	1.3765***	1.0911*	1.1662*	1.3807***	0.7027*	0.9664***	0.6689*	0.4959	0.9408***
	(2.8670)	(3.0585)	(1.7220)	(1.7957)	(3.0699)	(1.9567)	(3.5602)	(1.7090)	(1.3010)	(3.5011)
*DIF_TCASH*DIV_DUMMY*	0.0291	0.0951**	0.0546	0.0676	0.0974**	0.0126	0.0278	-0.0128	-0.0141	0.0221
	(0.6877)	(2.3242)	(1.0894)	(1.3199)	(2.3949)	(0.3232)	(0.7985)	(-0.3124)	(-0.3307)	(0.6449)
*DIF_TCASH*DUMMY_RATING*	0.0041	0.0376	0.0124	0.0097	0.0382	0.0133	0.0088	0.0509	0.0443	0.0083
	(0.0777)	(0.7287)	(0.1942)	(0.1509)	(0.7506)	(0.2897)	(0.2234)	(0.9269)	(0.7959)	(0.2107)

*DIF_TCASH*MNC*	0.0806**	0.0063	0.0533	0.0487	0.0089	-0.0035	-0.0473	-0.0333	-0.0450	-0.0457
	(2.0231)	(0.1748)	(1.2837)	(1.1688)	(0.2452)	(-0.0862)	(-1.5479)	(-0.7444)	(-0.9750)	(-1.4472)
(Continue)										
*DIF_TCASH*LN_FIRM_AGE*	-0.0417	-0.0263	-0.0676	-0.0683	-0.0271	-0.0338	0.0008	-0.0480	-0.0473	0.0047
	(-1.0405)	(-0.7471)	(-1.5980)	(-1.6051)	(-0.7855)	(-1.0419)	(0.0294)	(-1.2457)	(-1.2011)	(0.1854)
Constant	-0.0028	-0.0245	0.0091	0.0053	-0.0242	-0.0211	-0.0182	-0.0927***	-0.0924***	-0.0235
	(-0.1742)	(-1.4592)	(0.5018)	(0.2871)	(-1.4365)	(-0.8177)	(-0.8201)	(-11.2938)	(-10.7667)	(-1.1655)
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
Observations	732	882	566	542	882	1,889	2,405	1,496	1,439	2,405
R-squared	0.5949	0.5614	0.6085	0.6004	0.5610	0.4313	0.4011	0.4446	0.4356	0.3990

This table reports the impact of the CEO inside debt on the cash adjustment speed when the actual cash ratio is below the target. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV*, *REL_INC*, and *REL_INC_CA*) are centred by their industry-year median. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-9: Dissipation of cash when cash ratio is below target

F.D_DIF_TCASH	(1)	(2)	(3)	(4)
M_D_DIF_TCASH	-0.0953**	-0.0954**	-0.1099*	-0.1179**
	(-2.0151)	(-2.0464)	(-1.8780)	(-2.0093)
REL_LEV	-0.0515**			
	(-2.2276)			
HIGH_LEV_DUM		-0.0079***		
		(-3.7043)		
REL_INC			-0.0330	
			(-1.2708)	
REL_INC_CA				-0.0024*
				(-1.8400)
Constant	-0.0143*	-0.0120	-0.0141	-0.0189
	(-1.7484)	(-1.5913)	(-1.6210)	(-1.1330)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	4,582	5,169	3,334	3,177
R-squared	0.0523	0.0492	0.0586	0.0619

The dependent variable is the difference between insufficient cash ratio (cash ratio below target) at time t+1 and insufficient cash ratio at time t; the independent variables are the measures for CEO inside debt compensation; *M_D_DIF_TCASH* is the industry mean of the change in *DIF_TCASH* from time t to t-1, where *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1. *M_D_DIF_TCASH* controls for the impact of firm characteristics which may influence the difference between cash level and the cash target. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-10: Dissipation of cash when cash ratio is above target

F.D_DIF_TCASH	(1)	(2)	(3)	(4)
M_D_DIF_TCASH	-0.4263***	-0.3774***	-0.4232***	-0.4252***
	(-3.7069)	(-3.7055)	(-3.5610)	(-3.5671)
REL_LEV	-0.0368***			
	(-2.6025)			
HIGH_LEV_DUM		-0.0154***		
		(-4.2167)		
REL_INC			-0.0348**	
			(-2.0863)	
REL_INC_CA				-0.0019***
				(-2.9014)
Constant	0.0487***	0.0515***	0.0726**	0.0686**
	(5.4133)	(7.3089)	(2.5138)	(2.1668)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,730	3,566	2,025	1,937
R-squared	0.0678	0.0607	0.0715	0.0730

The dependent variable is the difference between excess cash ratio (cash ratio above target) at time t+1 and excess cash ratio at time t; the independent variables are the measures for CEO inside debt compensation; *M_D_DIF_TCASH* is the industry mean of the change in *DIF_TCASH* from time t to t-1, where *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1. *M_D_DIF_TCASH* controls for the impact of firm characteristics which may influence the difference between cash level and the cash target. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-11: Accumulation of cash when cash ratio is below target

D_DIF_TCASH	(1)	(2)	(3)	(4)
L.M_D_DIF_TCASH	-0.3614***	-0.3143***	-0.3203***	-0.3322***
	(-5.0011)	(-4.8576)	(-4.6133)	(-4.6854)
L.REL_LEV	-0.0180			
	(-0.9475)			
L.HIGH_LEV_DUM		-0.0042*		
		(-1.7034)		
L.REL_INC			-0.0020	
			(-0.1024)	
L. REL_INC_CA				-0.0001
				(-0.0700)
Constant	0.0033	0.0115*	-0.0064	-0.0106
	(0.5156)	(1.8264)	(-0.6787)	(-0.6259)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	4,519	5,718	3,304	3,156
R-squared	0.0614	0.0585	0.0613	0.0637

The dependent variable is the difference between insufficient cash ratio (cash ratio below target) at time t and insufficient cash ratio at time t-1; the independent variables are the measures for CEO inside debt compensation; *L.M_D_DIF_TCASH* is the lagged value of *M_D_DIF_TCASH* which is the industry mean of the change in *DIF_TCASH* from time t to t-1, where *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1. *L.M_D_DIF_TCASH* controls for the impact of firm characteristics which may influence the difference between cash level and the cash target. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-12: Accumulation of cash when cash ratio is above target

D_DIF_TCASH	(1)	(2)	(3)	(4)
L.M_D_DIF_TCASH	-0.2434***	-0.3108***	-0.2324**	-0.2433**
	(-2.7073)	(-3.7341)	(-2.3354)	(-2.4376)
L.REL_LEV	0.0004			
	(0.0239)			
L.HIGH_LEV_DUM		0.0001		
		(0.0422)		
L.REL_INC			0.0002	
			(0.0109)	
L. REL_INC_CA				-0.0005
				(-0.6629)
Constant	-0.0340***	-0.0395***	-0.0614***	-0.0573***
	(-3.3835)	(-4.6433)	(-6.4107)	(-5.6254)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,793	4,002	2,055	1,958
R-squared	0.0546	0.0439	0.0516	0.0535

The dependent variable is the difference between excess cash ratio (cash ratio above target) at time t and excess cash ratio at time t-1; the independent variables are the measures for CEO inside debt compensation; *L.M_D_DIF_TCASH* is the lagged value of *M_D_DIF_TCASH* which is the industry mean of the change in *DIF_TCASH* from time t to t-1, where *DIF_TCAS*H is the difference between target cash ratio at time t and the actual cash ratio at time t-1. *L.M_D_DIF_TCASH* controls for the impact of firm characteristics which may influence the difference between cash level and the cash target. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-13: The impact of CEO inside debt on firm's investment when cash ratio is below target

FDINVESTMENT	(1)	(2)	(3)	(4)
REL_LEV	0.0347**			
	(2.4419)			
HIGH_LEV_DUM		0.0081***		
		(2.9442)		
REL_INC			0.0326*	
			(1.9397)	
REL_INC_CA				0.0016**
				(1.9989)
CEO_CASH_COMP_TC	0.0002	0.0149	-0.0071	-0.0229
	(0.0212)	(1.1835)	(-0.4974)	(-1.4769)
CEO_EQUITY_HOLDINGS_TC	0.0087	0.0171**	0.0089	0.0022
	(1.4945)	(2.5688)	(1.2777)	(0.3212)
DV	-0.0000	0.0000	-0.0000***	-0.0000**
	(-0.2108)	(0.2289)	(-2.8045)	(-2.4473)
VEGA_TC	-0.3946*	-0.4207*	-0.3928	-0.2434
	(-1.6759)	(-1.8281)	(-1.4651)	(-0.9007)
LN_AT	-0.0004	0.0001	-0.0007	-0.0011
	(-0.5777)	(0.0926)	(-0.8569)	(-1.3266)
CASH_FLOW	0.0765***	0.0732***	0.0786***	0.0849***
	(5.0065)	(5.0798)	(4.4475)	(4.6032)
INDUSTRY_SIGMA	0.0018	0.0025	0.0065	0.0046
	(0.2868)	(0.4090)	(0.9092)	(0.6480)
LEVERAGE	-0.0325***	-0.0307***	-0.0365***	-0.0353***
	(-5.1232)	(-4.9709)	(-4.9147)	(-4.6264)
SALES_GROWTH	-0.0378***	-0.0324***	-0.0375***	-0.0356***
	(-5.4785)	(-4.8157)	(-4.7412)	(-4.4660)
DIV_DUMMY	-0.0029	-0.0030	-0.0028	-0.0030
	(-1.4029)	(-1.5156)	(-1.1311)	(-1.2429)
Constant	-0.0013	-0.0174	-0.0026	0.0118
	(-0.1290)	(-1.5379)	(-0.2075)	(0.6387)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	4,460	4,868	3,493	3,342
R-squared	0.0604	0.0594	0.0645	0.0655

This table reports the effect of CEO inside debt on investment when there is insufficient cash (cash ratio below target). The dependent variable is the forward change in investment; the independent variables are measures for CEO inside debt compensation. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-14: The impact of CEO inside debt on firm's investment when cash ratio is above target

FDINVESTMENT	(1)	(2)	(3)	(4)
REL_LEV	0.0199			
	(1.2487)			
HIGH_LEV_DUM		0.0169***		
		(3.9744)		
REL_INC			0.0079	
			(0.4803)	
REL_INC_CA				0.0003
				(0.4617)
CEO_CASH_COMP_TC	0.0013	0.0172	-0.0165	-0.0171
	(0.0548)	(0.7453)	(-0.5205)	(-0.5115)
CEO_EQUITY_HOLDINGS_TC	0.0184	0.0359***	0.0094	0.0072
	(1.4087)	(2.9260)	(0.6344)	(0.4865)
DV	-0.0000	-0.0000	-0.0000	-0.0001*
	(-0.5069)	(-0.0405)	(-1.4690)	(-1.8696)
VEGA_TC	0.2911	-0.3567	0.0179	-0.1058
	(0.5186)	(-0.8050)	(0.0275)	(-0.1573)
LN_AT	-0.0027*	-0.0018	-0.0032*	-0.0035*
	(-1.7788)	(-1.5080)	(-1.8576)	(-1.9547)
CASH_FLOW	0.0409	0.0490**	0.0195	0.0169
	(1.3979)	(2.1251)	(0.5785)	(0.4807)
INDUSTRY_SIGMA	-0.0057	-0.0117	-0.0089	-0.0112
	(-0.4512)	(-1.1625)	(-0.6091)	(-0.7486)
LEVERAGE	-0.0662***	-0.0534***	-0.0816***	-0.0844***
	(-4.8626)	(-3.9098)	(-5.1695)	(-5.2331)
SALES_GROWTH	-0.0754***	-0.0658***	-0.0747***	-0.0717***
	(-5.4484)	(-5.4182)	(-4.6834)	(-4.3672)
DIV_DUMMY	0.0043	0.0018	0.0001	0.0011
	(1.0842)	(0.5439)	(0.0221)	(0.2383)
Constant	0.0231	-0.0057	0.0208	0.0302
	(0.9737)	(-0.2730)	(0.6020)	(0.8266)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,448	3,073	1,933	1,852
R-squared	0.0874	0.0831	0.0926	0.0917

This table reports the effect of CEO inside debt on investment when the cash level is above the target. The dependent variable is the forward change in investment; the independent variables are measures for CEO inside debt compensation; the control variables include firm characteristics. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-15: The impact of CEO inside debt on firm's payout when cash ratio is below target

FDPAYOUT	(1)	(2)	(3)	(4)
REL_LEV	-0.0040			
	(-0.3518)			
HIGH_LEV_DUM		0.0007		
		(0.3892)		
REL_INC			-0.0024	
			(-0.1759)	
REL_INC_CA				-0.0008**
				(-2.0695)
CEO_CASH_COMP_TC	0.0171***	0.0141*	0.0187**	0.0217***
	(2.8520)	(1.9506)	(2.4519)	(2.6093)
CEO_EQUITY_HOLDINGS_TC	0.0028	0.0041	0.0009	0.0001
	(0.7536)	(0.8800)	(0.1991)	(0.0136)
DV	0.0000	-0.0000	-0.0000	-0.0000
	(0.0857)	(-1.2739)	(-0.9740)	(-0.6241)
VEGA_TC	-0.3471**	-0.4516***	-0.5434***	-0.5082**
	(-2.0415)	(-2.5817)	(-2.6165)	(-2.5277)
LN_AT	0.0023***	0.0026***	0.0025***	0.0022***
	(5.2982)	(6.0044)	(4.6464)	(4.1664)
CASH_FLOW	-0.0028	0.0100	-0.0064	-0.0042
	(-0.2195)	(0.8630)	(-0.4199)	(-0.2700)
INDUSTRY_SIGMA	-0.0120***	-0.0110***	-0.0113***	-0.0122***
	(-3.7041)	(-3.1867)	(-2.9277)	(-3.1410)
LEVERAGE	-0.0375***	-0.0350***	-0.0349***	-0.0381***
	(-7.1189)	(-6.7606)	(-5.8663)	(-6.4581)
SALES_GROWTH	0.0079**	0.0076**	0.0077*	0.0077
	(2.0738)	(2.0998)	(1.7450)	(1.6416)
DIV_DUMMY	-0.0040***	-0.0052***	-0.0041**	-0.0045**
	(-2.7926)	(-3.6115)	(-2.2788)	(-2.4392)
Constant	0.0135	0.0106	0.0208*	0.0424
	(1.3588)	(1.0142)	(1.7601)	(1.3405)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	4,690	5,092	3,684	3,522
R-squared	0.0811	0.0779	0.0838	0.0873

This table reports the effect of CEO inside debt on payout policy when there is insufficient cash (cash ratio below target). The dependent variable is the forward change in payout; the independent variables are measures for CEO inside debt compensation. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-16: The impact of CEO inside debt on firm's payout when cash ratio is above target

FDPAYOUT	(1)	(2)	(3)	(4)
REL_LEV	0.0161*			
	(1.8312)			
HIGH_LEV_DUM		-0.0002		
		(-0.0675)		
REL_INC			0.0182**	
			(2.0632)	
REL_INC_CA				0.0004
				(0.7077)
CEO_CASH_COMP_TC	0.0243*	0.0223*	0.0342*	0.0345*
	(1.7490)	(1.6775)	(1.8197)	(1.8017)
CEO_EQUITY_HOLDINGS_TC	0.0067	0.0015	0.0028	-0.0003
	(0.9253)	(0.2077)	(0.3403)	(-0.0305)
DV	0.0000	-0.0000	0.0000*	0.0000*
	(0.4810)	(-0.7495)	(1.8750)	(1.6633)
VEGA_TC	-0.6653**	-1.1641***	-0.7112**	-0.7916**
	(-2.1349)	(-4.4143)	(-2.0108)	(-2.2134)
LN_AT	0.0034***	0.0035***	0.0037***	0.0035***
	(4.0012)	(4.4980)	(3.6429)	(3.4444)
CASH_FLOW	-0.0469**	-0.0409**	-0.0360*	-0.0479**
	(-2.4780)	(-2.5010)	(-1.7351)	(-2.1870)
INDUSTRY_SIGMA	0.0125*	0.0109*	0.0107	0.0104
	(1.9234)	(1.6883)	(1.3577)	(1.2815)
LEVERAGE	-0.0336***	-0.0387***	-0.0373***	-0.0395***
	(-4.8657)	(-5.3664)	(-4.3792)	(-4.4773)
SALES_GROWTH	0.0148***	0.0157***	0.0159***	0.0172***
	(2.8450)	(3.0600)	(2.7531)	(2.9329)
DIV_DUMMY	-0.0099***	-0.0107***	-0.0138***	-0.0123***
	(-3.8471)	(-4.5640)	(-4.4727)	(-4.0043)
Constant	-0.0105	0.0103	0.0002	0.0069
	(-0.7825)	(0.8329)	(0.0160)	(0.4685)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,325	2,905	1,831	1,749
R-squared	0.0915	0.0815	0.1137	0.1128

This table reports the effect of CEO inside debt on payout policy when the cash level is above the target. The dependent variable is the forward change in payout; the independent variables are measures for CEO inside debt compensation. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-17: The impact of CEO inside debt on firm's debt retirement when cash ratio is below target

FDDLTR_AT	(1)	(2)	(3)	(4)
REL_LEV	-0.0383*			
	(-1.8549)			
HIGH_LEV_DUM		-0.0058		
		(-1.0940)		
REL_INC			-0.0365	
			(-1.5448)	
REL_INC_CA				-0.0011
				(-1.4377)
CEO_CASH_COMP_TC	0.0183	-0.0045	-0.0065	0.0167
	(0.5956)	(-0.1470)	(-0.1665)	(0.3977)
CEO_EQUITY_HOLDINGS_TC	-0.0141	-0.0250	-0.0024	0.0029
	(-1.2137)	(-1.5903)	(-0.1905)	(0.2185)
DV	0.0000	0.0000	0.0000	0.0000
	(1.2705)	(1.0511)	(0.1035)	(0.7534)
VEGA_TC	0.1861	0.2043	0.0779	-0.0350
	(0.3323)	(0.3907)	(0.1198)	(-0.0519)
LN_AT	0.0005	0.0003	0.0004	0.0011
	(0.3402)	(0.2312)	(0.2271)	(0.5826)
CASH_FLOW	-0.0412	-0.0125	-0.0208	-0.0187
	(-0.9158)	(-0.3080)	(-0.3992)	(-0.3438)
INDUSTRY_SIGMA	-0.0067	-0.0085	-0.0056	-0.0029
	(-0.6492)	(-0.8648)	(-0.4497)	(-0.2250)
LEVERAGE	0.0029	0.0066	0.0145	0.0189
	(0.1878)	(0.4101)	(0.8120)	(1.0306)
SALES_GROWTH	-0.0073	-0.0028	-0.0120	-0.0155
	(-0.5710)	(-0.2437)	(-0.8257)	(-1.0006)
DIV_DUMMY	-0.0035	-0.0025	-0.0026	-0.0021
	(-0.8177)	(-0.6222)	(-0.5194)	(-0.4146)
Constant	0.0093	0.0215	-0.0074	-0.0250
	(0.3727)	(0.7710)	(-0.3476)	(-1.1565)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	4,837	5,258	3,814	3,649
R-squared	0.0058	0.0045	0.0075	0.0077

This table reports the effect of CEO inside debt on debt retirement when there is insufficient cash (cash ratio below target). The dependent variable is the forward change in debt retirement; the independent variables are measures for CEO inside debt compensation. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-18: The impact of CEO inside debt on firm's debt retirement when cash ratio is above target

FDDLTR_AT	(1)	(2)	(3)	(4)
REL_LEV	-0.0267*			
	(-1.6491)			
HIGH_LEV_DUM		-0.0056		
		(-1.2397)		
REL_INC			-0.0337*	
			(-1.7968)	
REL_INC_CA				-0.0015**
				(-2.2576)
CEO_CASH_COMP_TC	0.0604	0.0375	0.0816*	0.0912*
	(1.5775)	(1.2653)	(1.8382)	(1.9620)
CEO_EQUITY_HOLDINGS_TC	-0.0078	-0.0098	-0.0030	0.0026
	(-0.4826)	(-0.7406)	(-0.1652)	(0.1411)
DV	0.0000	0.0000	0.0001	0.0001
	(0.6515)	(0.6153)	(1.2927)	(1.1308)
VEGA_TC	0.1715	0.1110	0.4502	0.6318
	(0.2652)	(0.2226)	(0.7228)	(0.9818)
LN_AT	-0.0007	-0.0004	-0.0013	-0.0013
	(-0.3543)	(-0.2230)	(-0.6358)	(-0.6114)
CASH_FLOW	-0.0461	-0.0245	-0.0085	-0.0105
	(-0.9469)	(-0.7415)	(-0.1818)	(-0.2134)
INDUSTRY_SIGMA	-0.0214	-0.0152	-0.0237	-0.0248
	(-1.5138)	(-1.4550)	(-1.4826)	(-1.5227)
LEVERAGE	-0.0159	-0.0065	-0.0069	-0.0087
	(-0.7948)	(-0.3477)	(-0.2829)	(-0.3467)
SALES_GROWTH	0.0235	0.0198	0.0296	0.0274
	(1.4827)	(1.5739)	(1.6346)	(1.4362)
DIV_DUMMY	0.0051	0.0043	0.0035	0.0031
	(0.7932)	(0.8730)	(0.4850)	(0.4249)
Constant	-0.0129	-0.0126	0.0507	0.0476
	(-0.3245)	(-0.4470)	(1.5388)	(1.3581)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	2,416	3,041	1,902	1,822
R-squared	0.0309	0.0257	0.0378	0.0377

This table reports the effect of CEO inside debt on debt retirement when the cash level is above the target. The dependent variable is the forward change in debt retirement; the independent variables are measures for CEO inside debt compensation. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-19: The impact of CEO inside debt on adjustment speed of cash holding when actual cash is below target with GMM regression

DIF_CASH	(1)	(2)	(3)	(4)	(5)
DIF_TCASH	0.3952***	0.3264***	0.3765***	0.3991***	0.3843***
	(6.4333)	(5.2154)	(5.1752)	(5.4655)	(6.1481)
*DIF_TCASH*REL_LEV*	0.8970***				
	(3.0762)				
*DIF_TCASH*HIGH_LEV_DUM*		0.2388***			
		(3.9893)			
*DIF_TCASH*REL_INC*			0.5362*		
			(1.7310)		
*DIF_TCAS*REL_INC_CA*				0.0488***	
				(4.6518)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.0840	0.1715	0.0713	-0.2010	-0.1909
	(0.5296)	(0.9753)	(0.3692)	(-1.0227)	(-1.1333)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	0.0576	0.3197**	0.0542	-0.0456	-0.0426
	(0.6341)	(2.4725)	(0.5447)	(-0.4641)	(-0.4840)
*DIF_TCASH*DV*	0.0001	0.0000	0.0001	0.0001	0.0000
	(0.6991)	(0.4108)	(0.4592)	(0.4581)	(0.3069)
*DIF_TCASH*VEGA_TC*	-14.5696***	-16.1646***	-13.5604***	-14.1115***	-15.5617***
	(-3.3325)	(-3.3860)	(-2.7286)	(-2.7796)	(-3.2210)
*DIF_TCASH*LN_AT*	0.0127	-0.0256	0.0177	0.0188	-0.0300
	(0.7309)	(-1.3206)	(0.8624)	(0.9017)	(-1.5291)
*DIF_TCASH*CASH_FLOW*	0.3912	0.0208	0.5542*	0.6596**	0.0646
	(1.2423)	(0.0493)	(1.6575)	(2.0356)	(0.1502)
*DIF_TCASH*INDUSTRY_SIGMA*	-0.0138	-0.0213	-0.0558	-0.0359	-0.0351
	(-0.3065)	(-0.4550)	(-0.7634)	(-0.4776)	(-0.7465)
*DIF_TCASH*LEVERAGE*	-0.4084***	-0.6095***	-0.5420***	-0.5454***	-0.7865***
	(-3.3118)	(-4.7325)	(-3.6348)	(-3.6655)	(-5.9704)
*DIF_TCASH*SALES_GROWTH*	-0.1476	-0.1676	-0.1675	-0.2571**	-0.1885
	(-1.4361)	(-1.3642)	(-1.2833)	(-2.0472)	(-1.5287)
*DIF_TCASH*MTB*	0.0911***	0.1016***	0.0888***	0.0908***	0.1252***
	(2.9048)	(2.8439)	(2.6749)	(2.7163)	(3.4980)
*DIF_TCASH*NWC*	-0.8466***	-1.0614***	-0.7358***	-0.8041***	-1.0065***
	(-5.7341)	(-6.4585)	(-4.1795)	(-4.4467)	(-6.1706)
*DIF_TCASH*CAPEX*	-2.0608***	-2.6385***	-2.1245***	-2.0653***	-2.5373***
	(-5.0603)	(-5.6285)	(-4.4579)	(-4.3881)	(-5.6115)
*DIF_TCASH*ACQUISITION*	-2.3562***	-2.5430***	-2.2913***	-2.0800***	-2.5653***
	(-10.2613)	(-10.2268)	(-8.6006)	(-7.9808)	(-10.1719)
*DIF_TCASH*RND*	0.6346	0.8162	0.3132	0.5961	0.6274
	(0.5419)	(0.6355)	(0.2042)	(0.3773)	(0.4818)
*DIF_TCASH*DIV_DUMMY*	-0.1272***	-0.1667***	-0.1277***	-0.1313***	-0.1545***
	(-3.9711)	(-4.8001)	(-3.2024)	(-3.2197)	(-4.4858)
*DIF_TCASH*DUMMY_RATING*	0.0504	0.0841**	0.0355	0.0341	0.0855**
	(1.3649)	(2.1363)	(0.8394)	(0.8017)	(2.1599)
*DIF_TCASH*MNC*	-0.0622*	-0.0474	-0.0383	-0.0405	-0.0442
	(-1.7877)	(-1.2681)	(-0.9381)	(-0.9820)	(-1.1771)
*DIF_TCASH*LN_FIRM_AGE*	-0.0090	-0.0229	-0.0223	-0.0181	-0.0237
	(-0.4481)	(-1.0728)	(-0.9175)	(-0.7451)	(-1.0997)
Constant	-0.0120**	-0.0096*	-0.0077	-0.0214***	-0.0105*
	(-2.0979)	(-1.6631)	(-0.7610)	(-2.9062)	(-1.7526)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	4,744	4,967	3,667	3,513	4,967
R-squared	0.1185	0.1297	0.1071	0.1130	0.1251

This table reports the impact of the CEO inside debt on the cash adjustment speed when actual cash is below target. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1 derived by GMM regression; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1 derived by GMM regression; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV*, *REL_INC*, and *REL_INC_CA*) are centred by their industry-year median. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4-20: The impact of CEO inside debt on adjustment speed of cash holding when actual cash is above target with GMM regression

DIF_CASH	(1)	(2)	(3)	(4)	(5)
DIF_ TCASH	0.4987***	0.5776***	0.5046***	0.4921***	0.5057***
	(9.4439)	(11.4764)	(8.7663)	(8.1427)	(11.1478)
*DIF_ TCASH*REL_LEV*	-0.2653**				
	(-2.0182)				
*DIF_ TCASH*HIGH_LEV_DUM*		-0.1490***			
		(-3.3724)			
*DIF_ TCASH*REL_INC*			-0.2811**		
			(-2.1604)		
*DIF_ TCASH*REL_INC_CA*				-0.0109**	
				(-2.1640)	
*DIF_TCASH*CEO_CASH_COMP_TC*	0.2345	0.0861	0.2487	0.4471	0.2817
	(0.7438)	(0.2941)	(0.6751)	(1.2024)	(1.0020)
*DIF_TCASH*CEO_EQUITY_HOLDINGS_TC*	-0.6432***	-0.5005**	-0.6698***	-0.5652***	-0.2940*
	(-3.1024)	(-2.4772)	(-3.0684)	(-2.6329)	(-1.7327)
*DIF_TCASH*DV*	-0.0006	-0.0002	-0.0007*	-0.0007	-0.0002*
	(-1.6283)	(-1.3183)	(-1.7302)	(-1.5961)	(-1.7495)
*DIF_TCASH*VEGA_TC*	-0.1519	1.5385	-1.8537	-3.3649	0.5930
	(-0.0248)	(0.3064)	(-0.2794)	(-0.4783)	(0.1181)
*DIF_TCASH*LN_AT*	-0.0487**	-0.0331*	-0.0436*	-0.0509**	-0.0256
	(-2.3131)	(-1.8487)	(-1.8895)	(-2.1305)	(-1.4194)
*DIF_TCASH*CASH_FLOW*	-0.1126	-0.1472	-0.2021	-0.1845	-0.1464
	(-0.4325)	(-0.7003)	(-0.6905)	(-0.6153)	(-0.6956)
*DIF_TCASH*INDUSTRY_SIGMA*	0.0294	0.0312	0.0449	0.0610	0.0314
	(0.5355)	(0.8566)	(0.7366)	(0.9903)	(0.8569)
*DIF_TCASH*LEVERAGE*	0.0851	0.1269	0.0028	-0.0309	0.3107***
	(0.7113)	(1.0414)	(0.0201)	(-0.2237)	(2.9875)
*DIF_TCASH*SALES_GROWTH*	0.0447	0.1430*	0.0347	0.0198	0.1414
	(0.4279)	(1.6701)	(0.3069)	(0.1680)	(1.6326)
*DIF_TCASH*MTB*	-0.0012	-0.0141	0.0142	0.0127	-0.0209
	(-0.0584)	(-0.8505)	(0.7110)	(0.6518)	(-1.2937)
*DIF_TCASH*NWC*	1.0335***	1.1630***	0.9837***	0.9475***	1.0708***
	(4.7022)	(6.3309)	(3.8866)	(3.6546)	(5.8624)
*DIF_TCASH*CAPEX*	5.1329***	4.4512***	4.8439***	4.8158***	4.4183***
	(8.0276)	(6.7995)	(6.6592)	(5.9102)	(6.8886)
*DIF_TCASH*ACQUISITION*	6.5660***	6.1308***	6.4771***	6.4455***	6.1592***
	(27.1261)	(26.6512)	(24.4462)	(23.7656)	(26.2370)
*DIF_TCASH*RND*	-0.0635	0.1874	-0.2207	-0.2437	0.1411
	(-0.1784)	(0.6430)	(-0.5537)	(-0.6154)	(0.4820)
*DIF_TCASH*DIV_DUMMY*	0.0489	0.0815*	0.0402	0.0580	0.0712*
	(0.9826)	(1.8661)	(0.7191)	(0.9994)	(1.6546)
*DIF_TCASH*DUMMY_RATING*	0.0698	0.0357	0.0941	0.0861	0.0369
	(1.1093)	(0.6777)	(1.3071)	(1.1732)	(0.6836)
*DIF_TCASH*MNC*	0.0259	-0.0540	0.0038	0.0035	-0.0474
	(0.4707)	(-1.3117)	(0.0623)	(0.0578)	(-1.0994)
*DIF_TCASH*LN_FIRM_AGE*	-0.1030**	-0.0412	-0.1235***	-0.1223**	-0.0395
	(-2.3923)	(-1.2059)	(-2.5859)	(-2.5551)	(-1.1118)
Constant	-0.0042	-0.0012	-0.0101	-0.0015	-0.0032
	(-0.4439)	(-0.0976)	(-1.3386)	(-0.1882)	(-0.3373)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	2,705	3,543	2,146	2,052	3,543
R-squared	0.4395	0.4057	0.4348	0.4298	0.4025

This table reports the impact of the CEO inside debt on the cash adjustment speed when actual cash is below target. The dependent variable is the adjustment of cash ratio measured as the difference between actual cash holding at time t and t-1 derived by GMM regression; the independent variable, *DIF_TCASH* is the difference between target cash ratio at time t and the actual cash ratio at time t-1 derived by GMM regression; the interaction terms captures the impact of inside debt compensation on the adjustment speed of cash holding; the continuous variables in the interaction terms which measure the CEO inside debt compensation (including *REL_LEV*, *REL_INC*, and *REL_INC_CA*) are centred by their industry-year median. We control for firm characteristics which may affect the cash policy. The industry dummy is based on Fama-French 48 industry specification. We include industry and year dummies to control for industry-year fixed effects. The error terms are robust to firm-clustering specifications. We report the T-statistics in parentheses, where * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

CHAPTER 5: CONCLUSIONS AND FUTURE RESEARCH

This thesis aims to examine the impact of liquidity on investment strategies, as well as the influence of estimation bias on corporate liquidity management, from both the market level perspective and the firm level perspective. More specifically, we try to answer three questions which have not been addressed by the existing literature. First, does market liquidity drive the feedback trading behaviour? Second, does financial flexibility - the primary concern of a firm's financing strategy - influence the investment strategy regarding corporate social responsibility? Third, does the CEO compensation incentive resulting from inside debt have an impact on the adjustment speed of a firm's cash holding?

The theoretical background to the three empirical studies in the thesis is that liquidity is a priced factor in estimating risk. From this standpoint, we developed several hypotheses which are closely related to the three questions. We applied data from both the Asian markets and the US market to test the hypotheses. The empirical chapters in this thesis all cover the latest years which have full information available in order to derive our variables. Chapter 2 covers the daily trading information of six major Asian stock markets from 2000 to 2016, while Chapter 3 and Chapter 4 focus on the US-listed firms by applying firm-year level data which ends in 2014.

This chapter is organized as follows. Section 5.1 summarises the findings and implications of our three empirical studies, while Section 5.2 generalises the limitations of our studies and suggests directions for future research.

5.1. Conclusions and implications of empirical chapters

5.1.1. Liquidity and feedback trading: evidence from Asian stock markets

Chapter 2 examined the impact of liquidity on investment strategy at the market level. We assume that concerns about market liquidity should drive the feedback trading effect. We mainly focused on the stock market, since it is still the most widely engaged financial market with the largest market value. Our sample countries are the six East Asian countries ranked in order of market value. Existing literature documents a pronounced cognitive bias among Asian investors. More importantly, the Asian markets are dominated by individual investors. Existing studies document that individual investors are more likely to engage in positive feedback trading. Therefore, we supposed that the Asian stock market constitutes an ideal subject for examining influencing factors on feedback trading. Chau *et al.* (2011) confirm the impact of investor sentiment on feedback trading by extending the most widely applied feedback trading model proposed by Sentana and Wadhwani (1992) to include an investor sentiment term in the demand function of feedback traders. Inspired by their approach, we suppose that liquidity is a pricing factor in the demand function of feedback traders. More specifically, we tested the explanatory power of market liquidity on feedback trading by examining the performance of two augmented feedback trading models. In the first model, the demand function of feedback traders is a linear combination of lagged return and market liquidity. In the second model, the market liquidity and lagged return exert an impact on the demand function of feedback traders in a multiplicative way.

The results produced by the original feedback trading models revealed that the negative feedback trading effect is dominant in all six of the East Asian equity markets, namely China, Hong Kong, Taiwan, South Korea, Japan, and Singapore. It is worth noting that all our sample countries launched their derivative markets during or before our sample period. Given that the feedback trading effect in some western countries was greatly reduced or completely eliminated after the introduction of derivatives, the highly significant feedback trading effect among Asian stock markets suggests that the Asian market is less efficient than the Western market and that Asian investors are more irrational than Western investors.

To further examine the factors that drive feedback trading in the Asian stock market, we applied the two augmented feedback trading models with liquidity terms in the demand function. Most of the liquidity terms given by our augmented feedback trading models are significant, which confirms the notion that the feedback traders' demand for shares is determined by both the previous stock return and the market liquidity term. We also find that the featured SW Model's feedback trading term, γ_1, is insignificant in some sample countries under the specification of the two extended SW Models. The insignificant feedback trading term suggests that liquidity can take priority over ex-post return in the feedback trader's decision-making process. Since our sample period covers the financial crisis period starting from 2007, we included a regime dummy in our augmented SW models to measure the asymmetric impact of market liquidity on feedback trading between different market regimes. We found that the impact of liquidity is more intense under a bull market regime than under a bear market regime. The findings suggest that market inspectors can contribute to market stability by paying more attention to the impact of feedback traders under the bull market regime. Our specifications of the augmented SW Models are robust to alternative specifications of liquidity measures, and variance form as well as the market performance measures.

If all these findings are taken together, our study has the following implications. First, Asian stock markets still show a significant feedback trading effect after the introduction of stock derivatives. Therefore, studies on Asian stock markets should take the trading behaviour of individual investors into account as well as the estimation bias of Asian investors. Second, it is necessary to allow for the impact of market liquidity on the demand function of feedback traders. The significant liquidity terms reported by the two augmented SW models indicate that the feedback traders' demand function for shares can be approximated by either a linear combination of ex-post return and liquidity or by a cross-product of ex-post return and liquidity. The findings highlight the importance of liquidity in setting up investment strategies, which is consistent with the findings of Ibbotson *et al.* (2013). Market regulators can take precautionary policies regarding market liquidity to reduce the impact of feedback trading on market stability. Finally, our study helps to understand how investors with heterogeneous expectations make investment decisions regarding various market regimes. The more pronounced influence of market liquidity on feedback trading under a bull market regime suggests that market regulators should pay more attention to feedback trading when there is a bull market.

5.1.2. Financial flexibility, CEO conservatism, and corporate social responsibility: a lifecycle approach

Chapter 3 investigated whether financial flexibility, as the primary concern of corporate liquidity management, can determine a firm's investment policy regarding corporate social responsibility. Existing studies on CSR suggest that firms with a strong CSR performance have easy access to external funds. Thus investment in CSR can act as insurance which enables firms to meet their financial needs in case of emergency. It is worth noting that the financial flexibility achieved also helps a firm to meet their financial needs promptly. Therefore we supposed that financial flexibility could act as a substitute for CSR investments in ensuring that firms can fund their opportunity set at an optimal level. The information on CSR performance of the US-listed firms was taken from the MSCI database, and the variables for deriving financial flexibility were taken from the COMPUSTAT database. Consistent with our assumption, we documented a negative relationship between CSR investments and financial flexibility. The negative impact of financial flexibility on CSR can be exerted through two channels. First, as mentioned above, financially flexible firms have unused debt capacity which can help them to fund upcoming investment opportunities as well as to absorb adverse shocks in the future. CSR also plays as insurance which can reduce the risk of bankruptcy. Therefore, the substitution effect reduces the probability of financially flexible firms to invest in CSR. Second, when firms invest in CSR in exchange for cheaper financing[20], they have to spend their precious financial resources. Accordingly, the firms that pursue conservative financial strategies are likely to be more conservative in terms of resource allocation for CSR investments. In particular, firms whose shareholders consider financial flexibility more valuable are more likely to reserve debt capacity to prepare for future investment opportunities or negative shocks. This will cause these firms to spend their resources more conservatively and, consequently, to avoid luxury investments such as CSR activities.

To further examine the relationship between financial flexibility and CSR we considered the impact of two additional factors, CEO conservatism and the lifecycle stage of the firm. CEO conservatism is an internal factor which is closely related to corporate governance. We documented that the CEO, as the primary decision maker, exerts a positive impact on CSR investment if he/she is conservative. The positive correlation is ascribed to the estimation bias of conservative CEOs regarding risk. Conservative CEOs overestimate the moral risk and are likely to invest in CSR as an insurance instrument.

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20 Existing studies have found that firms with higher CSR performance have easier access to external funds. Empirical studies document an increase in the number of socially responsible customers, a decrease in the cost of capital and capital constraints after firms adopt strategic CSR (Baron, 2001; Cheng et al., 2014; El Ghoul et al., 2011). From the standpoint of cost of capital, El Ghoul et al. (2011) find that firms with better CSR scores can have access to cheaper equity financing. Similarly, Goss and Roberts (2011) find that the most socially responsible firms pay up to 20 basis points less than the least responsible firms. Therefore, CSR investments, which are likely to result in higher CSR performance, can provide firms with cheaper financing.

Our findings are consistent with the results of McCarthy *et al.* (2017) who documented the negative relationship between CSR and CEO overconfidence for the first time. In addition to the direct impact of CEO conservatism on CSR, we also test the incremental effect of CEO conservatism on the relationship between financial flexibility and CSR policy. We noticed that the adverse impact of financial flexibility on CSR is stronger when firms have conservative CEOs. Conservative CEOs will overestimate the leverage risk and impact of future negative shocks. Although CSR investments and financial flexibility are substitutes in reducing risk, conservative CEOs are more likely to increase the firm's financial flexibility instead of spending valuable resources on costly and long-term CSR investment.

When examining the impact of lifecycle stages on CSR investments, we found that firms have an improved CSR performance as they move from the birth stage to the mature stage of the lifecycle. However, firms in the decline stage have the poorest CSR performance. This finding is consistent with our assumptions that firms with greater financial resources are more likely to increase CSR expenditure. We also found that earlier lifecycle stages (with the exception of the decline stage) have a stronger impact on the negative relationship between financial flexibility and CSR. The findings indicate that while the drive for financial flexibility exerts an adverse impact on CSR, the constraints implied by the various lifecycle stages play a substitutive role in eliminating CSR investment. To control for the impact of endogeneity and bias in selecting measures, we applied the lagged OLS regression, Heckman two-step treatment effect models, alternative measures for CSR, alternative measures for financial flexibility, and subgroups with different levels of credit rating. The negative impact of financial flexibility and CSR was found to be robust to these alternative model specifications.

If all these findings are taken together, our study contributes to the literature on CSR in three ways. First, we examined the impact of financial flexibility on CSR investment for the first time. We documented a substitutive relationship between CSR and financial flexibility which supports the insurance role played by CSR. Second, we found a positive impact of CEO conservatism on CSR, which provided more evidence to (McCarthy et al. (2017)), which document a negative relationship between CEO overconfidence and CSR. We further revealed that the influence of financial flexibility on CSR is stronger when the firm has a conservative CEO. Finally, our study provides empirical evidence to show that the lifecycle theory has explanatory power in the firm's CSR strategy. In sum, our study draws attention to the causes and effects of corporate social responsibility, which will be useful for further study, since we demonstrate a clearer pattern for the motivation behind CSR investments, including the financial restrictions they face, executives' estimation bias, and the lifecycle stage of the firm.

5.1.3. CEO inside debt and the adjustment speed of cash holding

Chapter 4 extends the literature on corporate liquidity policy by focusing on the impact of CEO inside debt compensation, a crucial measure of CEO risk preference, on cash, the firm's most liquid asset. Inside debt compensation has a substantial impact on the incentive of CEOs regarding risk, since it is directly correlated with the wealth of a CEO. Existing literature has established a linkage between the CEO compensation incentive and a firm's cash holding, including the cash level and the value of cash. CEO risk preference has an impact on the firm's cash level given that cash is a major factor in controlling for the liquidity risk. Since the adjustment speed of cash has a direct impact on the cash level, it is necessary to examine whether the risk preference of a CEO can affect the ability of firms to adjust their cash level towards the target promptly. Our study extends the literature on the relationship between the CEO compensation incentive and cash by examining the influence of CEO risk preference introduced by inside debt compensation on the adjustment speed of cash holding. Furthermore, we identified the channels through which CEO inside debt compensation may exert such an influence. The subject of our study was listed firms in the US market for which the data on inside debt has been disclosed since 2006. We extended the sample period to 2014, which is the most recent fiscal year with all the data available to derive our variables.

When examining the impact of CEO inside debt compensation on the cash level, we documented a positive and significant relationship between CEO inside debt compensation and the level of cash holding. This finding is consistent with our hypothesis that risk aversion introduced by inside debt compensation can exert a positive impact on cash holding policy. CEOs with high inside debt compensation act like debt holders whose wealth can be greatly jeopardised by the risk of bankruptcy. Therefore, they are risk averse and are likely to keep a high level of cash reserves to ensure the survival of their firms.

We then analysed the relationship between CEO inside debt compensation and the adjustment speed of cash holding, which constitutes the most important issue of our study. We failed to identify any significant impact of CEO inside debt compensation on the adjustment speed of cash holding before measuring the relative value of the actual cash level and the target cash level. Therefore, we divided our firm-year observations into two sub-samples based on the relative value of the actual cash level and the target. On the one hand, we found that having CEOs with high inside debt compensation accelerates the adjustment speed of cash holding when the actual cash holding is below the target. On the other hand, we found that having CEOs with high inside debt compensation decelerates the adjustment speed of cash holding when the actual cash holding is above the target. These findings suggest that since CEOs with high inside debt compensation have a tendency to hold more cash, they adopt an asymmetric policy in response to the difference between the actual cash level and the target. More specifically, CEOs with a high level of inside debt compensation are motivated to accumulate cash promptly when the actual cash level is below the target. They are also reluctant to disburse cash when the actual cash level is below the target. This empirical result is consistent with our assumptions which indicate that CEOs with high inside debt compensation have a low risk preference and adopt a conservative cash policy both when there is a lack of cash and when there is sufficient cash.

Since dissipation of cash and accumulation of cash are two major channels for executives to influence the cash level, it is necessary to ascertain which one constitutes the main method for CEOs with high inside debt compensation to exert an influence. We concluded that generally, CEO inside debt compensation affects the adjustment speed of cash holding through modifying the dissipation of cash policy rather than the accumulation policy. These findings suggest that it is easier for risk-averse CEOs to manipulate cash policy by reducing dissipation than by accumulating cash. We proposed that CEOs can affect the dissipation of cash through major three channels, namely investment, pay-out and debt retirement. We found that when there is inadequate cash, CEOs with high inside debt increase cash dissipation in the form of investment. This finding is interesting because it seems that the increase in investments decreases the adjustment speed of cash when the cash level is below the target, which is inconsistent with our assumptions. Unlike the other two tunnels, investments in positive NPV projects can generate positive cash flow in the future which helps to move the adjustment of cash towards the target. Therefore, an increase in investment does not necessarily reduce the adjustment speed of cash. We also documented that firms that have CEOs with high inside debt compensation reduce debt retirement when the cash level is above the target. The finding is consistent with our hypothesis that CEOs with high inside debt compensation decrease the adjustment speed of cash when the actual cash level is above the target.

Additionally, we documented the asymmetric impact of CEO inside debt on the adjustment speed of cash holding under different levels of institutional ownership. Existing literature finds that the firms with higher percentage of institutional ownership are likely to have a higher level of corporate governance. We conjecture that the firms with high institutional investors, as a proxy for corporate governance, may prefer higher adjustment speed of cash to avoid the cost of holding cash when there is a deviation between actual cash level and the target. Since CEOs with high inside debt are risk averse and have a desire to hold more cash, they will accelerate the adjustment speed of cash when the actual cash level is below the target and decelerate the adjustment speed of cash holding when the actual cash holding is above the target. On the one hand, the interest of institutional investors and CEOs with high inside debt compensation is aligned when the actual cash level is below the target; on the other hand, there is a confliction in the interest between institutional investors and CEOs with high inside debt compensation when the actual cash holding is above the target. Consistent with our hypothesis, the influence of CEO inside debt compensation on the cash holding adjustment speed is more (less) pronounced with a high level of institutional ownership than with a low level of institutional ownership when the actual cash holding is below (above) the target. This finding also provides evidence that institutional owners are supportive of CEOs' conservative cash policies. Our primary findings are robust to the alternative specification of the target cash level, whereby we derive the target cash level from the GMM regressions to control for the impact of endogeneity.

If all these findings are taken together, our study contributes to the literature on cash policy in three ways. First, we examined the impact of CEO inside debt compensation on the adjustment speed of cash holding for the first time. We documented that CEOs with high inside debt compensation tend to hold more cash which results in an asymmetric impact on the cash adjustment speed regarding the relative value between the actual cash level and the target. Second, we found that CEOs with high inside debt compensation exert an influence on cash adjustment mainly through the channel of dissipation. Third, our study provides empirical evidence that CEO inside debt compensation affects the dissipation of cash through increased investments if cash is insufficient, and through decreased debt retirement if there is excess cash. Finally, we found that the impact of CEOs with high inside debt compensation is asymmetric under different level of institutional ownership. In sum, our study highlights the role of CEO risk preference in relation to cash policy. Financial analysts and corporate governors should therefore take the effect of CEO risk preference into account when inspecting a firm's cash level. When a firm's cash level is below the target, it has the potential to adjust promptly towards its target if the CEO has a high level of inside debt compensation.

5.2. Limitations and future research

The restriction observed in Chapter 2, which examines the impact of liquidity on feedback trading, is that we do not provide a clear pattern to show how the intensity of feedback trading changes when liquidity strength changes. Since the need for liquidity is affected by many underlying factors, namely market regime, culture, investor sentiment, and so on, the liquidity itself may be a proxy for other relevant factors. Therefore, it would be interesting to build upon the connections between the various factors that influence liquidity and feedback trading in further research. Another restriction to emerge from Chapter 2 is that we only examined the impact of liquidity on feedback trading in the stock market. Existing studies have documented the feedback trading effect in derivative markets such as the ETF market. Future research could, therefore, cover derivative markets as well since liquidity is also a pricing risk in these markets.

The restriction to come out of Chapter 3, which investigates whether CSR investment is affected by financial flexibility, is that we do not consider the impact of other factors which can act as an insurance tool. The insurance role of CSR investment could be confirmed more strongly if we find a substitute relationship between CSR and insurance tools which are well documented in the literature. In addition, when examining whether credit rating has an impact on the relationship between financial flexibility and CSR, we noticed that existing literature fails to establish an empirical relationship between financial flexibility and credit rating. Therefore, it would be interesting to examine the impact of credit rating on corporate liquidity management in more detail.

Regarding Chapter 4, which focuses on the relationship between the cash adjustment speed and CEO inside debt compensation, the main restriction is that there has been a financial crisis since 2007. Accordingly, the data featured in our sample is closely related to the specific market regime. Therefore, further research could examine whether the impact of the CEO compensation incentive on the adjustment speed of cash holding is asymmetric under different market regimes.

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