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**Four essays on capital structure dynamics:
special reference to level of leverage, state ownership,
corporate governance and climate risk**

A thesis

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Abstract

My thesis consists of four essays that investigate the issues regarding speed of adjustment of capital structure (SOA). Since any deviation in the observed leverage from the optimal level will reduce a firm's value, the questions pertaining to the existence of target capital structure and how fast firms adjust their leverage draw the attention of researchers and practitioners. To this end, two major approaches have been adopted to address the SOA issues. While some researchers discuss the best method to estimate the speed of leverage adjustment, others explore the determinants of SOA. In contrast to prior studies which focus on developed markets, we explore both a developed market (United States) and a developing market (Vietnam). Two of the four essays here focus on the U.S. market when examining the method of calculating SOA and the new determinant (drought) of SOA. The remaining two essays concentrate on Vietnam, an emerging market and a transitional economy. Nguyen, Locke, and Reddy (2015), after considering the relationship between corporate governance and firm performance in Vietnam, reveal that the legal system, the rule of law, and investor protection in developing countries are not as effective as in developed countries. As such, corporate governance in developing countries play a more important role in mitigating the agency problem and severe information asymmetry. Hence, the impact of corporate governance on SOA in developing countries can be different from developed countries (Buvanendra, Sridharan, & Thiyagarajan, 2017). Additionally, the role of state ownership is essential in transitional countries where the economy moves from a centrally-planned system to a market-oriented one. Hence, it is important to understand the impact of state ownership on SOA in transitional economies.

The first essay introduces a new approach to estimate SOA and investigates the relationship between the level of leverage and SOA of capital structure. Instead of

applying a blanket total leverage measurement, we consider three leverage settings: total leverage, long-term leverage, and short-term leverage to review other sources of debt. The drawbacks of different approaches, such as a sub-sampling model, applying optimal leverage as a criterion to measure the degree of leverage, or penalized quantile regression, are disclosed. Moreover, we prove that our framework, of employing the quantile regression model and excluding zero-leverage firms, is the best way to investigate the influences of the level of leverage on SOA. For the total and long-term leverage setting, our findings support Leary and Roberts (2005) who contend that the high- and low-levered firms are likely to make leverage adjustments quicker than mid-levered firms. Moreover, we extend the literature to reveal the asymmetry dynamics derived from low-versus high-levered firms. That is, the low-levered firms have a higher SOA than highly levered firms. While the existence of optimal short-term debt and the ways in which firms adjust their short-term debt are sources of controversy among researchers, our findings show that SOA becomes smaller and changes from positive to negative to positive across quantile levels, indicating that the existence of optimal short-term leverage is for firms with low short-term debt.

The second essay discusses the impact of state ownership on SOA by using a quantile regression approach in Vietnam – a transitional economy. This relationship has been only recently explored in China, and Vietnam, as an important transitional emerging market in Asia, warrants attention. Since privatisation is still ongoing, state-owned enterprises, which contribute 29% to the country's GDP, play a crucial role in the Vietnamese economy. The linkage between state ownership and SOA in the literature has produced mixed results thus far and we obtain new evidence that the effect of state ownership on SOA is conditional on the level of leverage. Specifically, the effect is significant where there are extreme leverage values, both very high and very low, but it

is not significant in the central area of leverage distribution. This effect is adverse for low-leveraged firms but positive for high-leveraged firms. Moreover, the magnitude of adverse effects on SOA is greater than those of favourable effects, implying an average negative effect of state ownership on SOA.

The third study investigates the impact of corporate governance in Vietnam. First, we disclose the effect of fundamental corporate governance mechanisms, namely gender diversity, foreign ownership and managerial ownership on SOA, which are left unexplored by the literature. Second, we are the first attempt to demonstrate the linkage between corporate governance and SOA in Vietnam. While most studies on capital structure dynamics and corporate governance concentrate on the United States (Chang, Chou, & Huang, 2015, 2014), minimal attention has been paid to the relationship between corporate governance and SOA in a developing country. The corporate governance system in Vietnam is in its initial stage of development and remains underdeveloped. Applying the GMM (Generalized Method of Moment) two step framework, we find the significant impact on SOA of six corporate governance mechanisms: board size, board independence, CEO duality, gender diversity, managerial ownership and foreign ownership. Our evidence indicates that board size, board independence, gender diversity, and managerial ownership positively affect SOA while CEO duality and foreign ownership have adverse influences. These findings have important policy implications for firms and Vietnamese authorities.

The fourth study demonstrates how firm respond, in terms of SOA of capital structure, to climate-change risk, namely, drought. Using a fractional dependent estimator (DPF) approach and 130,511 U.S. firm-year observations over the period 1970-2015, we document an adverse and significant influence of drought on capital structure and the speed of leverage adjustment. Our study makes four significant contributions to the extant

literature in climate finance. First, while there is virtually no disagreement among researchers that climate change poses substantial costs to the economy (e.g., Burke, Hsiang, & Miguel, 2015; Dietz, Bowen, Dixon, & Gradwell, 2016; Lesk et al., 2016), the impact of climate change in the form of drought on individual firms has yet to be well researched. Second, while the extant literature documents the impact of drought, mostly in food and agriculture industries (Blackhurst, Hendrickson, & Sels, 2010; Hong et al., 2019; Lesk et al., 2016), we report evidence of the spill over effect of drought on non-food industry firms. Third, our firm-level examination takes advantage of the heterogeneity in corporate policies and allows us to draw implications for managers as to how firms can palpably address climate risks in general and drought risk in particular. Last, we find that the role of cash flow and financial unconstrained factors are effective in mitigating the negative impact of drought on capital structure and the speed of leverage adjustment.

Keywords: Leverage, target capital structure, speed of adjustment, adjustment costs, ownership, drought risk, climate change

List of research papers

Refereed publications

Nguyen, T., Bai, M., Hou, G., & Vu, M. C. (2020). State ownership and adjustment speed toward target leverage: Evidence from a transitional economy. *Research in International Business and Finance*, 53, 101226. [SSCI and ABCD ranking = B]

Nguyen, T., Bai, M., Hou, G., & Vu, M. C. (2020). Corporate governance and capital structure dynamics: Evidence from Vietnam, *Global Finance Journal*, in press [ABCD ranking = A]

Refereed journal paper

Thao, N.H., Min, B., L., Greg, H., Truong, C. (2019). Speed of adjustment toward target leverage: Evidence from a quantile regression analysis, *Accounting and Finance*, revised and submitted [SSCI and ABCD ranking = A]

Thao, N.H., Min, B., L., Greg, H., Truong, C. (2019). Drought risk and capital structure dynamics, *Accounting and Finance*, submitted [SSCI and ABCD ranking = A]

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Thao, N.H., Leon, L., Greg, H., (2018). Examining dynamic speed of adjustment toward target leverage using quantile regression: an empirical study on Singapore. Paper presented at New Zealand Finance Colloquium PhD Symposium, Massey University, Palmerston North, New Zealand.

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Declaration

I, Thao Nguyen Huu, declare that the content of this thesis is the result of work that has been carried out by me in the University of Waikato. I further certify that except where explicit reference is made to the contribution of others, and where prior works referred to are duly acknowledged, this thesis is originally authored by me. The work has not been submitted previously, in whole or in part, to qualify for any other academic award anywhere.

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List of Abbreviations

CDF	Cumulative probability function
CG	Corporate Governance
DPF	Dynamic Panel Fractional Estimator
GDP	Gross Domestic Product
GMM	Generalized Method of Moment
HNX	Hanoi Stock Exchange
HOSE	Ho Chi Minh Stock Exchange
IPO	Initial Public Offering
LAD	Least-sum of Absolute Deviations
LOE	Law On Enterprises
LSDV	Least Square Dummy Variable
NCEI	National Centres for Environmental Information
NOAA	National Oceanic and Atmospheric Administration
OLS	Ordinary Least Square
PCVN	Vietnamese Communities Leading Party
PDSI	Palmer Drought Severity Index
QR	Quantile Regression
RTS	Russian Trading System
SIC	Standard Industrial Classification
SMEs	Small and Medium Enterprises
SOA	Speed Of Adjustment
SOA.LTL	Speed Of Adjustment of Long Term Leverage

SOA.STL	Speed of Adjustment of Short Term Leverage
SOA.TL	Speed Of Adjustment of Total Leverage
SOEs	State-Owned Enterprises
SSC	State Securities Commission
UPCoM	Unlisted Public Companies
US	United States of America
WB	World Bank

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Chapter 1

Introduction

1.1 Background of the thesis

This thesis investigates four important issues relating to speed of adjustment (SOA) of capital structure: level of leverage, state ownership, corporate governance, and drought.

Theoretically, to maximise value, firms should fully adjust their leverage to the optimal level; however, due to adjustment costs, firms partially change or rebalance their leverage only when the benefits of the adjustment process outweigh its costs. A number of studies have employed different methods to measure the speed of leverage adjustment in a bid to answer the question of how quickly firms move their leverage to their targets. For instance, Ozkan (2001) stipulated the value of 41% when employing Arellano and Bond's difference GMM estimator. In contrast, Flannery and Rangan (2006), using the basic panel fixed effects and instrumental variable estimator, found the pace of leverage adjustment to be 34%. In a recent study, Dang, Kim, and Shin (2015) concluded that the fractional dependent variable estimator (DPF) and bias-corrected fixed-effects estimator are the most suitable approaches to calculate SOA. The SOA value in Dang et al. (2015) of 26.4% is consistent with the estimate by Elsas and Florysiak (2011). Following this research trend, we focus on the heterogeneity in the SOA which is dependent on the level of leverage. We argue that our framework, in which the quantile regression model is applied and zero-leverage firms are excluded, is the best method to reveal the relationship between SOA and level of leverage. Additionally, we point out the downside of other

approaches such as adopting sub-sampling, applying optimal capital structure as a criterion to measure the degree of leverage, or using penalised quantile regression.

Since firms are unable to achieve the optimal capital structure level because of adjustment costs, some studies investigate the sources of adjustment costs which are impediments to achieving target levels (Banerjee, Heshmati, & Wihlborg, 2004; Drobetz & Wanzenried, 2006; Fama & French, 2002). Researchers have demonstrated that the agency costs resulting from conflicts between managers and shareholders contribute to adjustment costs (Chang, Chou, & Huang, 2014; Liao, Mukherjee, & Wang, 2015). Self-interested managers in firms with serious agency issues are likely to distort firm policies to maximise their own benefits at the expense of the wealth of shareholders. Since agency costs prevent firms from attaining the desired capital structure level to maximise firm value, factors associated with these costs should have clear impacts on SOA.

This research justifies the impact of state ownership on SOA since firms with a higher proportion of state ownership bear greater agency costs than private companies. Moreover, because firms with good corporate governance are associated with enhanced accountability, trust, and transparency, which in turn mitigate agency costs, we also investigate the relationship between corporate governance and SOA. We explore the Vietnamese market when considering agency costs because Vietnam is an important transitional emerging market in Asia. Ongoing privatisation has meant that state-owned enterprises, which contribute 29% to the country's GDP, play an essential role in the Vietnamese economy. Therefore, it is important to examine the relationship between state ownership and SOA in Vietnam. Moreover, in emerging markets, the legal system, the rule of law, and investor protection are not as effective as those in developed markets. As such, corporate governance plays a more important role in emerging markets in mitigating severe information asymmetry and agency problems. We examine crucial corporate

governance mechanisms by considering board size, board independence, CEO duality, gender diversity, managerial ownership and foreign ownership on SOA to understand the comprehensive impact of corporate governance on SOA in the Vietnamese market.

Significant concerns around the effect of climate risk on financial markets have provided a basis for this thesis' analysis on the linkage between SOA of capital structure and drought. Since risk is closely related to the costs (distressed costs and external financing costs) and benefits (expected value of tax shield) of leverage adjustment, risk is also considered a determinant of SOA.

The following sections (1.2 to 1.5) outline the four essays comprising the body of this thesis.

1.2 Level of leverage and speed of adjustment of capital structure

The first essay investigates the relationship between the degree of leverage and the speed of adjustment of capital structure by applying quantile regression and excluding the zero-leverage firms. They review and point out the drawbacks of empirical studies on the heterogeneity in SOA conditional on the level of leverage. In these essays, we examine the distortion of SOA, namely "SOA smile" and "SOA skew". More particularly, the "SOA smile" shows the discrepancy between low- and high-levered firms against mid-levered firms, whereas the "SOA skew" represents the differences between high and low-levered firms.

As the optimal capital structure is not observable (Hovakimian & Li, 2011), studies which apply target leverage as a criterion to measure the leverage level (Byoun, 2008; Faulkender, Flannery, Hankins, & Smith, 2012) remain theoretical. For instance, firms with a debt level of 90% are considered high-levered, but whether their leverage level is above or below the optimal level remains uncertain.

By applying a sub-sampling approach, Komera and Jijo Lukose (2016) explore the linkage between SOA and level of leverage in India. However, the limitation of sub-sampling for the dependent variable is that the observations in the same group of the explained variable will have similar values at a quantile. Therefore, the small variance of data would reduce the accuracy of the estimations. We assert that quantile regression, in which the data is not divided as all observations are used to estimate the parameters for each quantile, would be a better approach to capture the complicated relationship by estimating coefficients via the conditional quantile functions.

Additionally, due to issues of equivalence between the type of financing and the degree of raising debt (Chang, Chou, & Huang, 2014; Cook, Kieschnick, & McCullough, 2008), we point out a deficiency in estimating SOA without excluding zero-leverage firms in the study by Galvao and Montes-Rojas (2010) when they use the penalised quantile regression approach. We suggest that the drawback in calculating SOA can be critical when the proportion of the zero-leverage firms in the U.S. is relatively high at 10.24%.

By applying quantile regression and considering three types of leverage -- total leverage, long-term leverage and short-term leverage -- we conclude that the SOA towards target leverage is non-uniform. In particular, it varies significantly across various quantiles of the debt ratio. For the total and long-term leverage, the SOA is higher at the tail ends than at the central region of the leverage. Moreover, a slight difference between low and high quantiles of leverage creates the "SOA skew". This finding is consistent with Leary and Roberts (2005) who find that firms are likely to adjust their debt level when it is relatively high or low. However, the discrete regime-switching framework used in their study is problematic, with only three simulations being possible (i.e., central,

upper, and lower regimes). We propose an adjusted model involving a quantile-varying SOA, which can represent SOA dynamics effectively.

Moreover, while the existence of optimal short-term debt and adjustments of short-term leverage remains an empirical question, our contribution is to highlight that firms with a low level of short-term debt have a target level and can adjust their short-term debt quickly, whereas firms with high short-term debt ratio move away from the optimal level. Our findings for the total and long-term debt adjustments support the trade-off theory while the changes in short-term debt can be interpreted by the pecking order theory.

1.3 State ownership and speed of adjustment of capital structure

The second essay examines the impact of state ownership on adjusting the speed of capital structure in Vietnam by applying a quantile regression framework. We choose the context of Vietnam because it is a transitional economy with ongoing privatisation where in state-owned enterprises, which contribute 29% to the country's GDP, play an important role in the economy. Moreover, the bad debt and inefficiency of some large state-owned enterprises trigger severe consequences for the economy. Therefore, it is necessary for policymakers to consider the impact of state ownership on SOA in order to improve the performance of state-owned enterprises. While the relationship between state ownership and SOA has been explored in China, this study extends the literature by investigating Vietnam, another typical transitional economy.

Firms with high state ownership are likely to bear considerable agency costs for three reasons. First, when supported by the government, state-controlled banks are likely to bail out state-owned firms for their losses, leading to “soft budget” constraints. The flexibility of the budget has an adverse effect on the motivations of managers in state-owned enterprises (Zhu, 2012). Second, there is a divergence between voting rights and

cash flow rights where government shareholders have equity voting rights but not cash flow rights (Zou & Xiao, 2006). Third, the purpose of state-owned firms is to achieve political objectives, not to maximise the shareholders' interests (Zhou & Xie, 2015). Since agency costs are a part of adjustment costs, state-controlled firms should exhibit a slower speed of leverage adjustment. However, according to Qian, Tian, and Wirjanto (2009), owing to a good relationship with a state-controlled bank and a guratantee against bankruptcy and insolvency by the government, state-owned enterprises can borrow debt at cheaper costs, leading to a faster leverage adjustment. In other words, low transaction costs enable firms to adjust their leverage to the optimal level more quickly.

While the linkage between state ownership and SOA produces mixed findings based on explanations of transactions costs or agency costs, we come up with new evidence that the effect of state ownership on SOA is conditional on the level of leverage. More particularly, the effect is significant where there are extreme leverage values, both very high and very low; but the effect is insignificant in the central area of leverage distribution. This impact is adverse for low-levered firms but positive for high-levered firms. Moreover, the degree of negative influences is greater than that of the beneficial impacts. This indicates an average negative effect of state ownership on SOA. These findings, indeed, are firstly disclosed in the literature. While other studies on the Vietnamese market have made use of the data of publicly listed companies on the Ho Chi Minh (HOSE) and Hanoi stock exchanges (HNX) (Le & Tannous, 2016; Nhung & Okuda, 2015), this is the first to consider the firms recorded on the unlisted public companies (UPCoM) list.

1.4 Corporate governance and speed of adjustment of capital structure

The third essay investigates the impact of corporate governance on the adjustment speed of capital structure in the Vietnamese market. Since firms with good corporate

governance are likely to have enhanced accountability, trust and transparency, they bear low agency costs and perform a faster speed of leverage adjustment. While the impact of corporate governance on SOA has been demonstrated in the literature (Chang et al., 2014; Liao et al., 2015), most studies have focused on the developed market. Indeed, corporate governance in an emerging market plays a more important role in reducing the agency problem and information asymmetry than in developed economies because of a weaker state of national corporate governance, in terms of its legal system, rule of law and investor protection. Thus, the effect of corporate governance on SOA in emerging markets is different from a developed market. We choose to examine Vietnam owing to the fledgling and underdeveloped state of the Vietnamese corporate governance system. Vietnam achieved a corporate governance global score of 42.5% in 2011, which is much lower than Thailand (77%) and the Philippines (72%). Out of 183 nations, Vietnam was ranked 166th, exposing the weak protection rights for shareholders and investors (World Bank, 2013).

As the scope of corporate governance mechanism is wide-ranging, the impact of some important corporate governance variables, such as gender diversity, foreign ownership and managerial ownership on SOA, has, to date, been left unexplored in the literature. We address this gap by examining the effect of these factors on SOA in the Vietnamese market. Indeed, gender diversity has drawn scholarly attention as many firms today are under pressure to promote gender diversity (Sila, Gonzalez, & Hagendorff, 2016). Moreover, four European countries¹ have agreed on a binding proportion of female directors on board for certain firms. Generally, the female in the boardroom is believed to bring knowledge, skills, experiences, networking and monitoring ability for the firm development which are more advanced compared to the male counterparts

¹ Four countries include Belgium, France, Norway and Italy

(Adams & Ferreira, 2009). In addition, since foreign investors are likely to bring in new capital, cutting-edge technology, research and development abilities, the governments have introduced and implemented policies and strategies to attract foreign investment. Nevertheless, foreign investors also deal with the risks that come with doing business offshore and navigating the politics and systems of the local state.

Next, managerial ownership is known as a tool to align the interests between managers and shareholders (Jensen & Meckling, 1976). However, due to the certain different level of ownership, managers may not optimise the firm value and pursue their objectives (Demsetz, 1983; Fama & Jensen, 1983).

To have a comprehensive view of the Vietnamese stock market, we employ six corporate governance mechanisms: board size, board independence, CEO duality, gender diversity, managerial ownership and foreign ownership. Our evidence shows the negative effect of CEO duality and foreign ownership on SOA and the positive impact of board size, board independence, gender diversity, and managerial ownership on SOA

1.5 Drought and speed of adjustment of capital structure

The fourth essay examines the effect of drought on capital structure and SOA. The consequences of climate change is a highly topical issue today and this study focusses on one aspect of climate change: drought risk. According to Hong, Li, and Xu (2019), of all natural disasters related to climate change, drought is the most disastrous for the global economy. Likewise, after investigating 2,800 disasters in 100 countries, Lesk, Rowhani, and Ramankutty (2016) concluded that drought is the most destructive disaster for crop production. In a similar vein, Stahl, Tallaksen, De Stefano, and Vogt (2016) asserted that drought is one of the most destructive natural hazards in Europe in terms of its effect on the social, economic, and environmental system. To reduce significant losses from climate change, firms need to be responsive in the wake of a disaster.

We investigate how firms respond, in terms of SOA of capital structure, to a specific form of climate risk, namely, drought. Capital structure has a significant bearing on a firm's value and the cost of capital (Harris & Raviv, 1991; Modigliani & Miller, 1958).² Despite widespread discussion on the impact of firm-specific risk and macroeconomic risk on capital structure, the literature has largely been silent on the effects of climate risk on capital structure. An exception is Chen and Wang (2012), who consider the Kyoto ratification as a proxy for climate risk and indicate an inverse relationship between climate risk and capital structure. Although drought risk plays an important role and has a huge impact on the social and economic environment, no studies have been conducted to review its effect on capital structure.

As the variation of risks is involved with costs -- this may include the relative expenses of external financing and the potential of distressed costs, and other benefits such as the expected value of a tax shield of increasing debt -- risks are shown to be determinants of SOA (Baum, Caglayan, & Rashid, 2017). Several studies have explored traditional types of risk, such as bankruptcy risk, liquidity risk, default risk, crash risk, firm-specific risk and macroeconomic risk, in considering the relationship between risks and SOA. However, to the best of our knowledge, no studies have explored the possible link between climate risk and SOA.

Our study makes four significant contributions to the extant literature in climate finance. First, while there is virtually no disagreement among researchers that climate change causes substantial costs to the economy (e.g., Burke, Hsiang, & Miguel, 2015; Dietz, Bowen, Dixon, & Gradwell, 2016; Lesk et al., 2016), the effects of climate change

² The change in capital structure can trigger the agency problem, which in turn increases a firm's risk. Firms, therefore, are likely to adjust their capital structure in response to risk and control the overall risk level. The relationship between risk and capital structure is, however, inconsistent in the literature. This relationship can be positive, negative or insignificant depending on the types of the risk (Bradley, Jarrell, & Kim, 1984; Carleton & Silberman, 1977; Ferri & Jones, 1979; Titman & Wessels, 1988; Toy, Stonehill, Remmers, Wright, & Beekhuisen, 1974).

in the form of drought on individual firms has been left unexplored. Second, while the extant literature documents the impact of drought, mostly in food and agriculture industries (Blackhurst, Hendrickson, & Sels, 2010; Hong et al., 2019; Lesk et al., 2016), we show evidence of the spill over effect of drought on non-food industry firms. Third, our firm-level examination takes advantage of the heterogeneity in corporate policies and allows us to draw implications for managers as to how firms can palpably address climate risks in general and drought risk in particular. Last, we show the role of cash flow and financial unconstrained factors to be effective in mitigating the negative impact of drought on capital structure and the speed of leverage adjustment.

The remainder of the thesis is organised into six chapters. Chapter one introduces the concept of adjustment speed of capital structure and explains how the four topics are linked. Chapter two then looks at the relationship between level of leverage and the speed of leverage adjustment. Chapter three presents the impact of state ownership on adjustment speed of capital structure by a quantile regression approach. Chapter four examines the impact of corporate governance on adjustment speed of capital structure in the Vietnamese market. Chapter five considers the impact of drought on capital structure and adjustment speed of capital structure. Chapter six summarises the main findings of the four chapters and discusses the contributions and limitations of the research before offering suggestions for future studies.

Chapter 2

Speed of Adjustment toward Target Leverage: Evidence from A Quantile Regression Analysis

2.1 Introduction

Questions pertaining to the existence of target leverage and how fast firms move their capital structure to the optimal level capture attention of researchers, any deviation in the observed leverage from the desired leverage level will lower firms' value. A number of studies apply different methodology to estimate the speed of adjustment (SOA) (Dang, Kim, & Shin, 2015; Elsas & Florysiak, 2011; Flannery & Rangan, 2006; Hovakimian & Li, 2011; Huang & Ritter, 2009; Ozkan, 2001) while some studies investigate the impediments to achieve target levels (Banerjee, Heshmati, & Wihlborg, 2004; Drobetz & Wanzenried, 2006; Fama & French, 2002; Flannery & Hankins, 2007; Öztekin & Flannery, 2012).

In this study, we introduce a new approach to estimate SOA and examine the relationship between the level of leverage and the speed of adjustments of capital structure. In the literature, some attempts have been made to highlight the heterogeneity in SOA relying on the level of leverage. However, most of these studies apply optimal leverage as a criterion to measure leverage level (Byoun, 2008; Faulkender, Flannery, Hankins, & Smith, 2012). As optimal leverage is not observable (Hovakimian & Li, 2011), we argue that it remains theoretically to consider debt level relying on the target³ from that perspective. Adopting a quantile framework, our paper examines "SOA smile" and "SOA skew" patterns to fill the gap for the extant literature. The "SOA smile" makes a

³ For instance, if a firm has a debt ratio of 90%, we argue they are high-levered firms but we are not sure whether they are above or below the target or not.

comparison of SOA between low- and high-levered firms against mid-levered firms, whereas the “SOA skew” indicates the differences between high and low-levered firms.

Recently, Komera and Jijo Lukose (2016) employ the sub-sampling approach to explore the relationship between SOA and the level of leverage in India. Nevertheless, while the sample is divided into a particular quantile, the observations in the same group will have similar value for the dependent variable at that quantile. Consequently, a small variance of data would reduce the reliability of the estimations. In that case, we argue that quantile regression would be a better approach to examine the complicated relationship for that by estimating models via the conditional quantile functions. Notably, the data is not separated as all observations are employed in the calculation of parameters for each quantile.

Although Galvao and Montes-Rojas (2010) employ penalized quantile regression to estimate SOA in the US market, the inclusion of zero-leverage firms in the calculation introduces bias more or less, through problems of equivalence between the type of financing and the degree of raising debt (Chang, Chou, & Huang, 2014; Cook, Kieschnick, & McCullough, 2008). We assert that the error in estimating SOA will be critical when employing quantile regression for the US market with a significant proportion of zero-leverage firms (10.24%). For the above reasons, we postulate that quantile regression for the non-zero debt issuance firms is the most appropriate method to examine the SOA depending on the level of leverage. Instead of applying the blanket of total leverage measurement to review other sources of debt, we consider three leverage settings: total leverage, long-term leverage and short-term leverage

Applying the quantile regression (QR) and using 206,046 US firm-year observations, from 1970 to 2017, we show that the SOA towards target leverage is not fixed; it varies significantly across various quantiles of the debt ratio. For the total and

long-term leverage, the SOA is higher at the tail ends than at the central region of the capital structure. And, there is a slight difference between low and high quantiles of leverage, creating the “SOA skew”. Our results support Leary and Roberts (2005) who find firms adjust their debt ratios when it is relatively high or low. However, the discrete regime-switching framework used in Leary and Roberts (2005) is dramatic, with only three simulations being possible (i.e., central, upper, and lower regimes). We propose an adjusted model involving a quantile-varying SOA, which can exhibit SOA dynamics effectively. Specifically, we examine SOA estimates at 19 distinct quantiles ranging from 0.05 to 0.95 (increasing at intervals of 0.05). Leary and Roberts (2005) generate their three-regime framework using the levels of leverage but do not consider the possible asymmetry dynamics derived from low- versus high-levered firms. The model estimating a quantile-varying SOA we propose the asymmetry dynamics.

The existence of optimal short-term debt and adjustments of short-term leverage are controversial in the literature. Our contribution is to highlight that firms with a low level of short-term debt can adjust their short-term debt quickly whereas firms with high short-term debt ratio move away from the optimal level. Our findings for the total and long-term debt adjustments support the trade-off theory while the changes in short-term debt can be explained by the pecking order theory.

This paper is organized as follows. Section 2 reviews the literature and develops the research hypotheses. Section 3 explains the econometric models used in the research method. Section 4 shows data and empirical results. Section 5 shares the findings of the robustness tests. Finally, section 6 summarises the study, offers conclusions and policy implications.

2.2 Literature review and research hypotheses

2.2.1 Literature review

2.2.1.1 Existence of a target leverage

According to the trade-off theory, a target capital structure can be achieved by firms when they balance the benefits against the costs of issuing debt. Also, the theory indicates that capital structure selection can minimise the cost of deviating from the target capital structure (Chang & Dasgupta, 2009). Notwithstanding the above, some theories disagree with the trade-off theory and claim that there is no target capital structure for firms. For example, the pecking order theory argues that the firm does not use a target capital structure but seeks the cheapest source. Further, due to asymmetric information, firms prefer to use internal financing rather than debt and consider issuing shares as a last resort finance source.

Although trade-off and pecking order theories seem to be inconsistent with each other, De Haan, Koedijk, and Vrijer (1994) survey Dutch firms and reveal that most firms attain target leverage by following the pecking order theory. Notably, 75% of publicly traded firms have a target debt ratio, but they follow a financing hierarchy which is well explained by the pecking order theory. Moreover, some empirical studies imply that trade-off behaviour is correct for the long-term, but pecking order theory can be used for firms to make short-term debt decisions (Hovakimian, Opler, & Titman, 2001; Kayhan & Titman, 2007). Titman and Tsyplakov (2007) demonstrate that while the leverage improvement process is based on a pecking order, the movement towards target leverage is defined by trade-off considerations. To support this argument, Graham and Harvey (2001) find 81% of the firms in their sample have a target debt ratio when making financing decisions.

Another research perspective discusses the existence of target leverage for firms. For instance, Heshmati (2001) asserts that the primary purpose of capital structure

theories is to identify the inconsistency of target debt, not the differences of observed debt. Likewise, Drobetz and Wanzenried (2006) argue that in case of high adjustment costs will bias the observed leverage results. Similarly, Cheng and Tzeng (2014) examine the effect of optimal leverage on firm value and indicate that firms with significant deviation from optimal leverage are associated with a low value.

2.2.1.2 Issues of adjustment speed of capital structure

Since the existence of optimal leverage is established, recent studies turn their attention to examine how fast firms adjust their leverage to their desired level. Theoretically, firms should change their capital structure to the optimal level and maximise their value; nevertheless, due to the rebalancing costs, they do not adjust entirely but only partially to their target. Numerous studies attempt to estimate the average speed of capital structure adjustment through different approaches. For instance, Ozkan (2001), by applying Arellano and Bond's difference GMM estimator, has calculated the speed of leverage adjustment as 41%. Flannery and Rangan (2006) employ the basic panel fixed effects and instrumental variable estimator and report the SOA of 34% for firms in the US. Also, the SOA was estimated at 23.2% in the US by Huang and Ritter (2009) when applying a long differencing estimator. Investigating US market but using fractional dependent variable estimator (DPF), Elsas and Florysiak (2011) find the pace at which firms shift their leverage to an optimal level is 26.3%. Dang et al. (2015) asserted that the bias-corrected fixed-effects estimator is one of the best methods to measure the leverage adjustment speed. Their result at 26.4% is close to the Elsas and Florysiak (2011) estimate.

While the average movement of capital structure is explored, much of the current literature pays attention to the causes of the heterogeneity and asymmetry in the speed of leverage adjustment. For example, Drobetz and Wanzenried (2006) highlight a discrepancy of SOA between the upward and downward trends of the interest rate

structure. Faster adjustment speed is achieved when the interest rate is increasing. Additionally, according to Cook and Tang (2010), firms change their leverage more quickly under favourable macroeconomic conditions rather than under unfavourable conditions. Dudley (2012) and Faulkender et al. (2012), point out the rapid capital structure adjustment when large investment projects are conducted. Also, firms with high cash flows can quickly speed up the leverage changing process due to low adjustment costs (Faulkender et al., 2012). Additionally, Chang et al. (2014) and Liao, Mukherjee, and Wang (2015) argue that agency conflicts can be taken into consideration to explain the dynamic capital structure adjustment. More specifically, with good corporate governance firms quicken their pace of leverage adjustment, whereas, with weak corporate governance firms exhibit ‘snail’ speed of capital structure changes.

Some attempts have been made to investigate the heterogeneity in SOA depending on the level of leverage by different approaches. Leary and Roberts (2005) apply simulations for the dynamic capital structure to introduce three scenarios of adjustment costs consisting of a fixed cost, a proportional cost and a fixed cost plus weakly convex component. In each case, there is a target leverage range, which is defined by the upper (\bar{L}) and lower (\underline{L}) boundary. Interestingly, only when the capital structure touches the boundaries, firms change their leverage. There is a variety of size of adjustment: it can be large, small, or complex depending on the particular scenario. After analysing each cost regime, Leary and Roberts (2005) find a high probability that firms will raise (or reduce) debt when their leverage is relatively low (or high). Although Leary and Roberts (2005) indicate SOA dynamics across various leverage levels, the discrete segmentations used in their study is simple and dramatic. Moreover, they were unable to test the possible asymmetry SOA dynamics derived from low- versus high-levered firms.

The asymmetry of adjustment speed is explored by some studies. For instance, Byoun (2008) indicates that over-levered firms adjust their leverage faster than under-levered firms. Similarly, Faulkender et al. (2012) conclude the pace at which firms change leverage is 56.4% for over-levered firms and 29.8% for under-levered firms.

Most of the studies employ optimal leverage as a criterion to measure debt level; however, Hovakimian and Li (2011) argue the target capital structure of a firm is not observable. Hence, to investigate the heterogeneity and asymmetry of adjustment speed, instead of focusing on a range of optimal capital structure, we will analyse the actual leverage to show a smooth pattern from low-levered firms to highly levered firms.

The sub-sampling approach is employed by Komera and Jijo Lukose (2016) to examine the relationship between SOA and the level of leverage in India. They conclude that firms with a high level of leverage adjust their capital structure faster than firms with lower leverage. Compared to the subsampling framework, quantile regression is a better method to capture the complicated relationship as it uses an estimation model. The data is not separated as all observations are utilized in the calculation of parameters for every quantile. Moreover, if the sample is divided into a particular quantile, the observations in the same group will have similar value for the dependent variable at that quantile. Consequently, there would be no variance to explain.

As the strength of quantile regression, several studies have applied this approach to investigate the determinants of capital structure. For instance, Fattouh, Scaramozzino, and Harris (2005) argue that the variables such as firm's size, growth, tangibility and profitability are associated with the asymmetric information costs on their distribution; therefore, their impact on firms are different conditional on the degree of leverage. Likewise, Fattouh, Harris, and Scaramozzino (2008) evidence that the effect of firm size on leverage changes sign between low-levered and high-levered firms. Therefore, to

overcome these shortcomings of sub-sampling and take advantage of quantile regression approach, we propose a model with quantile-varying SOA coefficients, which allows us to capture the heterogeneity and asymmetry in the speed of leverage adjustment across various leverage levels.

Although leverage proxy can be measured by the total debt ratio, short-term leverage, and long-term leverage in exploring SOA, researchers have frequently applied the total debt ratio. Short-term and long-term leverage is employed infrequently, and a discrepancy between short-term leverage and long-term leverage adjustment is reported. For instance, Dufour, Luu, and Teller (2017), note the cash flow raised from long-term debt is generally used to buy fixed assets. The process of raising cash is costly and time-consuming, particularly due to the value of the fixed assets and particularly the complexity of borrowing for obtaining tangible assets. By contrast, when firms use short-term debt to finance the operating cycle, the process is more straightforward. Accordingly, the costs of the short-term debt adjustment are less than that of long-term debt adjustment leading to the faster SOA of short-term debt than the SOA of long-term debt. Similarly, Bhaduri (2002) highlights the restructuring costs involved in reaching the desired ratio of the short-term debt to long-term debt and indicates that firms adjust the short-term debt more quickly rather than the long-term debt (75% vs. 53%).

The existence of optimal and adjustments of short-term leverage are controversial in the literature. While most of the studies find the target and estimate the speed of short-term debt leverage adjustments (Ariff & Hassan, 2008; Deesomsak, Paudyal, & Pescetto, 2004; Dufour et al., 2017; Serrasqueiro, Nunes, & da Silva, 2012), Chipeta and Mbululu (2013) and Ahsan, Man, and Qureshi (2015) produce contradictory results. Investigating 191 JSE-listed non-financial firms from 2000 to 2010, Chipeta and Mbululu (2013) concluded that firms achieve the optimal total and long-term leverage, but not the short-

term leverage. Likewise, Ahsan et al. (2015) explored 13,115 firm-year observations listed on Karachi Stock Exchange Pakistan between 1973 and 2010 and found that only 16% of firms pursue a short-term target. More specifically, aside from firms in Vanaspati, tobacco, and jute industry, profitable firms in other sectors do follow optimal short-term leverage. Hence, to gain a comprehensive overview of the leverage adjustment, we consider short-term leverage, long-term leverage, and total debt leverage.

Galvao and Montes-Rojas (2010) employ penalized quantile regression to estimate SOA in the US market. However, they focus only on total debt leverage rather than on the effect of long- and short-term leverage. By combining the data of zero and non-zero leverage firms in calculating SOA, the findings that the leverage adjustment speed gets smaller from 44% to 3% across the leverage quantiles (Galvao & Montes-Rojas, 2010) do not support the theories and other empirical studies (Leary & Roberts, 2005). Cook et al. (2008) adopt the zero-inflated beta model and assert that including the zero-leverage and non-zero leverage firms will result in the problems of the equivalent between the type of financing and the degree of raising debt. Zero-leverage firms are likely to maintain the debt-free and do not maximise the firm's value (Byoun, 2008). Dang (2013) clarify that firms follow the zero-debt policy results from the financial constraints and the reduction in investment distortions. In recent studies, Chang et al. (2014) and Liao et al. (2015) address the boundary issue of incorporating zero-leverage firms in estimating SOA. As the US market has a high proportion of zero-debt leverage (10.24%), this bias will be more critical when using the quantile regression approach to estimate the reversion rate of the leverage.

Since the quantile regression developed by Koenker and Bassett (1978) represents the effect of independent variables on the conditional distribution of a dependent variable, and all observations are utilized in the estimations of the coefficients for every quantiles;

some of empirical studies on capital structure have employed this method (Cho, El Ghouli, Guedhami, & Suh, 2014; Fattouh et al., 2008; Fattouh et al., 2005). Nevertheless, to the best of our knowledge, very few studies have applied quantile regression approach to examine the heterogeneity and asymmetry in the speed of capital structure adjustment and comprehensively consider three measures of leverage. By considering short-term, long-term, and total leverage, we capture dynamic SOA across the varying level of leverage in a continuous and smooth pattern.

2.2.2 Development of research hypotheses

According to the trade-off theory, firms try to keep an optimal leverage level to balance the costs and benefits of debt. Several empirical studies adopt various arguments to examine this theory. For instance, the partial adjustment model indicates that the actual target leverage of each period depends on the determinants of capital structure from the previous period. Besides, according to the costly adjustment model developed by Leary and Roberts (2005), the optimal financial policy is explained by the initial leverage and the boundaries (the high and low level of the leverage). Fischer, Heinkel, and Zechner (1989) affirm that firms choose their leverage level based on tax benefits and anticipated bankruptcy costs. Nevertheless, any shocks to asset values lead to costly adjustments for firms to recapitalise their finance, indicating there is a range of target leverage levels, not an optimal leverage level. Goldstein, Ju, and Leland (2001) show that firms raise their leverage only if their leverage reaches an upper boundary.

Drawing from Leary and Roberts (2005), we argue that adjustment speeds are conditional - in accordance with the level of leverage. Thus, high-levered firms would repurchase debt to reduce bankruptcy costs, while low-levered firms are likely to increase debt to take advantage of the tax shield. For mid-levered firms, the benefit of adjustment

is marginal, and thus is insufficient to compensate for the cost of adjustment. Based on the evidence above, we formulate our SOA hypothesis:

Hypothesis 1: High- and low-levered firms are likely to make leverage adjustments quicker than mid-levered firms.

Following the trade-off theory, several empirical studies show that firms make adjustments when their leverage is far above or below the target. Similarly, we postulate that high- and low-levered firms are associated with a faster SOA than mid-levered firms. To further examine the potential asymmetry of the leverage adjustment, most research has been conducted to test between over-levered and under-levered firms under different scenarios. For instance, to test the SOA asymmetry Byoun (2008) considers the condition of financial surplus versus deficit, Faulkender et al. (2012) use operating cash flows, and Lockhart (2014) examines credit lines.

While most studies apply target debt ratios as the criteria to examine the asymmetry in adjustment pace, these target levels are unobservable (Hovakimian & Li, 2011). Hence, we investigate the asymmetry in SOA by testing the differences between low-levered versus high-levered firms. The disparity of the moving speed originating from the adjustment costs of capital structure. To reduce the bankruptcy costs, highly levered firms issue equity to repurchase debt. Since firms with high financial leveraged are associated with poor credit ratings, they have a limited ability to reduce debt. Conversely, low levered firms are associated with good credit ratings that equip them with the freedom to increase leverage at a low cost. For these reasons, we formulate our second SOA hypothesis:

Hypothesis 2: Low levered firms have a higher SOA than highly levered firms.

Research has reported a discrepancy between short-term leverage and long-term leverage adjustments. The differences arise from the features of short-term versus long-

term debt. Generally, due to the complexity and high-priced of the tangible assets, it is costly and takes a long time to raise fund for the long-term debt. In contrast, firms usually issue short-term debts to fund the operating cycle; the procedure is more straightforward and smoother resulting from the low value and short period of the operating activity. For those reasons, the transactions costs of short-term debt adjustment are less than that of long-term debt adjustment. Therefore, most of the studies report the faster adjustment of short-term debt movements compared to the long-term debt (Ariff & Hassan, 2008; Deesomsak et al., 2004; Dufour et al., 2017; Serrasqueiro et al., 2012).

However, since firms do not target the short-term leverage (Ahsan et al., 2015; Chipeta & Mbululu, 2013) whether optimal short-term leverage exists or not and how it changes over the time remain empirical questions. Generally, firms with a low level of short-term debt are motivated to increase short-term debt to take advantage of the tax shield. Additionally, due to the lower transaction costs of short-term debt compared to long-term debt, at low quantile level, the adjustment of short-term debt would perform a faster pace toward their optimal than that of the long-term debt. By comparison, a high level of short-term debt reduces the firms' ability to replace short-term debt with long-term debt or equity. Therefore, firms are likely to keep raising short-term debt for their financing need owing to its cheap transaction costs.

According to Leary and Roberts (2005), firms make a capital structure adjustment when their leverage reaches the low or high boundaries, hence high-levered firms should reduce their leverage to achieve the optimal level. Nevertheless, firms do not always adjust leverage to the optimal level, they sometimes move away because of good credit lines (Lockhart, 2014) or high cash flow (Dufour et al., 2017). In our case, firms with high short-term debt level will increase short term debt, indicating that firms move away from their target short-term leverage and exhibit a negative speed of adjustment. Since

the speed of short-term leverage adjustment changes from positive to negative with large magnitude at low quantile, whereas the speed of long-term debt adjustment remains positive and follow “smile” and “skew” pattern across the quantile level of short-term debt and long-term debt respectively. From these findings we formulate the following hypothesis:

Hypothesis 3: The SOA of short-term debt is different from the SOA of long-term debt in terms of magnitude, volatility and sign.

2.3 Econometric models

2.3.1 The QR model

To discuss how QR works,

$$y_{it} = x_{it}' \beta_{\theta} + u_{\theta it} \quad (2.1)$$

Where y_{it} is the explained variable (i.e., leverage) and x_{it} is the $k \times 1$ vector of explanatory variables for the firm i and in time period t . In Eq. (2.1), θ is the quantile value of the y_{it} variable. This value refers to a cumulative probability density function of y_{it} with a range from 0% to 100%. For instance, the value of y_{it} at the 50th (50%) quantile represents the median of y_{it} . As the median value (i.e. $\theta = 50\%$) of the leverage is close to 0.5, the leverage associated with the above (below) 50% leverage quantiles could range from 0.5 to 1 (0 to 0.5). The key feature of the QR approach is to use the coefficient vector β_{θ} in Eq. (2.1) to explain the relations between explanatory variables, x_{it} and the dependent variable, y_{it} , at its θ quantile where θ ranges from 0 to 100%.

Specifically, the optimal function for estimation of β_{θ} is shown as:

$$\begin{aligned} & \min \sum_{it:u_{\theta it}>0} \theta \times |u_{\theta it}| + \sum_{it:u_{\theta it}<0} (1-\theta) \times |u_{\theta it}| \\ & = \sum_{it:y_{it}-x_{it}'\beta_{\theta}>0} \theta \times |y_{it}-x_{it}'\beta_{\theta}| + \sum_{it:y_{it}-x_{it}'\beta_{\theta}<0} (1-\theta) \times |y_{it}-x_{it}'\beta_{\theta}|. \end{aligned} \quad (2.2)$$

Eq. (2.2) shows the estimator vector of β_θ changes according to θ , the quantile value of the dependent variable (i.e., the y variable). By contrasting β_θ estimates across various θ , we are able to examine whether the relationship between x and y variables is non-uniform across the different levels of the latter. This is the key advantage of the QR method.

For comparison purpose, the least-sum of absolute deviations (LAD) and ordinary least square (OLS) estimators are presented. First, the traditional non-quantile regression approach is as follows:

$$y_{it} = x_{it}'\beta + u_{it} \quad (2.3)$$

Second, the LAD estimate is as follows:

$$\min \sum_{it} |u_{it}| = \sum_{it} |y_{it} - x_{it}'\beta| \quad (2.4)$$

A comparison between equations (2.2) and (2.4) reveals the difference between LAD and QR approaches. The LAD employs an equal weight (i.e., the value of 1) on positive and negative errors. By contrast, the QR adopts unequal weights on positive and negative errors (i.e., θ for positive errors and $(1-\theta)$ for negative errors). Moreover, the LAD estimators β are the special case of QR estimators β_θ under the restriction of $\theta = 50\%$.

The OLS estimator is used to obtain the vector of β in Eq. (2.5), which is showed as:

$$\min \sum_{it} u_{it}^2 = \sum_{it} (y_{it} - x_{it}'\beta)^2 \quad (2.5)$$

The comparison of equations (2.4) and (2.5) reveals the difference between the OLS and LAD approaches. OLS estimate is solved by minimising the sum of residual squared while the coefficients of LAD estimate form minimising the absolute value of the errors. Therefore, the LAD and OLS present the outcome on the conditional median and mean functions of the dependent variable (y_{it}) on the independent variables (x_{it}),

respectively.⁴ They are both different from quantile regression approach as quantile indicates the relationship is conditional on the contribution of the dependent variable.

2.3.2 Empirical models

A regression specification is used to estimate SOA in our study. First we determine the target leverage by regressing leverage on a set of explanatory variables which are proxies of the firm's characteristics (Antoniou, Guney, & Paudyal, 2008; Hovakimian & Li, 2011; Liao et al., 2015)

$$LEV_{i,t+1}^* = \alpha + \beta X_{i,t} \quad (2.6)$$

where LEV^* represents firm's predicted target leverage, and X is a vector of firm characteristic variables, including firm size ($SIZE$), asset tangibility ($TANG$), market to book ratio (M/B), research and development expenses ($R\&D$), research and development expense indicator ($R\&D_IND$), depreciation and amortization (DEP), median debt ratio of industries (MED), operating income before depreciation ($PROFIT$). These variables are the main determinants of the optimal capital structure defined by the trade-off theory (Chang et al., 2014; Hovakimian & Li, 2011). We use three measures of leverage consisting of total debt leverage, short-term debt leverage and long-term debt leverage (Bhaduri, 2002; Dufour et al., 2017).

⁴ The QR approach widely applies in finance research. For example, Yu, Lu, and Stander (2003) summarized research using QR method. More recently, Armstrong, Blouin, Jagolinzer, and Larcker (2015) also apply this regression method to investigate whether corporate governance would mitigate the degree of tax avoidance.

Table 2.1 provides a list of variable definitions.

Table 2.1: Definition of leverage and explanatory variables for leverage

Variables	Definitions
<i>Dependent variables</i>	
Total leverage (TLEV)	Total debt/The sum of market equity and debt
Short-term leverage (SLEV)	Short-term debt/ The sum of market equity and debt
Long-term leverage (LLEV)	Long-term debt/The sum of market equity and debt
<i>Independent variables</i>	
Firm size (SIZE)	The natural logarithm of total assets
Tangibility (TANG)	Property, plant, and equipment as a proportion of total assets (fixed assets)
Market-to-book ratio (M/B)	(Book debt + Market equity)/Total assets
Research and development expenses (R&D)	Research and development expenses scaled by total assets
R&D indicator (R&D_IND)	Missing values of R&D are replaced with zeroes. One for firms with non-missing R&D
Depreciation (DEP)	Depreciation divided by total assets
Industry Median debt ratio (MED)	Industry is defined based on the four-digit SIC
Profitability (PROFIT)	The ratio of earnings before interest and tax to total assets

Second, the partial adjustment model is presented as below (Fama & French, 2002; Kayhan & Titman, 2007)

$$LEV_{i,t+1} - LEV_{i,t} = \delta(LEV_{i,t+1}^* - LEV_{i,t}) + \varepsilon_{i,t} \quad (2.7)$$

Where LEV and LEV^* represents the firm's achieved and target leverage levels, and δ is the SOA of leverage towards its optimal level. When $SOA = 1$, firms fully adjust to the optimal level, whereas when $SOA < 1$, the presence of adjustment costs prevent the speed of capital structure adjustments towards the target⁵. Following the literature (Dang et al., 2015; Mark J. Flannery & Rangan, 2006; Hovakimian & Li, 2011), we merge Equations (2.6) and (2.7) to obtain a reduced form partial adjustment leverage model:

⁵ The adjustment costs may come from financial distress and other costs of debt (Hovakimian & Li, 2011)

$$LEV_{i,t+1} = \alpha \times \delta + \beta \times \delta \cdot X_{i,t} + (1 - \delta) LEV_{i,t} + \varepsilon_{i,t} \quad (2.8)$$

Lastly, we transform Equation (2.8) into Equation (2.9) as follows:

$$LEV_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 LEV_{i,t} + \varepsilon_{i,t} \quad (2.9)$$

Where $\pi_0 = \alpha \times \delta$, $\pi_1 = \beta \times \delta$, $\pi_2 = 1 - \delta = 1 - \text{SOA}$ (i.e., $\text{SOA} = 1 - \pi_2$). Comparing Equations (2.8) and (2.9) indicates that the SOA is measured as $1 - \pi_2$. Theoretically, the value of π_2 lies between 0 and 1, which indicates firms adjust their leverage to achieve the optimal level (Antoniou et al., 2008).

We apply quantile regression for Equation (2.9) to examine the heterogeneity in SOA depending on the level of leverage. To compare the results of quantile regression with the sub-sampling approach in estimating SOA, we follow Dang et al. (2015) and Elsas and Florysiak (2011) and use dependent fractional variable (DPF) to calculate the speed of leverage adjustment for the sub-sample. This method is to extend tobit regression and consider the dependent fractional variable. According to Dang et al. (2015), DPF is one of the most suitable models to estimate SOA for several reasons. First, the panel data in our sample are unbalanced. Second, the leverage is a ratio bounded by 0 and 1. Third, Elsas and Florysiak (2011) prove the robustness of the DPF estimator for simulation across the different time dimensions of panel data. Appendix 2.1 provides evidence of biased results when the sub-sampling approach is applied to evaluate SOA hinging on the level of total leverage.

2.4. Data and empirical results

2.4.1 Data

We obtain data from the Compustat database. Firms in the financial industries (SIC codes 6000-6999) and regulated utilities (SIC codes 4900-4999) are excluded from

our analyses (Bauer, Frijns, Otten, & Tourani-Rad, 2008; Dittmar & Mahrt-Smith, 2007; Laing & Weir, 1999; Ukaegbu & Oino, 2014). To reduce the influence of the outliers and misreported data, we remove firms with a value of total assets less than one million dollars and winsorize all variables at the 1st and 99th percentile.

According to Cook et al. (2008), including both the zero-leverage and non-zero leverage firms can lead to issues of the equivalence between the type of financing and the degree of raising debt. In other words, whether firms issue debt or not and how much debt they want to use is overlapped. Similarly, Chang et al. (2014) take into consideration the bias of SOA estimate resulting from the incorporating of zero-debt issuance firms. Moreover, because zero-leverage and non-zero leverage firms have different motivations regarding financial constraints, financial flexibility and the need of external financing (Devos, Dhillon, Jagannathan, & Krishnamurthy, 2012; Z. Huang, Li, & Gao, 2017), we exclude all zero-leverage firms. Also, our purpose is to examine the adjustment speed depending on the level of leverage; hence omitting zero-leverage firms will enable us to focus only on firms deliberately adjusting the leverage rather than on firms following a zero-leverage policy.

Because of these exclusions, 24,749 firms in the US with all the required data from 1970 to 2017 (a period of 48 years), are included in the study providing 206,046 firm-year observations for the statistical analyses. Table 2.2 lists the descriptive statistics of variables for the sample firms included in this study. These statistics, in general, are consistent with other studies on leverage in the US market (Dang et al., 2015; Flannery & Rangan, 2006).

Table 2.2 Descriptive statistics of variables

Variable	N	Mean	SD	Min	Max
Total leverage (TLEV)	206,046	0.226	0.192	0.000	0.996
Short-term leverage (SLEV)	206,046	0.062	0.105	0.000	0.990
Long-term leverage (LLEV)	206,046	0.164	0.166	0.000	0.991
Firm size (SIZE)	206,046	4.744	2.357	0.250	10.478
Tangibility (TANG)	206,046	0.332	0.250	0.000	0.943
Market-to-book ratio (M/B)	206,046	1.800	1.680	0.449	14.767
Research and development expenses (R&D)	206,046	0.035	0.087	0.000	0.725
R&D indicator (R&D_IND)	206,046	0.404	0.491	0.000	1.000
Depreciation (DEP)	206,046	0.053	0.043	0.000	0.281
Industry Median debt ratio (MED)	206,046	0.156	0.085	0.000	0.487
Profitability (PROFIT)	206,046	0.072	0.195	-0.778	0.703

This table presents the number of observations, mean, standard deviation, minimum and maximum of the variables (1970-2017). All variables are collected from Compustat database. As we have deleted all zero-leverage firms, the min of total leverage is $6.48 * 10^{-7}$

2.4.2 Empirical results

To show the heterogeneity in the adjustment speed of capital structure across various leverage quantiles, we use the QR approach to estimate Equation (2.9). The empirical results of the adjustment speeds (i.e., $1 - \pi_2$) of short-term, long-term and total debt using market value are disclosed at the various level of leverage. While estimating QR, we start from the 5% quantile of leverage, and then repeat estimation by 5% increases. The estimation procedure ends at the 95% quantile. The narrower gap of 95% confidence intervals implies the accuracy of SOA estimates. For comparisons, the OLS and DPF estimates of SOA are also shown. To simplify the presentation of these tables, we do not provide the estimated coefficients of the explanatory variables for the optimal leverage (i.e., $X_{i,t}$ in Equation (2.9))⁶

2.4.2.1 The adjustment speed of total leverage

⁶ In the literature, some studies have been conducted to find the determinants of capital structure by quantile regression approach. Because of the asymmetric costs throughout the distribution of the leverage, the impacts of different factors on different degree of leverage are diversified; especially for over-levered firms, many factors are no longer significant (Fattouh et al., 2005; Sánchez-Vidal, 2014). In our paper, we also find the changes in the impacts of some factors on the distribution of the leverage. More specifically, the degree of impacts may change from negative to positive or from significance to insignificance. .

Table 2.3: SOA of total leverage estimates across various leverage quantile levels

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	0.522	(0.00)**	0.55	0.052	(0.00)**
0.10	0.381	(0.00)**	0.60	0.044	(0.00)**
0.15	0.303	(0.00)**	0.65	0.039	(0.00)**
0.20	0.245	(0.00)**	0.70	0.039	(0.00)**
0.25	0.199	(0.00)**	0.75	0.041	(0.00)**
0.30	0.162	(0.00)**	0.80	0.045	(0.00)**
0.35	0.129	(0.00)**	0.85	0.055	(0.00)**
0.40	0.102	(0.00)**	0.90	0.072	(0.00)**
0.45	0.080	(0.00)**	0.95	0.116	(0.00)**
0.50 (LAD)	0.064	(0.00)**	OLS	0.162	(0.00)**
			DPF	0.230	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (2.9) when we apply quantile regression to find the different values of π_2 throughout the distribution of the total leverage. With each value of π_2 , we find the value of $SOA = 1 - \pi_2$. To compare the results of quantile approach versus the LAD/OLS, we also show SOA under LAD and OLS methods. While quantile regression shows a smooth pattern of SOA on different degree of the total leverage, LAD/OLS/DPF methods just shows one value of the middle level or a moving average of SOA over the time.

The adjustment speeds of total debt ratio (SOA.TL) across total differential leverages are shown in Table 2.3. By DPF and OLS, the degrees of SOA are estimated at 16.2% and 23.0% respectively. It supports the notion that firms adjust their leverage toward the optimal level partially. Our result is consistent with other studies in the literature, which apply different methods and find a range of SOA.TL from 7% to 40% (Fama & French, 2002; Flannery & Hankins, 2007; Kayhan & Titman, 2007; Lemmon, Roberts, & Zender, 2008). Next, we examine the quantile-varying SOA estimates. The SOA.TL estimates are positive and significant across all quantiles. While the sign and significance of the SOA.TL estimates are consistent across various quantiles; the magnitude changes dramatically. For example, the SOA.TL is 52.2 % at the 5% quantile of leverage and decreases monotonically from 52.2 % to 3.9 % at 70% total leverage quantiles. The SOA.TL reaches the lowest value at the 70% quantile (SOA = 3.9%). From

70% to 95% leverage quantiles, an increasing pattern of SOA.TL is observed (i.e., from SOA.TL = 3.9% at the 70% quantile to SOA = 40% at 95% the quantile).

To illustrate the heterogeneity in SOA across various leverage quantiles, Figure 2.1 graphs the QR estimates of SOA across leverage levels with 95% confidence intervals. As shown in Figure 1, the SOA.TL estimates at the tail ends on the left (i.e., 52.2 % at 5% leverage quantile) are considerably higher than SOA.TL estimate at the central quantile (i.e., 6.4% at 50% leverage quantile). The SOA.TL estimates at the tail ends on the right (11.6% at 95% quantile) is slightly larger than that at the central region (6.4% at 50% leverage quantile).

Figure 2.1: The QR estimate of SOA total leverage across various quantiles of total leverage

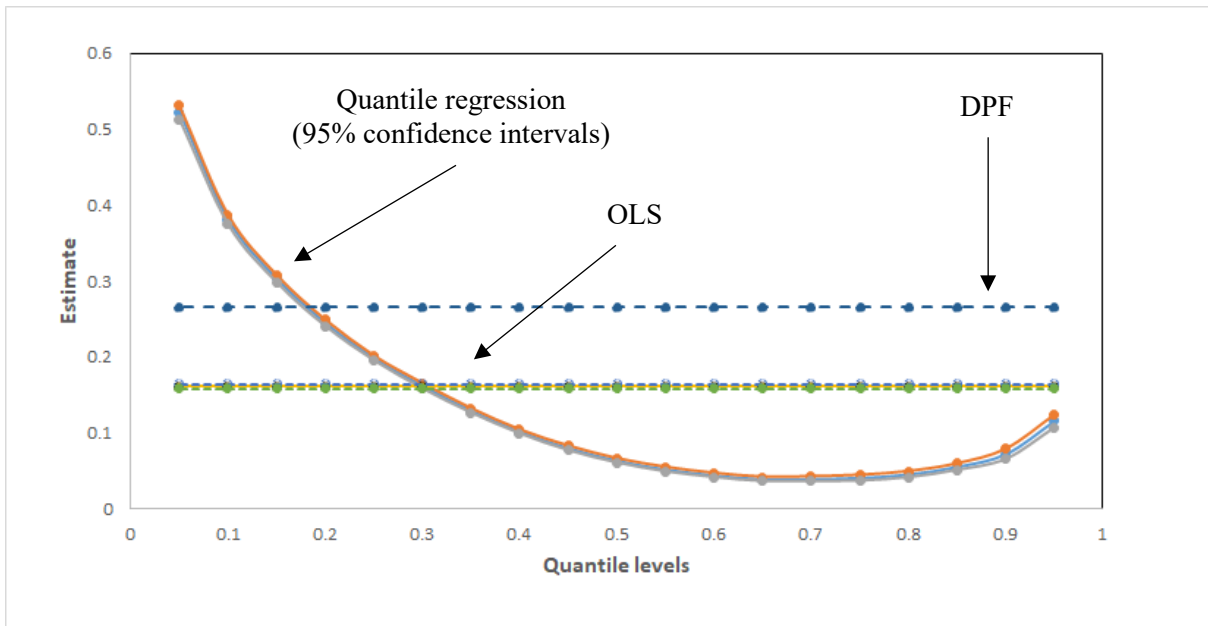


Table 2.4: Test on SOA total leverage smile

Quantile	F-statistic	P-value	Quantile	F-statistic	P-value
0.05 vs. 0.50	10811.12	(0.00)**	0.60 vs. 0.50	714.07	(0.00)**
0.10 vs. 0.50	13742.52	(0.00)**	0.65 vs. 0.50	672.72	(0.00)**
0.15 vs. 0.50	12402.86	(0.00)**	0.70 vs. 0.50	500.74	(0.00)**
0.20 vs. 0.50	7697.32	(0.00)**	0.75 vs. 0.50	221.75	(0.00)**
0.25 vs. 0.50	7008.19	(0.00)**	0.80 vs. 0.50	113.41	(0.00)**
0.30 vs. 0.50	5330.29	(0.00)**	0.85 vs. 0.50	22.1	(0.00)**
0.35 vs. 0.50	2619.78	(0.00)**	0.90 vs. 0.50	7.71	(0.00)**
0.40 vs. 0.50	1542.38	(0.00)**	0.95 vs. 0.50	161.1	(0.00)**
0.45 vs. 0.50	771.57	(0.00)**			
0.55 vs. 0.50	363.29	(0.00)**			

Note: * Significant at the 5% level, ** Significant at the 1% level

In Table 2.4, we present the results of F -statistics for the test of inequality of SOA across the various leverage quantiles. We test hypothesis 1 by considering the significance of the “SOA smile” pattern in which high- and low-levered firms adjust their leverage more quickly than that of mid-levered firms. In this SOA distortion, we adopt the SOA estimate at the 50% quantile as a benchmark and then discuss the difference between the two quantiles. We note the inequality of SOA is significant across all quantiles. Although we see all the significance at 1% of the difference between all the quantiles to the 50% quantile level, the SOA.TL of high-levered firms is just slightly faster than that of the mid-levered firms whereas SOA.TL of high-levered firms is much quicker than mid-levered firms. Therefore, the “SOA smile” pattern is obtained for total leverage adjustment.

Table 2.5 lists the F statistics for the test of SOA.TL skew pattern showing a large difference in SOA between low-levered firms and high-levered firms. These statistics show the inequalities of the SOA.TL estimate between the θ and $(1-\theta)$ quantiles. Based on F statistics, it shows that the pattern of SOA skew is significant at the 1% level.

Table 2.5: Test on SOA of total leverage skew

Quantile	F-statistic	P-value
0.05 vs. 0.95	5127.33	(0.00)**
0.10 vs. 0.90	9072.99	(0.00)**
0.15 vs. 0.85	18696.52	(0.00)**
0.20 vs. 0.80	6747.95	(0.00)**
0.25 vs. 0.75	7456.48	(0.00)**
0.30 vs. 0.70	6538.95	(0.00)**
0.35 vs. 0.65	3795.24	(0.00)**
0.40 vs. 0.60	2970.18	(0.00)**
0.45 vs. 0.55	1118.15	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level

Since the “SOA smile” and “SOA skew” patterns are significant at all quantile levels, hypothesis 1 and 2 are true for SOA of the total leverage.

2.4.2.2 The adjustment speed of long-term leverage

Table 2.6 presents the rate at which long-term leverage reverts to its target (SOA.LTL). By applying OLS and DPF framework, SOA of LTL is found at 20.5 % and 26.6% respectively. However, when employing quantile regression, SOA.LTL changes substantially from 1.0% to 72.1% across various long-term debt ratios. This speed range is consistent with other studies⁷. The SOA of long-term leverage is like the SOA of the total debt ratio in that they are both significant positive. The SOA.LTL is 72.1% at the 5% quantile of long debt ratio, and from this point it falls gradually to 1.0% at 75% quantile of long-term leverage. This quantile level is also recorded as the lowest boundary value of adjustment speed for long-term debt ratio. There is an upward trend of SOA.LTL from 75% to 95% quantile of long debt ratio.

⁷Chipeta and Mbululu (2013) conclude that the adjustment speed for long-term leverage is 54% when they investigate 191 non-financial firms listed on JSE. Dufour et al. (2017) reveal the SOA of long-term debt ratio in French SME, which is 67.8%. Ramjee and Gwatidzo (2012) consider the SOA of long-term leverage in South Africa and conclude a speed of 65.5%.

Table 2.6: SOA of long-term leverage estimates across various leverage quantile levels

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	0.721	(0.00)**	0.55	0.049	(0.00)**
0.10	0.474	(0.00)**	0.60	0.033	(0.00)**
0.15	0.364	(0.00)**	0.65	0.020	(0.00)**
0.20	0.294	(0.00)**	0.70	0.013	(0.00)**
0.25	0.242	(0.00)**	0.75	0.010	(0.00)**
0.30	0.198	(0.00)**	0.80	0.011	(0.00)**
0.35	0.160	(0.00)**	0.85	0.021	(0.00)**
0.40	0.125	(0.00)**	0.90	0.042	(0.00)**
0.45	0.096	(0.00)**	0.95	0.099	(0.00)**
0.50 (LAD)	0.042	(0.00)**	OLS	0.205	(0.00)**
			DPF	0.266	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (2.9) when we apply quantile regression to find the different values of π_2 throughout the distribution of the total leverage. With each value of π_2 , we find the value of $SOA = 1 - \pi_2$. To compare the results of quantile approach versus the LAD/OLS, we also show SOA under LAD and OLS methods. While quantile regression shows a smooth pattern of SOA on different degrees of the total leverage, LAD/OLS/DPF method just shows one value of the middle level or a moving average of SOA over the time.

Table 2.7 describes the results of the “SOA smile” pattern of long-term leverage by applying F -statistics. We find a significant difference at 5% between low- and high-levered firms versus mid-levered firms. Notably, the SOA of low-levered firms moves more quickly (72.1% versus 4.2%) while SOA of high-levered firms are just slightly higher than mid-levered firms (9.9% versus 4.2%). Our outcomes support the hypothesis 1 in which low- and high-levered firms perform a faster adjustment speed than the mid-levered firms.

Table 2.7: Test on SOA of long-term leverage smile

Quantile	F-statistic	P-value	Quantile	F-statistic	P-value
0.05 vs. 0.50	6191.02	(0.00)**	0.60 vs. 0.50	1524.37	(0.00)**
0.10 vs. 0.50	10898.71	(0.00)**	0.65 vs. 0.50	1597.5	(0.00)**
0.15 vs. 0.50	8766.83	(0.00)**	0.70 vs. 0.50	1219.43	(0.00)**
0.20 vs. 0.50	11014.3	(0.00)**	0.75 vs. 0.50	1251.84	(0.00)**
0.25 vs. 0.50	8179.78	(0.00)**	0.80 vs. 0.50	3926.6	(0.00)**
0.30 vs. 0.50	8428.65	(0.00)**	0.85 vs. 0.50	970.03	(0.00)**
0.35 vs. 0.50	4826.21	(0.00)**	0.90 vs. 0.50	66.2	(0.00)**
0.40 vs. 0.50	3340.37	(0.00)**	0.95 vs. 0.50	19.97	(0.00)**
0.45 vs. 0.50	3339.87	(0.00)**			
0.55 vs. 0.50	832.52	(0.00)**			

Note: * Significant at the 5% level, ** Significant at the 1% level

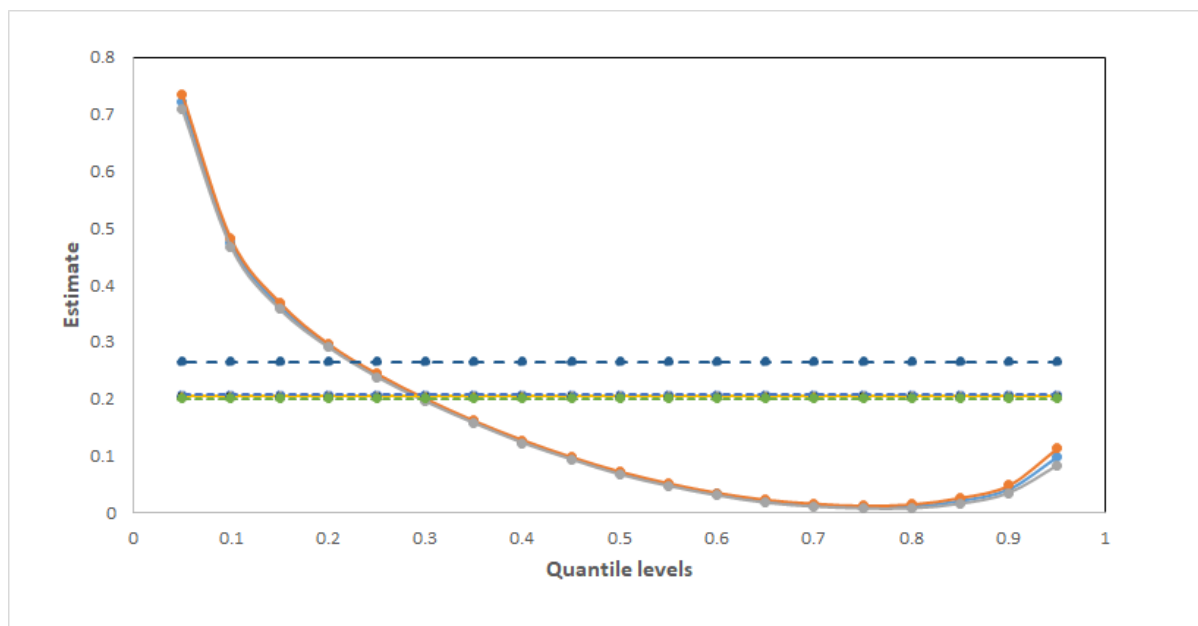
To analyse the differences between SOA of low- versus high-levered firms, we employ F -statistics. Table 2.8 shows that the pattern of SOA skews significant at the 1% level for all the differences between the θ and $(1-\theta)$ quantiles. This pattern is consistent with our prediction in hypothesis 2 that the low-levered firms change their SOA faster than that of the high-levered firms.

Table 2.8: Test on SOA of long-term leverage skew

Quantile	F-statistic	P-value
0.05 vs. 0.95	5039.87	(0.00)**
0.10 vs. 0.90	8494.98	(0.00)**
0.15 vs. 0.85	6696.46	(0.00)**
0.20 vs. 0.80	10732.78	(0.00)**
0.25 vs. 0.75	7991.53	(0.00)**
0.30 vs. 0.70	6850.70	(0.00)**
0.35 vs. 0.65	5471.08	(0.00)**
0.40 vs. 0.60	5373.21	(0.00)**
0.45 vs. 0.55	2919.12	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level

Figure 2.2: The QR estimate of SOA of long-term leverage across various quantiles of long-term leverage



2.4.2.3 The adjustment speed of short-term leverage (SOA.STL)

The heterogeneity in the speed of short-term debt adjustment by the level of the short-term debt ratio is revealed in Table 9. The SOA is calculated at 31.0% by OLS and 44.1% by DPF. By the quantile regression framework, we find a decreasing pattern of SOA.STL from positive to negative at varying short-term debt levels.

The highest speed is achieved at 5% quantile of 94.9%, from this point, the SOA.STL diminishes from 94.9% to 2.6% at 65% quantile. The positive SOA supports the tradeoff theory that firms target a short-term debt ratio and try to move short-term debt to the desired level to maximise their value (Ariff & Hassan, 2008; Deesomsak et al., 2004; Dufour et al., 2017; Serrasqueiro et al., 2012).

However, the SOA.STL undergoes a negative movement between 65% to 95% quantile of short-term debt ratio. This indicates firms also move away from their target level and exhibit a negative speed of adjustment. This view supports the pecking order theory that argues firms do not use an optimal capital structure but seek the cheapest

source. More specifically, due to asymmetric information, firms prefer to use internal financing rather than debt and consider issuing shares as the last financing source. Although firms with a high level of short-term debt reach the optimal point, they still add more short-term debt as the cheapest sources to meet their financial needs. Our results are consistent with some earlier published studies⁸

Table 2.9: SOA of short-term leverage estimates across various leverage quantile levels

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	0.949	(0.00)**	0.55	0.107	(0.00)**
0.10	0.861	(0.00)**	0.60	0.061	(0.00)**
0.15	0.762	(0.00)**	0.65	0.026	(0.00)**
0.20	0.654	(0.00)**	0.70	-0.010	(0.00)**
0.25	0.549	(0.00)**	0.75	-0.046	(0.00)**
0.30	0.456	(0.00)**	0.80	-0.082	(0.00)**
0.35	0.369	(0.00)**	0.85	-0.114	(0.00)**
0.40	0.288	(0.00)**	0.90	-0.155	(0.00)**
0.45	0.223	(0.00)**	0.95	-0.200	(0.00)**
0.50 (LAD)	0.161	(0.00)**	OLS	0.310	(0.00)**
			DPF	0.441	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (2.9) when we apply quantile regression to find the different values of π_2 throughout the distribution of the short-term leverage. With each value of π_2 , we find the value of $SOA = 1 - \pi_2$. To compare the results of quantile approach versus the LAD/OLS, we also show SOA under LAD and OLS methods. While quantile regression shows a smooth pattern of SOA on different degrees of the short-term leverage, the LAD/OLS method just shows one value of the middle level or a moving average of SOA over the time.

We also apply the *F*-statistics to test the “SOA smile” and the “SOA skew” of the short-term debt leverage adjustment. Although the results are significant at 1% across all quantiles, there is no “SOA smile” or “SOA skew” pattern as the adjustment speed of short-term debt follows a downward trend from positive to negative.

⁸ Chipeta and Mbululu (2013) argue that firms do not target the short-term debt ratio. Similarly, Lemmon, Roberts, and Zender (2008) find that’s managers are more concerned about the equilibrium levels of long-term leverage, as opposed to short-run fluctuation..

Table 2.10: Test on SOA of short-term smile

Quantile	F-statistic	P-value	Quantile	F-statistic	P-value
0.05 vs. 0.50	50306.71	(0.00)**	0.60 vs. 0.50	1365.89	(0.002)**
0.10 vs. 0.50	29134.58	(0.00)**	0.65 vs. 0.50	2529.76	(0.00)**
0.15 vs. 0.50	24748.99	(0.00)**	0.70 vs. 0.50	2251.62	(0.00)**
0.20 vs. 0.50	8957.49	(0.00)**	0.75 vs. 0.50	4291.25	(0.00)**
0.25 vs. 0.50	7838.85	(0.00)**	0.80 vs. 0.50	3650.47	(0.00)**
0.30 vs. 0.50	5346.78	(0.00)**	0.85 vs. 0.50	2413.79	(0.00)**
0.35 vs. 0.50	3737.36	(0.00)**	0.90 vs. 0.50	2209.64	(0.00)**
0.40 vs. 0.50	2093.18	(0.00)**	0.95 vs. 0.50	865.11	(0.00)**
0.45 vs. 0.50	1283.05	(0.00)**			
0.55 vs. 0.50	625.13	0.829			

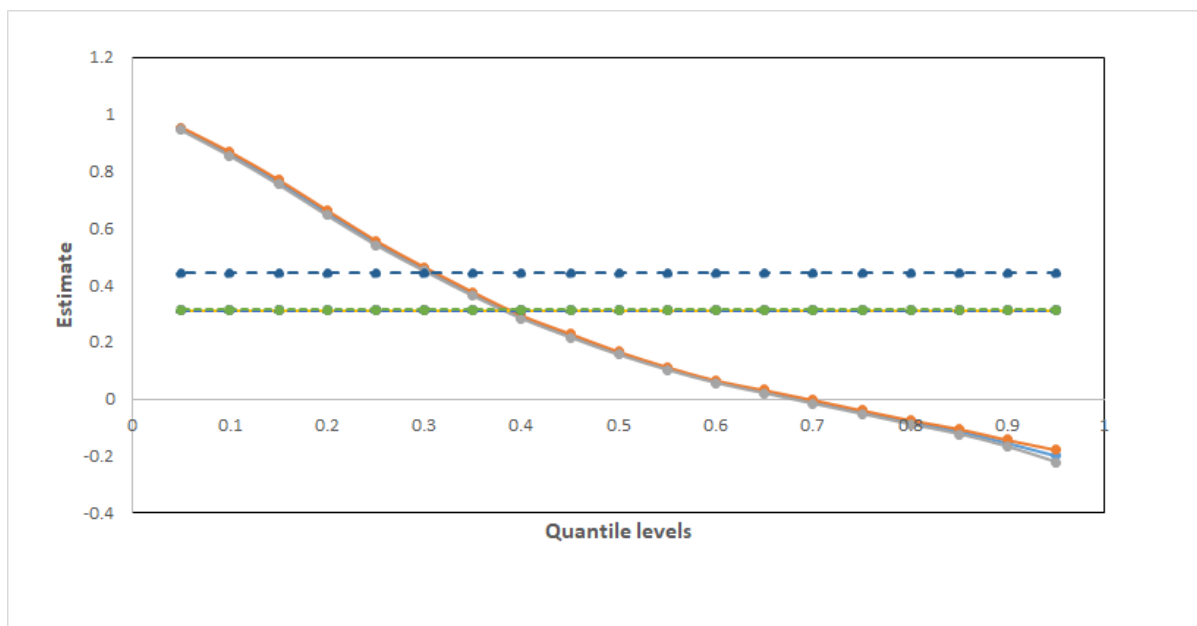
Note: * Significant at the 5% level, ** Significant at the 1% level

Table 2.11: Test on SOA of short-term leverage skew

Quantile	F-statistic	P-value
0.05 vs. 0.95	9330.09	(0.00)**
0.10 vs. 0.90	19357.57	(0.00)**
0.15 vs. 0.85	30148.98	(0.00)**
0.20 vs. 0.80	17304.49	(0.00)**
0.25 vs. 0.75	20521.26	(0.00)**
0.30 vs. 0.70	14432.98	(0.00)**
0.35 vs. 0.65	8394.64	(0.00)**
0.40 vs. 0.60	7494.11	(0.00)**
0.45 vs. 0.55	2596.67	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level

Figure 2.3: The QR estimate of SOA of short-term leverage across various quantiles of short-term leverage



2.4.2.4 A comparison between the adjustment speed of long-term leverage and short-term leverage

There is an apparent discrepancy between the pattern of the SOA of short and long-term debt at respective target levels. That is, at the low quantile level SOA.STL moves more quickly than SOA.LTL, and at high quantile level SOA.LTL remains positive whereas SOA.STL becomes negative. The differences come from the lower costs of short-term debt versus long-term debt. According to the information asymmetry (liquidity and signalling) theory, lenders may put some restrictions on long-term debt to reduce the liquidity risk. Hence, the costs of issuing short-term debt are cheaper than that of the long-term debt. Also, the contracting costs theory argue that issuing short-term debt can reduce the agency costs as the lenders have the better opportunities to monitor the managers, especially when firms would like to renew the short-term debt. Empirical studies support this view as well. For instance, according to Dufour et al. (2017), the cash flow raised from long-term debt is generally used to buy the fixed assets; it is costly and time-consuming resulting from the complex and high value of the tangible assets. In contrast,

firms usually issue short-term debt to establish a fund for the operating cycle; the procedure is more straightforward and smoother resulting from the low value and short-period of the borrowing requirements. For these reasons, the costs of issuing short-term debt are cheaper compared to the costs of issuing long-term debt.

At low quantile level, the SOA of short-term debt is faster than that of the long-term debt because of its lower adjustment costs. Moreover, at the high quantile level, although firms with high short-term debt ratio move away from the optimal level, they still increase the short-term debt because it is cheaper financing. This behaviour of firms is consistent with the prediction of the pecking order theory. On the other hand, firms with a high level of long-term debt follow the trade-off theory to adjust the long-term debt to the desired level to maximise the firms' value. Our results support the hypothesis 3 in which the adjustment speed of short-term debt is different from the long-term debt regarding the magnitude, volatility and sign.

2.5 Robustness tests

2.5.1 Alternative measure of leverage

To check the robustness of the results in Section 4, we carry out additional tests. These tests include an alternative measure of leverage. The results in Section 4 are based on market-value measures of the leverages: total debt leverage (total debt/(total debt + market value of equity)), long-term leverage (long-term debt/(total debt + market value of equity)), short-term leverage (short-term debt/(total debt + market value of equity)). To examine the robustness of estimates, we use the book-value measure of leverage: total leverage (total debt/book value of total asset), short-term leverage (short-term debt/book value of total asset), long-term leverage (long-term debt/book value of total asset) to re-run the QR estimations. The empirical results are listed in Figure 2.4, Figure 2.5 and

Figure 2.6. They demonstrate the similar pattern of adjustment speed for the total leverage, long-term leverage and short-term leverage.

Figure 2.4: The QR estimate of SOA of total leverage using book value across various quantiles of total leverage

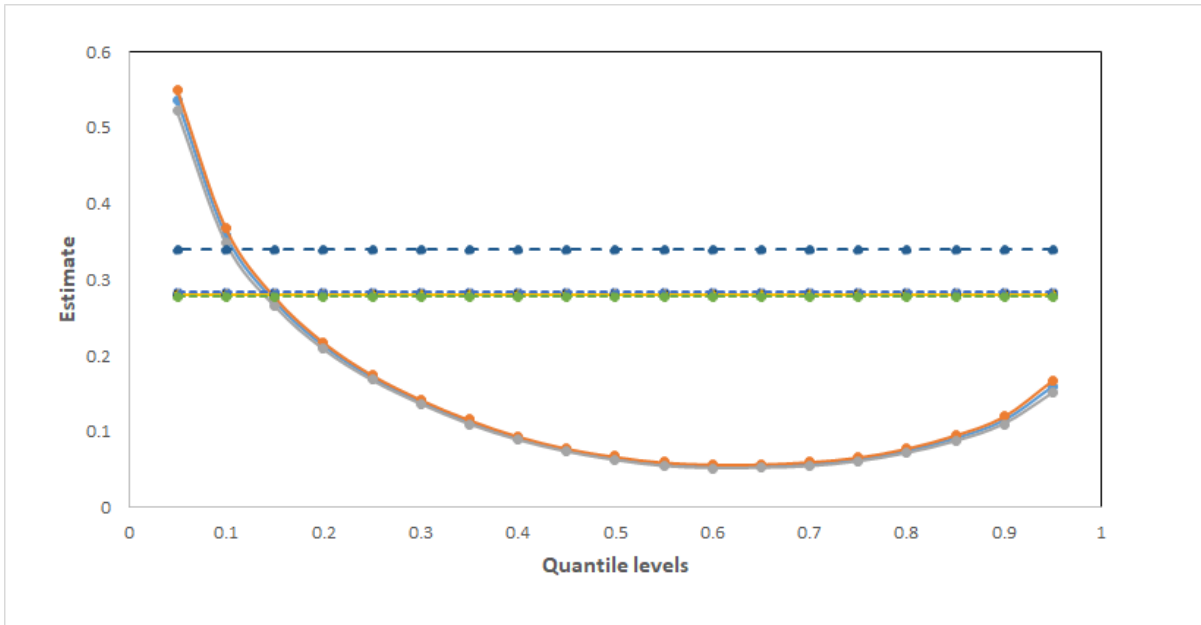


Figure 2.5: The QR estimate of SOA book value of long-term leverage using book value across various quantiles of long-term leverage

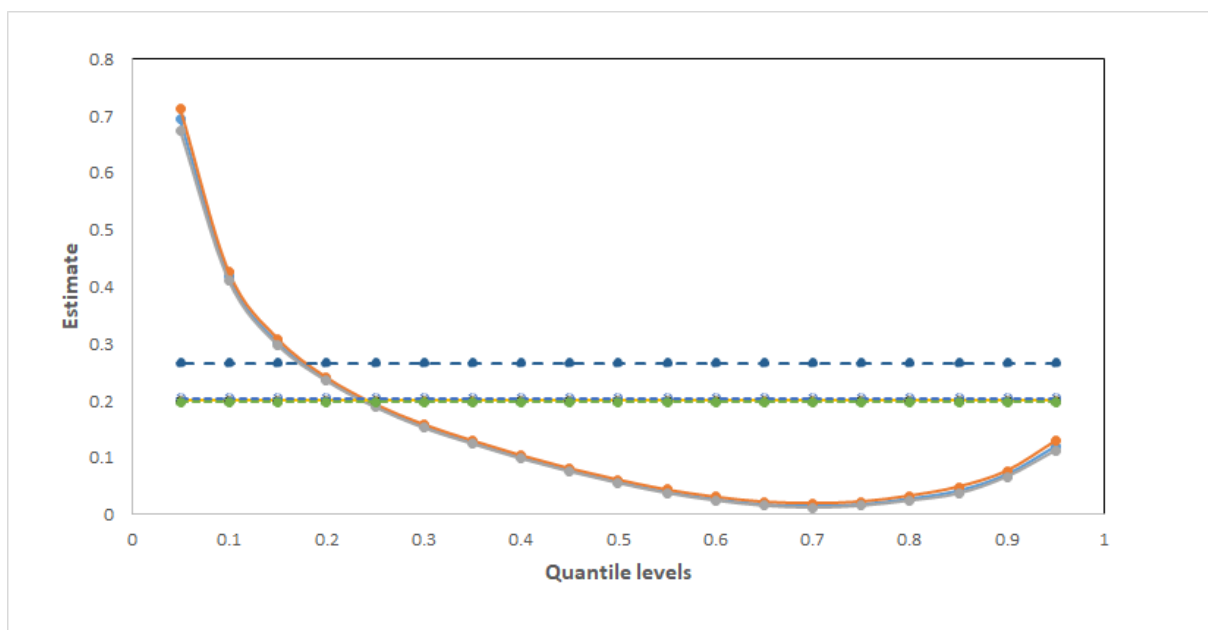
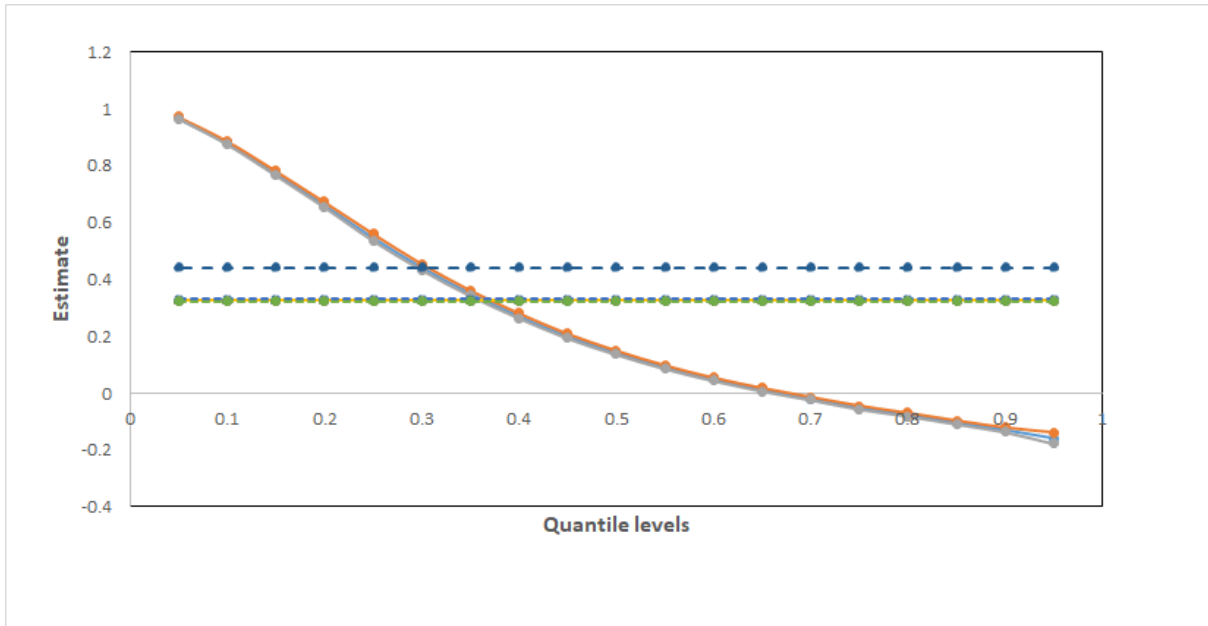


Figure 2.6: The QR estimate of SOA book value of short-term leverage using book value across various quantiles of short-term leverage



In Figure 2.4, when we use book value to measure the total debt leverage, the fastest SOA (53.7%) is achieved at 5% quantile, which is considerably higher than the central region of quantile (6.5 % at 50% quantile level). At the end tail of the pattern, SOA.TL is nearly three times quicker than at the middle quantile (15.9% at 95% quantile versus 6.5% at 50% quantile). Firms with low total leverage present a faster SOA than firms with high total leverage (i.e., 53.7% at 5% quantile versus 15.9% at 95% quantile) which meets our assumption of SOA skew.

In Figure 2.5, we take into consideration the book value to estimate the long-term debt leverage. The SOA.LTL also follows the same pattern as the SOA.TL. Notably, firms with low and high long-term leverage level converge to the optimal levels more quickly than firms with mid-levered of long-term debt ratio (i.e., SOA.LTL is 69.4% and 12.1% at 5% and 95% quantile level respectively versus SOA.LTL of 5.9% at 50% quantile). On a long-term debt ratio basis, the SOA of the high-levered firms is much faster than that of

the low-levered firms (i.e., SOA is 69.5% at 5% quantile versus 12.1% at 95% quantile), which supports our hypothesis of a SOA skew.

In Figure 2.6, short-term debt is estimated by applying the book value of the total asset. We find the same pattern of SOA.STL estimated by the market value. Specifically, the SOA is extremely rapid at low quantile leverage (i.e., 96.8% at 5% quantile). Additionally, there is a downward trend of the rate at which firms change their short-debt ratio from positive to negative across the quantile level (i.e., 96.8% at five quantile to -15.8% at 95 quantiles). We also find significant differences in SOA between short-term leverage and long-term leverage. First, at low quantile level, SOA of short-term leverage is faster than that of long-term leverage (i.e., 96.8% versus 69.4% at 5% quantile level). Second, while the adjustment speed of the long-term debt remains positive across the quantile that of the short-term debt becomes negative at a high level of short-term leverage.

2.5.2 Sub-period estimations

To check robustness through sup-period estimations, we divide our data into two sub-periods of 24 years: (1) 1970 to 1993 and (2) 1994 to 2017. We also apply the Wald test to check the joint significant between two-subsample and get all significant results⁹. The patterns of adjustment speed of total leverage, long-term leverage and short-term leverage from 1970 to 1993 are shown in Figure 2.7, Figure 2.8 and Figure 2.9 whereas that from 1994 to 2017 are represented in Figure 2.10, Figure 2.11 and Figure 2.12. Generally, we find consistent patterns of speed at which firms change their total leverage, long-term leverage and or short-term leverage. In other words, the SOA of the three

⁹ The null hypothesis for the Wald test is the same adjustment of speeds of short-term leverage, long-term leverage and total leverage between two sub-periods.

proxies for leverage does not change between two sub-samples, and between two sub-samples and the whole period.

Figure 2.7: The QR estimate of SOA of total leverage across various quantiles of total leverage from 1970-1993

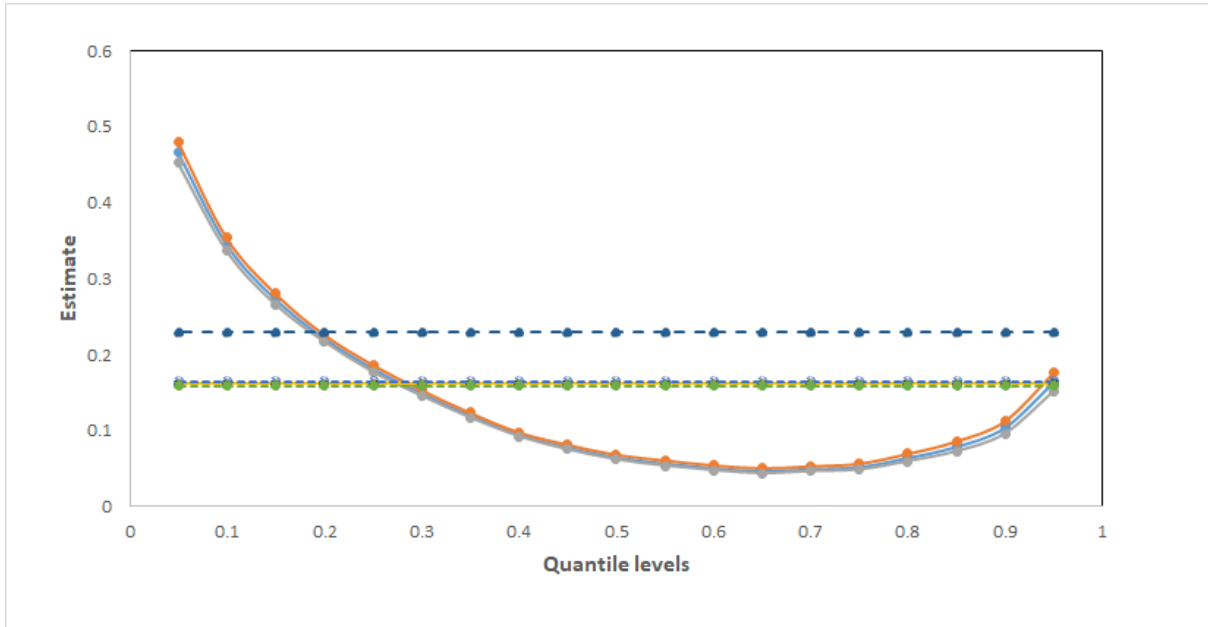


Figure 2.8: The QR estimate of SOA of long-term leverage across various quantiles of long-term leverage from 1970-1993

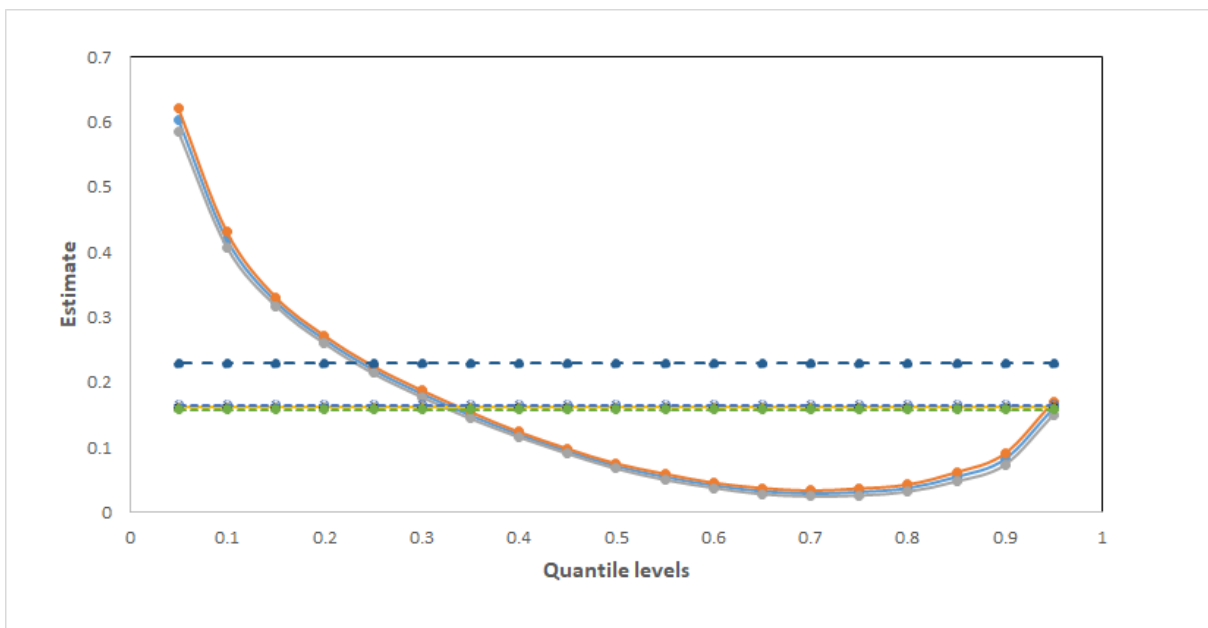


Figure 2.9: The QR estimate of SOA of short-term leverage across various quantiles of short-term leverage from 1970-1993

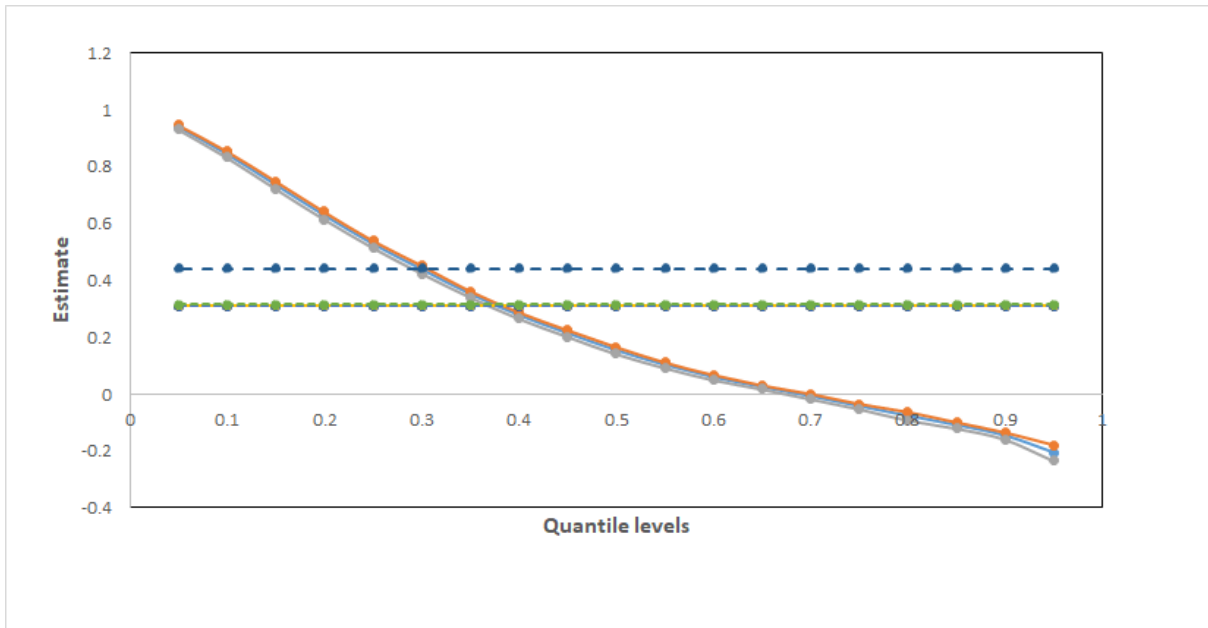


Figure 2.10: The QR estimate of SOA of total leverage across various quantiles of total leverage from 1994-2017

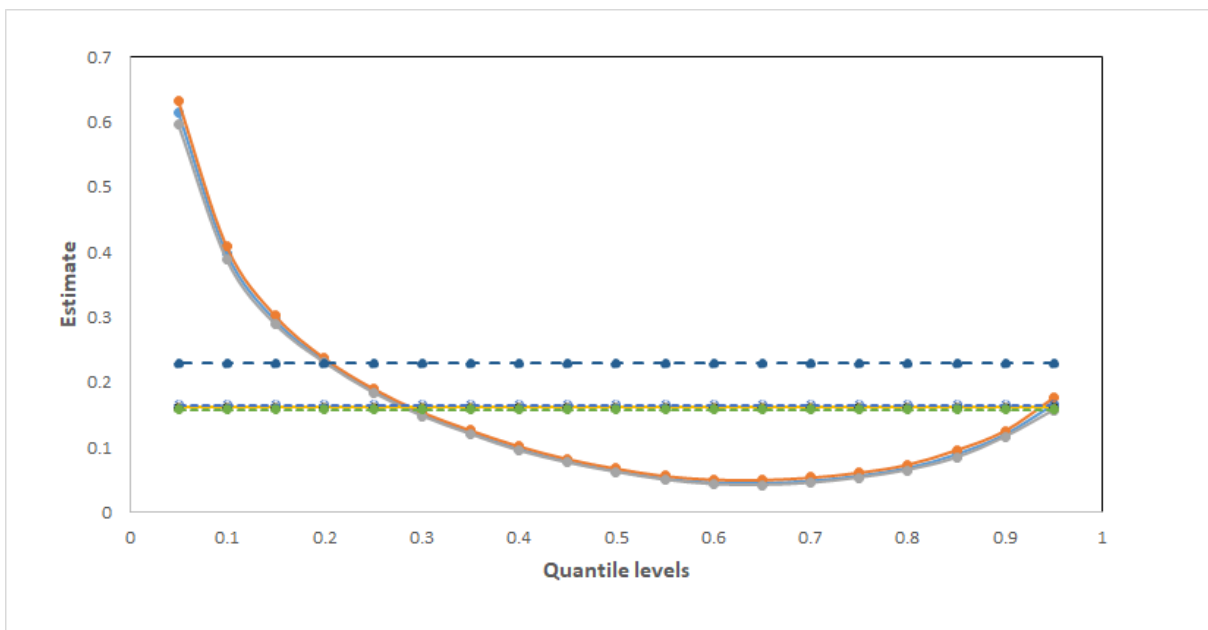


Figure 2.11: The QR estimate of SOA of long-term leverage across various quantiles of long-term leverage from 1994-2017

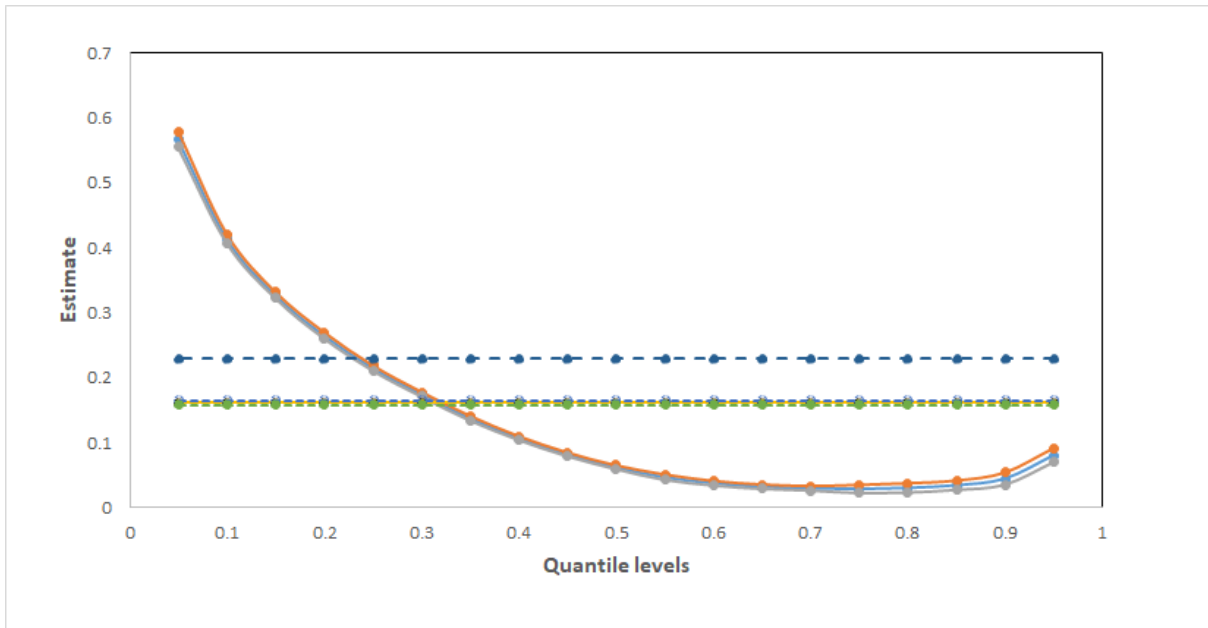
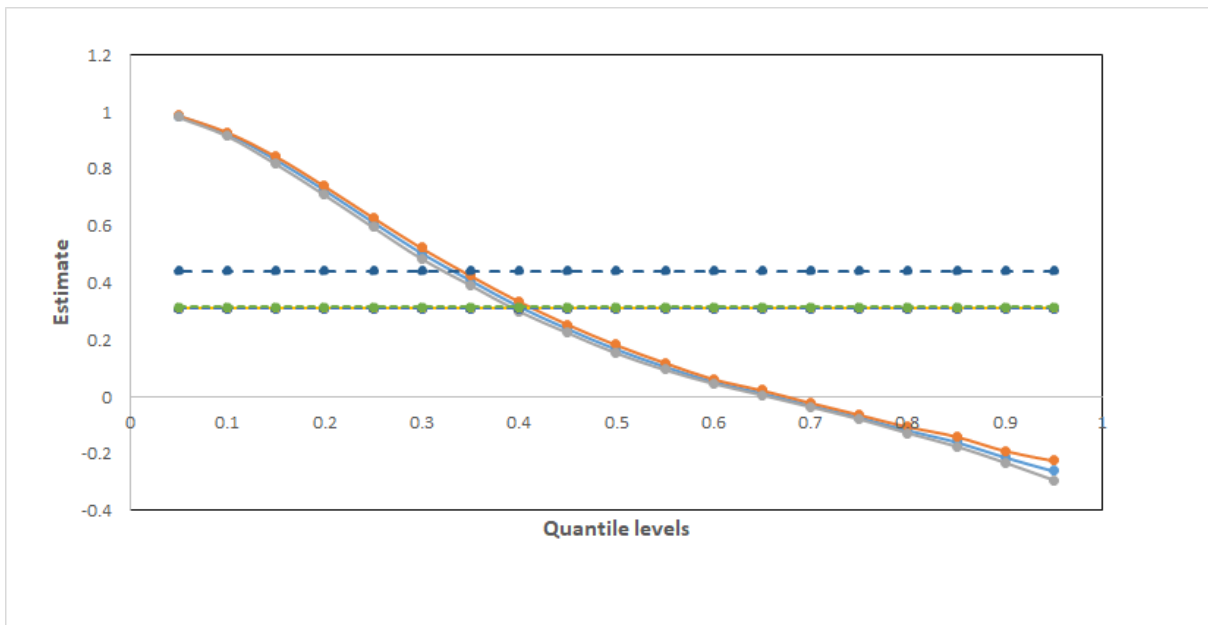


Figure 2.12: The QR estimate of SOA of short-term leverage across various quantiles of short-term leverage from from 1994-2017



2.6 Conclusions

This study is one of the first studies to examine the heterogeneity and asymmetry in SOA across various levels of leverage using the QR approach. We consider three leverages including the total leverage, long-term leverage and the short-term leverage. The SOA estimates are significant for all the measurements. While the adjustment of the total leverage and long-term leverage follow the same pattern, the SOA of short-term debt ratio reveals the different behaviours.

On the total debt and long-term debt ratio basis, we find that low- and high-levered firms are associated with higher degree of SOA than mid-levered firms. Moreover, we establish that high-levered firms have lower SOA than low-levered firms because of the higher costs of adjustment, which develops a SOA skew. As predicted, the SOA estimate is higher in the tail ends of leverage distribution than in the central region. Additionally, the SOA estimate at the upper quantiles of leverage is smaller than that at the lower quantiles of leverage. These findings support the pattern of the SOA skew.

On a short-term leverage ratio basis, firms get a high SOA at the low quantile level, but this diminishes across the level of short-term debt. Notably, at higher short-term debt, firms move away from the target level leading to the negative of adjustment speed. Compared to the long-term leverage adjustment, at low quantile level, the short-term leverage moves faster due to the lower adjustment costs. Moreover, as a cheap source of financing needs, firms with a high level of short-term debt overcomes the optimal point and increases short-term debt resulting in the negative adjustment speed whereas firms with high long-term debt ratio continue to move toward their optimal debt level to maximise the firms' value.

Our results support the information asymmetry (liquidity and signalling) theory and contracting costs theory, which explain the lower costs of short-term debt as opposed to the long-term debt. Also, the trade-off theory is successful in explaining the behaviour

of total – and long-term leverage adjustment. These movement of short-term debt at high quantile level are consistent with the pecking order theory in which firms seek the cheap sources for raising fund.

The empirical findings are robust according to the alternative measure of leverages and different sub-periods. By applying the quantile regression approach, we investigate SOA according to the different level of leverage, not the optimal range as most of the studies have been conducted (Byoun, 2008; Leary & Roberts, 2005). According to Hovakimian and Li (2011), it should be more practical as the target capital structure is unobservable. Our results for the total- and long-term leverage adjustment are consistent with Leary and Roberts (2005) which use simulations for the optimal capital structure range and find the extreme values of leverage – both very high and low tend to converge significantly compared to mid-levered firms. Taking a cue from Leary and Roberts (2005), we also identify asymmetry dynamics in SOA between low- and high-levered firms. Our result presents a smooth and dynamic pattern of SOA across different leverage levels.

Our findings offer policy implications for firms. At the low level of debt, whether it is the total-, long- or short-term debt, firms prefer debt and can quickly change the leverage at high speed. On the other hand, firms with high level of total and long-term debt deliberately adjust their debt, but the rate is much slower, which indicates that managers should take into consideration when firms have a high level of total or long-term debt. For the firms with high level of short-term debt, it is easy to keep increasing short-term debt; however, managers should think of this decision carefully as too much short-term debt may cause liquidity problems.

Appendix

We apply DPF to determine the adjustment speed of total leverage (the most common proxy to measure leverage in capital structure studies) in each sub-sample. We conclude that the sub-sampling approach is not appropriate as the SOA.TL is much faster than the reported value literature (at around 24%). Moreover, when the number of groups increases, the variance of dependent variables is less, leading to the more critical error in the results.

Table 2.12: SOA of total leverage estimates if we divide our sample into 19 groups

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
1	0.999	(0.00)**	11	0.995	(0.00)**
2	0.997	(0.00)**	12	0.993	(0.00)**
3	0.994	(0.00)**	13	0.993	(0.00)**
4	0.994	(0.00)**	14	0.992	(0.00)**
5	0.994	(0.00)**	15	0.992	(0.00)**
6	0.995	(0.00)**	16	0.988	(0.00)**
7	0.995	(0.00)**	17	0.980	(0.00)**
8	0.997	(0.00)**	18	0.959	(0.00)**
9	0.995	(0.00)**	19	0.838	(0.00)**
10	0.996	(0.00)**			

Table 2.13: SOA of total leverage estimates if we divide our sample into ten groups

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
1	0.996	(0.00)**	6	0.979	(0.00)**
2	0.985	(0.00)**	7	0.974	(0.00)**
3	0.980	(0.00)**	8	0.968	(0.00)**
4	0.979	(0.00)**	9	0.944	(0.00)**
5	0.981	(0.00)**	10	0.764	

Table 2.14: SOA of total leverage estimates if we divide our sample into five groups

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
1	0.966	(0.00)**	4	0.898	(0.00)**
2	0.932	(0.00)**	5	0.653	(0.00)**
3	0.928	(0.00)**			

Table 2.15: SOA of total leverage estimates if we divide our sample into four groups

$$Lev_{i,t+1} = \pi_0 + \pi_1 \cdot X_{i,t} + \pi_2 Lev_{i,t} + \varepsilon_{i,t}, \text{ where SOA} = 1 - \pi_2$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
1	0.938	(0.00)**	3	0.873	(0.00)**
2	0.899	(0.00)**	4	0.610	(0.00)**

Chapter 3

State ownership and adjustment speed toward target leverage:

Evidence from a transitional economy

3.1 Introduction

The trade-off theory suggests that, a firm who has an optimal capital structure, will adjust their debt to the desired level to maximise firm value. However, with the presence of adjustment costs, firms rebalance their capital structure only when the benefits of adjustment outweigh its costs (Fischer, Heinkel, & Zechner, 1989; Strebulaev, 2007). Since self-interested managers may distort firm policies to maximise their benefit rather than the wealth of shareholders, agency costs resulting from conflicts between managers and shareholders are a part of adjustment costs (Chang, Chou, & Huang, 2014). Hence, one could expect that the speed of adjustment (SOA) to the optimal capital structure has a latent relationship with the agency problem.

In this paper, we explore the effect of state ownership on SOA. Indeed, state-owned enterprises play an essential role in countries with transitional economies, moving from centrally planned to market-oriented economic systems. Due to certain factors, moreover, state-owned enterprises generally bear greater agency costs than private companies. First, supported by the government, state-controlled banks are likely to bail out state-owned firms for their losses, resulting in “soft budget” constraints. The flexibility of the budget has a negative effect on state-owned enterprises managers’ incentives (Zhu, 2012). Second, there is a divergence between voting rights and cash flow rights where government shareholders have equity voting rights but not cash flow rights (Zou & Xiao, 2006). Third, the purpose of state-owned enterprises is not to maximise shareholder wealth, but to achieve political objectives (Zhou & Xie, 2015). Therefore, the

more the state ownership characterises firms have, the more severe the agency problems they face. Henceforth, state ownership is perceived to be a proxy for the agency problem, in turn exerting an influence on SOA.

While the relationship between state ownership and SOA has been studied recently in China, we examine Vietnam, which is an important transitional emerging market in Asia. The Vietnamese context provides a unique financial system to investigate the impact of state ownership on SOA due to different institutional environment features. First, apart from European Western countries, Vietnamese Communities Leading Party (PCVN) employed the transitional process to change the economy from centralised and planned model into the market-oriented framework; nevertheless, the transformation focuses only on the economic aspects of the society. Until now, Vietnam has partially but not fully completed the transitional process. Second, the state-owned enterprises (SOEs) have a substantial influence on the economy. Some of them are the leading companies in their own industries with good corporate governance and strong financial health¹⁰. Third, the Vietnamese stock market is at the infant stage of the development. Ho Chi Minh trading centre was first established in 2000 with only 2 listed firms. The number of firms on public trading system raised rapidly to 1,115 in 2016 over three stocks exchange markets¹¹. Moreover, Vietnam' stock market is strongly concentrated but not high liquid¹². Finally, Vietnamese firms deal with the issues of information asymmetry, high transaction costs and volatility which are in turn effect on capital structure decision (Vo, 2017)

¹⁰ For instance, Vietnam Airline, Petrol Vietnam Power Corporation (PV Power), Binh Son Refinery and Chemicals Corporation (BSR), and Petro Vietnam Oil Corporation (PV Oil)

¹¹ Hanoi stock exchange market started in 2005 and Unlisted Public Companies (UPCoM) first appeared in 2009

¹² The leading 40 firms by market capitalization account over three-fourths of the entire market, both market turnover are between 30% and 40% of GDP, which is less than other countries in South East Asia.

Before 1986, Vietnam followed a centrally planned economic system which depended heavily on state-owned firms. However, the socialist model failed, resulting in hyperinflation and a period of fiscal crisis. Consequently, in 1986 the government implemented a reform program to transform the economy from a planned to a market system. One principal feature of this program was to convert state-owned enterprises into private firms.

Since privatisation is still ongoing, state-owned enterprises, which contribute 29% to the country's GDP, play a crucial role in the Vietnamese economy. Notably, the bad debt and inefficiency of some large state-owned enterprises have led to severe consequences for the economy. Accordingly, investigating the influence of state ownership on SOA is necessary for policymakers to adjust and improve the performance of state-owned enterprises. Since any deviation away from the target is likely to reduce the firms' value and the speed of adjustment back to the optimal pertains to value recovery, all previous studies in the Vietnamese context have investigated the relationship between state ownership and debt level; however, none of them has examined the effect of state ownership on SOA. Hence, the examination on such effect enriches the evidence on the impacts of governments' control on capital structure decisions of firms in the emerging markets.

This paper contributes to the literature by exploring the effect of state ownership on SOA in Vietnam under a quantile regression framework. While the linkage between state ownership and SOA produces mixed results, according to the literature, we come up with new evidence that the effect of state ownership on SOA is conditional on the level of leverage. Specifically, the effect is significant where there are extreme leverage values, both very high and very low, but is not significant in the central area of leverage distribution. This effect is adverse for low-leveraged firms but positive for high-leveraged

firms. Moreover, the extent of adverse influence on SOA is greater than that of favourable influence. This implies an average negative effect of state ownership on SOA. These findings, indeed, are firstly revealed in the literature.

Regarding the Vietnamese data sources, most studies are based on publicly listed companies on the Ho Chi Minh (HOSE) and Hanoi stock exchanges (HNX). This paper is the first one to consider companies recorded on the unlisted public companies (UPCoM) list, while other papers focusing on the issues of Vietnamese firms use the data of publicly listed companies on the Ho Chi Minh (HOSE) and Hanoi stock exchanges (HNX). In addition, by using a quantile regression approach, this paper finds some facts neglected in other papers. This trading system of UPCoM encourages unlisted firms to join the stock market. At the end of 2016, UPCoM had the most significant number of listed firms among the three trading systems, and its market capitalisation accounted for 32.3% of the total capital market. Due to its crucial role and the increase in size and trading volume of UPCoM, the inclusion of this market helps to provide a more thorough view on the effect of state ownership on SOA.

This paper is organized as follows. Section 2 reviews the literature and develops the research hypotheses. Section 3 explains the research method. Section 4 shows variable definition and data. Section 5 presents the empirical results. Section 6 shows the findings of the robustness tests. Finally, Section 7 summarises the study and draws some policy implications.

3.2 Literature review and hypotheses development

3.2.1. Literature review

3.2.1.1 The impact of state ownership on capital structure

From the perspective of agency theory, conflicts between managers and shareholders distort firm policies, resulting in the poor performance of these companies.

To explain the influence of self-interested managers on finance policies, Chang et al. (2014) analyse two agency framework debt models, the disciplinary effect and the takeover defence effect. When managers consider debt as a takeover defence tool, they maintain high leverage to prevent raiders from taking over the company; on the other hand, while debt is employed as a disciplinary tool, managers are likely to issue more equity than debt to gain the benefits of free cash flow. Moreover, applying a variety of measurements for corporate governance, the relationship between corporate governance and leverage can be seen from a range of perspectives (Ahmed Sheikh & Wang, 2011).

As a proxy for corporate governance, ownership structure, reflected in monitoring costs, the threat of takeovers, and managers' risk aversion, have a principal effect on leverage level (King & Santor, 2008). Different types of ownership structure are also revealed in the literature. For instance, Liao, Mukherjee, and Wang (2015) review institutional ownership – the percentage of a firm's common shares owned by institutional investors – as a factor for identifying debt ratio. Specifically, the presence of institutional investors provides better monitoring of managers. Hence, the managers are likely to promote shareholders' interests rather than their own. Besides, owning a substantial proportion of a company, large shareholders can monitor managers to ensure that they work effectively for the firm. Accordingly, leverage is closely associated with large ownership (Le & Tannous, 2016; Nhung & Okuda, 2015; Zeckhauser & Pound, 1990).

Adopting the Herfindahl index to estimate ownership concentration, Céspedes, González, and Molina (2010) maintain that shareholders with a high concentration of ownership have a preference of taking on debt rather than equity to mitigate loss from dilution. Additionally, in the literature, the effect of managerial ownership on leverage is found mixed. A negative relation between managerial ownership and leverage implies that managers are likely to avoid the risk of high-leveraged firms (Holderness & Sheehan,

1988) whereas a positive relation suggests that there is an incentive for managers to reinforce their control and avoid share dilution (Harris & Raviv, 1988; Kim & Sorensen, 1986).

Despite broad discussion of a range of ownership in studies above, little attention has been paid to state ownership. State-controlled firms play an essential role in transitional economy countries, going through the process from a centrally planned system to a market economy. Generally, when state-owned firms are on the brink of bankruptcy, because of government support, state-controlled banks are very likely to bail out those companies for their losses, resulting in “soft budget” constraints. This flexibility in the budget has an adverse influence on state-owned firm’s managers’ incentives (Zhu, 2012).

Additionally, according to Grosman, Okhmatovskiy, and Wright (2016), state control entails minimal transparency and disclosure because current or former government officials are generally appointed as board members in these firms, and they adopt a corporate governance mechanism to protect their interests rather than those of shareholders. Therefore, wholly state-owned enterprises are less transparent than partially state-controlled firms (Pöyry & Maury, 2010).

Although several investigations have been conducted to examine the linkage between state ownership and leverage, this relationship remains an empirical issue in different contexts. Carrying out the analysis for 216 firms from 1993-2000 in China, Zou and Xiao (2006) conclude that state-owned enterprises maintain a high debt ratio level. First, they have better access to bank loans. In particular, with the support of the State bank, state-owned firms are less likely to face bankruptcy. Therefore, creditors readily lend to state-owned firms.

Second, to prevent the loss of state control and to preserve their voting rights, government shareholders avoid issuing equity and increasing debt for financing needs. Third, the high level of state ownership leads to severe conflicts between shareholders and managers. Specifically, there is a complete separation between voting rights and cash flow rights. Government shareholders have equity voting rights but no cash flow rights because ownership belongs to the citizens, and the dividends from shares are allocated to the ministry of finance (Zou & Xiao, 2006). Thus, by monitoring managers, issuing debt can reduce this problem (Jensen, 1986). Similarly, Li, Yue, and Zhao (2009) explore private firms in China from 2000 to 2004 and also find a positive relation between state ownership and leverage. This result is consistent with that of Huang, Lin, and Huang (2011), who analyse 767 firms listed on the Chinese stock market from 2000 to 2005. They also emphasise that the effect of state ownership on capital structure is mostly seen in high-leveraged firms.

As a transitional economy, Vietnam offers a prime case for examining the relationship between state ownership and leverage. Nguyen and Ramachandran (2006) conducted a survey of 558 small and medium enterprises (SMEs) in Vietnam from 1998 to 2001 and noted that state-owned enterprises have a good relationship with the bank and gain considerable advantages when borrowing money. Likewise, Nguyen, Diaz-Rainey, and Gregoriou (2012) employ a panel GMM system to consider the determinants of 116 non-financial firms listed on the Ho Chi Minh (HOSE) and Hanoi stock exchanges (HNX). Owing to the high level of government ownership of commercial banks, state-owned enterprises get support from these banks to issue debt. Consequently, state ownership is highly correlated with the debt ratio. Okuda and Nhung (2012) analyse 299 firms listed on HOSE and HNX and point out the discrepancy between state-owned and private enterprises regarding the debt ratio. Furthermore, they disclose that firms listed

on HOSE rely less on debt than those listed on HNX. In the recent empirical studies, Le and Tannous (2016) and Thai (2017) also argue that state-owned firms can issue debt at a lower cost as a result of their strong relationship with the state-controlled bank and government guarantees. For these reasons, there is a positive relationship between state ownership and capital structure.

The positive relationship between state ownership and leverage is also consistent in the Russian context. Investigating 95 publicly traded firms in the Russian Trading System (RTS) during the period 2000-2004, Pöyry and Maury (2010) highlight that companies with a large proportion of shares held by the state are likely to maintain a high level of debt because of favourable borrowing conditions.

While most of the researchers report a positive relationship between state ownership and leverage, a few studies reveal different results. For instance, Dharwadkar, George, and Brandes (2000) investigate nine transitional economies in Europe¹³ and demonstrate that most state-controlled enterprises are generally characterised by weak corporate governance and poor transparency monitoring systems. Therefore, banks are reluctant to lend them money to avoid the bad debt. As a result, there is an inverse relationship between state ownership and capital structure.

3.2.1.2 The influence of state ownership on the speed of adjustment of capital structure

According to trade-off theory, firms achieve optimal capital structure when the marginal costs of debt are equal to the marginal benefits of debt. The existence of a target debt level becomes a debatable topic since any deviation of the observed leverage away from its optimal level decreases firm value. Various factors have been identified to explain how quickly firms adjust to their optimal leverage. To this point, there have been

¹³ Of 26 countries in the process of privatization in Europe, Dharwadkar, George, and Brandes (2000) examine 9 – Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic, and Slovenia.

rich discussions investigating the impact of state ownership on capital structure, but the literature has been silent on the effects of state ownership on the speed of adjustment of capital structure. To the best of our knowledge, only two studies have discussed the impact of state ownership on SOA, both of which examine the Chinese market.

Qian, Tian, and Wirjanto (2009) employ DPD-GMM to examine the determinants of SOA for 650 Chinese publicly listed companies from 1999 to 2004. They explain how quickly firms achieve their target deriving from transaction costs associated with debt issuance and repurchase. With favourable conditions for accessing loans and a good relationship with the state-controlled banks, state-owned firms can raise funds more cheaply and adjust their leverage rate more quickly than non-state-owned firms. Qian et al. (2009) measure the state ownership proxy as the percentage of shares held by the state whereas Zhou and Xie (2015) use dummy variables to distinguish between state-controlled and private firms. Interestingly, they obtain different results, whereby state-owned companies have a slower adjustment speed than private companies do. The researchers argue that state-owned firms are likely to pursue political objectives rather than seek to maximise the wealth of shareholders. Therefore, state-controlled firms work less effectively than private firms and their SOA should be lower.

The evidence that different leverage levels are associated with various costs of adjustment has been revealed in the literature. Specifically, low-leveraged firms can readily increase debt to take advantage of tax shields, due to their low agency and bankruptcy costs, whereas firms with high financial leverage are likely to face considerable restructuring costs because of the strong probability of bankruptcy and severe conflicts between shareholders and managers. Accordingly, some studies have reported heterogeneity and asymmetry in SOA, depending on the leverage level. For instance, Leary and Roberts (2005) employ three simulation models and reveal that firms

adjust their leverage when the debt ratio is relatively high or low. Using a sub-sampling approach, Komera and Jijo Lukose (2016) conclude that there is a positive correlation between leverage level and SOA, whereas Galvao and Montes-Rojas (2010), employing penalised quantile regression, indicate that there is a negative influence for this relationship. Sánchez-Vidal (2014) confirms that factors related to these costs can have varying effects on firms, depending on the debt level. Due to the separation of voting rights from cash flow rights, the conflict between political objectives and shareholder interests, and the negative influence on managers' incentives from "soft budget constraints," state-owned enterprises generally suffer from substantial agency costs.

The literature also indicates a positive relationship between agency costs and leverage. Notably, as debt increases, agency costs rise because leveraged firms are less likely to follow the investment policy of maximising the benefit of shareholders (Jensen, 1986; Myers, 1977). Some researchers also provide evidence of agency costs with high debt ratios. For instance, Smith and Watts (1992) document a negative relation between investment opportunities and leverage while Titman and Wessels (1988) disclose the adverse effect of leverage on research and development (R&D). The agency costs of debt are relatively low for low-leveraged firms but considerably high for firms with high financial leverage. Meanwhile, one could expect the existence of state ownership affects agency costs which in turn raise the adjustment costs. Given these reasons, we argue that state ownership has an effect on SOA and this effect varies across the leverage levels. While most studies only investigate the overall impact of state ownership on the leverage adjustment toward the optimal level, we fill the gap by examining varying effects across leverage levels using the quantile regression approach.

Although the linkage between state ownership and SOA has been highlighted in China, this relation has remained unexplored in the literature in the Vietnamese market.

In fact, before 1986, Vietnam pursued a centrally-planned economic system which relied heavily on state-owned firms. However, the socialist model did not work effectively and Vietnam underwent hyperinflation and a period of fiscal crisis. As a result, in 1986 the government implemented a reform program, named *Doi Moi*, to transform the economy from a planned to a market system. As a result of this policy, Vietnam's economy has achieved significant growth and sustainable development. In the privatisation process, wholly state-owned enterprises will become partially state-owned enterprises. However, since they contribute 29% of the country's GDP, state-owned enterprises continue to play a crucial role in the economy due to the incomplete privatisation process (Thai, 2017).

Vietnam stock market is in the early stage of the development with only two listed firms in Ho Chi Minh stock exchange (HOSE) in 2000. After that, Hanoi Stock Exchange (HNX) was established in 2005 with the purpose of encouraging the industrial modernisation and trading the government bonds and the stock of mid-sized start-ups. Also, the government has implemented some policies to promote the stock trading markets. For instance, firms were exempted from corporate income tax for the first two years after they are listed on the trading systems; however, this policy ended in 2006. Therefore, the number of firms on the stock exchange market grew quickly to 1,115 firms at the end of 2016. The Vietnamese stocks were heavily influenced by the global financial crisis: The VN-Index has reached a peak of 1,200 points in 2007 but dropped dramatically to 235 points by February 2009. Furthermore, the stock market in Vietnam is strongly concentrated but not highly liquid as the leading 30-40 firm's account for around 75% of the market capitalisation. According to Vo (2017), due to unique legal, institutional and culture features, Vietnamese firms raise the issues of information asymmetry, high transaction costs and volatility which are in turn effect on their capital structure option.

Notably, the bad debt and inefficiency of some of the largest state-owned firms have entailed severe consequences for the economy.¹⁴ Some banks have embroiled with these state-owned firms and have become insolvent. Consequently, by December 31, 2016, the Vietnam State Bank had bought three banks¹⁵ for 0 VND and appointed VietinBank and VietcomBank to help them restructure (Vu, Phan, & Le, 2018). According to Asian Development Bank (2018), there are some problems to maintain the market financial stability in Vietnam. For instance, many agencies are responsible for supervising and regulating the market which does not provide a sustainable framework for firms to operate. Moreover, the weak supervision system for banks which is far behind the international standards. The lending activities incur substantial risk as the credits keep raising on the unproductive sectors including inefficient public firms and real estate.

Moreover, while most studies on SOA focus only on developed markets, the emerging Vietnamese market provides a different perspective on SOA because of its institutional framework such as financial features, legal, regulatory rules and regulations (Supra, Narender, Jadiyahappa, & Girish, 2016). Therefore, it is necessary to investigate the effects of state ownership on SOA in Vietnam.

Regarding the Vietnamese market, most studies focus on public stock exchange markets, namely HOSE and HNX. The Unlisted Public Company Market (UPCoM) seems to be ignored in the literature. However, the UPCoM trading system, established in 2009, aims to motivate unlisted companies to join the securities market. The current goods are mainly stocks and convertible bonds of unlisted firms. When listed on UPCoM, stocks become visible and accessible to investors so that firms can increase their equity liquidity.

¹⁴ The Vinashin Business Group, for instance, was established in 2006, owned by the Vietnamese government. By the end of 2010, Vinashin's total unpaid debt (bad debt) totalled USD 6 billion (Vu, Phan, & Le, 2018).

¹⁵ The three banks are the Vietnam Construction Bank (VNCB), Ocean Bank and The Global Petroleum Bank (GP Bank).

A listing on UPCoM is also a useful step to enhance the transparency of corporate governance as firms are required to disclose the information regarding the transactions of board directors, the board of management and supervisory board. However, the requirement for the information disclosure for firms traded on UPCoM is less than those operated on HOSE and HNX. In the next steps, they are encouraged to list on the HOSE and HNX exchange markets.

Since the State Securities Commission (SSC) pushes state-owned firms to list on UPCoM to improve their transparency, UPCoM plays an important role in monitoring state-owned enterprises. Some large-cap SOEs operated on UPCoM; for example, Vietnam Airlines which government has 86% ownership, and Hanoi Beer Alcohol Beverage Corporation (Habeco) with the state holding of 82%. As the post-Initial Public Offering (IPO) of SOEs is regulated to trade on UPCoM; market regulators are likely to attract more investors and enhance the influence of the unlisted exchange market. Several SOEs traded on UPCoM are also considered as the leading in their own industries with strong corporate governance and good financial capacity such as Petrol Vietnam Power Corporation (PV Power), Binh Son Refinery and Chemicals Corporation (BSR), and Petro Vietnam Oil Corporation (PV Oil). Therefore, prior studies that ignored the UPCoM may provide a limited picture of state-owned firms.

Moreover, UPCoM constitutes a new market with a legal and regulatory framework for investors. In 2011, the new regulation required firms to trade in the regulated markets within in one year before they want to make the IPO. When this law came into effect, a significant number of companies are forced to trade on the government-run markets. Therefore, by the end of 2016, UPCoM had the most significant number of listed firms among the three trading systems (414 firms compared to 320 and 375 firms listed on HOSE and HNX, respectively), and the market capitalisation of

UPCoM rose to VND 306,639 turn (USD 13.6bn), accounting for 32.3% of the total capital market. UpCOM also recorded as the highest growth market with the number of listed stock soaring rapidly from 256 in 2015 to 414 in 2016. Furthermore, the total market capitalisation has a leap from VND 61.03trn (2.7bn) to VND303.36 (\$13.6bn) between 2015 and 2016. UPCoM is somewhat similar to publicly listed stock exchanges in that both are regulated by the Law on Securities and managed by Vietnam Securities Depository (VSD) regarding the registering and depositing securities. Besides, UPCoM also protects the investors by creating a warning list consisting of the restricted and suspended stock for trading. As UPCoM plays a crucial role for firms and investors and enables the SSC to monitor state-owned enterprises, the inclusion of firms listed on UPCoM is necessary when examining the Vietnamese market.

In short, although the effects of state ownership on SOA have been identified in the literature, there are two gaps that we want to fill. First, we re-examine the relationship between state ownership and the adjustment speed of capital structure, which is conditional on the level of leverage. Second, while the relationship between state ownership and SOA has recently been explored in the Chinese context, we investigate a new transitional economy and emerging market, Vietnam. Additionally, because of the increase in the size and trading volume of UPCoM, we consider three stock exchanges, namely HOSE, HNX and UPCoM, instead of including only publicly listed stock exchanges, as most studies of the Vietnamese market have conducted.

3.2.2 Hypotheses development

According to the trade-off theory, firms maximise their value by adjusting their leverage to reach an optimal level where the marginal cost of debt is equal to the marginal benefits of debt. Nevertheless, adjustment costs are impediments for firms seeking to achieve their target leverage level (Fischer et al., 1989; Strebulaev, 2007). Due to the fact

that self-interested managers are likely to distort firm policies and promote their benefit rather than the wealth of shareholders, agency costs resulting from conflicts between managers and shareholders account for part of the adjustment costs (Chang et al., 2014; Liao et al., 2015).

Moreover, the agency costs of debt fluctuate according to leverage level. Specifically, with a high debt ratio, leveraged firms may be unable to follow investment policy to maximise shareholder benefit (Jensen, 1986; Myers, 1977). Similarly, Smith and Watts (1992) and Titman and Wessels (1988) reaffirm the considerable agency costs of highly leveraged debt when examining the relationship between leverage, investment opportunities, and R&D. As the level of agency costs varies by degree of leverage, the impact of factors associated with agency costs depends on the leverage level. To support this argument, Sánchez-Vidal (2014) affirms that different leverage levels are related to various adjustment expenses. Therefore, factors related to these costs can have multiple effects on firms, depending on their debt level.

Resulting from the divergence of cash flow rights and voting rights, the conflict between political objectives and shareholder interests, and the negative impact of “soft budget constraints” on managers’ incentives, state-owned enterprises generally incur considerable agency costs. According to the agency theory, firms with large state ownership ratio are likely to have a slower speed of leverage adjustment as they bear larger agency costs, which prevent firms from achieving the optimal level. On the other hand, based on transactions costs, firms with a higher level of state ownership have easier access to the local financial systems and incur fewer costs to make the leverage adjustments. This is especially the case where the leverage is higher than the target, and state-owned firms need to reduce debt ratio. High-leveraged state-owned firms are pressured to alleviate debt by government to avoid the potential insolvency risk. Since

the governments possess a tight control of both financial systems and state-owned firms, it is easier for state-owned firms to reduce the debt levels to fulfil the orders imposed by the governments than non-state-owned firms. In such sense, the state ownership might have a positive effect on SOA.

For these reasons, we hypothesize a competition between those two effects leads to different impacts of the state ownership on SOA across the leverage levels. When the leverage is low, the agency problems are a major concern when the state-owned firms need to adjust the leverage ratio upwards. In this situation, state-owned firms are safe from bankruptcy and insolvency problems. Hence a negative effect of state ownership may take the lead. For these reasons, we have the following hypothesis:

Hypothesis 1: There is a negative relationship between state ownership and SOA in low-leveraged firms

When leverage level is high, state-owned firms are likely to reduce debt to alleviate the probability of bankruptcy and insolvency problems, presenting a good image to the government. To help the state-owned firms accomplish the mission, the local governments make it easier for state-owned firms to retire the debts or issue new shares. In other words, state-owned enterprises with high state ownership are entitled to lower adjustment costs than non- state-owned firms. Hence, one may expect a positive relationship between state ownership and SOA. Therefore, we propose the following hypothesis:

Hypothesis 2: There is a positive relationship between state ownership and SOA in high-leveraged firms

3.3 Econometric models

3.3.1 QR model

The quantile regression developed by Koenker and Bassett (1978) affords a complete overview of how explanatory variables affect the conditional distribution of the dependent variable. Moreover, while ordinary least squares (OLS) is likely to be biased and inefficient for the data with a large outlier and non-normal distribution of the disturbances, quantile regression is robust regarding the normality and skewed tails distribution (Mata & Machado, 1996). To explore QR, we can start with the following linear model:

$$y_{it} = x_{it}' \beta_{\theta} + u_{\theta it} \quad (3.1)$$

Where y_{it} is the dependent variable and x_{it} is the $k \times 1$ vector of explanatory variables for the firm i and in time period t . In Eq. (3.1), θ is the quantile value of the y_{it} variable. Specifically, θ indicates the position where an observation lies within an ordered series of y_i . It refers to a cumulative probability function (CDF) of y_{it} with a range from 0% to 100%. When $F(y)$ is the cumulative distribution of a random variable y :

$Q(\theta) = \inf y: F(y) \geq \theta$ in which \inf means the infimum. In other words, the lowest value of y meets the condition.

To resolve Eq. (3.1), Koenker and Bassett (1978) minimise the sum of absolute deviation residuals in the following equation:

$$\begin{aligned} \min & \sum_{it: u_{\theta it} > 0} \theta \times |u_{\theta it}| + \sum_{it: u_{\theta it} < 0} (1 - \theta) \times |u_{\theta it}| \\ = & \sum_{it: y_{it} - x_{it}' \beta_{\theta} > 0} \theta \times |y_{it} - x_{it}' \beta_{\theta}| + \sum_{it: y_{it} - x_{it}' \beta_{\theta} < 0} (1 - \theta) \times |y_{it} - x_{it}' \beta_{\theta}|. \end{aligned} \quad (3.2)$$

Eq. (3.2) shows that the estimator vector of β_{θ} changes according to θ , the quantile value of the dependent variable (i.e., the y variable). By contrasting β_{θ} estimates across various θ , we are able to examine whether the relationship between the x and y variables is non-

uniform across the entire distribution of the latter. This is the crucial advantage of the QR method.

In Ordinary Least Square (OLS), the mean is the key to minimise the sum of squared residuals, whereas in least absolute deviation (LAD), the median is the answer to solve the question of minimising the sum of absolute residuals. Obviously, quantile regression does not employ the OLS method but the LAD to find the solution. Additionally, LAD, a special case of quantile regression under the restriction of $\theta = 50\%$, employs the same weight on positive and negative errors. In QR, there is a different weight for the positive and negative errors (i.e., θ for positive errors and $(1-\theta)$ for negative errors).

3.3.2 Empirical models

In the first stage, the target leverage is defined by a function of the firm's characteristics. These factors are identified by the trade-off theory and some empirical studies as the main determinants of the optimal capital structure (Antoniou, Guney, & Paudyal, 2008; Hovakimian & Li, 2011; Liao et al., 2015)

$$LEV_{i,t+1}^* = \beta X_{i,t} \quad (3.3)$$

where LEV^* refers to a firm's target leverage, and X is a set of explanatory variables, including firm size ($SIZE$), asset tangibility ($TANG$), depreciation and amortisation (DEP), and operating income before depreciation ($PROFIT$).

In the second stage, to estimate how quickly a firm moves its current leverage to the optimal level, we employ the partial adjustment model (Chang et al., 2014; Fama & French, 2002; Kayhan & Titman, 2007). According to the trade-off theory, firms should fully adjust to their target leverage to maximise their value. However, due to adjustment costs, they can only partially adjust their leverage.

$$LEV_{i,t+1} - LEV_{i,t} = \alpha + \delta(LEV_{i,t+1}^* - LEV_{i,t}) + \varepsilon_{i,t} \quad (3.4)$$

Where LEV and LEV^* represents the firm's achieved target leverage levels, and δ is the SOA of leverage at its optimal level. The value of $SOA = 1$ implies that firms fully adjust to the optimal level, whereas $SOA < 1$ indicates the presence of adjustment costs.¹⁶ Following the literature (Flannery & Rangan, 2006; Hovakimian & Li, 2011), we merge equations (3.3) and (3.4) to achieve a reduced-form partial adjustment leverage model:

$$LEV_{i,t+1} = \alpha + \beta\delta X_{i,t} + (1 - \delta) LEV_{i,t} + \varepsilon_{i,t+1} \quad (3.5)$$

According to Öztekin and Flannery (2012), the firm's characteristics obviously influence both target leverage and the adjustment speed of capital structure. Hence, we apply the same control variables in the regression to examine the effect of state ownership on SOA:

$$\delta_{i,t} = \partial_0 + \partial_1 SO_{i,t} + \partial_2 X_{i,t} \quad (3.6)$$

Where $SO_{i,t}$ is the state ownership of firm i at time t , $X_{i,t}$ is a vector of control variables, including firm size ($SIZE$), asset tangibility ($TANG$), depreciation, amortisation, and operating income before depreciation ($PROFIT$).

Now, we substitute Eq. (3.6) into Eq. (3.5) to obtain the following model:

$$LEV_{i,t+1} = \alpha + \beta\delta X_{i,t} + [1 - (\partial_0 + \partial_1 SO_{i,t} + \partial_2 X_{i,t})] LEV_{i,t} + \varepsilon_{i,t+1} \quad (3.7)$$

Partly multiplying Eq. (7) out, we obtain:

$$LEV_{i,t+1} = \alpha + \partial'_1 (SO_{i,t} * LEV_{i,t}) + \partial'_2 (X_{i,t} * LEV_{i,t}) + (1 - \partial_0) LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1} \quad (3.8)$$

where $\partial'_1 = -\partial_1$, $\partial'_2 = -\partial_2$. In Eq. (3.8), the effect of state ownership on SOA is represented in the interaction terms of state ownership and the leverage, with the same magnitude but with the opposite sign. We apply quantile regression for Equation (3.8) to

¹⁶ The adjustment costs may come from financial distress and other costs of debt (Hovakimian & Li, 2011)

examine the effects of state ownership on the conditional distribution of the leverage (Liao et al., 2015). Moreover, we also follow Blendell and Bond (1998) and Antoniou et al. (2008) to apply system generalized method of moment (GMM) for Eq. (3.8) to consider the overall effect of state ownership on SOA as GMM can alleviate the potential endogeneity problems of the independent variables and control for firm fixed effects. Additionally, two-step GMM methodology can control for the correlation of errors over time, heteroskedasticity across firms, simultaneity, and measurement errors due to the utilization of orthogonal conditions on the variance-covariance matrix.

3.4 Variable definition and data

3.4.1. Variable definition

3.4.1.1. Leverage ratio

Empirical studies have applied both market and book values to investigate leverage (Chang et al., 2014; Cook & Tang, 2010; Dang, Kim, & Shin, 2015; Hovakimian & Li, 2011). Nevertheless, according to Flannery and Rangan (2006), the book values are likely to be far from the market values for small firms. Chang et al. (2014) also affirm that market values play a more important role than book values in finance theory. Therefore, we adopt market values first and use book values for the robustness test. Accordingly, our market leverage ratio is:

$$MLEV_{i,t} = \frac{D_{i,t}}{D_{i,t} + S_{i,t}P_{i,t}} \quad (3.9)$$

$D_{i,t}$ denotes the book value of firm i 's interest-bearing debt at time t , $S_{i,t}$ is the number of common shares outstanding of the firm at time t , and $P_{i,t}$ denotes the stock price per share at time t . For the book leverage ratio, we use:

$$BLEV_{i,t} = \frac{D_{i,t}}{TA_{i,t}} \quad (3.10)$$

$D_{i,t}$ is the sum of short-term debt and the long-term debt book value of interest-bearing. $TA_{i,t}$ denotes the book value total assets of firm i at time t .

3.4.1.2. *State ownership*

State ownership is a typical feature of firms in a transition from a planned to a market economy. China and Vietnam are prominent examples. Some studies employ dummy variables to distinguish between state and private ownership (Nhung & Okuda, 2015; Zhou & Xie, 2015). However, since our purpose is to examine the relationship between the level of state ownership and SOA, we follow the literature and measure state ownership as the percentage of shares held by the state (Huang, 2006; Le & Tannous, 2016; Li et al., 2009; Zou & Xiao, 2006).

3.4.1.3. *Firm characteristics*

As the adjustment costs are likely to be different from firm to firm, firm characteristics are important factors for determining the target leverage as well as SOA. We follow the literature in applying the crucial elements to identify the choice of capital structure.

Large firms are likely to have more debt as their assets are less volatile. These firms, moreover, have easy access to public loan markets. We follow Rajan and Zingales (1995), Hovakimian and Li (2011) and Chang et al. (2014) in measuring firm size (*SIZE*) as the natural logarithm of total assets.

Firms with considerable assets generally face little risk of bankruptcy and have a good credit rating. Thus, they can readily increase debt. We estimate asset tangibility (*TANG*) as fixed assets, consisting of property, plant and equipment (Rajan & Zingales, 1995; Titman & Wessels, 1988).

With a high percentage of depreciation, firms can save money from taxation and are therefore less likely to take advantage of debt as a tax shield. Depreciation (*DEP*) is

measured as the ratio of depreciation to total assets (Chang et al., 2014; Hovakimian & Li, 2011).

Due to their high retention of earnings, firms with large profits can reduce the need to issue debt. We follow Fama and French (2002) and Hovakimian and Li (2011) to measure profit (*PROFIT*) as operating income before depreciation.

3.4.2 Data

We obtain data from three stock exchange markets, namely the Ho Chi Minh stock exchange (HOSE), the Hanoi stock exchange (HOSE) and the Unlisted Public Company Market (UPCoM) from 2000 to 2016. We start in 2000 because the Ho Chi Minh stock exchange was established in that year.¹⁷ The sample ends in 2016 owing to the availability of the data at the time when the study starts. Tai Viet Corporation (Vietstock), a leading financial information service provider in Vietnam, provided all the financial and ownership data.

Following standard practice, firms in the finance industries (SIC codes 6000-6999) and regulated utilities (SIC codes 4900-4999) are excluded from our analyses (Bauer, Frijns, Otten, & Tourani-Rad, 2008; Dittmar & Mahrt-Smith, 2007; Laing & Weir, 1999; Ukaegbu & Oino, 2014). Each sample firm must have at least two consecutive years of data. We also restrict our data by dropping firms if large amounts of basic data are missing and if observations include an extreme value.¹⁸ Finally, our sample consists of 662 firms with 5,374 firm-year observations.

¹⁷ The Hanoi stock exchange (HOSE) was established in 2005, whereas the Unlisted Company Market first appeared in 2009.

¹⁸ For instance, observations with a leverage ratio above 1 or below 0 are excluded from our database.

Table 3.1: Descriptive statistics of variables

Variable	N	Mean	SD	Min	Max
Leverage (LEV)	5,374	0.535	0.267	0.000	1.000
Firm size (SIZE)	5,374	15.286	1.470	11.667	21.314
Tangibility (TANG)	5,374	0.196	0.196	0.000	0.976
Depreciation (DEP)	5,374	0.220	0.274	0.000	5.308
Profitability (PROFIT)	5,374	0.058	0.119	-3.842	0.993
State Ownership (SO)	5,374	0.213	0.244	0.000	0.967

This table presents the number of observations, mean, standard deviation, minimum and maximum of the variables (2000-2016). All firm variables are collected from the Ho Chi Minh stock exchange (HOSE), the Hanoi stock exchange (HNX) and the unlisted public company market (UPCoM). The state ownership is collected from the annual report.

Table 3.1 represents the summary statistics for the main variables in our model. The results for firm variables are similar to those of other studies of the Vietnamese market (Le & Tannous, 2016; Nhung & Okuda, 2015). The highest percentage of ownership reported in this paper is greater than that reported in other studies because our database covers an extended period (17 years). We also consider the listed stock exchanges as well as the Unlisted Public Company Market. The sample selection criteria is provided in Table 3.2.

Table 3.2: Sample selection criteria

	Hanoi Stock Exchange (HNX)	Ho Chi Minh Stock Exchange (HOSE)	Unlisted Public Company (UPCOM)
Number of listed firms in 2016	375	320	414
Less than 2 years	33	18	249
Financial and Utilities firms	28	25	29
Leverage less than 0 or higher than 1	10	9	24
Zero market capitalisation			22
Final sample	304	268	90

To test the multicollinearity problem, we disclose the correlation coefficients among explanatory variables in Table 3.3.

Table 3.3: Correlation among variables

Variable	LEV	SIZE	TANG	DEP	PROFIT	SO
LEV	1.000					
SIZE	0.224	1.000				
TANG	-0.006	0.008	1.000			
DEP	-0.115	-0.193	0.434	1.000		
PROFIT	-0.481	-0.009	-0.021	0.018	1.000	
SO	0.045	0.061	0.149	0.213	0.106	1.000

It can be seen from Table 3.3 that those variables are not highly correlated.

Therefore, our analysis is not affected by multicollinearity problems.

3.5. Empirical results

3.5.1 Ordinary Least Square (OLS) and Least Absolute Deviation (LAD) estimates

Table 3 provides the estimation results of Eq.(3.8) in which leverage is the dependent variable. Also, this paper presents the OLS, LAD and GMM estimates in comparison with QR estimates. Since we concentrate primarily on the influence of state ownership on the rate at which firms adjust towards their targets, we report the results of the interactive coefficient (*leverage * state ownership*) in Table 3.4.

Table 3.4: The impacts of state ownership on SOA across various leverage quantiles

$$LEV_{i,t+1} = \alpha + \partial'_1(SO_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	-0.198	(0.00)**	0.55	0.007	(0.37)
0.10	-0.157	(0.00)**	0.60	0.008	(0.23)
0.15	-0.115	(0.00)**	0.65	0.008	(0.22)
0.20	-0.087	(0.00)**	0.70	0.014	(0.04)*
0.25	-0.073	(0.00)**	0.75	0.018	(0.01)**
0.30	-0.043	(0.01)**	0.80	0.018	(0.04)*
0.35	-0.038	(0.01)**	0.85	0.019	(0.00)**
0.40	-0.017	(0.12)	0.90	0.023	(0.04)*
0.45	-0.010	(0.39)	0.95	0.029	(0.00)**
0.50 (LAD)	-0.004	(0.69)	OLS	-0.040	(0.00)**
			GMM	-0.238	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (3.8) when we apply quantile regression to find the different values of ∂'_1 throughout the distribution of the leverage. With each value of ∂'_1 , we find the impacts of state ownership on SOA : $\partial'_1 = -\partial_1$. We provide the estimate of ∂_1 in the table. To compare the results of quantile approach versus the LAD/OLS, we also show the coefficient of the interaction terms under LAD and OLS method. While quantile regression shows the impacts of state ownership on different degree of the leverage, LAD/OLS method just shows one effect conditional on the mean or the median of leverage over time. We also check the average impact by GMM approach.

As can be seen from Table 3.4, the OLS and GMM method show significant negative estimate, implying an inverse relationship between state ownership and SOA. This results are consistent with Qian et al. (2009) who investigate the Chinese market from 1999 to 2004. In contrast, the LAD delivers an insignificant estimate at any conventional level, suggesting there is no relationship between the state ownership and SOA.

It is particularly noteworthy that both OLS and LAD concentrate mainly on the central area of the leverage distribution. Specifically, in OLS the mean is the key for which the sum of squared residuals is minimised whereas in LAD, the median is the core question around which the sum of absolute residuals is minimised. Naturally, it is

reasonable to examine the linkage between state ownership and SOA in the non-central area (i.e., in the left or right tail of the leverage distribution), which would reveal new evidence regarding the interaction between state ownership and SOA. To deal with this issue, we adopt the quantile regression to explore the effect of state ownership on SOA, which is conditional on the leverage level.

3.5.2 QR estimates

While estimating QR, we begin with a 5% quantile of leverage, and then repeat estimations by increments of 5% quantile for each. The process ends with the 95% quantile. In Table 4, the estimate of the interactive coefficient (*leverage * state ownership*) changes substantially across quantile levels of leverage regarding the sign and magnitude. At low quantile levels from 5% to 35%, the coefficients ∂_1 are significantly negative. The size of impact becomes weaker as the leverage increases (e.g., 0.198 at the 5% quantile and 0.043 at the 35% quantile). Between 40% and 65% quantiles of leverage, the estimates of the interactive coefficient are insignificant at any conventional level. Starting from quantile level of 70%, the interactive coefficient turns out to be significant and positive, along with an increase in the size (e.g., 0.014 at the 70% quantile, 0.018 at the 80% quantile and 0.029 at the 95% quantile). Therefore, the results of Table 4 suggest that when the leverage level is relatively low (high) whereby firms need to adjust the leverage upwards (downwards), the state ownership has a negative (positive) relationship with SOA. Henceforth, Hypotheses 1 and 2 are not rejected. Moreover, as the leverage level is extremely high (low), the state ownership exerts a substantially positive (negative) influence on the speed of adjustment. Implications of the findings are discussed in Section 3.5.

Table 3.5: Statics tests of the equality of slope estimates across leverage quantile

Quantile	F-statistic	P-value
0.05 vs. 0.95	26.61	(0.00)**
0.10 vs. 0.90	53.36	(0.00)**
0.15 vs. 0.85	27.05	(0.00)**
0.20 vs. 0.80	17.26	(0.00)**
0.25 vs. 0.75	21.34	(0.00)**
0.30 vs. 0.70	11.12	(0.00)**
0.35 vs. 0.65	12.38	(0.00)**
0.40 vs. 0.60	7.64	(0.00)**
0.45 vs. 0.55	7.79	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level

Table 3.5 shows the F tests of the equality-of-slope of the interactive estimate (*leverage * state ownership*) across various quantiles of leverage. The differences between the slope estimates at the θ and $(1 - \theta)$ quantiles of the interaction terms are highlighted. Interestingly, the outcomes of the comparison are significant at the 1% level for all quantiles. The results of Table 4 confirm that the effects of the state ownership on SOA differ between high and low leverage levels. The effects when firms adjust downwards are differentiated from those when firms adjust upwards.

Figure 3.1: The impact of state ownership on SOA across leverage quantiles: QR estimates with 95% confidence level vs. OLS estimate

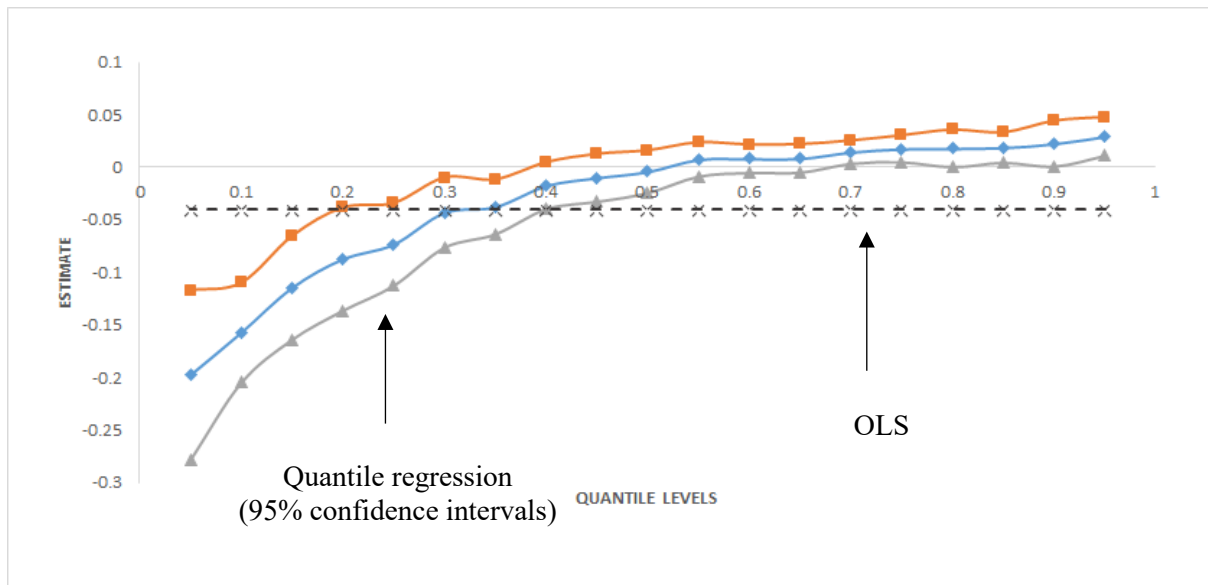


Figure 3.1 depicts the QR estimates of the interactive coefficient (*leverage * state ownership*) with 95% confidence intervals across quantiles of leverage. For comparison, OLS estimates are also given in the figure. As discussed above, the OLS result only indicates the effect of state ownership on SOA conditional on the mean of leverage. But such a method fails to capture the effects across the various levels of leverage.

It is apparent from Figure 3.1 that in the central region of leverage distribution, the interaction coefficients are insignificant, whereas they are significant at the right and left tails of the leverage distribution. Notably, the sign effects of state ownership on SOA change from negative to positive. The adverse effects are more significant than the favourable ones (e.g., 0.198 at the 5% quantile and 0.029 at the 95% quantile). Figure 3.1 consists with the results in Table 3.4.

3.5.3 Further discussions

Our results show that in Vietnam for firms with low financial leverage an adverse relation exists between state ownership and SOA. This relation is positive for high-leveraged firms. Although the impact is substantial for the extreme values of leverage –

both very high and very low – the evidence indicates that adverse effects are much higher than favourable ones.

The adverse effect at the low quantile of leverage supports the arguments of Zhou and Xie (2015), who justify their assessment of adjustment speed based on agency costs. In particular, due to the separation of voting rights from cash flow rights, state-owned enterprises are likely to focus on political objectives rather than on maximising the benefit for shareholders. Moreover, “soft budget constraints” have a negative effect on managers’ motivations. Consequently, state-owned enterprises bear considerable agency costs, which prevent firms from adjusting leverage to the optimal level. In such sense, the regulators associated with state-owned enterprises in Vietnam need to pay more attention to the impediments incurred by high control of government on the process that the firms adjust the leverage upward to the target.

On the other hand, a positive relationship between state ownership and SOA for highly leveraged state-owned enterprises is consistent with Qian et al. (2009), who analyse SOA based on transaction costs. Specifically, state-owned enterprises do not only maintain a strong relationship with the state-controlled banks but also enjoy government guarantees against bankruptcy and insolvency. Consequently, they can borrow at lower cost, resulting in a faster leverage adjustment speed than that of private firms. These features in Vietnam explain why when state-owned enterprises need to adjust the leverage downwards, it is easier for them to do transactions in a quick manner. The higher the extent to which the Vietnamese government controls the firms, the higher the efficiency of downward adjustment. Moreover, in Vietnam, the members of state-owned enterprises boards of directors are generally government officials or former government officials. Since a high debt ratio often results in bankruptcy, insolvency, non-performing loans and

therefore a bad reputation, managers in state-owned enterprises try to reduce debt levels to avoid losing their jobs and seek to impress the government with better performance.

Finally, although the effects of state ownership on SOA are non-uniform across the debt level, the adverse effects are reported to be greater than the positive ones. This implies that the governments' connections in Vietnam make it easier for state-owned firms to reduce the debt when a need arises; therefore, the low efficiency of increasing debt level is more substantive. This is especially the case when the Vietnam government's shares in state-owned firms are high. The local regulators and practitioners should pay more attention to this phenomenon and consider possible ways to mitigate such impacts.

3.6. Robustness tests

3.6.1 Alternative measure of leverage

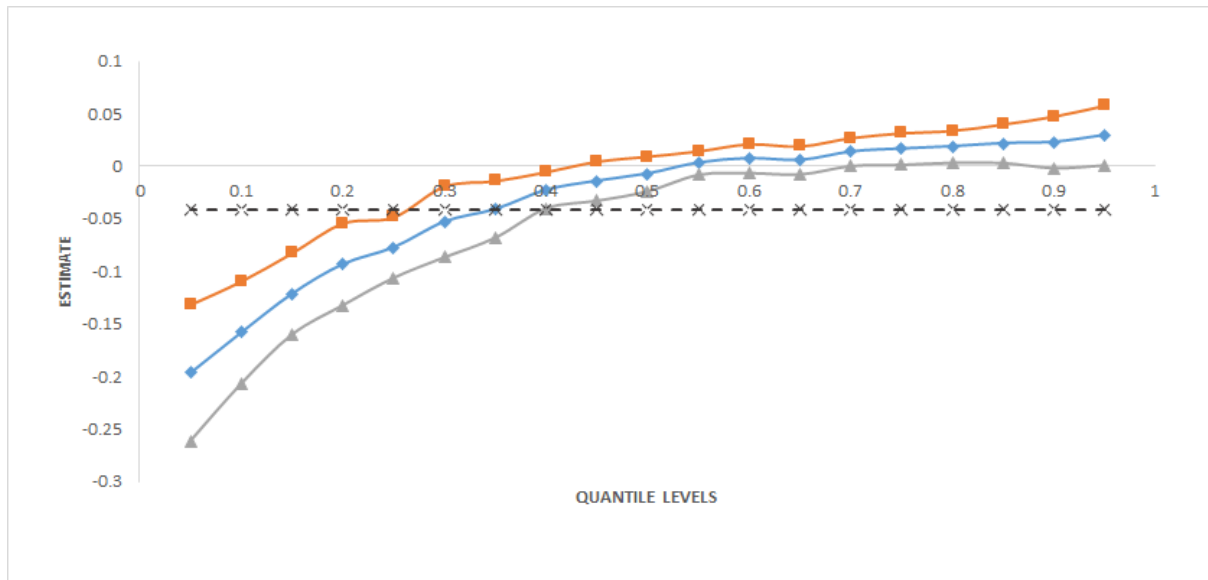
In order to determine whether the results shown in Section 5 are robust, we carry out additional tests. In the first test, we apply an alternative measure of leverage to check if the results change. We use the book-value measure of leverages – total debt leverage (total debt/book value of total assets) – and re-run the QR estimation. The empirical results are presented in Table 5 and Figure 2.

Table 3.6: The impacts of state ownership on SOA across various book value of the leverage quantiles

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	-0.196	(0.00)**	0.55	0.003	(0.58)
0.10	-0.158	(0.00)**	0.60	0.007	(0.30)
0.15	-0.121	(0.00)**	0.65	0.006	(0.41)
0.20	-0.093	(0.00)**	0.70	0.014	(0.04)*
0.25	-0.077	(0.00)**	0.75	0.016	(0.05)*
0.30	-0.053	(0.00)**	0.80	0.019	(0.04)*
0.35	-0.041	(0.00)**	0.85	0.022	(0.02)*
0.40	-0.023	(0.01)	0.90	0.023	(0.05)*
0.45	-0.014	(0.14)	0.95	0.029	(0.04)*
0.50 (LAD)	-0.007	(0.40)	OLS	-0.040	(0.00)**
			GMM	-0.267	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (3.8) when we apply quantile regression to find the different values of ∂'_1 throughout the distribution of the leverage. With each value of ∂'_1 , we find the impacts of state ownership on SOA : $\partial'_1 = -\partial_1$. We provide the estimate of ∂_1 in the table. To compare the results of quantile approach versus the LAD/OLS, we also show the coefficient of the interaction terms under LAD and OLS method. While quantile regression shows the impacts of state ownership on different degree of the leverage, LAD/OLS method just shows one effect conditional on the mean or the median of leverage over time.

Figure 3.2: The impact of state ownership on SOA across the book value of leverage quantiles: QR estimates with 95% confidence level vs. OLS estimate



The results from Table 3.6 and Figure 3.2 are consistent with those using the book value of leverage. In particular, the effects of state ownership on SOA are only significant for extreme values of leverage, both very high and very low. Moreover, the adverse effects in the lower quantile of leverage outweigh those in the top quantile.

3.6.2 Non-zero debt issuance firms

According to Cook, Kieschnick, and McCullough (2008), the issues on the equivalent question between debt-equity choice and how much debt firms want to incur can be more serious when studies include zero leverage and non-zero leverage firms in the sample. Additionally, in terms of the different incentives between zero leverage and non-zero leverage firms, the financial constraints on firms, their financial flexibility and need for external financing (Devos, Dhillon, Jagannathan, & Krishnamurthy, 2012; Huang, Li, & Gao, 2017), the findings between the sample with and without zero leverage can be different. In turn, we run the QR estimation with data only including non-zero debt issuance firms. The results are shown in Table 3.7 and Figure 3.3.

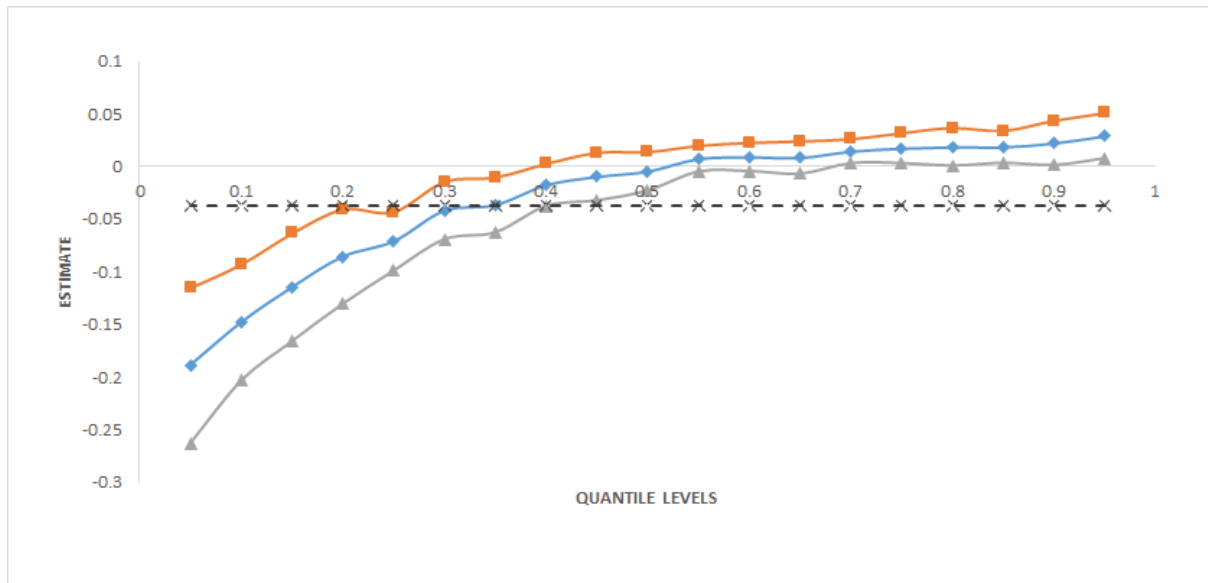
Table 3.7: The impacts of state ownership on SOA across various leverage quantiles for non-zero debt issuances firms

$$LEV_{i,t+1} = \alpha + \partial'_1(SO_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	-0.189	(0.00)**	0.55	0.008	(0.23)
0.10	-0.148	(0.00)**	0.60	0.009	(0.18)
0.15	-0.115	(0.00)**	0.65	0.009	(0.22)
0.20	-0.085	(0.00)**	0.70	0.015	(0.27)
0.25	-0.071	(0.00)**	0.75	0.017	(0.01)**
0.30	-0.042	(0.00)**	0.80	0.019	(0.02)*
0.35	-0.036	(0.01)**	0.85	0.019	(0.02)**
0.40	-0.017	(0.09)	0.90	0.023	(0.04)*
0.45	-0.009	(0.41)	0.95	0.029	(0.01)**
0.50 (LAD)	-0.004	(0.64)	OLS	-0.037	(0.00)**
			GMM	-0.266	(0.00)**

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (3.8) when we apply quantile regression to find the different values of ∂'_1 throughout the distribution of the leverage. With each value of ∂'_1 , we find the impacts of state ownership on SOA : $\partial'_1 = -\partial_1$. We provide the estimate of ∂_1 in the table. To compare the results of quantile approach versus the LAD/OLS, we also show the coefficient of the interaction terms under LAD and OLS method. While quantile regression shows the impacts of state ownership on different degree of the leverage, LAD/OLS method just shows one effect conditional on the mean or the median of leverage over time.

Figure 3.3: The impacts of state ownership on SOA across various leverage quantiles for non-zero debt issuances firms



As can be seen from Table 3.7 and Figure 3.3, the influence of state ownership on SOA varies across the leverage level. Specifically, the effects are significantly negative (positive) at the left (right) tails. Negative effects are greater than positive effects. These results are similar to the sample with both zero and non-zero debt issuance firms.

3.6.3 The impact of state ownership on SOA with different control variables

To check the robustness of the results in Section 5, we add more control variables. The first group is the corporate governance variables as with good corporate governance, firms are likely to enhance the accountability, trust, and transparency and mitigate the agency costs which in turn increase the speed of adjustment of capital structure (SOA) (Chang et al., 2014; Liao et al., 2015). Accordingly, we add four corporate governance factors in our model, namely board independence (*BIND*), CEO duality (*DUALITY*), Board ownership (*BO*), and CEO and BOD ownership (*CO*)¹⁹. Furthermore, macroeconomic variables such as GDP growth (*GDPG*) and Inflation (*INF*) may have potential impacts on SOA. Cook and Tang (2010) posited that firms tend to adjust the SOA more quickly in the good macroeconomic states than in the bad scenarios as they have more favourable conditions to access the financial sources. Therefore, we consider the GDP growth (*GDPG*) and Inflation (*INF*) in our model²⁰. All the new control variables definition and descriptive statistics are provided in the appendix.

¹⁹ Tai Viet Corporation (Vietstock), a leading financial information service provider in Vietnam, provided all corporate governance variables

²⁰ We obtain the macroeconomic variable information from the website of World Bank at <https://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG?locations=VN>

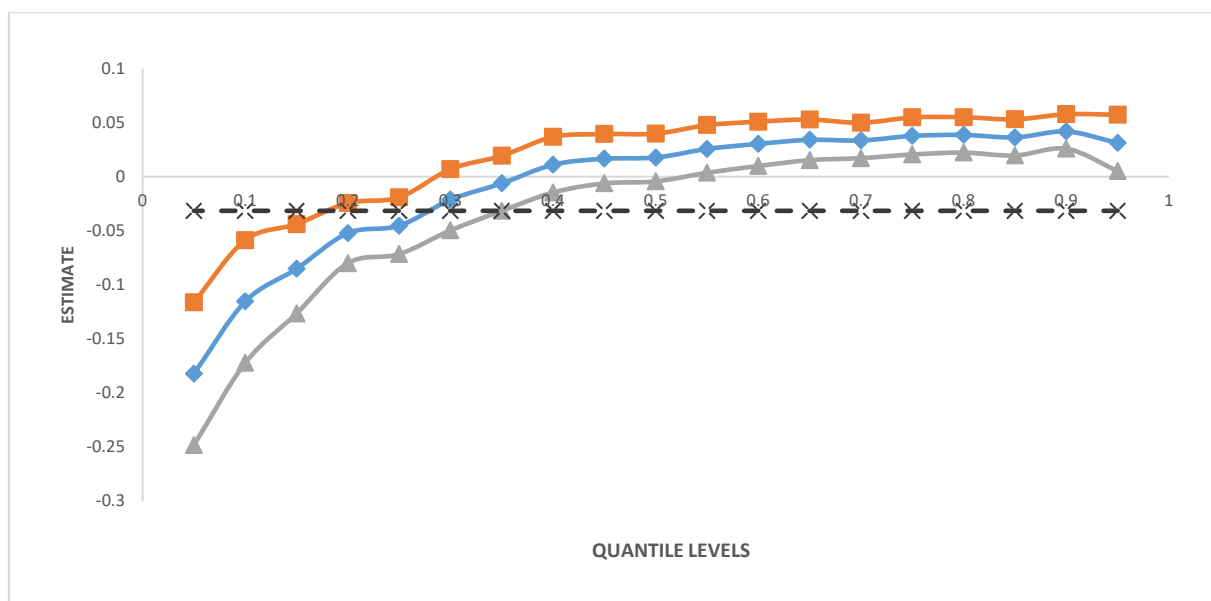
Table 3.8: The impacts of state ownership on SOA across various leverage quantiles with different control variables

$$LEV_{i,t+1} = \alpha + \partial'_1(SO_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	-0.173	(0.00)**	0.55	0.011	(0.19)
0.10	-0.108	(0.00)**	0.60	0.011	(0.21)
0.15	-0.099	(0.00)**	0.65	0.022	(0.01)**
0.20	-0.062	(0.00)**	0.70	0.019	(0.01)**
0.25	-0.044	(0.03)*	0.75	0.021	(0.00)**
0.30	-0.033	(0.00)**	0.80	0.027	(0.00)*
0.35	-0.019	(0.15)	0.85	0.029	(0.00)**
0.40	-0.005	(0.69)	0.90	0.032	(0.00)*
0.45	0.001	(0.92)	0.95	0.026	(0.00)**
0.50 (LAD)	0.008	(0.44)	OLS	-0.032	(0.02)*
			GMM	-0.142	(0.03)*

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (3.8) when we apply quantile regression to find the different values of ∂'_1 throughout the distribution of the leverage. With each value of ∂'_1 , we find the impacts of state ownership on SOA : $\partial'_1 = -\partial_1$. We provide the estimate of ∂_1 in the table. To compare the results of quantile approach versus the LAD/OLS, we also show the coefficient of the interaction terms under LAD and the OLS method. X includes firms' variables, corporate governance variables and macroeconomic variables

Figure 3.4: The impacts of state ownership on SOA across various leverage quantiles with different control variables



The findings from Table 3.8 and Figure 3.4 with new control variables are consistent with the previous model. More specifically, the impact of state ownership on SOA are only significant for the low and high level of leverage but not in the central region of leverage distribution. The sign changes from negative for low-levered firms to positive for high-levered firms. Furthermore, the adverse effects in the lower quantile of leverage outweigh those in the top quantile.

3.6.4 The impact of state ownership on SOA with winsorizing the data

In order to check the robustness of the results revealed in Section 5 are robust, we re-arrange our data in a different way by following Chang et al. (2014) and Liao et al. (2015) to winsorize all the variables at the 1st and 99th percentiles to alleviate the effect of outliers and avoid the influence of extreme values.

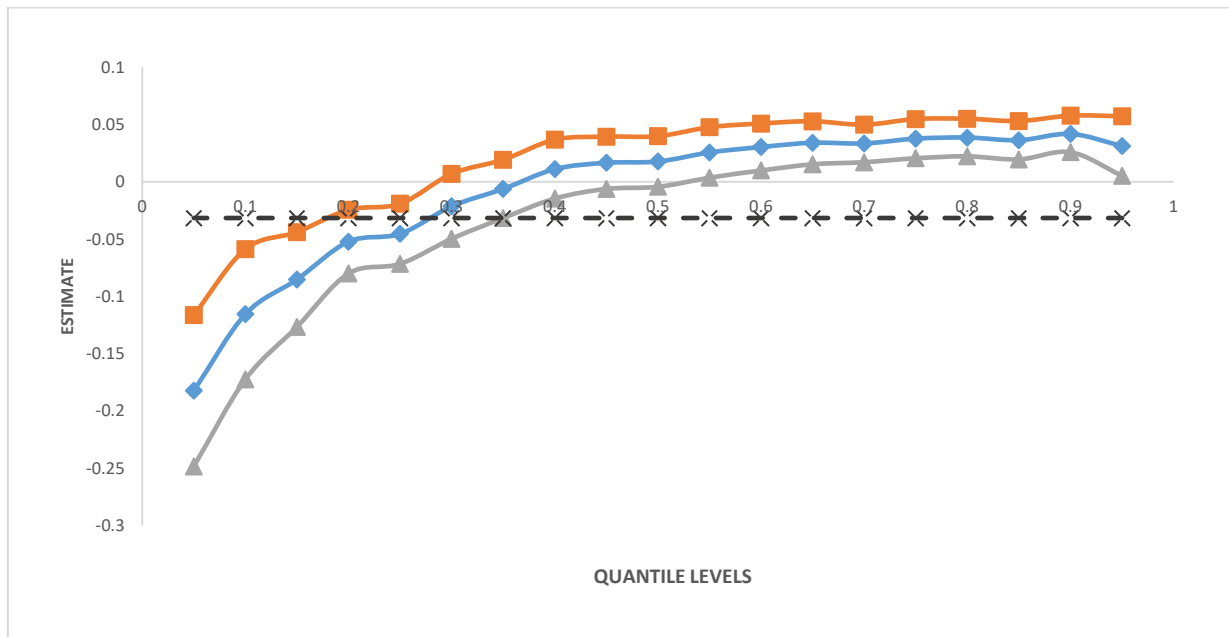
Table 3.9: The impacts of state ownership on SOA across various leverage quantiles with winsorizing the data

$$LEV_{i,t+1} = \alpha + \partial'_1(SO_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Quantile	Estimate	P-value	Quantile	Estimate	P-value
0.05	-0.182	(0.00)**	0.55	0.026	(0.02)*
0.10	-0.116	(0.00)**	0.60	0.030	(0.00)**
0.15	-0.085	(0.00)**	0.65	0.034	(0.00)**
0.20	-0.052	(0.00)**	0.70	0.033	(0.00)**
0.25	-0.045	(0.03)*	0.75	0.038	(0.00)**
0.30	-0.021	(0.14)	0.80	0.039	(0.00)*
0.35	-0.006	(0.63)	0.85	0.036	(0.00)**
0.40	0.011	(0.40)	0.90	0.042	(0.00)**
0.45	0.017	(0.15)	0.95	0.031	(0.02)*
0.50 (LAD)	0.018	(0.11)	OLS	-0.032	(0.02)*
			GMM	-0.157	(0.02)*

Note: * Significant at the 5% level, ** Significant at the 1% level. Results from equation (3.8) when we apply quantile regression to find the different values of ∂'_1 throughout the distribution of the leverage. With each value of ∂'_1 , we find the impacts of state ownership on SOA : $\partial'_1 = -\partial_1$. We provide the estimate of ∂_1 in the table. To compare the results of quantile approach versus the LAD/OLS, we also show the coefficient of the interaction terms under LAD and OLS method. X includes firms' variables, corporate governance variables and macroeconomic variables. Variables are winsorized at the 1st and 99th percentile.

Figure 3.5: The impacts of state ownership on SOA across various leverage quantiles with winsorizing the data



As can be seen from Table 3.9 and Figure 3.5, the sign and the magnitude of the impact of state ownership on SOA varies across the leverage distribution. Notably, the effects are significantly negative and higher at the left tail but positive and smaller at the right tail. Additionally, the influence is insignificant in the central region of leverage distribution. These results are similar to the sample by removing the extreme values.

3.7 Conclusions

The effects of state ownership on the adjustment speed of capital structure in emerging economies are inconclusive in the literature. These effects are found either positive or negative depending on different underlying reasons such as transaction costs (Qian et al., 2009) or agency costs. Vietnam is still going through the privatisation process, in which wholly state-owned enterprises are transformed into partially state-owned enterprises. Additionally, privatisation is complete only when all state-owned enterprises become private companies. Since the process is not complete yet, state-owned firms still play an essential role in the economy. Hence it is our academic interest to investigate how

state ownership affects the efficiency of capital structure adjustment in the Vietnamese market with some special institutional features.

This paper contributes to the literature by using a quantile regression approach to examine this issue in Vietnam. This model enables examining the varying relationships between state ownership and SOA across the distribution of leverage. New evidence is revealed. It is found that the influence of state ownership on SOA is negative for low-leveraged firms while positive for high-leveraged firms. Notably, the adverse effects are greater than the favourable effects.

Our findings suggest, first, the government should speed up the privatisation process to ensure that high control by the government in the state-owned firms cannot be the cause of negative consequences for the economy. Second, since for low-leveraged state-owned firms the adjustment process suffers from low efficiency, the local regulators and practitioners should be cautious about the impediments brought about by the high state control via the agency conflicts. Third, since high-leveraged state-owned firms enjoy favourable conditions when repurchasing debt or increasing equity to lower their leverage, the government should impose policies to monitor state-owned firms when their leverage is relatively high and needed to be adjusted downwards.

Appendix

Table 3.10: Definition of the new control variables

Variables	Definitions
<i>Corporate governance variables</i>	
Board independent (BIND)	The percentage of independent directors on the board
CEO duality (DUALITY)	The dummy variable equals to one if CEO is also the chairman of the board, otherwise zero
Board ownership (BO)	Ratio of shares held by board of directors
CEO and BOD ownership (CO)	Ratio of shares held by CEO and board of directors
<i>Macroeconomics variables</i>	
GDP growth (GDPG)	Annual growth in nominal gross domestic product (GDP)
Inflation (INF)	Annual Inflation rate. Growth in consumer price index

Table 3.11: Descriptive statistics of the new control variables

Variable	N	Mean	SD	Min	Max
Board independent (BIND)	5,374	0.596	0.201	0.000	1.000
CEO duality (DUALITY)	5,374	0.369	0.482	0.000	1.000
Board ownership (BO)	5,374	0.140	0.161	0.000	0.854
CEO and BOD ownership (CO)	5,374	0.132	0.250	0.000	1.000
GDP growth (GDPG)	5,374	6.054	0.565	5.247	7.547
Inflation (INF)	5,374	8.058	5.931	-1.710	23.116

This table presents the number of observations, mean, standard deviation, minimum and maximum of the new control variables (2000-2016).

Chapter 4

Corporate governance and capital structure dynamics:

Evidence from a transitional economy

4.1. Introduction

According to trade-off theory, there is a target capital structure in which any deviation of the observed leverage from an optimal level can reduce the firm's value. However, because of the adjustment costs, firms rebalance their leverage only when the benefits of adjustment outweigh its costs. Strong corporate governance, which is associated with the enhancement of accountability, trust, and transparency for firms, can mitigate the agency costs²¹, which in turn increase the speed of adjustment (SOA) of capital structure. Therefore, some studies have been conducted to examine the effect of corporate governance on SOA. For instance, Chang, Chou, and Huang (2014) apply the G-index and E-index as proxies for corporate governance quality and find that firms with good governance adjust leverage to the optimal level faster than firms with weak governance. Similarly, Liao, Mukherjee, and Wang (2015) consider some corporate governance mechanisms such as CEO-chairman separation, outside directors, institutional ownership, and conclude there are clear impacts of these factors on SOA.

Since the scope of corporate governance mechanisms is very broad, the effects of some essential governance mechanisms, including gender diversity, foreign ownership, and managerial ownership on SOA remain unclear. Notably, many firms are under pressure to promote gender diversity (Sila, Gonzalez, & Hagendorff, 2016), and four European countries reached an agreement for a compulsory proportion of female directors

²¹ Agency costs are a part of adjustment costs

on boards. Generally, female board members are expected to have knowledge, skills, experience, and networking and monitoring abilities relating to the the firm's development that are more advanced than those of their male counterparts (Adams & Ferreira, 2009). Secondly, as foreign investors are likely to bring new capital, cutting-edge technology, research, and development abilities to local businesses, the government has introduced and implemented policies and strategies to attract foreign investment. However, foreign investors also deal with higher risks associated with the business, the country, and the politics of the local state. Finally, managerial ownership is recognised as a tool for aligning the interests of managers and shareholders (Jensen & Meckling, 1976). However, due to different levels of ownership, managers may not optimise the firm's value and may also pursue their own objectives (Demsetz, 1983; Fama & Jensen, 1983). With regard to the relationship between corporate governance and SOA, most studies have concentrated on the US market and remained largely silent on developing markets. However, corporate governance in emerging markets plays a vital role in alleviating agency problems and severe information asymmetry as legal systems, the rule of law, and investor protection are not as effective as in developed countries (Nguyen, Locke, & Reddy, 2015). Buvanendra, Sridharan and Thiyagarajan (2017) were among the first to examine the linkage between corporate governance and SOA in developing countries (Sri Lanka and India). They investigated five governance variables, and concluded that only CEO duality (or family ownership) has significant impacts on SOA in Sri Lanka (and India).

Our paper extends the literature in two main ways by investigating the impact of corporate governance in Vietnam, a developing and transitional economy, from 2000 to 2016. First, we disclose the effect of fundamental corporate governance mechanisms, namely gender diversity, foreign ownership and managerial ownership on SOA, which

have not been explored in the literature. Second, we have made the first attempt to demonstrate a linkage between corporate governance and SOA in Vietnam. There has been little previous investigation of the relationship between corporate governance and SOA in a developing country. Interestingly, the corporate governance system in Vietnam is in the initial stage of development and remains underdeveloped. Vietnam had a corporate governance global score of 42.5% in 2011, which was much lower than Thailand (77%) and the Philippines (72%). According to the World Bank (2013), Vietnam was ranked 166th out of 183 nations, which revealed weak protection rights for shareholders and investors.

Following its transformation from a planned to a market economy, the Vietnamese economy has made some progress. However, the average debt ratio of listed firms is much more than 0.5, which implies a high probability of bankruptcy (Deangelo & Roll, 2015). The insolvency and bankruptcy of banks, as well as one of the biggest corporations (Vinashin) in 2010, indicates the severe problem of high leveraging for Vietnamese firms. We apply six corporate governance mechanisms – gender diversity, foreign ownership, managerial ownership, board size, board independence, and CEO duality – to review corporate governance from a range of perspectives. Our results with regard to the relationship between corporate governance and SOA in Vietnam indicate two differences from developed countries. First, foreign-controlled firms considered to have good corporate governance are likely to perform faster with regard to leverage adjustment (Chang, Chou, & Huang, 2014). We found “snail”-paced adjustment in the Vietnamese market. Second, while better-governed countries can alleviate the CEO duality problem (Liao et al., 2015), in a country with weak governance, CEO duality has adverse effects on SOA.

This paper is organized as follows. Section 4.2 reviews the literature and develops the research hypotheses. Section 4.3 explains the econometric models. Section 4.4 presents the data and empirical results. Section 4.5 presents the robustness tests. Finally, Section 4.6 summarises the study and discusses some policy implications.

4.2 Literature review and research hypotheses

4.2.1. Literature review

In this section, we first summarise the crucial theories and empirical studies associated with capital structure and corporate governance; then we review this relationship in Vietnam, an emerging and transitional economy.

4.2.1.1 The impact of corporate governance on the adjustment speed of capital structure

From a theoretical perspective, capital structure has primarily been defined by three theoretical models: the trade-off theory; the pecking order theory; and the agency theory. According to trade-off theory, firms pursue an optimal capital structure by considering a combination of debt and equity that optimises the difference between the benefits and the costs of debt financing. In other words, firms rebalance debt until the marginal costs of debt match the marginal costs of equity. While the advantages of debt come from its tax deductible aspects²² (Modigliani & Miller, 1958, 1963), the drawbacks of issuing debt derive from bankruptcy costs. More specifically, bankruptcy costs consist of indirect costs, such as legal and administrative expenses, and direct costs, which are estimated from the decrease in the value of firm assets during bankruptcy procedures.

In contrast, the pecking order theory developed by Myers and Majluf (1984) and Myers (1984) suggests that because of adverse selection costs, firms have a preference sequence of financing sources, from internal to external funds. The theory is based on asymmetric

²² As the debtholders have to pay interest, the interest is considered a financial expense, which is deducted for firms from their taxes; therefore, firms are incentivised to issue debt: the more debt they issue, the less tax they pay.

information issue between managers and shareholders. As managers have more information about the company than the shareholders, internal financing sources give them more valuable investment opportunities. Furthermore, if additional sources of funding are required, debt can be used. Equity is considered the last resort of financing because of its risky and higher adverse selection costs. Under pecking order theory, firms prefer to use retained earnings over debt, short-term debt over long-term debt and debt over equity. To recap, the changes in leverage are determined by the need for external funds, not by an attempt to achieve the target capital structure (Shyam-Sunder & Myers, 1999).

According to agency theory, the notion of agency costs resulting from conflicts of interest is the determinant of capital structure decisions (Harris & Raviv, 1991; Jensen & Meckling, 1976). The severity of agency problems is likely to distort corporate policy, which in turn leads to poor financial performance. Agency conflicts can be between shareholders and managers, shareholders and creditors (Jensen & Meckling, 1976) or between minority shareholders and large controlling block holders (Shleifer & Vishny, 1997).

As a tool for improving the accountability, trust and transparency of the firms, corporate governance can reduce the agency costs and enhance the confidence of investors. Corporate debt policy is also considered an important corporate governance mechanism in terms of alleviating agency conflicts. First, by issuing debt, firms can shrink their equity base, thereby increasing the percentage of equity owned by management. In this scenario, high managerial ownership implies that the managers are also the shareholders, who mitigate agency conflicts. Second, highly leveraged firms generally deal with an increased probability of bankruptcy costs. The additional risk may further encourage managers to limit their self-interest and improve efficiency (Grossman

& Hart, 1982). Finally, the use of debt leads to responsibility for interest payments, which prevents managers from taking advantage of free cash flow (Gompers, Ishii, & Metrick, 2003; Jensen, 1986)

Agency theory also reveals that strong corporate governance and better shareholder and creditor rights provide more opportunities for firms to gain access to external financing sources (Porta, Lopez - De - Silanes, Shleifer, & Vishny, 1997). Likewise, with strong corporate governance mechanisms, managers act for the wealth of the company's shareholders and adopt capital structure decisions to maximise the shareholders' interests. Several studies have been conducted to disclose the relationship between corporate governance and capital structure. Berger, Ofek, and Yermack (1997) and Jiraporn, Kim, Kim, and Kitsabunnarat (2012) show that firms with good corporate governance use less debt and have better performance than those with poor corporate governance. Similarly, Jiraporn et al. (2012) show an inverse association between leverage and governance quality.

As the scope of corporate governance also includes the board, some studies apply aggregate governance indicators such as the G-index, E-index or corporate governance quality (Chang, Chou, & Huang, 2015; Chang, Chou, & Huang, 2014; Haque, Arun, & Kirkpatrick, 2011; Jiraporn et al., 2012) while other studies analyse corporate governance from two angles: board structure, such as the size of the board of directors (BOD), the proportion of independent directors, the portion of female directors, the gender of the CEO and chairperson, the duality between CEO and chairperson; and ownership structure, which includes institutional ownership, concentration of ownership, state ownership, foreign ownership, and managerial ownership (Berger et al., 1997; Harford, Li, & Zhao, 2008; Jiraporn & Kitsabunnarat, 2007; Le & Tannous, 2016).

A range of studies have reviewed the importance of corporate governance in analysing the capital structure choice; a smaller number of studies have focused on the impact of corporate governance on the adjustment speed (SOA) of capital structure. While some determinants of SOA have been revealed, such as firm variables (Antoniou, Guney, & Paudyal, 2008), and macroeconomic variables (Cook & Tang, 2010), little is known or tested with regard to the relationship between dynamic capital structure and corporate governance. For instance, Chang et al. (2014) apply the G-index and E-index as proxies for corporate governance quality and find that firms with good governance adjust leverage to the optimal level faster than firms with weak governance. Similarly, Liao et al. (2015) consider some corporate governance mechanisms such as CEO-chairman separation, outside directors, institutional ownership, and note the clear impacts of these factors on SOA.

While most studies have analysed the relationship between corporate governance and SOA in the US (Chang et al., 2015; Chang et al., 2014; Morellec, Nikolov, & SchÜRhoff, 2012), Supra, Narender, Jادیyappa, and Girish (2016) show that because of institutional structures and organizational setups, the SOAs of firms in emerging markets are different. Additionally, Nguyen et al. (2015) point out that as a result of the legal system, the rule of law, and investor protection, the role of corporate governance in developing countries is more crucial than in developed countries. Since there is a discrepancy between developing and developed countries regarding corporate governance and SOA, we argue that the effect of corporate governance on the speed of capital structure adjustment in developing countries may result in new findings compared to developed countries.

However, very few studies have explored the influence of corporate governance on SOA in developing markets. Buvanendra et al. (2017) examine Sri Lanka and India

by applying five corporate governance mechanisms including board size, non-executives, CEO–chairman duality, family ownership and directors’ compensation. Of these five corporate governance mechanisms, in Sri Lanka, only the duality of CEO and chairman has a significant negative impact on SOA, which indicates that one person acting as both chairman and CEO is likely to create conflicts and reduce SOA. Likewise, in India, only family-ownership has a positive influence on SOA, which suggests that family control plays an important role in increasing the speed of leverage adjustment. As the scope of corporate governance is very broad, the effects of some crucial elements of governance mechanisms such as gender diversity, foreign ownership, and managerial ownership on SOA remain unexplored in the literature.

As there is a relatively low proportion of women on boards compared to their presence in the population²³, the issue of gender diversity has received considerable attention recently. A variety of firms are under public pressure to improve their corporate board diversity (Sila et al., 2016), and four countries in Europe – Belgium, France, Norway and Italy – have produced a binding quota to increase board gender diversity. Empirical studies also suggest that greater gender diversity on boards of directors is correlated with better-quality decisions and monitoring functions. Simpson, Carter, and D'Souza (2010) assert that female directors have more advanced degrees compared to their male counterparts. Furthermore, female directors generally have more experience in marketing and sales, are more careful and sensible with regard to risks, and pay more attention to corporate social responsibility (Burgess & Tharenou, 2002; Post & Byron, 2015). Female directors also have different socialisation networks and experiences compared to male directors (Simpson et al., 2010). Female directors provide better

²³ Terjesen, Aguilera, and Lorenz (2015) show that females only accounted for 10.3% of board members across 67 countries. Similarly, MSCI (2014) conducted a survey of S&P 1500 and found that the average proportion of women directors on boards was around 15.8% in 2014. At that time, 81.4% of firms in the sample had at least one woman on the board of directors.

monitoring ability because they tend to enhance managerial accountability by improving board meeting attendance; in addition, their thinking is more independent and not influenced by the old-boys' club syndrome (Adams, Gray, & Nowland, 2011; Adams & Ferreira, 2009). In short, promoting gender diversity in boards of directors brings firms benefits resulting from the knowledge, skills, experiences, networks and monitoring ability of female directors.

Recently, governments have produced admission policies to attract foreign investments, to help them bring in new capital, cutting-edge technology, research and development abilities, which in turn increase the competitiveness of the host country (Lindemanis, Loze, & Pajuste, 2019; Piscitello & Rabbiosi, 2005). Additionally, foreign institutions play an important role in mitigating information asymmetry and agency problems by enhancing corporate governance quality and transparency (Chen, El Ghouli, Guedhami, & Wang, 2017). Foreign-controlled firms tend to maintain more information disclosure and keep strict control over managers' decisions (Boubakri, Cosset, Guedhami, & Omran, 2007). However, empirical studies also acknowledge some disadvantages of foreign investment associated with adaptation to a new country, business risk, country risk, political risk, and cultural barriers (Kogut, 1985). Most studies have focused on the relationship between foreign ownership and firm performance. The results are diverse: they can be positive, negative, non-linear or insignificant depending on the research methods, data sources and markets (Aydin, Sayim, & Yalama, 2007; Gelübcke, 2013; Hintosová & Kubíková, 2016; Pastusiak & Jasiniak, 2015).

Some researchers have investigated the effect of foreign ownership on leverage; these findings are also mixed and inconsistent. For instance, Zou and Xiao (2006) and Gurcharan (2010) found a negative relationship between foreign ownership and capital structure. As foreign investors face more severe information asymmetry than domestic

companies and are also restricted by law and regulations, they have less power to manage firms. Therefore, they take advantage of debt as a monitoring mechanism. On the other hand, other studies have indicated an adverse influence of foreign ownership on leverage (Huang, Lin, & Huang, 2011; Li, Yue, & Zhao, 2009). They argue that firms with more significant proportions of foreign ownership can access capital more cheaply because of their reputation and relationship; therefore, they can choose other financing sources rather than borrowing. Additionally, foreign ownership and leverage can be substituted to reduce managerial conflicts (Le & Tannous, 2016). Since empirical studies have focused on the link between foreign ownership and leverage, we extend the literature to explore the impact of foreign ownership on the adjustment speed of capital structure.

Managerial ownership, estimated as the fraction of shares owned by a firm's managers, is considered a corporate governance mechanism to align the interests of managers and shareholders (Jensen & Meckling, 1976). In contrast, Demsetz (1983) and Fama and Jensen (1983) contend that with a low ownership proportion, managers are pushed to cling to value maximisation because of market discipline rather than ownership. Furthermore, managers may not optimise a firm's value while their consumption of perquisites (for instance, high influence and commissions) significantly outweigh the loss they bear from a reduction of the firm's value. With a large fraction of company ownership, managers have a strong ability to pursue their objectives without fear of action from other block holders (Morck, Shleifer, & Vishny, 1988).

Managerial ownership affects managers' views, goals, and desires, which in turn influence capital structure decisions. Empirical studies show mixed results on the linkage between managerial ownership and capital structure. For instance, Kim and Sorensen (1986) and Harris and Raviv (1988) find a positive impact of managerial ownership on capital structure. When managers increase their equity ownership, they become

shareholders and prefer to issue debt to prevent raiders from taking over companies. However, some studies indicate a negative impact of managerial ownership on leverage. Jensen and Meckling (1976), for example, argue that high managerial ownership can reduce agency costs; therefore, it is unnecessary for firms to use debt as a tool to mitigate the conflicts of managers and shareholders. Likewise, Begley and Feltham (1999) indicate that managers can reduce leverage to avoid bankruptcy and ease financial distress costs. Empirical studies have been limited by their focus on the impact of managerial ownership on leverage; therefore we fill the gap by exploring the effect of managerial ownership on SOA.

In conclusion, the relationship between corporate governance and SOA has been mainly centred on the US market rather than developing countries. Moreover, as the scope of corporate governance is very broad, the impact of several essential governance mechanisms, including gender diversity, foreign ownership and managerial ownership, on the speed of leverage adjustment is still unexplored in the literature. This paper extends the research by investigating the effects of these governance variables on SOA in Vietnam, a transitional and emerging market. To highlight the multi-dimensional nature of corporate governance, we consider the impact of six corporate governance mechanisms on SOA: board size, board independence, CEO duality, gender diversity, managerial ownership and foreign ownership.

4.2.1.2 Research on corporate governance and capital structure in Vietnam

Corporate governance (CG) is a new term in the Vietnamese language and there are no equivalent words to fully explain its meaning; the closest term applied to interpret CG is “company administration” (OECD, 2006). Corporate governance systems in Vietnam are in the early stages of development and exhibit the following features: (1) the regulations are less developed and enforced (World Bank, 2013); (2) public

understanding of CG is limited (Freeman & Nguyen, 2006); (3) the state sector plays a substantial role in the economy; (4) protection rights for creditors and shareholders are weak; and (5) internal and external corporate governance are not efficient (Minh & Walker, 2008; Nguyen, 2008). Additionally, the pace of reform in corporate governance has increased since the Vietnamese government applied the legal principles of Anglo-American jurisdictions to establish a regulatory system and introduced the Law on Enterprises (LOE) in 2005 (Minh & Walker, 2008). This law came into effect in 2006, which is marked as a turning point for the development of the CG legal framework (Hai & Nunoi, 2008).

The efficiency of the LOE was examined by Freeman and Nguyen (2006). They found that Vietnamese firms did comply with the new law and regulations. However, since the law did not provide clear guidance and direction, enforcement and implementation of the rules and regulations were not highly successful. The aim for firms to enforce, regulate, and develop the capital market was hard to achieve due to limited resources. It is important to enhance the disclosure, the role of the board of directors and inspection committee, and the protection rights for creditors and shareholders. The World Bank (2013) also pointed out three challenging tasks for Vietnam: (i) to implement the new law, (ii) to grant the necessary powers to regulatory agencies, and (iii) to strengthen law enforcement.

Although the Law on Enterprise framework not only showed the effort made by the government to improve governance mechanisms but also drew attention to the requirements for reform, the Vietnamese corporate governance system remains underdeveloped. For instance, Vietnam had a global score²⁴ of 42.5% in 2011 (43.9% in

²⁴ Corporate governance score is produced by International Finance Corporation (IFC), the higher value of global score indicates the efficiency of the corporate governance

2009), which is much lower than other ASEAN (Association of Southeast Asian Nation) countries; for instance, Thailand and the Philippines achieved scores of 77% and 72% respectively (Vu, Phan, & Le, 2018). Furthermore, according to the World Bank (2013), the strength of investor protection in Vietnam was very weak, ranking 166th out of 183 countries.

The large financial scandal related to the Vietnam Shipbuilding Industry Group (Vinashin) is a remarkable example that symbolises the poor corporate governance in many Vietnamese firms. Vinashin was first established in 1996 with the mission of creating a strong shipbuilding industry for Vietnam. It followed a parent-subsidiary model and was owned by the Vietnamese government with 100% of the charter capital. Between 2006 and 2008, Vinashin invested in many sectors in addition to its primary tasks of building new ships and repairing old ships. It built up 200 subsidiaries in Vietnam in a wide range of industrial sectors, such as producing steel and cement, providing banking and insurance services, and assembling motorcycles (Nguyen, 2018). Vianshin's diversification strategy was dramatically impacted by the financial crisis in 2008-2009. Many projects were cancelled, and foreign investors started withdrawing money to their home countries. The weaknesses of Vinashin became apparent, such as poor management skills and ability, and the moral hazard of self-interested actions. Due to its excessive debt²⁵, Vinashin was on the brink of bankruptcy in 2010. To solve this problem, the government divided Vianshin into three parts, then merged them with two corporations: the Vietnam Oil and Gas group, and Vinalines Shipping Corporation.

With regard to the debt market, before 1986, Vietnam had a centrally-planned economic system, based on agriculture and heavy industry. At that time, Vietnam suffered hyperinflation and a fiscal crisis. As a result, in 1986 the Vietnamese government

²⁵ The unpaid debt of Vinashin in 2010 is VND 120 billion, which is equivalent to over USD 6 billion

implemented a reform program to transform the economy from a planned to a market economy. Although the Vietnamese economy has made some achievements, many firms are highly leveraged. A debt ratio considerably above 0.5 is likely to increase the probability of bankruptcy (Deangelo & Roll, 2015). The bankruptcy and insolvency of the three largest banks and the biggest corporation, Vinashin, illustrate the issues of high leverage for Vietnamese firms, since a major role of corporate governance in developing countries is to help managers make capital structure decisions. Several studies have explored the effect of corporate governance mechanisms on capital structure in Vietnam. For instance, Le and Tannous (2016) find the impact on capital structure can be positive (for state ownership and managerial ownership), negative (for foreign ownership), or of no significance (for substantial ownership). On the other hand, Thai (2017) finds no linear relationship but an inverted U-shaped relationship between state investment and leverage. Since the literature focuses on the relationship between corporate governance and capital structure in Vietnam, an emerging and transitional economy, we make the first attempt to explore the effect of corporate governance on the SOA of capital structure in the Vietnamese context.

4.2.2 Research hypotheses

4.2.2.1 Board size and SOA

The board of directors is responsible for overseeing the efficiency and proper operations of a company. The relationship between board size and capital structure is well-established but mixed in the literature. Mehran (1992) and Berger et al. (1997) find a negative correlation between the number of directors and leverage. They argue that a larger board of directors puts more pressure on managers to maintain a low debt ratio and improve firm performance. On the other hand, according to Jensen (1986), larger boards are likely to use more debt than equity. Despite extensive discussions on board size and

leverage, little empirical evidence has been obtained for the linkage between board size and the SOA of capital structure. Buvanendra et al. (2017) explore Sri Lanka and India and find no correlation between board size and SOA in these countries. As a developing country and transitional economy, Vietnam is profoundly affected by information asymmetry; therefore, with a large number of directors, their network is likely to help firms to access external financing at cheaper costs. For these reasons, we offer the following hypothesis:

Hypothesis 1: There is a positive relationship between board size and SOA

4.2.2.2 Board independence and SOA

Board independence is defined by the percentage of outside directors working for a firm but not connected to the internal managers; hence, such directors can mitigate agency costs between managers and shareholders (Fama, 1980; Fama & Jensen, 1983). Some studies indicate that firms with more independent directors generally have better information disclosure and less information asymmetry. For instance, Ajinkya, Bhojraj, and Sengupta (2005) assert that outside directors provide earnings prediction more frequently, accurately, and in a less biased manner than internal directors. Also, outside directors are more responsible for monitoring the quality of the financial report and improving the frequency of issuing public information (Kanagaretnam, Lobo, & Whalen, 2007). Most studies present a positive correlation between outside directors and leverage. As outside directors are aligned to shareholder interests, they prefer to issue debt to prevent the managers from taking advantage of free cash flows (Berger et al., 1997). As the independent directors are likely to have more knowledge and information, their network can provide a firm with easy access to external funds. We therefore propose the following hypothesis:

Hypothesis 2: There is a positive relationship between board independence and SOA

4.2.2.3 CEO duality and SOA

CEO duality occurs when the CEO is also the chairman of the firm. The existence of CEO duality results in a conflict of interests as the CEO is less dependent because of a high concentration of power. Moreover, it is hard for outsiders to monitor the executive member effectively as the CEO can hide some problems relating to the firm's operation (Coles, Daniel, & Naveen, 2008; Duchin, Matsusaka, & Ozbas, 2010). From the literature, the relationship between CEO duality and leverage is mixed and inconclusive. While Abor (2007) and Fosberg (2004) find firms with CEO duality use more debt, Alves, Couto, and Francisco (2015) conclude that firms with more independent boards employ more risky sources of financing. To explain the differences, Detthamrong, Chancharat, and Vithessonthi (2017) note that firms' debt ratios rely on the risk preference of the CEO. Therefore, if CEOs are more risk-averse, they are likely to use equity; on the other hand, CEO risk-takers use debt for financing needs.

There has been growing interest in research on the linkage between CEO duality and leverage, but there continues to be limited evidence on the association between CEO duality and the SOA of capital structure. Buvanendra et al. (2017) investigated India and Sri Lanka and found a negative relationship between CEO duality and SOA in India only. As firms with CEO duality bear agency costs and face more significant information asymmetry problems, we propose the following hypothesis:

Hypothesis 3: There is a negative relationship between CEO duality and SOA

4.2.2.4 Gender diversity and SOA

There is a growing belief that board diversity can enhance the efficiency of the board of directors. In this respect, Norway requires boards of directors to be at least 40% female.

Also, according to Zelechowski and Bilimoria (2004), female directors are better than their male counterparts with regard to management skills, human resource management, communication, and knowledge of public relations. Adams and Ferreira (2009) indicate that female directors attend meetings more frequently than male directors; therefore, they provide better monitoring. Virtanen (2012) investigated Finland and concluded that female board members were more likely to take active roles on their board. Similarly, Strøm, D'Espallier, and Mersland (2014), after examining 73 countries from 1998-2008, concluded that firms with a female CEO or a female director on the board of directors obtain better results than those without a female on the board of directors. Since greater gender diversity can take advantage of the knowledge, skills, experiences, network, and monitoring skills of female directors, it, in turn, enhances the board of director's efficiency and lowers information asymmetry. Therefore, we propose the following hypothesis:

Hypothesis 4: There is a positive relationship between gender diversity and SOA

4.2.2.5 Managerial ownership and SOA

Since emerging markets generally are highly uncertain and sometimes corrupted, their external corporate governance mechanisms do not work properly. Vietnam is also known as a market with low minority protection and a weak rule of law (Nguyen et al., 2015). In such circumstances the role of managerial ownership is relatively crucial. When managers own shares in a firm, they are likely to work harder and be more responsible because they are not only the managers but also the owners of the company. Hence, high managerial ownership can mitigate agency costs between managers and shareholders because their interests are aligned (Jensen & Meckling, 1976).

The relationship between capital structure and managerial ownership is inconclusive in terms of the results of empirical studies. A positive relationship is

disclosed by Kim and Sorensen (1986) and Harris and Raviv (1988), who argue that with high ownership, managers are likely to issue debt to prevent raiders from taking over companies. On the other hand, Jensen and Meckling (1976) assert that high managerial ownership can alleviate agency costs; therefore, it is unnecessary for firms to use debt as a tool to mitigate the conflicts of managers and shareholders. Similarly, managers can also reduce leverage to avoid bankruptcy and mitigate financial distress costs (Begley & Feltham, 1999). As firms with high managerial ownership have a low agency cost, the SOA of these firms should be faster. Therefore, the following hypothesis was formulated:

Hypothesis 5: There is a positive relationship between managerial ownership and SOA

4.2.2.6 Foreign ownership and SOA

Due to booming foreign investment inflow, the influences of foreign investors on firm activities are growing, especially in emerging markets. However, the impact of foreign ownership on leverage is mixed in the literature. On one hand, Zou and Xiao (2006) and Gurcharan (2010) conclude there is a negative relationship between foreign ownership and capital structure. They explain this based on the severe information asymmetry that foreign investors deal with, such as restrictions by law and regulations in emerging markets. Therefore, they take advantage of debt as a tool to monitor the firms. On the other hand, some studies have indicated an adverse influence of foreign ownership on leverage (Huang et al., 2011; Li et al., 2009). These researchers argue that firms with high foreign ownership can access capital at a cheaper price because of their reputation and relationships. Moreover, foreign ownership and leverage can be substituted to mitigate managerial conflicts (Le & Tannous, 2016).

Generally, foreign-owned firms require more information disclosure and keep strict control of managers' actions, leading to lower agency costs. However, the agency problem may come from the high level of misalignment between owners and managers

because of the geographical distance of foreign owners (Wellalage & Locke, 2013). Additionally, foreign investors are exposed to information asymmetry issues due to the divergence between ownership and control, and they also suffer both country and business risks. These risks result in uncertainty about future cash flow and information, which in turn causes an increase in transaction costs for firms. As transaction costs are also a part of adjustment costs, based on these costs, foreign-controlled firms should make tiny leverage adjustments. According to Lindemanis, Loze, and Pajuste (2019), foreign owners have better performance in strong-governance countries than in poor-governance countries. Since corporate governance in Vietnam is in the initial stages and remains undeveloped, we argue that the downside effect of foreign ownership offsets its advantages. For these reasons, we propose the following hypothesis:

Hypothesis 6: There is a negative relationship between foreign ownership and SOA

4.3. Econometric models

Following Liao et al. (2015) and Chang et al. (2014), we obtain the partial adjustment model for leverage is as below:

$$LEV_{i,t+1} - LEV_{i,t} = \alpha + \delta(LEV_{i,t+1}^* - LEV_{i,t}) + \varepsilon_{i,t} \quad (4.1)$$

Where $LEV_{i,t}$, and $LEV_{i,t+1}^*$ are the observed leverage and the optimal leverage respectively. Besides, δ represents the speed of adjustment of capital structure. When $\delta = 1$, firm fully adjusts its debt to the target leverage and the adjustment is complete, whereas $SOA < 1$ indicates the presence of adjustment costs²⁶. Following Faulkender, Flannery, Hankins, and Smith (2012), we first define the target leverage as a regression of firm's characteristics $LEV_{i,t+1}^* = \beta X_{i,t}$ and then achieve a reduce-form dynamic adjustment model:

²⁶ The adjustment costs may come from financial distress and other costs of debt (Hovakimian & Li, 2011)

$$LEV_{i,t+1} = \alpha + \beta\delta X_{i,t} + (1 - \delta) LEV_{i,t} + \varepsilon_{i,t+1} \quad (4.2)$$

Where β is the vector of coefficients to be calculated at the same time as δ , and $X_{i,t}$ is a set of firm characteristic variables. These factors are revealed by the trade-off theory and some empirical studies as the key determinants of leverage²⁷ (Antoniou et al., 2008; Hovakimian & Li, 2011; Liao et al., 2015)

According to Öztekin and Flannery (2012), there are clear impacts of firm's features on both target leverage and SOA. Therefore, we adopt the same control variables in the model to investigate the influences of corporate governance on SOA:

$$\delta_{i,t} = \partial_0 + \partial_1 GOV_{i,t} + \partial_2 X_{i,t} \quad (4.3)$$

Where $GOV_{i,t}$ is the set of corporate governance of firm i at time t , $X_{i,t}$ is a vector of control variables including firm size (*SIZE*), asset tangibility (*TANG*), depreciation amortisation (*DEP*) and operating income before depreciation (*PROFIT*).

Table 4.1 provides a list of variable definitions.

²⁷ In our model, X consists of firm size (SIZE), asset tangibility (TANG), depreciation and amortisation (DEP) and operating income before depreciation (PROFIT).

Table 4.1: Definition of leverage and explanatory variables for leverage

Variables	Definitions
<i>Dependent variables</i>	
Leverage (LEV)	Total debt/The sum of market equity and debt
<i>Independent variables</i>	
Board size (BSIZE)	The total number of directors on the firm's board
Board independent (BIND)	The percentage of independent directors on the board
CEO duality (DUALITY)	The dummy variable equals one if the CEO is also the chairman of the board, otherwise zero
% Women (WOMEN)	The percentage of women on the board of directors
Gender of CEO (GCEO)	The dummy variable equals one if the CEO is male, otherwise zero
Gender of Chairman (GCHAIR)	The dummy variable equals one if the chairman is male, otherwise zero
Board ownership (BO)	Ratio of shares held by board of directors
CEO and BOD ownership (CO)	Ratio of shares held by CEO and board of directors
Foreign ownership (FO)	Ratio of shares held by foreign investors
<i>Control variables</i>	
Firm size (SIZE)	The natural logarithm of total assets
Tangibility (TANG)	Property, plant, and equipment as a proportion of total assets (fixed assets)
Depreciation (DEP)	Depreciation divided by total assets
Profitability (PROFIT)	The ratio of earnings before interest and tax to total assets

Now, we merge Eq. (4.3) with Eq. (4.2) to achieve the model as below:

$$LEV_{i,t+1} = \alpha + \beta\delta X_{i,t} + [1 - (\partial_0 + \partial_1 GOV_{i,t} + \partial_2 X_{i,t})] LEV_{i,t} + \varepsilon_{i,t+1} \quad (4.4) \quad \text{Partly}$$

multiplying Equation (4.4) out, we obtain:

$$LEV_{i,t+1} = \alpha + \partial'_1 (GOV_{i,t} * LEV_{i,t}) + \partial'_2 (X_{i,t} * LEV_{i,t}) + (1 - \partial_0) LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1} \quad (4.5)$$

Where $\partial'_1 = -\partial_1$, $\partial'_2 = -\partial_2$. In Eq. (4.5), the impacts of corporate governance on SOA are represented in the interaction terms of corporate governance and the leverage, with the same magnitude but opposite sign. As system generalized method of moment (GMM) is able to control for firm fixed effects and potential endogeneity of independent variables (Blundell & Bond, 1998; Liao et al., 2015; Paudyal, Guney, & Antonious, 2002), we apply system GMM for Eq. (4.5).

4.4. Data and empirical results

4.4.1. Data

With regard to the context in Vietnam, most studies focused on publicly listed companies on the Ho Chi Minh (HOSE) and Hanoi stock exchanges (HNX) but ignored the unlisted public companies (UPCoM). UPCoM was established to motivate unlisted firms to join the stock market. At the end of 2016, UPCoM had the most significant number of traded firms among the three trading systems, and its market capitalisation accounts for 32.3% of the total capital market. Since UPCoM plays a crucial role in the development of the Vietnamese stock exchange market, this paper makes one of the first attempts to examine UPCoM to provide a comprehensive view of the stock market.

We chose the period from 200-2016 due to the availability of the data and the date of establishment of these stock markets. We followed Bauer, Frijns, Otten, and Tourani-Rad (2008) and Laing and Weir (1999) in excluding firms in the financial industries and regulated utilities because of their different financial features. In our sample, each firm was required to have at least two consecutive years of trading. We also restricted our database by excluding companies if large amounts of primary data were missing and if observations included an extreme value. Our final sample included 662 firms with 5,374 firm-year observations.

Table 4.2 presents the summary statistics of the variables in the model:

Table 4.2: Descriptive statistics of variables

Variable	N	Mean	SD	Min	Max
Leverage (LEV)	5,374	0.535	0.267	0.000	1.000
Board size (BSIZE)	5,374	5.144	1.616	0.000	13.000
Board independent (BIND)	5,374	0.596	0.201	0.000	1.000
CEO duality (DUALITY)	5,374	0.369	0.482	0.000	1.000
% Women (WOMEN)	5,374	0.137	0.165	0.000	1.000
Gender of CEO (GCEO)	5,374	0.221	0.348	0.000	1.000
Gender of Chairman (GCHAIR)	5,374	0.912	0.283	0.000	1.000
Board ownership (BO)	5,374	0.140	0.161	0.000	0.854
CEO and BOD ownership (CO)	5,374	0.132	0.250	0.000	1.000
Foreign ownership (FO)	5,374	0.060	0.111	0.000	1.000
Firm size (SIZE)	5,374	15.286	1.470	11.667	21.314
Tangibility (TANG)	5,374	0.196	0.196	0.000	0.976
Depreciation (DEP)	5,374	0.220	0.274	0.000	5.308
Profitability (PROFIT)	5,374	0.058	0.119	-3.842	0.993

This table presents the number of observations, mean, standard deviation, minimum and maximum of the variables (2000-2016).

The mean of capital structure in the firms was 0.535, which means the average ratio of debt in Vietnam is 53.5%, and the range of total leverage was from 26.7% to 100.0%. These ratios reveal that most Vietnamese firms are over-leveraged. They are similar to the ratios found in other developing countries; for instance, the leverage ratios in Sri Lanka and India are 43.1% and 60.3%, respectively (Buvanendra et al., 2017). However, the debt ratio in Vietnamese firms is much higher than in developed countries such as France (23.2%), Germany (19.9%), Japan (30.1%), and the UK (17.9%) (Antoniou et al., 2008). A plausible explanation links to the early stage of development of the stock market and the domination of the banking sector in Vietnam. Board size ranges from 5 to 13 in Vietnam; generally, the optimal board size depends on the firm's characteristics, monitoring costs and organisational complexity. With regard to gender diversity, female directors were only 13.7% of the total, and most CEOs and Chairpersons were male. Looking at board ownership structure, the average ownership of the board of directors and the amount of board of directors and CEO are 14.0% and 13.2%,

respectively. Also, the average of foreign ownership accounted for 6.0% of the total ownership; this is because of the limitation to 49% foreign ownership in some typical firms in Vietnam. Correlation coefficients are presented in Table 4.3, which shows that there are no problems with multicollinearity as the variables are not significantly correlated:

Table 4.3: Correlations among variables

Variable	LEV	BSIZE	BIND	DUALITY	WOMEN	GCEO	GCHAIR	BO	CO	FO	SIZE	TANG	DEP	PROFIT
LEV	1.000													
BSIZE	-0.007	1.000												
BIND	-0.151	0.102	1.000											
DUALITY	-0.016	-0.209	-0.339	1.000										
WOMEN	-0.174	0.043	-0.004	0.071	1.000									
GCEO	-0.160	-0.396	0.101	0.204	0.348	1.000								
GCHAIR	0.079	-0.003	-0.012	-0.011	-0.349	-0.214	1.000							
BO	0.024	-0.030	-0.086	0.058	0.015	0.007	0.034	1.000						
CO	-0.027	-0.627	-0.187	0.442	0.022	0.472	0.010	0.522	1.000					
FO	-0.118	0.218	0.053	-0.024	0.071	-0.007	-0.086	-0.048	-0.094	1.000				
SIZE	0.224	0.276	0.080	-0.085	-0.024	-0.066	-0.056	0.033	-0.115	0.230	1.000			
TANG	-0.006	0.000	-0.012	-0.031	-0.077	-0.008	0.045	0.081	0.071	-0.043	0.008	1.000		
DEP	-0.115	-0.091	-0.033	-0.062	-0.026	-0.053	0.020	0.066	0.074	-0.042	-0.193	0.434	1.000	
PROFIT	-0.481	0.051	-0.012	-0.009	0.059	0.039	-0.043	0.049	-0.018	0.109	-0.009	-0.021	0.018	1.000

From Table 4.3, we find that there are no problems with multicollinearity as the variables are not significantly correlated.

4.4.2 Empirical results

Table 4 presents the impacts of different corporate governance variables on the SOA of capital structure. The directions of these influences are shown by the opposite sign of the interaction term (*corporate governance * leverage*)

Table 4.4: The impact of corporate governance on the adjustment speed of the leverage

$$LEV_{i,t+1} = \alpha + \partial'_1(GOV_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Board size * Leverage (BSIZE _t * LEV _t)	-0.023***								
	(0.006)								
Board independent * Leverage (BIND _t * LEV _t)		-0.282**							
		(0.117)							
CEO duality * Leverage (DUALITY _t * LEV _t)			0.145***						
			0.040						
% Women * Leverage (WOMEN _t * LEV _t)				-0.380***					
				(0.095)					
Gender of CEO * Leverage (GCEO _t * LEV _t)					0.205**				
					(0.089)				
Gender of Chairman * Leverage (GCHAIR _t * LEV _t)						0.099**			
						(0.044)			
Board ownership * Leverage (BO _t * LEV _t)							-0.001**		
							(0.000)		
CEO ownership * Leverage (CO _t * LEV _t)								-0.077**	
								(0.036)	
Foreign ownership * Leverage (FO _t * LEV _t)									1.093***
									(0.065)
Observations	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of corporate governance variables on adjustment speed of capital structure .

Table 4.4 (continued)
The impact of corporate governance on the adjustment speed of the leverage
 $LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$

Leverage (LEV _t)	0.189 (0.432)	-0.199 (0.467)	0.483 (0.637)	0.843* (0.449)	0.460 (0.444)	0.949** (0.381)	0.463 (0.482)	1.409*** (0.378)	1.431*** (0.465)
Tangibility (TANG _t)	-0.002 (0.051)	-0.038 (0.085)	-0.387** (0.185)	0.088 (0.074)	0.092 (0.087)	0.070 (0.077)	0.102 (0.087)	0.010 (0.141)	-0.279 (0.197)
Depreciation (DEP _t)	-0.032 (0.039)	-0.076* (0.041)	-0.139 (0.117)	-0.010 (0.038)	-0.024 (0.038)	-0.044 (0.033)	-0.013 (0.038)	-0.082 (0.093)	-0.285*** (0.105)
Profitability (PROFIT _t)	-0.156** (0.068)	-0.118 (0.099)	-0.113 (0.085)	-0.026 (0.092)	-0.020 (0.105)	-0.020 (0.091)	0.005 (0.099)	-0.112 (0.077)	-0.688*** (0.095)
Firm size (SIZE _t)	-0.030* (0.017)	-0.039* (0.023)	-0.026 (0.023)	-0.009 (0.020)	-0.008 (0.022)	-0.009 (0.016)	-0.006 (0.021)	0.014 (0.017)	0.046** (0.019)
Tangibility * Leverage (TANG _t * LEV _t)	-0.020 (0.092)	0.016 (0.116)	0.428* (0.239)	-0.168 (0.103)	-0.164 (0.115)	-0.133 (0.126)	-0.165 (0.118)	0.016 (0.196)	0.692*** (0.267)
Depreciation * Leverage (DEP _t * LEV _t)	-0.027 (0.072)	0.113* (0.064)	0.162 (0.197)	-0.038 (0.059)	0.002 (0.059)	0.009 (0.060)	0.025 (0.059)	0.062 (0.151)	0.431** (0.185)
Profitability * Leverage (PROFIT _t * LEV _t)	0.016 (0.096)	0.018 (0.104)	-0.216 (0.193)	-0.064 (0.098)	-0.094 (0.107)	-0.091 (0.116)	-0.107 (0.102)	0.044 (0.168)	0.939*** (0.181)
Firm size * Leverage (SIZE _t * LEV _t)	0.046 (0.029)	0.053* (0.029)	0.015 (0.039)	0.005 (0.029)	0.013 (0.028)	-0.006 (0.024)	0.028 (0.031)	-0.040 (0.025)	-0.079*** (0.028)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table

For the relationship between board size and adjustment speed of capital structure, the coefficient of the interaction term is -0.023, which is significant at the 1% level and indicates a positive association between the number of directors in the board and the pace at which firms change their leverage to the optimal level. The results are consistent with our prediction; firms with more directors can access financing sources more cheaply due to the directors' networks.

Table 4.4 also shows that the proportion of independent directors on the board has a positive relationship with SOA. Generally, outside directors have some advantages over inside directors with regard to knowledge, information and networks. Also, there is an alignment of interest between outside directors and shareholders. Therefore, independent directors are likely to work for the wealth of the shareholders. As a result, firms with large numbers of independent directors have a faster speed of leverage adjustment, as these directors can help firms to find different sources and work efficiently for the shareholders' interests.

The coefficient of the interaction term (*CEO duality * leverage*) is 0.145 and significant at the 5% level, which indicates that CEO duality prevents firms from achieving optimal leverage and maximising value. When the chairman is also the CEO, there is a high concentration of power and less opportunity for outsiders to monitor the company's actions. Firms with duality problems are likely to have high agency costs; therefore, their SOA of leverage is slower than in firms with a separation between the CEO and the chairman. These results are also consistent with our hypothesis. Our finding is different from that of Liao, Mukherjee, and Wang (2015) who found an insignificant impact of CEO duality on SOA in the US market. Since the US possesses good national corporate governance quality because of its legal system, the rule of law, and protection rights, CEO duality issues can be alleviated; on the other hand, in Vietnam, which is a

transitional and emerging market, CEO duality does matter in a poorly-governed economy.

To investigate the relationship between gender diversity and the adjustment speed of capital structure, we used three variables: the proportion of female directors on the board, and dummy variables if the CEO and chairman were female. The results are consistent for the three variables. The interaction term (*% woman*leverage*) is negative and significant at the 1% level, and the dummy variables for the gender of the CEO and Chairman are positive and significant at the 5% level, which indicates a more gender-diverse board will enable better movement of leverage to the target. Our results are consistent with other studies that point out the advantages of gender diversity. Women can increase the efficiency of a board of directors, and their knowledge and skills in the areas of human resources, management, and communication are better than those of male directors.

Table 4.4 also shows a significant positive relationship between managerial ownership and SOA. We used two proxies to examine managerial ownership, including the ownership of the board of directors and the ownership of the board of directors and CEO. Firms with higher managerial ownership will display better financing decisions as managers are more responsible and work harder for the firms as their interests are aligned with those of the shareholders. Therefore, managerial ownership reduces agency costs and raises the SOA of capital structure.

Foreign ownership represents a negative link with the rate at which firms adjust their leverage to the optimal level. Due to the low transparency in emerging markets, foreign investors face problems related to geographical distance, country risks, and business risks, which prevent them from moving to the optimal leverage level. The results

are consistent with our predictions and support earlier studies relating to the difficulties that foreign investors face in emerging countries.

However, firms with high foreign ownership should be considered as having strong corporate governance, since foreign investors bring new capital, cutting-edge technology, research and development abilities, provide more information disclosure, and maintain strict control over managers' activities (Lindemanis, Loze, & Pajuste, 2019; Piscitello & Rabbiosi, 2005). In developed countries such as the US, firms with strong governance exhibit faster SOA than poorly governed ones; however, in an emerging market with high information asymmetry, and under-developed corporate governance, foreign-owned firms must deal with the difficulties of country risk, business risk, political risk and cultural barriers (Kogut, 1985).

Although all the variables have clear associations with SOA, the magnitudes of marginal influences are different. The most substantial influences are foreign ownership, followed by gender diversity and board independence. Managerial ownership and board size are shown to have weaker links with SOA.

4.5. Robustness test

4.5.1 Alternative measure of leverage

To check the results in Section 4 were robust, we conducted additional tests. The first test used an alternative measure of leverage. In particular, the outcomes in Section 4 were determined where leverage was measured by the market value. To determine the consistency of the outcomes, we used an alternative measurement of leverage as book value (total debt/book value of total asset) and re-ran Equation (4.5). The results are shown in Table 4.5.

Table 4.5: The impact of corporate governance on the adjustment speed of the book value of leverage

$$LEV_{i,t+1} = \alpha + \partial'_1(GOV_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Board size * Leverage (BSIZE _t * LEV _t)	-0.012**								
	(0.006)								
Board independent * Leverage (BIND _t * LEV _t)		0.301***							
		(0.112)							
CEO duality * Leverage (DUALITY _t * LEV _t)			0.178***						
			(0.044)						
% Women * Leverage (WOMEN _t * LEV _t)				-0.270***					
				(0.078)					
Gender of CEO * Leverage (GCEO _t * LEV _t)					0.157**				
					(0.07)				
Gender of Chairman * Leverage (GCHAIR _t * LEV _t)						0.150***			
						(0.045)			
Board ownership * Leverage (BO _t * LEV _t)							-0.300***		
							(0.099)		
CEO ownership * Leverage (CO _t * LEV _t)								-0.112**	
								(0.056)	
Foreign ownership * Leverage (FO _t * LEV _t)									0.302***
									(0.062)
Observations	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of corporate governance variables on adjustment speed of capital structure.

Table 4.5 (continued)
The impact of corporate governance on the adjustment speed of the book value of leverage

$$LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Leverage (LEV _t)	0.649*** (0.044)	0.631*** (0.058)	0.629*** (0.056)	0.843* (0.043)	0.625*** (0.059)	0.682*** (0.444)	0.743*** (0.069)	0.626*** (0.048)	0.675*** (0.038)
Tangibility (TANG _t)	-0.008 (0.042)	0.019 (0.079)	-0.269 (0.193)	-0.154*** (0.053)	0.079 (0.068)	-0.091 (0.069)	0.022 (0.069)	-0.073 (0.181)	0.070 (0.140)
Depreciation (DEP _t)	0.045* (0.024)	0.050 (0.034)	0.115 (0.124)	0.013 (0.022)	0.079** (0.033)	0.009 (0.021)	0.057* (0.031)	0.027 (0.103)	-0.065 (0.067)
Profitability (PROFIT _t)	0.041 (0.059)	0.040 (0.094)	-0.154 (0.116)	-0.183*** (0.062)	0.056 (0.084)	-0.012 (0.079)	-0.011 (0.084)	0.053 (0.085)	0.201** (0.097)
Firm size (SIZE _t)	0.009 (0.011)	0.053*** (0.015)	0.027** (0.013)	0.021*** (0.006)	0.061*** (0.015)	0.050*** (0.013)	0.049*** (0.013)	0.031** (0.012)	-0.001 (0.007)
Tangibility * Leverage (TANG _t * LEV _t)	-0.014 (0.074)	-0.065 (0.132)	0.314 (0.256)	0.222** (0.094)	-0.167* (0.098)	0.158 (0.101)	-0.043 (0.109)	0.058 (0.238)	-0.183 (0.219)
Depreciation * Leverage (DEP _t * LEV _t)	-0.070 (0.044)	0.061 (0.065)	-0.125 (0.192)	-0.009 (0.046)	-0.014 (0.061)	-0.053 (0.055)	0.024 (0.059)	0.042 (0.158)	0.002 (0.110)
Profitability * Leverage (PROFIT _t * LEV _t)	0.020 (0.092)	0.057 (0.137)	0.233 (0.157)	0.317*** (0.09)	0.024 (0.099)	0.174* (0.101)	0.146 (0.111)	0.014 (0.112)	-0.341** (0.174)
Firm size * Leverage (SIZE _t * LEV _t)	0.016*** (0.004)	-0.002 (0.006)	0.009* (0.005)	0.002 (0.002)	0.001 (0.006)	0.008 (0.006)	0.005 (0.005)	0.010** (0.005)	0.010*** (0.004)
Constant	-0.075 (0.160)	-0.748*** (0.234)	-0.275 (0.197)	-0.165** (0.083)	-0.883*** (0.221)	0.098*** (0.027)	-0.682*** (0.206)	-0.386** (0.183)	0.120 (0.106)
Observations	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of control variables on adjustment speed of capital structure

It can be seen from Table 4.5 that the results are consistent with Section 4.4, all the impacts are significant. More specifically, while the impacts of board size, board independence, gender diversity, managerial ownership are positive, CEO duality and foreign ownership reveal significant adverse influences on SOA.

4.5.2 Non-zero debt issuance firms

Cook, Kieschnick, and McCullough (2008) highlight the issues on the question of equivalence between the kind of financing choice (debt or equity) and the particular level of debt (the leverage ratio) in a sample. There is also a discrepancy between zero leverage and non-zero leverage in terms of financial constraints, financial flexibility, and the need for external financing (Devos, Dhillon, Jagannathan, & Krishnamurthy, 2012; Huang, Li, & Gao, 2017). Furthermore, the inclusion of zero-leverage firms can introduce bias in estimating the speed of leverage adjustment (Chang, Chou, & Huang, 2014). To examine the robustness of the findings in section 4, we removed the zero-debt issuance firms and re-estimated Eq. (4.5)

Table 4.6: The impact of corporate governance on the adjustment speed of non-zero debt issuance firms

$$LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Board size * Leverage (BSIZE t * LEVt)	-0.026*** (0.007)								
Board independent * Leverage (BIND t * LEVt)		-0.251** (0.118)							
CEO duality * Leverage (DUALITY t * LEVt)			0.124*** (0.034)						
% Women * Leverage (WOMEN t * LEVt)				-0.424*** (0.089)					
Gender of CEO * Leverage (GCEO t)					0.933*** (0.095)				
Gender of Chairman * Leverage (GCHAIR t * LEVt)						0.132*** (0.040)			
Board ownership * Leverage (BO t * LEVt)							-0.452*** (0.058)		
CEO ownership * Leverage (CO t * LEVt)								-0.158*** (0.010)	
Foreign ownership * Leverage (FO t * LEVt)									1.094*** (0.052)
Observations	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of corporate governance variables on adjustment speed of capital structure.

Table 4.6 (continued)
The impact of corporate governance on the adjustment speed of non-zero debt issuance firms

$$LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of control variables on adjustment

Leverage (LEV _t)	0.080 (0.533)	-0.671 (0.473)	0.629*** (0.056)	0.307 (0.455)	-0.934* (0.561)	-1.276*** (0.378)	0.743*** (0.069)	0.626*** (0.048)	0.675*** (0.038)
Tangibility (TANG _t)	0.005 (0.156)	-0.012 (0.086)	0.017 (0.137)	0.120 (0.076)	-0.420*** (0.057)	-0.442*** (0.050)	-0.505*** (0.054)	-0.467*** (0.051)	-0.551*** (0.056)
Depreciation (DEP _t)	-0.147 (0.112)	-0.075* (0.042)	-0.183* (0.106)	-0.007 (0.038)	-0.115*** (0.035)	-0.176*** (0.037)	-0.194*** (0.035)	-0.134*** (0.039)	-0.202*** (0.042)
Profitability (PROFIT _t)	-0.197** (0.089)	-0.105 (0.100)	-0.108 (0.078)	-0.002 (0.093)	-0.707*** (0.072)	-0.703*** (0.069)	-0.703*** (0.068)	-0.734*** (0.068)	-0.787*** (0.072)
Firm size (SIZE _t)	-0.014 (0.022)	-0.038* (0.023)	-0.013 (0.019)	-0.008 (0.020)	0.051*** (0.016)	-0.003 (0.015)	-0.004 (0.015)	0.028*** (0.007)	0.026** (0.011)
Tangibility * Leverage (TANG _t * LEV _t)	-0.017 (0.226)	-0.034 (0.119)	-0.004 (0.204)	-0.229** (0.105)	0.659*** (0.095)	0.660*** (0.088)	0.816*** (0.094)	0.770*** (0.089)	0.925*** (0.095)
Depreciation * Leverage (DEP _t * LEV _t)	0.194 (0.180)	0.149** (0.065)	0.230 (0.172)	0.001 (0.058)	0.214*** (0.069)	0.370*** (0.070)	0.375*** (0.068)	0.257*** (0.075)	0.368*** (0.083)
Profitability * Leverage (PROFIT _t * LEV _t)	0.046 (0.132)	-0.019 (0.105)	-0.033 (0.133)	-0.109 (0.099)	0.740*** (0.093)	0.823*** (0.111)	0.781*** (0.101)	0.741*** (0.089)	0.767*** (0.089)
Firm size * Leverage (SIZE _t * LEV _t)	0.048 (0.033)	0.084*** (0.029)	0.008 (0.032)	0.040 (0.029)	0.015 (0.032)	0.088*** (0.024)	0.068*** (0.025)	0.010 (0.009)	-0.005 (0.017)
Constant	0.415 (0.329)	0.720** (0.366)	0.374 (0.289)	0.197 (0.319)	-0.292 (0.244)	0.530** (0.224)	0.553** (0.230)	0.031 (0.103)	0.128 (0.170)
Observations	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

speed of *Note:* ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of control variables on adjustment speed of capital structure

Table 4.6 shows that our results with non-zero leverage firms are consistent with the findings in Section 4.4. That is, there are adverse effects of CEO duality and foreign ownership on the reversion rate of the leverage but positive influences from board size, board independence, gender diversity, and managerial ownership on SOA.

4.5.3 Publicly listed companies and unlisted public companies

In this section, we divided our sample into two groups: publicly listed companies and unlisted public companies; then, we re-ran Eq. (4) to investigate the effect of corporate governance on the SOA of capital structure. In Vietnam, we have two public stock exchange markets; the Ho Chi Minh stock exchange (HOSE) and the Hanoi stock exchange (HNX), and one Unlisted Public Company Market (UPCoM). Since the UPCoM trading system aims to encourage unlisted firms to join the stock market, stocks listed in this exchange are accessible to investors. However, the firms listed on UPCoM do not meet the specific requirements to list on HOSE and HNX. It was of interest to see whether the impacts of corporate governance on SOA were different or not between these stock exchanges.

Table 4.7: The impact of corporate governance on the adjustment speed of leverage for firms listed in UPCoM stock exchange

$$LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Board size * Leverage (BSIZE _t * LEV _t)	-0.011*** (0.002)								
Board independent * Leverage (BIND _t * LEV _t)		-0.080*** (0.160)							
CEO duality * Leverage (DUALITY _t * LEV _t)			0.031** (0.014)						
% Women * Leverage (WOMEN _t * LEV _t)				-0.758*** (0.143)					
Gender of CEO * Leverage (GCEO _t * LEV _t)					0.404*** (0.083)				
Gender of Chairman * Leverage (GCHAIR _t * LEV _t)						0.476*** (0.155)			
Board ownership * Leverage (BO _t * LEV _t)							-0.005*** (0.001)		
CEO ownership * Leverage (CO _t * LEV _t)								-0.058*** (0.017)	
Foreign ownership * Leverage (FO _t * LEV _t)									1.031*** (0.223)
Observations	525	525	525	525	525	525	525	525	525
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of corporate governance variables on adjustment speed of capital structure.

Table 4.7 (continued)
The impact of corporate governance on the adjustment speed of the book value of leverage in UPCoM stock exchange

$$LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Leverage (LEV _t)	2.160*** (0.556)	-0.748 (1.229)	1.415*** (0.516)	-3.070*** (0.939)	0.804 (0.548)	-0.076 (0.541)	0.978 (0.741)	1.927*** (0.562)	2.282*** (0.261)
Tangibility (TANG _t)	-0.271** (0.106)	-0.014 (0.262)	-0.166 (0.164)	-0.976*** (0.264)	-0.589*** (0.143)	-0.737*** (0.141)	0.166 (0.183)	-0.240** (0.113)	-0.141 (0.119)
Depreciation (DEP _t)	0.239*** (0.057)	-0.002 (0.087)	0.231*** (0.065)	-0.307*** (0.077)	-0.047 (0.065)	-0.121** (0.050)	0.133* (0.069)	0.215*** (0.053)	0.293*** (0.039)
Profitability (PROFIT _t)	-0.349 (0.219)	-0.378 (0.312)	-0.532** (0.256)	-0.841*** (0.286)	-0.238 (0.305)	-0.388 (0.302)	-0.561* (0.305)	-0.301 (0.221)	-0.467* (0.246)
Firm size (SIZE _t)	0.206*** (0.031)	0.095 (0.063)	0.185*** (0.031)	-0.066 (0.046)	0.145*** (0.033)	0.106*** (0.031)	0.218*** (0.039)	0.193*** (0.027)	0.219*** (0.025)
Tangibility * Leverage (TANG _t * LEV _t)	0.314** (0.130)	-0.133 (0.385)	0.192 (0.196)	1.109*** (0.336)	0.636*** (0.198)	0.884*** (0.186)	0.267 (0.268)	0.303** (0.136)	0.215 (0.147)
Depreciation * Leverage (DEP _t * LEV _t)	-0.211** (0.084)	0.424*** (0.154)	-0.152 (0.092)	0.351** (0.148)	0.174* (0.102)	0.190*** (0.063)	0.281*** (0.104)	-0.182** (0.092)	-0.298*** (0.048)
Profitability * Leverage (PROFIT _t * LEV _t)	0.055 (0.241)	0.123 (0.353)	0.282 (0.269)	0.763** (0.296)	-0.187 (0.357)	0.037 (0.343)	0.202 (0.344)	-0.013 (0.248)	0.234 (0.263)
Firm size * Leverage (SIZE _t * LEV _t)	-0.128*** (0.036)	0.070 (0.087)	-0.076** (0.033)	0.200*** (0.062)	-0.050 (0.034)	0.002 (0.035)	-0.042 (0.048)	-0.109*** (0.036)	-0.131*** (0.018)
Constant	-2.567*** (0.472)	-1.204 (0.884)	-2.260*** (0.481)	1.894*** (0.691)	-1.079** (0.512)	-1.285** (0.500)	-2.779*** (0.605)	-2.366*** (0.420)	-2.800*** (0.359)
Observations	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374	5,374
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of control variables on adjustment speed of capital structure

Table 4.8: The impact of corporate governance on the adjustment speed of leverage for firms listed in HOSE and HNX stock exchange

$$LEV_{i,t+1} = \alpha + \partial'_1(GOV_{i,t} * LEV_{i,t}) + \partial'_2(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Board size * Leverage (BSIZE _t * LEV _t)	-0.040*** (0.002)								
Board independent * Leverage (BIND _t * LEV _t)		-0.208*** (0.061)							
CEO duality * Leverage (DUALITY _t * LEV _t)			0.194*** (0.047)						
% Women * Leverage (WOMEN _t * LEV _t)				-1.107*** (0.054)					
Gender of CEO * Leverage (GCEO _t * LEV _t)					0.421*** (0.055)				
Gender of Chairman * Leverage (GCHAIR _t * LEV _t)						0.149*** (0.049)			
Board ownership * Leverage (BO _t * LEV _t)							-0.004*** (0.001)		
CEO ownership * Leverage (CO _t * LEV _t)								-0.360*** (0.019)	
Foreign ownership * Leverage (FO _t * LEV _t)									0.886*** (0.063)
Observations	5,022	5,022	5,022	5,022	5,022	5,022	5,022	5,022	5,022
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: ***Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level. This table shows the impact of corporate governance variables on adjustment speed of capital structure.

Table 4.8 (continued)
The impact of corporate governance on the adjustment speed of leverage in HOSE and HNX stock exchange

$$LEV_{i,t+1} = \alpha + \partial_1'(GOV_{i,t} * LEV_{i,t}) + \partial_2'(X_{i,t} * LEV_{i,t}) + (1 - \partial_0)LEV_{i,t} + \beta\delta X_{i,t} + \varepsilon_{i,t+1}$$

Leverage (LEV _t)	-1.014***	-1.054***	1.049**	-1.092***	-0.934*	-1.244***	-0.268	-0.053	-0.203
Tangibility (TANG _t)	-0.410***	-0.413***	-0.012	-0.449***	-0.358***	-0.428***	-0.463***	-0.423***	-0.487***
	(0.050)	(0.053)	(0.189)	(0.068)	(0.060)	(0.053)	(0.053)	(0.048)	(0.049)
Depreciation (DEP _t)	-0.203***	-0.216***	-0.140	-0.143***	-0.193***	-0.215***	-0.192***	-0.192***	-0.193***
	(0.035)	(0.032)	(0.128)	(0.055)	(0.039)	(0.031)	(0.032)	(0.037)	(0.038)
Profitability (PROFIT _t)	-0.811***	-0.804***	-0.080	-0.836***	-0.801***	-0.778***	-0.749***	-0.752***	-0.815***
	(0.074)	(0.069)	(0.109)	(0.079)	(0.082)	(0.069)	(0.067)	(0.069)	(0.067)
Firm size (SIZE _t)	-0.007	-0.010	-0.015	0.043***	0.057***	-0.011	0.007	0.007	0.013
	(0.015)	(0.014)	(0.019)	(0.013)	(0.014)	(0.013)	(0.016)	(0.016)	(0.016)
Tangibility * Leverage (TANG _t * LEV _t)	0.593***	0.617***	0.011	0.568***	0.520***	0.643***	0.755***	0.687***	0.782***
	(0.088)	(0.094)	(0.244)	(0.116)	(0.103)	(0.094)	(0.093)	(0.082)	(0.088)
Depreciation * Leverage (DEP _t * LEV _t)	0.426***	0.419***	0.162	0.261***	0.372***	0.420***	0.370***	0.362***	0.393***
	(0.068)	(0.061)	(0.207)	(0.091)	(0.071)	(0.062)	(0.065)	(0.068)	(0.075)
Profitability * Leverage (PROFIT _t * LEV _t)	1.208***	1.205***	-0.020	1.139***	1.123***	1.196***	1.177***	1.181***	1.208***
	(0.112)	(0.109)	(0.296)	(0.123)	(0.134)	(0.113)	(0.112)	(0.108)	(0.111)
Firm size * Leverage (SIZE _t * LEV _t)	0.064***	0.088***	-0.013	0.077***	0.037*	0.084***	0.034	0.019	0.019
	(0.023)	(0.023)	(0.029)	(0.020)	(0.022)	(0.019)	(0.022)	(0.022)	(0.027)
Constant	0.593***	0.639***	0.376	0.037	-0.758***	0.654***	0.351	0.342	0.282
	(0.221)	(0.214)	(0.288)	(0.193)	(0.216)	(0.203)	(0.249)	(0.239)	(0.243)
Observations	5,022	5,022	5,022	5,022	5,022	5,022	5,022	5,022	5,022
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4.7 and Table 4.8 show that the effects of corporate governance on SOA are consistent between publicly listed trading systems (HOSE and HNX) and the unlisted public trading system (UPCoM). The adverse influence of CEO duality and foreign ownership on SOA and the positive effects of board size, board independence and gender diversity support the findings in Section 4. In short, our results are robust for the two types of trading systems in Vietnam.

4.5.4 Sub-sampling approach

We applied a sub-sampling approach to examine the impacts of corporate governance variables on SOA as another robustness test. Specifically, we divided our sample into different groups depending on quartiles and corporate governance variables; then we followed the method of Dang, Kim, and Shin (2015) to apply bias-corrected LSDV (Least Square Dummy Variable) to estimate the leverage adjustment in each group²⁸. In our sample, we defined strong (weak) corporate governance while they used positive (negative) effects on SOA (Chang et al., 2014). The results are shown in Table 4.9.

²⁸ Everaert and Pozzi (2007) develop a bias-corrected FE estimator (BC) based on an iterative bootstrap that simulates the distribution of the FE estimator using the original (biased) FE estimates. This method then corrects the bias iteratively until unbiased estimates of the true parameters are found

Table 4.9: Speed of Adjustment in Partition Based on Governance

	Board size	Board independence	CEO duality	Gender diversity	Managerial ownership		Foreign ownership
					BOD ownership	BOD and CEO ownership	
SOA in Weak governance	0.389	0.412	0.334	0.462	0.427	0.515	0.488
SOA in Strong governance	0.625	0.492	0.445	0.513	0.448	0.606	0.358

Note: This table presents annual speed of leverage adjustment estimates for various sub-sample groups. For CEO duality, we divide the samples into 2 groups one with the CEO duality problem (weak corporate governance) and another without duality problems (strong corporate governance). For the board size, board independence, the proportion of female in the board of directors (gender diversity), managerial ownership and foreign ownership, we define the weak (strong) governance firms are those firms located in the highest (lowest) quartile.

Table 4.9 shows that the firms with strong corporate governance achieved faster SOA than those with weak corporate governance, except in the case of foreign ownership. This outcome is consistent with Section 4, which showed negative impacts of CEO duality and foreign ownership but positive influences of board size, board independence, gender diversity, and managerial ownership on SOA.

4.6 Conclusions

Over the last decade, the issues of gender diversity, foreign ownership, and managerial ownership have attracted considerable attention from researchers and mass media worldwide. However, the effect of these factors on the SOA of capital structure is largely unexplored in the literature. Additionally, most of the studies on the link between corporate governance and SOA have limited their focus to the US. Very few studies have explored this relationship in developing and transitional markets. Corporate governance in emerging markets plays a more important role because of such markets' weakness in terms of legal systems, the rule of law, and protection rights of shareholders and creditors. Therefore, this study aimed to extend the literature by examining the effects of gender diversity, foreign ownership, and managerial ownership in the context of Vietnam. To gain a comprehensive picture of the Vietnamese corporate governance mechanisms, we took into consideration the effect of other governance variables such as board size, board independence, and CEO duality on SOA.

Interestingly, our results showed significant impacts of all corporate governance mechanisms on SOA, which confirmed the crucial role of corporate governance mechanisms in developing countries in reducing agency costs and severe information asymmetry. This role is more pronounced in Vietnam, where corporate governance systems are underdeveloped and much lower than in other ASEAN countries. Our results are different from previous studies in developed markets from two perspectives. First,

foreign-owned firms are considered to provide good corporate governance and should exhibit faster SOA (Chang, Chou, & Huang, 2014). However, we found slow SOA in the Vietnamese market. Second, better-governed countries can reduce the CEO duality problem (Liao et al., 2015), resulting in no adverse influence on SOA, but in a weakly governed country like Vietnam, CEO duality has a negative influence on the speed of leverage adjustment. Depending on the features of each corporate governance mechanism, the impact on the speed of leverage adjustment can be positive for board size, board independence, gender diversity, and managerial ownership but negative for CEO duality and foreign ownership.

We offer some recommendations to enhance the efficiency of corporate governance mechanisms in making financial decision policies. First, it is important to promote gender diversity. The Vietnamese government should follow some European countries and introduce a binding quota (Sila et al., 2016), as the average proportion of female directors in Vietnam is relatively low at only 13.7%. Second, the adverse influence of foreign ownership on SOA indicates that foreign investors in Vietnam face significant information asymmetry and agency problems due to the separation between ownership and control. It is noteworthy that foreign investors are subject to a ceiling limit of a 49% holding in a specific firm in the Vietnamese stock exchange at the moment. The government should take some steps to attract foreign investment by reducing the restrictions; for instance, increasing the ownership limitations for foreign investors or giving them more favourable conditions for raising funds and operating in Vietnam. Third, to take advantage of managerial ownership, firms could consider some policies or promotional programmes to encourage managers to buy their firm's stock. Fourth, the positive effects of board size and board independence on SOA imply that networking, knowledge, and the experience of the board of directors are beneficial for firms' access

to external funding. Firms could apply this finding to determine suitable numbers of directors and the required qualifications, experience, knowledge, and skills of candidates for directors' positions. From the government's perspective, they should strictly monitor the borrowing and lending activities for firms that have a close relationship with banks and other financial institutions. The lesson learned in the collapse of Vinashin with an unpaid debt of over 6 billion USD should not be repeated. Last, firms should consider duality problems and create a divergence between ownership and control as they have an adverse influence on SOA.

Despite the contributions mentioned above, this study has some limitations. First, due to the available data, we focused on internal corporate governance mechanisms rather than external mechanisms. Further studies could investigate external governance factors such as audit reputation and audit committee size. Second, we understand that female directors have many good traits, such as knowledge, skills, experience, networks, and monitoring abilities, which are beneficial for firms. However, the particular characteristics that are important in financial decision making were not determined and could be explored in future studies. Third, due to some difficulties in estimating the SOA for each firm with regard to the econometrics method and the required number of observations, we ignored the potential marginal effects of SOA on corporate governance variables. Further studies could address this issue.

Chapter 5

Drought risk and capital structure dynamics

5.1 Introduction

While firm management (World Economic Forum, 2015) and various other stakeholders (Mercer, 2015; Eccles, Serafeim & Krzus, 2011; SEC, 2010), have shown a heightened interest in understanding climate risk, there is little research on how firms make adjustments to corporate policies when climate risk is eminent.²⁹ Motivated by significant concerns regarding the impact of climate risk on financial markets, this study examines how firms respond, in terms of speed of adjustment (SOA) of capital structure, to climate risk in the form of drought. As one of the major financing decisions, capital structure and the adjustment towards an optimal level has a bearing impact on the firm's value and the cost of capital (Harris & Raviv, 1991; Modigliani & Miller, 1958).³⁰

As the variation of risks are associated with costs, such as the relative expenses of external financing and the potential of distressed costs, and with other benefits, such as the expected value of tax shield and of leverage adjustment, risks are important determinants of the adjustment speed of capital structure (Baum, Caglayan, & Rashid, 2017). A large body of literature has focused on traditional types of risks such as bankruptcy risk, liquidity risk, default risk, crash risk, firm-specific risk and macroeconomic risk in examining the relationship between risks and SOA (Bokpin & Osei, 2010; Harris & Roark, 2018; Hatzinikolaou, Katsimbris, & Noulas, 2002; Kale,

²⁹ In 2015, global investment consultant Mercer (2015) identified climate risks as 'a significant source of portfolio risk for institutional investors to manage over the next 20 years'. Regulatory bodies are also concerned that market participants may not pay enough attention to climate risks and urge both voluntary and mandatory disclosures of firms' exposure to these risks (e.g., SEC 2010).

³⁰ The change in capital structure can trigger agency problems, which in turn increases firm risk. Firms, therefore, are likely to adjust their capital structure in response to risk and to control their overall risk level. The relationship between risk and capital structure is, however, inconsistent in the literature. This relationship can be positive, negative, or insignificant, depending on the types of risk being investigated by researchers (Bradley, Jarrell, & Kim, 1984; Carleton & Silberman, 1977; Ferri & Jones, 1979; Titman & Wessels, 1988; Toy, Stonehill, Remmers, Wright, & Beekhuisen, 1974).

Noe, & Ramirez, 1991). However, to the best of our knowledge, no studies have explored the possible link between climate risk and SOA. Accordingly, we make the first attempt to justify the effect of climate risk on SOA by considering drought risk, which is considered to be one of the most disastrous for the global economy (Hong, Li, & Xu, 2019; Lesk, Rowhani, & Ramankutty, 2016). In line with the view that business risks and financial distress risks emanate from the operating environment (Modigliani & Miller 1958, 1963), we expect that climate risk arising from the surrounding environment affects a firm's business risk and its capital structure.

We choose drought as the focus of our study in examining the SOA for individual firms for three reasons. First, of all the natural disasters related to climatic conditions, drought is considered the most common in the United States (Ding, Hayes, & Widhalm, 2011) and the most disastrous for economic activities (Hong, Li, & Xu, 2019; Lesk, Rowhani, & Ramankutty 2016; Stahl, Tallaksen, De Stefano & Vogt, 2016).³¹ Second, droughts are geographically widespread and can affect most regions on a random basis over time (Cook, Seager, Cane & Stahle, 2007). This offers a naturally unique setting where at the same point in time we can investigate firms with similar characteristics to determine their SOA but which differ only in their exposure to drought conditions. Any difference in SOA identified with drought conditions offers a strong causal interpretation. Third, Palmer (1965) provides a method to identify drought and quantify its severity, namely the Palmer Drought Severity Index (PDSI), which enables us to conveniently trace drought history and drought intensity across all states in the U.S.³²

³¹ According to Hong et al. (2019), among all natural disasters related to climate change, drought is viewed as the most disastrous for the global economy. Likewise, in their investigation of 2,800 disasters in 100 countries, Lesk et al. (2016) conclude that drought is the most destructive disaster for crop production. In a similar vein, Stahl, Tallaksen, De Stefano, and Vogt (2016) assert that drought is one of the most damaging natural hazards in Europe in terms of its effect on the social economic and environmental system.

³² This PDSI is the most popular data in climatology studies on drought (see, for example, Alley, 1984; Dai, 2011; Trenberth et al., 2014) and allows us to construct science-based definitions of drought intensity. It employs information on temperature and moisture in soil levels to derive an index that measures drought

To test the relation between drought and SOA, we first construct yearly PDSI index values for each state by averaging PDSI values for the particular state from the past 12 months for the fiscal year. Next, based on this 12-month average PDSI variable and the scientific establishment in the climatology literature, we create a dummy drought intensity variable indicating severe drought conditions as the most damaging to economic activities. We also follow the existing literature (Coval & Moskowitz, 1999; Ivkovic & Weisbenner, 2005; Pirinsky & Wang, 2006; Hilary & Hui, 2009; Korniotis & Kumar, 2013) and use a firm's headquarter location as a proxy for the firm's principal location, since it represents the core of the firm's business activities (Pirinsky & Wang, 2006; Chaney, Sraer, & Thesmar, 2012; Tuzel & Zhang, 2017).³³ The state of a firm's headquarter is used to determine if the firm is exposed to drought conditions in that particular state.

Using a fractional dependent estimator (DPF) approach and 130,511 U.S. firm-year observations over the period 1970-2015, we document an adverse and significant influence of drought on capital structure and the speed of leverage adjustment. Due to the significant impacts of climate risk on economic and social activities, banks take into consideration climate risk in their risk management strategies (Chen & Wang, 2012; Cogan, 2008). Moreover, the determinants of the banking industry are recognised as factors affecting firms' the leverage choice of firms as firms raise funds for their project through financial institutions such as banks. Therefore, climate risk is also considered as a determinant of capital structure. Similarly, as the risk affects gets involved with the costs and benefits of leverage adjustment, it is also considered as a factor in affecting

intensity in each station location. The data also allow researchers to compare the severity of drought across states or in a global setting on an equal footing basis (Dai, 2011).

³³ Chaney et al. (2012) document that 80% of firms that report real estate ownership in both COMPUSTAT and in their 10-K file have a substantial portion of properties in the states where their headquarters are located.

adjustment speed of capital structure. Our finding is plausibly intuitive because drought is considered as the most natural hazard resulting from climate change and drought in turn increases business risk. Furthermore, drought disrupts business activities and significantly raises operating costs. The uncertainty of future cash flow caused by drought leads firms to pay higher costs for the borrowing fees. Therefore, a firm is likely to reduce the debt level to mitigate the overall risk. In addition, because operating costs and transaction fees are part of adjustment costs, drought causes a slower speed of leverage adjustment. Our results are robust for different measurement of leverage, drought and by OLS and fixed-effects approach. We also disclose the spill over effect of drought on capital structure and SOA in non-food industry. As the consequences of climate risk, local and national levels of the consumption of local as well as national may decrease, which in turn reduces the revenues of firms in both food and non-food industries. Therefore, the drought risk at the state level can be considered as the local systematic risk, which results affects in the influence on both food and non-food industries.

Our study makes four significant contributions to the extant literature in climate finance. First, while there is virtually no disagreement among researchers that climate change poses substantial costs to the economy (e.g., Burke, Hsiang, & Miguel, 2015; Dietz, Bowen, Dixon, & Gradwell, 2016; Lesk et al., 2016), the impact of climate change in the form of drought on individual firms has yet to be well researched.³⁴ An important issue for business risk assessment now is what exactly these costs are, how to measure them, and how to address them. As firms are likely to change their leverage in response

³⁴ There have also been considerable concerns expressed by investors, regulators, standard-setters, and the community at large about the impact of climate related risk on firms. The issue of whether climate related risk poses material impact on firms and to what extent has, however, largely remained unexplored. Our study joins an emerging body of literature reporting on the material impacts of climate risk on firms (Berkman, Jona, Lim, & Soderstrom 2017; Truong, Nguyen, & Huynh, 2017; Matsumura, Prakash, & Vera-Munoz, 2014). Recent efforts from the banking industry also identify the impact of drought on loan portfolios and highlight that drought risk could be a significant source of tail risks for banks (Gesekkaft fur Internationale Zusammenarbeit, 2017).

to risk, we expect firms to make adjustments of capital structure to deal with drought risk.³⁵ In this study, we document strong evidence that drought places significant impacts on capital structure. We also highlight the impact of drought on the adjustment speed of capital structure. Because drought disrupts business activities, thereby raising operating costs, drought prevents firms from quickly achieving the target leverage to maximise firm value.

Second, while the extant literature documents the impact of drought, mostly in food and agriculture industries (Blackhurst, Hendrickson, & Sels, 2010; Hong et al., 2019; Lesk et al., 2016), we report evidence of the spill over effect of drought on non-food industry firms. This empirical finding challenges a common perception that the effects of drought, if there are any, would be trivial or almost non-existent among non-agricultural industries. However, we demonstrate that this is not the case because of important interconnections between firms and sectors in the economy (Acemoglu, Ozdaglar & Tahbaz-Salehi, 2010; Acemoglu, Carvalho, Ozdaglar & Tahbaz-Salehi, 2012). Our finding is consistent with the key message from the report of the World Economic Forum (2015) that drought is considered as the most risky natural disaster as it damages a wide range of industries in the next ten years.

Last, our firm-level examination takes advantage of the heterogeneity in corporate policies and allows us to draw implications for managers as to how firms can palpably address climate risks in general and drought risk in particular. Specifically, we find the role of cash flow and financial unconstrained factors as effective in mitigating

³⁵ Despite widespread discussion on the impact of firm-specific risk and macroeconomic risk on capital structure, the literature has been largely silent on the effects of climate risk on capital structure. For instance, Chen and Wang (2012) consider Kyoto ratification as a proxy for climate risk and indicate an inverse relationship between climate risk and capital structure. Although drought risk plays an important role and has a huge impact on the social and economic environment, no studies have been conducted to review its effect on capital structure. Therefore, this study occupies a significant gap to examine the impact of drought on capital structure.

the negative impact of drought on capital structure and the speed of leverage adjustment. This evidence, together with policies encouraging the disclosure of corporate exposure to climate risk (e.g., SEC, 2010), point toward measurable effectiveness of corporate climate related policies.

The remainder of the paper is organised as follows. Section 2 reviews the literature and Section 3 develops the research hypotheses. Section 4 explains the data and research method. Section 5 shows the empirical results. Section 6 presents the findings of the robustness tests. Section 7 represents the role of cash flow and financial unconstrained factors. Finally, Section 8 summarises the study, offering conclusions and policy implications.

5.2. Literature review

5.2.1 Drought risk

Climate change causes several natural disasters, such as drought, heat waves, floods, and cold spells. Among these disasters, drought is considered as the most disastrous for the global economy (Hong et al., 2019). Lesk et al. (2016) examine a list of 2,800 weather disasters in 100 countries and conclude that drought is the most damaging to crop production. Drought reduces a nation's crop production by 10%, followed by heat waves (at 9%) while floods and cold spells show no significant effects on agriculture production. The income losses and reduction in GDP are recorded at 20% and 1.6% respectively in Australia due to the impact of drought between 2002 and 2003 (Horridge, Madden, & Wittwer, 2005). Iglesias, Báez, and Diaz-Ambrona (2016) document an increase in economic losses at an escalating rate when long-lasting droughts hit. Moreover, while economic losses associated with drought often take place with a delay of 3 to 4 weeks, these losses can last for a long period. Stahl et al. (2016) conclude that drought is one of the most significant natural hazards in Europe because drought has

a very diverse impact on social economic and environmental systems. In this vein, Kevin et al. (2013) evidence a clear impact of drought on a firm's profit. Additionally, drought is different from other natural disasters in that it is geographically widespread and influences most regions on a random basis over time (Li, Chen, Cook, Gou, & Zhang, 2007).

Although the term drought is widely used, there is no single and universal definition for this natural hazard. Depending on how it is being used, the term can refer to a range of concepts. Overall, there are four types of drought: meteorological, hydrological, agricultural, and socioeconomic³⁶ (American Meteorological Society, 1997). Drought measures are equally diverse and some can be used in combination with others. For instance, in the U.S., drought indices consist of the Palmer Drought Severity Index, the Standardized Precipitation Index, the Crop Moisture Index, the Surface Water Supply Index, and the United States Drought Monitor (Heim, 2002).

As economic activities in the agriculture and food industries are reliant on water supply, these industries are directly impacted by drought (Blackhurst et al., 2010; Hong, Lim, & Stein, 2000; Lesk et al., 2016). According to a report from the World Economic Forum (2015), water crises are considered as the foremost natural disaster risk in terms of economic impact since they are damaging to a wide range of industries over the next ten years. Likewise, Bansal, Ochoa, and Kiku (2016) imply an inverse relationship between global warming and global assets' value due to the elasticity of equity prices to temperature changes. Since drought is one of the principal causes of water crises and global warming, it is more likely to have some impact on individual firms. Additionally,

³⁶ Meteorological drought takes place when there is a lack of rainfall over a long period. Hydrological drought is described by a lack of access to surface water. Agricultural drought is defined as a shortage of water in the soil to support plant growth and livestock. Socioeconomic drought exists when human activities are influenced by drought.

from the agency theory perspectives, the use of debt can alleviate agency costs by reducing the free cash flow available at the discretion of managers. Empirical studies also evidence the association between cash flow shock and capital structure. For instance, Harris and Roark (2018) document that as a consequence of cash flow risk, firms with poor performance are likely to employ more debt. Similarly, Keefe, Amp, Apos, Connor, and Yaghoubi (2016) conclude a significant negative effect of cash flow volatility on capital structure. As one disaster of climate risk, drought, which is related to the uncertainty of future cash flows, should directly affect capital structure. Despite the extensive discussion on the influence of drought at an industry level, the literature has been largely silent about this effect on individual firms, especially for those outside of the agriculture and food industry. Therefore, we fill the gap in the literature to disclose the impact of drought on individual firms.

5.2.2 Capital structure and risk

Capital structure, which refers to different combinations of debt and equity, is one of the most important financial decisions that firms make. Modigliani and Miller (M&M) offer the first theory of capital structure, including two provisions: M&M theory without taxes (1958) and M&M theory with corporate and personal taxes (1963). Following the introduction of this seminal theory, direct tests have investigated the impact of capital structure changes on stock price movement (Boness, Chen, & Jatusipitak, 1974; Masulis, 1980) and cross-sectional tests are conducted on the relationship between business risk and leverage which M&M theory does not predict (Ferri & Jones, 1979; Flath & Knoeber, 1980). Therefore, climate risk, which is closely related to business risk, may have a potential effect on the leverage. Several studies have empirically examined the determinants of capital structure. A common notion in the literature is that certain important firm-specific factors affect leverage. These include a firm's growth, the

collateral value of an asset, earnings volatility, and firm size (Gupta & Sapienza, 1992; Kjellman & Hansén, 1995; Taub, 1975). In more recent literature, several studies have documented new determinants, such as corruption³⁷ (Baxamusa & Jalal, 2014), ownership structure (Li, Feng, Lu, & Song, 2015)³⁸, and the gender of the managers (Hernandez-Nicolas, Martín-Ugedo, & Mínguez-Vera, 2015)³⁹.

Moreover, the effect of risk on capital structure is also implied by several theories. According to agency theory (Haugen & Senbet, 1988), debt can be employed as a tool to prevent the managers' incentives of taking the free cash flow for their own interests. Since risk is associated with the uncertainty of future cash flow, it is more likely to have a clear impact on debt level. According to trade-off theory, firms increase debt when the benefits of issuing debt outweigh the costs. Given that risk is positively correlated with the cost of debt (Chen & Gao, 2012), risk should be included within the leverage ratio. In pecking order theory, information asymmetry means that firms prefer internal sources over external sources and use equity as the last resort. Risk is likely to increase information asymmetry because with high risk, stock price becomes less informative (Grossman & Stiglitz, 1980). Therefore, in pecking order prediction, risk resulting in a more serious information asymmetry should exert an effect on the leverage ratio. As previously mentioned, drought, which is considered one of the most destructive disasters, should have the same features of other risks, such as getting involved with uncertain future cash flow, increasing the costs of debt, and leading the information asymmetry to become more

³⁷ Baxamusa and Jalal (2014) find a non-linear relationship between corruption and capital structure. They highlight that a lower corruption level can reduce the costs of debt and equity.

³⁸ Li et al. (2015) investigate the impact of state-owned shares, legal-person shares, and tradable shares on capital structure.

³⁹ Hernandez-Nicolas et al. (2015) conclude that firms run by women and groups with gender diversity are likely to maintain a lower debt level.

serious. All three theories indicate that drought is likely to have an effect on capital structure.

Empirical studies consider different types of risk as the determinants of capital structure. For instance, Kale, Noe, and Ramirez (1991) reaffirm that business risk is one of the main factors to determine capital structure and they document a U-shaped relationship between optimal debt level and business risk. Bokpin and Osei (2010) conclude that managers adjust capital structure differently in response to business risk and financial risk. Specifically, managers reduce or increase debt ratio to control the business risk (or financial risk). Harris and Roark (2018) investigate the relationship between cash flow risk and capital structure and find that this relationship is conditional depending on financial performance. For firms with the poorest performance, higher cash flow risk results in the usage of more debt, whereas, for firms with the strongest financial performance, the linkage between cash flow risk and capital structure is insignificant. Hatzinikolaou, Katsimbris, and Noulas (2002) consider risks at the macroeconomic level by examining the impact of inflation risk on capital structure. They conclude a negative correlation between inflation uncertainty and the debt ratio. Likewise, Baum, Chakraborty, and Liu (2010) highlight the impacts of macroeconomic risks in combination with corporate governance on capital structure. Particularly, since firms with good corporate governance have less constrained credit than those with poor-governed counterparts, and strongly-governed firms are easier to manage, they are likely to take more risks. Hence, firms with better corporate governance will increase more debt financing than those with weak corporate governance in response to macroeconomic risks. Furthermore, Chen (2010) applies a dynamic capital structure model to investigate the impact of macroeconomic risks on financing policies. Particularly, macroeconomic risks reduce the value of expected tax benefits; therefore, firms decrease the leverage as the tax

benefits lessen during recessions. In a recent study, Dierker, Lee, and Seo (2019) apply different variables to measure risk⁴⁰ and conclude that firms are more likely to issue equity (or debt) when the risk increases (or decreases).

A handful of studies have gone beyond an examination of traditional risks to investigate the impact of external risk on capital structure. For instance, Voulgaris, Asteriou, and Agiomirgianakis (2002) explore the competition risk on capital structure for large size firms in the manufacturing sector during the accession of Greece to the EU. They find that firms need to improve their capital structure by achieving higher asset utilisation and profit margins to prepare for a higher level of competition. Ulph and Valentini (2004) document the impact of environment risk on capital structure. They find that when the environmental liability is imposed on firms, firms increase bank borrowing by 15-20%. In a similar vein, Chen and Wang (2012) examine the impact of climate risk on capital structure by investigating the influence of Kyoto ratification on firms in 45 countries from 2002 to 2007. They find that firms in ratifying countries are likely to use less debt than those in non-ratifying countries due to the risks and the costs associated with the changes required to become eco-friendly businesses.

Overall, the relationship between risk and capital structure can be either positive or negative, depending on the different types of risk. More specifically, the risk proxies are embedded in business risk, financial risk, macroeconomic risk, and environmental risk. Although drought is considered as one of the most disastrous for the global economy (Hong et al., 2019; Lesk et al., 2016), the existing literature has been mostly silent on the impact of drought on capital structure; therefore, this paper fills the gap by investigating this relationship.

⁴⁰ Dierker et al. (2019) apply stock return volatility, default risk, implied asset volatility, and adjusted Ohlson (1980) scores to investigate the risk.

5.2.3 Speed of adjustment of capital structure and risk

According to trade-off theory (Myers, 1984), firms can achieve target capital structure when they balance between the benefits and drawbacks of issuing debt. In a qualitative study, Graham and Harvey (2001) find support for this contention and document that 81% of firms in their survey sample aim to achieve a target debt ratio. Given that there exists a level of optimal leverage, recent studies have turned their attention to examine how fast firms adjust their leverage to the desired level of capital structure. Due to the presence of adjustment costs, firms may temporarily deviate from the target capital structure and change their leverage into optimal level only when the benefits outweigh the costs of adjustment. Certain firm-specific characteristics serving as the determinants of SOA include tangibility, firm size, growth opportunity, profitability, distance between observed and target as well as macroeconomic factors (term spread, growth in GDP, inflation) (Antoniou, Guney, & Paudyal, 2008; Dang, Kim, & Shin, 2015; Drobetz & Wanzenried, 2006; Öztekin & Flannery, 2012).

As the changes of risks are associated with the costs and benefits of rebalancing capital structure, few studies have discovered the impact of risks on the adjustment speed toward the firm's target leverage. For instance, Dang, Kim, and Shin (2012) employ the threshold partial adjustment model and show that over-levered firms adjust SOA faster to limit the potentially large financial distress costs when they face bankruptcy and liquidity risks. These outcomes are also consistent with those reported in He and Kyaw (2018) who apply Altman's Z score as a proxy for bankruptcy risk. Likewise, Elsas and Florysiak (2011) use a sample of 16,357 firms in the U.S. from 1965-2009 to analyse the impact of default risk on SOA. They demonstrate that the SOA of firms in the group of highest

default risk exhibit the fastest of leverage adjustment at 51%, which is around two times quicker than the SOA of average firms (26%).⁴¹

Furthermore, An, Li, and Yu (2015) examine the relationship between crash risk and SOA and highlight that firms with higher crash-risk are likely to adjust the leverage slower due to the extreme information asymmetry between inside managers and outside investors⁴². Additionally, Baum et al. (2017) explore the impact of firm-specific risk and macroeconomic risk on SOA for manufacturing firms listed on the London Stock Exchange from 1981 to 2009. They construct firm-specific risk and macroeconomic risk based on the firms' sales data and the conditional variance of UK real GDP. Interestingly, the rapid adjustment speed can be attained in two scenarios. The first is for the over-levered firms with financial surpluses when firm-specific risk is low, but the macroeconomic risk is high. The second is for under-levered firms with financial deficit while both risks are low.

In summary, although several studies have investigated the impact of risk on capital structure, there is little attention on the effects of risk on the adjustment speed toward the firm's optimal leverage. So far, most studies examining the linkage between SOA and risk focus on the traditional types of risk such as bankruptcy risk, liquidity risk, default risk, crash risk, firm-specific risk and macroeconomic risk, but none have examined climate risk. This is despite the fact that climate risks such as drought, flood, storms and sea level rises lead to substantial financial losses. For insured assets, they badly affect the insurance firms, and for uninsured assets, they reduce the value of the physical assets (Batten, 2018). Moreover, according to Chen and Gao (2012), climate risks are associated with uncertainty of future cash-flows and information which in turn

⁴¹ Elsas and Florysiak (2011) determine the firms with the highest default risk to be those that have credit rating in the group ('CCC+ to D').

⁴² An et al. (2015) apply crash risk as a proxy to consider the impact of extreme information asymmetry.

impact on firm value. Although a few studies have investigated the impact on environment risk on capital structure (Chen & Wang, 2012; Ulph & Valentini, 2004), none of them have examined the effect of climate risk on SOA. As one important manifestation of climate risk, drought poses potentially major effects on economic activities. In this study, we fill the gap in the literature to scrutinise the impacts of drought on the speed of leverage adjustment.

5.3 Hypothesis development

As the financing policy has a bearing on firm value and the cost of capital (Harris & Raviv, 1991; Modigliani & Miller, 1958), firms are likely to adjust their capital structure to sustain the business in response to risk. However, there is strong disagreement on the direction of the effect of business risk on capital structure. Specifically, some studies indicate a positive relationship (Bradley, Jarrell, & Kim, 1984; Carleton & Silberman, 1977), while another asserts a negative effect (Toy, Stonehill, Remmers, Wright, & Beekhuisen, 1974). On the other hand, according to Ferri and Jones (1979) and Titman and Wessels (1988), there is no significant relationship between business risk and capital structure.

Due to the significant impacts of climate risk on economic and social activities, banks take into consideration climate risk in their risk management strategies⁴³ (Chen & Wang, 2012; Cogan, 2008). Moreover, the determinants of the banking industry are recognised as factors affecting the leverage choice of firms as they raise funds for their project through financial institutions such as banks. Therefore, climate risk is also considered a determinant of capital structure. As drought is seen as the most disastrous out of all-natural disasters resulting from climate change, which in turn leads to the

⁴³ According to Cogan (2008), the 40 largest banks in the world have come to an agreement to offer favourable lending rates for firms that apply environmental management technology in their production. Conversely, the banks have also decided to limit lending to industries that generate high pollution.

increase in business risk, firms should reduce leverage to mitigate their overall risk levels. Furthermore, the business risk is generally associated with increased operating costs and the uncertainty of profitability; firms should lower the debt level to reduce their earnings volatility and to protect their investments. Additionally, lending costs tend to increase since banks adopt the lending policies and strategies designed to deal with climate risk; these result in lower borrowing level. For these reasons, we have the following hypothesis:

Hypothesis 1: There is a negative impact of drought on leverage level.

As the risk affects the costs and benefits of leverage adjustment, it is also considered a factor in affecting adjustment speed of capital structure. However, the effects of risk on SOA are also informed by different types of risk. For instance, while Elsas and Florysiak (2011) indicate a positive relationship between SOA and the default risk, An et al. (2015) evidence a negative impact of crash-risk exposure on SOA. Furthermore, Baum et al. (2017) show that firms change the speed of leverage adjustment differently to firm-specific and macroeconomic risks, depending on their financial performance and the actual leverage -- whether it is below or above the target level.

The influence of climate risk on firm value has been analysed from two different angles, one related to the uncertainty of future cash flow and the other with information uncertainty (Chen & Gao, 2012). Notably, the change of future cash flow comes from the required costs to comply with regulation, the legislation of unpredictable events. Moreover, the potential shifts in supply and demand, and the changes in prices of products and services also have an influence on future cash flow (Clarkson, Li, & Richardson, 2004; Cormier, Magnan, & Morard, 1993; Garber & Hammitt, 1998). The information uncertainty arises from the dispersion of investors' predictions for firm performance, which potentially discounts the firm value further (Francis, LaFond, Olsson, & Schipper, 2004).

We apply drought as a proxy to represent climate risk and investigate its impact on SOA. Since drought has a tremendous economic impact on a wide range of industries for an extended period of time (World Economic Forum, 2015), it leads to an increase in the costs of business operations and disruptions to business activities. For banks, drought risk leads to higher costs in terms of the uncertainty of future cash flow, and the agreement and the action needed to deal with climate risks, all of which raise the lending rate and transaction fees. From the viewpoint of firms, drought disrupts business activities and increases the operating costs; moreover, the uncertainty of future cash flow and information are likely to compel firms to pay higher transaction costs for their funding. Since the speed of adjustment depends on the adjustment costs, in this case, the transaction costs, we propose the following hypothesis:

Hypothesis 2: There is a negative impact of drought on the speed of adjustment of capital structure.

5.4. Data and econometric models

5.4.1 Data

The data in this paper originates from two main data sources. The firm's characteristics are from Merge CRSP Compustat database, and the drought risk proxy Palmer Drought Severity Index (PDSI) is obtained from the National Centres for Environmental Information (NCEI) of the U.S. National Oceanic and Atmospheric Administration (NOAA).

We employ the Palmer Drought Severity Index (PDSI) to construct drought measures. Although several drought proxies have been applied to identify drought, PDSI is the most popular measurement in the U.S. (Dai, 2015). This index was created initially by Palmer (1965) to estimate the severity and frequency of abnormally dry periods. PDSI is standardised and changes between -10 and +10 with a lower PDSI representing a more

serve drought. More specifically, when PDSI is less than -4, it indicates an extreme drought condition. If it is in the range from -4 to -3, it is a severe drought. If the PDSI is between -3 and -2, it indicates a moderate drought. A PDSI of -2 to -1 implies a mild drought while -1 to -0.5 suggests an incipient drought.

As a firm's headquarters describes its principal business activities (Chaney, Sraer, & Thesmar, 2012; Pirinsky & Wang, 2006), we follow Coval and Moskowitz (1999) and Ivković and Weisbenner (2007) to consider the firm's location as the location of its headquarters. More specifically, Chaney et al. (2012) assert that headquarters and firms' essential production plants are likely to cluster in the same state. Similarly, Ivković and Weisbenner (2007) reveal that firms tend to have larger real estate ownership in the same state of their headquarters and propose that a firm's headquarters location is a reasonable proxy for the area of its business activities. We assert the state location of firms headquarter to see whether a firm is tolerated to drought.

Based on the PDSI of the state location of the firm's headquarters, we construct two drought measures. The first is *Drought*, a categorical variable generated from a 12-month average of state-level PDSI. The variables *Drought* can take four possible values illustrating the different level of drought intensity. More specifically, if the average PDSI is greater than -2, then *Drought* takes the value of 1, implying non-drought or mild drought conditions. For average PDSI values which are more than -3 and equal or less than -2, *Drought* takes the value of 2, suggesting moderate drought conditions. If it is between -4 and -3, *Drought* is equal to 3 implying severe drought conditions. Finally, if the value of PDSI is equal to or less than -4, then *Drought* takes a value of 4, indicating extreme drought conditions. The second measure is a dummy drought variable: *Sev_Drought*. This variable presents two possible drought outcomes in the state where a

firm's headquarters is located. The *Sev_Drought* takes the value of 1 when PDSI is equal or less than -3, implying severe drought conditions, and zero otherwise.

For the firm's characteristics, we exclude data for firms in the financial industries (SIC codes 6000-6999) and regulated utilities (SIC codes 4900-4999) (Bauer, Frijns, Otten, & Tourani-Rad, 2008; Dittmar & Mahrt-Smith, 2007; Laing & Weir, 1999; Ukaegbu & Oino, 2014). To mitigate the influence of outliers and misreported data, we winsorise all variables at the 1st and 99th percentile. We then merged the financial data with the drought data. From these exclusions, we ended up with the final sample of 130,511 firm-year observation from 1970 to 2015.

5.4.2 The impact of drought on capital structure

To determine whether drought affects capital structure, we model leverage as a function of drought and firm-specific factors. Dummy variables are included to control the impact of year and industry.

$$LEV_{i,t+1} = \alpha + \delta \cdot Drought_{i,t} + \beta X_{i,t} + \varepsilon_{i,t} \quad (5.1)$$

Where $LEV_{i,t+1}$ refers to a firm's leverage, proxy *Drought* is measured by drought (*DRO*) and severe drought (*SEV_DRO*). *X* is a set of explanatory variables which are identified as the key determinants of capital structure by trade-off theory and by some empirical studies (Antoniou et al., 2008; Hovakimian & Li, 2011; Liao, Mukherjee, & Wang, 2015). These key determinants include firm size (*SIZE*), asset tangibility (*TANG*), market to book ratio (*M/B*), research and development expense (*R&D*), research and development indicator (*R&D_IND*), depreciation and amortisation (*DEP*), industry median debt ratio (*MED*) and operating income before depreciation (*PROFIT*).

Table 5.1 provides a list of variable definitions.

Table 5.1: Definition of leverage and explanatory variables for leverage

Variables	Definitions
<i>Dependent variables</i>	
Total leverage (LEV)	Total debt/The sum of market equity and debt
<i>Independent variables</i>	
Drought (DRO)	Derived from 12-month average state-level PDSI
Sev_Drought (SEV_DRO)	Take value of 1 when average state-level PDSI is equal or smaller than -3, and zero otherwise
Firm size (SIZE)	The natural logarithm of total assets
Tangibility (TANG)	Property, plant, and equipment as a proportion of total assets (fixed assets)
Market-to-book ratio (M/B)	(Book debt + Market equity)/Total assets
Research and development expenses (R&D)	Research and development expenses scaled by total assets
R&D indicator (R&D_IND)	Missing values of R&D are replaced with zeroes. One for firms with non-missing R&D
Depreciation (DEP)	Depreciation divided by total assets
Industry Median debt ratio (MED)	Industry is defined based on the four digit SIC
Profitability (PROFIT)	The ratio of earnings before interest and tax to total assets

We follow Elsas and Florysiak (2015) and Dang et al. (2015) to apply a fractional dependent variable (DPF estimator) for Eq. (5.1) for three reasons. First, the panel data in our sample are unbalanced. Second, the leverage is a ratio bounded by 0 and 1. Third, Elsas and Florysiak (2011) prove the robustness of the DPF estimator for simulation across the different time dimensions of panel data.

5.4.3 The impact of drought on adjustment speed of capital structure

We follow Faulkender, Flannery, Hankins, and Smith (2012) and Antoniou et al. (2008) to apply the partial adjustment model, where target leverage of firm i at time $t+1$ is determined by a vector of firm characteristics $X_{i,t}$ that are associated with the costs and benefits of debt regarding trade-off theory.

$$LEV_{i,t+1}^* = \alpha + \beta X_{i,t} \quad (5.2)$$

Where $LEV_{i,t+1}^*$ denotes the firm's predicted target leverage, and $X_{i,t}$ consists of firm size ($SIZE$), asset tangibility ($TANG$), market to book ratio (M/B), research and development expense ($R\&D$), research and development indicator ($R\&D_IND$),

depreciation and amortisation (*DEP*), industry median debt ratio (*MED*) and operating income before depreciation (*PROFIT*).

The partial adjustment model takes on the form below (Fama & French, 2002; Kayhan & Titman, 2007)

$$LEV_{i,t+1} - LEV_{i,t} = \delta(LEV_{i,t+1}^* - LEV_{i,t}) + \varepsilon_{i,t} \quad (5.3)$$

Where $LEV_{i,t}$ and $LEV_{i,t+1}^*$ represents the firm's achieved and target leverage levels, and δ is the SOA of leverage towards its optimal level. When $SOA = 1$, firms fully adjust to the optimal level, whereas when $SOA < 1$, the presence of adjustment costs prevent the speed of capital structure adjustments towards the target.⁴⁴

We examine the effect of drought on SOA by modifying Eq. (5.3) to allow for drought and other factors affecting SOA as follows:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t}) D_{i,t} + \varepsilon_{i,t} \quad (5.4)$$

Where $\Delta L_{i,t+1}$ is the change in leverage, $LEV_{i,t+1} - LEV_{i,t}$; $D_{i,t}$ is the leverage deviation, $LEV_{i,t+1}^* - LEV_{i,t}$; and $C_{i,t}$ is a set of control variables including the firm's characteristics⁴⁵ (Öztekin & Flannery, 2012), and the absolute value of leverage deviation⁴⁶ (Mukherjee & Wang, 2013).

As the leverage is a ratio bounded by 0 and 1, we argue that the change in leverage ($\Delta L_{i,t+1}$) value is also between 0 and 1. Therefore, we employ a fractional dependent variable (DPF estimator) for Eq. (5.4) as it controls for unobserved heterogeneity, unbalanced panel data, and a bounded ratio (Dang et al., 2015; Elsas & Florysiak, 2015).

⁴⁴ The adjustment costs may come from financial distress and other costs of debt (Hovakimian & Li, 2011).

⁴⁵ According to Öztekin and Flannery (2012), the firm's characteristics influence both target leverage and the adjustment speed of capital structure. Therefore, the firm's set of characteristics are the same as in Table 5.1.

⁴⁶ According to Mukherjee and Wang (2013), for the larger deviation from observed leverage to target leverage, firms adjust their leverage faster to get greater benefits from rebalancing.

5.5 Empirical results

5.5.1 Descriptive statistics

Table 5.2 reports descriptive statistics of variables including the key firm characteristics and the drought risk proxies in this study.

Table 5.2: Descriptive statistics of variables

Variable	N	Mean	SD	Min	Max
Total leverage (TLEV)	130,511	0.194	0.194	0.000	0.996
Drought (DRO)	130,511	1.206	0.599	1.000	4.000
Sev_Drought (SEV_DRO)	130,511	0.065	0.247	0.000	1.000
Firm size (SIZE)	130,511	4.573	2.296	0.250	10.478
Tangibility (TANG)	130,511	0.320	0.252	0.000	0.943
Market-to-book ratio (M/B)	130,511	1.920	1.872	0.449	14.767
Research and development expenses (R&D)	130,511	0.039	0.092	0.000	0.725
R&D indicator (R&D_IND)	130,511	0.415	0.493	0.000	1.000
Depreciation (DEP)	130,511	0.051	0.043	0.000	0.281
Industry Median debt ratio (MED)	130,511	0.150	0.084	0.000	0.394
Profitability (PROFIT)	130,511	0.194	0.194	0.000	0.996

This table presents the number of observations, mean, standard deviation, minimum and maximum of the variables (1970-2015).

The mean of two drought variables *Drought* and *Sev_Drought* are 1.206 and 0.065 respectively. In particular, the mean of *Drought* is less than 2 which implies that on average, firms are located in areas with normal and wet conditions. Nevertheless, 6.05 % of the firm-year observations are from states with severe drought conditions. The standard deviation of *Drought* and *Sev_Drought* are 0.599 and 0.247 respectively.

The mean values of other control variables are as follows: loading on firm size (*SIZE* = 4.573), tangibility (*TANG* = 0.320), market-to-book ratio (*M/B* = 1.920), research and development expenses (*R&D* = 0.039), research indicator (*R&D_IND* = 0.415), depreciation (*DEP* = 0.051), industry median debt ratio (*MED* = 0.150), and profitability (*PROFIT* = 0.194).. In general, these statistics are consistent with other studies examining leverage in the U.S market (Dang et al., 2015; Flannery & Rangan, 2006).

To check the multicollinearity, we report the correlation coefficient in Table 5.3.

Table 5.3: Correlation among variables

	LEV	DRO	SEV_DRO	SIZE	TANG	M/B	R&D	R&D_IND	DEP	MED	PROFIT
LEV	1.000										
DRO	-0.026	1.000									
SEV_DRO	-0.021	0.900	1.000								
SIZE	0.145	0.084	0.091	1.000							
TANG	0.263	-0.005	-0.001	0.145	1.000						
M/B	-0.344	0.027	0.025	-0.183	-0.165	1.000					
R&D	-0.248	0.037	0.020	-0.157	-0.273	0.306	1.000				
R&D_IND	-0.227	-0.012	-0.018	0.024	-0.330	0.161	0.499	1.000			
DEP	0.115	0.035	0.025	-0.020	0.296	-0.019	0.052	-0.036	1.000		
MED	0.277	-0.110	-0.105	-0.095	0.171	-0.191	-0.227	-0.207	-0.025	1.000	
PROFIT	0.080	-0.014	-0.010	0.311	0.144	-0.248	-0.447	-0.132	0.002	0.199	1.000

Two proxies for drought variables, *Drought* and *Sev_drought*, are highly correlated at 0.900; therefore we will run two variables separately to avoid the problems of multicollinearity. For other variables, the strongest correlation is less than 0.500, which indicates no multicollinearity problems in our study.

5.5.2 The impact of drought on capital structure

Table 5.4 provides the results of two regression models of Eq. (5.1) to examine the impact of drought on capital structure. We also include the year and industry fixed effect based on the Standard Industrial Classification (SIC) industry.

Table 5.4: The impact of drought on capital structure

	(1)	(2)
DRO	-0.001** (0.000)	
SEV_DRO		-0.003** (0.001)
SIZE	0.031*** (0.000)	0.028*** (0.004)
TANG	0.178*** (0.004)	0.176*** (0.000)
M/B	-0.016*** (0.000)	-0.013*** (0.000)
R&D	-0.309*** (0.016)	-0.245*** (0.017)
R&D_IND	-0.006*** (0.001)	-0.008*** (0.001)
DEP	-0.112*** (0.021)	-0.046** (0.021)
MED	0.210*** (0.016)	0.186*** (0.016)
PROFIT	-0.280*** (0.004)	-0.327*** (0.029)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents the results from estimating the following equation:

$$LEV_{i,t+1} = \alpha + \delta \cdot Drought_{i,t} + \beta X_{i,t} + \varepsilon_{i,t}$$

Drought represents drought proxies including drought and sev_drought variables, X denotes the set of control variables including firm size, tangibility, market-to-book ratio, research & development expense, research and development indicator, depreciation, industry median debt ratio, and profit.

In Table 5.4, the coefficients of both drought measures (*Drought* and *Sev_Drought*) are negative and significant at the 5% level. The results indicate that drought is related to a lower leverage level for firms in affected areas. In terms of economic significance, an increase of one unit in *Drought* leads to a decrease of 10 bps in capital structure. Furthermore, when we apply *Sev_Drought* as a dummy variable, we find that severe drought conditions trigger a reduction of 30 bps on the debt ratio.

The results support our first hypothesis on the adverse influence of drought on capital structure. Our finding suggests that firms recognise the drought risk and try to reduce debt to alleviate the overall risk and protect their investment. Additionally, our results can also be explained from the banks' perspectives. Since banks take into consideration drought as relevant credit risk, they develop appropriate strategies, join agreements, and take actions to deal with the risk, which brings about higher costs of lending. Therefore, firms lower their leverage due to the high expenses of debt borrowing. This behavior is also consistent with the prediction of the pecking order theory.

As a type of climate risk, the negative impact of drought on leverage revealed in our paper is consistent with Chen and Wang (2012), who employ Kyoto ratification as a measure for the climate risk, and with Bokpin and Osei (2010), Chen (2010), and Hatzinikolaou et al. (2002), who investigate the impact of business risk and inflation risk on capital structure. However, our results are different from Bokpin and Osei (2010) and Harris and Roark (2018) who explore the effects of financial risk and cash flow risk on leverage. More specifically, Bokpin and Osei (2010) conclude that firms increase debt to deal with the financial risk and Harris and Roark (2018) show that firms with poor performance are likely to employ more debt.

5.5.3 The impact of drought on speed of adjustment of capital structure

We next present the effect of drought on the adjustment speed of capital structure by two models of Eq.(5.4) in Table 5.5. Year and industry dummy variables are applied to control for time and industry fixed effects in our regressions. Since the influence of drought on SOA is represented by the opposite sign of interaction terms between deviation and drought, we provide the opposite sign of the interaction term to show the actual impact of drought and other control variables on SOA.

Table 5.5: The impact of drought on adjustment speed of capital structure

	(1)	(2)
DRO	-0.014*** (0.003)	
SEV_DRO		-0.026*** (0.007)
Deviation	-0.159*** (0.009)	-0.165*** (0.009)
<i>Deviation</i>	0.039*** (0.003)	0.046*** (0.003)
SIZE	0.007*** (0.001)	0.008*** (0.001)
TANG	-0.019* (0.010)	-0.039*** (0.010)
M/B	0.014*** (0.001)	0.015*** (0.001)
R&D	0.024 (0.055)	0.034 (0.057)
R&D_IND	-0.012*** (0.004)	-0.015*** (0.004)
DEP	-0.247*** (0.066)	-0.227*** (0.068)
MED	0.022 (0.023)	-0.016 (0.023)
PROFIT	0.057*** (0.020)	0.064*** (0.021)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents the results from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

Where $\Delta L_{i,t+1}$ denotes the change in leverage in firm *i* in period *t*+1, Drought represents drought proxies including drought and sev_drought variables, $C_{i,t}$ are a set of control variables including the magnitude of initial deviation (*|Deviation|*), firm size, tangibility, market-to-book ratio, research & development expense, research and development indicator, depreciation, industry median debt ratio, and profit; $D_{i,t}$ denotes the deviation from the target leverage at the start of year *t*

As shown in Table 5.5, the coefficient on the interaction term between leverage deviation and drought is negative. This indicates an adverse influence of drought on the adjustment speed of capital structure. The coefficients of the interaction terms for both measurements of drought (*Drought* and *Sev_Drought*) are -0.014 and -0.026 and are significant at the 1% level. Our results indicate that drought increases the adjustment costs for firms, which in turn prevents firms from achieving the optimal leverage level and maximising their value. This outcome is consistent with our prediction in hypothesis 2 that there is a negative association between drought and the speed of leverage adjustment.

Our findings suggest that the climate risk results in the uncertainty of future cash flow and information, which in turn leads to an increase in transaction costs for firms. Therefore, firms temporarily deviate their leverage from the target level. The higher adjustment costs can be explained from the perspective of banks. Since banks follow the lending policies and strategies to deal with climate risk, there will be a rise in operating costs, which in turn increases the lending for firms.

Our results also support both the trade-off theory and the pecking order theory. According to the trade-off theory (Myers, 1984), firms change their capital structure to the optimal level to maximise the firm's value. However, due to the adjustment costs, firms are also reluctant to rebalance their capital structure. In this case, adjustment costs mainly come from transaction costs or borrowing costs. An increase in transaction costs prevents firms from moving to the optimal capital structure. Additionally, pecking order theory indicates a hierarchy for firms for their financing needs; particularly, firms choose the cheap sources of finance first (internal finance, debt) and look to the expensive sources (equity) as the last resort. In this case, when the borrowing rate gets higher, firms are likely to choose other sources for their financing.

Finally, the negative impacts of drought as a proxy of climate risk on SOA is consistent with An et al. (2015) who apply crash-risk exposure as a measure of risk. On the other hand, Elsas and Florysiak (2011) and Baum et al. (2017), who consider risks by examining the default risk, the firm-specific risk, and macroeconomic risk, reach different findings.

5.5.4 The spillover effect of drought on capital structure and speed of adjustment of capital structure

In this section, we investigate the spillover effect of drought on non-food industries. Since the direct impact of drought risk on food industries is disclosed in the literature (Blackhurst et al., 2010; Hong et al., 2000; Lesk et al., 2016), this risk can be transmitted among industries within the economy. Empirical studies also assert that the shocks from one industry can spill over to other industries. For instance, Mitchell and Mulherin (1996) find that takeovers and restructuring are informed by industry shocks, with an announcement at one firm being potentially associated with the prediction of ongoing takeover or restructuring of other industry firms. Shea (2002) finds the volatility in the production of an industry is influenced by shocks in all other industries in the economy. Likewise, Becker and Thomas (2010) observe significant spillover effects from the customer industry concentration to the supplier industry concentration. Wang (2010) concludes that the shocks emanating from business supplies, machinery, and consumer goods sectors are hazard sources that have effects on most other industries. Symitsi and Chalvatzis (2018) demonstrate the volatility spillovers from technology firms to Bitcoin and from Bitcoin to energy companies.

In our case, due to drought, the loss in production in the agriculture industry can influence other industries. As the consequences of climate risk, local and national levels of consumption may decrease, which in turn reduces the revenues of firms in both food

and non-food industries. Therefore, the drought risk at the state level can be considered a local systematic risk, which affects both food and non-food industries. Table 6 presents the effect of drought on SOA in both food and non-food industries:

Table 5.6: The impact of drought on adjustment speed of capital structure in Food and Non-Food Industries

	Non- Food Industries		Food Industries	
	(1)	(2)	(3)	(4)
DRO	-0.019*** (0.005)		-0.012*** (0.003)	
SEV_DRO		-0.031** (0.013)		-0.021** (0.009)
Deviation	-0.159*** (0.018)	-0.180*** (0.017)	-0.165*** (0.011)	-0.166*** (0.011)
Deviation	0.042*** (0.006)	0.043*** (0.006)	0.040*** (0.004)	0.047*** (0.004)
SIZE	0.010*** (0.002)	0.010*** (0.002)	0.006*** (0.001)	0.007*** (0.001)
TANG	0.023 (0.016)	0.022 (0.016)	-0.046*** (0.013)	-0.067*** (0.014)
M/B	0.011*** (0.002)	0.012*** (0.002)	0.016*** (0.024)	0.016*** (0.001)
R&D	0.184 (0.112)	0.179 (0.112)	-0.037 (0.064)	-0.040 (0.066)
R&D_IND	-0.004 (0.012)	-0.007 (0.012)	-0.012** (0.005)	-0.015*** (0.005)
DEP	-0.299*** (0.098)	-0.299*** (0.098)	-0.199** (0.094)	-0.234** (0.097)
MED	-0.013 (0.043)	-0.010 (0.043)	0.061** (0.029)	0.029 (0.029)
PROFIT	0.048 (0.042)	0.049 (0.042)	0.051** (0.024)	0.055** (0.024)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents the results from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

Table 5.6 shows how the negative impact of drought on SOA is consistent for both food and non-food industries. When we apply *Drought* to measure drought risk, the

coefficients of interaction terms between drought and deviation are -0.019 and -0.012 and significant at 1% for both food and non-food industries. Furthermore, when *Sev_Drought* is used as a proxy for the climate risk, the value of interaction terms between drought and deviation is -0.031 and -0.021 and significant at 5% for both food and non-food industries respectively. Our findings support the idea that drought risk leads to an increase in the transaction costs for companies in both food and non-food industries. Therefore, the speed of leverage adjustment for these companies becomes slower.

5.6 Robustness Test

5.6.1 OLS and fixed effect method

In this section, we apply a pooled ordinary least square (OLS) and fixed-effect approach to investigate the impact of drought on capital structure and on the adjustment speed of capital structure in order to check the robustness of our findings in the previous sections. In the OLS model, we apply year and industry dummy variables to control the effects of these variables in our model. For the fixed-effect approach, we use industry dummy variables to consider the effects of industries. Two measurements of drought, including *Drought* and *Sev_Drought*, are applied. Table 5.7 and Table 5.8 below show the outcomes when we use OLS and a fixed-effect approach to re-estimate Eq. (5.1) and Eq. (5.4)

Table 5.7: The impact of drought on capital structure by OLS and Fixed effects

	OLS		Firm Fixed Effects	
	(1)	(2)	(3)	(4)
DRO	-0.003*** (0.000)		-0.003*** (0.000)	
SEV_DRO		-0.004** (0.002)		-0.008*** (0.001)
SIZE	0.007*** (0.000)	0.007*** (0.000)	0.023*** (0.000)	0.024*** (0.000)
TANG	0.188*** (0.003)	0.188*** (0.003)	0.194*** (0.004)	0.205*** (0.004)
M/B	-0.028*** (0.000)	-0.028*** (0.000)	-0.012*** (0.000)	-0.026*** (0.000)
R&D	-0.478*** (0.014)	-0.479*** (0.014)	-0.243*** (0.018)	-0.188*** (0.017)
R&D_IND	-0.022*** (0.001)	-0.021*** (0.001)	0.006*** (0.001)	0.001*** (0.001)
DEP	-0.136*** (0.020)	-0.137*** (0.020)	-0.152*** (0.023)	0.088*** (0.014)
MED	0.456*** (0.008)	0.457*** (0.008)	0.510*** (0.009)	0.505*** (0.008)
PROFIT	-0.381*** (0.005)	-0.381*** (0.005)	-0.256*** (0.005)	-0.259*** (0.004)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents OLS regression and firm fixed effects outcomes from estimating the following equation:

$$LEV_{i,t+1} = \alpha + \delta \cdot Drought_{i,t} + \beta X_{i,t} + \varepsilon_{i,t}$$

Table 5.8: The impact of drought on adjustment speed of capital structure by OLS and Fixed effects

	OLS		Firm Fixed Effects	
	(1)	(2)	(3)	(4)
DRO	-0.014*** (0.003)		-0.015*** (0.003)	
SEV_DRO		-0.026*** (0.007)		-0.031*** (0.008)
Deviation	-0.140*** (0.009)	-0.148*** (0.008)	-0.424*** (0.012)	-0.426*** (0.012)
Deviation	0.039*** (0.003)	0.049*** (0.003)	0.054*** (0.004)	0.066*** (0.004)
SIZE	0.008*** (0.001)	0.008*** (0.001)	0.016*** (0.001)	0.016*** (0.001)
TANG	-0.018* (0.009)	-0.035*** (0.010)	-0.002 (0.013)	-0.034** (0.014)
M/B	0.013*** (0.001)	0.014*** (0.001)	0.030*** (0.001)	0.031*** (0.001)
R&D	0.001 (0.054)	-0.001 (0.056)	0.160** (0.065)	0.156** (0.068)
R&D_IND	-0.011*** (0.004)	-0.014*** (0.004)	0.025*** (0.006)	0.025*** (0.006)
DEP	-0.253*** (0.064)	-0.216*** (0.066)	-0.374*** (0.082)	-0.311*** (0.085)
MED	0.004 (0.022)	-0.039* (0.023)	0.198*** (0.030)	0.139*** (0.030)
PROFIT	0.063*** (0.020)	0.065*** (0.021)	0.006 (0.023)	0.004 (0.023)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents the OLS regression and firm fixed effects outcomes from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

The results from Table 5.7 show the influence of drought on capital structure. The findings indicate a negative and significant relationship between drought and capital structure. Based on the OLS estimate and firm fixed effect estimate, the coefficients on drought in model (1) and model (3) have the same results of -0.003, and are statistically

significant at the 1% level. These coefficients indicate that an increase of one-unit in *Drought* results in a decrease of 30 bps in the leverage. Furthermore, when we consider *Sev_Drought* as a dummy variable to represent drought, we reveal that severe drought conditions decreases 40 bps by the OLS approach and 80 bps by the fixed effect approach on the debt ratio. The findings on *Sev_Drought* are also significant at the 5% level and the 1% level using OLS and the fixed effect framework, respectively.

Table 5.8 reports the findings on the impact of drought on adjustment speed of capital structure. Consistent with our findings in the previous sections, in both OLS and the fixed effect framework, the interaction terms between drought and leverage deviation loads negative. This implies an adverse influence of drought on SOA. Particularly, the coefficients of the interaction terms for *Drought* and leverage deviation variables are -0.014 and -0.015 and significant at the 1% level by OLS and the fixed effect models respectively. Furthermore, when we apply *Sev_Drought* as the dummy variable to consider the drought risk, the coefficients on the interaction terms from OLS and the fixed effect approach are -0.026 and -0.031 and significant at the 1% level.

5.6.2 Alternative measure of leverage

In this section, we examine the robustness of our findings using the book-value measure of the leverage - total debt leverage (total debt/book value of total assets) and re-run Eq. (5.1) and Eq. (5.4). We examine the impact of drought on capital structure and adjustment speed of capital structure by applying the *Drought* and *Sev_Drought* variables:

Table 5.9: The impact of drought on capital structure by book leverage

	(1)	(2)
DRO	-0.001** (0.000)	
SEV_DRO		-0.004** (0.001)
SIZE	0.027*** (0.000)	0.027*** (0.000)
TANG	0.165*** (0.004)	0.165*** (0.004)
M/B	-0.004*** (0.000)	-0.005*** (0.000)
R&D	-0.336*** (0.017)	-0.344*** (0.017)
R&D_IND	-0.007*** (0.001)	-0.009*** (0.001)
DEP	0.016 (0.023)	0.014 (0.023)
MED	0.127*** (0.018)	0.127*** (0.018)
PROFIT	-0.251*** (0.005)	-0.252*** (0.005)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents outcomes using book leverage from estimating the following equation:

$$LEV_{i,t+1} = \alpha + \delta \cdot Drought_{i,t} + \beta X_{i,t} + \varepsilon_{i,t}$$

Table 5.10: The impact of drought on adjustment speed of capital structure by book leverage

	(1)	(2)
DRO	-0.013*** (0.003)	
SEV_DRO		-0.023*** (0.007)
Deviation	-0.190*** (0.006)	-0.222*** (0.004)
Deviation	0.024*** (0.003)	0.030*** (0.003)
SIZE	0.007*** (0.000)	0.009*** (0.000)
TANG	0.025*** (0.009)	0.018* (0.009)
M/B	0.019*** (0.001)	0.018*** (0.001)
R&D	-0.080* (0.045)	-0.088* (0.046)
R&D_IND	-0.009** (0.004)	-0.006 (0.004)
DEP	-0.231*** (0.056)	-0.179*** (0.057)
MED	0.167*** (0.019)	0.212*** (0.020)
PROFIT	-0.028* (0.017)	-0.037** (0.017)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents the results of using book leverage from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

Table 5.9 illustrates the effect of drought on capital structure, and the results indicate a negative and significant relation between drought and capital structure. The coefficients on drought in model (1) and model (2) are -0.001 and -0.004, respectively, and statistically significant at the 5% level. These coefficients imply that an increase of one-unit in *Drought* results in a decrease of 10bps in the leverage. Additionally, when we

employ *Sev_Drought* as a dummy variable, we highlight that severe drought condition reduces 40 bps on the debt ratio.

Table 5.10 provides the outcomes on the impact of drought on the adjustment speed of capital structure. Consistent with our findings in the previous sections, the interaction terms between drought and leverage deviation loads negative, which implies a negative relationship between drought and SOA. Particularly, the coefficients of the interaction terms for both drought variables (*Drought* and *Sev_Drought*) are -0.013 and -0.023 and significant at the 1% level.

5.6.3 *Alternative measures of drought*

In section 5, we created the drought variables from the 12-month average of the PDSI. As long-lasting droughts are likely to produce stronger effects than brief drought conditions, we reexamine the impact of drought on capital structure and on the adjustment speed of capital structure by applying alternative proxies of drought resulting from the PDSI. That is, we use *Drought_24M*, *Drought_36M*, *Sev_Drought_24M* and *Sev_Drought_36M*. These variables are built similarly to *Drought* and *Sev_Drought* in the previous section, except these measures are estimated from the 24- and 36-month moving average of the PDSI. We re-run Eq. (5.1) and Eq. (5.4) to investigate the effect of drought on capital structure and the speed of leverage adjustment:

Table 5.11: The impact of drought on capital structure with alternative measures of drought

	(1)	(2)	(3)	(4)
DRO_24M	-0.002*** (0.000)			
DRO_36M		-0.010*** (0.001)		
SEV_DRO_24M			-0.005** (0.002)	
SEV_DRO_36M				-0.024*** (0.002)
SIZE	0.030*** (0.000)	0.016*** (0.000)	0.030*** (0.000)	0.016*** (0.000)
TANG	0.173*** (0.004)	0.178*** (0.005)	0.173*** (0.004)	0.179*** (0.005)
M/B	-0.017*** (0.000)	-0.015*** (0.000)	-0.017*** (0.000)	-0.015*** (0.000)
R&D	-0.358*** (0.019)	-0.431*** (0.023)	-0.358*** (0.019)	-0.431*** (0.023)
R&D_IND	-0.006*** (0.001)	-0.001 (0.002)	-0.006*** (0.001)	-0.001 (0.002)
DEP	-0.138*** (0.024)	-0.186*** (0.027)	-0.138*** (0.024)	-0.189*** (0.027)
MED	0.167*** (0.017)	0.418*** (0.009)	0.167*** (0.017)	0.418*** (0.009)
PROFIT	-0.314*** (0.005)	-0.318*** (0.006)	-0.314*** (0.005)	-0.318*** (0.006)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents outcomes using different measurements of drought such as DRO_24M, DRO_36M, SEV_DRO_24M, SEV_DRO_36M. We estimate the average PDSI over the past 24 months and 36 months respectively. By applying the historical average, we construct DRO_24M and DRO_36M as categorical variables from one to four relying on severe drought level. The variables SEV_DRO_24M and SEV_DRO_36M are the dummy variables that take the value of one if the corresponding historical PDSI is less than or equal to -3 and zero otherwise. The findings are from estimating the following equation:

$$LEV_{i,t+1} = \alpha + \delta.Drought_{i,t} + \beta X_{i,t} + \varepsilon_{i,t}$$

Table 5.12: The impact of drought on adjustment speed of capital structure with alternative measures of drought

	(1)	(2)	(3)	(4)
DRO_24M	-0.019*** (0.004)			
DRO_36M		-0.024*** (0.005)		
SEV_DRO_24M			-0.046*** (0.010)	
SEV_DRO_36M				-0.052*** (0.013)
Deviation	-0.125*** (0.010)	-0.109*** (0.012)	-0.141*** (0.009)	-0.136*** (0.010)
Deviation	0.034 0.034***	0.033*** (0.004)	0.033*** (0.003)	0.033*** (0.004)
SIZE	0.004*** (0.001)	0.003*** (0.001)	0.004*** (0.001)	0.003** (0.001)
TANG	-0.016 (0.011)	-0.026*** (0.012)	-0.018* (0.011)	-0.025** (0.012)
M/B	-0.015*** (0.001)	0.014*** (0.001)	0.014*** (0.001)	0.014*** (0.001)
R&D	-0.138** (0.058)	-0.177*** (0.086)	-0.057 (0.065)	-0.183** (0.085)
R&D_IND	-0.014*** (0.005)	-0.011*** (0.005)	-0.014*** (0.005)	-0.011* (0.005)
DEP	-0.228*** (0.075)	-0.182*** (0.083)	-0.243*** (0.075)	-0.183** (0.083)
MED	-0.026 (0.025)	-0.030*** (0.028)	-0.029 (0.025)	-0.029 (0.028)
PROFIT	0.050** (0.024)	0.070*** (0.026)	0.055** (0.024)	0.070*** (0.026)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents the results with different measurements of drought such as *DRO_24M*, *DRO_36M*, *SEV_DRO_24M*, *SEV_DRO_36M*. We estimate the average *PDSI* over the past 24 months and 36 months respectively. By applying the historical average, we construct *DRO_24M* and *DRO_36M* as categorical variables from one to four relying on severe drought level. The variables *SEV_DRO_24M* and *SEV_DRO_36M* are the dummy variables that take the value of one if the corresponding historical *PDSI* is less than or equal to -3 and zero otherwise. The findings are from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_o + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

Table 5.11 shows the results of the impact of drought on capital structure. They imply that all of the long-term drought measures have a negative and significant impact on leverage choice. Additionally, longer-lasting droughts exhibit a stronger effect on

capital structure. More specifically, the drought conditions based on the 24-month average of the PDSI are related to a decrease of 2-bp in the debt ratio, and the drought conditions constructed from the 36-month average are associated with a reduction of 10-bp in debt ratio. Likewise, the severe drought conditions constructed from the 24-month and 36-month average of the PDSI are associated with a decrease of 5-bp and 24-bp in the leverage respectively.

Table 5.12 represents the findings on the effect of drought on the speed of leverage adjustment. Consistent with the outcomes in the previous section, the interaction term between drought and leverage deviation is negative, which indicates an adverse association between drought and SOA. In detail, the magnitude of the interaction terms for longer-lasting drought are larger than that of the shorter-lasting droughts (0.024 of *DRO_36M* vs 0.019 of *DRO_24M* and 0.052 of *SEV_DRO_36M* vs 0.046 of *SEV_DRO_24M*) which implies a more significant impact of the long-term droughts on adjustment speed. The coefficients of all interaction terms are significant at the 1% level.

5.7 The role of cash flow and financial constraints

5.7.1 Drought risk, capital structure and the adjustment speed of capital structure: the role of financial constraints

In this section, we investigate the role of financial constraints on the relationship between drought, capital structure and SOA. We expect that unconstrained firms, which are more flexible, to access external funding which can alleviate the negative effect of drought on capital structure and SOA.

Empirical studies have illustrated an association between the financial constraints of firms and bond ratings. Particularly, firms with bond ratings can easily issue the debt to the market and bear a lower adjustment cost than those without bond ratings (Cook & Tang, 2010; Faulkender et al., 2012; Korajczyk & Levy, 2003). In other words, a

financially unconstrained firm is likely to have more favorable conditions to access the financial market. Therefore, we follow Cook and Tang (2010) to define unconstrained firms as firms that have a bond rating ($Rate = 1$), and zero otherwise. We apply three proxies for drought: *Drought*, *Drought_24M* and *Drought_36M*. The definitions of these measures are in the previous sections. The interaction term between *Drought* and *Rate* indicates the role of financial constraints on the effect of drought on capital structure and SOA.

Table 5.13: Financial constraints and the impact of drought on capital structure

	(1)	(2)	(3)
DRO	-0.001*** (0.000)		
DRO_RATE	0.008*** (0.002)		
DRO_24M		-0.002*** (0.001)	
DRO_24M_RATE		0.009** (0.004)	
DRO_36M			-0.012*** (0.001)
DRO_36M_RATE			0.011** (0.005)
SIZE	0.030*** (0.000)	0.029*** (0.000)	0.019*** (0.000)
TANG	0.178*** (0.004)	0.163*** (0.005)	0.177*** (0.005)
M/B	-0.016*** (0.000)	-0.016*** (0.000)	-0.017*** (0.000)
R&D	-0.309*** (0.016)	-0.400*** (0.023)	-0.403*** (0.023)
R&D_IND	-0.006*** (0.001)	-0.005** (0.002)	-0.006*** (0.002)
DEP	-0.112*** (0.021)	-0.131*** (0.027)	-0.099*** (0.027)
MED	0.211*** (0.016)	0.148*** (0.019)	0.440*** (0.010)
PROFIT	-0.280*** (0.004)	-0.336*** (0.006)	-0.293*** (0.006)
Year dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents outcomes of the interaction term between drought and financial constraint on capital structure. We measure drought by three proxies *DRO*, *DRO_24M* and *DRO_36M*. They are the categorical variables from one to four depending on the severity of drought. The interaction variable definition are: *Rate* =1 if firm has a bond rating and zero otherwise. The findings are from estimating the following equation:

$$LEV_{i,t+1} = \alpha + \delta \cdot Drought_{i,t} + \theta \cdot Drought_Rate_{i,t} + \beta X_{i,t} + \varepsilon_{i,t}$$

Table 5.14: Financial constraints and the impact of drought on adjustment speed of capital structure

	(1)	(2)	(3)
DRO	-0.074*** (0.006)		
DRO_RATE	0.059*** (0.007)		
DRO_24M		-0.047*** (0.005)	
DRO_24M_RATE		0.018*** (0.006)	
DRO_36M			-0.055*** (0.006)
DRO_36M_RATE			0.027*** (0.008)
Deviation	-0.155*** (0.008)	-0.103*** (0.011)	-0.098*** (0.012)
<i>Deviation</i>	0.034*** (0.004)	0.021*** (0.005)	0.013** (0.005)
SIZE	0.008*** (0.001)	0.004*** (0.001)	0.003*** (0.001)
TANG	-0.021** (0.010)	-0.021* (0.012)	-0.006 (0.013)
M/B	0.014*** (0.001)	0.013*** (0.002)	0.015*** (0.002)
R&D	0.026 (0.058)	-0.188** (0.087)	-0.394*** (0.100)
R&D_IND	-0.018*** (0.005)	-0.017*** (0.006)	-0.009 (0.006)
DEP	-0.172*** (0.066)	-0.137* (0.082)	-0.148* (0.089)
MED	-0.089* (0.046)	-0.213*** (0.056)	-0.231*** (0.061)
PROFIT	0.051*** (0.019)	0.059** (0.025)	0.045 (0.028)
Year dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. This table presents outcomes of the interaction term between drought and financial constraint on capital structure. We measure drought by three proxies *DRO*, *DRO_24M* and *DRO_36M*. They are the categorical variables from one to four depending on the severity of drought. The interaction variable definition are: *Rate* =1 if firm has a bond rating and zero otherwise. The findings are from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t} + \lambda_3 Drought_Rate_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

Table 5.13 reports the hedging effect from financial unconstrained firms to mitigate the adverse influence of drought on capital structure. In models (1), (2) and (3), the coefficients on the interaction terms are positive and significant at 1%. These interaction coefficients suggest that highly unconstrained firms still increase leverage in spite of drought effects.

Table 5.14 represents how the factor of being financially unconstrained serves to alleviate the impact of drought on the speed of leverage adjustment. We find that the coefficient estimate on the interaction term between *Drought* and *Rate* is positive and significant at the 1% level. This indicates that the financially unconstrained firm can attenuate the adverse influence of drought on adjustment speed of capital structure. Our findings are also consistent with the evidence in the literature that if a firm is financially unconstrained, it is more likely to issue a security at a lower cost, which performs a faster pace of capital structure adjustment toward the optimal level than the constrained firm (Cook & Tang, 2010; Korajczyk & Levy, 2003)

5.7.2 Drought risk and the adjustment speed of capital structure: the role of cash flow

In this section, we examine the impact of drought on the adjustment speed of capital structure, taking into account a firm's cash flow. As the adjustment speed of capital structure relies on transaction costs, and cash flow is a source that is involved with low transaction costs, several studies have found the moderating effect of cash flow on SOA (Dufour, Luu, & Teller, 2017; Faulkender et al., 2012). That is, firms with positive cash flow can change the leverage at low transaction costs. This study therefore investigates whether cash flows are helpful for firms to mitigate the impact of drought on adjustment speed of capital structure. We follow Faulkender et al. (2012) to define the cash flow as:

$$CF_{i,t} = \frac{OIBD_{i,t} - T_{i,t} - Int_{i,t}}{A_{i,t-1}} - CapEx_{i,t} .$$

Where $OIBD_{i,t}$ is the operating income before depreciation, $T_{i,t}$ is the total tax allocated on the income statement, $Int_{i,t}$ is the interest

paid, $CapEx_{i,t}$ is the value of capital expenditures, and $A_{i,t-1}$ is value of total assets for the year ending at t-1

Table 5.15: Cash flow and the impact of drought on adjustment speed of capital structure

	(1)	(2)
DRO	-0.009*** (0.003)	
DRO_CF	0.049*** (0.015)	
SEV_DRO		-0.030*** (0.007)
SEV_DRO_CF		0.197** (0.094)
Deviation	-0.147*** (0.011)	-0.184*** (0.009)
Deviation	0.032*** (0.003)	0.032*** (0.003)
SIZE	0.007*** (0.001)	0.007*** (0.001)
TANG	-0.012 (0.012)	-0.009 (0.010)
M/B	0.015*** (0.001)	0.015*** (0.001)
R&D	-0.012 (0.090)	-0.018 (0.060)
R&D_IND	-0.016*** (0.005)	-0.012** (0.004)
DEP	-0.249*** (0.091)	-0.330*** (0.069)
MED	0.018 (0.026)	0.038 (0.024)
PROFIT	-0.064* (0.033)	0.052** (0.022)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes

Note: *Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level. We define a firm's operating cash flow as: $CF_{i,t} = \frac{OIBD_{i,t} - T_{i,t} - Int_{i,t}}{A_{i,t-1}} CapEx_{i,t}$. Where $OIBD_{i,t}$ is the operating income before depreciation, $T_{i,t}$ is the total tax allocated on the income statement, $Int_{i,t}$ is the interest paid, $CapEx_{i,t}$ is the value of capital expenditures, and $A_{i,t-1}$ is value of total assets for the year ending at t-1. This table presents the interaction impact between drought and cash flow on adjustment speed of capital structure, the outcomes from estimating the following equation:

$$\Delta L_{i,t+1} = (\lambda_0 + \lambda_1 Drought_{i,t} + \lambda_2 C_{i,t} + \lambda_3 Drought_Cashflow_{i,t}) D_{i,t} + \varepsilon_{i,t}$$

Table 5.15 displays the findings of this analysis. We find that the interaction term between drought and cash flow, and between severe drought and cash flow is positive (0.049 and 0.197) and significant (at 1% and 5%) respectively, indicating that firms with larger cash flow can mitigate the adverse influence of cash flow on SOA.

5.8 Conclusions

This study examines the impact of climate risk in the form of drought on capital structure and the speed at which a firm reverts to its target level of leverage. We focus on drought because this is the most catastrophic type of climate change-related disasters for the global economy (Hong et al., 2019; Lesk et al., 2016). Firms operating in areas affected by drought face the risk of increased operational costs, disrupted business, increased earnings volatility, and higher uncertainty of future cash flows. While a firm's management and regulators are increasingly aware of climate risk implications (SEC, 2010; World Economic Forum, 2015), whether climate risk is reflected in the adjustment of corporate policies remains, however, unexplored. In this study, we address this important question by first quantifying the effect of drought on risk on capital structure and the speed of adjustment, documenting that this effect is widespread due to an integrated economy, and then investigate various firm characteristics that could mediate the effect of drought on capital structure and the speed of adjustment.

Our main finding is consistent with several contemporary developments in the literature on the impact of climate risk. Because banks consider drought as a relevant credit risk (Cogan, 2008), they develop strategies, work with other banks to reach a consistent agreement and change some policies to deal with the threat, which in turn increases operating costs; hence, banks are likely to raise their lending rates. From the perspective of firms, they lower their debt to mitigate the overall risk and find other cheaper financing sources. Our finding is consistent with Chen and Wang (2012) who

employ Kyoto ratification as a proxy of the effect of climate risk and who report that this ratification causally changes capital structure. Furthermore, the expensive nature of borrowing costs and a rise in transaction costs, because of the uncertainty of future cash flows and information for firms, affect the cost of adjusting firm leverage toward the target. Consequently, firms slow down the reversion rate of leverage in response to drought risk. Our results support An et al. (2015) who evidence the same behaviour of firms when they deal with crash-risk exposure.

Additionally, while a number of studies have reported the effect of drought on food and agriculture industries (Blackhurst et al., 2010; Hong et al., 2000; Lesk et al., 2016), this paper extends the literature by exploring the spillover effect of drought on non-food industry firms. We document a spillover effect of drought on the adjustment speed of capital structure and point out a significant and adverse influence on drought on both food and non-food industries. This finding implies that drought risk causes an increase in the transaction costs for both food and non-food industry companies. Furthermore, we implement additional tests to examine the role of cash flows and financing constraints on the relationship between drought, capital structure, and SOA. We conclude that firms with high cash flows can reduce the adverse influence of drought on SOA. Moreover, the debt level and SOA of unconstrained firms are less affected than the constrained firms.

Our study offers important insights for policymakers, lenders, borrowers and firms, especially in raising public awareness of the role of climate risk in the financial market. For example, policymakers could consider implementing innovative policies to support banks as well as firms during prolonged drought conditions. At the same time, lenders and borrowers should carefully consider the associated risk for their business

activities. For firms, a higher level of cash flow and credit rating should mitigate the negative effects of drought on their leverage decisions.

Our study also offers interesting implications for future research avenues. First, we only investigate the impact of drought on capital structure and adjustment speed of capital structure among firms listed in the U.S. market. Future studies can examine the effect of drought on the capital structure of international firms to provide out-of-sample evidence. Second, researchers can also study other important corporate policies such as investment, equity financing, and pay-out when firms are exposed to drought conditions.

Appendix 5.1: Food industry identification based on Fama-French 17 industry classification

SIC code	Industry description	SIC code	Industry description
0100-0199	Agricultural production - crop	2082-2082	Malt beverages
0200-0299	Agricultural production - livestock	2083-2083	Malt
0700-0799	Agricultural services	2084-2084	Wine
0900-0999	Fishing, hunting & trapping	2085-2085	Distilled and blended liquors
2000-2009	Food and kindred products	2086-2086	Bottled-canned soft drinks
2010-2019	Meat products	2087-2087	Flavouring syrup
2020-2029	Dairy products	2090-2092	Misc food preps
2030-2039	Canned-preserved fruits-vegs	2095-2095	Roasted coffee
2040-2046	Flour and other grain mill products	2096-2096	Potato chips
2047-2047	Dog and cat food	2097-2097	Manufactured ice
2048-2048	Prepared feeds for animals	2098-2099	Misc food preparations
2050-2059	Bakery products	5140-5149	Wholesale - groceries & related prods
2060-2063	Sugar and confectionery products	5150-5159	Wholesale - farm products
2064-2068	Candy and other confectionery	5180-5182	Wholesale - beer, wine
2070-2079	Fats and oils	5191-5191	Wholesale - farm supplies
2080-2080	Beverages		

Chapter 6

Summary and Conclusion

The research outcomes of this PhD thesis contribute to the knowledge of capital structure. We examine the efficiency of financial decision policy by taking into consideration the pace at which firms converge to the optimal capital structure. Since a faster speed of leverage adjustment indicates better financial decision making, our study concentrates on how quickly firms adjust their leverage and the impediments they face in achieving their target levels.

The second chapter of the thesis reveals the relationship between level of leverage and SOA. We show the heterogeneity and asymmetry in SOA which is conditional on the level of leverage. The total leverage, long-term leverage and short-term leverage were employed to provide a comprehensive view of capital structure. Our findings disclose that total leverage and long-term leverage follow the same pattern of “SOA smile” and “SOA skew” whereas the SOA of short-term leverage changes from positive to negative across the quantile levels.

The third chapter of the thesis explores the impact of state ownership on SOA in Vietnam, a transitional economy where state-owned enterprises play an important role in the economy. The fourth chapter reviews the impact of corporate governance on speed of leverage adjustment in Vietnam. We consider Vietnam due to its underdeveloped corporate governance system where the rule of law, and investor protection, are not as effective as that in the developed countries (Nguyen, Locke, & Reddy, 2015). The fifth chapter highlights the influence of climate risk on the financial market by investigating how firms react, in terms of speed of adjustment of capital structure, to climate risk in the form of drought.

The main findings from this thesis are:

- (i) High and low-levered firms adjust more quickly than mid-levered firms in the total and long-term leverage setting.
- (ii) There is a slight difference in SOA between low-levered and high-levered firms, which produces the SOA skew.
- (iii) In the short-term leverage basic, the speed of leverage adjustment gets smaller at varying level of short-term debt.
- (iv) Trade-off theory is successful in explaining the total and long-term leverage adjustment processes whereas the pattern of short-term debt changes aligns with pecking order theory.
- (v) The effect of state ownership on SOA is negative for low-leveraged firms, positive for high-leveraged firms, but insignificant in the central area of leverage distribution.
- (vi) The negative effect of state ownership on SOA is more pronounced than the positive effect.
- (vii) Board size, board independence, gender diversity, and managerial ownership positively influence SOA whereas CEO duality and foreign ownership produce adverse effects on the speed of leverage adjustment.
- (viii) Drought risk has negative effects on both leverage and the speed of leverage adjustment.
- (ix) There is a spill over effect of drought on the adjustment speed of capital structure among non-food industry firms.
- (x) Cash flow and financially constrained factors are effective in alleviating the negative effect of drought.

The details of the findings are disclosed in Section 5.1 through to Section 5.4. Section 5.5 outlines this study's key contributions to knowledge and its policy implications. The limitations of the research and suggestions for future study are discussed in Section 5.6

6.1 Main findings of Chapter 2 (Essay one)

The first paper presented in Chapter 2, "Speed of adjustment toward target leverage: Evidence from a quantile regression analysis", investigates the relationship between level of leverage and the rate at which leverage reverts to its optimal level. In order to draw comparisons with other studies estimating speed of leverage adjustment, we employ 24,749 firms in the U.S. with data spanning a period of 48 years from 1970 to 2017, which include 206,046 firm-year observations. Moreover, we provide a comprehensive view by considering different types of leverage consisting of short-term leverage, long-term leverage and total leverage.

With regard to the total debt and long-term debt ratio basis, we posit that low- and high-levered firms have a stronger correlation with faster speed of leverage adjustment than mid-levered firms. This is because high-levered firms are likely to repurchase debt to mitigate bankruptcy costs whereas low-levered firms have a strong incentive to raise debt and obtain the benefits of a tax shield. For the mid-levered firms, the advantages of leverage adjustment are marginal.

In terms of short-term leverage ratios, we find that firms exhibit a high speed of leverage adjustment at low short-term leverage levels, but this decreases across short-term debt distribution. Interestingly, at high levels of short-term leverage, firms do not adjust the leverage towards the target but move far away from it, leading to a negative speed of reversion rate. Due to the sources of adjustment costs, at the low quantile level, the SOA of short-term leverage is faster than that of long-term leverage. More particularly, short-term debts are generally used to fund operating cycles whereas long-term debt is

for tangible assets; the transaction costs of short-term debt are cheaper than that of long-term debt.

Although different approaches have been conducted to investigate the relationship between level of leverage and SOA, our framework, which employs quantile regression for non-zero leverage firms, is ideal for estimating the value of SOA conditional on the degree of leverage. From a theoretical perspective, our results support the information asymmetry (liquidity and signalling) theory and contracting costs, which highlights the cheaper costs of short-term debt versus long-term debt. Additionally, the behaviour of total- and long-term leverage adjustment are depicted by trade-off theory in which there is an existence of an optimal capital structure and firms more likely to move their debt to this level to maximise the value. The changes of short-term leverage at high quantile levels are also consistent with the pecking order theory prediction that firms follow a hierarchy in choosing sources of finance. In this case, firms raise short-term debts because of its low costs compared to other financing sources. Our findings are consistent with Leary and Roberts (2005) who apply simulations and observe high speed of adjustment for extreme values of leverage. We extend the literature by analysing the asymmetry dynamics in SOA between low- and high-levered firms.

6.2 Main findings of Chapter 3 (Essay two)

The second paper presented in Chapter 3, “State ownership and adjustment speed toward target leverage: Evidence from a transitional economy”, explores the impact of state ownership on speed of adjustment of capital structure.

Although state ownership plays an important role in transitional economies, the impact of state ownership on adjustment speed of capital structure has produced mixed findings in the literature, with positive or negative effects dependent on different sources of adjustment costs. By applying a quantile regression for 5,374 firm-year observations

in Vietnam from 2000 to 2016, we offer new evidence that the effect of state ownership on SOA is negative for low-leveraged firms but positive for high-leveraged firms. Moreover, the adverse effect is stronger than the positive effect, which implies an overall negative impact of state ownership on SOA in Vietnam.

Our findings on the adverse effect for the low-levered firms support Zhou and Xie (2015), who consider the influence of state ownership on SOA based on agency costs. More specifically, because state-owned enterprises have a separation between voting rights and cash flow rights, they are inclined to prioritise political objectives over maximising the interests of shareholders. “Soft budget constraints” from government guarantees also produce negative effects on the motivations of managers. Since state-ownership firms bear considerable agency costs which are a part of adjustment costs, they will exhibit a slow speed of leverage adjustment. We argue that at low leverage levels, agency costs are the major concerns which prevent a firm from moving toward its optimal leverage level.

Additionally, our results of a positive link between state ownership and SOA for high-levered firms are consistent with Qian, Tian, and Wirjanto (2009), who justify the effect of state ownership on SOA depending on transaction costs. Because there is a strong relationship between state-controlled banks and government guarantees against bankruptcy and insolvency, state-owned enterprises can access debt financing at lower transaction costs. We argue that in Vietnam, current and former government officials are normally assigned as members of the boards of directors of state-owned enterprises. Since firms with high debt ratio are associated with bankruptcy, insolvency, non-performing loans, and bad reputations, managers in state-controlled firms are compelled to try to reduce debt in order to avoid losing their jobs. Moreover, although state-owned enterprises may carry high debt, with strong support from the government and state-

controlled banks, they can easily retire their debt or issue new shares to alleviate their loan amount.

6.3 Main findings of Chapter 4 (Essay three)

Chapter four includes a research paper titled “Corporate governance and capital structure dynamics: Evidence from a transitional economy” which explores how corporate governance affects the adjustment speed of capital structure in Vietnam. We extend the literature by first investigating the effect of gender diversity, foreign ownership and managerial ownership on SOA. While most studies examining the relationship between corporate governance and speed of leverage adjustment tend to focus on the U.S., this paper examines Vietnam, a transitional and emerging market where corporate governance plays a more important role in alleviating agency issues that arise as a result of weaknesses in the rule of law and in protection rights for shareholders and creditors. To alleviate the problem of endogeneity, we apply a generalized method of moment (GMM) approach for 5,374 firm-year observations in Vietnam from 2000 to 2016. Different corporate governance variables consisting of board size, board independence, CEO duality, gender diversity, managerial ownership and foreign ownership are applied to consider the overall impact of corporate governance on the pace at which leverage reverts to its target.

Notably, all corporate governance mechanisms have a significant effect on SOA which indicates the essential role of corporate governance in developing countries to alleviate issues of agency and information asymmetry. As Vietnam is in an infant stage of corporate governance development, the effects of corporate governance in our findings reveal two differences from those normally observed in a developed market. First, strong corporate governance should prompt a quicker speed of leverage adjustment (Chang,

Chou, & Huang, 2014), but foreign-owned firms⁴⁷, which are considered to have good corporate governance, show a slow reversion rate in Vietnam. This finding supports Lindemanis et al. (2019) who argue that foreign investors perform better in good-governance economies than in poor-governance economies. This is because they are exposed to problems involving the divergence between ownership and control in addition to the usual risks of doing business offshore and being subject to the systems and rules of that country. While strongly-governed countries with good legal systems and comprehensive protection rights for shareholders and creditors can reduce the negative impact of CEO duality (Liao, Mukherjee, & Wang, 2015), the adverse influence of CEO duality on the pace of leverage adjustment is still significant in Vietnam.

While all corporate governance variables have a significant effect on SOA, our findings indicate the adverse influence of CEO duality and foreign ownership on SOA. Conversely, board size, board independence, gender diversity, and managerial ownership have a positive influence on the reversion rate of the leverage.

6.4 Main findings of Chapter 5 (Essay four)

The fourth paper presented in Chapter 5, “Drought risk and capital structure dynamics”, investigates how the climate risk of drought affects the SOA of firms. We apply a fractional dependent variable (DPF estimator) for 130,511 firm-year observations from 1970 to 2015 in the U.S. to examine the effect of drought on capital structure and the pace of capital structure adjustment.

Banks consider drought to be an important credit risk (Cogan, 2008) and they have subsequently developed strategies and worked with other banks to agree upon how to deal

⁴⁷ We consider firms with high percentage of ownership are those with strong corporate governance because foreign investors generally bring new capital, cutting-edge technology, research and development abilities which in turn increase the competitiveness of the country (Lindemanis, Loze, & Pajuste, 2019; Piscitello & Rabbiosi, 2005)

with this risk. Since firms raise funds through financial institutions such as banks, climate risk is also considered a determinant of capital structure. As predicted, our study found that drought has an adverse influence on leverage levels. Given that drought is regarded as the most damaging of the natural disasters arising from climate change, it is imperative that firms should reduce their leverage levels to alleviate their overall risks. With lending costs likely to increase as a result of banks managing climate risks, firms will work to reduce their debts in order to acquire cheaper costs of financing, which supports the pecking order theory.

Our study found that drought has a negative effect on speed of leverage adjustment. Climate risk is associated with the uncertainty of future cash flow and information asymmetry (Chen & Wang, 2012) which contributes to higher required costs to comply with regulations and with the legislation of unpredictable events (Clarkson, Li, & Richardson, 2004; Cormier, Magnan, & Morard, 1993). Given that the transaction costs for funding will increase and, since the speed of capital structure adjustment depends on costs, it is not surprising that firms should exhibit a snail pace adjustment during drought. This finding is consistent with An, Li, and Yu (2015), who demonstrate a similar reaction by firms to crash-risk exposure.

In contrast to most study which explore the impact of drought on food and agriculture industries (Blackhurst, Hendrickson, & Sels I Vidal, 2010; Hong, Lim, & Stein, 2000), we examine the spill over effect of drought on firms in non-food industries. In doing so, we extend the literature by demonstrating the significant and adverse influence of drought on both food and non-food industries. The additional tests we conducted helps to explain the position of cash flow and financial constraints in connection with capital structure and the rate of capital structure adjustment. We reveal

that unconstrained firms and firms with good cash flow can mitigate the negative effect of drought risk on capital structure and SOA.

6.5 Research contributions and policy implications

This research makes a number of significant contributions at a theoretical and practical level. The first essay introduces a new method of estimating SOA and reveals new insights into the relationship between SOA and the level of leverage. In contrast to most studies, which focus on the behaviour of long-term leverage movement, we consider all types of leverage including total-leverage and short-term leverage. In particular, the insights we provide on the behaviours of short-term leverage adjustment addresses a current knowledge gap and we show that it is only at low quantile levels that a short-term target exists and adjustments of short-term leverage to optimal levels are made only in this context. Conversely, at high quantile levels, firms do not have a target for the short-term leverage and move debt level far away from the optimal level.

The second essay contributes to the capital structure literature by extending the empirical analysis on the impact of state ownership on the adjustment speed of capital structure by employing a quantile regression approach. This is the first study to investigate the relationship between state ownership and the reversion rate of the leverage conditional on the level of leverage. We find the discrepancy between the impact of state ownership on SOA at low versus high level of leverage regarding to the sign and the magnitude of the effect. Additionally, while the relationship between state ownership and SOA has been explored in China, we extend the literature by examining Vietnam, a transitional market where state-owned enterprises play a crucial role in the economy. Our study is the first to carry out an analysis for the unlisted public companies (UPCoM) list and, given its significant role and trading volume in relation to the Vietnamese market, this investigation was well overdue.

The third essay contributes to the literature on capital structure and corporate governance in several ways. First, it is the first study to explore how crucial corporate governance mechanisms such as gender diversity, foreign ownership and managerial ownership impact on the speed of leverage adjustment of a firm. Second, in examining Vietnam, an emerging economy where corporate governance is underdeveloped, this study is in contrast to other studies which have investigated the relationship between corporate governance and SOA but in developed countries. It reports two significant differences from studies of developed countries, relating to the impact of foreign ownership and the effect of CEO duality on SOA. Finally, it offers a focused examination of how corporate governance influences the pace of leverage reversion rates in Vietnam.

The fourth essay provides a significant contribution to the existing literature on climate finance. First, while researchers agree that climate change has a huge impact on social and economic activities (Lesk, Rowhani, & Ramankutty, 2016; Simon, Alex, Charlie, & Philip, 2016), the specific effects of a particular form of climate change, drought, has yet to be well investigated. Since firms are likely to adjust their leverage level in response to risk, we argue that drought has a considerable influence on capital structure. We also provide insights into the impact of drought on adjustment speeds of capital structure. Since drought increases operating and transaction costs, it prevent firms from achieving their optimal target levels. The paper also demonstrates the spill over effect of drought on non-food industries. This finding is consistent with the World Economic Forum (2015) that drought is regarded as the greatest risk of all natural disasters as drought has the potential to damage a wide range of industries. The paper highlights the role of cash flow and financial unconstrained factors as effective tools to alleviate the adverse influence of drought on capital structure and the pace of leverage adjustment.

This thesis offers policy implications for both policymakers and firms. Firms with high levels of total and long-term leverage are likely to reduce their debt; however, the rate of adjustment is relatively low due to bankruptcy and agency costs. Therefore, managers should pay more attention when firms have considerable total- or long-term debt volume. Additionally, although firms with high short-term debt can raise more short-term debt, there are problems of liquidity that managers should anticipate and handle.

For the Vietnamese market, despite the essential role of state-owned firms, the government should accelerate the privatisation process due to the significantly adverse influence of state ownership on the economy. To address the inefficiency of the current state-owned enterprises, the Vietnamese government should impose policies to monitor their financing activities and consider the raising of equity for both low- and high-leveraged state-owned enterprises and repurchasing their debt. Local regulators, practitioners, state-controlled banks, and other parties which are associated with the financing activities of state-owned firms should also be supervised closely. Moreover, in order to improve the overall quality of corporate governance, the Vietnamese government should follow other European countries in having a binding quota to promote gender diversity and taking active measures to attract foreign investment by providing them with more favourable conditions. Firms can also impose their own policies to enhance gender diversity, increase managerial ownership as it is helpful for firms, and give serious consideration to what is the ideal number of members in their board of directors, as the skills, knowledge, experiences and networks of board members are very important for fund raising in the Vietnamese market.

This paper also offers suggestions to reduce the negative impact of drought. Policymakers should consider imposing innovative policies to support banks as well as firms during a prolonged drought. Additionally, borrowers and lenders should take into

account the factors associated with business risks such as droughts and other natural disasters. Firms need to be actively mitigating the risks associated with drought by increasing their cash holdings and credit ratings.

6.6 Limitations and directions for future research

Despite the aforementioned contributions, this study is, of course, subject to some limitations. We concentrate on internal corporate governance mechanisms rather than external ones. Further studies can examine external governance variables such as the reputation of the audit committee and the size of the audit committee. In terms of advancing research in relation to the influence of gender diversity, the specific characteristics that female directors may bring to financial decision making could be more clearly identified by future studies.

Our examination of drought, capital structure and the adjustment speed of capital structure had only focused on the listed firms in the U.S. market. Future studies can investigate the effect of drought on firms in other national contexts to provide out-of-sample evidence. While our focus was on how firms respond to drought, in the form of financial decisions, future researchers could consider an exploration of other corporate policies, such as investment, equity financing, and pay-out.

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Appendices

Appendix 1: Co-authorship Form



Co-Authorship Form

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Chapter 2: Currently under review of the Accounting and Finance:
Thao, N. H., Min, B., L., Greg, H., Truong, C. (2019). Speed of adjustment toward target leverage: Evidence from a quantile regression analysis.

Nature of contribution by PhD candidate	Data collection, Literature review, Empirical analysis, Writing of the draft
Extent of contribution by PhD candidate (%)	70%

CO-AUTHORS

Name	Nature of Contribution
Min Bai	Qualitation, Supervision, Investigation, writing-reviewing and Editing
Greg Hou	Qualification, Supervision, Investigation, Writing-reviewing and Editing
Cameron Au	Share the account to collect data on Compustat

Certification by Co-Authors

The undersigned hereby certify that:

- ❖ the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

Name	Signature	Date
Min Bai		22/01/2022
Greg Hou		23/01/2020
Cameron Au		22/01/2020

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Thao, N. H., Min, B., L., Greg, H., Vu, M.C. (2019). Examining the impacts of state ownership on adjustment speed leverage: Evidence from Vietnam

Nature of contribution by PhD candidate: Firms' variables collection, Literature review, Empirical analysis, Writing of the draft
Extent of contribution by PhD candidate (%): 70%

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Name	Nature of Contribution
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Greg Hou	Visualization, Supervision, Investigation, writing-reviewing and editing
Vu M.C.	Share the state ownership variables data

Certification by Co-Authors

The undersigned hereby certify that:

- ❖ the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

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Nature of contribution by PhD candidate: Firms variables collection, Literature review, Empirical analysis, writing of the draft

Extent of contribution by PhD candidate (%):

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Name	Nature of Contribution
Min Bai	<i>Visualization, Supervision, Investigation, writing - Review and Editing.</i>
Greg Hou	<i>Visualization, Supervision, Investigation, Writing, Review and Editing</i>
Vu M.C.	Share the corporate governance variables data

Certification by Co-Authors

The undersigned hereby certify that:
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Name	Signature	Date
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Vu M.C.	<i>Mank-Chien Vu</i>	21/01/2020

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Nature of contribution by PhD candidate	Data collection, Literature review, Empirical analysis, Writing of the draft
Extent of contribution by PhD candidate (%)	70%

CO-AUTHORS

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