Firm Financial Behaviour Dynamics and Interactions: Is Leverage Residually Determined?

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Doctor of Philosophy

University of York

Management

June 2019

Abstract

This thesis investigates the dynamics and interactions of firm financial behaviours, with a focus on capital structure (leverage) decisions. The thesis is composed of three empirical chapters, after a review of the literature in Chapter 2. Chapter 3 of the thesis uses a five-variable Structural Vector Autoregression (SVAR) framework to investigate the dynamics and interactions of firm financial behaviours (i.e., investment, dividend, leverage, equity issuance and profitability). The results show that the aforementioned financial behaviours are jointly-determined. Firms deviate from the desired level of each financial characteristic to absorb shocks to the other financial characteristics. The deviation is followed by a reversion in subsequent periods. Leverage is the most easily-influenced variable among the five, but there is still a clear tendency to revert. Chapter 4 discusses the mechanical effects of other financial behaviours on leverage target adjustments. This chapter extends the traditional partial adjustment model of capital structure by using interaction terms to capture the mechanical effects of other financial behaviours. The results show that capturing other financial behaviours reduces the estimated leverage adjustment speed by around 50%. Beyond that, there is still a substantial fraction of the observed adjustment, which is not controlled by the mechanical effects. This indicates that firms actively adjust their leverage ratio. Chapter 5 evaluates the supply-side effects on firm capital structure. Using a list of macroeconomic proxies, this chapter empirically demonstrates that firm leverage policy is associated with supply-side factors. However, controlling these factors does not eliminate leverage target adjustments. This indicates that the observed leverage target adjustment is not driven by the cyclical supply-side factors. Although firms adjust their leverage ratio to accommodate other financial behaviours and supply-side effects, the results show that leverage target adjustment remains robust. Overall, the evidence in this thesis supports the *trade-off theory* of capital structure, against the criticism that firm leverage policy might be residually determined. This thesis contributes to understanding corporate financial decisions in dynamic settings.

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Acknowledgement

I am deeply indebted to my supervisors, Dr. Hafiz Hoque and Prof. Jacco Thijssen, and the third Thesis Advisory Panel member, Dr. Keith Anderson, for their suggestions in the four years of my study. Without their suggestions, I could not have structured and polished my work into a thesis. I would also like to thank all of the supporting staffs at the University of York for the research environment and the resources.

I am very grateful to my family, my wife, Xiamei Zhu, my parents, Xiaoguang Li and Aihua Guo, and my grandparents, Zhongzhou Li and Kelan Feng, for their love and support so that I can overcome all of the difficulties during my study.

Declaration

I declare that this thesis is a presentation of original work, and I am the sole author. This thesis has not been submitted for examination at this or any other institution for another award. All sources are acknowledged as References.

Chapter 1 Introduction

1.1 Motivations and Research Questions

Capital structure (or leverage) denotes the proportion of debt capital in firms' assets (debt capital plus equity capital). It shows the extent to which firms use borrowed funds to support operation activities and to generate returns. Modern studies on firm capital structure start from Modigliani and Miller (1958). In the classical world of *MM theorem* (Modigliani and Miller, 1958), firm financing decisions are 'irrelevant'. Under the assumption of a perfect market where there is no tax, financial constraint or friction, financing choices do not add value to firms. Although the *MM theorem* lays the foundation for studies in corporate finance, the studies in later years moved away from perfect market assumptions. As firstly noted in Dhrymes and Kurz (1967), when the capital market is not perfect and firms are constrained by the availability of external funds, there are interactions behind firm financial behaviours.

Recent studies aim to clarify the relationship behind firms' investment behaviours, dividend behaviours and financing behaviours. For instance, Hennessy and Whited (2005) develop a trade-off model, and find that firms make financing decisions jointly with investment and dividend decisions. Lambrecht and Myers (2012) build up an agency model. Assuming that managers maximize their own payoffs, Lambrecht and Myers find that firms tend to smooth the dividend payout ratio; and hence, debt absorbs shocks to investment and operating profits in order to balance the budget constraint. DeAngelo and Roll (2015) indicate that firm investment, dividend and equity issuance are more important than the leverage ratio, and question whether leverage is residually determined among these financial behaviours. Overall, these studies suggest that firm investment, dividend and leverage are jointly determined when the capital market is not perfect. However, the number of empirical studies exploring these issues falls short. This thesis aims to fill some of the gaps from this perspective.

Previous studies leave a few issues. First, many of previous studies tend to explain firm investment decisions, dividend decision and financing decisions separately. However, firm financial decisions are linked by the budget constraint (Lambrecht and Myers, 2012). Are firms able to achieve all of the tasks (i.e., investment, equity market timing, dividend target and leverage target) at the same time? If not, which one do firms give a higher or lower priority? Is leverage determined as a residual so that it is used to accommodate other financial behaviours. Moreover, previous studies tend to use a vector of firm-level and institutional-level characteristics to model the target leverage ratio and to examine an identical speed of adjustment (SOA). Although some studies (such as Oztekin and Flannery, 2012; Cook and Tang, 2010; and Drobetz et al., 2015) shed lights on the heterogeneous features of SOA, to my knowledge, there is no study explaining how other financial behaviours are involved in explaining leverage target adjustment. Third, financing decisions being driven by cyclical supply-side factors can lead to passive reversions in the leverage ratio. Do firms actively adjust leverage beyond the cyclical variation? These issues question whether firms actively adjust the leverage ratio towards a target and whether the *trade-off* *theory* of capital structure is valid. These questions are examined in this thesis.

Chapter 2 of the thesis gives a brief review of the literature and more detailed discussions on the issues and research questions. It first introduces the classical theories of capital structure and the empirical studies. Then, it reviews the dynamics of each firm financial behaviour and gives detailed discussions on the motivations and the related studies to the three more specific research areas.

Chapter 3 enriches corporate finance literature by using a Structural Vector Autoregression (SVAR) framework to model and to analyse the dynamics and interactions of firm financial behaviours. More specifically, Chapter 3 provides rich empirical evidence on the interactions of leverage decisions, investment decisions, dividend decisions, equity issuances (or repurchases) and profitability, and shows how an exogenous shock to one of the financial behaviours is absorbed by the system. The results are new to the literature because most of previous empirical studies tend to evaluate firm financial decisions individually, while the impact of other financial behaviours is not examined. Furthermore, the results suggest that there exist a rank of priority among firm financial behaviours. In practice, firms accommodate the financial task with the highest priority (typically, equity decisions) first and accommodate the financial task with the lowest priority (typically, leverage decisions) last.

A few recent studies (such as Chang and Dasgupta, 2009) question whether the leverage target adjustment observed by using the partial adjustment model (Flannery and Rangan, 2006) is mechanically determined, rather than discretionarily determined. The *trade-off theory* of capital structure (Kraus and Litzenberger, 1973) suggests that firms target an optimal leverage ratio at which firm value is maximized. Numerous empirical studies [1] demonstrate the existence of a leverage target and measure the SOA. The partial adjustment model is the most popular model to estimate the SOA. However, several recent studies question the results of the estimated SOA. For instance, Chang and Dasgupta (2009) find that the estimated SOAs of firms who have a leverage target and who have random-financing behaviours (no target) are very close. Lambrecht and Myers (2012) and DeAngelo and Roll (2015) indicate that firm debt decisions are residually determined, because firms need to accommodate other financial policies. Hovakimian and Li (2011, 2012) and Elsas and Florysiak (2015) question whether partial adjustment models have the power to distinguish leverage target adjustment from other financial motives. Overall, these studies question the validity of the measurement of SOA.

Since other financial behaviours can lead to variations in the leverage ratio through cash flows in the firm, a natural question is whether they are also the sources of leverage target adjustment. If yes, to what extent do these factors drive leverage target adjustment? If the observed target adjustment is purely mechanically-determined, it should not be used to support the *trade-off theory*. Therefore, Chapter 4 aims to differentiate the mechanical effects from an active target adjustment and to evaluate whether

[1] For example, Jalilvand and Harris (1984), Flannery and Rangan (2006), Kayhan and Titman (2007), Antoniou et al. (2008), Cook and Tang (2010), Faulkender et al. (2012), and DeAngelo and Roll (2015).

the active target adjustment is robust. It contributes to the literature by discussing how other financial behaviours mechanically drive leverage target adjustments and whether there remains a non-mechanical fraction of the SOA that can be used to support the *trade-off theory*.

Another important issue is the supply-side effect. The influence of capital supply on firm capital structure has been largely ignored in earlier studies (as noted in Titman, 2002; Baker, 2009, etc); however, this issue receives increasing attention in the last decade (such as in Faulkender and Petersen, 2006; Baker, 2009; Leary, 2009; Lemmon and Roberts, 2010; Graham and Leary, 2011, and Antzoulatos et al., 2016). Classical *MM theory* assumes that capital market is fully elastic and that firm capital structure depends entirely on the demand of firms. Recent studies start to realize that supply shocks also have an impact on firm capital structure. Chapter 5 enriches this branch of literature by using several variables to capture the supply-side factors (such as capital supply, investor sentiment, business cycle, stock return and risk proxies) and empirically examining how these factors influence firm leverage policy. Specifically, Chapter 5 answers the following questions: How are firms' financing choices influenced by supply-side factors? Do firms change their capital structure according to supply-side effects? Is firm leverage ratio pro-cyclical or counter-cyclical? Do the cyclical supply-side factors generate a mechanical mean reversion in firm leverage ratio?

In brief, this thesis contributes to understanding corporate financial decisions in dynamic settings. Empirical studies in capital structure literature tend to regard leverage target adjustment as the evidence for an optimal leverage ratio. If the observed target adjustment is mechanically determined by either the other financial behaviours or by the supply-side factors, the evidence of adjustment may fail to support the *trade-off theory*. Therefore, it is important to evaluate whether there is an active target adjustment beyond the mechanical effects and whether the active adjustment is robust.

1.2 Data Collection

The thesis uses firm data of the CRSP/Compustat merged database. Consistent with recent capital structure studies (such as Graham et al., 2014; and DeAngelo and Roll, 2015), the thesis collects annual report data of all the firms, with financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) excluded. Slightly earlier studies exclude only financials and utilities. This thesis also excludes telecommunications and railroads, because these firms are also labelled as regulated firms in Graham et al. (2014) and DeAngelo and Roll (2015). The four categories of firms are excluded for two reasons. First, Graham et al. (2014) notice that regulated firms tend to use an extraordinarily high leverage ratio and that the leverage ratio is constrained by financial regulations. Hence, regulated firms tend to show different financing behaviours, compared with unregulated firms. Second, this thesis uses the same sampling criteria with previous capital structure studies, so that the results are comparable with previous studies. For the full sample, the sample period is from 1964 to 2014. The three empirical chapters use subsamples with different sample period, due to specific requirements. The details will be discussed in each empirical chapter. Macroeconomic characteristics variables are collected from various sources in Datastream.

In each empirical chapter, the sample firms are required to have a continuous record in the specific sample period. The reason for this restriction is that corporate finance theories are more appropriate for large and mature firms (Myers, 2015). To construct a targeting sample, each chapter reserves those firms with a continuous record in the sample period. Although there might be the survivorship bias, using surviving firms helps restrict the sample to large and mature firms. Similar sampling criteria are also used in Shyam-Sunder and Myers (1999), Fama and French (2002) and Huang and Ritter (2009). I check the robustness of the main findings using the full sample.

In baseline regressions of each chapter, the first three years of data are not used, to remove potential IPO effects. This is motivated by Alti (2006) and Covas and Den Haan (2011). Alti (2006) states that IPO has a negative impact on firm leverage ratio. According to Alti (2006, Table 1), the mean of leverage ratio is 43.17% at the third year after the IPO[2]. This ratio falls into the interval between 42.90% at the 5th year and 43.44% at the 7th year. This evidence suggests that it takes three years for the leverage ratio to return to the natural level. Covas and Den Haan (2011) also find that excluding IPO firms gives a better description of firms' responses towards financial frictions over the business cycle. Since numerous studies, such as Baker and Wurgler (2002), regard the first year in Compustat as the IPO

[2] Alti (2006) define leverage as (total liabilities + preferred stock)/ Assets. Therefore, the calculated leverage ratio is higher than does this thesis.

year, this thesis excludes the first 3 years of data, to remove the IPO effect. In our sample, the mean equity issuance ratio in the first 3 years is about three times higher than that of the remaining sample period.

1.3 Main Findings

Chapter 3 of this thesis uses a five-variable SVAR framework to investigate the dynamics and interactions behind firm investment, dividend payout, leverage, equity issuance (or repurchase) and profitability. This chapter shows empirical evidence on how firm financial behaviours are interdependent. The results show that none of these financial behaviours is completely independent, as predicted by the theories under perfect market assumptions. Instead, firm financial behaviours are determined by their previous realizations and the previous realizations of other financial characteristics. The results are robust to the sampling of firms from 1964 onward or from 1980 onward. The results are also robust in the groups of high-growth firms and low-growth firms.

By decomposing forecast error variances, section 3.4 compares the relative exogeneity (independence) of the simultaneously determined financial behaviours. The results show the order of priority. Specifically, the results indicate that firms tend to give the highest priority to equity issuance and repurchase decisions. Dividend is smoother than firm profitability. Firms use debt and investment to absorb a proportion of shocks to operating profits and to smooth out distributions. Dividend is also smoother than leverage. Dividend shows a faster reversion than does leverage, suggesting that dividend target is given a higher priority than the leverage target. The empirical results support Lambrecht and Myers (2012) who state that firms issue debt to smooth dividend, although the results in Chapter 3 show that debt is not a pure shock-absorber. The order of priority reveals the relative cost of deviating from the desired levels of these financial characteristics. Adjusting equity issuance decisions (to absorb the shocks to the other financial behaviours) is the most costly. Deviating from the target dividend ratio is more costly than deviating from the target leverage ratio. Adjusting investment decisions is more costly than adjusting leverage decisions.

To further examine the interactions, section 3.5 uses orthogonal Impulse Response Functions (IRFs) to visualize how an exogenous shock to one of the financial characteristics leads to responses in the system. The results show that all of the firm financial characteristics deviate from the desired levels to accommodate shocks to other financial characteristics and revert to the desired levels at varying speeds. These results suggest that firms may jointly minimize over the costs of deviating from the desired levels of financial characteristics. There is neither a residually-determined financial behaviour, nor a completely sticky financial behaviour.

Chapter 4 extends the partial adjustment model in Flannery and Rangan (2006), by using interaction terms to capture the mechanical effects of other financial behaviours. This chapter provides an explanation for the mean reversion in leverage, by investigating the extent to which other financing behaviours mechanically drive leverage target adjustments and whether there is a non-mechanical fraction of the estimated SOA.

The results in Chapter 4 show that the other financial behaviours have a mechanical impact on leverage target adjustments. Specifically, firm investment, equity issuance and ROA are associated with the SOA of over-levered firms; whereas investment and ROA are associated with the SOA of under-levered firms than in unconstrained firms. The mechanical effects are more pronounced in financially-constrained firms. These results are robust to an alternative specification by using the financing deficit variable to test the mechanical effects. Another interesting point is that over-levered firms tend to use equity financing to fund the financing deficit, which supports the debt capacity explanation (Leary and Roberts, 2010; Lemmon and Zender, 2010).

Beyond the mechanical effects, there is a substantial fraction of the SOA, which cannot be explained by the mechanical effects. Although controlling the mechanical effects reduces the estimated SOA by around 50%, it does not wipe out leverage target adjustment behaviours. This indicates that the leverage target adjustment is not completely driven by other financial behaviours. Rather, nearly a half of leverage target adjustments is actively determined. The existence of active target adjustment is robust to the partitions according to firm size and dividend payment. These results point to a unified theory of capital structure in which firms consider both targeting an optimal leverage ratio and balancing the budget constraint when making financing decisions.

Furthermore, the results show that under-levered firms adjust faster than over-levered firms, which supports the leverage ratchet effects explanation (Admati et al, 2018). The *leverage ratchet effect theory* suggests that over-levered firms are reluctant to cut debt and then refinance, which shows a lower SOA from above the leverage target. The results in this thesis are robust to using traditional partial adjustment model and using the extended partial adjustment model. Among the partitioned subgroups, constrained and over-levered firms show the lowest adjustment speed. The asymmetry in the estimated SOA suggests future studies examine firm capital structure for over-levered firms and under-levered firms separately.

Recent studies (such as Baker, 2009; and Graham and Leary, 2011) highlight the issue that the impact of supply-side effects on firm leverage decisions has not been fully considered. Chapter 5 contributes to this branch of literature by discussing how the supply-side effects influence firm leverage policy through influencing the costs of financing sources and whether cyclical supply-side factors lead to a mechanical mean reversion in leverage. This chapter empirically examines a list of supply-side factors that are related to the supply of capital on the market. These factors include aggregate stock market return, investor sentiment, interest rate, default risk, economic growth, financial development, and government borrowings.

Chapter 5 finds that firms consider the cost of financing sources when making financing choices. Section 5.3 extends the model testing the *pecking order theory* in Shyam-Sunder and Myers (1999), by using proxies for the supply-side factors to interact with the pecking order coefficient. The results show that firms tend to use equity financing when the cost of equity financing is low or when the cost of debt financing is high, and vice versa. Using a partial adjustment framework, section 5.4 finds that the supply-side factors are important determinants of firm capital structure, even when the demand-side effects are controlled. Section 5.5 examines the cyclicality of the leverage ratio. The results show that firm capital structure is pro-cyclical to the economic cycle but counter-cyclical to the financial cycle.

Although supply-side factors influence firm capital structure and the choice between debt financing and equity financing, these supply-side effects do not wipe out observed leverage target adjustments. Although firm capital structure is pro-cyclical to the economic cycle and counter-cyclical to the financial cycle, the estimated SOA after controlling for the supply-side effects is not reduced. This indicates that although firms consider the supply of capital, the leverage target remains an important consideration to managers. The results in Chapter 5 suggest that firms consider both the supply of capital and the optimal leverage ratio when making financing decisions.

1.4 Thesis Outline

The remainder of the thesis is structured as follows. Chapter 2 reviews the literature and gives more explanations to the researches questions. Chapter 3 uses an SVAR framework to investigate the dynamics and interactions of firm financial behaviours and to evaluate the priority of firm financial behaviours. Chapter 4 focuses on firm capital structure. It extends the traditional partial adjustment model by using interaction terms to capture the mechanical effects and examines whether there is active leverage target adjustment. Chapter 5 investigates supply-side effects on firm financing decisions and evaluates whether the observed leverage target adjustment is actively-determined or is driven by cyclical supply-side effects. Chapter 6 summarizes the thesis, discusses the limitations and gives recommendations for further research.

Chapter 2 Literature Review

Compared with the rich literature on firm capital structure[3], section 2.1 of this chapter gives a relatively brief introduction to the key theories that the thesis is closely related to. Section 2.2 broadly classifies empirical studies into two categories. Some studies focus on testing capital structure theories, whereas the others explain the variation in leverage at different levels. Section 2.3 reviews the key literature on the dynamics of each financial behaviour and the potentially "bi-directional" relationship. After introducing the relevant studies, section 2.4 moves on to the key research questions. Specifically, section 2.4 points out the conflicts and gaps in the literature, and highlights the research questions that are examined in the three empirical chapters.

2.1 Traditional Capital Structure Theories

The study on firm capital structure originates in the famous *MM theorem* in which Modigliani and Miller (1958) find that issuing debt does not add value to firms under perfect market assumptions. In a later version of the theory, Modigliani and Miller (1963) add the third party (the government) in the game. In the latter case, firms could reduce the slice of pizza to the government by using debt financing to shield the tax. As a result, debt adds values to firms. However, a potential issue is that, under this theory, firms should use 100% of debt capital to maximize the value of the firm.

[3] A recent and systematic review of the literature (especially empirical studies) is available in Graham and Leary (2011).

Kraus and Litzenberger (1973) put forward a *trade-off theory* of capital structure in which the authors consider the benefits of tax-shield and the bankruptcy cost. It is argued that issuing debt brings the risk of firms' going bankrupt and that the firms with a larger amount of debt are more likely to go bankrupt. The bankruptcy cost increases when firms use more debt. According to the *trade-off theory,* there is a specific leverage ratio at which firm value is maximized. At this point, the marginal tax-shield benefit of an extra dollar of debt is equal to the marginal bankruptcy cost. This specific ratio is taken as the optimal leverage ratio of the firm. If the leverage ratio is lower than the optimal leverage ratio, firms can benefit from the tax-shield by issuing more debt. If the leverage ratio is higher than the optimal leverage ratio, firms can benefit from reducing the bankruptcy cost by cutting debt or by issuing equity.

In subsequent years, many studies join the discussion and enrich the *trade-off theory* of capital structure. For example, Miller (1977) and DeAngelo and Masulis (1980) indicate that the existence of personal tax can reduce the benefit of using debt to shield corporate tax. DeAngelo and Masulis also find that depreciations can be used as a substitute for the tax-shield of debt financing. Fischer et al. (1989) develop a dynamic trade-off model of capital structure when there is recapitalization cost, namely, the transaction cost. The transaction cost delays leverage target adjustment and potentially leads to a target zone rather than the targeting of a specific ratio. Jensen (1986) find that firms can use debt to discipline managers so that managers make a better use of the cash generated by firms. The disciplinary effects make managers less likely to build skyscrappers. This in turn reduces the agency cost of free cash flows. Berger et al. (1997) find that firms can also use debt to reduce the possibility of being taken over. In terms of the cost of debt financing, Lemmon and Zender (2010) find that issuing debt has a cost of using the debt capacity and that firms tend to issue equity to rebalance the leverage ratio and to maintain their debt capacity. Modern theoretical studies use models in which firm financial behaviours are allowed to interact, such as Lambrecht and Myers (2017). The authors find that managers set debt as a constant that is a proportional to firms' net worth. It suggests that the *trade-off theory* that predicting an optimal leverage ratio still holds.

Myers and Majluf (1984) put forward a *pecking order theory* which ranks the costs of financing sources. Internally-generated funds have the lowest cost, and firms are suggested to use retained earnings as the first choice to fund the financing deficit. If external capital is needed, firms are suggested to use debt financing. Equity financing has the highest transaction cost, because it sends the signal that firm stock price is over-valued. Therefore, equity financing is used as the last resort after debt financing. According to the pecking order theory, the firms with a higher profitability will use a lower leverage ratio because these firm have less demand for debt financing. In the complex version of pecking order theory, firms consider the ability to raise funds for the investment opportunities in the future. Hence, the firms with more expected investment opportunities in the future will use a lower leverage ratio. Under the *pecking order theory,* firms have no intention to rebalance the leverage ratio towards a target.

The *market timing hypothesis* (Baker and Wurgler, 2002) suggests that firms make financing decisions based on the relative cost of financing sources. Specifically, firms issue equity when the stock price is high and repurchase equity when the stock price is low. Under the *market timing hypothesis*, firm capital structure is the accumulated results by continuously timing the security market; and firms do not target a specific leverage ratio.

The *trade-off theory*, the *pecking-order theory* and the *market timing hypothesis* become the "racing horses" in capital structure literature, with a long-lasting debate on which leverage policy firms use. Among the empirical studies focusing on testing these theories, Fama and French (2002) and Huang and Ritter (2009) find that the three theories share many predictions. For example, Fama and French (2002) suggest that both the *trade-off theory* and the *pecking order theory* predict a negative relationship between earnings volatility and leverage, and that both of the theories predict a negative relationship between target payout and firm leverage. In addition, the *trade-off theory*, the *market timing hypothesis* and the complex version of *pecking order theory* (with debt capacity) all predict a negative relationship between investment opportunities and firm leverage. It is concluded that all of the three theories are important explanations of firm capital structure decisions. Moreover, there is not a single theory that can explain all of the variation in leverage.

2.2 Empirical Studies

Numerous empirical studies test the three theories of capital structure. Using the simulated marginal tax rate, Graham (1996) find that high-tax-rate firms use a higher leverage than low-tax-rate firms. In another study, Graham and Tucker (2006) find that the firms engage in tax sheltering have an 8% lower leverage. These studies provide strong evidence that firms use debt to shield tax, as predicted by the *trade-off theory*. In addition, Graham (1999) find that personal tax offsets the corporate tax advantage. Specifically, the study finds a negative impact of personal tax on firm leverage, which is in line with the prediction in Miller (1977) and DeAngelo and Masulis (1980) that the existence of personal tax offsets the benefit of using debt to shield corporate debt.

A large number of studies test the existence of a target leverage ratio. For example, Hovakimian et al. (2001) find that firms use debt (or equity) financing more often, when the current leverage ratio is below (or above) a time-varying leverage target. Flannery and Rangan (2006) develop a partial adjustment model to test the existence of a leverage target and to estimate the speed of adjustment (SOA). In their model, leverage is determined by a one-year lagged leverage ratio. Using the coefficient of lagged leverage to measure the adjustment speed, Flannery and Rangan find that the adjustment speed is over 30% per year, on average. Graham and Leary (2011) compare the SOAs estimated using different estimation methods. The authors find that OLS estimation under-estimates the SOA while fixed effects method over-estimates the SOA. Compared with these two methods, two-step GMM (Blundell and Bond, 1998) generates an SOA falling between those generated by OLS and fixed effects method. In another study, Antoniou et al. (2008) discuss the endogeneity issue in capital structure studies and conclude that two-step GMM is the most robust method to estimate dynamic leverage models. The SOA reported by Antoniou et al. is at around 25%. Alti (2006) investigates the reversion of leverage ratio after the IPO and find that it takes 2-3 years for leverage to revert. Harford et al. (2009) examine M&A data and find that being above or below the leverage target influences the choice of bidders to finance acquisitions. Their study provide additional supports to the *trade-off theory*.

A few of recent studies discusses the heterogeneous features of SOA. For example, Antoniou et al. (2008) find that the adjustment is faster for small firms. Oztekin and Flannery (2012) find that a lower transaction cost of debt financing leads to a faster SOA. Faulkender et al. (2012) further point out that cash flow realizations can provide opportunities for leverage target adjustments. Using a double-censored Tobit estimator, Drobetz et al. (2015) find that firms adjust faster in economic expansions than in economic recessions. It appears that the leverage target adjustment is robust in the partitioned groups of those studies.

Shyam-Sunder and Myers (1999) test the *pecking order theory* by regressing firm debt issuance on the financing deficit. Shyam-Sunder and Myers report a regression coefficient at around 0.8 which indicates that firms fund 80% of the financing deficit by debt financing. This result suggests that debt is the primary source of external financing, as predicted by the *pecking order theory* of capital structure. Lemmon and Roberts (2010) test the complex version of pecking order theory, by using a squared financing deficit variable to capture the impact of debt capacity. The authors find that the *pecking order theory* gives a good description of firm financing behaviours after accounting for the impact of debt capacity.

Baker and Wurgler (2002) find that firm leverage ratio is related to the historical market value of firms and suggest that the market timing effect on firm capital structure is persistent. Their results indicate that firm leverage ratio is the cumulative outcome of previous attempts to time the equity market. By examining the issuance of stocks, Fama and French (2005) find that equity is not used to rebalance the leverage ratio or as the last resort after debt financing. Instead, Fama and French (2005) find that market timing is the primary reason for equity issuance decisions. Huang and Ritter (2009) provide additional evidence to support the *market timing hypothesis*. Specifically, when the cost of equity financing is low, firms are more likely to use equity financing to fund the financing deficit. This indicates that firms care about the cost of financing sources rather than follow a fixed pecking order coefficient.

Besides the studies focusing on testing the three theories, there are also a few studies analysing the variation in firm leverage ratio. These studies examine variations in leverage at firm level (such as Rajan and Zingales, 1995), industry level (MacKay and Phillips, 2005) and country level (Fan et al., 2012). Rajan and Zingales (1995) find that tangibility, firm size, Market-to-book ratio, and profitability are important determinants of firm capital structure. Specifically, the firms with more tangible assets and a larger size tend to use more debt while the firms with a higher market-to-book ratio and higher profitability tend to use less debt. MacKay and Phillips (2005) find that standard industry effects and the firm's position within the industry also determine firm capital structure. Different from Rajan and Zinglaes (1995) who find firm leverage is homogeneous across

G-7 countries, Fan et al. (2012) find that a country's legal and tax system, corruption and the preferences of capital structure explain the variation in firm leverage.

Issues from at least two dimensions are not yet examined. The first one is the impact of other financial behaviours on firm leverage decisions. DeAngelo and Roll (2015) argue that debt is used to balance the budget constraint, and hence, debt decisions can be driven by other financial motives. The second one is the supply-side effects. As Faulkender and Petersen (2005) and Baker (2009) point out, supply side effects on firm capital structure decisions have largely been ignored. Although Fan et al. (2012) shed lights on this issue by capturing bank deposits, the funds available to insurance companies and pension funds, and domestic savings, many of other factors have not been examined, such as GDP growth, stock market return, investor sentiment. Moreover, these factors lead to a cyclical variation in leverage which is mis-interpreted as target adjustment behaviours? This thesis enriches the empirical literature from these two perspectives.

2.3 The dynamics of other Financial Behaviours

Many of previous studies analyse the dynamics of individual financial behaviour of which the corresponding variable is explained by its previous realizations.

Fama (1974) suggests that firm investment activities follow a flexible accelerator model, in which new investment is a function of previously accumulated capital. Gatchev et al. (2010) further suggest that current investment is positively associated with previous investment, where investment is measured by capital expenditure. The reason is that firms tend to stick to their investment plans because frequent stopping and restarting investment projects are costly.

Lintner (1956) suggests that firms target a dividend payout ratio. Empirically, Lintner (1956) uses a partial adjustment framework to model dividend payout ratio and find that dividend is positively correlated with lagged dividend ratio. This indicates that firms smooth dividend payout ratio Otherwise, the variation in dividend may send the signal to investors that firms' profitability is not stable, and hence, brings the information cost. In a recent study, Lambrecht and Myers (2012) provide theoretical supports. Using an agency model in which managers are risk-averse, Lambrecht and Myers find that managers smooth dividend payout to maximize their own payoffs. Lambrecht and Myers (2012) note that Lintner's specification provides a good fit of the time series of firms' cash dividend.

Firms time the stock market by issuing new equity when the stock price is over-valued and by repurchasing equity when the stock price is under-valued, according to Baker and Wugler (2002). This finding is also supported by subsequent studies, such as Alti (2006), Huang and Ritter (2009) and Butler et al. (2011). If firms time the stock market, equity decisions should be driven by the serial correlation of the stock price; and hence, there is a potential serial correlation in firm equity decisions.

Firms should follow these dynamics entirely, if there is no financial friction. However, due to the budget constraint (Lambrecht and Myers, 2012), firms cannot achieve all of the tasks (i.e., investment, equity market timing, dividend target and leverage target) at the same time. When there is a shock to any one of the factors in the budget constraint, firms have to drop one of the financial tasks to accommodate the others. This motivates to look at firm financial behaviours together, rather than investigating each financial behaviour separately.

A few studies indicate a unidirectional relationship among firm financial behaviours. Traditional *pecking order theory* suggests that there exists a pecking order among financing sources, due to the transaction cost of financing sources. Under the *pecking order theory*, investment and dividend are regarded as exogenous. Firms tend to use internally-generated cash to fund the capital demand. If external capital is needed, firms would issue debt first, and the remaining is covered by equity financing. Under the assumption that firms aim to maximize managers' rents, Lambrecht and Myers (2012) argue that firms would issue debt to absorb shocks to internally-generated capital and to smooth investment and dividend payout ratio. Dhrymes and Kurz (1967) take debt financing and equity financing as a whole and argue that external financing decisions are residually determined, depending on investment and dividend decisions. These studies indicate there is an order of priority when firms make financial decisions. Some characteristics (i.e. investment and dividend payout) are very sticky, and others with a lower priority (i.e. debt and equity decisions) are residually determined after the factors with a higher priority. These studies indicate that the relationship among firm financial behaviours is unidirectional.

There is also the evidence supporting an argument on a bidirectional relationship. According to the dynamic framework developed by Hennessy and Whited (2005), firm leverage decisions, dividend payout and investment decisions are jointly determined. On one hand, firm investment needs to be covered by external capital, typically debt financing; on the other hand, new debt also disciplines CEO to drop less profitable investment projects (Aivazian et al., 2005). Dhrymes and Kurz (1967) and Lambrecht and Myers (2012) suggest the firms issue debt to fund investment and dividend, whereas Peterson and Benesh (1983) find financing decisions also have an impact on firm investment because of the capital constraint. Lintner (1956) suggests dividend payment is a targeted proportion of firms' earnings; however, dividend payout also signals future profitability (Miller and Modigliani, 1961). Jensen et al. (1992) suggest that previous investment has a negative impact on current dividend payment. Hoang and Hoxha (2016) find investment is used to cover 40.7% of variation in profitability, to smooth the dividend payout. Overall, these results appear to suggest a bidirectional relationship in which firm financial behaviours are jointly-determined.

2.4 Research Questions and the Relevant Studies

This section presents more details about the main conflicts. It reviews the relevant studies and highlights the main research questions that will be examined in the three empirical chapters.

2.4.1 Firm Financial Behaviour Dynamics and Interactions

Recent studies stress the existence of budget constraints (Lambrecht and Myers, 2012) and financial frictions (Chang et al., 2014), and suggest that firm investment behaviours, dividend behaviours and leverage behaviours need to be modelled together. Lambrecht and Myers (2012) use a budget constraint equation to explain how shocks to one of the financial behaviours are transmitted to the other financial behaviours:

$$\Delta\text{Debt} + \text{Net income} = \text{CAPEX} + \text{Payout}$$

The left side of the budget constraint equation shows that firms raise funds by external debt financing (ΔDebt) and internally-generated operating profits (Net income). The right side of the budget constraint equation shows that the generated funds are utilized through investment activities (CAPEX) and the distributions to shareholders. To keep investment activities and distributions unaffected, firms need to raise or retire debt to erase the shock to operating net income. The budget constraint links firms' investment decisions, dividend decisions and leverage decisions, and provides a direct explanation on why changes in one of the financial behaviours tend to influence the others.[4]

DeAngelo and Roll (2015) point out the issue that the desired levels of these financial characteristics cannot be fully achieved at the same time, because the system is over-determined and the budget is limited. The failure to manage these financial behaviours in practice may lead to an increase in agency conflicts. As suggested in Jensen et al. (1992), asymmetric

[4] Besides the budget constraint, there are other ways that firm financial behaviours are interrelated. For example, new investment increases the collateral, which is necessary to back up new borrowings. The thesis covers this explanation and other related studies when discussing the empirical results in Chapter 3.

information and misaligned incentives of stakeholders generate agency costs, and firms could minimize these costs by optimizing jointly over the aforementioned financial behaviours. Therefore, it can be inferred that firms would allow interactions behind these financial behaviours and jointly balance to reduce the relevant costs. Gatchev et al. (2010) question the studies on a single financial behaviour and argue that the estimates are biased and misleading, due to the lack of variables to capture the impact of other financial behaviours. Compared with the studies explaining a single financial behaviour, the number of studies investigating the interactions behind multiple financial behaviours is relatively small.

A series of questions concerning financial behaviour interactions remains unanswered. First, there is not a systematic empirical examination on the joint-dependence behind firm financial behaviours. Do firm investment behaviours, dividend behaviours, and financing behaviours help explain each other? Second, if firm financial behaviours are simultaneously and jointly determined, does any financial behaviour own a higher (or lower) priority and tend to be less (more) influenced by the other financial behaviours? Since the system is over-determined, firms must use some of the financial behaviours with a lower priority to accommodate the others with a higher priority, when the targets cannot be achieved at the same time. So, which financial policy (i.e., leverage target, dividend target, investment, equity market timing) do firms give a high priority? Is the financial policy with the lowest priority residually determined after those with a higher priority, in order to balance the budget constraint? Third, if firm financial behaviours are interrelated, how do they interact with each other? To put it in another way, how is the shock to one of the financial behaviours absorbed by the other financial behaviours? Do firms have a residual financial behaviour to absorb shocks and to smooth other financial policies? These questions are answered in Chapter 3.

2.4.2 Is Leverage Target Adjustment Mechanically Determined?

The *trade-off theory* of capital structure suggests that there is an optimal leverage ratio at which firm value is maximized. On one hand, firms need a certain amount of debt to shield tax (Modigliani and Miller, 1963), to defend against take-overs (Berger et al., 1997) and to discipline managers (Jensen, 1986). On the other hand, overleverage leads to a high bankruptcy cost and a heavy interest burden (Kraus and Litzenberger, 1973). The firm value is maximized, when the marginal benefit of debt financing is equal to the marginal cost. Hovakimian et al. (2001) enrich the *trade-off theory* by suggesting that firms target an optimal leverage ratio, although the target may change over time. The partial adjustment model is widely used to test the *trade-off theory* and to estimate the SOA. Flannery and Rangan (2006) document an SOA at around 30% per year. Kayhan and Titman (2007) summarize and conclude that firms revert to the target leverage ratio at a slow speed after the deviations caused by the financing deficit, the demand for external capital, and the stock price tendency. Other empirical studies (such as Antoniou et al., 2008; and DeAngelo and Roll, 2015) find qualitatively similar results, although the estimated SOA varies. Recent studies investigate the heterogeneous features of the SOA estimated by using partial adjustment models, such as Oztekin and Flannery (2012), Cook and Tang (2010), Drobetz et al. (2015). It seems the existence of a leverage target is robust across all of their partitioned samples. As an alternative test to the partial adjustment model, Hovakimian and Li (2011) find that debt-equity choice models generate similar results. Specifically, whether the current leverage ratio is above or below the leverage target influences firms' financing decisions on whether to use debt financing or equity financing.

A few studies question the validity of the estimated SOA. Shyam-Sunder and Myers (1999) argue that the motivation of external financing is the demand for funds, rather than the targeting of a specific leverage ratio. Shyam-Sunder and Myers find that the *pecking order theory* predicts firm capital structure better than the *trade-off theory*. Moreover, leverage mean reversion could also be driven by cyclical fluctuations in firms' investment and profitability. Therefore, Shyam-Sunder and Myers argue that the mean reversion does not prove targeting a specific ratio. Simulation results in Chang and Dasgupta (2009) show that the estimated SOA of firms financing randomly (0.31) is very close to that of firms with leverage targets (0.37). Hovakimian and Li (2011, 2012) and Elsas and Florysiak (2015) criticize the validity of partial adjustment models and question whether the estimated SOA is economically meaningful[5], because leverage ratio is technically bounded between 0 and 1. As Hovakimian and Li (2011) note, many over-levered firms reduce leverage due to financial transactions rather than targeting a specific ratio. The model of leverage without commitment to a specific leverage target built by DeMarzo and He (2016) also show mean reversion in leverage. DeAngelo et al. (2011) find that a model in which

[5] In Hovakimian and Li (2011), the 'real SOA' is between 5% and 8%, which is much lower than the results generated by the partial adjustment model (around 30%) in Flannery and Rangan (2006).

firms issue or retire transitory debt to absorb shocks generates a slow SOA. Lambrecht and Myers (2012) argue that firms need to issue or repurchase debt to smooth investment and distributions. DeAngelo and Roll (2015) further point out that firms cannot complete all of the financial tasks (i.e. dividend target, leverage target, investment, and market timing) at the same time and that debt decisions may be residually determined. According to these studies, the estimated SOA may fail to capture the real adjustment speed. In particular, it cannot differentiate active target adjustment activities from mechanical reversions driven by other financial motives. While potential mechanical effects have been noticed in these studies[6], the importance and impact of the mechanical effects have not been fully explained.

Previous studies leave at least three gaps in the literature. First, previous studies tend to use a vector of firm-level and institutional-level characteristics to model the target leverage ratio and to examine an identical SOA. Although some studies (such as Oztekin and Flannery, 2012; Cook and Tang, 2010; and Drobetz et al., 2015) shed lights on the heterogeneous features, to my knowledge, there is no study explaining how other financial behaviours are involved. Second, most of empirical studies tend to estimate an identical SOA for over-levered firms and under-levered firms. However, the reverting speed should be asymmetric, when firms are temporarily above or below the leverage target, because adjusting from above and adjusting from below do not face the same adjustment cost. Controlling profitability,

[6] While a few studies (such as Chang and Dasgupta, 2009; Lemmon and Zender, 2010) compare the ‘target adjustment’ of firms with a target and firms with random financing; a weakness is that simulations do not control the heterogeneity at firm level. It has a potential to result in biased estimates.

over-levered firms reduce leverage by issuing equity or by dropping existing investment project; while under-levered firms could issue debt to shield tax, which has lower costs. Therefore, the estimated SOAs should also differ. Although some studies (such as Flannery and Rangan, 2006; and Faulkender et al., 2012) notice the difference, the asymmetry between over-levered and under-levered firms has not been fully explained, especially in terms of an active adjustment. Third, if leverage target adjustment is driven by other financial behaviours, how important are the mechanical effects? Is there any active target adjustment beyond the passive reversion driven by the mechanical effects? If yes, is the active target adjustment influenced by the financial constraint? These questions are answered in Chapter 4.

2.4.3. Supply-side Effects on Firm Capital Structure

Earlier studies tend to assume that external funds are always available to firms and that the leverage ratio depends on firms' selections between debt financing and equity financing. For instance, the *trade-off theory* suggests that the optimal leverage ratio depends on the trade-off between the benefit of tax-shield and the bankruptcy cost. The demand of firms for tax-shield or to reduce bankruptcy cost is the primary reason to issue debt or equity, under the *trade-off theory*. The *pecking order theory* assumes that the cost of equity financing is larger than the cost of debt financing, due to asymmetric information. Therefore, firms prefer debt capital over equity capital. The two theories, together with their assumptions, form the foundation for follow-up studies. As noted in Baker (2009), supply-side effects on firm capital structure are largely ignored.

Several recent studies stress the impact of capital supply. For instance, Faulkender and Petersen (2006) find that firms with bond ratings have a significantly higher leverage ratio, because firms with bond ratings have more access to debt capital. Baker (2009) points out that traditional corporate finance studies focusing on demand-side effects do not provide sufficient evidence explaining the time series of firm financial decisions. Using case studies, Lemmon and Roberts (2010) find that even large firms with bond ratings are subject to shocks to the supply of capital (i.e., credits). Graham et al. (2014) find that the aggregate leverage ratio increases dramatically in the last century and that firm-level characteristics are unable to explain these aggregate changes. Graham et al. suggest that the economic and institutional environment is better able to explain the secular trend of firm capital structure. Overall, these studies highlight the importance of considering supply-side effects when explaining firms' financing decisions.

A series of questions concerning supply-side effects need to be answered. Numerous studies (such as Baker and Wurgler, 2002; Huang and Ritter, 2009) indicate that the costs of financing sources influence firms' financing decisions because firms time the security market. Since the cost of financing sources is not only influenced by the demand, but also influenced by capital supply; supply-side factors should also influence firms' financing decisions and the capital structure. Traditional *pecking order theory* assumes a lower transaction cost of debt capital than that of equity capital. However, what if both costs fluctuate, and equity financing is sometimes cheaper than debt financing? Do investors still want to use equity financing as the last resort after debt financing? Moreover, if the market condition is cyclical, firms may change their financing decisions following market conditions (Huang and Ritter, 2009) and the investor sentiment (Mclean and Zhao, 2014). As a result, the leverage ratio may be driven by the business cycle. Shyam-Sunder and Myers (1999) and Chang and Dasgupta (2009) question whether the observed leverage target adjustment is due to a mechanical reversion in leverage. Since firm leverage ratio can be driven by the business cycle, a further question is whether leverage target adjustments are mechanically determined when the leverage ratio follows the business cycle, especially cyclical supply-side factors. Chapter 5 answers these questions.

Chapter 3 Dynamics and Interactions of Firm Financial Behaviours

Recent studies aim to clarify the relationship behind firms' investment behaviours, dividend behaviours and financing behaviours, such as in Hennessy and Whited (2005) and Lambrecht and Myers (2012; 2017). DeAngelo and Roll (2015) point out that firm investment, dividend and equity issuance are more important than the leverage ratio, and question whether leverage is residually determined among these financial behaviours. Overall, these studies suggest that firm investment decisions, dividend decisions and financing decisions are jointly determined. Therefore, the studies on one of the financial behaviours without controlling for the others may generate biased and inconsistent estimates. This chapter seeks to enrich this branch of literature by empirically examine the dynamics and interactions of firm financial behaviours. More specifically, using a five-variable Structural Vector Auto-regression (SVAR) framework, this chapter provides rich empirical evidence on the interactions behind leverage decisions, investment decisions, dividend decisions, equity issuances (or repurchases) and profitability, and shows how an exogenous shock to one of the financial behaviours is absorbed by the firm.

Using the SVAR framework and the data of Compustat firms, this chapter shows that firm financial behaviours are interdependent. SVAR models are better than the traditional regression approach because it allows the variables to be endogenously determined. The results suggest that none of these financial behaviours is completely independent, as predicted by the theories under perfect market assumptions. Instead, firm financial behaviours are determined by their previous realizations and the previous realizations of other financial characteristics. The results are robust to the sampling of firms from 1964 onward or from 1980 onward and to a few alternative definitions of variables. The results are also robust in the groups of high-growth firms and low-growth firms.

By decomposing forecast error variances, this chapter compares the relative exogeneity (independence) of the simultaneously-determined financial behaviours. The results show that firms tend to give the highest priority to equity issuance or repurchase decisions. This is followed by the dividend target and then investment. Firms use debt and investment to absorb a proportion of shocks to operating profits and to smooth out distributions. Dividend is also smoother than leverage, with a faster reversion, suggesting that the dividend target is given a higher priority than the leverage target. Although debt is used to smooth dividend, the results suggest that debt decisions are driven by its own shocks to a large extent (over 70%), rather than being completely driven by the other financial behaviours. It implies that debt is not a pure shock-absorber.

To further examine the interactions, section 3.5 uses orthogonal Impulse Response Functions (IRFs) to visualize how an exogenous shock to one of the financial characteristics leads to responses in the system. The results show that all of the firm financial characteristics deviate from the desired levels to accommodate shocks to other financial characteristics, and revert to the desired levels at varying speeds. These results suggest that firms may jointly minimize over the costs of deviating from the desired levels of financial characteristics. There is not a residually-determined financial behaviour[7].

Chapter 3 is structured as follows. Section 3.1 discusses the data. Section 3.2 shows the methodology. Section 3.3 specifies the SVAR model and investigates the interdependence of firm financial behaviours. Section 3.4 evaluates the priority of financial behaviours by decomposing the forecast error variance of each financial behaviour variable. Section 3.5 uses Impulse Response Functions (IRFs) and examines how financial behaviours respond to orthogonal shocks to other financial behaviours. Section 3.6 discusses the robustness of the results. Section 3.7 analyses and compares the responses of high-growth firms and low-growth firms. Section 3.8 discusses the results, concludes, and states the limitations of the study.

3.1 Data, Time Series Characteristics and Unit Root Tests

This chapter uses the whole sample period that is from 1964 to 2014. It uses firms that have successfully survived for over 50 years, rather than all of the observations. This is consistent with the corporate finance theories focusing on large and mature firms (Myers, 2015). Moreover, this chapter works with panel time-series, and a relatively-smaller panel with a longer period is more favourable than a larger panel with a shorter period. This leaves a balanced panel of 285 firms. For each firm, there are 51 years of data. The regression analysis uses data from 1967 onwards, three years after 1964, to remove potential IPO effects (Alti, 2006) so that the data can start from a 'natural status'. This chapter uses a different sample period, from 1980 to

[7] In this thesis, the residual role indicates that firms use this financial decision to balance the budget constraint and to accommodate other financial behaviours.

2014, as a robustness check. This requires sample firms to have data from 1977 onwards. In this case, there are 485 firms in the sample, compared to the 285 firms in the baseline sample. Descriptive statistics are provided in Table 3.1. Definitions of variables are summarized in Appendix 1, at the end of this thesis.

Table 3.1 presents descriptive statistics of the firms that are used in this chapter. *Leverage ratio (Lev)* measures the proportion of total debt (long-term debt plus short-term debt) to the book value of total assets. The mean of *leverage ratio* is 0.229, and the median is 0.215. The mean leverage ratio is slightly lower than that of the full sample (0.231 as shown in Appendix 3) because the full sample contains the firms going bankrupt. The value is also close to a recent study in which Chang et al. (2019) report a mean leverage ratio of 0.218. *Netlev* has a mean of 0.173 after treating cash holdings as negative debt. *Return on Assets (ROA)* measures firms' ability to generate funds internally, with a mean of 0.058 and a median of 0.061. Net income is nearly a half of the earnings before interest and tax (*ROAe*). Following Gatchev et al. (2014), this chapter uses capital expenditure scaled by total assets to measure firm investment (*Inv*). Investment stands for around 6.4% of firm total assets. Following Fama and French (2002), this chapter uses cash dividend scaled by total assets to measure *dividend payout ratio (Divc)*. The mean of *Divc* is 0.022 and the median is 0.018.[8] This chapter uses *equity issuance ratio (Equ)* to measure the proportion of net

[8] A few studies, such as Strebulaev and Yang (2013) and Fama and French (2002), discuss the behaviours of zero-leverage firms and dividend nonpayers. In this study, zero-leverage and dividend nonpayer are not important factors. Seldom of the large and mature firms do not use debt financing, or continuously retain all their earnings. Therefore, these observations are not discussed separately.

equity issued in year *t* to total assets at the end of year *t*. A mean of 0.007 indicates that net equity issuance makes up 0.7% of total assets at the end of the year, on average. A negative value of *Equ* indicates net equity repurchase.

Figure 3.1 shows the aggregate trends of firm financial behaviour variables. According to Panel A of Figure 3.1, the median leverage ratio raises from 0.15 at 1964 to 0.24 at around 1970. Firms reduce debt after 1970 and start to issue more debt after 1985. The trend of leverage is close to the plot of NYSE firms in Graham et al. (2015, Figure 3) in which median leverage ratio decreases between 1970 and 1980, then rises after 1980, and finally fluctuates at a high level[9]. Panel B of Figure 3.1 shows that median *ROA* fluctuates at around 0.07 before 1980s. Firms' average profitability drops slightly after 1990, and it becomes more volatile. Additionally, panel B shows that firm profitability drops heavily in crisis periods (the Gulf War in 1991, the Asian financial crisis and the dot-com bubble from 1997 to 2001, and the subprime mortgage crisis in 2008). Panel C shows that firm investment is on a long-run decrease after 1980. The median investment ratio drops from over 0.08 at 1980 to around 0.03 after 2010. Panel D shows that firms reduce dividend payment during expansion, and the dividend payout ratio drops from over 0.023 at 1964 to below 0.015 in earlier 2000s. After 2003, dividend payout ratio bottoms out and returns to 0.015 level in 2008. The median equity issuance ratio in Panel E fluctuates at around 0.002 in the whole sample period, but becomes more

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[9] Please mind that Graham et al. (2014) define leverage as total debt over (total debt + total equity) where retained earnings are not included. This thesis uses total assets as the denominator, which will generate a lower leverage ratio.

volatile after 1980. The net debt ratio, after treating cash holdings as negative debt, follows a similar trend with that of the leverage ratio.

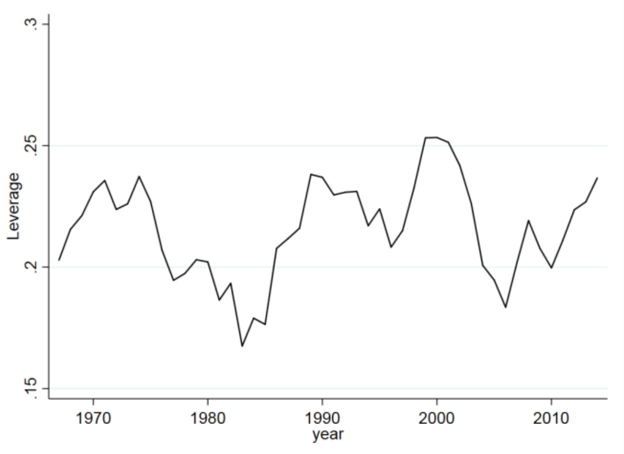
Table 3.1 Descriptive Statistics

Variable	N	Mean	Median	Std. Dev	p5	p95	Skewness	Kurtosis	Jarque-Bera
Lev	13,641	0.229	0.215	0.155	0.009	0.493	0.642	3.308	5,945.839
Levl	13,237	0.369	0.351	0.411	0.038	0.770	1.198	4.981	31,984.487
ROA	13,647	0.058	0.061	0.105	-0.036	0.149	-0.797	5.702	33,577.215
ROAe	13,645	0.114	0.108	0.082	0.002	0.245	0.242	3.558	1,861.246
Inv	13,541	0.064	0.052	0.050	0.012	0.158	1.499	5.596	53,240.572
Divc	12,361	0.022	0.018	0.029	0	0.060	1.579	6.237	63,199.114
Equ	13,575	0.007	0.001	0.057	-0.048	0.078	1.694	11.774	300,216.620
NetLev	11,949	0.173	0.171	0.181	-0.092	0.459	0.148	3.259	462.119

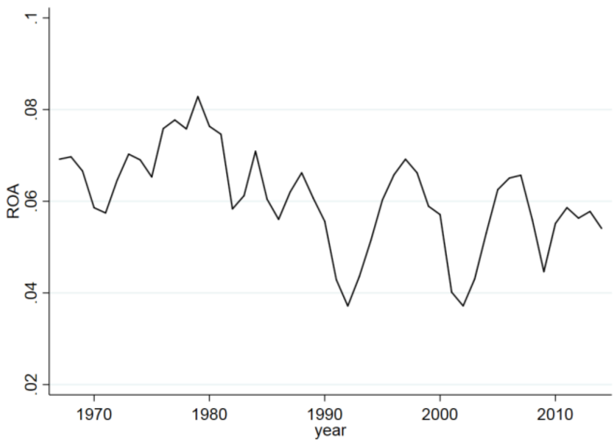
This table presents descriptive statistics of variables capturing firm financial behaviours. The data are collected from CRSP/ Compustat merged database. The sample includes all of the unregulated Compustat firms with a continuous record from 1964 to 2014, and the data are collected on annual basis. This table reports the number of firm-year observations, mean, median, standard deviation, 5th and 95th quantile values, skewness, kurtosis and Jarque-Bera Statistics. The definitions and explanations of variables are summarized in Appendix 1.

Figure 3.1 Trends of Firm Financial Behaviour Variables

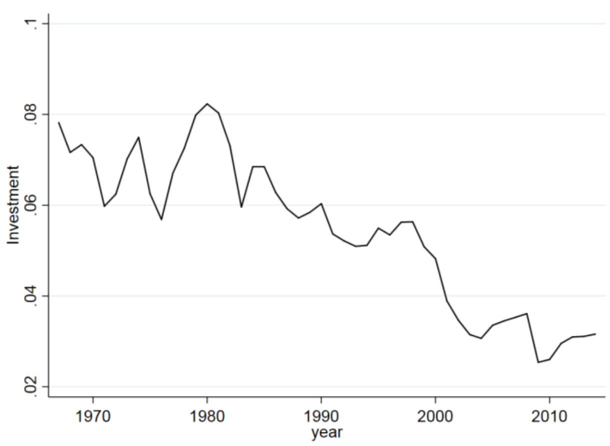
Panel A. Leverage



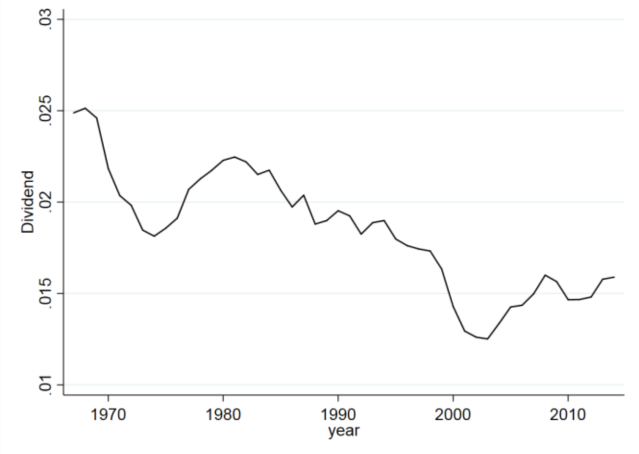
Panel B. ROA



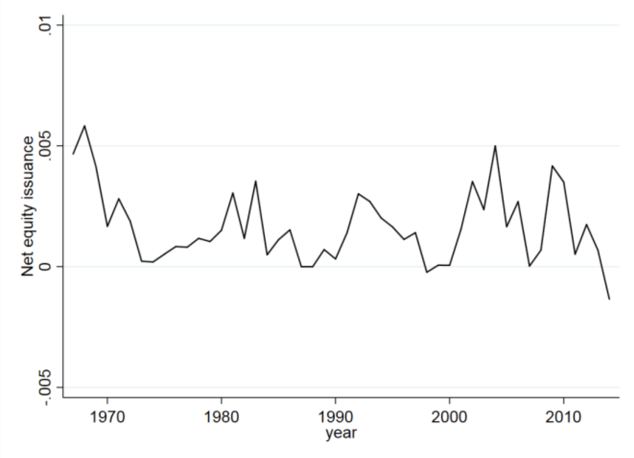
Panel C. Investment



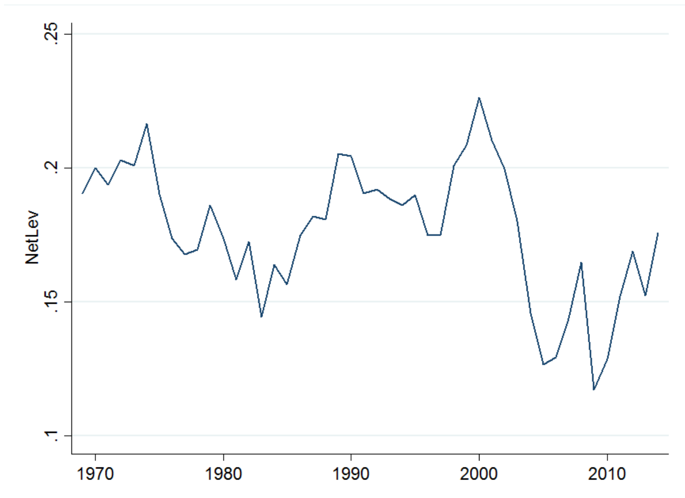
Panel D. Dividend



Panel E. Net Equity Issuance



Panel F. Net Debt Ratio



This figure shows the aggregate trends of firm financial behaviour variables. The sample includes all of the unregulated Compustat firms with a continuous record from 1964 to 2014. The median values of Leverage ratio, ROA, Investment to assets ratio, Dividend to assets ratio, Net equity issuance ratio and Net debt ratio are shown in Figure 3.1. Definitions of variables are shown in Appendix 1.

SVAR models require variables to have stationary time series, as unit roots lead to the weak instrument problem (Blundell and Bond, 1998). Abrigo and Love (2016) cite Blundell and Bond (1998) and explain that First Difference and Forward Orthogonal Deviation transformations (details are explained in section 3.2) generate white-noise error terms when there exists the unit root; in this situation, moment conditions of Instrumental Variables (IVs) do not provide relevant information. Nelson and Plosser (1982) also suggest that the unit root process has non-standard statistical properties[10] and emphasize the role of unit root tests to make sure standard time series methods are applicable. Besides the fact that all of the employed variables in this chapter are scaled by total assets to eliminate unit roots, this chapter also checks the stationarity of the data by performing unit root tests on these variables.

This chapter uses the Fisher-type Augmented Dicky-Fuller test (Maddala and Wu, 1999, referred to as ADF test) and the Phillips and Perron test (1998, referred to as PPerron test) to test the unit root in the employed variables. The fisher-type ADF test uses meta-analysis to combine the p-values of unit root tests on separated time series basis and performs an over-all test (Choi, 2001). As further suggested by Choi, the ADF test could accommodate possible lag lengths variation across panels. Unlike the ADF test which uses lags of differenced dependent variable to control the serial correlation, the PPerron test uses Newey-West standard errors to control the serial correlation. Therefore, this chapter uses PPerron test as the alternative to test unit roots. In both tests, the null hypothesis (H_0)

[10] For example, if there is the drift in the process, the mean value of the first half of the process would not be equal to the mean value of the second half.

is that there exist unit roots, while the alternative hypothesis (H_1) is that the time series is stationary.

Table 3.2 Unit Root Tests

Variable	N-Panel	ADF	Phillip-Perron
Lev	285	12.66***	19.17***
Levl	285	15.05***	30.28***
ROA	285	50.56***	100.58***
ROAe	285	33.42***	38.16***
Inv	285	63.82***	82.77***
Divc	285	14.26***	31.00***
Equ	285	102.20***	227.01***
NetLev	285	9.94***	14.47***

This table presents results of unit root tests for the variables capturing firm financial behaviours. The sample includes all of the unregulated Compustat firms with a continuous record from 1964 to 2014, and the data are collected on annual basis. This table reports the number of firms, and unit root test results. *** indicates significance at the 1% level.

Table 3.2 reports the results of ADF test and PPerron test. Specifically, this chapter uses the Pm statistics of both the ADF test and the PPerron test, because this estimator have standard asymptotic distribution and perform well in large *N* and large *T* panels (Choi, 2001, see p.255 for the definition of Pm statistics). *N* denotes the number of panels and *T* denotes the length of sample period. In the baseline regression, 285 firms are employed, and the sample period is 51-year. Therefore, the sample is regarded as 'large *N* and large *T*', or at least 'moderate *N* and moderate *T*' according to Levin et al. (2002), rather than finite sample. Constant terms are included. Time trends of the variables are included to control fixed effects on yearly basis. Based on the results in Table 3.2, the null hypothesis is rejected at the 1% level. This suggests that the employed variables are stationary, and eliminates the doubts on possible weak-instruments problem caused by unit roots.

3.2 Methodology

The SVAR framework is originally developed in Sims (1980), and it is widely used to model the monetary transmission mechanism behind a list of simultaneously-determined variables in macroeconomics. The SVAR model explains an endogenous variable by its own lags and the lags of the other variables in the system. It uses a structure of models to capture the contemporary effects. SVAR models use orthogonal innovations in the endogenous variables to achieve identification by which simultaneity could be avoided.[11] Holtz-Eakin et al. (1988) suggest a method to estimate SVAR coefficients in panel dataset.[12] This chapter uses an SVAR framework to model the dynamic relationship behind firm investment, dividend payout, profitability, leverage, and equity issuance. Under the SVAR framework, each financial behaviour variable is explained by its previous realizations and the previous values of the other financial behaviour variables.

SVAR models have merits over other methods. Compared with theoretical models, SVAR models do not need to limit the dimensionality[13]; and hence, all of the five variables can be taken as endogenously determined. This gives a more practical environment. Compared to single equation regression models, SVAR models allow interdependence among the financial variables. This generates more efficient and consistent estimates than single equation regression models. Sims (1980) criticizes

[11] Sims (1980) transforms the innovations into the orthogonal form, in order to show the distinct patterns of movements in the simultaneously determined variables.

[12] This method is also referred to as Panel Vector Autoregression (PVAR) is some literature.

[13] Theoretical models assume the exogeneity of some variables to reduce the dimensionality. See Titman and Tsyplakov (2007, Table 1) for a summary of the assumptions.

traditional simultaneous equation models and argues that the assumed exogeneity of explanatory variables leads to incredible interpretations. Instead, Sims suggests a novel approach and uses the orthogonal shocks to achieve the identification.[14] Unlike in simultaneous equation models, where error terms of the simultaneous equations are correlated with each other; SVAR models impose a restriction that the error term in one equation is orthogonal to the error terms in the other equations. Considering the difficulty in finding completely exogenous IVs in corporate finance studies, this chapter uses the SVAR approach. Specifically, this chapter uses the general equation (3.1) below to represent any one of the five equations in the SVAR framework:

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{4} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ \mathrm{N}(0,\ \sigma^2) \quad (3.1)$$

where $Y_{i,t}$ denotes the dependent variable of firm i at year t. $X_{j,i,t}$ is the jth independent variable, k is the lag order of the SVAR model. k starting from 1 gives a restriction on the SVAR model, indicating that firms make financial decisions based on the previous values of explanatory variables, rather than current values (at year t) or expected values for the future. The SVAR model uses a structure of equations to control the contemporary effect. m captures the maximum length of time lags in the equation. This chapter follows Holtz-Eakin et al. (1988) and assumes all of the variables have an identical lag length, as this is a typical practice of the SVAR methodology. The relevance of each explanatory variable is tested. This

[14] Holtz-Eakin et al. (1988) provides a detailed discussion on the identification of SVAR models.

chapter looks for an identical order for all of the independent variables, and the optimal lag selection is discussed in Section 3.3. μ_i stands for fixed effects at firm level, and η_t represents fixed effects at year level. $\varepsilon_{i,t}$ is an idiosyncratic error term. Changes in the intercept α_0 and changes in the variance of error term $\varepsilon_{i,t}$ help control individual effects, because the dynamic interactions may not be the same for all of the firms (Holtz-Eakin et al., 1988). This thesis investigates five factors that capture firm investment, dividend payout, leverage ratio, equity issuance decisions, and firm profitability respectively. Therefore, there are five equations in the dynamic system, and j in model (3.1) ranges from 1 to 4.

Estimating a single equation of the dynamic system by ordinary least square or fixed effects method leads to biased and inconsistent estimates, due to the endogeneity in lagged dependent variables and the other independent variables (Blundell and Bond, 1998; Wintoki et al., 2012). Abrigo and Love (2016) cite Alvarez and Arellano (2003), and suggest that Generalized Methods of Moments (GMM) generate consistent estimates for autoregressive models. Taking the first difference is widely used to eliminate fixed effects μ_i. However, Abrigo and Love (2016) argue that taking first difference magnifies the impact of gaps in datasets and propose using a Forward Orthogonal Deviation (FOD, originally created in Arellano and Bover (1995)) to correct the bias caused by the data loss. This chapter controls year-fixed effects η_t by removing cross-sectional means from employed variables, following Abrigo and Love (2016).

In the monetary economics literature, a number of studies, such as Rudebusch (1998), questioning the economic sense of shocks in SVAR models. In this thesis, shocks refer to unexpected variations in the endogenous variables of the dynamic system (i.e., *Inv, Div, Lev, Equ* and *ROA*), and the shocks to each financial behaviour are assumed homogenous. Technically, shocks refer to the innovations in the regression model, which are not predicted by explanatory variables in the system (Sims, 1980).[15] One source of shocks is that there are always unexpected facts that managers cannot foresee. Hence, there are unexpected behaviours revealed by these variables. The second source of the shock is due to the changing preference of firms and the timing issue. Managers have time-varying preferences over investment, maintaining stable dividend payout ratio or leverage ratio, and timing the stock market. Therefore, some decisions could be randomly drawn or could be driven by market conditions (such as investment opportunities). These random decisions and the decisions to time the market generate shocks to the dynamic system.

3.3 Joint Determination behind Firm Financial Behaviours

Although the literature implies a joint determination behind firm financing behaviours; there is not yet a clear answer on the direction of the determinations. For example, on one hand, firm investment needs to be covered by external capital, typically debt financing[16]; on the other hand, a high leverage ratio also forces CEOs to take more investment to reduce the underinvestment problem (Jensen, 1986). Dhrymes and Kurz (1967) suggest that firms issue debt to fund investment and dividend, whereas Peterson and Benesh (1983) find financing decisions also have an impact on firm

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[15] Sims (1980) transforms the innovations into the orthogonal form, in order to show the distinct patterns of movement in the simultaneously determined variables.

[16] Firms tend to use debt financing before equity financing, according to the *pecking order theory*.

investment due to the capital constraint. Lintner (1956) suggests dividend payment is a targeted proportion of firms' net profits; however, dividend payment also signals future profitability, according to Miller and Modigliani (1961). Jensen et al. (1992) suggest that previous investment has a negative impact on current dividend payment, whereas Hoang and Hoxha (2016) find investment is also used to smooth dividend payout. These studies seem to suggest a bidirectional determining relationships behind firm financial behaviours. Under such a bidirectional relationship, all of the financial characteristics could be determining factors to other financial behaviours. In another word, the variable capturing one financial behaviour is explained by the variables capturing other financial behaviours.

This section first uses the information criteria to specify an optimal lag order for the SVAR model. Then, it presents regression results and discusses how each of the financial variables determines the other financial variables. Lastly, this section uses Granger Causality test to evaluate the joint determination of all the distributed lags of each factor on the explained factor.

Thornton and Batten (1985) and Holtz-Eakin et al. (1988) highlight the importance of using an appropriate lag structure of SVAR models, indicating that inappropriate lag structure leads to misspecifications in SVAR models and misleading results of Granger Causality tests. Andrews and Lu (2001) suggest the criteria to select an optimal lag order for SVAR models, using GMM estimation. Simulation results in Andrews and Lu (2001) show that, after the selection following the Method of Moments Selection Criteria (MMSC), SVAR models generate lower-biased estimates, and show a more accurate rejection rate. The MMSC created by Andrews and Lu requests the number of moment conditions larger than the number of endogenous variables. This indicates that the length of IVs needs to be larger than the lag order of the SVAR model. In an earlier study, McCabe (1979) finds that financial ratios lagged beyond three years do not convey significant explanatory power but bring extra multicollinearity. Therefore, this chapter tests the first-order, second-order and third-order SVAR models, and the lag length of IVs is set to four. The results of the MMSC are reported in Table 3.3.

Table 3.3 Model and Moments Selection Criteria

Lags(n)	CD	Hansen-J-stats	P	MBIC	MAIC	MQIC
1	0.924	177.90	0.000	-508.19*	27.90	-154.13
2	0.785	55.46	0.343	-403.93	-46.54*	-167.89*
3	-5.659	19.98	0.748	-208.71	-30.02	-90.69

This table presents the results of Model and Moments Selection Criteria (MMSC) for the SVAR model, selected under various criteria. For each lag order from 1 to 3, Coefficients of Determinant (CD), Hansen J-Statistics and P-values are reported. MBIC, MAIC, and MQIC show the results under different selection criteria. * indicate the best selection.

The results in Table 3.3 show that the second-order SVAR model is the best selection among other choices. MBIC, MAIC and MQIC[17] are the three criteria based on different trade-offs between model over-identification and model specification. The definitions can be found in Andrews and Lu (2001, p.136). According to Table 3, the MBIC criteria generate the smallest optimal-order statistics when the number of lags equals one, followed by the second-order SVAR model. The MAIC and MQIC criteria generate the smallest optimal-order statistics when the number of lags is equal to two. Comparing these two selections, first-order SVAR model rejects the

[17] These criteria are analogues of the classic Akaike information criterion (AIC), Bayesian information criterion (BIC), and Hannan–Quinn information criterion (HQIC) criteria, with MBIC indicating MMSC-BIC.

Hansen-J over-identification restrictions at the 1% level, which indicates misspecification according to Abrigo and Love (2016).[18] Therefore, this chapter uses the second-order SVAR model, with a Hansen test p-value of 0.343. The coefficients of one-year lagged variables capture the short-run effect, while the coefficients of two-year lagged variables capture the effect in the long-run. According to the result of Coefficient of Determination (CD), the distributed lags of the second-order SVAR model explain 78.5% of the variation in the five variables, with the rest captured by error terms.[19]

Table 3.4 Structural Vector Autoregression Model Results

	(1)	(2)	(3)	(4)	(5)
	Lev	ROA	Inv	Divc	Equ
$Lev_{i,t-1}$	0.788***	-0.018	-0.040***	-0.022***	0.028**
	(31.73)	(-0.54)	(-7.03)	(-5.95)	(2.15)
$Lev_{i,t-2}$	0.082***	-0.064**	0.010*	0.004*	-0.003
	(4.14)	(-2.53)	(1.78)	(1.68)	(-0.21)
$ROA_{i,t-1}$	0.171***	-0.033	0.003	-0.004	0.003
	(3.26)	(-0.54)	(0.42)	(-1.05)	(0.30)
$ROA_{i,t-2}$	0.116***	-0.106**	-0.000	0.003	0.009
	(3.73)	(-2.39)	(-0.01)	(1.38)	(1.01)
$Inv_{i,t-1}$	0.074**	0.126***	0.501***	0.010	0.052***
	(2.26)	(3.53)	(19.05)	(1.40)	(2.90)
$Inv_{i,t-2}$	-0.034	-0.032	0.032*	0.007	0.016
	(-1.13)	(-1.26)	(1.67)	(1.28)	(0.80)
$Divc_{i,t-1}$	-0.167***	0.227***	-0.008	0.212***	-0.005
	(-2.62)	(4.73)	(-0.27)	(5.97)	(-0.29)
$Divc_{i,t-2}$	-0.122*	0.277***	-0.071***	0.192***	0.0335
	(-1.70)	(3.97)	(-2.34)	(5.31)	(1.56)
$Equ_{i,t-1}$	0.009	-0.022	0.002	-0.003	0.070***
	(0.47)	(-1.22)	(0.42)	(-1.05)	(4.14)
$Equ_{i,t-2}$	0.018	-0.026*	-0.101*	0.007	0.034***
	(0.91)	(-1.65)	(-1.95)	(1.28)	(2.38)
N					11,309
Hansen J-stats					209.40***
Maximum Moduli					0.852

[18] The null hypothesis (H_0) of Hansen test is that the over-identifying restrictions are valid, while the alternative hypothesis (H_1) is that there is over-identification problem.
[19] The fourth-order SVAR model is just identified (the length of IVs is equal to the lag order of the SVAR model); therefore, no MMSC results are reported.

This table presents the regression results of SVAR model (3.1). The sample includes all of the unregulated Compustat firms with a continuous record from 1964 to 2014. Column (1) to column (5) show regression results of the 5 equations, respectively. One-year lagged and two-year lagged variables are used as independent variables, and the lengths of IVs are 4.

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{n} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ N(0,\ \sigma^2) \quad (3.1)$$

Regression coefficients and Z-statistics are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. N reports the number of firm-year observations. Hansen J-statistics report the results of over-identification test. Maximum Moduli reports the results of model stability test, with the value lower than one indicating stable.

Table 3.4 shows regression results of the SVAR model, and each column shows the results for one equation. The results show that dynamic effects play an important role. Firm investment, dividend, leverage and equity issuance are all positively associated with their previous realizations. Besides dynamic effects, all of the financial behaviour variables are explained by at least some of the other financial behaviour variables, showing evidence of interdependence. The explanatory roles of each financial behaviour variable are discussed as follows.

Previous leverage ratio is associated with all of the other financial behaviours at year *t*. The coefficient of $Lev_{i,t-1}$ is not significantly different from zero in *ROA* equation (Column 2); however, the coefficient of $Lev_{i,t-2}$ is statistically significant (-0.064, z=-2.53), which indicates that long-run leverage is negatively associated with firm profitability. Column (3) shows that long-run leverage ratio is positively related to investment. This is consistent with the disciplinary explanation (Jensen, 1986) that managers invest more under the pressure of a high interest burden. However, short-run leverage is negatively associated with investment and dividend, according to column (3) and column (4). The possible reason is that firms reduce investment and dividend payment and use the saved cash to reduce debt. These results suggest that financing decisions have a reverse impact on investment and dividend decisions. One-year lagged leverage ratio is a statistically significant factor (0.028, z=2.15) in *Equ* equation (column 5). This indicates that the firms with a higher leverage ratio tend to issue more equity in the next year. This evidence is consistent with the prediction of *trade-off theory* which suggests that firms with a higher (or lower) leverage ratio are more likely to issue (repurchase) equity to rebalance the leverage ratio.

Profitability positively determines firm leverage ratio. Column (1) shows that both $ROA_{i,t-1}$ and $ROA_{i,t-2}$ are positively correlated with $Lev_{i,t}$. According to the *trade-off theory*, firms with a higher profitability need more debt to shield the tax and possess more debt capacity. Hence, the *trade-off theory* predicts a positive relationship between firm profitability and leverage ratio. The *pecking order theory* suggests profitable firms have less demand on external financing, especially debt financing. Hence, the *pecking order theory* predicts a negative relationship. The results in Table 3.4 favour the *trade-off theory* explanation to the *pecking order theory* explanation.

Firm investment is associated with leverage decisions, equity issuances decisions and firm profitability, whereas the relationship with dividend is not significant. Column (1) shows that $Inv_{i,t-1}$ is positively correlated with $Lev_{i,t}$ (0.074, z=2.26). This evidence is consistent with Titman and Wessels' (1988) explanation that investment increases collaterals which is needed to backup borrowings; and hence, firms tend to use a higher leverage. At the same time, the investment also leads to an increase in equity issuance speed, according to column (5). In *ROA* equation (column 2), $Inv_{i,t\text{-}1}$ has a positive coefficient of 0.126 (z=3.53). This indicates a return (net income)-to-investment rate of 12.6%. An interesting point is that, in column (4), investment is not significantly correlated with dividend decisions. This result is in line with Lintner's (1956) study, in which investment is not considered as one of the determining factors for dividend payment.

Dividend payout determines leverage, profitability and investment decisions. Column (1) of Table 3.4 shows that lagged dividend payout ratio is negatively correlated with the leverage ratio at year *t*. One explanation is that firms paying more dividend tend to have a higher stock price; this in turn reduces the cost of equity financing.[20] Therefore, these firms tend to use equity financing more often and use a lower proportion of debt capital. Column (2) shows that firms with more dividend payments tend to have a higher profitability in the future. This is in line with the *signalling theory* (Miller and Modigliani, 1961) that dividend payment is a signal of the profits in the future. In addition, the result is opposite to the prediction of the tax-preference theory which suggests that firm paying dividend should have a lower value. Although this study does not examine the impact of dividend on firm value, the positive relationship between lagged dividend and current *ROA* suggests that dividend-payers generate more return to shareholders. Column (3) shows that firms with more long-run distributions invest less. Specifically, $Div_{i,t\text{-}2}$ is negatively correlated with $Inv_{i,t}$ (-0.071,

[20] In the sample, the firms with dividend payment tend to possess a higher market value than do non-payers (1.21 compared with 0.69), measured by the Market-to-Book ratio.

z=-2.34). Controlling other factors, firms possessing a higher long-run dividend payout ratio have less funds available for investment. This evidence supports Jensen et al. (1992) who suggest that investment and distributions play competing roles in allocating financing sources.

Equity issuance negatively determines investment and profitability. According to Table 3.4, $Equ_{i,t-2}$ has negative signs in investment equation (column 3) and *ROA* equation (column 2). This suggests that firms with a higher equity issuance do not necessarily invest more. Hence, these firms do not show a higher profitability. This evidence calls for the attention of investors and suggests that the firms with equity issuances in the secondary market make a better plan of the use of their raised funds.

The SVAR model in this thesis satisfies the over-identification requirement and the stability condition; and the error term in each equation is orthogonal to those in other equations. Enders (2015) suggests that SVAR models need to be over-identified. In Table 3.4, the reported Hansen J-statistics is 209.40. The null hypothesis of no over-identification is rejected at the 1% level. Abrigo and Love (2016) suggest that model stability is the condition for further analysis using Forecast Error Variance Decomposition (FEVD) analysis and Impulse Response Functions, in order to make valid interpretation. The reported maximum modulus (0.852) is less than one, which satisfies the stability condition that all of the moduli need to be less than unit (Enders, 2015; Abrigo and Love, 2016). This suggests that the SVAR model is time-invariant and that the dynamic process do not diverge to infinity. Table 3.5 presents the variance-covariance matrix of SVAR model error terms. As shown in Table 3.5, the reported co-variances approach zero, indicating that the error term in one equation is orthogonal to the error terms in the other equations. In sum, the results of these tests suggest that the SVAR model used in this thesis provides valid representation of the dynamic system.

Table 3.5 Error Variance Covariance Matrix

	Lev	ROA	Inv	Divc	Equ
Lev	0.006				
ROA	-0.004	0.010			
Inv	0.000	0.000	0.001		
Divc	0.000	0.000	0.000	0.001	
Equ	0.000	0.000	0.000	0.000	0.003

This table presents the variance-covariance matrix of the SVAR model error terms.

The Granger Causality test is used to test whether one can predict dependent variable *Y* better, based on lagged values of *Y* and *X*, than of *Y* alone. This chapter uses Granger Causality test to test the joint explanatory power of the distributed lags of each proxy. The null hypothesis (H_0) is that the coefficients of all the lags of an independent variable are jointly equal to zero, which indicates no Granger causality.

Table 3.6 reports the results of Granger Causality tests. The evidence suggests that all of the financial behaviour variables are explained by some of the other variables. As shown in column (1) of Table 3.6, leverage is determined by profitability, investment and dividend. Investment is determined by dividend. Dividend is determined by leverage. Equity decisions are determined by investment and leverage. Another interesting point is that leverage helps predicts all of the other financial behaviours. The last row of Table 3.6 suggests that all of the financial variables are determined by at least some of the other financial variables, suggesting that firm financial behaviours are jointly-determined.

Table 3.6 Granger Causality Matrix

	Lev	ROA	Inv	Divc	Equ
Lev	-	36.70***	63.23***	43.08***	10.53***
		(0.00)	(0.00)	(0.00)	(0.00)
ROA	20.87***	-	0.19	4.19	1.03
	(0.00)		(0.91)	(0.12)	(0.60)
Inv	5.31*	12.45***	-	4.44	10.69***
	(0.07)	(0.00)		(0.11)	(0.01)
Divc	10.56***	39.95***	5.92*	-	3.38
	(0.01)	(0.00)	(0.05)		(0.18)
Equ	1.04	3.46	4.09	1.12	-
	(0.60)	(0.18)	(0.13)	(0.57)	
All	56.09***	115.56***	73.63***	76.97***	26.76***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

This table presents Granger Causality matrix of firm financial behaviour variables. Each cell shows whether the column variable is Granger caused by the row variable. The last row shows whether the column variable is Granger caused by all of the row variables. Chi-square statistics and p-values are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

3.4 The Priority of Firm Financial Behaviours

Section 3.3 shows that firm financial behaviours are explained by their previous realizations and the other financial characteristics. Since firms target the desired levels of several financial characteristics, there must be a rank of priority for these targets, especially when the budget is constrained and the targets cannot be fully achieved at the same time. In this situation, firms would firstly allocate financing sources to the target with the highest priority, then to the other targets. For the financial policy with a higher priority, the corresponding financial behaviour should be more independent of the other financial behaviours. On the contrary, for the financial policy with a lower priority, the corresponding financial behaviour should be more explained by other financial behaviours. This section discusses the priority of these factors and evaluates which financial behaviour is relatively more important to firms.

This section measures the relative independence of firm financial behaviours and evaluates which financial behaviour is the most (or the least) easily-influenced by analysing the forecast errors of the five endogenously-determined variables. Enders (2015) suggests regarding the variable most explained by its own shocks as "the most exogenous" (independent) variable, and regarding the variable most explained by shocks to the other variables as "the most endogenous" (easily-influenced) variable. This section uses Enders' approach and regards the variable, of which the forecast errors are most explained by shocks to the other variables, as the most endogenous (or the least exogenous) variable. The variable, of which forecast errors are most explained by its own shocks, is regarded as the most exogenous (independent) variable.

Enders (2015) and Abrigo and Love (2016) suggest using a logical order supported by the theory.[21] This chapter follows the corporate finance literature and uses the following order: *Inv – Equ – ROA – Div – Lev*. The reasons are explained as follows.

The corporate finance literature suggests the formation of the recursive order behind the employed variables. Previous studies tend to take firm investment as the first-moving financial behaviour, under both perfect and imperfect market assumptions. Under perfect market assumptions,

[21] Abrigo and Love (2016) suggest that the order of endogenous variables in FEVD should be based on the theoretical background that states the timing of responses. There is no empirical method, so far, to test the ordering.

investment determines firm value (Fama, 1974; Myers, 2015). Firms are assumed rational and tend to make independent investment decisions to take full advantage of the investment opportunities generating a positive net present value. Under imperfect market assumptions, Gatchev et al. (2010) suggest that changing financing decisions generates lower costs than changing investment plans. Similar to investment decisions, equity issuances and repurchases are largely driven by capital market conditions and the opportunities to time the security market. Fama and French (2005) find that firms do not issue equity as the last resort predicted by the *pecking order theory*[22]. Instead, firms time the stock market and issue (or repurchase) equity when the stock price is over-valued (under-valued) (Butler et al., 2011). These studies indicate that firms issue or repurchase equity with a main aim to time the stock market than to balance the budget constraint. Therefore, this thesis takes investment and equity issuance as the first and the second order variables.[23]

Firms' operating profits are generated from investment; therefore, ROA is taken as the third-order variable. Previous studies, such as Lintner (1956) and Lambrecht and Myers (2012), suggest that firms target an optimal dividend payout ratio, of which dividend payment is a proportion of firms' long-run profits. Therefore, dividend payout ratio is taken as the fourth-order variable, following ROA. Fama and French (2002) find that

[22] The *pecking order theory* suggests a pecking order among financing sources. Under the *pecking order theory*, equity financing is used as the last resort to cover the financing deficit that cannot be fully covered by retained earnings and debt financing, due to the higher transaction cost of equity financing.

[23] Section 3.3 finds that investment determines equity issuance. This motivates to give investment the first order. I also tried to change the order between investment and equity issuance, but this does not make a qualitative difference to the results. This is the only robustness check in terms of the recursive order, because there is no motivation in corporate finance literature to try other orderings.

firms stick to the dividend target more closely than the leverage target. Lambrecht and Myers (2012) suggest that firms issue or retire debt to smooth dividend payout. Hence, leverage ratio is taken as the fifth-order variable. In sum, investment and equity issuance decisions are taken as the first-order and the second-order variables, followed by ROA. Dividend payout ratio is the fourth-order variable, followed by the leverage ratio.

This section compares the relative exogeneity (independence) of firm financial behaviours by performing an Forecast Error Variance Decomposition (FEVD) analysis. The FEVD calculates the percentage of forecast errors in each variable that can be explained by exogenous shocks to other financial behaviours and its own shocks at each forecast horizon. The results of FEVD differ according to the ordering of endogenous variables in the SVAR framework (Enders, 2015). The thesis follows the corporate finance literature and uses the recursive order (*Inv – Equ – ROA – Div – Lev*) that is proposed above. Table 3.7 shows the decomposition of forecast error variance of the employed financial behaviour variables. Table 3.7 presents the results of each variable at 6 forecast horizons, namely the 1^{st}, 2^{nd}, 4^{th}, 6^{th}, 8^{th} and 10^{th} year. The value stands for the proportion of variations in the error of each panel variable, explained by shocks to the column variable.

Table 3.7 Forecast Error Variance Decomposition

	(1)	(2)	(3)	(4)	(5)
			Panel A: Lev		
Lags(n)	Lev	ROA	Inv	Divc	Equ
1	0.662	0.302	0.000	0.021	0.014
2	0.729	0.236	0.002	0.017	0.016
4	0.791	0.175	0.004	0.013	0.017
6	0.809	0.157	0.005	0.011	0.018
8	0.817	0.149	0.005	0.011	0.018
10	0.821	0.145	0.006	0.010	0.018
			Panel B: ROA		
Lags(n)	Lev	ROA	Inv	Divc	Equ
1	0.000	0.993	0.003	0.000	0.004
2	0.000	0.989	0.004	0.003	0.004
4	0.005	0.980	0.004	0.007	0.004
6	0.007	0.978	0.004	0.007	0.004
8	0.009	0.976	0.004	0.007	0.004
10	0.009	0.976	0.004	0.007	0.004
			Panel C: Inv		
Lags(n)	Lev	ROA	Inv	Divc	Equ
1	0.000	0.000	1.000	0.000	0.000
2	0.007	0.004	0.989	0.000	0.000
4	0.018	0.005	0.970	0.007	0.000
6	0.027	0.006	0.958	0.009	0.000
8	0.032	0.006	0.952	0.009	0.000
10	0.035	0.006	0.949	0.009	0.001
			Panel D: Divc		
Lags(n)	Lev	ROA	Inv	Divc	Equ
1	0.000	0.004	0.001	0.994	0.001
2	0.003	0.005	0.001	0.989	0.001
4	0.007	0.007	0.001	0.983	0.001
6	0.011	0.007	0.001	0.979	0.001
8	0.014	0.008	0.001	0.977	0.001
10	0.015	0.008	0.001	0.975	0.001
			Panel E: Equ		
Lags(n)	Lev	ROA	Inv	Divc	Equ
1	0.000	0.000	0.000	0.000	1.000
2	0.001	0.000	0.001	0.000	0.998
4	0.002	0.000	0.002	0.000	0.996
6	0.002	0.000	0.002	0.000	0.995
8	0.002	0.000	0.002	0.000	0.995
10	0.002	0.000	0.002	0.000	0.995

In this table, Panel A to Panel E shows the proportion of forecast errors in each financial behaviour variable, predicted by its own shocks and shocks to the other financial behaviour variables. Lags(n) denotes the forecast horizons, from 1-step-ahead to 10-step-ahead, on yearly basis.

A large proportion of variation in leverage is explained by its own shocks, although ROA and equity issuance also play explanatory roles. According to Panel A of Table 3.7, shocks to the leverage ratio explains

66.2% of the forecast errors in leverage at the first forecast horizon, and the ratio increases to 82.1% at the tenth forecast horizon. ROA has certain power in explaining the forecast errors in leverage. Specifically, exogenous shocks to ROA explain 30.2% of the forecast errors in leverage at the first forecast horizon. The effects of ROA persist and remain above 14% till the tenth forecast horizon. Investment has a minor impact (0.6% at the tenth forecast horizon) on the leverage ratio. Shocks to dividend payout explain a minor part (2.1%) at the first forecast horizon, and the effects drop towards 1.0% at the tenth forecast horizon. The impact of equity issuance increases from 1.4% at the first forecast horizon to 1.8% at the tenth forecast horizon.

Not much variation in the forecast errors of ROA can be explained by shocks to firm financial behaviours. According to Panel B, only 0.4% of the forecast errors in ROA are explained by investment at the tenth forecast horizon. Financial behaviours are slightly more influential in the long-run. At the tenth forecast horizon, the forecast errors of ROA explained by shocks to leverage and to dividend payout increase to 0.9% and 0.7%, respectively. However, the variance explained by shocks to *Equ* is not economically significant, and the magnitude remains around 0.4% throughout the period. These results suggest that the variation in firm profitability is more caused by its own shocks (such as shocks to the demand for products or services) than by shocks to firms' financial behaviours.

The results suggest that firm investment decisions are endogenously determined but to a small extent. According to Panel C of Table 3.7, investment has more than 94% of forecast errors accounted for by its own innovations at all of the forecast horizons. The percentage explained by leverage shocks is 0.7% at the second forecast horizon, but it increases to 3.5% at the tenth forecast horizon. Shocks to ROA (0.6%), dividend payout (0.9%) and equity issuance (0.1%) have a little impact on the variation in investment at the tenth forecast horizon. This indicates that there is a high deviation cost (opportunity cost) to stop or to start an investment project; and hence, firms are reluctant to adjust investment decisions to accommodate the other financial behaviours. The impact of financing constraint revealed by leverage shocks have some long-run impact on investment, but not much short-run impact. Variations in firm investment are rarely explained by the shocks to equity issuance. This indicates that the cash generated by (unexpected) market timing behaviours do not influence real investment.

The results show that dividend payout is highly smoothed. According to Panel D, at the first forecast horizon, most of the forecast errors in dividend payout ratio are explained by shocks to dividend (99.4%). Shocks to ROA explain a minor proportion of the variation (0.4%). This indicates that some of the shocks to ROA must have been smoothed by debt and investment, since the budget constraint needs to be balanced.[24] As time moves on, shocks to the leverage ratio and to ROA become slightly more important and explain 1.5% and 0.8% of the forecast errors in dividend payout ratio, respectively. The forecast errors explained by shocks to

[24] Figure 2 shows that an exogenous shock to ROA results in responses in both leverage and investment, and the response in dividend is relatively smaller. The thesis revisit this point in section 3.5.

investment and to equity issuance are not economically significant, even in the long run (both are 0.1% at the tenth forecast horizon).

The results in Table 3.7 are consistent with previous studies (such as Fama and French, 2002; Lambrecht and Myers, 2012; and DeAngelo and Roll, 2015) arguing that dividend payout ratio is more sticky than the leverage ratio. According to column (1) of Panel A, 82.1% of the forecast errors in the leverage ratio at the tenth forecast horizon are explained by its own shocks, which is substantially smaller than the 97.5% in dividend payout ratio (Column 3 of Panel D). This indicates that leverage is more vulnerable than dividend when there are shocks to other financial behaviours. An exogenous shock to investment, ROA or equity issuance is more likely to lead to a deviation from the leverage target than a deviation from the dividend target.

Equity issuance decisions show the highest independence, with a tiny proportion explained by the shocks to leverage and to investment. According to Panel E of Table 3.7, shocks to *Equ* explain 100% of its forecast errors at the first forecast horizon, and 99.5% at the tenth forecast horizon. Shocks to leverage and to investment explain 0.2% of the forecast errors in equity issuance at the tenth forecast horizon. Although firms issue or retire equity to rebalance the leverage ratio, it involves a small magnitude of equity capital; and this effect is almost negligible, compared with exogenous equity issuance shocks (such as market timing opportunities). These results are in line with Fama and French (2005) that market timing is the primary reason for equity issuances.

Overall, the results in this section suggest that sample firms give the highest priority to equity issuance decisions. Dividend targeting is given a higher priority than leverage targeting. Investment decisions are more endogenous than equity issuance decisions and dividend decisions, but more exogenous than leverage decisions. The extent that one financial behaviour is explained by shocks to other financial behaviours reflects the deviation cost. The results suggest that equity issuance decisions have the highest deviation cost. Firms are reluctant to issue (or repurchase) equity to absorb shocks to other financial behaviours. Adjusting dividend payout signals managers' predictions on future profitability, which generates the information cost. Firms adjust investment, to a minor extent, to absorb shocks to other financial behaviours. Therefore, firms absorb ROA shocks mostly by debt and try to smooth out distributions. The fact that firm dividend decisions are more independent than leverage decisions indicates that the information cost of adjusting dividend payout is higher than the transaction costs of issuing or repurchasing debt. The relative deviation cost motivates firms to give different priorities to these financial behaviours.

3.5 Exogenous Shocks and Responses

Since firm financial behaviours are interrelated, a further question is how the shock to one of the financial behaviours is absorbed by the system. This section uses IRFs to measure how one of the financial behaviours responds to orthogonal shocks to the other financial behaviours and discusses whether there exists a pure residual among these financial behaviours.[25] More

[25] In this thesis, the residual role indicates that decisions concerning the financial behaviour depend on decisions made for the other financial behaviours. To put it in another way, the

specifically, this section uses orthogonal IRFs to measure the extent to which firm investment, dividend payout, profitability, leverage ratio, and equity issuance respond to shocks to the others, and how long it takes these financial characteristics to revert to their natural levels. Three predictions are developed, based on the literature:

a) Several studies (such as Jensen et al., 1992; Hennessy and Whited, 2005) suggest that firms jointly optimize over several financial behaviours when the market is not perfect. When there is an exogenous shock to one of the financial behaviours, firms may not tolerate the shock. Instead, *firms may temporarily deviate from the natural status of several financial characteristics to absorb the shock.* In this way, firms can jointly minimize over the cost of deviations.

b) Lambrecht and Myers (2012) indicate that debt decisions may play the residual role among other financial behaviours[26] and that changes in debt absorb all of the shocks to net profits in order to smooth out dividend. If debt is the shock-absorber, shocks to investment or to ROA should not lead to a response in dividend payout ratio, because firms use debt to smooth out distributions. If constrained by the debt capacity according to Lemmon and Zender (2010), firms cannot always use debt to absorb all of the shocks. Hence, it can be predicted that *shocks to investment and to profitability would result in a response in dividend payment* and that *the exogenous shock to leverage is also absorbed by investment and dividend*, to some extent.

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residual financial behaviour needs to absorb shocks to the other financial behaviours, in order to balance the budget constraint.

[26] In Lambrecht and Myers (2012), the bankruptcy cost is not considered, which facilitates firms to issue debt to cover the needs of investment and dividend payment.

c) Acharya and Lambrecht (2015) note that managers take advantages of asymmetric information, and do not immediately distribute all of the unexpected profits to shareholders, because managers are reluctant to make dividend changes that have to be reversed. As one of the practices to smooth out distributions, the extra profits should be distributed gradually. Therefore, it can be predicted that *a positive and temporary shock to ROA do not lead to a temporary increase in dividend payout*. Instead, *firms gradually absorb the positive shock by dividend*. At the same time, leverage and investment may absorb some of the temporary shock to ROA, to smooth out dividend.

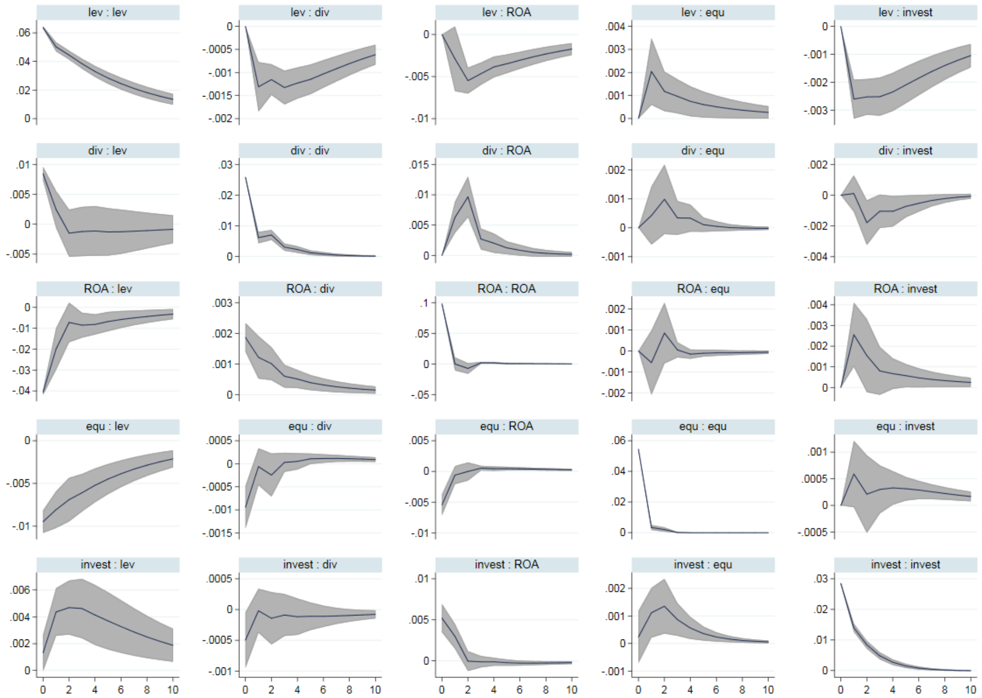
The IRFs are constructed based on the estimated SVAR model coefficients. By using orthogonal IRFs, this section measures the impact of exogenous shocks to each of the financial behaviours. The orthogonal condition indicates that there is no continuous shock in the subsequent period and that there is no shock to the other financial characteristics at the same time. Figure 3.2 visualizes how one standard deviation of positive shocks to each financial behaviour are absorbed and how long it takes these financial characteristics to return to the natural status. The grey area denotes the 95% confidence interval, and the confidence interval is established using 2,000 Monte Carlo simulation draws. The results are robust to the number of Monte Carlo simulation draws. Figure 3.3 and Figure 3.4 report the results by using 500 and 5,000 draws respectively, in which responses of variables are in similar patterns with those reported in Figure 3.2. This thesis claims there is a response if zero falls out of the 95% confidence interval.

A. Leverage Shocks

The results in Figure 3.2 show that firms reduce dividend to absorb leverage shocks. According to Graph (lev: div), a positive shock to leverage is followed by a negative response in dividend. The response in dividend is statistically significant and persistent. This indicates that sample firms cut dividend payment to cover a sudden interest burden. It can also be explained by using the *agency theory* (Jensen and Meckling, 1976) that increased leverage raises the bargaining power of debt holders, which in turn reduces the distributions to shareholders. The response of dividend to leverage shocks is persistent, with half of the response remaining for over ten years, according to Graph (lev: div). One of the reasons is that leverage does not fully revert as well, after ten years. The shock to leverage leads to a persistent and smooth change in the stakeholder structure (see Graph (lev: lev)), which in turn leads to a persistent change in distributions.

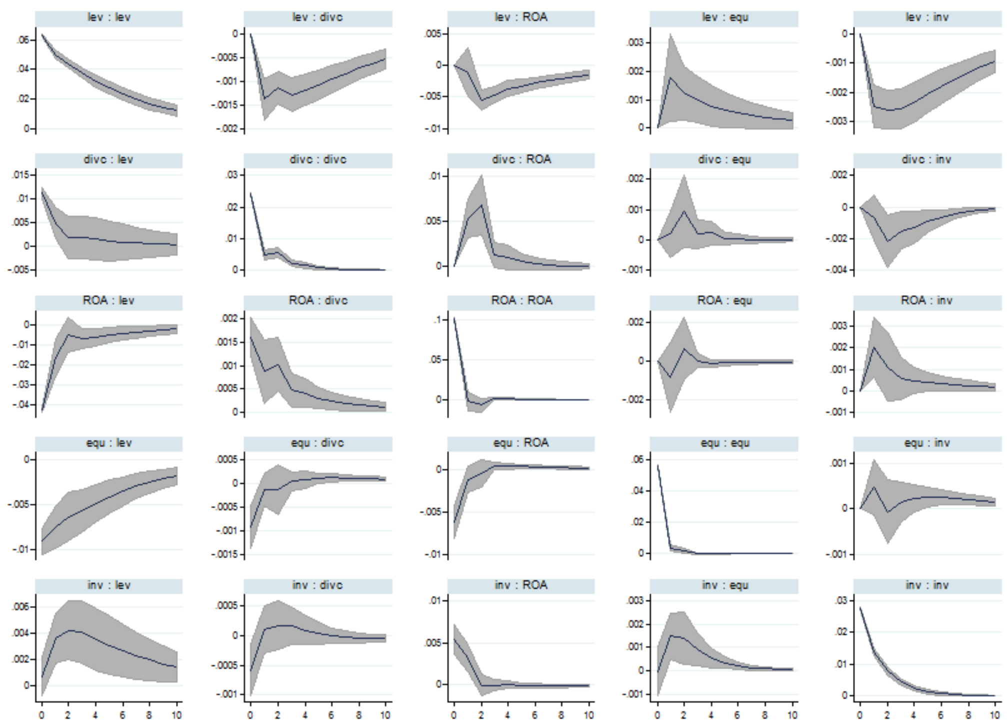
According to Graph (lev: invest), investment responds negatively to exogenous leverage shocks. This indicates that sample firms reduce investment to cover the extra debt burden. Jensen (1986) suggests that managers invest more when there is a high interest burden. However, it seems the financial constraint effect is larger than the disciplinary explanation. Since firms cut dividend and investment to absorb shocks to leverage, the results do not suggest that debt is a pure residual among other financial behaviours.

Figure 3.2. Impulse Response Functions



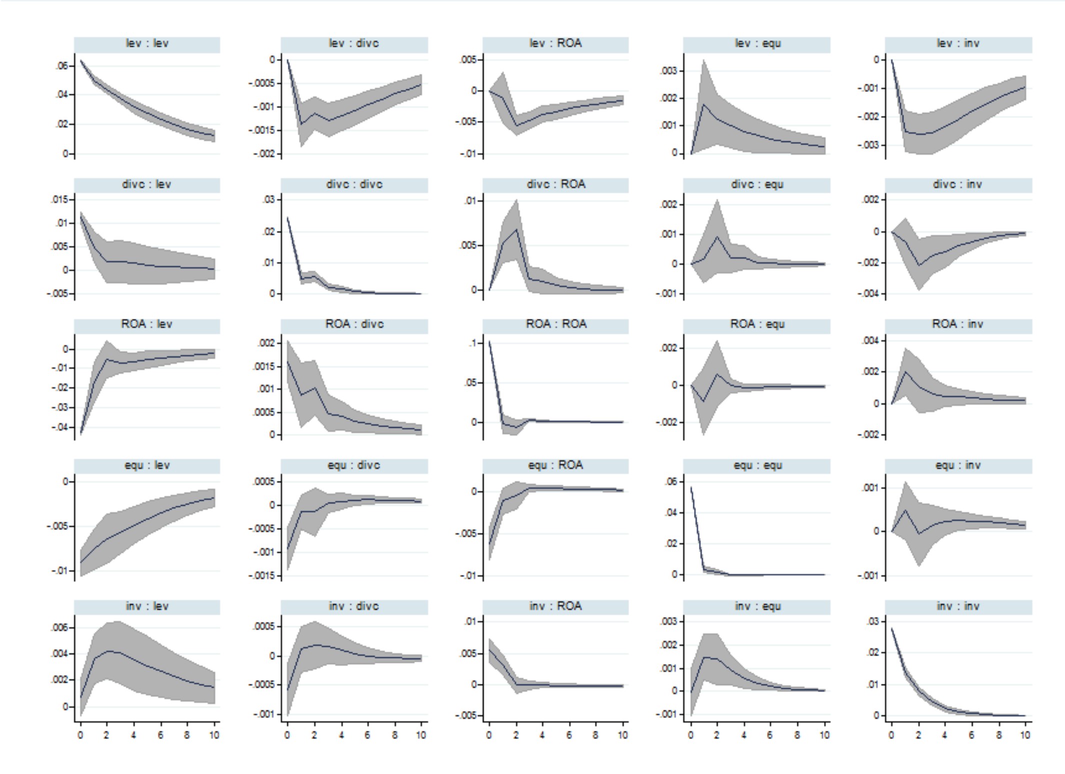
This figure illustrates the impulse response to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Figure 3.3 Impulse Response Functions Using 500 Draws



This figure illustrates the impulse responsesto one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 500 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Figure 3.4 Impulse Response Functions Using 5,000 Draws



This figure illustrates the impulse responses to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 5,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Equity issuances respond positively to leverage shocks. According to Graph (lev: equ), a positive shock to leverage is followed by a minor but statistically significant response in equity issuance ratio. Although issuing equity may send the signal that the stock price is over-valued, firms still issue equity to rebalance the leverage ratio, as predicted by the *trade-off theory*.

Shocks to leverage persist for at least ten years, suggesting a low speed of adjustment. According to Graph (lev: lev), although shocks to leverage reduce from above 0.06 at year 0 to below 0.02 at year 10, the shock still exists and remains statistically significant. According to Graph (lev: lev), it takes around 5 years to erase half of the leverage shock. This is in line with the literature arguing that leverage adjustment speed is fairly low and that it takes a long time for the leverage ratio to fully recover from deviations. Among these studies, Fama and French (2002) using simultaneous equations find that leverage reverts at a speed between 7% and 17%; DeAngelo and Roll (2015) document a speed around 15% by simulation. The results (around 13%) in this thesis, generated by orthogonal IRFs, are quantitatively close to their results, although this study examine the responses to exogenous leverage shocks.

B. Investment Shocks

The results suggest that firms change leverage and equity issuance to absorb the shocks to investment. According to Graph (invest: lev) of Figure 3.2, a positive shock to investment is followed by a positive response in leverage. This can be explained by the collateral effects (Titman and

Wessels, 1988) that new investment (especially the long-term asset component) increases the collateral that can be used to back up new borrowings. As a result, firms choose debt capital rather than equity capital. The results show that the positive response of leverage does not diminish after 10 years, which also reflects a slow speed of adjustment. The response in equity issuance is milder than the response in leverage, indicating debt is the primary tool to absorb investment shocks, among others..

The response in dividend payout is small and diminishes rapidly. According to Graph (invest: div), dividend negatively responds when the investment shock takes place. However, the response becomes insignificant in the next period. This suggests that dividend payout is very sticky. Moreover, the magnitude of the response in dividend (-0.0005 at the first forecast horizon) is substantially lower than the response in ROA (0.005) to investment shocks. This suggests that dividend is much smoother than firm profitability. Although firms reduce dividend payment to absorb the positive shocks to investment, it appears that dividend payout ratio is less vulnerable than the leverage ratio. This is in line with the previous studies (such as Fama and French, 2002; Lambrecht and Myers, 2012; and DeAngelo and Roll, 2015) stating that dividend is more sticky than leverage.

C. Profitability Shocks

Leverage, dividend payout and investment all respond to the shocks to firm profitability. The Graph (ROA: lev) shows that a positive shock to ROA is followed by a negative response in the leverage ratio and that it takes more than ten years for the leverage ratio to fully recover. The negative response in leverage can be explained by the *pecking order theory*, which suggests that the cost of internally-generated capital is lower than the cost of debt financing. A positive shock to ROA results in a decreased reliance on debt financing. One can also explain by the deleverage incentive. Chang et al. (2014) find that firms with higher profitability tend to use a lower debt ratio, and the reason is that these firms use the extra profits to relax the leverage burden. On the other hand, the negative shock to ROA is followed by a positive response in leverage. This suggests that firms with temporary low profitability need to raise debt to balance the budget constraint, as predicted by Lambrecht and Myers (2012).

The results show that dividend payout and investment respond positively to positive ROA shocks. Consistent with the prediction (c), sample firms do not immediately raise dividend to distribute all of the extra profits to shareholders. Instead, firms smooth distributions, and the response of dividend payout ratio persists. Although the shock to ROA diminishes in one year, the response in dividend remains statistically significant over eight years. According to Graph (ROA: inv), a favourable shock to ROA is associated with a positive response in investment. This indicates that firms reinvest and increase capital input after the favourable shock to profitability. Graph (ROA: inv) shows that firms react in the short-run but not in the long run, and the response diminishes in the second year when the shock to ROA diminishes. In sum, a negative shock to ROA is followed by reductions in dividend payout ratio and firm investment, but a positive response in leverage. Although firms issue debt to absorb shocks to ROA, it seems neither dividend nor investment remains unaffected. This evidence suggests that both dividend and investment suffer financial restrictions and respond to the shock to ROA.

Debt decisions are more sensitive than distributions and investment, as a response to profitability shocks. According to the third row of Figure 3.2, dividend (around 0.0015 at the first forecast horizon) and investment (0.0024) responds to profitability shocks to a minor extent, whereas leverage responds more dramatically (-0.03). This indicates that a larger proportion of unexpected profits are used to release the debt burden than to be distributed to shareholders or to be reinvested. The evidence is consistent with the results in Chang et al. (2014) who decompose firm cash flows and find that firms use a large proportion (32%) of the increased cash flow to deleverage and use very little cash (1%) to increase dividend or to investment. The fact that leverage is more sensitive than investment provides further supports to Gatchev et al.'s (2010) assertion that the cost of changing financing decisions are lower than the cost of changing investment decisions because stopping and then restarting an investment project is costly.

D. Dividend Shocks

Leverage ratio, profitability and investment all respond to the shock to dividend. The Graph (div: ROA) shows that a favourable shock to dividend payout is followed by a positive response in ROA. This can be explained by the *signalling theory* that an increase in dividends signals profits in the future. Firm investment responds negatively to the shock to dividend payout, and the response of investment diminishes rapidly.

Jagannathan et al. (2000) suggest that dividend is an ongoing commitment to shareholders. Lambrecht and Myers (2012) suggest that managers smooth dividend payout to smooth their own payoffs. These studies explain why firms shrink investment to reserve cash for the dividend payment. The negative response of investment is also consistent with Gatchev et al. (2010) who argue that financial restrictions could force firms to forgo valuable investment opportunities. Graph (div: lev) shows that a positive shock to dividend payout ratio is followed by a positive response in leverage at year zero. This suggests that firms issue debt to cover dividend payment. This evidence supports the assertion in Hennessy and Whited (2005) and Lambrecht and Myers (2012) that firms issue debt to fund increased distributions.

The exogenous shock to dividend is not persistent. According to Graph (div: div), the shock dramatically reduces from 0.025 to 0.005 in one year. This indicates that firms absorb the shock to dividends, and the dividend payout ratio returns to its natural status at a high speed of adjustment. The results in this section, by investigating exogenous shocks, is consistent with the literature (such as Lintner, 1956; Fama and French, 2002; Lambrecht and Myers, 2012) stating that dividend payout ratio is sticky.

E. Equity Issuance Shocks

The shocks to equity issuance lead to a persistent response in leverage, a temporary response in dividend, and a long-run positive response in investment. Graph (equ: lev) shows that it takes more than ten years for the leverage ratio to recover, after a positive shock to equity issuance. This indicates that sample firms do not immediately rebalance the leverage ratio from the deviation caused by timing the stock market. This evidence is in line with Baker and Wurgler (2002) who argue that the market timing effects on leverage are persistent. Graph (equ: div) shows that dividend payout has a negative response to an exogenous shock to equity issuance ratio. This suggests that firms with net equity issuance are unlikely to maintain their previous dividend payout ratios. This is in line with Fama and French (2005) who argue that issuing stocks to pay dividend reduces the wealth of current shareholders and that firms do not issue equity to pay dividend. The response in dividend vanishes after one year, together with the shock to equity issuance ratio.

The shock to equity issuance ratio diminishes rapidly. According to Graph (equ: equ), the shock is above 0.05 at year 0 and drops to nearly 0 after one year. This is the possible reason that investment does not immediately respond to equity shocks. It shows that firms' market timing behaviours are more independent of the other financial behaviours. Although market timing behaviours influence short-term capital supply, results show that sample firms do not immediately set up new investment projects or drop existing ones. As a result, ROA and dividend do not have persistent responses to equity issuance shocks. These results provide additional evidence to the finding in Butler et al. (2011) that firms' market timing behaviours are not correlated with future returns. The response of investment turns out significant in the long-run, according to Graph (equ:

invest). This might indicate that it takes 4 years, on average, for firms to put the money generated from market-timings into operations.

Overall, the results in section 3.5 support the conjecture on firm financial behaviour interactions. Firms temporarily deviate from the desired levels of at least some financial characteristics to absorb shocks to the other financial characteristics. All of the financial characteristics revert to their desired levels in subsequent periods, although the adjustment speed varies. The results in this section show that firms adjust leverage decisions to absorb a large proportion of shocks to other financial behaviours. This is consistent with the prediction in Lambrecht and Myers' (2012); however, it seems that leverage is not a pure residual. The fact that all of the financial behaviour variables deviate from the desired levels to absorb shocks to the firm suggests that there is not a pure shock-absorber. This evidence is more opt for an explanation that firms jointly optimize over several financial behaviours and minimize the overall costs of deviations. A positive shock to ROA is not immediately and completely absorbed by dividend. Instead, firms use debt and investment to absorb a fraction of the shock. Dividend payout ratio responds smoothly; and sample firms gradually distribute the extra profits. In brief, the empirical results support the three predictions.

3.6 Robustness of the Results

This section discusses the robustness of the results to alternative definitions of variables and to alternative sample periods.

In terms of the alternative definitions of variables, I first define ROAe as EBIT over assets to substitute ROA, because this is a more classical definition of ROA and it is an important determinant of leverage (such as in Rajan and Zingales, 1995). As shown in Table 3.8 and Table 3.9, the main findings that firm financial behaviours are jointly-determiend hold. Table 3.8 shows that ROAe is positively associated with one-year lagged ROAe. This is in line with previous studies (such as Wintoki et al., 2012) that firm profitability is auto-regressive. Figure 3.5 suggest that the impact of ROAe shocks on other financial behaviours are more persistent than the impact of ROA shocks as reported in Figure 3.2. One of the possible reasons is that ROAe shocks are more persistent. As we can see in Figure 3.2, ROA shocks diminish rapidly, while the ROAe shocks in Figure 3.5 persist for nearly ten years.

Second, I define leverage as long-term liabilities over the sum of long-term liabilities and net worth of the firm (following Booth et al., 2001), because the investment in this chapter is defined as capital expenditure over assets which mainly covers long-term investment. Hence, I use the long-term leverage ratio as the alternative to the classical leverage ratio. As shown in Table 3.10 and Table 3.11, the main finding that firm financial behaviours are jointly determined holds. An interesting point is that ROA is a statistically-significant determinant of dividend, under this definition of leverage.

Table 3.8 Results of the SVAR Model Using EBIT

	(1)	(2)	(3)	(4)	(5)
	Lev	ROAe	Inv	Divc	Equ
Lev i,t-1	0.618***	-0.018	-0.033***	-0.022***	0.021*
	(7.44)	(-0.54)	(-6.93)	(-5.95)	(1.87)
Lev i,t-2	0.199***	-0.064**	0.004	0.004*	0.004
	(2.91)	(-2.53)	(0.96)	(1.68)	(0.39)
ROAe i,t-1	-0.256***	0.724***	0.103***	-0.004	-0.008
	(-3.32)	(21.26)	(11.93)	(-1.05)	(-0.38)
ROAe i,t-2	0.156***	-0.015	-0.031***	0.003	-0.001
	(3.16)	(-0.60)	(-3.66)	(1.38)	(-0.04)
Inv i,t-1	0.152***	-0.068***	0.482***	0.004	0.053***
	(5.17)	(-3.06)	(17.83)	(0.64)	(2.84)
Inv i,t-2	-0.016	0.010	0.041**	0.008	0.002
	(-0.50)	(0.52)	(2.17)	(1.45)	(0.09)
Divc i,t-1	0.018	0.044	-0.053	0.184***	-0.003
	(0.24)	(1.56)	(-1.53)	(5.46)	(-0.17)
Divc i,t-2	-0.283***	0.241***	-0.154***	0.196***	0.023
	(-2.71)	(4.11)	(-4.09)	(6.12)	(1.11)
Equ i,t-1	-0.040*	0.055**	0.006	-0.002	0.070***
	(-1.88)	(2.21)	(1.05)	(-0.72)	(4.15)
Equ i,t-2	0.002	-0.054**	-0.010*	0.003	0.028**
	(0.09)	(-2.48)	(-1.79)	(0.07)	(1.97)
N					11,309
Hansen J-stats					172.73***
Maximum Moduli					0.859

This table presents the regression results of SVAR model (3.1). The sample includes all the unregulated Compustat firms with a continuous record from 1964 to 2014. Column (1) to column (5) show regression results of the 5 equations, respectively. One-year lagged and two-year lagged variables are used as independent variables, and the lengths of IVs are 4.

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{n} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ N(0,\ \sigma^2) \quad (3.1)$$

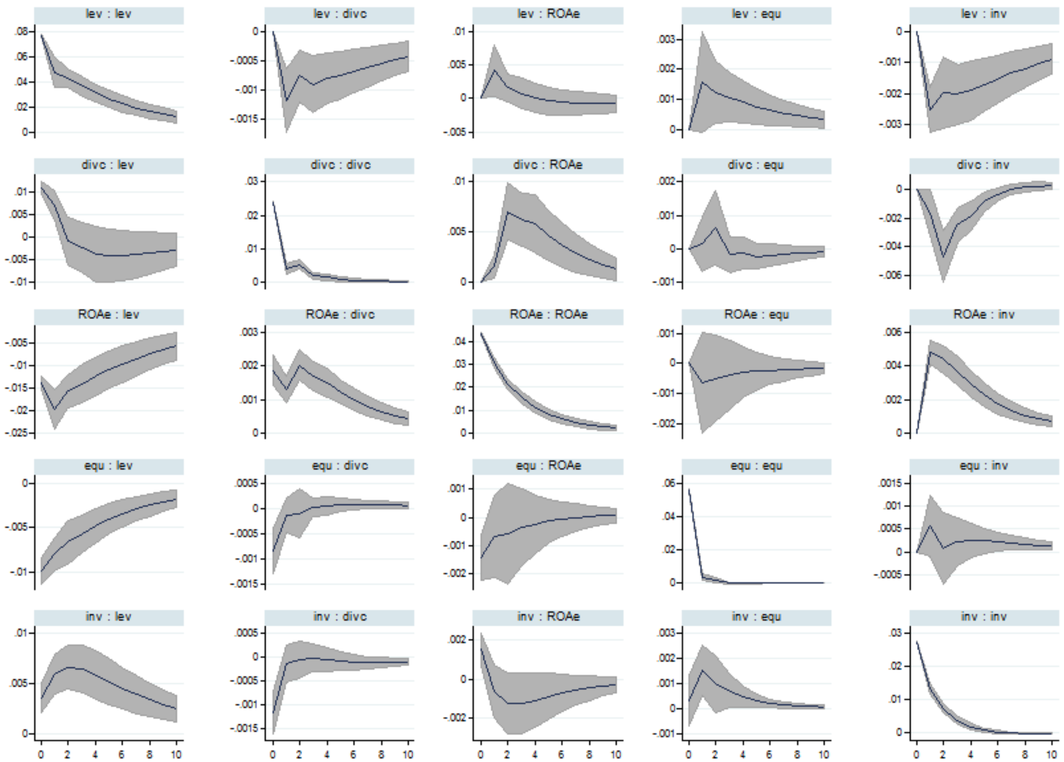
Regression coefficients and Z-statistics are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. N reports the number of firm-year observations. Hansen J-statistics report the results of over-identification test. Maximum Moduli reports the results of model stability test, with the value lower than one indicating stable.

Table 3.9 Granger Causality Test Results Using EBIT

	Lev	ROAe	Inv	Div	Equ
Lev	-	6.67**	59.18***	26.60***	11.18***
		(0.04)	(0.00)	(0.00)	(0.00)
ROAe	11.26***	-	147.24***	30.53***	0.19
	(0.00)		(0.00)	(0.00)	(0.91)
Inv	27.76***	9.55***	-	3.14	8.51**
	(0.00)	(0.00)		(0.21)	(0.01)
Divc	7.38**	21.05***	24.15***	-	1.64
	(0.03)	(0.00)	(0.00)		(0.44)
Equ	3.55	1.65	4.47	0.53	-
	(0.17)	(0.44)	(0.11)	(0.77)	
All	44.30***	44.88***	296.90***	137.60***	21.29***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

This table presents Granger Causality matrix of firm financial behaviour variables. Each cell shows whether the column variable is Granger caused by the row variable. The last row shows whether the column variable is Granger caused by all of the row variables. Chi-square statistics and p-values are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Figure 3.5 Impulse Response Functions Using EBIT



This figure illustrates the impulse response to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Table 3.10 Results of the SVAR Model Using Long-term Debt Ratio

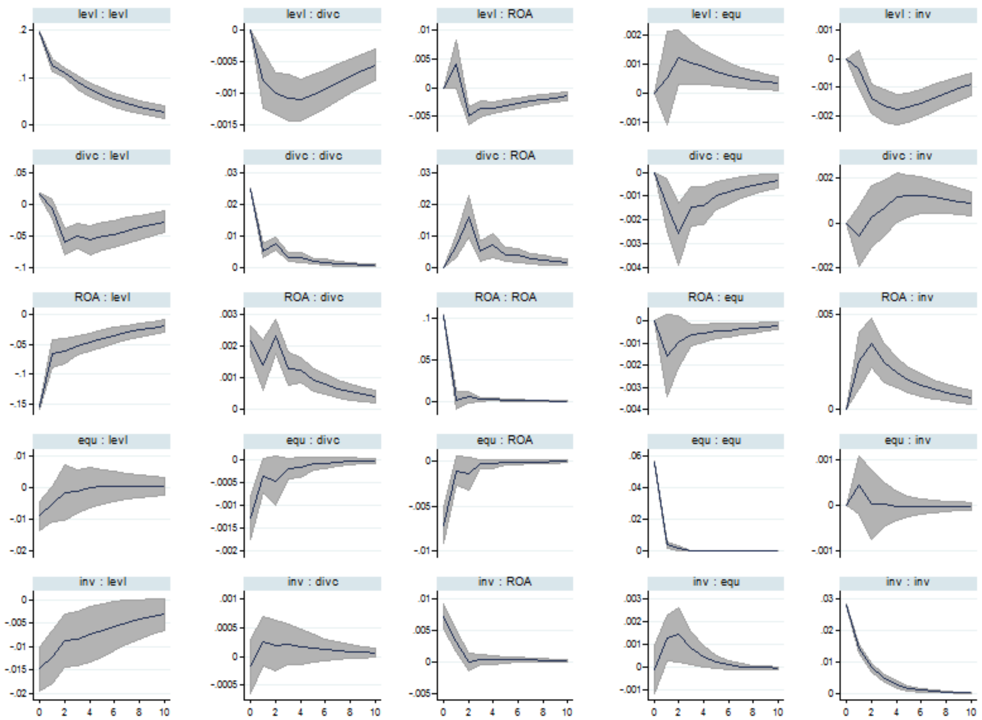
	(1)	(2)	(3)	(4)	(5)
	Levl	ROA	Inv	Divc	Equ
Levl i,t-1	0.645***	0.021*	-0.002	-0.004***	0.003
	(19.41)	(1.90)	(-1.03)	(-3.43)	(0.62)
Levl i,t-2	0.140***	-0.039	-0.006***	-0.002*	0.005
	(4.45)	(-4.26)	(-3.27)	(-1.79)	(1.29)
ROA i,t-1	0.344***	0.046	0.022***	0.003	-0.010
	(3.77)	(0.99)	(3.71)	(0.93)	(-0.79)
ROA i,t-2	0.075	-0.007	0.012**	0.009***	0.002
	(0.76)	(-0.24)	(2.37)	(4.00)	(0.29)
Inv i,t-1	-0.188*	0.116***	0.501***	0.008	0.050***
	(-1.99)	(3.54)	(18.85)	(1.01)	(2.72)
Inv i,t-2	0.072	-0.075***	0.032	-0.003	0.027
	(0.35)	(-2.85)	(1.61)	(-0.42)	(1.31)
Divc i,t-1	-0.684**	0.262***	-0.023	0.212***	-0.058***
	(-2.37)	(3.64)	(-0.81)	(4.62)	(-2.59)
Divc i,t-2	-2.256***	0.611***	0.025	0.256***	-0.086***
	(-4.72)	(4.20)	(1.11)	(5.46)	(-3.15)
Equ i,t-1	0.040	-0.004	0.010*	-0.002	0.069***
	(0.87)	(-0.27)	(1.75)	(-0.49)	(3.94)
Equ i,t-2	0.013	-0.013	-0.003	-0.000	0.031**
	(0.21)	(-0.83)	(-0.53)	(-0.10)	(2.13)
N					10,909
Hansen J-stats					169.49***
Maximum Moduli					0.856

This table presents the regression results of SVAR model (3.1). The sample includes all the unregulated Compustat firms with a continuous record from 1964 to 2014. Column (1) to column (5) show regression results of the 5 equations, respectively. One-year lagged and two-year lagged variables are used as independent variables, and the lengths of IVs are 4.

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{n} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ N(0, \sigma^2) \quad (3.1)$$

Regression coefficients and Z-statistics are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. N reports the number of firm-year observations. Hansen J-statistics report the results of over-identification test. Maximum Moduli reports the results of model stability test, with the value lower than one indicating stable.

Figure 3.6 Impulse Response Functions Using Long-term Leverage Ratio



This figure illustrates the impulse response to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Table 3.11 Granger Causality Results Using Long-term Debt Ratio

	Levl	ROA	Inv	Div	Equ
Levl	-	40.22***	42.39***	37.12***	7.42**
		(0.00)	(0.00)	(0.00)	(0.03)
ROA	15.16***	-	20.23***	16.18***	0.73
	(0.00)		(0.00)	(0.00)	(0.70)
Inv	3.96	14.75***	-	1.08	11.10***
	(0.14)	(0.00)		(0.58)	(0.00)
Divc	46.45***	50.54***	1.79	-	18.66***
	(0.00)	(0.00)	(0.41)		(0.00)
Equ	0.75	0.71	3.50	0.25	-
	(0.69)	(0.70)	(0.17)	(0.88)	
All	54.46***	150.15***	73.96***	84.09***	40.90***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

This table presents Granger Causality matrix of firm financial behaviour variables. Each cell shows whether the column variable is Granger caused by the row variable. The last row shows whether the column variable is Granger caused by all of the row variables. Chi-square statistics and p-values are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Third, I use another definition of leverage. Specifically, I replaces the leverage ratio with a net leverage ratio in which firm cash holdings are deducted from total debt. The definition follows Lambrecht and Myers (2012). The results in Table 3.12 and Table 3.13 are consistent with previous results that firm financial behaviours are jointly-determined. Panel A of Table 3.16 reports the results of FEVD, in which net leverage ratio is more vulnerable (74.8% at the tenth forecast horizon) than the 82.3% of leverage ratio in Table 3.7. However, the main source of the variation is still due to the own shocks. Although the results in Figure 3.7 show that net leverage ratio responds to a larger extent does the leverage ratio (Figure 3.2) when there are investment or profitability shocks, there is still a clear tendency to revert. This suggests that the existence of a leverage target is robust. Lambrecht and Myers (2017) find that there is a target leverage ratio when managers have Constant Relative Risk Aversion (CRRA) utility but there is no target when managers have Constant Absolute Risk Aversion

(CARA) utility. Although this thesis does not examine the utility of managers, the results show that the existence of a leverage target is robust. This may suggest that managers have CRRA utility rather than CARA utility.

Table 3.12 Results of the SVAR Model Using Net Leverage Ratio

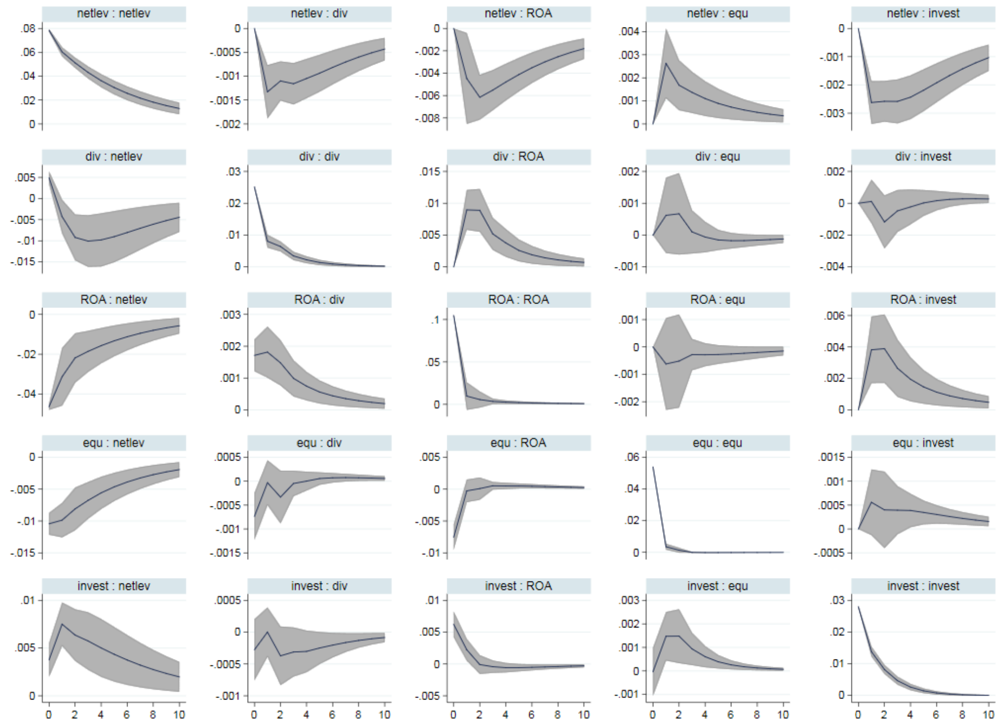
	(1)	(2)	(3)	(4)	(5)
	NetLev	ROA	Inv	Divc	Equ
NetLev i,t-1	0.789***	-0.042	-0.032***	-0.015***	0.034***
	(30.98)	(-1.52)	(-6.90)	(-4.45)	（3.23）
NetLev i,t-2	0.047**	-0.032	0.009***	0.003	-0.005
	(2.38)	(-1.50)	(2.02)	(1.28)	（-0.57）
ROA i,t-1	0.047	0.099	0.021**	0.006	-0.010
	(0.61)	(1.12)	(2.08)	(1.33)	(-0.79)
ROA i,t-2	0.057*	-0.001	0.010*	0.006***	0.002
	(1.75)	(-0.02)	(1.77)	(2.73)	(0.29)
Inv i,t-1	0.150***	0.070*	0.499***	0.005	0.058***
	(3.73)	(1.81)	(17.04)	(0.80)	(2.91)
Inv i,t-2	-0.063	-0.038	0.045**	0.000	0.014
	(-1.57)	(-1.26)	(2.08)	(0.06)	(0.64)
Divc i,t-1	-0.391**	0.373***	-0.039	0.309***	-0.004
	(-4.18)	(5.33)	(-1.09)	(6.98)	(-0.21)
Divc i,t-2	-0.101	0.185***	-0.086**	0.132***	0.017
	(-1.00)	(2.81)	(-2.40)	(4.43)	(0.79)
Equ i,t-1	-0.024	-0.004	0.007	-0.002	0.077***
	(-0.92)	(-0.19)	(1.02)	(-0.59)	(4.90)
Equ i,t-2	0.014	-0.013	-0.004	-0.001	0.014
	(0.54)	(-0.71)	(-0.70)	(-0.18)	(0.64)
N					9,900
Hansen J-stats					191.12***
Maximum Moduli					0.841

This table presents the regression results of SVAR model (3.1). The sample includes all the unregulated Compustat firms with a continuous record from 1964 to 2014. Column (1) to column (5) show regression results of the 5 equations, respectively. One-year lagged and two-year lagged variables are used as independent variables, and the lengths of IVs are 4.

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{n} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ N(0,\ \sigma^2) \quad (3.1)$$

Regression coefficients and Z-statistics are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. N reports the number of firm-year observations. Hansen J-statistics report the results of over-identification test. Maximum Moduli reports the results of model stability test, with the value lower than one indicating stable.

Figure 3.7 Impulse Response Functions Using Net Leverage Ratio



This figure illustrates the impulse response to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Table 3.13 Granger Causality Results Using Net Leverage Ratio

	NetLev	ROA	Inv	Div	Equ
NetLev	-	23.97***	53.62***	24.52***	15.23***
		(0.00)	(0.00)	(0.00)	(0.00)
ROA	3.65	-	7.99**	9.43***	0.15
	(0.16)		(0.02)	(0.01)	(0.93)
Inv	14.07***	3.63	-	0.69	10.25***
	(0.00)	(0.16)		(0.71)	(0.01)
Divc	20.18***	44.72***	8.26**	-	1.03
	(0.00)	(0.00)	(0.02)		(0.60)
Equ	3.65	0.51	1.66	0.37	-
	(0.16)	(0.77)	(0.44)	(0.83)	
All	48.29***	88.24***	75.06***	62.37***	33.09***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

This table presents Granger Causality matrix of firm financial behaviour variables. Each cell shows whether the column variable is Granger caused by the row variable. The last row shows whether the column variable is Granger caused by all of the row variables. Chi-square statistics and p-values are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Fourth, I define dividend as cash dividend plus equity repurchase, and I restrict equity decisions to equity issuances only. The results are reported in Table 3.14 and Table 3.15. In brief, the results show that the main finding that firm financial behaviours are jointly determined hold. In this case, dividend becomes more exogenous. As reported in Panel D of Table 3.16, the proportion of forecast errors explained by its own shocks increases from 0.976 in the baseline model to 0.983, while equity decisions drop slightly from 0.995 to 0.992. Figure 3.8 reports the results of impulse response functions. One interesting point is that, after restricting *Equi* to equity issuance decisions, the responses of other financial behaviours become insignificant. This is in line with the finding in section 3.3 that firms did not immediately put the cash generated by timing the security market into operation activities.

Table 3.14 Results of SVAR Model Separating Equity Decisions

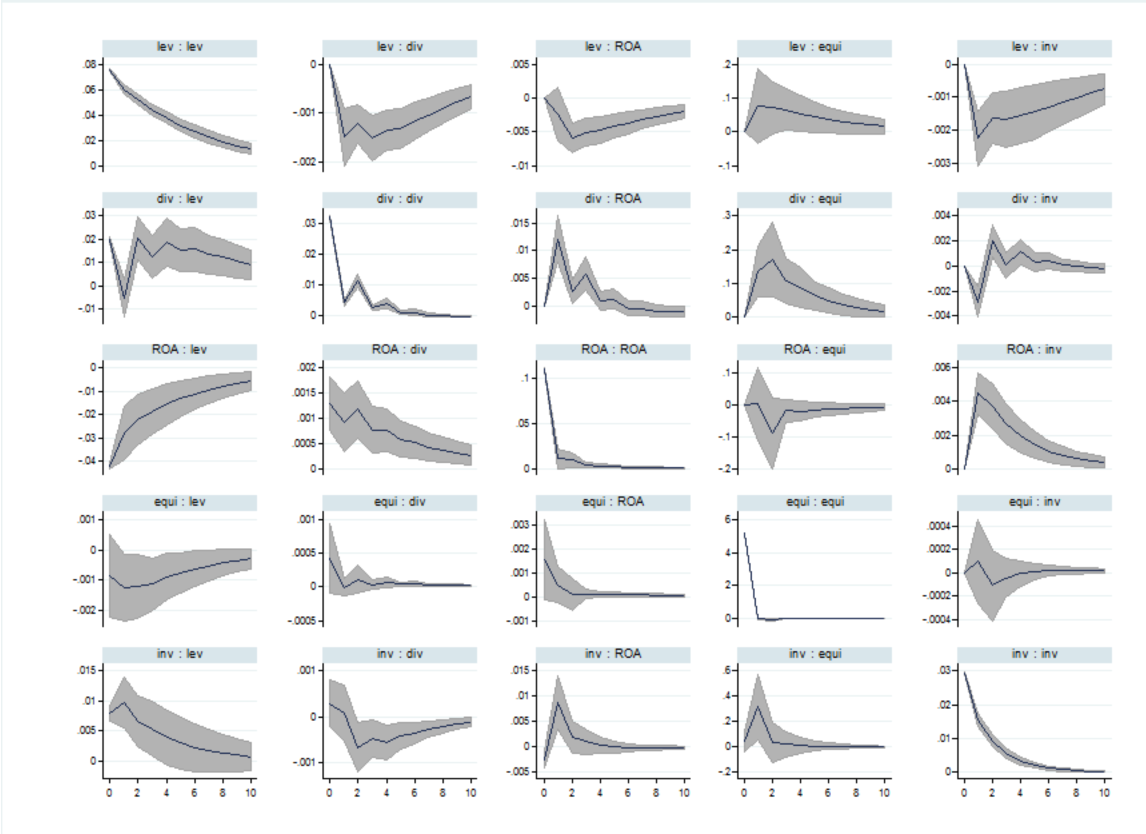
	(1)	(2)	(3)	(4)	(5)
	Lev	ROA	Inv	Dvt	Equi
Lev i,t-1	0.759***	-0.054**	-0.030***	-0.029***	0.030*
	(30.77)	(-2.42)	(-7.60)	(-5.24)	(1.91)
Lev i,t-2	0.017	-0.011	0.012***	0.009**	0.10
	(0.89)	(-0.55)	(3.17)	(2.15)	(0.89)
ROA i,t-1	-0.017	0.133*	0.031***	-0.005	0.022
	(-0.24)	(1.69)	(3.39)	(-0.84)	(1.16)
ROA i,t-2	-0.003	0.052	0.011***	0.008***	-0.026
	(-0.10)	(1.33)	(3.41)	(3.59)	(-1.30)
Inv i,t-1	0.169***	0.108	0.486***	-0.005	0.067**
	(2.86)	(1.33)	(19.86)	(-0.66)	(1.60)
Inv i,t-2	-0.107***	-0.032	0.058***	0.004	0.170**
	(-2.62)	(-1.16)	(3.51)	(0.69)	(4.16)
Dvt i,t-1	-0.173***	0.209***	-0.010	0.219***	0.038
	(-2.07)	(5.24)	(-0.52)	(8.13)	(1.34)
Dvt i,t-2	-0.125***	0.110***	-0.068***	0.174***	-0.060***
	(-2.21)	(4.16)	(-3.66)	(7.05)	(-2.88)
Equi i,t-1	0.015	-0.027	-0.001	-0.001	0.047
	(1.05)	(-1.44)	(-0.27)	(-0.45)	(1.61)
Equi i,t-2	-0.001	0.010	0.002	0.000	0.003
	(-0.10)	(0.75)	(0.59)	(0.09)	(0.18)
N					11,844
Hansen J-stats					260.85***
Maximum Moduli					0.799

This table presents the regression results of SVAR model (3.1). The sample includes all the unregulated Compustat firms with a continuous record from 1964 to 2014. Column (1) to column (5) show regression results of the 5 equations, respectively. One-year lagged and two-year lagged variables are used as independent variables, and the lengths of IVs are 4.

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{n} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ \mathrm{N}(0,\ \sigma^2) \quad (3.1)$$

Regression coefficients and Z-statistics are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. N reports the number of firm-year observations. Hansen J-statistics report the results of over-identification test. Maximum Moduli reports the results of model stability test, with the value lower than one indicating stable.

Figure 3.8 Impulse Response Functions Separating Equity Issuances and Repurchases



This figure illustrates the impulse response to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Table 3.15 Granger Causality Results Separating Equity Decisions

	Lev	ROA	Inv	Dvt	Equi
Lev	-	16.07***	27.62***	38.14***	7.06***
		(0.00)	(0.00)	(0.00)	(0.03)
ROA	1.30	-	34.43***	0.59	2.97
	(0.52)		(0.00)	(0.75)	(0.23)
Inv	10.08***	12.83***	-	6.78**	6.02**
	(0.01)	(0.00)		(0.03)	(0.05)
Dvt	97.03***	46.33***	40.72***	-	19.02***
	(0.00)	(0.00)	(0.00)		(0.00)
Equi	11.60	0.49	7.72**	4.67	-
	(0.00)	(0.78)	(0.02)	(0.10)	
All	124.22***	83.99***	131.97***	64.63***	30.95***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

This table presents Granger Causality matrix of firm financial behaviour variables. Each cell shows whether the column variable is Granger caused by the row variable. The last row shows whether the column variable is Granger caused by all of the row variables. Chi-square statistics and p-values are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

Table 3.16 Forecast Error Variance Decomposition for Robustness Checks

	(1)	(2)	(3)	(4)	(5)
Panel A: NetLev					
Lags(n)	NetLev	ROA	Inv	Divc	Equ
10	0.748	0.965	0.920	0.965	0.990
Panel B: ROAe					
Lags(n)	Lev	ROAe	Inv	Divc	Equ
10	0.856	0.947	0.878	0.961	0.996
Panel C: Levl					
Lags(n)	Levl	ROA	Inv	Divc	Equ
10	0.598	0.944	0.946	0.964	0.991
Panel D: Separating Equity Decisions					
Lags(n)	Lev	ROA	Inv	Dvt	Equi
10	0.733	0.967	0.938	0.983	0.992
Panel E: Data from 1980 on					
Lags(n)	Levl	ROA	Inv	Divc	Equ
10	0.864	0.967	0.951	0.984	0.988

This table shows the results of Forecast Error Variance Decomposition. Each ceel reports the proportion of forecast errors of the panel variable variables that is predicted by the column variable at the 10th forecast horizon.

Table 3.17 Results of SVAR Model Using Data from 1980 On

	(1)	(2)	(3)	(4)	(5)
	Lev	ROA	Inv	Divc	Equ
Lev i,t-1	0.756***	-0.012	-0.031***	-0.023***	0.025
	(32.11)	(-0.37)	(-6.26)	(-5.65)	(1.20)
Lev i,t-2	0.055***	-0.052**	0.007	0.002	0.019
	(3.06)	(-2.00)	(1.51)	(0.59)	(1.27)
ROA i,t-1	0.110**	0.002	0.017**	-0.006	0.022
	(2.30)	(0.04)	(2.31)	(-1.49)	(1.07)
ROA i,t-2	0.003	0.047	0.011***	0.010***	-0.052**
	(0.13)	(1.22)	(3.19)	(3.90)	(-2.43)
Inv i,t-1	0.032***	0.242***	0.502***	-0.002	0.075*
	(0.67)	(3.75)	(20.99)	(-0.26)	(1.71)
Inv i,t-2	-0.085**	-0.029	0.057***	0.011*	0.123***
	(-2.49)	(-1.00)	(3.66)	(1.75)	(2.66)
Divc i,t-1	-0.029	0.089***	0.003	0.127***	0.000
	(-0.66)	(2.85)	(0.21)	(5.96)	(0.02)
Divc i,t-2	-0.048	0.141***	-0.030**	0.171***	-0.032
	(-1.29)	(4.16)	(-2.25)	(6.38)	(-1.54)
Equ i,t-1	0.018**	-0.025	-0.001	0.001	0.050*
	(2.12)	(-1.46)	(-0.11)	(0.33)	(1.93)
Equ i,t-2	0.012*	0.001	0.002	0.001	0.000
	(1.65)	(0.08)	(0.71)	(0.64)	(0.03)
N					14,569
Hansen J-stats					193.12***
Maximum Moduli					0.819

This table presents the regression results of SVAR model (3.1). The sample includes all the unregulated Compustat firms with a continuous record from 1964 to 2014. Column (1) to column (5) show regression results of the 5 equations, respectively. One-year lagged and two-year lagged variables are used as independent variables, and the lengths of IVs are 4.

$$Y_{i,t} = \alpha_0 + \sum_{k=1}^{m} \alpha_k Y_{i,t-k} + \sum_{j=1}^{n} \sum_{k=1}^{m} \beta_{j,k} X_{j,i,,\ t-k} + \mu_i + \eta_t + \varepsilon_{i,t},\ \varepsilon_{i,t} \sim i.i.d.\ \mathrm{N}(0,\ \sigma^2) \quad (3.1)$$

Regression coefficients and Z-statistics are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level. N reports the number of firm-year observations. Hansen J-statistics report the results of over-identification test. Maximum Moduli reports the results of model stability test, with the value lower than one indicating stable.

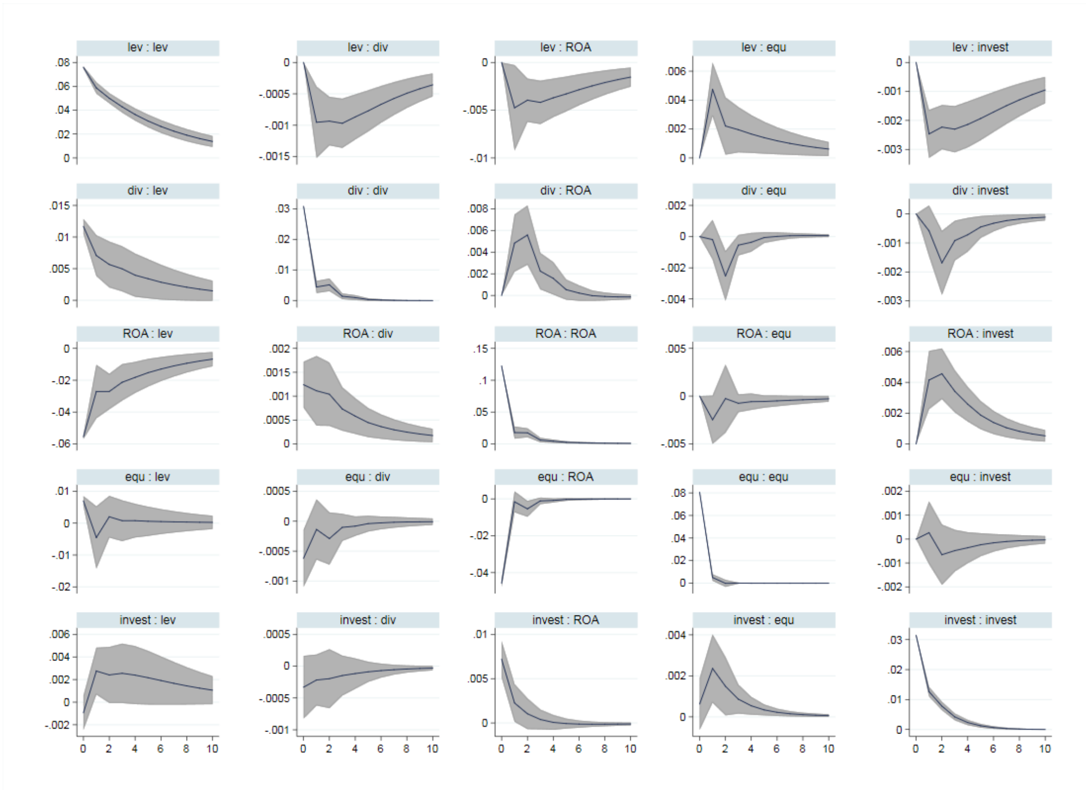
Table 3.18 Granger Causality Results Using Data from 1980 On

	Lev	ROA	Inv	Divc	Equ
Lev	-	16.00***	54.11***	45.09***	2.43
		(0.00)	(0.00)	(0.00)	(0.30)
ROA	5.29*	-	14.63***	18.25***	2.32**
	(0.07)		(0.00)	(0.00)	(0.31)
Inv	6.32**	14.17***	-	3.06	8.58**
	(0.04)	(0.00)		(0.22)	(0.01)
Divc	2.11	23.97***	5.10*	-	2.29
	(0.35)	(0.00)	(0.08)		(0.32)
Equ	6.36**	2.14	0.512	0.43	-
	(0.04)	(0.34)	(0.77)	(0.81)	
All	16.64**	81.18***	80.15***	92.98***	28.80***
	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)

This table presents Granger Causality matrix of firm financial behaviour variables. Each cell shows whether the column variable is Granger caused by the row variable. The last row shows whether the column variable is Granger caused by all of the row variables. Chi-square statistics and p-values are reported. *** indicates significance at the 1% level, ** indicates significance at the 5% level, and * indicates significance at the 10% level.

In terms of the sample period, I conduct another test using the sample period from 1980 to 2014. There are 485 firms in the sample, compared to the 285 firms in the baseline sample. The results of IRFs are reported in Figure 3.9. The two samples, as reported in Figure 3.2 and Figure 3.9, generate qualitatively similar results. This suggests that the main findings are robust to the alternative sample period in which I decrease the length of the time period but increase the number of firms. The results are attached in Table 3.17 and Table 3.18.

Figure 3.9 Impulse Response Functions – Firms from 1980 onward



This figure illustrates the impulse response to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

3.7 Impulses and Responses of High-Growth Firms and Low Growth Firms

Table 3.19 Univariate Differences of High-growth Firms and Low-growth Firms

Variable		High-growth	Low-growth
Lev	Mean	0.234***	0.225***
	Median	0.217	0.213
Levl	Mean	0.342***	0.428***
	Median	0.307***	0.350***
ROA	Mean	0.063***	0.055***
	Median	0.063***	0.060***
ROAe	Mean	0.118***	0.111***
	Median	0.110*	0.107*
Inv	Mean	0.072***	0.059***
	Median	0.061***	0.047***
Divc	Mean	0.025***	0.020***
	Median	0.020***	0.016***
Equ	Mean	0.003***	0.009***
	Median	0.001	0.001
NetLev	Mean	0.189***	0.173***
	Median	0.182**	0.174**

This table presents the univariate differences based of high-growth firms and low-growth firms. The sample includes all of the unregulated firms with continuous records, and the sample period is from 1964 to 2014. This table reports the mean and the median for each subsample group. This table tests the difference in mean by the Wilcoxon rank-sum test, and tests the difference in median by the chi-square test. *** indicates significant difference between compared groups at 1% level. ** indicates significant difference at 5% level; *indicates significant difference at 10% level. The definitions and explanations of variables are summarized in Appendix 1.

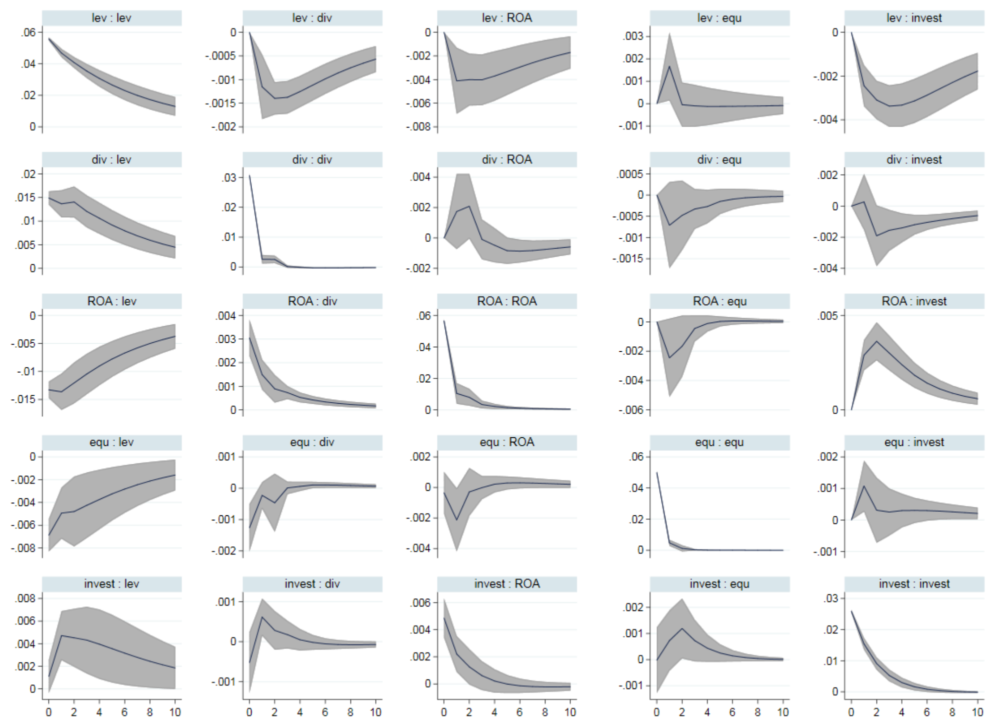
Section 3.5 and section 3.6 illustrate the impulses and responses of sample firms to exogenous shocks. A further concern is the heterogeneous features of the responses. Growth is an important factor, since numerous studies (such as Frank and Goyal, 2003; Leary and Michaely, 2011) find high-growth firms and low-growth firms do not have the same financial policy. For example, Frank and Goyal (2003) find that high-growth firms do not follow the *pecking order theory*. The authors also suggest that high-growth firms are expected to have a higher leverage adjustment speed, because these firms need to maintain the debt capacity. Leary and Michaely (2011) suggest that low-growth firms are expected to have a smoother dividend payout because these firms have more cash available. This section presents and discusses the differences in the responses of high-growth firms and low-growth firms. Sample firms are partitioned into two subsamples, based on the mean growth rate of total assets in the sample period. Finally, 149 firms are marked as high-growth firms and 136 firms are marked as low-growth firms. The results show that high-growth firms (reported in Figure 3.10) and low-growth firms (Figure 3.11) follow similar patterns with the full sample (Figure 2). This suggests that the results in section 3.5 are robust to both high-growth firms and low-growth firms. Besides the common features, several interesting differences worth noting. Univariate differences of high-growth firms and low growth-firms are reported in Table 3.19.

The results of IRFs show that equity issuance decisions are more exogenous in the group of high-growth firms. As can be seen in Figure 3.10, the equity issuance of high-growth firms responds to a small extent to leverage shocks and investment shocks; and the responses to dividend shocks and profitability shocks are not statistically significant. However, in the group of low-growth firms (in Figure 3.11), equity issuance responds to all of the other shocks significantly. Leverage shocks and investment shocks both lead to a larger response in the equity issuance of low-growth firms, compared to the response in the group of high-growth firms. This indicates that low-growth firms are more likely to use equity financing to accommodate other financial behaviours. The possible reason is that low-growth firms tend to have a larger size (19,483.1 million dollar compared to 1,156.5 million dollar); and hence, those firms have a lower cost to access the equity market. High-growth firms have the potential to continuously increase the stock price; and hence, these firms are reluctant to use equity financing to accommodate other financial behaviours.

The results show that high-growth firms have a tighter leverage target than do low-growth firms. When there is a shock to ROA, the leverage ratio of high growth firms responds more but diminishes faster. In Graph (ROA: lev) of Figure 3.10, the initial response of leverage is -0.06, but it reduces to insignificance in two periods. The response of low-growth firms is weaker (-0.015), and it diminishes smoothly as shown in Graph (ROA: lev) of Figure 3.11. These results suggest that high-growth firms revert to the leverage target faster than low-growth firms.

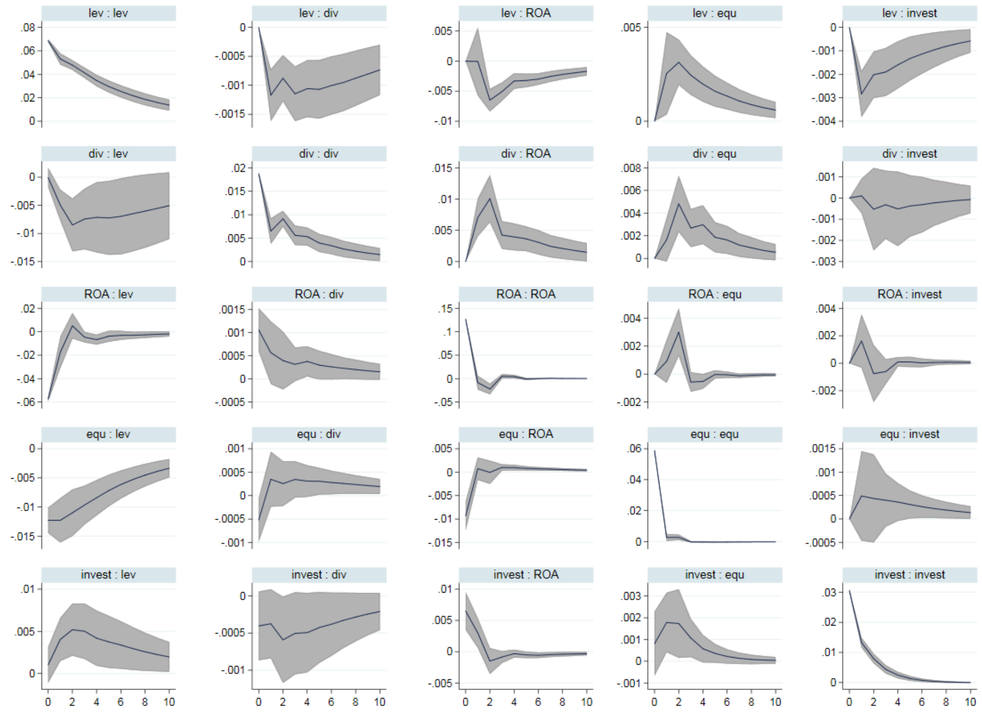
The results show that dividend payout is smoother in the group of low-growth firms. According to Graph (ROA: div) of Figure 3.10, a standard deviation of shocks to *ROA* is followed by around 0.003 units of responses in *div*; while the responses of low-growth firms are 0.001 in Figure 3.11. Considering the response in Graph (ROA: lev) together, the results suggest that low-growth firms tend to use extra profits to reduce the debt burden. This finally leaves dividend payout smoothed. One possible explanation is that low-growth firms have more free cash flow problems, and these firms need to maintain smoothed distributions for the interest of equity holders. These results are in line with Leary and Michaely (2011) that dividend is smoother in the group of cash cows.

Figure 3.10 Impulse Response Functions of High-Growth Firms



This figure illustrates the impulse response of high-growth firms to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

Figure 3.11 Impulse Response Functions of Low-Growth Firms



This figure illustrates the impulse response of low-growth firms to one standard deviation of shocks to firm financial behaviour variables, and the shaded area denotes the 95% confidence interval calculated by 2,000 Monte Carlo draws from SVAR Model (3.1). The X-axis shows steps of forecast horizons in years, and the Y-axis shows the magnitude of the response. Graph (A: B) illustrates the response of variable B to an exogenous shock to variable A.

3.8 Discussion, Conclusion and Limitations

Chapter 3 investigates the dynamics and interactions of firm investment, dividend payout, profitability, leverage and equity issuance, using a five-variable SVAR framework. This method allows analysing the impact and response of the five endogenously-determined factors. SVAR models have two advantages. First, compared to theoretical works that need to assume the exogeneity of several factors to limit the dimensionality, SVAR models allow all of variables to be endogenously determined and use orthogonal shocks to achieve the identification. Second, using an SVAR approach avoids the potential bias resulting from the misspecification caused by the assumed exogeneity in simultaneous equation models (Sims, 1980; Bagliano and Favero, 1998). This chapter uses the Model and Moments Selection Criteria (MMSC) suggested in Andrews and Lu (2001) to choose an optimal lag structure of the SVAR model. As a result, the second-order SVAR model seems to fit the best. The main findings are robust to the two samples. The first sample contains 285 firms with continuous records from 1964 to 2014; and the second sample in the robustness check section contains 485 firms with continuous records from 1980 to 2014. The results are also robust to alternative definitions of variables and robust in the groups of low-growth firms and high-growth firms.

This chapter evaluates the joint determination of firm financial behaviour by testing whether each financial behaviour variable helps explain the other financial behaviour proxies. The results of the SVAR model show that firm financial characteristics are explained by their previous realizations and the previous realizations of other financial variables. Leverage is determined by profitability, investment and dividend payout. Investment is determined by leverage and long-run distributions. Dividend payout ratio is determined by the leverage ratio. Equity issuance is determined by investment and leverage. This thesis uses a Granger Causality test (Granger, 1969) to evaluate the joint explanatory power of the distributed lags of a single financial behaviour. The results show that all of the financial behaviour variables are determined by at least some of the other variables. In sum, the empirical results are in line with the theoretical studies (such as Hennessy and Whited, 2005) stating that firm financial policies are interdependent. The studies exploring one financial behaviour without controlling for other financial behaviours may lead to biased estimates.

Although several theoretical studies (e.g., Hennessy and Whited, 2005, 2007; Lambrecht and Myers, 2012; 2017) suggest that firm financial behaviours are jointly-determined, the priority of firm financial behaviours has not been empirically examined. Section 3.4 decomposes forecast errors of the five variables in the dynamic system and analyses how the variance of each variable is due to its own shocks and the shocks to other financial characteristics. This facilitates a direct comparison on the relative independence of firm financial behaviours. This thesis hypothesizes that the financial policy with a higher priority tends to be less influenced by shocks to other financial behaviours. The evidence of FEVD suggests that firm equity decisions are the most independent (exogenous), with 99.5% of forecast error variance explained by its own shocks. Dividend payout is smoothed by debt and investment, and it is less volatile than firm profitability. Investment is a bit more vulnerable (endogenous) than dividend (97.6%), but it still shows high independence (95.1%). Leverage policy is the most vulnerable, but there is also a clear tendency of target reversion. The relative exogeneity reveals the relative cost of adjusting these financial behaviours to accommodate other financial behaviours. The results indicate that adjusting equity decisions is the most costly. This is followed by adjusting dividend decisions and then investment decisions. Adjusting debt decisions has the lowest cost. These results contribute to the corporate finance literature by showing the relative cost of deviations from the desired levels of financial characteristics. More than 80% of forecast errors of these variables is explained by their own shocks, which suggests that none of the financial behaviours is completely driven by shocks to other financial behaviours.

Considering the nature of interdependence of firm financial behaviours, section 3.5 uses orthogonal Impulse Response Functions (IRFs) to examine the interactions and to visualize how an exogenous shock to each financial behaviour impulses on the other financial behaviours. The results show that firm financial characteristics temporarily deviate from their desired levels to absorb shocks to other financial characteristics and revert at varying speeds. Specifically, shocks to investment lead to responses in ROA, dividend, leverage and equity issuance; and firm investment also responds to the shocks to ROA, dividend and leverage. ROA impacts on leverage, dividend and investment; and ROA also responds to the shocks to leverage, dividend, investment and equity issuance. Dividend impacts on leverage, ROA, and investment, and responds to the shocks to leverage, ROA investment and equity issuance. Leverage absorbs shocks to all of the other financial behaviours (i.e., dividend, ROA, investment and equity issuance); and in reverse, leverage also impacts on these financial behaviours variables. Equity issuance impacts on leverage, ROA, dividend and investment, and is also used to absorb the shocks to leverage and investment. Section 3.5 uses this method to directly examine the interactions behind firm financial behaviours and to measure how strong and how persistent the responses are. Using orthogonal IRFs enables to measure the response of financial behaviours towards exogenous shocks. To my knowledge, this is the first study systematically examining the response of firm financial behaviours towards the shocks to other financial behaviours.

This thesis also adds to the literature examining firm financial behaviours under financing restrictions. In particular, the results of IRFs show that firm investment and dividend payout respond to shocks to financing decisions and profitability. Modigliani and Miller (1958) and Fama (1974) suggest that firms make independent investment and dividend decisions. The results in this thesis suggest that investment and dividend have competing demands on financing sources (consistent with the assertion in Jensen, 1992) and respond negatively to each other. Moreover, both investment and dividend deviate from their natural levels to absorb shocks to firm profitability and leverage. These results suggest that, when sample firms are constrained by available funds, investment and dividend decisions are influenced by financing decisions and the shocks to profitability. The results generated by IRFs provide further support to the literature (such as

Dhrymes and Kurz, 1967; Peterson and Benesh, 1983; Jalilvand and Harris, 1984; Jensen et al., 1992; and Hennessy and Whited, 2005) arguing for financial behaviour interactions in an imperfect market. The fact that all of the financial behaviours impact on some of the other financial behaviours supports Jensen et al. (1992) who argue that firms jointly optimize over several financial behaviours under the influence of financial restrictions. It appears that firms aim to jointly minimize over the costs of deviation from the desired level of each financial characteristic.

The results in this chapter are in line with three branches of the literature. First, the results are in line with Jensen et al. (1992) who suggest that firms may jointly optimize over several financial behaviours. This chapter shows empirically that firms temporarily deviate from the natural status of several financial characteristics to absorb shocks to the other financial characteristics and revert to their natural levels in subsequent periods. Unlike previous studies using simultaneous equation models[27], this chapter uses a method by which firm financial behaviours are allowed to be endogenously determined. Second, the results in this chapter support the *trade-off theory* which suggests that firms target an optimal leverage ratio. Although firms issue or retire debt to absorb shocks to other financial behaviours, the percentage of forecast errors explained by shocks to other financial behaviours is less than 20%. Moreover, IRFs show a clear tendency that the response of leverage diminishes after exogenous shocks, although the speed of adjustment is slow. These results indicate that firm leverage ratio is not residually determined, because there is a clear tendency

[27] See Lee et al. (2016) for a review of the literature.

to revert. The existence of a leverage target is robust when the net leverage ratio is used to replace the leverage ratio. In this sense, although the empirical evidence is in line with the theoretical setting in DeAngelo et al. (2011) that firms use transitory debt to absorb shocks, it appears that neither leverage nor dividend is residually determined. Third, the results in this thesis are consistent with a list of studies (such as Fama and French, 2002; Lambrecht and Myers, 2012; and DeAngelo and Roll, 2015) indicating that firms follow the dividend target more closely than the leverage target. By examining the impact of exogenous shocks, this thesis shows that the dividend payout ratio reverts faster than the leverage ratio. Moreover, this thesis provides empirical evidence supporting the assertion in Acharya and Lambrecht (2015) that firms do not immediately distribute all of the unexpected profits to shareholders. Instead, firms use debt and investment to smooth dividend, and gradually distribute the extra profits to shareholders.

This chapter uses a newly-developed method (Abrigo and Love, 2016), namely an SVAR model, to explore the dynamics and interactions among firm financial behaviours. At the same time, it is unavoidably subject to a few limitations. First, the newly-developed methodology is not yet able to accommodate more explicit specifications of each equation. In the real world, many factors, such as tax rate, stock prices, other events (such as M&A and IPO) and potential industry effects influence more than one financial behaviours at the same time. For example, Becker et al. (2013) find that dividend taxes reduce dividend payment but increase investment; Campello and Graham (2013) find that, during the tech bubble, constrained non-tech firms take advantage of the overvaluation of stock prices to issue equity, increase investment and accumulate cash holdings. Whether investment in the form of M&A is financed by debt or equity depends on whether the bidder is currently under-levered or over-levered (Harford et al., 2009). The SVAR methodology is unable to test these effects explicitly. In addition, these factors are rarely orthogonal, and it is hardly possible to claim a real shock as the shock to one financial behaviour. Instead, the method relies on the orthogonal shocks that are extracted technically (Sims, 1980) and use the demean processes to remove fixed effects at firm level and year level.

Second, the financial behaviours and the shocks that this chapter refers to are assumed homogeneous. This chapter uses the VAR methodology (Sims, 1980) to extract orthogonal shocks to achieve the identification, but the real shocks to firms are rarely homogeneous. Taking debt for an example, in a financial market where the cost of issuing debt is higher, firms could potentially raise the priority of the leverage target. As a result, these firms would use debt to absorb shocks less often. This study has not accounted for the heterogeneous features of financial behaviours.

Third, since time series methods require a long time period, this chapter is unable to take into account the firms that go bankrupt in the sample period. These firms have a negative profitability and accumulate debt until a level that is unable to be repaid. Therefore, their leverage ratios are unable to revert to the natural status. Otherwise, the firms will not go bankrupt. Hence, it is expected that these firms give a lower priority to debt decisions but can hardly use other financial behaviours to absorb leverage shocks.

Chapter 4 Mechanical Reversion and Leverage Target Adjustment

A few recent studies (such as Chang and Dasgupta, 2009; DeAngelo and Roll, 2015) question whether the leverage target adjustment observed by using the classical partial adjustment model (Flannery and Rangan, 2006) is mechanically determined when firms accommodate the other financial behaviours, rather than being discretionarily determined. In addition, Hovakimian and Li (2011, 2012) and Elsas and Florysiak (2015) question whether partial adjustment models have the power to distinguish leverage target adjustment from other financing motives. Since the other financial behaviours lead to variations in the leverage ratio through cash flows in the firm, they are also likely to lead to leverage target adjustments. A natural question is, to what extent these factors drive leverage target adjustments. If the observed target adjustment is purely mechanically-determined, it should not be used to support the *trade-off theory*, because it does not show a motivation to actively revert. Therefore, Chapter 4 seeks to differentiate the mechanical effects from an active target adjustment and to evaluate whether there is a robust active target adjustment. It contributes to the literature by discussing how other financial behaviours (i.e., investment decisions, dividend decisions, equity decisions and variation in net income) mechanically drive leverage target adjustments and whether there remains a non-mechanical fraction of the SOA that can be used to support the *trade-off theory*.

Specifically, after providing an explanation for the mechanical effects on leverage target adjustments, Chapter 4 extends the partial adjustment model in Flannery and Rangan (2006), by using interaction terms to capture the mechanical effects. The results shows that other financial behaviours have a mechanical impact on leverage target adjustment. Moreover, these effects are more pronounced in the group of financially-constrained firms. These results are robust to an alternative specification by using the financing deficit variable to test the mechanical effects.

There is a substantial fraction of the SOA, which is not explained by the mechanical effects. Although controlling the mechanical effects reduces the estimated SOA by over 50%, it does not wipe out leverage target adjustment behaviours. This indicates that leverage target adjustment is not completely driven by other financial behaviours. Rather, nearly half of the observed leverage target adjustment is actively determined. The existence of active target adjustment is robust to the partitions according to firm size and dividend payment. These results point to a unified theory of capital structure in which firms consider both targeting an optimal leverage ratio and balancing the budget constraint.

Furthermore, the results show that under-levered firms adjust faster than over-levered firms, supporting the *leverage ratchet effect* explanation (Admati et al, 2018). The faster adjustment speed is robust to using traditional partial adjustment model and the extended partial adjustment model. Among the partitioned subgroups, constrained and over-levered firms show the lowest adjustment speed.

Chapter 4 is structured as follows. Section 4.1 presents the theoretical background and shows why and how other financial behaviours can lead to mechanically leverage target adjustment. Section 4.2 explains the methodology and introduces the empirical setting to test the mechanical effects. Section 4.3 describes the data. Section 4.4 presents descriptive evidence on leverage target adjustments. Section 4.5 compares the leverage target adjustment speed from above and from below. Section 4.6 shows evidence for the mechanical target adjustment and the active target adjustment. Section 4.7 discusses the robustness of the main findings. Section 4.8 evaluates the impact of financial constraint on the mechanical effects. Section 4.9 discusses the results, concludes the chapter and states the limitations.

4.1 Mechanical Effects on Leverage Target Adjustment

The mechanical effects on leverage are referred to as the variation in leverage ratio that is driven by other financial behaviours through influencing the cash flow in firms. The mechanical effects are also linked to leverage target adjustments and the estimated SOA.

Lambrecht and Myers (2012) use the budget constraint equation to link firm debt decisions to other financial behaviours. If investment decisions, dividend decisions and equity decisions are more important than leverage decisions, as suggested in DeAngelo and Roll (2015), debt decisions should play the role of balancing the budget constraint. [28]

[28] The empirical setting in this chapter is based on the condition that the other financial decisions are more important than leverage decisions. Otherwise, there will be endogeneity problems. Chapter 3 decomposes forecast errors of firm financial behaviours and find that

Considering that investment activities are driven by investment opportunities, and that firm equity decisions largely depend on market timing opportunities (Baker and Wurgler, 2002; Fama and French, 2005); it is reasonable to accept that firm investment and equity issuance are more important than the leverage target, as firms are rational[29] and tend to take advantages of good opportunities. Fama and French (2002) document a higher SOA of dividend ratio than the SOA of leverage ratio, suggesting that firms target a dividend payout ratio more closely than targeting a leverage ratio. The explanation in Fama and French (2002) is that firms need to maintain stable and attractive distributions for the interest of shareholders. Hence, it is reasonable to accept that firms give a higher priority to targeting a dividend payout ratio than targeting a leverage ratio. In sum, firms need to raise or retire debt to absorb shocks to other financial behaviours. In this way, other financial behaviours drive debt decisions; and, hence, firm leverage ratio is likely to be mechanically-determined.

Why do firms allow mechanical target adjustments? Flannery and Rangan (2006) suggest that the adjustment cost is the reason for the slow SOA. If there is no adjustment cost such as the transaction cost of debt, firms would immediately revert to the optimal leverage ratio. If the adjustment cost is higher than the benefit from reversion, firms would remain deviated from the optimal leverage ratio. If firms need to accommodate other financial behaviours, which happens to bring extra

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firm investment, equity issuance (repurchase), dividend, profitability are more exogenous (independent) than the leverage ratio.

[29] Corporate finance studies tend to assume that firms are rational. Irrational corporate finance behaviours (in behaviour corporate finance literature) is beyond the scope of this study.

benefits by moving the leverage ratio closer to the target, firms are likely to incorporate these changes.

Korteweg (2010) estimates the net benefit of leverage based on Modigliani and Miller's (1956) framework. In MM's framework, $B(L) = V^L - V^U$ measures the net benefit of debt. The benefit of debt financing $B(L)$ is equal to the difference between the value of levered firms (V^L) and the value of unlevered firms (V^U). Korteweg uses $B(L^*)$ to represent the net benefit of debt at the optimal leverage ratio L^*. Therefore, the difference $B(L^*) – B(L)$ measures the benefit of moving the leverage ratio from L to the optimal leverage ratio L^*, which is equal to the adjustment cost.[30]

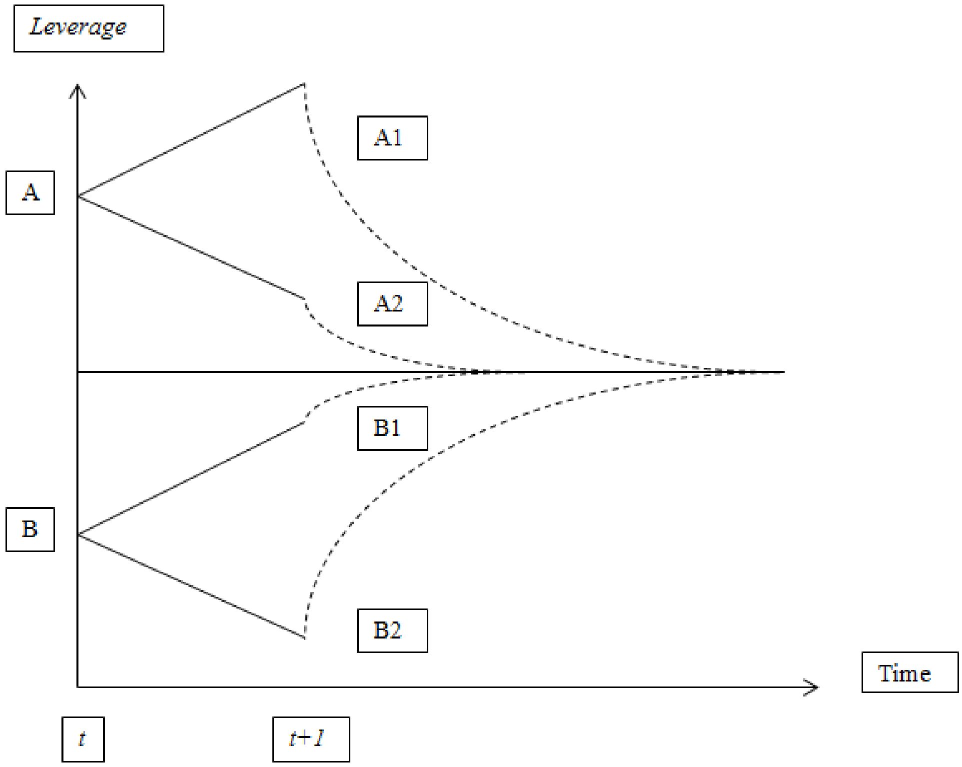
Using debt to balance the budget constraint brings extra benefits to firms, such as by pursuing a profitable investment project. The extra benefit is denoted by a new term, $B(T)$. If balancing the budget constraint happens to lead to target adjustments, the benefits of adjustment become $B(L^*) – B(L) + B(T)$, which is necessarily larger than the adjustment cost $B(L^*) – B(L)$; and hence, firms choose to revert. On the other hand, balancing the budget constraint may result in a further deviation of leverage from L to L'. In this situation, if $B(T)$ is larger than the cost of the further deviation $B(L) – B(L')$, firms would allow the mechanical deviation.

Figure 4.1 illustrates the routes that firm leverage ratio could be driven by other financial behaviours, followed by reversions. The Y-axis shows the leverage ratio. The X-axis shows the time. The horizontal line

[30] Modern studies tend to explain the heterogeneous SOA in the context of the adjustment cost, such as Oztekin and Flannery (2012), Cook and Tang (2010), Drobetz et al. (2015). According to these studies, firms with higher adjustment cost tend to revert slowly.

indicates the optimal leverage ratio (the leverage target)[31]. Position A stands for the situation when current leverage ratio is above the leverage target; while position B stands for the situation when current leverage ratio is below the leverage target. The four routes (A1/A2/B1/B2) show the routes that firm leverage ratio could follow. The solid line, from *t* to *t+1*, shows the variation in leverage driven by other financial behaviours. The dashed line after *t* shows target adjustments in subsequent periods.

Figure 4.1 Variations in Leverage



This figure shows the impact of the mechanical effects on firm leverage ratio, followed by the reversion. Y-axis shows the leverage ratio, and X-axis shows the time. The horizontal line in the middle is the leverage target. Status A and status B are situations when firms are above and below the target leverage ratio respectively, at *t*. A1, A2, B1, B2 are the four routes leverage ratio moves along. The solid line from *t* to *t+1* shows the influence of the mechanical effects on the leverage ratio, and the dashed line after *t+1* shows adjustments towards the target.

[31] To simplify, on this graph, an assumption is that the optimal (target) leverage ratio is constant during the process, and the move of leverage ratio from *t* to *t+1* is only driven by the motivation to balance the budget constraint (the mechanical effects).

Issuing debt to balance the budget constraint leads to a mechanical increase in the leverage ratio. Let L_t denotes the leverage ratio at year t:

$$L_t = \frac{D_t}{D_t + E_t} = 1 - \frac{E_t}{D_t + E_t} \tag{4.1}$$

where D_t is debt and E_t is equity. To simplify, it is assumed that there is no retained earnings. The *pecking order theory* suggests that debt is cheaper than equity in terms of the transaction cost and the information cost. Once external capital is needed, debt financing is preferred to equity financing, to cover investment and dividend. See the situation when firms issue new debt d_{t+1} to fund a new investment project, a dividend payment or an increased cash holding, while there is no equity issuance or new income. The leverage ratio at $t+1$ becomes:

$$L_{t+1} = \frac{D_t + d_{t+1}}{D_t + E_t + d_{t+1}} = 1 - \frac{E_t}{D_t + E_t + d_{t+1}} \tag{4.2}$$

It can be clearly noticed that L_{t+1} is higher than L_t. Depending on whether the initial leverage ratio is at A or B in Figure 4.1, to balance the budget constraint, leverage ratio follows route A1 or B1 to fund investment, distributions or the increased cash holdings. If firms consider the debt capacity (Lemmon and Zender, 2010) and issue equity to fund investment projects from above the leverage target, the leverage ratio will follow A2. On the contrary, reducing investment, dividend payout or cash holdings leads to a reduction in debt capital. The leverage ratio follows route A2 or B2.

Holding the demand for capital constant, an increase in profitability leads to a decrease in the leverage ratio. To balance the budget constraint, controlling CAPEX and Payout, an increase in Net Income can be used to release the debt burden. When the net profit at year *t+1* increase by p_{t+1} (from zero), the leverage ratio becomes:

$$L_{t+1} = \frac{D_t - p_{t+1}}{D_t + E_t - p_{t+1}} = 1 - \frac{E_t}{D_t + E_t - p_{t+1}} \tag{4.3}$$

It can be clearly noticed that L_{t+1} is lower than L_t. Therefore, the leverage ratio decreases (following route A2 or B2) if more funds are generated internally. On the contrary, a negative shock to firm profitability is covered by the newly-issued debt to balance the budget constraint. In this case, firm leverage ratio follows route A1 or B1.

Equity issuance or repurchase activities also lead to variations in the leverage ratio in the short run. A list of studies (such as Baker and Wurgler, 2002; Fama and French, 2005) indicate that equity financing is conducted following market timing opportunities, rather than working as the last resort after debt financing.[32] Fama and French provide two strong pieces of evidence. First, the fact that the net issuance of equity often succeeds the net issuance of debt violates the *trade-off theory*. Second, the evidence that

[32] According to the *trade-off theory*, equity financing is taken as a tool to rebalance debt ratios. When it comes to the *pecking order theory*, equity financing is used only if retained earnings and the raised debt are not sufficient to meet the demand for capital. Both the *trade-off theory* and the *pecking order theory* indicate that equity financing is considered after debt financing.

equity repurchases also happen among those firms with huge capital demand violates the *pecking order theory*. Moreover, according to the *market timing hypothesis*, firms' equity issuances and repurchases are highly based on stock price fluctuations, but not for the purpose of rebalancing the leverage ratio or maintaining the debt capacity. Additionally, Fama and French (2005) find that equity issuance and repurchase activities often happen in the same year. This provides further evidence that firms are timing the stock market, rather than using equity financing as the last resort after debt financing. As one of the financing sources, equity capital is a substitution to debt capital. An equity issuance mechanically reduces the leverage ratio in the short run[33] (following route A2 or B2); whereas an equity repurchase increases the leverage ratio (following route A1 or B1), ceteris paribus.

The passive variation in leverage has the potential to result in a mechanical leverage target adjustment. As shown in Figure 4.1, routes A1 and B2 drive firm leverage ratio farther away from the leverage target, and it takes a longer time for the leverage ratio to revert. On the contrary, routes A2 and B1 drive firm leverage ratio closer to the target, and it takes a shorter time for the leverage ratio to fully revert. In A2 and B1, the mechanical effects even constitute part of the adjustment; and this consequently exaggerates the estimated SOA, which is supposed to be self-motivated. In sum, this thesis anticipates that other financial behaviours would, or at least to some extent, lead to a mechanical mean reversion (or

[33] Although researchers debating on whether there is the long-run impact of market timing effects on firm leverage ratio, it seems the short-run impact has been widely approved by the literature (such as in Baker and Wurgle, 2002; Flannery and Rangan, 2006; Graham and Leary, 2011; and Faulkender et al., 2012).

deviation). For the mechanical effects, this chapter develops three hypotheses:

Hypothesis One: *If leverage target adjustment is mechanically-determined, other financial behaviours should contribute to explaining the SOA*, because these financial behaviours drive leverage target adjustment, by either accelerating or reducing the SOA. The effect differs when firms are above or below individual leverage target, as illustrated in Figure 4.1.

Hypothesis Two: *If leverage target adjustment is self-motivated, there should be at least a fraction of the SOA, which cannot be explained by the mechanical effects.* This indicates firms actively rebalance the leverage ratio, rather than leave it purely mechanically-determined.

Hypothesis Three: *The mechanical effects should be connected to the financial constraint.* If firms are financially-constrained, they are more likely to take advantage of these opportunities (mechanical reversion) to adjust the leverage ratio. Therefore, the mechanical effects should play a more important role in leverage target adjustment of financially-constrained firms.

4.2 The Empirical Setting

Due to the adjustment cost, firms do not immediately and completely rebalance the leverage ratio after the deviation from target. Flannery and Rangan (2006) suggest that firms gradually adjust towards the optimal leverage ratio. Every year, firms offset a proportion of the deviation from leverage target. A partial adjustment framework (Flannery and Rangan, 2006) is used to model this process, with the key assumption that all of the sample firms target a time-varying leverage ratio at an identical speed of adjustment.

Equation (4.4) below is the partial adjustment function, in which changes in the leverage ratio at year *t* is a proportion of leverage deviation from the target at the start of year *t*. $Lev_{i,t}$ denotes the book leverage ratio of firm *i* at year *t*. $Lev_{i,t}^{*}$ is the target leverage ratio of firm *i* at year *t*. λ captures the speed of adjustment (SOA). $\varepsilon_{i,t}$ is the error term. According to Flannery and Rangan (2006) and Antoniou et al. (2008), a λ falling in (0, 1) is interpreted as the evidence for partial adjustment towards the target. One could move $Lev_{i,t-1}$ to the right side and derive equation (4.5).

$$Lev_{i,t} – Lev_{i,t-1} = \lambda\ (Lev_{i,t}^{*} – Lev_{i,t-1}) + \varepsilon_{i,t}, \qquad (4.4)$$

$$Lev_{i,t} = \lambda * Lev_{i,t}^{*} + (1- \lambda)\ Lev_{i,t-1} + \varepsilon_{i,t}, \qquad (4.5)$$

DeAngelo and Roll (2015) simulate and compare the performances of stationary target model, target zone model and Time-Varying Target (TVT) model. The authors conclude that the TVT model fits the best. The TVT model is based on the assumption that firms target a time-varying leverage target, which is modelled by a vector of firm level characteristics related to the benefits and costs of financing sources (Flannery and Rangan, 2006; Antoniou et al., 2008; DeAngelo and Roll, 2015).

Motivated by Rajan and Zingales (1995), Leary and Roberts (2010) and Fan et al. (2012), this thesis uses the conventional set of firm characteristics to capture the target leverage ratio, namely, tangibiligy, Market-to-Book ratio, firm size and profitability. According to Rajan and Zingales (1995), tangible assets serve as collaterals that reduce the risk of debt holders. This in turn reduces the cost of borrowings and raises the leverage ratio. According to the market-timing theory, the firm with a higher Market-to-Book (M/B) ratio tends to have a lower cost of equity financing. Another explanation (Antoniou et al., 2008) is that the cost of financial distress and agency costs of debt are higher for fast-growing firms with a higher M/B ratio; and lenders request a higher payoff. Therefore, debt capital is less attractive to fast-growing firms. Firm size is expected to be positively associated with leverage ratio, because larger firms are more diversified and it is easier (less costly) for large firm to raise debt capital (Rajan and Zingales, 1995). According to the *pecking order theory*, firms with higher profitability tend to have more retained earnings, and this in turn, reduces the demand for debt capital. In the robustness check section, I add two factors, namely the effective tax rate and depreciation, to capture the effect of tax-shield and non-debt tax-shield. Equation (4.6) is the function of the time-varying leverage target, where X captures these characteristics.

$$Lev_{i,t}^{*} = \beta * X_{i,t-1} + v_{i,t},\ v_{i,t} \sim i.i.d.\ N(0, \sigma_v^2) \qquad (4.6)$$

Substituting equation (4.6) into equation (4.5) and reparameterizing the equation could derive model (4.7) which is widely used in previous empirical studies.

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta * X_{i,t-1} + u_i + \eta_t + \varepsilon_{i,t}, \qquad (4.7)$$

where u_i controls the time-invariant unobservable heterogeneity and η_t captures the time-varying unobservable heterogeneity. The error term $\varepsilon_{i,t}$ is assumed mean zero and robust to heteroscedasticity. Equation (4.7) is a dynamic panel data model, and the adjustment speed λ in Equation (4.4) is calculated by $1- \beta_0$ in Equation (4.7). Since partial adjustment requires λ falling into (0, 1), β_0 also falls into (0, 1). The value of β_0 close to zero indicates a high adjustment speed, and the value of β_0 close to one indicates a low adjustment speed.

To test Hypothesis One and Hypothesis Two, this chapter sets the adjustment speed λ as a function of the other financial behaviours at year *t*.

$$\lambda = \gamma_0 + \gamma_1 * Z_{i,t} + \epsilon_{i,t}, \ \epsilon_{i,t} \sim i.i.d.\ N(0, \sigma_v^2) \tag{4.8}$$

where *Z* captures the mechanical effects. This chapter uses the other financial behaviours (i.e., *Investment, Dividend, Cash flow, Equity issuance* and *Net profits*) to capture the mechanical effects. A positive value of γ_1 indicates increasing the SOA, whereas a negative value indicates reducing the SOA. γ_0 captures the proportion of SOA that cannot be explained by the mechanical effects. $\epsilon_{i,t}$ is an error term. Substituting equation (4.8) into equation (4.5) could derive equation (4.9), in which both the mechanical component in the SOA and the non-mechanical component in the SOA are accommodated.

$$Lev_{i,t} = (\gamma_0 + \gamma_1 * Z_{i,t}) * Lev_{i,t}^{*} + (1 - \gamma_0 - \gamma_1 * Z_{i,t}) * Lev_{i,t-1} + \varepsilon_{i,t}, \tag{4.9}$$

Reparameterizing equation (4.9) leads to the testable regression model (4.10):

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * Z_{i,t} * Lev_{i,t-1} + \beta_2 * X_{i,t-1} + \beta_3 * Z_{i,t} * X_{i,t-1} + u_i + D_{year} + \varepsilon_{i,t}, \tag{4.10}$$

where α_0 is a constant, u_i stands for unobservable firm fixed effects. Year dummies D_{year} captures the time-varying unobservable heterogeneity η_t. $\varepsilon_{i,t}$ is an idiosyncratic error term. $Z_{i,t}*Lev_{i,t-1}$ captures the mechanical effects. This chapter evaluates the mechanical effects by testing whether β_1 is different from zero. $Lev_{i,t-1}$ tests the remaining proportion of the SOA, which is not explained by the mechanical effects. This part is taken as the active target adjustment. $Z_{i,t}*X_{i,t-1}$ captures the interaction between the mechanical effects and leverage target determinants.[34] Therefore, one should no longer rely on $X_{i,t-1}$ only, to explain how firm-level characteristics determines the leverage ratio.

The list of variables ($Z_{i,t}$) capturing the mechanical effects, along with the predicted relationship with the SOA and the predicted signs of interaction terms in model (4.10), are summarized in Table 4.1.

Table 4.1 Predicted Signs of the Mechanical Effects

	(1)	(2)	(3)	(4)
	Above Target		Below Target	
Interactions	On SOA	On Lev	On SOA	On Lev
Inv	-/+	+/-	+	-
Div	-	+	+	-
Cash	-	+	+	-
Equ	+	-	-	+
ROA	+	-	-	+

This table shows predicted signs of the mechanical effects. Above Target and Below Target indicate whether sample firms are over-levered or under-levered in year *t-1*. Column (1) and column (3) show the predicted signs of $Z_{i,t}$ in Equation (4.5). Column (2) and Column (4) show the predicted signs of $Z_{i,t}*Lev_{i,t-1}$ in equation (4.7).

$$\lambda = \gamma_0 + \gamma_1 * Z_{i,t} + \epsilon_{i,t}, \epsilon_{i,t} \sim i.i.d.\ N(0, \sigma_v^2) \quad (4.8)$$

$$Lev_{i,t} = \alpha_0 + \beta_0*Lev_{i,t-1} + \beta_1* Z_{i,t} *Lev_{i,t-1} + \beta_2*X_{i,t-1} + \beta_3* Z_{i,t} *X_{i,t-1} + u_i + D_{year} + \varepsilon_{i,t}, \quad (4.10)$$

[34] Increasing the number of variables in X and Z boosts the number of variables in model (7). Regressions in this chapter control these interacted terms. However, to save space, the estimated coefficients of $Z_{i,t} *X_{i,t-1}$ is not reported.

As discussed in section 4.1, investment by issuing debt when leverage is above the target reduces the SOA (A1 in Figure 4.1). Hence, a positive sign of $Inv_{i,t}*Lev_{i,t-1}$ is anticipated. There is also the possibility of a negative sign, because firms may choose equity financing due to the constraint of debt capacity. When firms are under-levered, investment will increase the SOA (B1 in Figure 4.1). A negative sign of $Inv_{i,t}*Lev_{i,t-1}$ can be predicted. Similarly, positive signs of $Div_{i,t}*Lev_{i,t-1}$ and $Cash_{i,t}*Lev_{i,t-1}$ are expected when leverage is above the target; and negative signs are expected when leverage is below the target. Issuing equity when leverage is above the target mechanically increases the SOA (A2 in Figure 4.1). A negative sign of $Equ_{i,t}*Lev_{i,t-1}$ is expected. Issuing equity when leverage is below the target reduces the SOA (B2 in Figure 4.1). A positive sign of $Equ_{i,t}*Lev_{i,t-1}$ is expected. Similarly, this chapter also anticipates a negative sign of $ROA_{i,t}*Lev_{i,t-1}$ when leverage is above the target and a positive sign of $ROA_{i,t}*Lev_{i,t-1}$ when leverage is below the target.

Antoniou et al. (2008) and Wintoki et al. (2012) highlight the endogeneity problem in corporate finance studies and propose using system GMM (Blundell and Bond, 1998, also known as two-step GMM) to estimate the dynamic model and to control the endogeneity problem. Firstly, system GMM could eliminate unobservable heterogeneity by taking first difference and subtracting u_i from equation (4.10). Secondly, system GMM uses the lagged differences of endogenous variables as instrumental variables (IVs) to control simultaneity. Thirdly, model (4.10) and the system GMM estimation in this chapter use a one-year lagged dependent variable as an independent variable, which corrects the bias caused by the omission of dynamic effects; and this could substantially increase the explanatory power, compared with a static regression model (see Antoniou et al., 2008). Fourthly, Antoniou et al. (2008) and Roodman (2009) suggest that system GMM estimates are robust to heteroskedatisity. The endogeneity problem leads to biased and inconsistent estimates (Wintoki et al., 2012); Antoniou et al. (2008), Roodman (2009), Wintoki et al. (2012) and Flannery and Hankins (2013) suggest that system GMM is better than other estimation methods by controlling the endogeneity and that system GMM is so far the most robust method to estimate the dynamic leverage model. Additionally, GMM estimation generates strongly consistent estimates (Hansen, 1982), which enables to compare the regression coefficients of subsamples directly. Therefore, this study use system GMM as the main estimation method.

Following Roodman (2009) and Wintoki et al. (2012), this chapter uses auto-regression (AR) test, Hansen test and Difference-in-Hansen test to check the validity of instrumental variables that is used in the GMM estimation. Firstly, this chapter tests the serial correlation in the first-differenced equation of model 4.10. Due to the difficulty in obtaining an exogenous shock (Antoniou et al., 2008, and Wintoki et al., 2012), this chapter follows Blundell and Bond (1998) and uses internally-generated IVs. This IV method requests completely exogenous instruments, which indicate no second-order serial correlation in the differenced equation (Antoniou et al., 2008). For the AR test, the null hypothesis (H_0) is that there is no serial correlation; and the alternative hypothesis (H_1) is that there is serial correlation at the specific order. Although there is no consensus on an optimal number of IVs, Roodman (2009) and Wintoki et al. (2012)

suggest reducing the number of IVs to avoid potential bias and over-identification caused by too many IVs. Therefore, this chapter uses collapsed IVs to avoid the IV proliferation.[35] This chapter uses the Hansen test to check the over-identification problem. The null hypothesis (H_0) is that the over-identifying restrictions are valid, whereas the alternative hypothesis (H_1) is that there is the over-identification problem. The Difference-in-Hansen test is a supplement to the Hansen-test, by testing a subset of the original set of orthogonality conditions (Baum and Schaffer, 2003), with a null hypothesis (H_0) that the instrumental variables are valid.

4.3 Data and Descriptive Statistics

The baseline result in this chapter uses data from 1998 to 2014, because this sample period gives the largest number of total observations. As this chapter uses data with a continuous record, increasing the sample period will reduces the number of firms in the sample, whereas increasing the number of firms will require reducing the length of sample period. Both methods lead to a reduction in the number of observations. Using a sample period from 1998 to 2014 achieves a balance between the sample period and the number of firm and leaves a strongly balanced panel of 1,399 firms. For each firm, there are 17 years of data. All of the sample firms are requested to have records since 1995, to remove the IPO effects. This is motivated by Alti (2006, Table 1) who finds that IPOs have a negative impact on the leverage ratio. Since Baker and Wurgler (2002) regard the first year that Compustat reports data for firm market value as the IPO year, this chapter

[35] A detailed discussion on the IVs is available in Wintoki et al. (2012, Appendix A and Appendix B).

regards the third year as the starting point when leverage ratio returns to normal. Definitions of variables are summarized in Appendix 1. The results by using the full sample is discussed in the robustness check section.

Table 4.2 presents descriptive statistics of the sample firms. All of the variables are winsorized at 1% level on both tails to remove the impact of outliers. *Leverage* measures the proportion of total debt to the book value of total assets, and it has a mean value of 0.208 which is close to a recent study in which Chang et al. (2019) report a mean value of 0.219. This chapter uses book leverage ratio as the dependent variable, rather than market leverage ratio, because firms tend to make financial decisions based on the book value of assets (Graham et al., 2014). Specifically, book leverage ratio reflects the 'active rebalancing' of firms, whereas market leverage ratio contains shocks to the stock price. The shocks to stock price are not controlled by firms. *Debt issuance ratio* measures the proportion of net debt issuance to the book value of total assets, and a negative value indicates net debt repurchase. *Total assets* refer to the book value of total assets, with a mean value of 6,979.51 million dollars. This chapter uses the natural log of *total assets* in the regression analysis. *Tangibility* measures the proportion of property, plant and equipment on firm total assets. It has a mean value of 0.278 which is close to the 0.296 in Chang et al. (2019). Market-to-Book ratio is the ratio of firm market value at the end of the year, divided by the book value of total assets. *Return on Assets (ROA)* is employed to capture firm profitability, which shows firms' ability to generate funds internally. Because this thesis uses the firms with a continuous record, the mean value of *ROAe* (EBIT/Total Assets) in this study (0.046) is higher than the 0.021 in Chang et al. (2019). This chapter uses capital expenditure scaled by total assets to capture investment, following Gatchev et al. (2010). E*quity issuance ratio* measures the proportion of net equity issued in year *t* to the book value of total assets at the end of year *t*. The mean of *equity issuance ratio* (0.05) exceeds the mean of *debt issuance ratio* (0.01), suggesting that firms rely on equity financing more than debt financing. This piece of evidence is not consistent with Shyam-Sunder and Myers (1999) who find that debt is the primary source of external financing but consistent with Frank and Goyal (2003) who find that firms use equity financing more than debt financing. This chapter uses *Cash Flow to Assets* ratio (*Cash*) to measure the change in cash holdings scaled by total assets. *Deficit* denotes the financing deficit scaled by total assets. A mean value of 0.077 indicates that annual external financing is as much as 7.7% of total assets, on average.

Table 4.2 Descriptive Statistics

Variable	N	Mean	Median	Std. Dev	p1	p99	Skewness	Kurtosis	Jarque-Bera
Leverage	23,624	0.208	0.177	0.197	0	0.930	1.229	4.192	44,074.281
Market Leverage	22,392	0.437	0.150	0.913	0	6.283	4.382	25.031	3,147,042.5
Long-term Leverage	23,472	0.332	0.29	0.289	0	1.557	1.383	5.995	97,530.743
Debt issuance ratio	23,571	0.010	0	0.097	-0.327	0.365	0.497	8.511	184,791.67
Total assets	23,714	6,979.51	733.45	30,335	4.60	120,223	12.616	225.23	296,560,328
Tangibility	23681	0.278	0.211	0.228	0.006	0.894	1.010	3.155	24,299.222
Market to Book ratio	22,468	1.548	1.029	1.740	0.081	9.817	3.541	19.820	1,870,838.0
ROAe	23,698	0.046	0.081	0.210	-1.054	0.342	-3.954	24.103	3,008,894.0
Return on Assets (ROA)	23,702	-0.001	0.047	0.230	-1.228	0.287	-4.458	28.176	4,226,813.4
Etr	23,706	0.225	0.312	0.117	0	0.519	-1.687	12.125	560,940.27
Dpr	23,649	0.043	0.038	0.028	0.002	0.159	1.596	6.641	138,617.11
Investment / Assets	23,552	0.054	0.035	0.001	0.059	0.311	2.601	11.508	585,543.16
Dividend / Assets	23,641	0.014	0	0.027	0	0.159	3.686	20.380	2,106,476.8
Equity issuance ratio	23,464	0.050	0.006	0.186	-0.195	1.048	4.562	27.999	4,154,285.8
Cash change / Assets	23,367	0.007	0.003	0.105	-0.408	0.389	0.114	13.486	642,640.29
Deficit	23,464	0.077	0.029	0.235	-0.442	1.154	2.683	14.559	952,664.43

This table presents the descriptive statistics of sample firms. The data are collected from CRSP/Compustat database. The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. This table reports the number of observations (N), the mean, the median, the standard deviation, the values at the 1st and 99th quantiles, skewness, kurtosis and Jaque-Bera statistics. The definitions of variables are summarized in Appendix 1.

4.4 Mean Reversion Revealed by Financing Behaviours

Previous studies suggest that, compared with the reversion in leverage ratio, firms' financing behaviours are more valid evidence to support the existence of a leverage target. Shyam-Sunder and Myers (1999) argue that the mean reversion in leverage could be driven by cyclical fluctuations in firm investment and profitability. If the observed reversion is driven by cyclical fluctuations rather than discretionary target adjustment, regression models using the change in leverage ratio as the dependent variable may fail to reject the mechanical reversion. A mechanical mean reversion should not be interpreted as an active target adjustment. Chang and Dasgupta (2009) also notice the mechanical effects and suggest looking at firms' financing behaviours rather than changes in the leverage ratio only. Therefore, before presenting regression results, this section calculates the probability of having net debt issuance or net equity issuance to show evidence of leverage reversion in firms' financing behaviours. These results provide a preliminary perspective on firms' financing behaviours.

Specifically, this section investigates the financing behaviour of sample firms at year *t*, given the range of *Leverage ratio* at year *t-1*. Sample firms are divided into ten groups, based on the leverage ratio at year *t-1*. For each leverage interval, the number of observations is reported. *Leverage reduction* shows the percentage of observations with a decrease in leverage ratio ($Lev_t < Lev_{t-1}$) at year *t*. *Net debt issuance* shows the percentage of firms with *Total Debt* at year *t* higher than *Total Debt* at year *t-1*. Similarly, *Net equity issuance* shows the percentage of firms with *Equity issuance ratio* higher than zero at year *t*. Table 4.3 reports the percentage of observations with net debt issuance and net equity issuance, conditional on the percentage of observations falling in each leverage interval. It also shows the percentage of firms with a positive value of financing deficit at year *t*.

Table 4.3 Leverage Reversion Revealed by Financing Behaviours

Leverage Intervals	Observations	Leverage reduction	Net debt issuance	Net equity issuance	Positive Deficit
0.9-1.0	66	56%	52%	88%	64%
0.8-0.9	99	60%	36%	89%	55%
0.7-0.8	195	55%	43%	85%	60%
0.6-0.7	461	61%	45%	81%	61%
0.5-0.6	890	57%	49%	74%	61%
0.4-0.5	1,602	59%	45%	75%	56%
0.3-0.4	2,985	57%	49%	73%	59%
0.2-0.3	4,252	57%	50%	70%	63%
0.1-0.2	4,406	53%	52%	69%	66%
0.0-0.1	4,933	54%	46%	73%	71%
Overall	19,889	56%	49%	72%	64%

This table reports the percentage of firms having net debt (equity) issuance at year *t*, conditional on the percentage of observations falling in each leverage interval. The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. *Leverage Intervals* list the intervals of leverage ratio at year *t-1*, and the number of observations is reported. *Leverage reduction* indicates reducing leverage ratio at year *t*. *Net debt issuance* refers to a positive value of *Debt issuance ratio*, and *Net equity issuance* refers to a positive value of *Equity issuance ratio*. The percentages of firms with net debt (equity) issuance at year *t* are reported. *Positive Deficit* refers to the percentage of firms with $Deficit_t$ higher than zero.

Firms' financing behaviours revealed in Table 4.3 suggest that firms actively adjust the leverage ratio. First, from 0.1-0.2 interval to 0.8-0.9 interval, the percentage of firms with net debt issuance is on a decrease. Among firms with Lev_{t-1} in 0.1-0.2 interval, 52% of observations have net debt issuance in the next year. The ratio reduces to 36% for firms in 0.8-0.9 leverage interval. At the same time, the percentage of firms with net equity issuance is on an increase. Among those firms with Lev_{t-1} in 0.1-0.2 interval, 69% of the observations have net equity issuance in the subsequent year;

and the ratio increases to 89% for firms in 0.8-0.9 leverage interval. These results show a tendency to reduce the reliance on debt capital, when the leverage ratio increases.

Second, it seems many firms in 0.4-0.5 leverage interval choose to reduce the reliance on debt in the next year. Compared to the firms in 0.3-0.4 interval (49%), the percentage of firms in 0.4-0.5 interval with net debt issuance reduces to 45%. Similarly, 75% of firms choose to issue net equity, whereas it is 73% in 0.3-0.4 interval. It suggests that some of the sample firms want to maintain the leverage ratio below 0.5.

Third, the results show that the firms with Lev_{t-1} higher than 0.5 are more reluctant to fund the financing deficit with debt. In the three intervals from 0.5 to 0.8, around 60% of sample firms face positive financing deficit; however, the percentage of firms with net debt issuance does not persist. The *pecking order theory* indicates that firms prefer debt financing to equity financing. However, when leverage ratio exceeds 0.5, the percentage of firms with net debt issuance in the next year continues to decrease (from 49% to 43%), and the percentage of firms with net equity issuance increase substantially (from 74% to 85%).

Firms' financing behaviours provide evidence for an active reversion in leverage.[36] Overall, the results in Table 4.3 show that sample firms become reluctant to issue debt when the leverage ratio increases. It suggests

[36] Strebulaev and Yang (2013) find zero-leverage policy and almost-zero-leverage policy are persistent. In Table 4.3, fewer firms in 0-0.1 interval (46%) have net debt issuance at year *t* than those firms in 0.1-0.2 interval (52%). Evidence in this thesis is consistent with Strebulaev and Yang (2013). It is similar for those firms employing a high leverage policy (over 0.9). This is the possible reason that firms in 0-0.1 interval and 0.9-1.0 interval do not exhibit target adjustment behaviours.

that the mean reversion and leverage target adjustments observed in previous studies are not completely driven by a mechanical mean reversion. This prediction is tested in the following sections.

4.5 Adjustment from Above and from Below

This section first estimates the baseline partial adjustment model (4.7). Second, it investigates leverage target adjustment from above and from below separately.

4.5.1 The Baseline Model and the Estimated SOA

Table 4.4 presents regression results of the baseline model (4.7) and uses Ordinary Least Square (OLS), Fixed Effects method (FE) and system GMM (SYS-GMM) as the three alternative estimation methods. Graham and Leary (2011) cite Hsiao (2003) and suggest that OLS generates an underestimated SOA while FE generates an overestimated SOA. Although OLS and FE generate biased estimates, these two methods provide a boundary for the true SOA. The true SOA should fall between the coefficients estimated by OLS and FE. Compared with OLS, FE method and SYS-GMM remove the time-invariant unobservable heterogeneity u_i. Dummy variables on yearly-basis are used to control the time-variant unobservable heterogeneity η_t.

This results of the baseline model (4.7) are consistent with most of the existing literature, and the results suggest that firms adjust the leverage ratio towards a time-varying leverage target. The reported SOAs by OLS and FE are 0.137 (column 2) and 0.349 (column 4), respectively. The coefficient of $Leverage_{i,t-1}$ estimated by SYS-GMM is 0.784 in column (6), indicating an SOA of 0.216. Tangibiliy, Market-to-Book ratio, Firm size and profitability appear to be important determinants of firm capital structure. These results are in line with most of previous studies (such as Rajan and Zingales, 1995). Column (4) suggests that firm-heterogeneity stands for 26.2% of the variation in leverage ratio. These results are consistent with the literature (such as Graham and Leary, 2011) that system GMM generates an SOA between the results of OLS and FE. The null hypotheses of AR(2) test, Hansen test and Difference-in-Hansen test are not rejected, according to Column (6). These results suggest that the IVs are exogenous and that there is no over-identification problem (Antoniou et al., 2008; Roodman, 2009; and Flannery and Hankins, 2013). Regression results of the baseline model (4.7) motivate to use system GMM estimation in the following sections.

Table 4.4 Baseline Partial Adjustment Model

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, cluster		FE, cluster		SYS-GMM	
Leverage i,t-1	0.864***	0.863***	0.659***	0.651***	0.795***	0.784***
	(110.93)	(109.07)	(54.81)	(53.78)	(53.96)	(48.57)
Tangibility i,t-1	0.016***	0.016***	0.030**	0.020	0.060***	0.078***
	(4.82)	(4.90)	(2.13)	(1.40)	(2.65)	(3.31)
M/B i,t-1	-0.001	-0.002***	-0.001	-0.003***	0.002*	-0.002**
	(-1.59)	(-2.59)	(-1.49)	(-2.59)	(1.86)	(-1.96)
Ln_assets i,t-1	0.004***	0.004***	0.006***	0.011***	0.009***	0.003
	(10.73)	(10.39)	(4.35)	(5.21)	(3.99)	(0.96)
ROA i,t-1	-0.007	-0.010	-0.020*	-0.028***	-0.001	-0.009
	(-0.99)	(-1.50)	(-1.91)	(-2.63)	(-0.16)	(-1.09)
Constant	0.000	0.017***	0.023**	0.024*	-0.035*	0.000
	(0.03)	(4.55)	(1.99)	(1.89)	(-1.91)	(0.000)
Variance due to FE			25.11%	26.16%		
Year Dummy	No	Yes	No	Yes	No	Yes
Number of IVs					81	81
AR(1)					0.000	0.000
AR(2)					0.257	0.312
Hansen test p-value					0.000	0.260
Difference in Hansen test					0.000	0.902
Wald test p-value					0.000	0.000

R2	78.26%	78.56%	77.97%	77.50%		
Observation	20,981	20,981	20,981	20,981	20,981	20,981

This table shows regression results of the baseline partial adjustment model (4.7). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. OLS, FE and SYS-GMM are used as the three alternative methods to estimate model (4.7). Firm-clustered standard errors are used in OLS and FE estimations.

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta * X_{i,\,t-1} + u_i + \eta_t + \varepsilon_{i,t}, \tag{4.7}$$

The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. X denotes the variables to capture firm target leverage ratio. X includes *Tangibility*, *Market to Book ratio*, *firm size* and *ROA*. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1. Coefficients and t-values (z-stats in SYS-GMM) are reported. R^2 and the variance due to firm fixed effects are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

4.5.2 Over-levered Firms and Under-levered Firms

Since adjustment cost determines the SOA (Flannery and Rangan, 2006), firms should revert at varying speeds when they are temporarily above or below the leverage target. Over-levered firms revert by retiring debt or by issuing new equity. Controlling firm profitability, to retire debt, firms need to forgo valuable investment opportunities. This is associated with huge opportunity costs; and it is also costly to refinance in subsequent periods. Issuing equity signals manager’s negative attitude towards future earnings, according to the Myers and Majluf (1984). Therefore, reverting from above the leverage target is associated with higher adjustment costs.[37] On the contrary, under-levered firms benefit from the leverage target adjustment, either from the tax-shield of new debt or by signalling managers’ positive attitude towards future profitability via equity repurchase. The benefit of reverting from below the leverage target offsets some of the adjustment

[37] Although adjusting from above brings benefits by reducing financial distress costs; this study focuses on mature and long-surviving firms of which the risk of going bankrupt is relatively lower.

cost, and this in turn results in a rapid adjustment. This explanation is in line with the *leverage ratchet effect* explanation (Admati et al., 2018) in which the authors suggest that firms are reluctant to reduce leverage from above but desired to increase leverage from below. Therefore, a higher adjustment speed of under-levered firms is expected, due to the lower adjustment cost.

The sample is partitioned by whether the previous leverage ratio is above or below firm-specific median leverage ratios.[38] This method is similar to Leary and Michaely (2011) who analyse the adjustment towards a dividend payout ratio, by which Leary and Michaely find that dividend targeting is faster from below the target than from above the target.

Column (1) and Column (2) of Table 4.5 present univariate differences between over-levered firms and under-levered firms. Over-levered firms tend to have a lower ROA (-0.021 compared to 0.025) than that of under-levered firms, while there is no significant difference in investment and net equity issuance. The evidence explains why these firms are over-levered, as these firms need to issue debt to balance the budget constraint. Descriptive evidence is in line with the prediction that over-levered firms face higher costs to rebalance the leverage ratio. With a lower profitability, over-levered firms have less internally-generated funds to reduce debt. Since the opportunity cost of stopping current investment projects is high, over-levered firms may have to issue equity to balance the leverage ratio, which signals managers' negative attitude toward future profits. Therefore, a lower SOA is expected.

[38] The study also tried to partition according to the estimated target leverage ratio *Lev**. The test generates a similar result that over-levered firms adjust slower. Therefore, the extra results are not reported. An advantage of partitioning by firm-specific median leverage ratio is that it generates two subgroups with a similar sample size (around 9,000 observations).

Table 4.6 presents the regression results separately for over-levered firms and under-levered firms. Consistent with the prediction, over-levered firms adjust slower (an SOA of 0.518 in column 1) towards the target leverage ratio than do under-levered firms (0.879 in column 2). An interesting point is that both over-levered firms and under-levered firms adjust faster than the full sample. The reason is that the leverage target in this model is captured by firm characteristics and that the partitioned subsample has a more precise leverage target than that of the full sample. Therefore, readers should not compare the SOAs of the full sample and its subsamples if the leverage targets are measured separately.

Table 4.5 Univariate Differences

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Previous leverage ratio		Large firms vs Small firms		Dividend-paying vs nonpayers		High-growth vs Low-growth	
		Over-levered	Under-levered	Large firms	Small firms	Dividend-paying	Nonpayers	High-growth	Ligh-growth
Leverage	Mean	0.304***	0.150***	0.258***	0.159***	0.214***	0.203***	0.203***	0.214***
	Median	0.280***	0.125***	0.237***	0.083***	0.196***	0.145***	0.171***	0.184***
Debt issuance	Mean	0.033***	-0.011***	0.018***	0.002***	0.013***	0.007***	0.019***	0.001***
	Median	0.010***	-0.002***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Total assets	Mean	7712.00***	7456.02***	13,740.81***	218.22***	11338.19***	2252.67***	4474.69***	9484.338***
	Median	835.67***	926.76***	3,248.51***	124.63***	1714.02***	298.19***	791.76***	666.00***
Tangibility	Mean	0.293***	0.286***	0.311***	0.245***	0.303***	0.252***	0.297***	0.259***
	Median	0.227***	0.220***	0.246***	0.179***	0.246***	0.172***	0.207***	0.214*
Market to Book ratio	Mean	1.322***	1.519***	1.293***	1.787***	1.410	1.683	1.789***	1.311***
	Median	0.863***	1.071***	0.956***	1.116***	1.035	1.020	1.206***	0.887***
ROA	Mean	-0.021***	0.025***	0.050***	-0.052***	0.043***	-0.045***	0.006***	-0.008***
	Median	0.036***	0.057***	0.054***	0.036***	0.059***	0.029***	0.055***	0.040***
Investment / Assets	Mean	0.055	0.056	0.056***	0.052***	0.054***	0.054***	0.061***	0.046***
	Median	0.035	0.037	0.038***	0.031***	0.031***	0.038***	0.040***	0.031***
Dividend / Assets	Mean	0.012***	0.014***	0.016***	0.011***	0.027***	0.000***	0.011***	0.000***
	Median	0.000***	0.003***	0.008***	0.000***	0.017***	0.000***	0.000***	0.016***
Equity issuance ratio	Mean	0.047	0.046	0.011***	0.089***	0.022***	0.078***	0.063***	0.037***
	Median	0.005***	0.005***	0.003***	0.010***	0.003***	0.010***	0.009***	0.003***
Cash Flow	Mean	0.004***	0.010***	0.007	0.008	0.009***	0.006***	0.003***	0.012***
	Median	0.001***	0.004***	0.003	0.003	0.003**	0.002**	0.002***	0.004***
Deficit	Mean	0.096***	0.054***	0.050***	0.105***	0.054***	0.101***	0.109***	0.046***
	Median	0.041***	0.019***	0.024***	0.034***	0.022***	0.039***	0.048***	0.012***

This table presents the univariate differences based on previous leverage ratio, firm size and dividend payment. The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 to 2014. This table reports the mean and the median for each subsample group. This table tests the difference in mean by the Wilcoxon rank-sum test, and tests the difference in median by the chi-square test. *** indicates significant difference between compared groups at 1% level. ** indicates significant difference at 5% level; *indicates significant difference at 10% level. The definitions and explanations of variables are summarized in Appendix 1.

Table 4.6 SOAs of Over-levered Firms and Under-levered Firms

	(1)	(2)
	Over-levered	Under-levered
Estimation Methods	SYS-GMM	
Leverage i,t-1	0.482***	0.121***
	(15.48)	(4.38)
Tangibility i,t-1	-0.213***	-0.017
	(-2.83)	(-0.26)
Market-to-Book i,t-1	0.004	-0.002
	(1.21)	(-0.76)
Ln_assets i,t-1	-0.072***	0.051***
	(-6.98)	(6.87)
ROA i,t-1	-0.178***	0.027**
	(-10.60)	(2.11)
Constant	0.000	0.000
	(0.00)	(0.00)
Year Dummy	Yes	Yes
Number of IVs	81	81
AR(1)	0.000	0.000
AR(2)	0.102	0.328
Hansen test p-value	0.000	0.003
Difference in Hansen test	0.000	0.297
Wald test p-value	0.000	0.000
Observation	9,169	8,597

This table shows regression results of the baseline partial adjustment model (4.7 The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. Column (1) and Column (2) report results for over-levered and under-levered firms separately. This table uses SYS-GMM to estimate model (4.7).

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta * X_{i,t-1} + u_i + \eta_t + \varepsilon_{i,t}, \quad (4.7)$$

The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. *X* denotes the variables to capture firm target leverage ratio. *X* includes *Tangibility*, *Market to Book ratio*, *firm size* and *ROA*. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

Conventional leverage determinants show different signs in the two groups. In particular, firm tangibility (-0.213, *t*=-2.83) and size (-0.072, *t*=-6.98) are negatively correlated with the leverage ratio, as shown in column (1) of Table 4.6. One possible explanation is that over-levered firms are more likely to use equity financing than debt financing, due to the influence of the positive leverage deviation. In the sample, over-levered firms with a positive leverage deviation have a mean value of *Equ* at 0.058, while it is 0.033 for under-levered firms. As a result, the firms with more tangible assets and a larger size tend to have a lower leverage ratio. Another point is that *ROA* is positively correlated with *leverage ratio* in the group of under-levered firms. This is in line with the prediction of *trade-off theory*.[39] Compared to over-levered firms, under-levered firms have a lower bankruptcy cost; therefore, these firms are more likely to benefit from the tax-shield of new debt. As a result, under-levered firms with a higher profitability issue more debt to shield the tax. On the contrary, over-levered firms tend to use the extra profits to reduce debt, which explains the negative relationship (-0.178, t=-10.6). In sum, over-levered firms and under-levered firms show different adjustment speed; and the leverage target determinants may play opposite roles in these two groups. Therefore, future studies on firm capital structure are suggested to analyse over-levered firms and under-levered firms separately.

4.6 Mechanical Adjustment and Target Adjustment

This section investigates the mechanical effects by estimating model (4.10) and compare the results with those generated by the baseline partial adjustment model (4.7).

Table 4.7 presents the regression results of model (4.10) in which the results show that other financial behaviours are related to leverage target adjustment. Specifically, the coefficients of $Inv_{i,t}*Lev_{i,t-1}$ are negative in both column (1) and column (2). This suggests that over-levered firms tend to

[39] The predictions of the *trade-off theory* are summarized in Fama and French (2002). According to the *trade-off theory*, firms with higher profitability tend to have a higher leverage ratio, because profitability is negatively associated with the bankruptcy cost.

issue equity to fund investment (route A2 in Figure 4.1), while under-levered firms tend to issue debt (route B1 in Figure 4.1). $Equ_{i,t}*Lev_{i,t-1}$ is significant in the group of over-levered firms but not in the group of under-levered firms. $ROA_{i,t}*Lev_{i,t-1}$ is negative in the group of over-levered firms (Column 1) but positive in the group of under-levered firms (Column 2). This is consistent with the assertion in Lambrecht and Myers (2012) that firm issue debt to absorb shocks in net profits. The results are consistent with the Hypothesis One that other financial behaviours (especially investment, equity issuance and profitability) drive a proportion of leverage mean reversion.

Table 4.7 The Mechanical Effects on Leverage Target Adjustment

	(1)	(2)	(3)
Estimating methods		SYS-GMM	
	Over-levered	Under-levered	Pooled
Leverage i,t-1	0.782***	0.539***	0.813***
	(6.17)	(3.25)	(12.84)
Inv i,t * Leverage i,t-1	-3.236**	-5.085***	-0.053
	(-2.36)	(-2.54)	(-0.05)
Div i,t * Leverage i,t-1	-0.679	10.512***	1.797
	(-0.21)	(2.67)	(0.74)
Cash i,t * Leverage i,t-1	0.348	-0.530	0.219
	(0.76)	(-0.74)	(0.58)
Equ i,t * Leverage i,t-1	-1.041***	-0.295	-0.764***
	(-4.04)	(-0.66)	(-2.58)
ROA i,t * Leverage i,t-1	-0.972***	1.019***	-0.207
	(-3.72)	(2.58)	(-0.84)
Tangibility i,t-1	0.130	-0.203	0.050
	(0.80)	(-1.28)	(0.64)
Market-to-Book i,t-1	0.059***	0.032**	0.010
	(2.90)	(1.94)	(1.23)
Ln_assets i,t-1	-0.025	0.023*	-0.001
	(-1.07)	(1.50)	(-0.11)
ROA i,t-1	0.148	0.089	0.074
	(1.20)	(1.21)	(1.24)
Constant	-0.037	0.121	0.033
	(-0.17)	(1.36)	(0.41)
Interactions with moving target	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes
Number of IVs	81	81	81
AR(1)	0.000	0.000	0.000
AR(2)	0.796	0.666	0.602
Hansen test p-value	0.799	0.506	0.830
Difference in Hansen test	0.038	0.074	0.909

Wald test p-value	0.000	0.000	0.000
Observation	8,907	8,350	20,412

This table shows regression results of model (4.10). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. Column (1) and Column (2) report results for over-levered and under-levered firms separately. Column (3) shows results when observations are pooled. This table uses SYS-GMM to estimate model (4.10).

$$Lev_{i,t} = \alpha_0 + \beta_0{*}Lev_{i,t-1} + \beta_1{*}\, Z_{i,t}\, {*}Lev_{i,t-1} + \beta_2{*}X_{i,\,t-1} + \beta_3{*}\, Z_{i,t}\, {*}X_{i,\,t-1} + u_i + D_{year} + \varepsilon_{i,t}, \quad (4.10)$$

The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. *X* denotes the variables to capture firm target leverage ratio. *Z* denotes the variables to capture the mechanical effects. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. The coefficients of $Z_{i,t}{*}X_{i,\,t-1}$ are not reported, to save space. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

The estimated SOA of model (4.10) is lower than that of model (4.7). Once the mechanical effects are controlled, an SOA at 0.218 for over-levered firms (Column 1 of Table 4.7) is observed, compared to the 0.518 when the mechanical effects are not controlled (Column 1 of Table 4.6). The estimated SOA is 0.461 for under-levered firms (Column 2 of Table 4.7), compared to 0.879 when the mechanical effects are not controlled (Column 2 of Table 4.6). In both groups, the estimated SOA decreases by over 50% after controlling for the mechanical effects. Column (3) of Table 4.7 pools all of the observations. The estimated SOA is 0.187 after controlling the mechanical effects. This is also lower than the 0.216 reported by the traditional partial adjustment model (Column 6 of Table 4.4). These results suggest that mechanical effects play an important role in formulating leverage mean reversion and that the traditional partial adjustment model over-estimates the active adjustment speed.

Although other financial behaviours drive nearly a half of the leverage target adjustment, the mechanical effects do not reduce the estimated SOA towards zero. According to Table 4.7, all of the reported SOAs are higher than zero. Specifically, over-levered firms revert at a speed of 0.218, while under-levered firms revert at a speed of 0.461. This indicates there is also a substantial fraction of the target adjustment activities that are not explained by the mechanical effects. This is consistent with Hypothesis Two that at least some of the target adjustment is non-mechanical (active). Therefore, the results in this chapter argue against the assertion that leverage target adjustment is purely mechanically-determined by other financial behaviours.

4.7 Robustness of the Results

This section checks the robustness of the results. First, I use an alternative specification to test the mechanical effects. Specifically, I use the financing deficit variable as an alternative specification to test the mechanical effects. *Financing deficit* measures the demand for external funds, and it is a widely used variable to test the *pecking order theory* (such as in Shyam-Sunder and Myers, 1999; Fama and French, 2005; and Huang and Ritter, 2009). Shyam-Sunder and Myers (1999) show that debt issuance makes up a major proportion of firms' financing deficit. This suggests that firm debt decisions are driven by the demand for external capital rather than by an optimal leverage ratio and that equity issuance works as the last resort after debt financing. Shyam-Sunder and Myers find that *financing deficit* has a good explanatory power of firms' debt issuances and suggest that cyclical fluctuations of *financing deficit* may result in leverage mean reversion. Therefore, this chapter uses the financing deficit variable, as the alternative to individual financial behaviour proxy, to test the mechanical effects. *Financing deficit* is defined as the change in total assets less the change in retained earnings, following Fama and French (2005).

The results in Table 4.8 are qualitatively similar to the results obtained by using several financial behaviour variables in Table 4.7. Compared to Table 4.4 and Table 4.6 when the mechanical effects are not controlled, Table 4.8 also reports lower adjustment speeds. The estimated SOA decreases from 0.518 (Column 1 of Table 4.6) to 0.235 (Column 1 of Table 4.8) for over-levered firms and decreases slightly from 0.879 (Column 2 of Table 4.6) to 0.839 (column 2 of Table 4.8) for under-levered firms. The full sample (Column 3 of Table 4.8) reports an SOA of 0.194, which is also lower than the 0.216 (Column 6 of Table 4.4) when the mechanical effects are not controlled.

Table 4.8 The Mechanical Effects on Leverage Target Adjustment -- An Alternative Specification Using Financing Deficit

	(1)	(2)	(3)
Estimation Methods		SYS-GMM	
	Over-levered	Under-levered	Pooled
Leverage i,t-1	0.765***	0.161***	0.806***
	(8.04)	(4.42)	(32.11)
Deficit i,t * Leverage i,t-1	-0.842***	-0.196*	-0.223*
	(-2.97)	(-1.87)	(-1.74)
Tangibility i,t-1	-0.374***	-0.022	0.034
	(-2.61)	(-0.37)	(0.96)
Market-to-Book i,t-1	0.041***	0.003	0.003
	(4.18)	(0.85)	(0.85)
Ln_assets i,t-1	-0.096***	0.039***	-0.001
	(-5.50)	(4.47)	(-0.23)
ROA i,t-1	-0.162***	-0.029	-0.013
	(-3.28)	(-1.24)	(-0.60)
Constant	0.000	0.025	0.000
	(0.00)	(0.41)	(0.00)
Interactions with moving target	Yes	Yes	Yes

Year Dummy	Yes	Yes	Yes
Number of IVs	81	81	81
AR(1)	0.000	0.000	0.000
AR(2)	0.082	0.330	0.089
Hansen test p-value	0.000	0.003	0.169
Difference in Hansen test	0.000	0.482	0.803
Wald test p-value	0.000	0.000	0.000
Observation	8,606	8,088	19,817

This table shows regression results of model (4.10). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. Column (1) and Column (2) report results for over-levered and under-levered firms separately. Column (3) shows results when observations are pooled. This table uses SYS-GMM to estimate model (4.10).

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * Z_{i,t} * Lev_{i,t-1} + \beta_2 * X_{i,t-1} + \beta_3 * Z_{i,t} * X_{i,t-1} + u_i + D_{year} + \varepsilon_{i,t}, \quad (4.10)$$

The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. X denotes the variables to capture firm target leverage ratio. This table uses financing deficit as the alternative specification to test the mechanical effects. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. The coefficients of $Z_{i,t} * X_{i,t-1}$ are not reported, to save space. The coefficients of $Z_{i,t} * X_{i,t-1}$ are not reported, to save space. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

An interesting point is that *financing deficit* has a negative coefficient in both column (1) and column (2) of Table 4.8. When below the target leverage ratio, firms should issue debt to cover the financing deficit, as predicted by the *pecking order theory*. This mechanically accelerates leverage target adjustment, according to Figure 4.1 (route B1). Therefore, the *pecking order theory* could explain the negative sign in the column (2), in which $Deficit_{i,t} * leverage_{i,t-1}$ is negatively (-0.196, t=-1.87) correlated with $Leverage_{i,t}$.

The negative sign in column (1) suggests that debt financing is not the primary financing source for over-levered firms. Instead, over-levered firms prefer to use equity rather than debt to fund the financing deficit. This results in the phenomenon that financing deficit accelerates the SOA of over-levered firms. This result violates the *pecking order theory* which suggests that the cost of debt capital is lower than the cost of equity capital. However, the result is in line with Lemmon and Zender (2010) who highlight the role of debt capacity. Lemmon and Zender enrich Shyam-sunder and Myers' (1999) test by adding a squared financing deficit variable. Lemmon and Zender find that debt capacity prevents firms with a high leverage ratio to issue further debt. Constrained by the debt capacity, over-levered firms issue equity to fund the financing deficit. As a result, debt capacity promotes leverage target adjustment, when firms are temporarily over-levered. Overall, firms tend to issue debt to cover the financing deficit when previous leverage ratio is below the leverage target and issue equity to cover the financing deficit when previous leverage ratio is above the leverage target.[40] This is consistent with the results generated by using a debt-equity choice model, in which Hovakimian et al. (2001) find that the deviation from leverage target influences issuance and repurchase decisions. In particular, Hovakimian et al. find that over-levered firms are more likely to issue equity or to repurchase debt while under-levered firms are more likely to issue debt or to repurchase equity.

In sum, results in Table 4.8 are in line with Shyam-Sunder and Myers' (1999) assertion that fluctuations in the financing deficit are associated with leverage target adjustment. Similar to the role of investment in Table 4.7, the results in Table 4.8 show that over-levered firms tend to cover the financing deficit by equity financing, whereas under-levered firms

[40] In the sample, the mean of *Equity issuance ratio* is higher in the group of over-levered firms (0.058) than that of under-levered firms (0.033). On the contrary, the mean of *debt issuance ratio* is higher in the group of under-levered firms (0.035) than that of over-levered firms (-0.01).

tend to cover the financing deficit by debt financing. As a result, financing deficit drives part of leverage target adjustments. These results are also consistent with the debt capacity explanation (Lemon and Zender, 2010) and the empirical results by using a debt-equity choice model (Hovakimian et al, 2001). Besides the mechanical effects due to the financing deficit, the active target adjustment is robust. Using the financing deficit variable to capture the mechanical effects does not wipe out the active leverage target adjustment, either.

Table 4.9 Interactions Terms Using EBIT

	(1)	(2)
Estimating methods	SYS-GMM	SYS-GMM
Leverage i,t-1	0.778***	0.832***
	(48.73)	(17.30)
Inv i,t * Leverage i,t-1		0.425
		(1.16)
Div i,t * Leverage i,t-1		2.291
		(1.13)
Cash i,t * Leverage i,t-1		-0.300
		(-1.19)
Equ i,t * Leverage i,t-1		-0.640**
		(-2.09)
ROA i,t * Leverage i,t-1		-0.098
		(-0.36)
Tangibility i,t-1	0.866***	0.081
	(3.72)	(0.90)
Market-to-Book i,t-1	-0.002	0.008
	(-1.52)	(1.40)
Ln_assets i,t-1	0.005*	0.004
	(1.65)	(0.39)
ROAe i,t-1	-0.030**	0.023
	(-2.52)	(0.46)
Constant	-0.028	0.000
	(-1.19)	(0.00)
Interactions with moving target	Yes	Yes
Year Dummy	Yes	Yes
Number of IVs	81	81
AR(1)	0.000	0.000
AR(2)	0.343	0.135
Hansen test p-value	0.280	0.565
Difference in Hansen test	0.874	0.198

Wald test p-value	0.000	0.000
Observation	20,980	19,883

This table shows regression results of model (4.10). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. This table uses SYS-GMM to estimate model (4.10).The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

Second, I check the robustness of the main findings to alternative definitions of the variables in the baseline specification. First, I define ROAe as EBIT over assets, as this is a more classical determinant of firm capital structure (such as in Rajan and Zingales, 1995) to replace the role of ROA in capturing the optimal leverage ratio in model (4.6). Second, I use two alternative definitions of leverage, namely the market leverage ratio (Flannery and Rangan, 2006) and long-term leverage ratio (Booth et al., 2001). The results are reported in Table 4.9 and Table 4.10. The main findings hold in these cases. Specifically, the estimated SOA decreases after controlling the mechanical effects, but not decrease to zero.

Third, I run the test using the full sample, compared to the firms with a continuous record as used in the baseline regression. In this case, the sample firms need a five-year period to perform the regression analysis. I find that the main findings hold in the larger sample. As reported in Table 4.11, after controlling the mechanical effects, the estimated SOA decrease from 0.26 to 0.04, indicating that a large amount of the leverage target adjustment is mechanically determined. This is even a larger decrease than that in the base sample. It indicates that smaller firms are more likely to use the chances to balance the balance constraint to mechanically adjust leverage. Overall, the results indicate that the main argument is robust to the sampling of using long-surviving firms and of using the full sample.

Table 4.10 Interaction Terms Using Other Definitions of Leverage

	(1)	(2)	(3)	(4)
Estimating methods	SYS-GMM			
	Market Leverage		Long-term Leverage	
Leverage i,t-1	0.649***	0.817***	0.658***	0.754***
	(28.71)	(3.33)	(38.28)	(7.75)
Inv i,t * Leverage i,t-1		3.865		0.182
		(1.48)		(0.10)
Div i,t * Leverage i,t-1		-4.403		-0.278
		(-0.46)		(-0.13)
Cash i,t * Leverage i,t-1		-1.08		0.221
		(-0.97)		(0.65)
Equ i,t * Leverage i,t-1		-1.004		-0.437
		(-1.27)		(-1.46)
ROA i,t * Leverage i,t-1		-2.171***		-0.172
		(-3.46)		(-0.77)
Tangibility i,t-1	0.229	-0.225	0.062	-0.152
	(1.52)	(-0.33)	(1.31)	(-0.55)
Market-to-Book i,t-1	-0.017***	0.016	-0.004	-0.017
	(-4.67)	(0.25)	(-1.29)	(-0.66)
Ln_assets i,t-1	0.002	-0.037	-0.003	0.022
	(0.09)	(-0.53)	(-0.36)	(0.61)
ROA i,t-1	-0.061*	-0.424	-0.082***	0.120
	(-1.90)	(-1.07)	(-4.31)	(0.55)
Constant	0.000	0.000	0.000	-0.035
	(0.00)	(0.00)	(0.00)	(-0.12)
Interactions with moving target	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
Number of IVs	81	81	81	81
AR(1)	0.000	0.000	0.000	0.000
AR(2)	0.662	0.103	0.396	0.824
Hansen test p-value	0.000	0.036	0.294	0.677
Difference in Hansen test	0.284	0.101	0.864	0.996
Wald test p-value	0.000	0.000	0.000	0.000
Observation	20,947	20,381	20,352	19,865

This table shows regression results of model (4.10). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. This table uses SYS-GMM to estimate model (4.10).The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

Table 4.11 Interaction Terms Using the Full Sample

	(3)	(6)
Estimating methods		
	Pooled	Pooled
Leverage i,t-1	0.741***	0.962***
	(58.02)	(20.14)
Inv i,t * Leverage i,t-1		-0.372
		(-0.57)
Div i,t * Leverage i,t-1		-2.494*
		(-1.82)
Cash i,t * Leverage i,t-1		-0.018
		(-0.08)
Equ i,t * Leverage i,t-1		-0.987***
		(-6.29)
ROA i,t * Leverage i,t-1		-0.397***
		(-3.19)
Tangibility i,t-1	0.082***	-0.128***
	(4.26)	(-2.80)
Market-to-Book i,t-1	-0.000	0.011**
	(-0.45)	(2.26)
Ln_assets i,t-1	0.019***	0.003
	(5.49)	(0.44)
ROA i,t-1	-0.012	0.035
	(-1.50)	(1.11)
Constant	0.000	0.000
	(0.00)	(0.00)
Interactions with moving target	Yes	Yes
Year Dummy	Yes	Yes
Number of IVs	314	314
AR(1)	0.000	0.000
AR(2)	0.598	0.789
Hansen test p-value	0.001	0.759
Difference in Hansen test	0.005	0.714
Wald test p-value	0.003	0.000
Observation	57,389	57,389

This table shows regression results of model (4.10) using the full sample. Firms are required to have at least five years to perform the regression analysis. This table uses SYS-GMM to estimate model (4.10).The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

Fourth, I add two terms that are closely-related to the *trade-off theory* of capital structure (i.e., in DeAngelo and Masulis, 1980) to capture the optimal leverage ratio, which are the effective tax rate and depreciation rate. *Effective tax rate* (*Etr*) is calculated by tax payment over earnings before tax, following Dyreng et al. (2017). It is used to capture firms' intention to use debt to shield tax. *Depreciation rate* (*Dpr*) is calculated by depreciation and amortization scaled by total assets, following Antoniou et al. (2008), and it is used to control the non-debt tax shield. The results are reported in Table 4.12. Although column (1) and column (2) suggest that effective tax rate and depreciation are not statistically significant determinants of leverage using OLS and Fixed Effects estimation, column (3) shows that the two factors are significant using a dynamic model and system GMM estimation. In column (3), the coefficient of $Etr_{i,t-1}$ is positive (0.007, z=3.26) whereas the coefficient of $Dpr_{i,t-1}$ is negative (-0.193, z=-2.80). This result is in line with the prediction of *trade-off theory* that firms use debt to shield tax and that non-debt-tax shield is a substitution to the tax-shield using debt. Column (4) uses the interaction terms to capture the mechanical effects, and the results suggest that the main findings hold. The estimated SOA decrease from 0.214 in column (3) to 0.124 in column (4), but it does not drop to zero. This result suggests that including the controls for the tax effects and the non-debt tax shield (depreciation) does not alter the main finding that leverage target adjustment is driven by other financial motives.

Table 4.12 Robustness to Controlling Tax-shield and Non-debt Tax Shield

	(1)	(2)	(3)	(4)
Estimating methods	OLS	FE	SYS-GMM	SYS-GMM
Leverage i,t-1			0.786***	0.876***
			(58.09)	(17.33)
Inv i,t * Leverage i,t-1				1.895*
				(2.02)
Div i,t * Leverage i,t-1				0.332
				(0.16)
Cash i,t * Leverage i,t-1				-0.420
				(-1.24)
Equ i,t * Leverage i,t-1				-1.167***
				(-5.20)
ROA i,t * Leverage i,t-1				-0.277
				(-1.47)
Tangibility i,t-1	0.161***	0.134***	0.065***	-0.033
	(7.88)	(4.27)	(3.08)	(-0.45)
Market-to-Book i,t-1	-0.020***	0.008	0.001	0.011*
	(-10.61)	(1.40)	(1.37)	(1.73)
Ln_assets i,t-1	0.022***	0.009***	0.009***	-0.006
	(12.97)	(2.62)	(4.42)	(-1.21)
ROAe i,t-1	-0.166**	-0.009***	-0.029**	-0.116**
	(-7.57)	(-5.23)	(-2.48)	(-2.14)
Etr i,t-1	-0.013**	0.000	0.007**	-0.026
	(-2.06)	(0.02)	(3.26)	(-1.03)
Dpr i,t-1	0.030	0.222*	-0.193**	-0.610
	(0.18)	(1.76)	(-2.80)	(-1.30)
Constant	0.063***	0.124***	-0.025	0.042
	(4.87)	(4.85)	(-1.50)	(0.96)
Interactions with moving target				Yes
Year Dummy	Yes	Yes	Yes	Yes
Number of IVs			113	113
AR(1)			0.000	0.000
AR(2)			0.400	0.570
Hansen test p-value			0.378	0.426
Difference in Hansen test			0.874	0.198
Wald test p-value			0.824	0.720
R2	14.91%	12.41%		
Observation	20,962	20,962	20,938	20,938

This table presents the regression results by controlling the tax effects and the non-debt tax shield. The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; **

indicates significant difference at 5% level; * indicates significant difference at 10% level.

4.8 The impact of Financial Constraint on the Mechanical Effects

Previous studies (such as Cook and Tang, 2010; Faulkender et al., 2012) suggest that financial constraint has an influence on the SOA, as the accessibility to financial market influences leverage target adjustments. This section evaluates the influence of financial constraint on active target adjustments and mechanical effects. It investigates the impact of the financial constraint using two measures motivated by the literature, which are firm size (Antoniou et al., 2008; and Faulkender et al., 2012) and dividend payment (Cook and Tang, 2010; Faulkender et al., 2012).

There are also other factors used to differentiate constrained firms from unconstrained firms, such as bond ratings or the possibility of having bond ratings (Faulkender et al., 2012; Elsas and Florysiak, 2015), economic recessions (Cook and Tang, 2010) and the financial constraint indexes. For the sample of this study, almost all of the observations (97%) have bond ratings in the sample period (from 1998 to 2014). The observations without bond ratings (the S&P Domestic Long Term Issuer Credit Rating) are very rare. Economic recessions in this sample period are much shorter than that in Cook and Tang (2010), based on the NBER business cycle identification. Leverage information is already built in the index measures of the financial constraint, such as the Kaplan and Zingales (KZ) index and the Whited and Wu (WW) index. Therefore, this chapter does not use these classifications.

Financially-constrained firms are expected to be more likely to take advantages of these mechanical effects to adjust the leverage ratio. This section compares the role of mechanical effects in the two subsamples and evaluate whether the non-mechanical fraction of the SOA is robust. GMM estimates are strongly consistent (Hansen, 1982), which facilitates to compare the regression coefficients directly. Univariate differences are summarized in Table 4.5.

A. Firm Size

Antoniou et al. (2008) suggest that firm size influences the accessibility to financial market. Large firms tend to have a better reputation and more diversified operation activities, and it is relatively easier (less costly) for large firms to raise external capital. On the contrary, small firms with higher Market-to-Book ratio and lower tangibility have higher costs of external financing. This also explains why small firms tend to hold more cash. Univariate differences in Table 4.5 (column 3 and column 4) show that small firms have a larger Market-to-Book ratio (a mean value of 1.79) compared to that of large firms (1.29). The mean value of tangibility of small firms is 0.25, which is lower than that of large firms (0.31). Cash holdings constitute 16.1% of the total assets in the group of small firms, while it is 8.5% in the group of large firms. Therefore, this chapter uses firm size as the first measure of the financial constraint. The firms with total assets higher than the median value (733.5 million dollar) are regarded as unconstrained firms, and the firms with total assets below the median value are regarded as financially-constrained firms. The regression results are reported in Table 4.13.

Table 4.13 The Impact of Financial Constraint Differentiated by Firm Size

	(1)	(2)	(3)	(4)
Estimating methods	SYS-GMM			
Size	Large firms		Small firms	
	Over-levered	Under-levered	Over-levered	Under-levered
Leverage i,t-1	0.511***	0.505**	0.622***	0.357**
	(2.37)	(2.21)	(3.95)	(2.36)
Inv i,t * Leverage i,t-1	-1.864	-3.213	1.084	-6.704***
	(-0.94)	(-1.46)	(0.60)	(-3.18)
Div i,t * Leverage i,t-1	8.395	-13.151**	-0.884	12.581***
	(1.60)	(-2.40)	(-0.27)	(3.39)
Cash i,t * Leverage i,t-1	-0.224	-0.682	0.533	-0.725
	(-0.14)	(-0.62)	(1.26)	(-1.47)
Equ i,t * Leverage i,t-1	0.169	-0.009	-1.061***	-0.047
	(0.13)	(-0.01)	(-4.73)	(-0.13)
ROA i,t * Leverage i,t-1	-1.886***	-0.414	-0.761***	0.873***
	(-2.47)	(-0.59)	(-3.12)	(2.58)
Tangibility i,t-1	-0.153	-0.347**	-0.068	0.138
	(-0.59)	(-1.98)	(-0.34)	(0.74)
Market-to-Book i,t-1	0.025	0.027	0.061***	0.033**
	(0.61)	(1.08)	(3.73)	(2.37)
Ln_assets i,t-1	-0.209***	0.027	-0.047	0.010
	(-4.04)	(0.73)	(-1.44)	(0.43)
ROA i,t-1	-0.066	0.101	-0.037	0.059
	(-0.38)	(0.72)	(-0.33)	(0.96)
Constant	0.000	0.000	-0.084	0.000
	(0.00)	(0.00)	(-0.49)	(0.00)
Interactions with moving target	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
Number of IVs	81	81	81	81
AR(1)	0.000	0.000	0.001	0.000
AR(2)	0.880	0.874	0.969	0.571
Hansen test p-value	0.986	0.824	0.693	0.012
Difference in Hansen test	0.112	0.650	0.148	0.003
Wald test p-value	0.000	0.000	0.000	0.000
Observation	4,394	4,349	4,513	4,001

This table shows regression results of model (4.10). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. Large (small) firms indicate the group of firms with previous size above (below) the median size (733.45 million USD). This table uses SYS-GMM to estimate model (4.10).

$Lev_{i,t} = \alpha_0 + \beta_0 {*} Lev_{i,t-1} + \beta_1 {*}\, Z_{i,t} {*} Lev_{i,t-1} + \beta_2 {*} X_{i,\,t-1} + \beta_3 {*}\, Z_{i,t} {*} X_{i,\,t-1} + u_i + D_{year} + \varepsilon_{i,t}$, (4.10)

The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. *X* denotes the variables to capture firm target leverage ratio. *Z* denotes the variables to capture the mechanical effects. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. The coefficients of $Z_{i,t}*X_{i,t-1}$ are not reported, to save space. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

The results in Table 4.13 show that unconstrained firms adjust faster towards the leverage target. Specifically, large over-levered firms revert at a speed of 0. 489 (column 1), while small over-levered firms revert at a speed of 0.378 (column 3). One explanation is that small firms are financially-constrained; and hence, small firms tend to have higher adjustment costs (the cost of external financing) and revert at a lower SOA. This can also be explained by using the *leverage ratchet effects theory* (Admati et al., 2018). It is more costly for small firms to forego valuable investment opportunities or to refinance. In all of the partitioned subgroups, the coefficients of previous leverage ratio are statistically significant, suggesting that the active target adjustment is robust to the partition according to firm size.

The results also show that the target adjustment of small firms is more influenced by the mechanical effects. As shown in column (3), variations in equity issuance (-1.061, *z*=-4.73) and profitability (-0.761, *z*=-3.12) mechanically drive the leverage ratio towards the target; while the leverage target adjustment of large firms are only driven by profitability (-1.886, *z*=-2.47) according to column (1). The coefficient of $Inv_{i,t}*leverage_{i,t-1}$ and $ROA_{i,t}*leverage_{i,t-1}$ are significant in the group of small firms, but not significant in the group of large firms. These results suggest that small (financially-constrained) firms are more likely to use debt to accommodate other financial behaviours. On the contrary, it is less costly for large (unconstrained) firms to raise funds from the capital market and to rebalance the leverage ratio.

B. Dividend payment

Faulkender et al. (2012) use dividend payment as one measure of the financial constraint and find that dividend paying firms adjust leverage ratio substantially faster than do non-payers. Cook and Tang (2010) suggest that unconstrained firms are more willing to distribute funds to shareholders. Column (5) and column (6) of Table 4.5 show the univariate differences. In the sample, dividend-paying firms tend to have a larger size (11,338.19 compared to 2,252.67), higher tangibility (0.303 compared to 0.252) and higher profitability (0.043 compared to -0.045). These firms would have a higher debt capacity and more internally-generated funds. Hence, it is reasonable to use dividend payment as the criteria to differentiate unconstrained firms from financially-constrained firms. This section tests whether the financial constraint, differentiated by dividend payment, affects the active leverage target adjustment. The firms with dividend payment at year *t-1* are regarded as unconstrained firms, while the firms without dividend payment at year *t-1* are regarded as financially-constrained firms. The regression results are reported in Table 4.14.

By examining partitioned subsamples, Table 4.14 shows that the other financial behaviours drive the leverage target adjustment of non-payers. Specifically, the results show that investment, equity issuances and ROA mechanically drive the leverage ratio back to the target in the group of small over-levered firms (column 3 of Table 4.14). Dividend payment has a mechanical impact on the leverage target adjustment in the group of under-levered firms (column 4 of Table 4.14). These results suggest that the leverage ratio of non-payers is more vulnerable to other financial behaviours. On the contrary, no mechanical impact of ROA is observed in dividend-paying firms' group. These results suggest that financially-constrained firms are more willing to adjust leverage when part of the adjustment cost can be borne by the need to balance the budget constraint.

Table 4.14 The Impact of Financial Constraint Differentiated by Dividend Payment

	(1)	(2)	(3)	(4)
Estimating methods	SYS-GMM			
Dividend payment	Dividend paying		Non payer	
	Over-levered	Under-levered	Over-levered	Under-levered
Leverage i,t-1	0.252	0.402*	0.732***	-0.031
	(1.34)	(3.31)	(4.68)	(-0.14)
Inv i,t * Leverage i,t-1	1.469	-1.694	-3.250**	0.817
	(0.78)	(-0.91)	(-2.26)	(0.48)
Div i,t * Leverage i,t-1	1.034	-3.339	0.001	-21.343*
	(0.34)	(-1.63)	(0.00)	(-1.84)
Cash i,t * Leverage i,t-1	-0.111	-0.135	-0.383	2.424**
	(-0.24)	(-0.32)	(-0.68)	(2.42)
Equ i,t * Leverage i,t-1	0.209	-0.029	-0.584**	-1.027***
	(0.51)	(-0.09)	(-2.37)	(-1.64)
ROA i,t * Leverage i,t-1	-0.015	-0.456	-0.637**	-0.201
	(-0.04)	(-1.61)	(-2.79)	(-0.48)
Tangibility i,t-1	0.110	-0.213	-0.0587	0.015
	(0.50)	(-1.12)	(-0.57)	(0.07)
Market-to-Book i,t-1	0.072**	0.005	0.022	0.038***
	(2.08)	(0.38)	(1.49)	(2.59)
Ln_assets i,t-1	-0.051	0.031**	-0.012	0.017
	(-1.29)	(2.06)	(-0.59)	(0.93)
ROA i,t-1	-0.631***	-0.077	0.129	-0.013
	(-2.75)	(-0.87)	(1.50)	(-0.17)
Constant	0.362	0.000	0.000	0.084
	(1.14)	(0.00)	(0.00)	(0.77)
Interactions with moving target	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
Number of IVs	81	81	81	81
AR(1)	0.000	0.004	0.000	0.000
AR(2)	0.763	0.087	0.491	0.202
Hansen test p-value	0.316	0.279	0.974	0.794
Difference in Hansen test	0.001	0.053	0.209	0.360
Wald test p-value	0.000	0.000	0.000	0.000
Observation	4,194	4,364	4,713	3,986

This table shows regression results of model (4.10). The sample includes all the unregulated firms with continuous records, and the sample period is from 1998 and 2014. This table partitions sample firms by whether firms pay dividend at year *t-1*. This table uses SYS-GMM to estimate model (4.10).

$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * Z_{i,t} * Lev_{i,t-1} + \beta_2 * X_{i,\, t-1} + \beta_3 * Z_{i,t} * X_{i,\, t-1} + u_i + D_{year} + \varepsilon_{i,t}$,(4.10)

The dependent variable is firm book leverage ratio, and one-year lagged dependent variable is used as one of the independent variables. *X* denotes the variables to capture firm target leverage ratio. *Z* denotes the variables to capture the mechanical effects. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1. Coefficients and z-values are reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and the Difference-in-Hansen test. This table uses the Wald test to check overall significance. The coefficients of $Z_{i,t}*X_{i,t-1}$ are not reported, to save space. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; *indicates significant difference at 10% level.

4.9 Discussion, Conclusion and Limitations

This chapter proposes a way to investigate the mechanical effects. It extends the partial adjustment model in Flannery and Rangan (2006) by using interaction terms to capture the mechanical effects. This method controls the proportion of the SOA that can be explained by other financial behaviours.[41] This study uses system-GMM (Blundell and Bond, 1998) to estimate the regression coefficients and to address the endogeneity concern. This chapter also tests the robustness by using the financing deficit variable as an alternative specification to capture the mechanical effects. Section 4.8 investigates the impact of the financial constraint and whether the mechanical effects vary between financially-constrained firms and unconstrained firms.

The results in this chapter show that a substantial fraction of leverage target adjustment is driven by the mechanical effects due to variations in firm investment, equity issuance and ROA. Increases in equity issuance and profitability mechanically accelerate leverage target

[41] In a recent study, Elsas and Florysiak (2015) propose a new estimator to control the mechanical effects due to the fractional nature of leverage ratio (bounded between 0 and 1). This estimator can be used, conditional on exogenous independent variables, according to Elsas and Florysiak. Faulkender et al. (2012) explain the mechanical effect by considering the value added by current-period net income. However, they did not consider the motivation to balance the budget constraint. This study takes a different approach and look at the mechanical reversion driven by the other financial behaviours.

adjustments when firms are temporarily over-levered and delay leverage target adjustment when firms are temporarily under-levered. Investment accelerates leverage target adjustments of both over-levered firms and under-levered firms. Controlling these effects reduces the estimated SOA by around 50% in both subgroups. Additionally, the results are robust to an alternative specification by using the financing deficit variable as an alternative to the disaggregated regressors to test the mechanical effects. The main finding is robust to a few alternative definitions of variables and using the full sample period. Overall, the results in this chapter are in line with Shyam-Sunder and Myers (1999), Chang and Dasgupta (2009) and Hovakimian and Li's (2011) concern that leverage mean reversion is not entirely active. It seems that other financial decisions (or the financing deficit) drive part of mean reversion in leverage and that the classical partial adjustment model overestimates the active adjustment speed.

Although the estimated SOA decreases after controlling the mechanical effects, there is still strong evidence implying active target adjustments. First, firms' financing behaviours show a tendency to revert. Descriptive evidence in Table 4.3 shows that the firms with a higher leverage ratio are more reluctant to issue debt in the subsequent period. Instead, these firms are more willing to fund the financing deficit by equity financing. It provides additional evidence for the mean reversion in leverage by investigating firms' financing behaviours. This is in line with the suggestion in Chang and Dasgupta (2009). Chang and Dasgupta point out that the mean reversion observed in previous studies may be driven by the autoregression of leverage ratio. Hence, Chang and Dasgupta suggest using firms' financing behaviours rather than the changes in leverage ratio as the evidence to support the existence of a leverage target. The results in section 4.4 (Table 4.3) suggest that the mean reversion recorded in previous studies (such as Marsh, 1982; Jalilvand and Harris, 1984; Fama and French, 2002; and Kayhan and Titman, 2007) is not completely driven by a 'mechanical reversion'.

Second, besides the proportion of SOA driven by the mechanical effects, there remains a substantial fraction of the SOA that indicates active adjustments. Specifically, controlling the mechanical effects does not wipe out active target adjustments. The active adjustment holds for both over-levered firms and under-levered firms, and it is robust to whether firms are subject to the financial constraint. Overall, the results in this chapter support the *trade-off theory* that firms adjust the leverage ratio towards a target, although the active adjustment speed is nearly a half of that observed by the classical partial adjustment model.

Empirical results in this chapter point to a unified theory of capital structure. Traditional *trade-off theory* suggests that firms benefit from targeting an optimal leverage ratio. This chapter shows that issuing (or retiring) debt to balance the budget constraint may bring an extra benefit, such as by funding a high-yield investment project. The extra benefits motivate part of the variation in leverage and results in a mechanical adjustment or deviation. It appears that firms consider both the optimal leverage ratio and balancing the budget constraint when making leverage decisions.

Previous studies tend to ignore the difference in the SOA when firms are above or below the optimal leverage ratio. Flannery and Rangan (2006) and Faulkender et al. (2012) are of the very few studies reporting the difference. However, the reason of the difference has not been fully explained. This chapter discusses the driving forces of leverage target adjustments for over-levered and under-levered firms separately. It is predicted that over-levered firms tend to revert at a lower SOA, due to a higher adjustment cost (for example, to stop existing investment projects) and the leverage ratchet effect. The results before controlling the mechanical effects show that over-levered firms revert at an SOA of 0.518 while under-levered firms revert at 0.879.[42] The fact that firms adjust faster from below than from above supports Admati et al.'s (2018) theory on leverage ratchet effects. After controlling the mechanical effects, the estimated SOAs decrease to 0.218 and 0.461 respectively. Under-levered firms adjust faster. Beyond the fact that over-levered firms and under-levered firms revert at different speeds, this study also finds that the leverage target determinants play opposite roles in these two groups. Therefore, future studies on leverage target adjustment are recommended to take into account whether firms are over-levered or under-levered.

[42] Results in this chapter are different from some prior studies (such as Flannery and Rangan, 2006; and Faulkender et al., 2012) which suggest over-levered firms revert faster. The literature explains it by the benefit of the reducing bankruptcy cost. Two reasons make the results in this study different from the literature: (1) bond ratings are more popular among the sample firms in this study, and (2) sample firms with continuous records in this study are more likely to survive. Therefore, these firms have an easier access to the bond market, compared to those in previous studies; and hence, these firms have less demand to rebuild the leverage capacity. Secondly, firms in this study have less risk of going bankrupt. Consequently, over-levered firms in this study are less motivated by leverage target adjustment.

This study uses two measures, motivated by the literature, to differentiate financially-constrained and unconstrained firms, i.e., firm size (Antoniou et al., 2008; and Faulkender et al., 2012) and dividend payment (Cook and Tang, 2010; Faulkender et al., 2012). The results show that the mechanical effects are more pronounced in the group of constrained firms. This indicates that financially-constrained firms are more willing to make leverage adjustments when part of the adjustment cost is borne by the need to balance the budget constraint. Unconstrained firms have more discretions to undertake active leverage target adjustments.

One limitation of this chapter is that it relies on an important assumption that firm financial behaviours are homogeneous. For example, it uses capital expenditure to account for investment while it does not account for mergers and acquisitions, research and development, etc. Harford et al. (2009), among other studies, find that firms use M&A activities to adjust leverage. In addition, equity decisions in this chapter account for the issuances and repurchases on the secondary market but do not account for IPO. Alti (2006) find that firm time the security market to go public, and the issuances of equity could be a source of the shocks to firm leverage and could potentially lead to mechanical variation in leverage if firms already forecast an IPO in the future and start to accumulate a certain level of debt today. Third, the study uses firms in the US while it does not account for the cross-country variation in the transaction cost of debt financing. This effect may influence firms' willingness to actively adjust leverage. Further studies could use more explicit specifications to account for these and other factors, or use event studies to see how firms use these chances to mechanically adjust leverage.

Chapter 5 Supply-side Effects on Firm Capital Structure

An underexplored issue in capital structure literature is the supply-side effect. Supply-side effects have been largely ignored in firm capital structure studies (as noted in Titman, 2002; Faulkender and Peteren, 2006; and Baker, 2009). However, supply-side effects receive increasing attention in the last decade (such as in Faulkender and Petersen, 2006; Baker, 2009; Leary, 2009; Lemmon and Roberts, 2010; Graham and Leary, 2011, and Antzoulatos et al., 2016). These studies indicate that firms financing decisions are not only influenced by firms but also influenced by the supply of capital. Chapter 5 enriches this branch of literature by using several variables at macroeconomic level to capture the supply-side factors and by empirically examining how these factors influence firm leverage policy. A further question is, if firm capital structure is influenced by the supply-side effect, cyclical supply-side factors may lead to a mechanical fluctuation in the leverage ratio. Do these cyclical supply-side factors generate a mechanical mean reversion in firm leverage ratio? Is leverage target adjustment robust, after controlling for the cyclical variation in leverage?

The results in this chapter suggest that firms consider the cost of financing sources when making financing decisions. Section 5.3 extends the model testing the *pecking order theory* (Shyam-Sunder and Myers, 1999), by using proxies for the supply-side factors to interact with the pecking order coefficient. The results show that firms are more likely to use equity financing when the supply side prefers equity capital, and vice versa. Using a partial adjustment framework, section 5.4 finds that the supply-side factors are important determinants of firm capital structure, even when the demand-side effects are controlled. Section 5.5 examines the cyclicality of the leverage ratio. The results show that firm capital structure is pro-cyclical to the economic cycle but counter-cyclical to the financial cycle.

Although supply-side factors influence firm capital structure and the choice between debt financing and equity financing, the factors captured by macroeconomic characteristics do not wipe out the observed leverage target adjustment. The estimated SOA is not reduced by controlling the supply-side effects. This indicates that although firms time the security market and consider the supply of capital, the leverage target remains an important consideration to managers. Overall, the results in Chapter 5 suggest that firms consider both market-timing and the optimal leverage ratio when making financing decisions. The observed mean reversion in leverage is not due to firms' following cyclical supply-side factors.

Chapter 5 is structured as follows. Section 5.1 reviews the literature and discusses how supply-side factors can influence firm leverage decisions. Section 5.2 presents the data and discusses the proxies to capture the supply-side effects. Section 5.3 to section 5.6 present empirical evidence and discuss the findings. The influence of supply-side effects on firm leverage policy is evaluated from three perspectives. First, section 5.3 test whether the supply-side factors are associated with firms’ financing choices. Second, section 5.4 tests whether the supply-side factors are associated with firm capital structure, using the partial adjustment model. After confirming the role of supply-side effects, section 5.5 evaluates the cyclicality of leverage ratio and discusses whether these supply-side effects lead to a mechanical reversion in leverage. Section 5.6 discusses the robustness of the main findings. Section 5.7 discusses the results, concludes and states the limitations.

5.1 Supply-side Effects on Firm Capital Structure

The *market timing hypothesis* suggests that firms use equity financing when the stock price is over-valued and use debt financing when the stock price is under-valued. Baker and Wurgler (2002) and Huang and Ritter (2009) demonstrate by showing that historical values of financing costs have a persistent impact on the current leverage ratio. Since the costs of financing sources are determined not only by the demand of firms for external capital, but also by the capital supply of external investors; supply-side effects, revealed by the costs of financing sources, should also be related to firms' financing decisions. This section reviews the literature and discusses how the supply-side factors could influence firm capital structure by influencing the costs of financing sources. This section also rationalizes the predictions to be tested in later sections.

A. The Cost of Equity Financing

The demand-side and the supply-side have opposite predictions on the relationship between stock return and firm leverage ratio. The demand-side predicts that firms with a high expected stock return are more likely to choose debt financing and use a high leverage ratio. According to the *agency theory* (Jensen, 1986), firms tend to use debt financing when a high stock return is forecasted, so that the profits of existing shareholders will not be diversified. Hence, a high stock return implies a high cost of equity financing, which leads to a preference for debt financing and finally a high leverage ratio. Leary (2009) finds that firms with a higher stock return (1-year specific equity return) tends to use less equity financing. On the contrary, the supply side predicts a negative relationship. If a higher stock return is forecasted by investors, there will be a higher demand for equity capital in the stock market, which results in an increase in the stock price. This could make it easier for firms to raise equity capital. Rational firms would take this opportunity and choose equity financing, which finally leads to a lower leverage ratio. Overall, the relationship between stock return and firm capital structure should depend on the tradeoff between supply-side effects and demand-side effects. The direction of the relationship needs to be empirically examined.

Stock market capitalization is another measure of capital supply, which also influences the transaction cost of external financing. On one hand, market capitalization shows the supply of capital to the stock market. A high level of market capitalization indicates more capital available in the equity market, which reduces the cost of equity financing. In this situation, firms are more likely to use equity financing. On the other hand, a developed stock market promotes transparency and disclosure, which improves the investor protection. This, in turn, reduces the cost to monitor firms and attracts more creditors (Antzoulatos et al., 2016). This reduces the cost of debt financing and enables firms to raise more debt capital. Overall, theory has an ambiguous prediction on the relationship between capital market capitalization and firm capital structure since stock market capitalization influence the cost of equity financing and the cost of debt financing. The direction of relationship needs to be empirically examined.

Lamont and Stein (2006) and Baker (2009) discuss the potential influence of investor sentiment on firm capital structure. Baker states that investors are not fully rational. As a result, the demand of investors is occasionally unrelated to firm fundamentals. Mclean and Zhao (2014) find that low investor sentiment increases the cost of external financing. Hence, variations in investor sentiment should have an impact on firm leverage policy. When the investor sentiment is low, it becomes harder for firms to raise sufficient funds to meet the financing deficit. According to the *pecking order theory*, firms in low sentiment periods should use equity financing more often, because it is the last resort that firms have to refer to. Moreover, according to Lemmon and Zender (2010), in low sentiment periods, firms would reduce debt to maintain the debt capacity. When the investor sentiment is high, there is an increased capital supply and external financing becomes less costly. Firms have more debt capacity, and it becomes cheaper to raise equity to rebuild the debt capacity. Therefore, firms should use a more aggressive leverage policy in high sentiment periods. Overall, a positive association between investor sentiment and firm capital structure is expected.

B. The Cost of Debt Financing

When it comes to the cost of debt financing, firms are expected to use more debt capital when the cost of debt financing is low. A direct measure of debt financing cost is interest rate. Baker (2009) states that firm debt issuances are influenced by the interest rate. Barry et al. (2008) also find that firms issue more bonds when the interest rate is lower than the historical average. A high interest rate indicates a high cost of debt financing. However, supply-side predicts the opposite. Investors tend to choose equity capital when the interest rate is low, and choose debt capital when the interest rate is high. When the interest rate is high, the increased demand for corporate bonds reduces the cost of firms to issue debt, and vice versa. Hence, supply-side predicts a positive relationship between interest rate and firm capital structure. Since the demand-side and the supply-side have opposite predictions, the relationship between the interest rate and firms' reliance on debt financing needs to be examined.

When investors forecast a higher default risk, there tends to be a decline in the demand for corporate debt. Huang and Ritter (2009) use *Default Spread* and *Term Spread* as the two measures for default risk, and find that these two variables are negatively correlated with firm leverage ratio. A high default risk increases the potential loss when investors buy corporate bonds. Rational investors forecasting a high default risk would reduce the buyings of corporate bonds, which increases the difficulty for firms to raise debt capital. Holding the demand for external funds fixed, firms would turn to equity financing. Therefore, a negative relationship between default risk and firm capital structure is expected.

The economic condition is an important factor influencing the cost of debt financing, since the availability of external funds varies due to the economic condition (Mclean and Zhao, 2014). When there is a decline in the supply of capital in economic recessions, it is harder for firms to raise external funds. When there is an increase in the supply of capital in economic booms, it is easier for firms to access external funds. Theory has an ambiguous prediction on the response of capital structure. On one hand, firms may use more debt capital in economic expansions when there is a large capital supply; on the other hand, the cost of equity financing also reduces, because of the high stock price in expansions. The relationship between the economic condition and firm capital structure needs to be examined.

A series of studies investigate the impact of capital supply on firm leverage decisions. Among these studies, Graham et al. (2014) explain that capital supply influences firm leverage ratio by shifting the demand curve of corporate debt. Financial development and government borrowings are the two typical factors influencing the demand for corporate bonds. Specifically, financial development reduces the agency cost for investors to monitor managers (Antzoulatos et al., 2016), which leads to a higher demand for corporate bonds. As a substitute, increased government borrowings reduce the demand of investors for corporate bond (Leary, 2009; Greenwood et al., 2010). Most of the previous studies, such as Faulkender and Petersen (2006), Roberts and Sufi (2009), Sufi (2009) and Leary (2009), find that supply shocks negatively influence firm leverage ratio, as noted in Lemmon and Roberts (2010). However, Lemmon and Roberts' (2010) work is an exception, in which the authors find that shocks to capital supply do not influence firm leverage ratio. The authors investigate supply-side effects by examining three exogenous shocks (i.e., the collapse of Drexel Burnham Lambert, Inc; the passage of the Financial Institutions Reform, Recovery, and Enforcement Act of 1989; and regulatory changes in the insurance industry), and find that the leverage ratio of sample firms remained stable after the three shocks. Lemmon and Roberts note that the negative shock to capital supply has a contemporaneous impact on debt financing and investment, which offsets the impact on firm capital structure; therefore, Lemmon and Roberts suggest that capital supply does not influence firm leverage policy, or at least not permanently. Since the literature has not reach a consensus, the relationship between capital supply and firm capital structure needs further examination.

C. Leverage Target Adjustment

Covas and Den Haan (2011) suggest that both equity issuance and debt issuance are pro-cyclical. Since firms issue debt and equity following the business cycle, the leverage ratio that is the cumulative result of financing behaviours, may also exhibit cyclical movements. If supply-side factors influence debt and equity decisions to the same extent, the impact on the leverage ratio could be offset. If either debt financing or equity financing is more sensitive, leverage ratio would exhibit cyclical movement. A few studies investigate the cyclicality of the leverage ratio, but have opposite findings. For instance, Mclean and Zhao (2014) find leverage ratio is pro-cyclical, while Halling et al. (2016) find leverage is counter-cyclical. Covas and Den Haan (2011) find debt issuance and equity issuance are both pro-cyclical. Further examinations on the cyclicality of firm capital structure are still needed.

The *trade-off theory* suggests that firm leverage ratio fluctuates around an optimal level. However, the observed mean reversion in leverage cannot prove the existence of a leverage target, if firms' financing decisions are cyclical. In particular, if firms issue debt and raise the leverage ratio in economic booms and cut debt and reduce the leverage ratio in economic recessions; it would generate a pro-cyclical movement of the leverage ratio and a mechanical reversion towards the mean value. This mechanical reversion can be mis-interpreted as (at least part of) the target adjustment behaviour.

Therefore, it is important to differentiate the cyclical movement of leverage from the active adjustment. If the leverage target adjustment is mechanically driven by the business cycle, including the proxies capturing business cycle effects should substantially reduce the magnitude of the variable to estimate the adjustment speed. If the leverage target adjustment is not driven by the business cycle, capturing business cycle effects should not wipe out the explanatory power of the variable capturing target adjustment behaviours. Therefore, this chapter also checks whether the observed leverage target adjustment is robust to the business cycle.

5.2 Data and Variables

A. Firm Characteristics Variables

The sample period in this chapter is from 1988 to 2015[43], because the data of one of the key independent variables, *Equity Risk Premium* (*ERP*), are

[43] The sample period of this chapter ends at 2015, rather than 2014 in Chapter 3 and Chapter 4, because the data collection work of this chapter starts in 2016. Keeping the data

available from 1988 on. Another important reason for this chapter to use firms with a continuous record is that the economic condition is associated with firms' joining or exiting the capital market. Many firms are listed during economic expansions, and there is also a higher possibility to go bankrupt in economic recessions. This tends to give more weights to good economic conditions. Using firms with a continuous record helps avoid this bias. The sample contains a strongly balanced panel of 733 firms. For each firm, there are 28 years of data. Definitions and sources of the variables capturing firm characteristics are summarized in Appendix 1. The results using the full sample are discussed in the robustness check section of this chapter.

Table 5.1 presents the descriptive statistics of variables capturing firm characteristics. To remove the influence of outliers, these variables are winsorized by 1% at both tails. *Leverage* is measured by the proportion of total debt to the book value of total assets, and it has a mean of 0.219. The median value of leverage ratio is 0.2, which is 2% lower but still close to the mean. The leverage ratio is again close to the 0.218 reported in Chang et al. (2019). This chapter uses book leverage ratio as the dependent variable rather than the market leverage ratio, to remove the impact of variations in firm stock prices. Moreover, according to Graham et al. (2014), firms tend to make financial decisions based on the book value of assets rather than the market value. *Debt issuance ratio* measures the increase in total debt, scaled by the book value of total assets, while *equity issuance ratio* measures the increase in shareholders' equity scaled by total assets. The mean of *equity*

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of 2015 adds to the total number of observations but do not make a qualitative difference to the results.

issuance ratio (0.022) exceeds the mean of *debt issuance ratio* (0.009), suggesting that sample firms use equity financing more than debt financing in the sample period. *Total assets* refer to the book value of assets owned by sample firms, with a mean value of 8,583.71 million dollars. *Tangibility* measures the proportion of property, plant and equipment (Net) on the book value of total assets. *Market-to-Book ratio* is calculated as book value of total debt plus the market value of equity, scaled by the book value of total assets. *Return on Assets (ROA)* is used to capture firm profitability. *Deficit* denotes the financing deficit scaled by the book value of total assets. A mean value of 0.049 indicates that annual external financing is as much as 4.9% of total assets, on average.

B. Macroeconomic Characteristics Variables

This chapter uses a list of macroeconomic characteristics variables to capture variations in the supply-side conditions. The sample period is from 1988 to 2015, although some variables (i.e., *Financial Development Index*) are not available for the full sample period. The data are collected from various sources via Datastream. The remainder of this section introduces these factors and shows the time series trends of variables. Table 5.2 presents the time series of these variables. Figure 5.1.1 to Figure 5.2.6 plots the trend of median leverage ratio, together with the variables capturing supply-side factors respectively. Definitions of the macroeconomic characteristics variables are summarized in Appendix 2.

Table 5.1 Descriptive Statistics – Firm Characteristics

Variable	N	Mean	Median	Std. Dev	p1	p99	Skewness	Kurtosis	Jarque-Bera
Leverage	20,339	0.219	0.200	0.176	0	0.822	0.858	3.699	17457.254
Marlet Leverage	19,954	0.213	0.158	0.204	0	0.858	1.151	3.773	29415.853
Long-term Leverage	18,582	0.349	0.333	0.257	0	1.310	0.983	4.478	28103.603
Debt issuance ratio	20,287	0.009	0	0.090	-0.337	0.346	0.263	7.514	104746.2
Total assets	20,422	8583.71	829.67	34472.96	2.639	150,874	10.870	166.85	139479452
Tangibility	20,345	0.296	0.245	0.214	0.009	0.891	0.923	3.142	17435.055
Market to Book ratio	20,012	1.823	1.460	1.172	0.656	7.842	2.754	12.371	591122.99
Return on Assets (ROA)	20,415	0.034	0.052	0.126	-0.702	0.260	-3.229	17.671	1311378
ROAe	20,413	0.080	0.090	0.122	-0.599	0.322	-2.546	14.351	789848.71
Effective tax rate	20,413	0.263	0.334	0.330	-1.681	1.474	-2.226	17.735	1209166.8
Depreciation	20,329	0.043	0.039	0.026	0.002	0.146	1.373	5.792	77940.268
Deficit	20,296	0.049	0.024	0.168	-0.450	0.807	1.455	8.884	218636.41

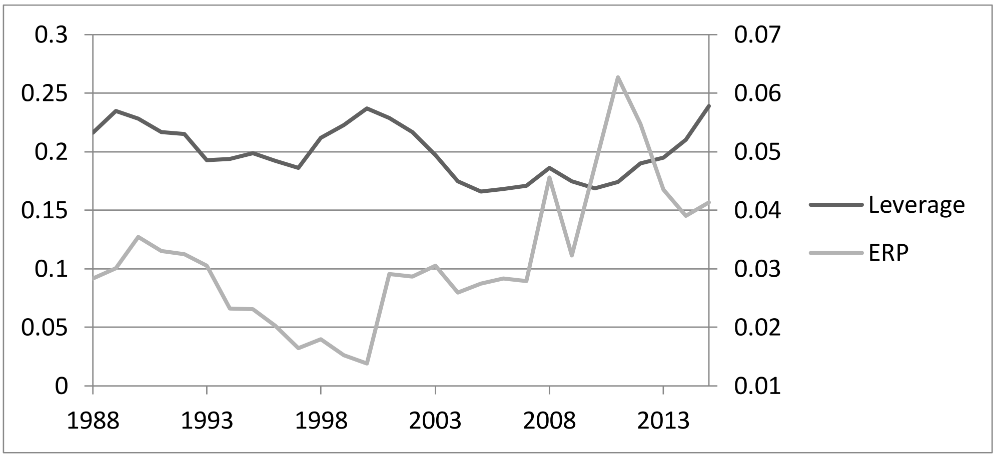
This table presents the descriptive statistics of sample firm characteristics. The data are collected from CRSP/Compustat merged database. The sample includes all the unregulated firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. This table reports the number of observations (N), the mean, the median, the standard deviation, the values at 1st and 99th quantiles, skewness, kurtosis and Jarque-Bera Statistics. Definitions of the variables are summarized in Appendix 1.

Table 5.2 Descriptive Statistics - Leverage Time Series and Macroeconomic Characteristics

Time	Leverage	ERP	ASR	STG	CSI	BFA	RIR	DSP	TSP	RGDP	FD	GBG
1988	0.216	0.028	0.118	0.374	0.937	0.574	0.028	0.011	0.012	0.042	.	0.601
1989	0.235	0.030	0.270	0.414	0.928	0.526	0.039	0.009	0.000	0.037	.	0.603
1990	0.228	0.035	-0.043	0.340	0.816	0.549	0.029	0.010	0.007	0.019	.	0.620
1991	0.217	0.033	0.203	0.347	0.776	0.493	0.028	0.010	0.020	-0.001	.	0.664
1992	0.215	0.032	0.042	0.387	0.773	0.495	0.010	0.008	0.031	0.036	.	0.686
1993	0.193	0.031	0.137	0.499	0.828	0.455	0.000	0.007	0.024	0.027	.	0.702
1994	0.194	0.023	0.021	0.499	0.923	0.383	0.004	0.007	0.018	0.040	.	0.694
1995	0.199	0.023	0.335	0.676	0.922	0.325	0.027	0.006	0.006	0.027	.	0.688
1996	0.192	0.020	0.260	0.860	0.936	0.273	0.026	0.007	0.009	0.038	.	0.680
1997	0.186	0.016	0.226	1.076	1.032	0.235	0.029	0.006	0.007	0.045	.	0.656
1998	0.212	0.018	0.161	1.354	1.046	0.219	0.040	0.007	0.002	0.044	.	0.625
1999	0.223	0.015	0.252	1.948	1.058	0.168	0.026	0.008	0.006	0.047	.	0.589
2000	0.237	0.014	-0.062	2.896	1.075	0.173	0.021	0.007	-0.001	0.041	.	0.531
2001	0.229	0.029	-0.071	1.966	0.892	0.217	0.037	0.009	0.015	0.010	.	0.530
2002	0.217	0.029	-0.168	1.553	0.896	0.301	0.002	0.013	0.026	0.018	.	0.554
2003	0.197	0.031	0.253	1.394	0.876	0.257	-0.010	0.011	0.028	0.028	.	0.585
2004	0.175	0.026	0.031	1.556	0.952	0.230	-0.017	0.008	0.024	0.038	.	0.655
2005	0.166	0.027	-0.006	1.970	0.886	0.217	-0.011	0.008	0.007	0.033	.	0.649
2006	0.168	0.028	0.163	2.207	0.873	0.204	0.010	0.009	-0.001	0.027	5.04	0.636
2007	0.171	0.028	0.064	2.960	0.856	0.208	0.024	0.009	0.001	0.018	5.05	0.640
2008	0.186	0.046	-0.338	3.210	0.638	0.301	0.004	0.018	0.019	-0.003	4.79	0.728
2009	0.175	0.032	0.188	2.379	0.663	0.312	0.006	0.020	0.028	-0.028	3.66	0.860
2010	0.169	0.048	0.110	2.407	0.718	0.316	-0.014	0.011	0.029	0.025	3.39	0.947
2011	0.174	0.063	0.055	2.645	0.674	0.353	-0.029	0.010	0.026	0.016	3.65	0.990
2012	0.190	0.055	0.073	2.002	0.765	0.363	-0.018	0.013	0.016	0.022	3.76	1.025
2013	0.195	0.044	0.265	1.992	0.792	0.297	-0.012	0.009	0.022	0.017	3.86	1.046
2014	0.210	0.039	0.075	2.241	0.841	0.294	-0.014	0.007	0.024	0.026	3.93	1.046
2015	0.239	0.041	-0.022	2.295	0.929	0.295	0.001	0.011	0.018	0.029	3.93	1.052

This table presents the time series of median leverage ratio, and the time series of macroeconomic characteristics. The sample period is from 1988 to 2015. The data of firm characteristics are collected from CRSP/Compustat merged database. The sample includes all the unregulated firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream. The definitions of firm characteristics variables and macroeconomic characteristics variables are summarized in Appendix 1 and Appendix 2, respectively.

Figure 5.1.1 Leverage and ERP



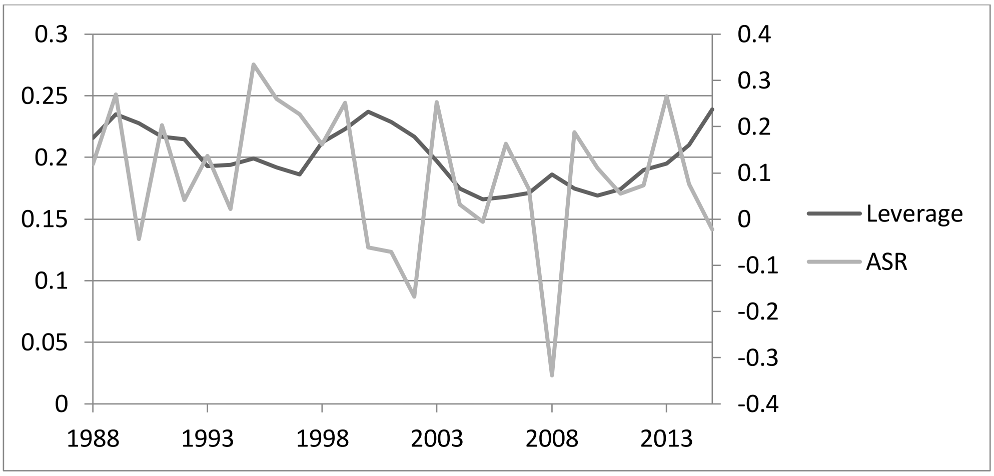
This chapter follows Huang and Ritter (2009) who use the *Equity Risk Premium* (*ERP*) to measure the cost of equity financing. A higher value of *ERP* shows that investors expect a higher return by holding stocks, which indicates a higher cost of equity financing for firms. Hence, firms should have a lower demand for equity capital, for the interest of existing shareholders. At the same time, a higher *ERP* also attracts investors, which reduces the cost of equity financing. The supply-side effect lead to a higher demand for equity capital. Figure 5.1.1 shows that *ERP* and *leverage ratio* follow similar patterns from 1988 to 2011. Although *ERP* has a decline from 0.063 at 2011 to 0.039 at 2014, it stops decreasing and recovers in 2015. The plot seems to show a positive relationship between *ERP* and *leverage*, which may favour the demand-side explanation.[44]

Aggregate Stock Return (*ASR*) is another measure of the cost of equity financing, which exhibits cyclical movement. *ASR* is calculated by using annual increases in the Dow Jones Industry Index scaled by the value

[44] The value of ERP calculated by Absolute Strategy Research has the same trend with that reported on Aswath Damodaran's Website (http://pages.stern.nyu.edu/~adamodar/), although the mean value of the former is around 4% lower than the latter.

of the index in the previous year. A high value of *ASR* is usually followed by an optimistic expectation of investors. As a result, the supply of capital to

Figure 5.1.2 Leverage and ASR



the equity market will increase. Lamont and Stein (2006) find that firm equity issuance is sensitive to the aggregate return of stock market and that it is even more sensitive than to firm-specific stock prices. Figure 5.1.2 seems to show a negative relationship between *leverage ratio* and *ASR* if any; because firm *leverage ratio* peaks at 1990, 2001, 2008, and 2015, whereas *ASR* drops to the bottom at these years. Hence, a negative relationship between the *leverage ratio* and *ASR* is expected; firms are more willing to use equity financing when *ASR* is high.

Stock market value To GDP (*STG*) is a measure of financial development in Antzoulatos et al. (2016). It is measured by the size of equity market to GDP. Using a first difference approach, Antzoulatos et al. find that a high stock market capitalization is associated with a high leverage ratio. The plot in Figure 5.1.3 suggests a positive relationship between *STG* and firm *leverage ratio*. Both *leverage* and *STG* are at a short-term peak at 2000 and 2008. This evidence seems to favour the prediction that a high market capitalization reduces the agency cost and attracts more investors to purchase corporate bonds. The positive relationship between *STG* and firms' reliance on debt capital will be tested.

Figure 5.1.3 Leverage and STG

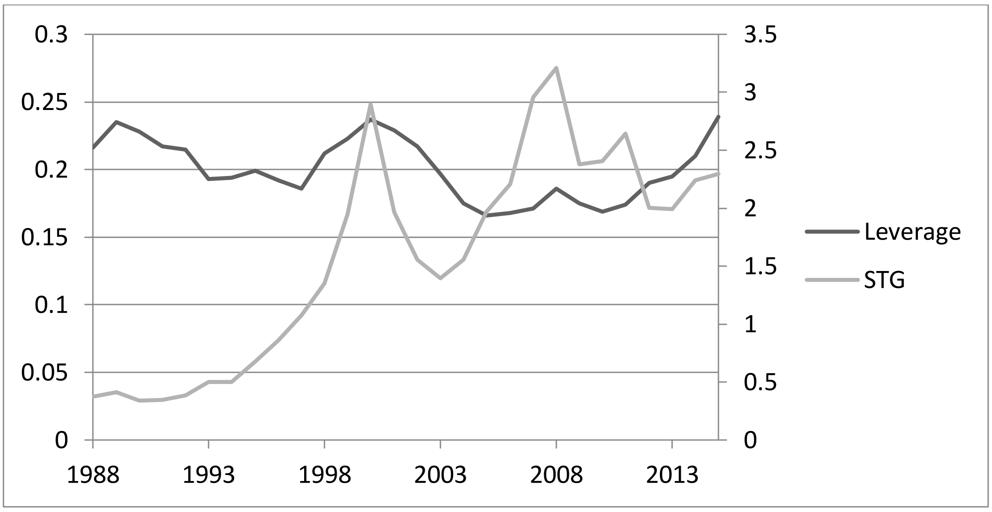
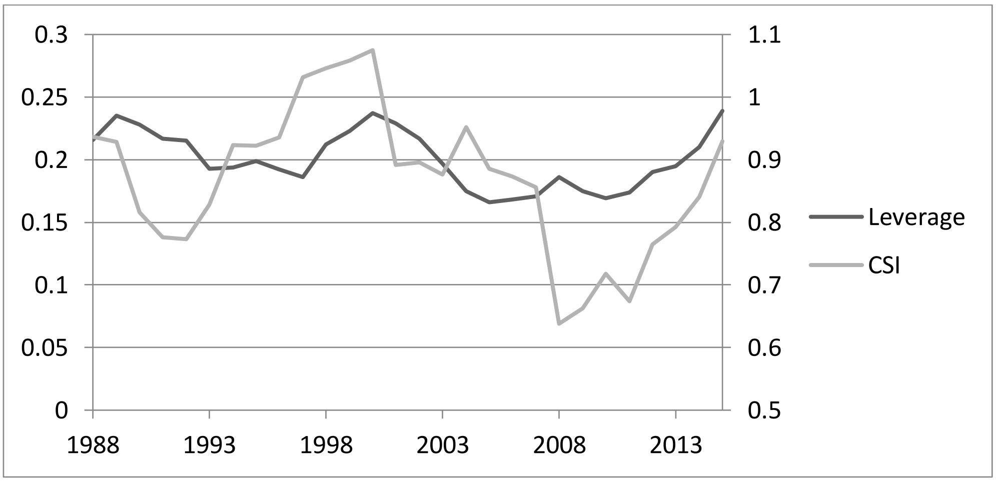


Figure 5.1.4 Leverage and CSI

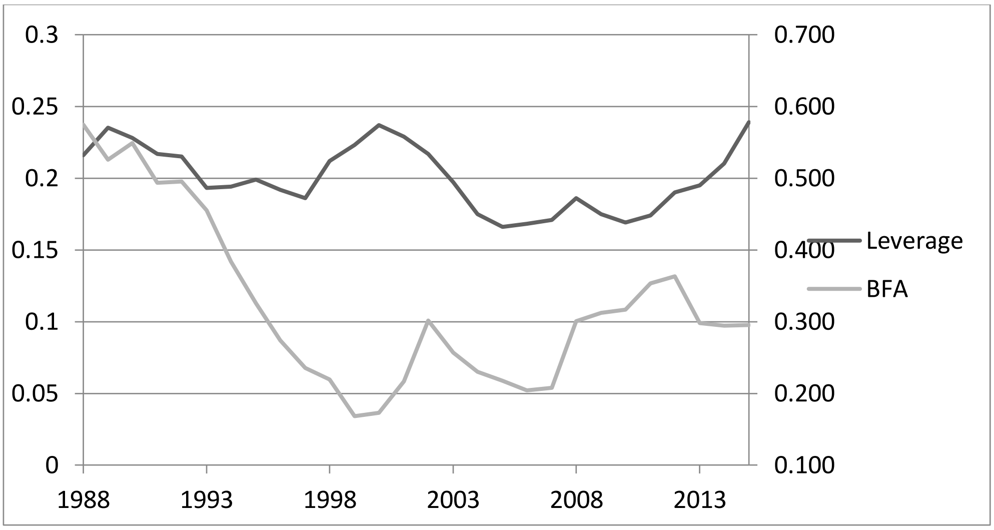


Mclean and Zhao (2014) and Baker (2009) suggest that investor sentiment influences the capital supply. Particularly, low sentiment raises the difficulty for firms to obtain capital externally. This chapter uses the *University of Michigan's Consumer Sentiment Index* (*CSI*) as the measure of investor sentiment.[45] Figure 5.1.4 plots the trend of *CSI* and *leverage*. It

[45] I also follows Mclean and Zhao (2014) and regress the consumer sentiment indexes on a list of business cycle variables (such as GDP growth rate, Inflation, industrial production

seems that leverage ratio and investor sentiment are positively related. For example, both *CSI* and *leverage* show a decline trend from 1988 to 1992 and from 2000 to 2007, while both *CSI* and *leverage ratio* climb from 1993 to 2000 and from 2009 to 2015. So, it is expected that firms use a high leverage ratio when investor sentiment is high.

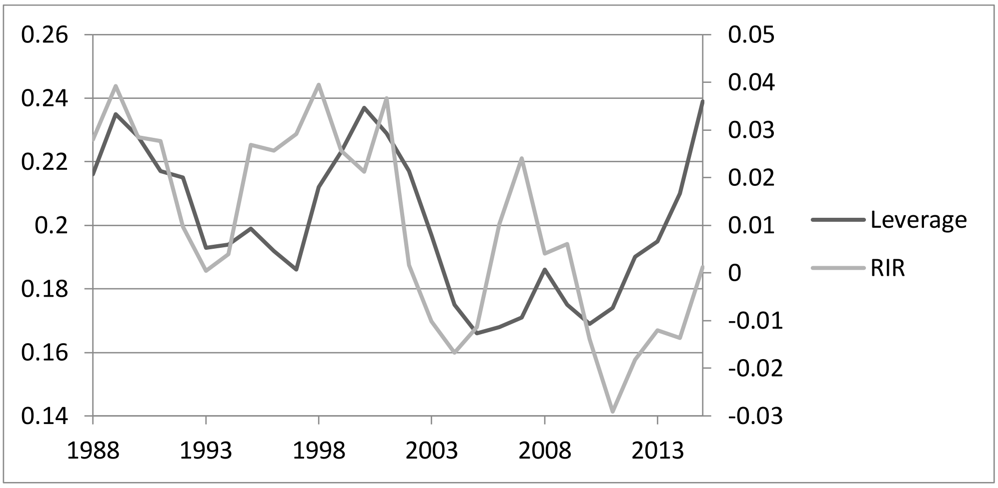
Figure 5.15 Leverage and BFA



Frazzini and Lamont (2008) and Ben-Rephael et al. (2012) find that cash flows of mutual funds show investor sentiment. Therefore, this chapter uses the net assets of all bond and income (mutual) funds, scaled by the sum of the net assets of all bond and income funds plus the net assets of all equity funds, to measure investor sentiment. A higher value of *BFA* indicates that investors prefer bond rather than equity capital, while a lower value of *BFA* indicates that investors prefer equity rather than bond. Similar to Figure 5.1.4, Figure 5.1.5 also suggests a positive relationship between investor sentiment and firm capital structure.

growth and NBER recessions), and use the residual as the measures of the investor sentiment. The results are qualitatively the same.

Figure 5.2.1 Leverage and RIR

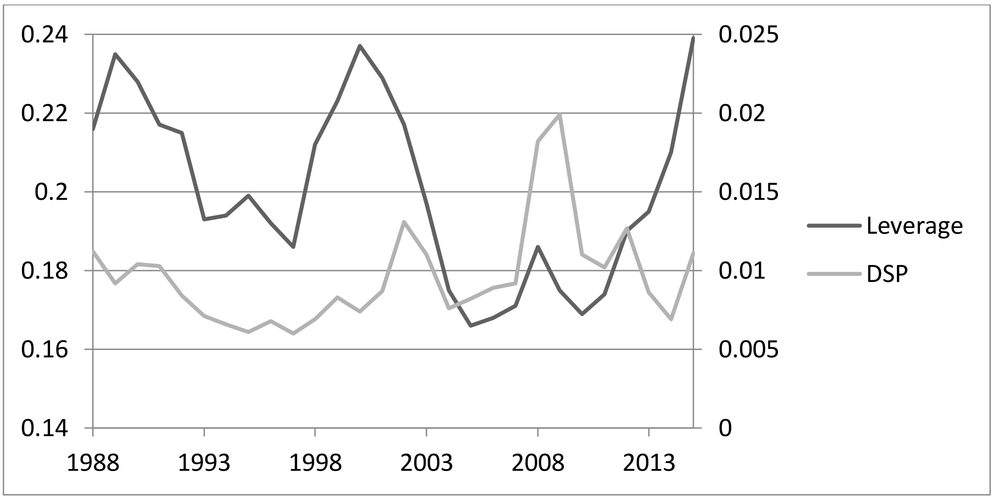


Huang and Ritter (2009) use the *Real Interest Rate* (*RIR*) to measure the cost of debt financing. Following Huang and Ritter, this chapter calculates *RIR* as the difference between nominal interest rate (the Federal funds target rate) and the inflation rate (the CPI). A higher value of *RIR* suggests a higher cost of debt financing for firms. Figure 5.2.1 displays the associated movements in *leverage* and *RIR*. Both *leverage* and *RIR* experienced a sharp decrease after the recession in early 1990s, the dot-com bubble in 2000, and the sub-prime mortgage crisis in 2008. The data seem to favour the explanation that investors have a high demand for corporate bond when the interest rate is high, and vice versa. Therefore, a positive relationship between *RIR* and *leverage* is expected.

Huang and Ritter (2009) use *Default Spread* (*DSP*) as one measure of the cost of debt financing. *DSP* is calculated as the difference between the yield of Baa-rated bonds and the yield of Aaa-rated bonds. A higher value of *DSP* indicates a higher default risk, and investors require a higher pay-off to buy corporate bonds. In Figure 5.2.2, *leverage* and *DSP* follow a similar long run trend, although departures in the short-run can be noticed.

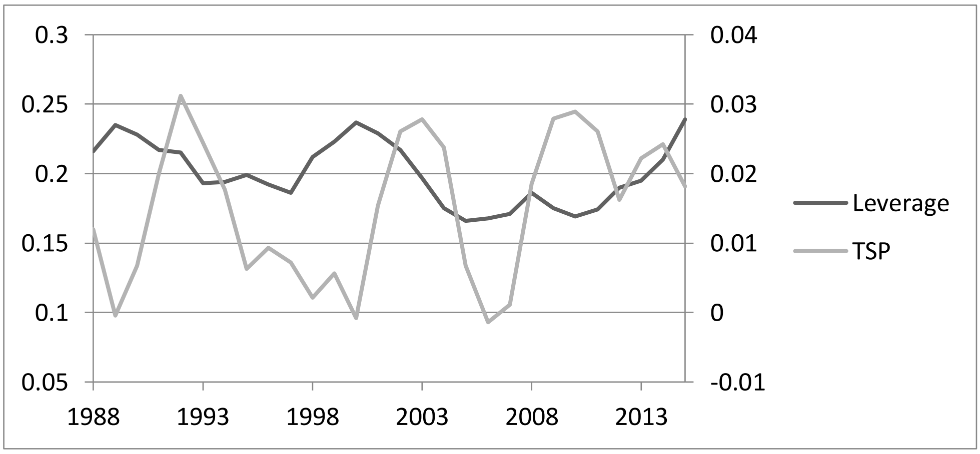
For example, *DSP* increases in 1989, 1995, 2001, and 2014, while *leverage* decreases in these years. The relationship between DSP and Leverage needs to be examined.

Figure 5.2.2 Leverage and DSP



Huang and Ritter (2009) use *Term Spread* (*TSP*) as another measure of the cost of debt financing. Following Huang and Ritter, this chapter calculates *TSP* as the difference between the yield of 10-year constant maturity treasure and one-year constant maturity treasure. A higher value of

Figure 5.2.3 Leverage and TSP



TSP suggests a higher cost of debt financing, as it shows that investors have a pessimistic expectation towards future earnings. Figure 5.2.3 shows that *leverage* and *TSP* move in opposite directions in many cases. For example, from 1988 to 1989, *TSP* reduces from 0.012 to 0, while *leverage* increases from 0.216 to 0.235. Similar situations happen during the dot-com bubble, and before the sub-prime mortgage crisis. Therefore, a negative relationship between *TSP* and firm *leverage* is expected.

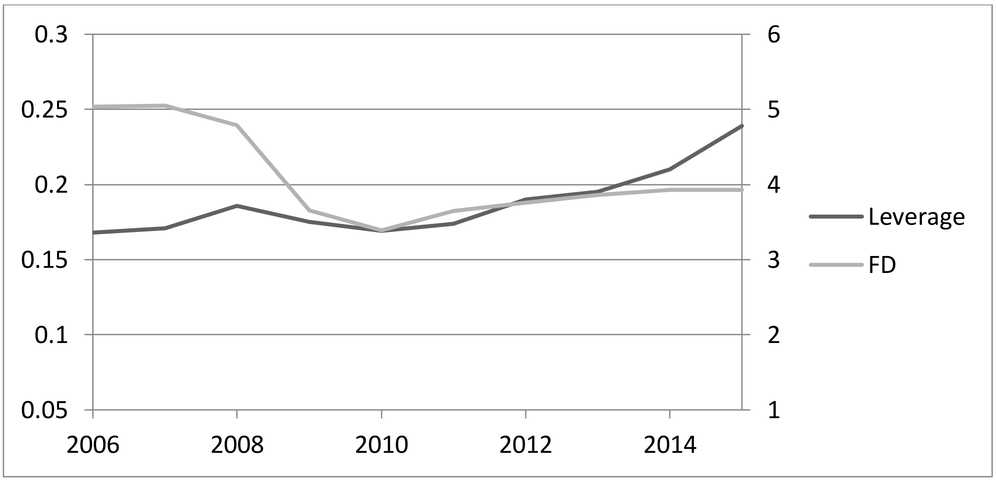
Figure 5.2.4 Leverage and RGDP

Huang and Ritter (2009) use the *Real Gross Domestic Product growth rate* (*RGDP*) to capture growth opportunities. *RGDP* is calculated as the increase in GDP at year *t* scaled by the value of GDP at year *t-1*. A higher value of *RGDP* indicates economic expansions and more growth opportunities, in which investors are willing to invest. On the contrary, a lower value of *RGDP* indicates less growth opportunities or economic recessions, in which investors are reluctant to invest. The plot does not show a clear relationship between *RGDP* and *leverage ratio*. For example, Figure 5.2.4 suggests a negative relationship between 1990 and 1998, but a positive relationship after 2010. The relationship between *RGDP* and firm capital structure needs to be empirically examined.

This chapter uses the World Bank financial development index score, measuring the accessibility to capital to capture the impact of

Financial Development (*FD*). Figure 5.2.5 shows that firm leverage ratio and financial development follow the same trend. Both *FD* and *leverage* faces a decrease from 2008 to 2010 and an increase from 2010 to 2015. Therefore, a positive relationship between firm leverage ratio and the level of financial development is expected, indicating that financial development reduces the cost to monitor firms and increases the purchase of corporate bonds.

Figure 5.2.5 Leverage and FD



Government Borrowings to GDP (*GBG*) captures the amount of capital absorbed by government bond scaled by the GDP. Figure 5.2.6 shows a negative relationship between *GBG* and *leverage* before 2005. Firm leverage ratio reaches the peak at 1989 and 2001, when government borrowings are fairly low. Similarly, *leverage* is at the bottom at 1993 and 2004, while the values of *GBG* are high. However, after 2006, both *GBG* and *leverage* are on a long-run increase; and this period has not been considered in previous studies. In sum, the relationship between the *GBG* and *leverage* needs to be empirically examined.

Figure 5.2.6 Leverage and GBG

5.3 Supply-side Effects on Firm Financing Choices

Shyam-Sunder and Myers (1999) test the *pecking order theory* by regressing firm debt issuance on the variable capturing financing deficit. Shyam-Sunder and Myers find that the estimated financing deficit coefficient is close to one, which indicates that debt is the primary source of external financing. Huang and Ritter (2009) extend this method by using market condition proxies (such as the firm-specific *ERP*) to interact with the financing deficit coefficient. Huang and Ritter find that market conditions influence firms' financing decisions. This section follows and extends Huang and Ritter's approach to examine the impact of supply-side effects on firm financing decisions. Specifically, this section analyses the interactions between the variables capturing supply-side factors and the financing deficit, as shown in model (5.1) below:

$$Debt\ issuance\ ratio_{i,t} = \alpha_0 + \beta_0 * Deficit_{i,t} + \beta_1 * Deficit_{i,t} * Z_t + u_i + \varepsilon_{i,t}, \quad (5.1)$$

where the dependent variable is *Debt issuance ratio* of firm *i* at year *t*. α_0 is a constant, u_i stands for unobservable firm-fixed effects. $\varepsilon_{i,t}$ is an error term clustered by firms. $Deficit_{i,t}$ denotes *financing deficit* of firm *i* at year *t*. Z_t denotes the variables capturing supply-side effects. Fixed Effects method (FE) is used to remove the unobservable heterogeneity at firm level. The regression results are reported in Table 5.3.

Table 5.3 suggests that the supply-side factors related to the cost of equity financing and firm financing choices are related. Column (1) reports the regression results of traditional pecking order model. The reported coefficient (0.361) is substantially lower than that in Shyam-Sunder and Myers (1999) but close to Frank and Goyal (2003). Column (2) to column (8) test whether supply-side factors influence firm financing choices. Column (2) reports a negative sign of $Deficit_{i,t}*ERP_t$. This favours the supply-side explanation that a higher *ERP* attracts stock investors and reduces the cost of equity financing; and hence, firms tend to choose equity financing. Column (5) and column (6) show that the coefficients of $Deficit_{i,t}*CSI_t$ and $Deficit_{i,t}*BFA_t$ are both positive and statistically significant. Moreover, the coefficients of $Deficit_{i,t}*CSI_t$ and $Deficit_{i,t}*BFA_t$ remain significant in column (7) when the supply-side factors related to the cost of equity financing are pooled. These results are in line with the assertion in Baker (2009) and Mclean and Zhao (2014) that investor sentiment influences firms' financing choices. In low sentiment periods, it is more costly for firms to raise external capital. Firms employ a defensive strategy and use a low leverage ratio. On the contrary, in high sentiment periods, firms use an aggressive financing strategy and use a high leverage ratio. Column (8) removes $Deficit_{i,t}*CSI_t$ because both *CSI* and *BFA* are proxies for investor sentiment. The results show that $Deficit_{i,t}*ERP_t$ turns significant (-2.01, t=-2.61) in this specification. Among the supply-side factors related to the cost of equity financing, it seems investor sentiment is the most robust when firms make financing choices.

Table 5.4 presents the results when the supply-side factors related to the cost of debt financing are used to interact with the pecking order coefficient. The results show that firms are more likely to use equity capital when the cost of debt financing is high. Column (2) reports a positive coefficient of $Deficit_{i,t} * RIR_t$ (1.37, t=4.44), which suggests that firms use a large proportion of debt financing when *real interest rate* is high. This favours the supply-side explanation that investors have a higher demand for corporate bonds when the interest rate is high. Column (4) of Table 5.4 shows that firms are more likely to use equity financing when the value of *TSP* is high. Every one percent of increase in *TSP* is associated with 1.4% of decrease in the proportion of net debt issuance to the total external financing. *GDP growth rate* is another important determinant of firms' financing choices. Column (5) reports a positive sign of $Deficit_{i,t} * RGDP_t$ (1.07, t=2.98). According to column (5), firms are more likely to use debt financing to cover the financing deficit during economic expansions. This result is consistent with Covas and Den Haan (2011) who state that firm debt issuance is pro-cyclical, and the evidence indicates that debt issuance is more sensitive to economic conditions than equity issuance. The results suggest that firms consider the cost of debt financing when making financing decisions.

Table 5.3 The Cost of Equity Financing and Firm Financing Choices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation Methods				FE, Clustered				
Deficit i,t	0.361***	0.392***	0.358***	0.388***	0.211***	0.327***	-0.065	0.335***
	(28.77)	(18.65)	(28.58)	(24.23)	(4.60)	(13.57)	(-0.54)	(7.43)
Deficit i,t * ERP t		-1.038*					0.533	-2.010***
		(-1.96)					(0.49)	(-2.61)
Deficit i,t * ASR t			0.032				0.001	0.008
			(0.72)				(0.02)	(0.16)
Deficit i,t * STG t				-0.017**			0.015	0.010
				(-2.35)			(1.07)	(0.74)
Deficit i,t * CSI t					0.169***		0.338***	
					(3.28)		(3.64)	
Deficit i,t * BFA t						0.106*	0.276***	0.218**
						(1.87)	(2.62)	(2.07)
Constant	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***
	(-14.72)	(-14.77)	(-14.59)	(-12.94)	(-14.82)	(-14.94)	(-14.98)	(-14.89)
Variance due to FE	11.86%	11.80%	11.86%	11.76%	11.78%	11.82%	11.71%	11.73%
R2	33.73%	33.82%	33.74%	33.88%	33.92%	33.82%	34.16%	33.98%
Observation	20,205	20,205	20,205	20,205	20,205	20,205	20,205	20,205

This table presents the results of model (5.1). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Debt\ issuance\ ratio_{i,t} = \alpha_0 + \beta_0 * Deficit_{i,t} + \beta_{1*} Deficit_{i,t} * Z_t + u_i + \varepsilon_{i,t}, \qquad (5.1)$$

The dependent variable is *debt issuance ratio* of firm *i* at year *t,* and *financing deficit* is used as one of the independent variables. Z_t denotes proxies for macroeconomic characteristics. From column (2) to column (8), this table includes interactions between *financing deficit* and the variables capturing supply-side factors related to the cost of equity financing. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses FE to estimate model (5.1). Standard errors are clustered by firms. Coefficients and t-values are reported. Variance due to fixed effects, R^2 and the number of observations are reported. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.4 The Cost of Debt Financing and Firm Financing Choices

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation Methods					FE, Clustered				
Deficit i,t	0.361***	0.344***	0.376***	0.380***	0.331***	0.409***	0.403***	-0.298	0.131*
	(28.77)	(26.71)	(15.80)	(24.40)	(22.30)	(5.32)	(13.26)	(-0.91)	(1.90)
Deficit i,t * RIR t		1.374***						0.458	2.144***
		(4.44)						(0.38)	(4.07)
Deficit i,t * DSP t			-1.627					2.000	6.422**
			(-0.84)					(0.42)	(2.28)
Deficit i,t * TSP t				-1.403**				2.428	0.948
				(-2.39)				(0.88)	(1.09)
Deficit i,t * RGDP t					1.070***			0.029	1.952***
					(2.98)			(0.02)	(3.38)
Deficit i,t * FD t						-0.016		0.082*	
						(-0.86)		(1.65)	
Deficit i,t * GBG t							-0.060	0.269*	0.109**
							(-1.51)	(1.77)	(1.99)
Constant	-0.009***	-0.009***	-0.009***	-0.009***	-0.009***	-0.002***	-0.009***	-0.002***	-0.009***
	(-14.72)	(-14.89)	(-14.52)	(-14.74)	(-14.77)	(-4.23)	(-14.80)	(-3.61)	(-14.66)
Variance due to FE	11.86%	11.69%	11.83%	11.83%	11.77%	19.54%	11.80%	19.59%	11.64%
R2	33.73%	34.11%	33.75%	33.83%	33.89%	29.75%	33.80%	29.97%	34.32%
Observation	20,205	20,205	20,205	20,205	20,205	7,288	20,205	7,288	20,205

This table presents the results of model (5.1). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$\textit{Debt issuance ratio}_{i,t} = \alpha_0 + \beta_0 * \textit{Deficit}_{i,t} + \beta_{1*}\textit{Deficit}_{i,t} * Z_t + u_i + \varepsilon_{i,t}, \qquad (5.1)$$

The dependent variable is *debt issuance ratio* of firm *i* at year *t*, and *financing deficit* is used as one of the independent variables. Z_t denotes proxies for macroeconomic characteristics. From column (2) to column (9), this table includes interactions between *financing deficit* and the variables capturing the supply-side factors related to the cost of debt financing. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses FE to estimate model (5.1). Standard errors are clustered by firms. Coefficients and t-values are reported. Variance due to fixed effects, R^2 and the number of observations are reported. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.5 The Cost of Financing Sources and Firm Financing Choices - Robustness Check

	(1)	(2)	(3)	(4)
Estimation Methods	FE, Cluster			
Deficit i,t	-0.168	-0.174	-0.051	0.258***
	(-1.08)	(-0.85)	(-0.26)	(4.75)
Deficit I,t * ERP t	2.872**	0.097	2.318*	-2.190*
	(2.14)	(0.07)	(1.81)	(-1.82)
Deficit i,t * ASR t	-0.006	0.095*	0.050	0.088*
	(-0.12)	(1.93)	(1.03)	(1.81)
Deficit i,t * STG t	0.002	0.050**	0.002	0.048**
	(0.12)	(2.56)	(0.21)	(2.48)
Deficit i,t * CSI t	0.397***	0.351**	0.328**	
	(3.41)	(2.18)	(2.05)	
Deficit i,t * BFA t	0.104	0.373**		0.351**
	(0.84)	(2.56)		(2.42)
Deficit i,t * RIR t	1.572***	0.757	1.076*	0.632
	(2.60)	(1.18)	(1.72)	(0.97)
Deficit i,t * DSP t	2.667	-1.496	1.589	-5.044
	(0.93)	(-0.40)	(0.44)	(-1.58)
Deficit i,t * TSP t	0.832	1.359	0.902	0.568
	(0.75)	(1.41)	(0.92)	(0.60)
Constant	-0.009***	-0.009***	-0.009***	-0.009***
	(-14.79)	(-14.08)	(-14.22)	(-14.11)
Lagged independent variables	No	Yes	Yes	Yes
Variance due to FE	11.66%	11.72%	11.80%	11.65%
R2	34.34%	33.36%	33.19%	33.29%
Observation	20,205	19,495	19,495	19,495

This table presents the results of model (5.1). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$\textit{Debt issuance ratio } i,t = \alpha_0 + \beta_0 * \textit{Deficit}_{i,t} + \beta_{1*} \textit{Deficit}_{i,t} * Z_t + u_i + \varepsilon_{i,t}, \quad (5.1)$$

The dependent variable is *debt issuance ratio* of firm *i* at year *t*, and *financing deficit* is used as one of the independent variables. Z_t denotes proxies for macroeconomic characteristics. *Deficit* $_{i,t-1}$*Z_t captures the interactions between *financing deficit* and the variables capturing the supply-side factors related to costs of equity financing and debt financing. This table uses a selected list of variables, rather than the full list, to reduce multicollinearity. All variables are defined and explained in Appendix 1 and Appendix 2. In column (2) to column (4), this table uses Z_{t-1} rather than Z_t for comparison. This table use FE to estimate model (5.1). Standard errors are clustered by firms. Coefficients and t-values are reported. Variance due to fixed effects, R^2 and the number of observations are reported. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

To examine the robustness of the results, two tests are performed.

The first test pools the proxies capturing the cost of equity financing and the proxies capturing the cost of debt financing. A selected list of variables is used, rather than the full list, to reduce the multicollinearity.[46] Column (1) of Table 5.5 reports the results. Among the employed variables, *CSI* is robust to controlling the cost of debt financing, and *RIR* is robust to controlling the cost of equity financing. The coefficient of $Deficit_{i,t}*ERP_t$ is positive (2.872, t=2.14), compared to the negative sign without controlling other supply-side factors (column 2 of Table 5.3). One explanation is that controlling other supply-side effects (especially *CSI*) makes the demand-side effects of *ERP* more pronounced. In the second test (column 2), all of the employed variables for the costs of financing sources are lagged by one period to reduce the endogeneity (simultaneity) concern, following Leary (2009). The coefficient of $Deficit_{i,t}*STG_{t-1}$ is positive (0.05, t=2.56), indicating that a highly-developed stock market reduces the agency cost to monitor and results in more reliance on debt financing. The coefficients of $Deficit_{i,t}*CSI_{t-1}$ and $Deficit_{i,t}*BFA_{t-1}$ are also statistically significant. In column (3) and column (4), the results of two additional tests with lagged proxies for the supply-side factors are reported. The difference is that the new tests remove $Deficit_{i,t}*BFA_{t-1}$ or $Deficit_{i,t}*CSI_{t-1}$ from the test in column (2), because both *BFA* and *CSI* are proxies for investor sentiment. In column (3), the coefficients of $Deficit_{i,t}*ERP_{t-1}$, $Deficit_{i,t}*CSI_{t-1}$ and $Deficit_{i,t}*RIR_{t-1}$ are positive and statistically significant. In column (4), the coefficient of $Deficit_{i,t}*BFA_{t-1}$ is positive and statistically significant (0.351, t= 2.42). The Coefficient of $Deficit_{i,t}*ERP_{t-1}$ turns negative (-2.19, t=-1.82), once *BFA* is used, rather than *CSI*, to control investor sentiment. The coefficient of

[46] In column (8) of Table 5.4 when the variables related to the cost of debt financing are pooled, the variables lose explanatory power due to multicollinearity. This motivates to use a selected list of variable rather than the full list of variables.

$Deficit_{i,t}*DSP_{t-1}$ is negative (-4.78, t=-1.52), although not statistically significant at 10% level.

Table 5.6 Supply-side Effects on Firm Financing Choices - Large Firms and Small Firms

	(1)	(2)
Firm Size	Large	Small
Estimation Methods	FE, Cluster	
Deficit i,t	0.351***	0.197***
	(4.58)	(2.76)
Deficit I,t * ERP t	-2.567*	-2.847
	(-1.85)	(-1.60)
Deficit i,t * ASR t	0.004	0.108*
	(0.06)	(1.70)
Deficit i,t * STG t	0.022	0.059**
	(0.87)	(2.20)
Deficit i,t * BFA t	0.350*	0.473**
	(1.88)	(2.37)
Deficit i,t * RIR t	-0.565	1.510
	(-0.72)	(1.62)
Deficit i,t * DSP t	0.607	-8.823***
	(0.16)	(-2.03)
Deficit i,t * TSP t	-0.556	1.415
	(-0.43)	(1.13)
Constant	-0.001***	-0.017***
	(-2.80)	(-16.82)
Lagged independent variables	Yes	Yes
Variance due to FE	11.29%	13.41%
R2	47.05%	27.63%
Observation	10,182	9,313

This table presents the results of model (5.1). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Debt\ issuance\ ratio\ i,t = \alpha_0 + \beta_0 {*} Deficit_{i,t} + \beta_1 {*} Deficit_{i,t} {*} Z_t + u_i + \varepsilon_{i,t}, \quad (5.1)$$

The dependent variable is *debt issuance ratio* of firm *i* at year *t*, and *financing deficit* is used as one of the independent variables. Z_t denotes proxies for macroeconomic characteristics. $Deficit_{\ i,t-1}*Z_t$ captures the interactions between *financing deficit* and the variables capturing the supply-side factors related to costs of equity financing and debt financing. This table uses a selected list of variables, rather than the full list, to reduce multicollinearity. All variables are defined and explained in Appendix 1 and Appendix 2. Similar to column (2) to column (4) in Table 5.5, this table use Z_{t-1} rather than Z_t to reduce the endogeneity concern. FE is used to estimate model (5.1). Standard errors are clustered by firms. Coefficients and t-values are reported. Variance due to fixed effects, R^2 and the number of observations are reported. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.6 shows the results when large firms and small firms are investigated separately. The results show that supply-side factors have a larger impact on the financing choice of small firms than on that of large firms. All of the coefficients (i.e., $Deficit_{i,t}*ERP_t$, $Deficit_{i,t}*ASR_t$, $Deficit_{i,t}*STG_t$, $Deficit_{i,t}*BFA_t$, $Deficit_{i,t}*RIR_t$, $Deficit_{i,t}*DSP_t$, and $Deficit_{i,t}*TSP_t$) are larger in the group of small firms (column 2). This suggests that small firms, with relatively higher costs to raise external funds, consider supply-side factors more seriously when making financing decisions. This may reflect the impact of financial constraint, as Covas and Den Haan (2011) find that the pro-cyclicality of financing decisions is stronger in the group of small firms due to the financial constraint.

5.4 Supply-side Effects on Firm Capital Structure

This section examines whether the supply-side factors related to the cost of financing sources determine firm capital structure. This issue is examined by testing whether the proxies for supply-side factors help explain firm leverage ratio, after controlling for the demand-side effects. Specifically, the variables capturing supply-side effects are included into the widely-used dynamic leverage model (such as in Flannery and Rangan, 2006; Antoniou et al., 2008; and Chang et al., 2014). Following the literature, such as Faulkender and Petersen (2006), Baker (2009), and Leary (2009), this chapter uses firm-level characteristics to control demand-side effects and uses macroeconomic characteristics to control the supply-side effects:

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * X_{i,t-1} + \beta_2 * Z_t + u_i + \varepsilon_{i,t}, \qquad (5.2)$$

where the dependent variable is *leverage ratio* of firm *i* at year *t*. One-year lagged leverage ratio is used as one of the independent variables to control the dynamic effects. α_0 is a constant, u_i stands for unobservable firm fixed effects, and $\varepsilon_{i,t}$ is the error term. $X_{i,t-1}$ is the traditional set of leverage determinants, motivated by Rajan and Zingales (1995) and Leary and Roberts (2010). Specifically, *X* includes *Tangibility*, *Market to Book ratio*, *firm size* and *ROA*. The robustness check section includes two additional variables, namely *effective tax rate* and *non-debt tax shield*. $Z_{i,t}$ denotes the variables capturing the supply-side effects. To examine these effects, this section tests whether β_2 is different from zero.

Model (5.2) is a dynamic panel data model, and the speed of adjustment is calculated by $1-\beta_0$. Since the partial adjustment framework requires the adjustment speed falling into (0, 1), β_0 also falls into (0, 1). The value of β_0 close to zero indicates a high adjustment speed, whereas the value of β_0 close to one indicates low adjustment speed. System GMM (SYS-GMM) is suggested as the most robust method so far to estimate the dynamic leverage model, due to the advantage in dealing with the endogeneity issue (Blundell and Bond, 1998; Antoniou et al., 2008; Wintoki et al., 2012)[47]. Therefore, this chapter uses SYS-GMM to estimate equation (2). GMM estimation generates strongly consistent estimates (Hansen,

[47] This chapter uses collapsed Instrumental Variables (IVs) to reduce the number of IVs, following the suggestion in Wintoki et al. (2012). Using this method generates an exogenous set of IVs, according to the results of AR(2) test. One shortcoming is that even using collapsed IVs does not completely eliminate the problem of IV prolification, according to the results of Hansen test. Therefore, this chapter uses OLS and FE to test the robustness of the results. Although this chapter has the limitation of potential IV prolification, the estimated SOA by SYS-GMM still falls in the interval between OLS and FE, indicating SYS-GMM is the most decent method (see the explanation in Chapter 4). Since this thesis focuses more on interpreting the empirical results than the econometric methods, please refer to Blundell and Bond (1998), Antoniou et al. (2008), and Wintoki et al. (2012) for a detailed discussion on SYS-GMM and IVs.

1982), which enables to compare the regression coefficients of subsamples directly.

The results in Table 5.7 suggest that the supply-side factors related to the cost of equity financing are important determinants of firm capital structure. Column (1) shows a positive relationship between *ERP* and *leverage* (0.132, z=2.77), indicating that firms tend to use debt financing when the expected return of equity is high. The results of this specification favours the demand-side explanation that firms use more debt for the interest of existing shareholders. Column (2) shows that *ASR* is negatively correlated with *leverage* (-0.013, z=-4.30). This indicates that sample firms use equity financing more often in stock market booms and use debt financing more often in stock market collapses. One of the explanations is that firms tend to take advantages of market timing opportunities and issue equity when the stock market return is high and when investors have a large demand for equity capital. Column (3) suggests that firms in a high stock market capitalization environment tend to possess a higher leverage ratio (0.04, z=3.65). Column (4) shows that the *University of Michigan Consumer Sentiment Index* is positively correlated with firm leverage ratio. BFA_t is also positively associated with *leverage* (0.016, z=2.52), according to column (5). These results are consistent with the prediction that firms use an aggressive leverage policy in high sentiment periods. Column (6) pools all of the supply-side proxies related to the cost of equity financing.[48] The

[48] *BFA* is included, because Ben-Rephael et al. (2012) find that measuring investor sentiment by mutual funds flows does not always generates the same results with those generated by using Consumer Sentiment Indexes to measure investor sentiment, although *CSI* and *BFA* generate qualitatively similar results in this chapter.

Table 5.7 The Cost of Equity Financing and Firm Capital Structure

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods			SYS-GMM			
ERP t	0.132***					0.338***
	(2.77)					(3.94)
ASR t		-0.013***				-0.001
		(-4.30)				(-0.34)
STG t			0.004***			0.013***
			(3.65)			(9.00)
CSI t				0.027***		0.123***
				(5.76)		(14.94)
BFA t					0.016**	0.127***
					(2.52)	(8.96)
Leverage i,t-1	0.821***	0.814***	0.824***	0.813***	0.816***	0.806***
	(86.77)	(86.16)	(87.19)	(85.71)	(86.60)	(79.03)
Tangibility i,t-1	0.053***	0.054***	0.055***	0.044**	0.052***	0.089***
	(2.94)	(3.01)	(3.02)	(2.43)	(2.91)	(4.84)
Market-to-Book i,t-1	0.003***	0.002*	0.002*	0.001	0.003***	0.001
	(2.98)	(1.94)	(1.79)	(1.08)	(3.12)	(0.75)
Ln_assets i,t-1	0.006***	0.007***	0.004**	0.008***	0.008***	0.009***
	(4.07)	(4.68)	(2.27)	(5.71)	(5.58)	(4.63)
ROA i,t-1	-0.002	-0.003	-0.002	-0.002	-0.003	0.002
	(-0.29)	(-0.36)	(-0.26)	(-0.30)	(-0.43)	(0.23)
Constant	-0.028**	-0.023*	-0.013	-0.055***	-0.042***	-0.225***
	(-2.03)	(-1.70)	(-0.96)	(-3.72)	(-2.86)	(-10.74)
Number of IVs	136	136	136	136	136	136
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.179	0.169	0.167	0.147	0.174	0.147
Hansen test p-value	0.000	0.000	0.000	0.000	0.000	0.653
Difference in Hansen test	0.476	0.508	0.711	0.403	0.175	0.417
Wald test p-value	0.000	0.000	0.000	0.000	0.000	0.000

Observation	19,127	19,127	19,127	19,127	19,127	19,127

This table presents the results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Lev_{i,t} = \alpha_0 + \beta_0 {*} Lev_{i,t-1} + \beta_1 {*} X_{i,\,t-1} + \beta_2 {*} Z_t + u_i + \varepsilon_{i,t}, \quad (5.2)$$

The dependent variable is the book leverage ratio of firm *i* at year *t*. One-year lagged leverage ratio is used as one of the independent variables. *X* denotes the firm characteristics variables capturing demand-side effects. *X* includes *Tangibility*, *Market to Book ratio*, *firm size* and *ROA*. *Z* denotes the macroeconomic variables capturing the cost of equity financing. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses SYS-GMM to estimate model (5.2). Coefficients and z-statistics are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

results show that the coefficients of *ERP*, *STG*, *CSI* and *BFA* remain statistically-significant. Overall, the results suggest that supply-side factors related to the cost of equity financing are important determinants of firm capital structure.

Table 5.8 presents the results by examining the impact of the supply-side factors related to the cost of debt financing on firm capital structure. The results show that firms increase leverage when the cost of debt financing is low and reduce leverage when the cost of debt financing is high. Column (1) shows that *real interest rate* is positively correlated with *leverage* (0.314, z=10.54), which can be explained by investors' demand for corporate bonds. Column (2) shows that DSP_t is negatively associated with *leverage*. For every one percent of increase in *DSP*, firms reduce the leverage ratio by 0.39 percent. Column (3) suggests that TSP_t is also negatively associated with *leverage*. For every one percent of increase in *TSP*, firms reduce *leverage ratio* by 0.51 percent. These results suggest that the supply-side factors related to the cost of debt financing are important determinants of firm capital structure. When investors forecast a high default risk and reduce the purchase of corporate bonds, firms tend to use equity financing as the substitution. This finally leads to a lower leverage ratio.

The results suggest that business cycle is an important determinant of firm capital structure. Column (4) of Table 5.8 shows that *RGDP* is positively correlated with *leverage* (0.173, z=5.88). This suggests that sample firms raise leverage during economic expansions and reduce leverage during economic recessions. Using continuous variables rather than

Table 5.8 The Cost of Debt Financing and Firm Capital Structure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimation Methods				SYS-GMM				
RIR t	0.314***						-0.015	0.394***
	(10.54)						(-0.19)	(8.69)
DSP t		-0.393***					2.052***	1.128***
		(-2.70)					(7.06)	(5.19)
TSP t			-0.513***				0.632***	-0.298***
			(-10.68)				(3.49)	(-4.06)
RGDP t				0.173***			0.543***	0.351***
				(5.88)			(6.50)	(7.54)
FD t					0.010***		0.035***	
					(6.69)		(10.28)	
GBG t						0.017***	0.077***	0.050***
						(4.41)	(6.85)	(11.28)
Leverage i,t-1	0.806***	0.818***	0.817***	0.817***	0.713***	0.823***	0.768***	0.815***
	(84.22)	(86.84)	(86.42)	(86.84)	(36.04)	(86.96)	(39.30)	(84.45)
Tangibility i,t-1	0.046**	0.046***	0.068***	0.045**	-0.063**	0.044**	-0.041*	0.043**
	(2.55)	(2.57)	(3.78)	(2.53)	(-2.44)	(2.41)	(-1.86)	(2.29)
Market-to-Book i,t-1	0.002*	0.002**	0.001	0.001	0.007***	0.003***	0.001	0.002
	(1.68)	(2.06)	(0.96)	(1.37)	(3.04)	(3.15)	(0.48)	(1.46)
Ln_assets i,t-1	0.012***	0.008***	0.011***	0.008***	0.057***	0.004**	0.031***	0.008***
	(8.02)	(5.28)	(7.07)	(5.71)	(14.05)	(2.44)	(6.62)	(4.63)
ROA i,t-1	-0.011	-0.002	-0.009	-0.002	-0.036***	-0.003	-0.019	-0.015**
	(-1.49)	(-0.35)	(-1.25)	(-0.25)	(-2.87)	(-0.40)	(-1.57)	(-2.12)
Constant	-0.060***	-0.026*	-0.045***	-0.036***	-0.390***	0.017***	-0.421***	0.084***
	(-4.23)	(-1.91)	(-3.24)	(-2.63)	(-12.26)	(4.41)	(-13.97)	(-5.75)
Number of IVs	136	136	136	136	136	136	136	136
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)	0.179	0.161	0.172	0.140	0.841	0.165	0.860	0.146

Hansen test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.134	0.000
Difference in Hansen test	0.139	0.422	0.556	0.480	0.000	0.462	0.022	0.504
Wald test p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observation	19,127	19,127	19,127	19,127	7,242	19,127	7,242	19,127

This table presents the results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * X_{i,\, t-1} + \beta_2 * Z_t + u_i + \varepsilon_{i,t}, \qquad (5.2)$$

The dependent variable is the book leverage ratio of firm *i* at year *t*. One-year lagged leverage ratio is used as one of the independent variables. *X* denotes the firm characteristics variables capturing demand-side effects. *X* includes *Tangibility*, *Market to Book ratio, firm size* and *ROA*. *Z* denotes the macroeconomic variables capturing the cost of debt financing. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses SYS-GMM to estimate model (5.2). Coefficients and z-statistics are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

a dummy variable, the results in this chapter enrich the literature (e.g., Mclean and Zhao, 2014) arguing firm capital structure is pro-cyclical. In another study, Covas and Den Haan (2011) find both debt issuance and equity issuance are pro-cyclical. Although the authors point out that business cycle influences firm debt decisions and equity decisions at the same time, there is not a clear answer to how the leverage ratio responds. The results in this chapter extend by showing that economic conditions and firm leverage ratio are positively correlated. Therefore, it appears that the business cycle influences debt issuances to a larger extant than equity issuances, which finally results in a pro-cyclical leverage ratio.[49]

Consistent with the literature (such as in Faulkender and Petersen, 2005; Baker, 2009; Leary, 2009; Lemmon and Roberts, 2010; Graham and Leary, 2011, and Antzoulatos et al., 2016), the results in this chapter show that capital supply is also an important determinant of firm capital structure. Specifically, the results show that financial development is positively associated with firm leverage ratio. According to column (5) of Table 5.8, one score of increase in *FD* is associated with one percent of increase in *leverage*. This is also in line with the evidence in column (7) of Table 5.7, in which *STG* is positively correlated with *leverage*. According to column (6) of Table 5.8, one score of increase in government borrowings is associated with 1.7% of increase in firm capital structure. Although the literature (such as Leary, 2009; Greenwood et al., 2010) states that government borrowings play a competing role to corporate borrowings, the results in Table 5.8 show

[49] Further (untabulated) evidence supports this explanation. In the untabulated descriptive statistics, the difference in *debt issuance ratio* between economic booms and economic recessions is larger than the difference in *equity issuance ratio*. This suggests debt issuance is more sensitive to economic conditions.

a positive relationship. One possible explanation is that investors' preference on bonds mitigates the impact of government borrowings on corporate bonds. As a result, government borrowings and corporate bonds move in the same direction. Another possible reason is that the period when *GBG* and *leverage* move in the same direction is after 2006, while this period is not considered in Leary (2009) and Greenwood et al. (2010).

Table 5.9 Supply-side Effects on Firm Capital Structure – Robustness Check

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ERP t		0.546***		0.307***		0.460***
		(4.70)		(2.60)		(4.59)
ASR t		-0.016***		-0.021***		-0.019***
		(-3.63)		(-4.87)		(-5.06)
STG t		0.003		0.002		0.001
		(1.59)		(0.81)		(0.45)
BFA t		0.007		0.036**		0.035**
		(0.46)		(2.39)		(2.38)
RIR t		0.326***		0.423***		0.417***
		(6.14)		(7.95)		(8.88)
DSP t		-1.226***		-1.421***		-1.294***
		(-4.89)		(-5.84)		(-6.36)
TSP t		-0.294***		-0.214**		-0.345***
		(-3.32)		(-2.47)		(-4.85)
Leverage i,t-1	0.875***	0.874***	0.756***	0.748***	0.818***	0.805***
	(130.93)	(127.60)	(78.02)	(74.49)	(87.20)	(78.40)
Tangibility i,t-1	0.013***	0.013***	0.016	0.008	0.049***	0.084***
	(4.16)	(4.12)	(1.58)	(0.81)	(2.73)	(4.46)
Market-to-Book i,t-1	0.000	-0.000	0.001	0.001	0.003**	0.002
	(0.23)	(-0.32)	(0.54)	(0.48)	(2.50)	(1.49)
Ln_assets i,t-1	0.003***	0.003***	0.004***	0.009***	0.007***	0.017***
	(9.90)	(9.63)	(4.88)	(6.86)	(5.00)	(8.15)
ROA i,t-1	-0.005	-0.010	-0.011	-0.025**	-0.003	-0.015**
	(-0.59)	(-1.31)	(-0.98)	(-2.20)	(-0.39)	(-2.07)
Constant	0.003	-0.006	0.018**	-0.165***	-0.028***	-0.112***
	(1.33)	(-1.14)	(2.04)	(-9.06)	(-2.02)	(-6.32)
Variance due to FE			12.97%	14.82%		
Number of IVs					136	136
AR(1)					0.000	0.000
AR(2)					0.167	0.166
Hansen test p-value					0.000	0.000
Difference in Hansen test					0.417	0.039
Wald test p-value					0.000	0.000
R2	78.58%	78.76%	78.50%	77.88%		
Observation	19,127	19,127	19,127	19,127	19,127	19,127

This table presents the results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015.

Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * X_{i,\, t-1} + \beta_2 * Z_t + u_i + \varepsilon_{i,t}, \qquad (5.2)$$

The dependent variable is the book leverage ratio of firm *i* at year *t*. One-year lagged leverage ratio is used as one of the independent variables. *X* denotes the firm characteristics variables capturing demand-side effects. *X* includes *Tangibility*, *Market to Book ratio*, *firm size* and *ROA*. *Z* denotes the macroeconomic variables capturing the cost of debt financing. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.9 checks the robustness of the results to alternative estimation methods. Besides SYS-GMM, Table 5.9 uses OLS and FE to estimate model (5.2). Although OLS and FE may have potential endogeneity problem (Wintoki et al., 2012), these two methods provide an interval for the estimated leverage adjustment speed. Graham and Leary (2011) find that OLS under-estimates the SOA while FE over-estimates the SOA. This generates an interval that the true SOA should fall in. This section also tests whether the proxies capturing supply-side effects are robust to these estimation methods. In OLS and FE estimations, standard errors are clustered by firms. A selected list of supply-side proxies is used, rather than the full list, to reduce the multicollinearity.[50] Column (1), column (3) and column (5) in Table 5.9 report the results without controlling supply-side effects, while column (2), column (4) and column (6) report the results after controlling the supply-side effects. According to the results in Table 5.9, the coefficients of *ERP*, *ASR*, *RIR*, *DSP* and *TSP* are

[50] Similar to column (8) of Table 5.4, pooling proxies related to the cost of debt financing in the leverage regression (column 7 of Table 5.8) also leads to multicollinearity problem. This motivates to use a selected list of variables rather than the full list.

robust and economically close under different estimation methods. The coefficient of *BFA* is not significant at 10% level using OLS (column 2), but turns out significant after controlling heterogeneity at firm level (column 4 and column 6).[51] Column (6) shows that *ERP*, *ASR*, *BFA*, *RIR*, *DSP* and *TSP* are significant determinants of firm capital structure. These results are consistent with the findings by examining these factors individually. Overall, the supply-side effects on firm capital structure are robust to alternative estimation methods, and robust to the pooling of factors related to the cost of equity financing and factors related to the cost of debt financing.

Table 5.10 presents the results when large firms and small firms are investigated separately. The results show that supply-side factors have a larger impact on the capital structure of small firms. Specifically, the coefficients of STG_t, BFA_t, DSP_t, and TSP_t are larger in the group of small firms (column 2) than in the group of large firms. The possible reason is that small firms are more like to be financially-constrained and more easily-influenced by the supply of capital. ERP_t, ASR_t, and RIR_t show the opposite. One possible explanation is that investors are more likely to choose large firms when they time the stock market. Compared to other factors, *ERP*, *ASR* and *RIR* are more related to the pricing of equity and debt capital, and hence, reflect the capital flow due to investors' market timing. Therefore, these factors have a larger impact on large firms than on small firms.

[51] Using *CSI* as the substitution to *BFA* generates similar results.

Table 5.10 Supply-side Effects on Firm Capital Structure - Large Firms and Small Firms

	(1)	(2)
Firm Size	Large	Small
Estimation Methods	SYS-GMM	
ERP t	0.567***	-0.236*
	(4.69)	(-1.77)
ASR t	-0.025***	-0.008
	(-5.73)	(-1.46)
STG t	-0.003	0.004*
	(-1.55)	(1.90)
BFA t	0.017	0.113***
	(0.87)	(5.73)
RIR t	0.479***	0.275***
	(8.49)	(4.02)
DSP t	-1.178***	-1.392***
	(-4.68)	(-5.10)
TSP t	-0.286***	-0.523***
	(-3.28)	(-5.29)
Leverage i,t-1	0.878***	0.768***
	(62.24)	(69.56)
Tangibility i,t-1	0.074***	0.088***
	(3.81)	(4.29)
Market-to-Book i,t-1	0.006***	-0.002
	(3.12)	(-1.37)
Ln_assets i,t-1	0.025***	0.011***
	(8.30)	(4.30)
ROA i,t-1	-0.001	-0.014**
	(-0.06)	(-2.11)
Constant	-0.212***	-0.058***
	(-7.61)	(-3.46)
Number of IVs	136	136
AR(1)	0.000	0.000
AR(2)	0.776	0.258
Hansen test p-value	0.000	0.000
Difference in Hansen test	0.128	0.969
Wald test p-value	0.000	0.000
Observation	9,989	9,138

This table presents the results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Lev_{i,t} = \alpha_0 + \beta_0 {*} Lev_{i,t-1} + \beta_1 {*} X_{i,\,t-1} + \beta_2 {*} Z_t + u_i + \varepsilon_{i,t}, \qquad (5.2)$$

The dependent variable is the book leverage ratio of firm *i* at year *t*. One-year lagged leverage ratio is used as one of the independent variables. *X* denotes the firm characteristics variables capturing demand-side effects. *X* includes *Tangibility, Market to Book ratio, firm size* and *ROA*. *Z* denotes the macroeconomic variables capturing the cost of debt financing. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses SYS-GMM to estimate model (5.2), and present the results of large firms and small firms separately. Coefficients and z-stats are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test, the Hansen test and Difference in Hansen test. This table uses the Wald test to check the overall significance. ***

indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

These results suggest that capital supply is important to firms' leverage policy. Supply-side factors, captured by the equity risk premium, aggregate stock market return, investor sentiment, real interest rate, default risk, economic growth, financial development and government borrowings are important determinants of firm capital structure. The empirical evidence in this section supports the literature (such as Faulkender and Petersen, 2005; Leary, 2009; Lemmon and Roberts, 2010; and Antzoulatos et al., 2016) stressing the role of supply-side effects on firm capital structure.

5.5 Timing Supply-side Factors, Business Cycle and Leverage Target Adjustment

So far, the empirical results are in line with the prediction of *market timing hypothesis* that firms consider the cost of financing sources when making financing decisions. In particular, sample firms raise the leverage ratio when the cost of equity financing is high or when the cost of debt financing is low, and reduce the leverage ratio when the cost of equity financing is low or when the cost of debt financing is high. Moreover, the results show that firm leverage ratio is cyclical. Sample firms raise the leverage ratio in economic booms and reduce the leverage ratio in economic recessions. These results provide further supports to the *market timing hypothesis* of capital structure.

These findings lead naturally to another question. Since the supply-side factors influencing the cost of financing sources are cyclical, these supply-side effects have the potential to generate cyclical variations in the leverage ratio. The cyclical variation may constitute, at least part of, the mean reversion in leverage. Previous empirical studies tend to estimate an SOA and use it to support the *trade-off theory* which states that firms target an optimal leverage ratio. A potential issue is that this method does not reject the mechanical reversion driven by the business cycle. Therefore, it is important to test whether the observed leverage target adjustment is due to the influence of cyclical macroeconomic conditions or is actively-determined. This section investigates the cyclicality of firm capital structure and compares the estimated SOAs with or without controlling cyclical supply-side factors.

Table 5.11 Business Cycle and Leverage Target Adjustment

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ASR t		-0.022***		-0.022***		-0.022***
		(-5.75)		(-5.77)		(-7.04)
RIR t		0.201***		0.368***		0.369***
		(6.67)		(9.48)		(12.09)
RGDP t		0.202***		0.255***		0.269***
		(5.58)		(6.71)		(8.68)
Leverage i,t-1	0.875***	0.872***	0.756***	0.749***	0.818***	0.796***
	(130.93)	(127.10)	(78.02)	(75.89)	(87.20)	(81.99)
Tangibility i,t-1	0.013***	0.011***	0.016	0.006	0.049***	0.048***
	(4.16)	(3.45)	(1.58)	(0.64)	(2.73)	(2.66)
Market-to-Book $_{i,t-1}$	0.000	-0.000	0.001	-0.000	0.003**	-0.001
	(0.23)	(-0.52)	(0.54)	(-0.10)	(2.50)	(-1.07)
Ln_assets i,t-1	0.003***	0.003***	0.004***	0.009***	0.007***	0.015***
	(9.90)	(10.54)	(4.88)	(8.19)	(5.00)	(9.12)
ROA i,t-1	-0.005	-0.010	-0.011	-0.021*	-0.003	-0.011
	(-0.59)	(-1.23)	(-0.98)	(-1.91)	(-0.39)	(-1.51)
Constant	0.003	-0.002	0.018**	-0.011	-0.028***	-0.072***
	(1.33)	(-0.63)	(2.04)	(-1.18)	(-2.02)	(-5.04)
Variance due to FE			12.97%	14.40%		
Number of IVs					136	126
AR(1)					0.000	0.000
AR(2)					0.167	0.159
Hansen test p-value					0.000	0.000
Wald test p-value					0.000	0.000
R2	78.58%	78.68%	78.50%	78.02%		
Observation	19,127	19,127	19,127	19,127	19,127	19,127

This table presents the results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream.

$$Lev_{i,t} = \alpha_0 + \beta_0 * Lev_{i,t-1} + \beta_1 * X_{i,t-1} + \beta_2 * Z_t + u_i + \varepsilon_{i,t}, \quad (5.2)$$

The dependent variable is the book leverage ratio of firm *i* at year *t*. One-year lagged leverage ratio is used as one of the independent variables. *X* denotes the firm characteristics variables capturing demand-side effects. *X* includes *Tangibility*, *Market to Book ratio*, *firm size* and *ROA*. *Z* denotes the macroeconomic variables capturing the business cycle. This table uses $\lambda = 1 - \beta_0$ to calculate the SOA, if $\lambda \in (0, 1)$. All variables are defined and explained in Appendix 1 and Appendix 2. OLS, FE and SYS-GMM are used as the three alternative methods to estimate model (5.2). Firm-clustered standard errors are used in OLS and FE estimations. Coefficients and t-values (z-stats in SYS-GMM) are reported. Variance due to fixed effects, R^2 and the number of observations are reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.11 reports the results when *ASR*, *RIR* and *RGDP* are used to capture the business cycle. Consistent with the predictions, the results in Table 5.11 show that *ASR* is negatively associated with *leverage* while *RIR* and *RGDP* are positively associated with *leverage*. These results suggest that firm capital structure is pro-cyclical to the economic cycle but counter-cyclical to the financial cycle. Particularly, leverage increases when the GDP growth rate is high (in economic booms) but decreases when there is a high aggregate stock return and a low interest rate. The evidence is robust to the three estimation methods.

One of the main interests is to evaluate whether controlling cyclical supply-side effects substantially reduces the estimated SOA. Using a dynamic specification, the empirical evidence shows that capturing the cyclical supply-side effects does not reduce the estimated target adjustment coefficient. As shown in Table 5.9 and Table 5.11, controlling the supply-side effects leads to a tiny variation in the coefficients of $Lev_{i,t-1}$. For example, in Table 5.9, controlling supply-side effects increases the estimated SOA from 0.182 (column 5) to 0.195 (column 6). In Table 5.11, controlling the business cycle increases the estimated SOA from 0.182 (column 5) to 0.204 (column 6). It seems that the observed leverage target adjustment is not mechanically driven by firms following the business cycle. Rather, there is an active adjustment. The variation in leverage caused by timing the business cycle is reversed in subsequent periods, as suggested in Covas and Den Haan (2011). Moreover, it seems that supply-side factors are important determinants of the optimal leverage ratio. One possible explanation for the increased SOA is that firms target an optimal leverage ratio in which supply-side effects are also considered. Therefore, measuring an SOA without capturing supply-side effects would under-estimate the true SOA.

5.6 Robustness of the Results

Beyond the fact that the supply side effects are robust to the two empirical specifications, the pooling of supply-side factors and the alternative estimation methods used to estimated the dynamic leverage model, this section perform a few additional tests to further check the robustness of the main findings.

This section checks the robustness of the main findings to alternative definitions of variables. First, I define ROAe as EBIT over assets to replace the ROA used in the dynamic leverage model, because this definition is a more classical determinant of firm capital structure (such as in Rajan and Zingales, 1995). Second, in the dynamic leverage model, I use two alternative definitions of leverage, namely the market leverage ratio (following Flannery and Rangan, 2006) and the long-term debt ratio (following Booth et al., 201). The new results, as reported in Table 5.12, Table 5.13 and Table 5.14 below, show that supply-side effects are important determinants of firm capital structure. In addition, the estimated SOA is not decreased by capturing the cyclical supply-side effects. It appears that the main findings are robust to these alternative definitions of variables.

Second, I include two control variables, namely *effective tax rate* and *non-debt tax shield*, in the spirit of DeAngelo and Masulis (1980) to control firms willingness to use debt to shield tax. *Effective tax rate* is measured by tax over profits before tax, following Dyreng et al. (2017). *Non-debt tax shield* is measured by depreciation and amortization over total assets, following Antoniou et al. (2008). The results, as reported in Table 5.15, show that the factors capturing supply-side effects are generally robust to capturing effective tax rate and the non-debt tax shield. The estimated SOA does not decrease after controlling supply-side factors. This indicates that the main findings are robust to controlling effective tax rate and non-debt tax shield.

In addition, this sections check the robustness of the findings to a larger sample. Specifically, I perform the main tests using the full sample period in which firms have at least five-year data to perform the regression analysis. The results reported in Table 5.16 show that supply-side factors are important determinants of capital structure and that the estimated SOA does not decrease. This indicates that the main findings hold in the larger sample.

Table 5.12 Supply-side Effects and Firm Capital Structure Using EBIT

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ERP t		0.891***		0.697***		0.826***
		(6.69)		(4.61)		(7.34)
		-		-		-
ASR t		0.079***		0.084***		0.064***
		(-9.43)		(-10.12)		(-9.92)
STG t		0.407		0.234		0.838***
		(1.39)		(0.81)		(3.56)
BFA t		-0.035		-0.009		-0.012
		(-1.16)		(-0.32)		(-0.50)
RIR t		0.174**		0.272***		0.023
		(2.34)		(3.68)		(0.37)
		-		-		-
DSP t		2.577***		2.328***		2.264***
		(-7.63)		(-6.59)		(-8.19)
TSP t		-0.142		0.079		-0.265**
		(-0.98)		(0.58)		(-2.36)
Leverage i,t-1	0.875***	0.886***	0.755***	0.698***	0.829***	0.863***
	(135.11)	(118.27)	(78.89)	(53.72)	(86.50)	(66.73)
Tangibility i,t-1	0.017***	0.015***	0.018	0.020	0.058***	0.018
	(4.46)	(3.36)	(1.59)	(1.09)	(3.00)	(1.25)
Market-to-Book i,t-1	0.000	0.001	0.001	0.001	0.003***	0.004***
	(0.39)	(1.05)	(0.78)	(0.52)	(2.70)	(2.63)
Ln_assets i,t-1	0.003***	0.003***	0.005***	0.009***	0.005***	0.005**
	(10.19)	(9.40)	(5.01)	(3.90)	(2.89)	(2.01)
				-	-	-
ROAe i,t-1	-0.013	-0.012	-0.027**	0.043***	0.066***	0.034***
	(-1.60)	(-1.24)	(-2.09)	(-2.64)	(-5.58)	(-2.67)
Etr i,t-1	-0.001	0.001	0.001	0.002	0.024**	-0.020
	(-0.33)	(0.42)	(0.54)	(0.78)	(2.10)	(-1.58)
					-	
Dpr i,t-1	-0.071**	-0.038	-0.018	0.004	0.648***	-0.047
	(-2.01)	(-0.98)	(0.31)	(0.05)	(-4.35)	(-0.31)
Constant	0.005**	0.020	0.018**	0.001	0.007	-0.005
	(1.98)	(0.76)	(2.03)	(0.05)	(0.42)	(-0.17)
Variance due to FE			13.00%	13.00%		
Number of IVs					136	136
AR(1)					0.000	0.000
AR(2)					0.408	0.676
Hansen test p-value					0.000	0.000
Difference in Hansen test					0.488	0.002
Wald test p-value					0.000	0.000
R2	78.61%	80.50%	78.52%	79.53%		
Observation	19,076	19,076	19,076	19,076	19,076	19,076

This table presents the regression results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015.

Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.13 Supply-side Effects and Firm Capital Structure Using Market Leverage

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ERP t		0.673***		-0.114		-0.076
		(4.28)		(-0.68)		(-0.48)
ASR t		-0.176***		-0.147***		-0.120***
		(-16.98)		(-14.59)		(-12.87)
STG t		2.271***		2.225***		1.935***
		(6.76)		(6.80)		(7.10)
BFA t		-0.126***		-0.095**		-0.168
		(-3.26)		(-2.52)		(-5.43)
RIR t		0.055***		0.28		0.176**
		(0.56)		(0.30)		(2.05)
DSP t		-2.366***		-0.428		-0.492
		(-6.35)		(-1.04)		(-1.34)
TSP t		-0.704***		-0.299**		-0.689***
		(-4.62)		(-2.08)		(-5.05)
Leverage i,t-1	0.855***	0.852***	0.721***	0.650***	0.748***	0.739***
	(145.03)	(111.27)	(79.31)	(51.66)	(79.21)	(58.43)
Tangibility i,t-1	0.022***	0.028***	0.051***	0.061***	0.105***	0.079***
	(5.81)	(6.00)	(4.70)	(2.93)	(5.04)	(3.85)
Market-to-Booki,t-1	-0.004***	-0.004***	-0.002**	-0.008***	-0.001***	-0.001
	(-7.04)	(-6.41)	(-2.47)	(-5.59)	(-0.98)	(-0.83)
Ln_assets i,t-1	0.003***	0.005***	0.009***	0.023***	0.011***	0.015***
	(9.49)	(10.74)	(8.72)	(8.32)	(7.35)	(-5.33)
ROAe i,t-1	-0.023***	-0.040***	-0.037**	-0.087**	-0.041***	-0.072***
	(-3.32)	(-4.63)	(-2.89)	(-4.93)	(-3.22)	(-5.33)
Constant	0.007***	0.078**	-0.014	-0.043	-0.058**	0.037
	(2.79)	(2.38)	(-1.61)	(-1.05)	(-3.78)	(1.01)
Variance due to FE			16.28%	16.32%		
Number of IVs					136	136
AR(1)					0.000	0.000
AR(2)					0.000	0.007
Hansen test p-value					0.000	0.000
Difference in Hansen test					0.595	0.001
Wald test p-value					0.000	0.000
R2	76.74%	78.79%	75.87%	72.14%		
Observation	19,095	19,095	19,095	19,095	19,095	19,095

This table presents the regression results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015.

Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.14 Supply-side Effects and Firm Capital Structure Using Long-term Leverage

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ERP t		1.321***		1.275***		1.03***
		(4.27)		(3.68)		(4.66)
ASR t		-0.118***		-0.133***		-0.083***
		(-5.34)		(-6.17)		(-5.66)
STG t		0.343		0.098		0.789*
		(0.47)		(0.14)		(1.68)
BFA t		-0.067		-0.022		-0.115**
		(-0.99)		(-0.31)		(-2.36)
RIR t		0.378*		0.538***		0.285**
		(1.91)		(2.82)		(5.51)
DSP t		-4.175***		-4.175***		-3.183***
		(-5.27)		(-5.01)		(-5.51)
TSP t		-0.159		0.176		-0.096
		(-0.44)		(0.50)		(-0.38)
Leverage i,t-1	0.812***	0.825***	0.692***	0.635***	0.800***	0.822***
	(79.24)	(66.06)	(50.62)	(36.84)	(63.89)	(58.89)
Tangibility i,t-1	-0.007	-0.000	0.021	0.044	0.117***	-0.006
	(-1.02)	(-0.05)	(0.88)	(1.12)	(3.30)	(-0.23)
Market-to-Book i,t-1	-0.003*	0.002	0.000	0.002	0.006***	0.006*
	(-1.71)	(0.61)	(0.02)	(0.33)	(2.82)	(1.89)
Ln_assets i,t-1	0.004***	0.006***	0.002	0.010*	0.016***	0.001
	(6.62)	(6.61)	(1.00)	(1.87)	(5.77)	(0.35)
ROAe i,t-1	-0.060***	-0.050**	-0.105***	-0.095**	-0.071***	-0.073***
	(-2.69)	(-1.97)	(-3.64)	(-2.42)	(-3.17)	(-2.66)
Constant	0.045***	0.071	0.090	0.058	-0.082**	0.116**
	(6.41)	(1.24)	(4.21)	(0.87)	(-3.02)	(2.33)
Variance due to FE			11.42%	11.25%		
Number of IVs					136	136
AR(1)					0.000	0.000
AR(2)					0.236	0.702
Hansen test p-value					0.000	0.010
Difference in Hansen test					0.001	0.001
Wald test p-value					0.000	0.000
R2	67.70%	68.48%	67.58%	68.03%		
Observation	18,181	18,181	18,181	18,181	18,181	18,181

This table presents the regression results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.15 Supply-side Effects and Firm Capital Structure Controlling Tax and Depreciation

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ERP t		0.891***		0.697***		0.826***
		(6.69)		(4.61)		(7.34)
ASR t		-0.079***		-0.084***		-0.064***
		(-9.43)		(-10.12)		(-9.92)
STG t		0.407		0.234		0.838***
		(1.39)		(0.81)		(3.56)
BFA t		-0.035		-0.009		-0.012
		(-1.16)		(-0.32)		(-0.50)
RIR t		0.174**		0.272***		0.023
		(2.34)		(3.68)		(0.37)
DSP t		-2.577***		-2.328***		-2.264***
		(-7.63)		(-6.59)		(-8.19)
TSP t		-0.142		0.079		-0.265**
		(-0.98)		(0.58)		(-2.36)
Leverage i,t-1	0.875***	0.886***	0.755***	0.698***	0.829***	0.863***
	(135.11)	(118.27)	(78.89)	(53.72)	(86.50)	(66.73)
Tangibility i,t-1	0.017***	0.015***	0.018	0.020	0.058***	0.018
	(4.46)	(3.36)	(1.59)	(1.09)	(3.00)	(1.25)
Market-to-Book i,t-1	0.000	0.001	0.001	0.001	0.003***	0.004***
	(0.39)	(1.05)	(0.78)	(0.52)	(2.70)	(2.63)
Ln_assets i,t-1	0.003***	0.003***	0.005***	0.009***	0.005***	0.005**
	(10.19)	(9.40)	(5.01)	(3.90)	(2.89)	(2.01)
ROAe i,t-1	-0.013	-0.012	-0.027**	-0.043***	-0.066***	-0.034***
	(-1.60)	(-1.24)	(-2.09)	(-2.64)	(-5.58)	(-2.67)
Etr i,t-1	-0.001	0.001	0.001	0.002	0.024**	-0.020
	(-0.33)	(0.42)	(0.54)	(0.78)	(2.10)	(-1.58)
Dpr i,t-1	-0.071**	-0.038	-0.018	0.004	-0.648***	-0.047
	(-2.01)	(-0.98)	(0.31)	(0.05)	(-4.35)	(-0.31)
Constant	0.005**	0.020	0.018**	0.001	0.007	-0.005
	(1.98)	(0.76)	(2.03)	(0.05)	(0.42)	(-0.17)
Variance due to FE			13.00%	13.00%		
Number of IVs					136	136
AR(1)					0.000	0.000
AR(2)					0.408	0.676
Hansen test p-value					0.000	0.000
Difference in Hansen test					0.488	0.002
Wald test p-value					0.000	0.000
R2	78.61%	80.50%	78.52%	79.53%		
Observation	19,076	19,076	19,076	19,076	19,076	19,076

This table presents the regression results of model (5.2). The sample includes all the unregulated Compustat firms with continuous records from 1988 to 2015. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. The data of macroeconomic characteristics are collected via Datastream. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

Table 5.16 Supply-side Effects and Firm Capital Structure Using the Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Methods	OLS, Cluster		FE, Cluster		SYS-GMM	
ERP t		1.025***		0.531***		0.292**
		(9.34)		(4.29)		(2.20)
ASR t		-0.091***		-0.083***		-0.079***
		(-12.99)		(-12.01)		(-9.97)
STG t		-0.129		-0.426*		-0.056
		(-0.56)		(-1.86)		(-0.18)
BFA t		0.021		0.070***		0.002
		(0.80)		(2.82)		(0.08)
RIR t		0.142**		0.139**		0.296***
		(2.32)		(2.30)		(3.76)
DSP t		-2.559***		-2.511***		-0.489
		(-10.44)		(-5.35)		(-1.38)
TSP t		-0.205*		-0.039		-0.171
		(-1.85)		(-0.37)		(-1.32)
Leverage i,t-1	0.850***	0.847***	0.701***	0.705***	0.760***	0.735***
	(166.12)	(131.97)	(88.39)	(56.00)	(82.94)	(61.47)
Tangibility i,t-1	0.029***	0.031***	0.026***	0.026**	0.043***	0.056***
	(11.45)	(9.79)	(3.35)	(2.14)	(3.43)	(3.27)
Market-to-Book i,t-1	-0.001***	-0.002***	-0.002***	-0.002***	0.004***	0.002**
	(-3.90)	(-3.52)	(-3.04)	(-3.20)	(6.23)	(2.80)
Ln_assets i,t-1	0.003***	0.005***	0.003***	0.015***	0.016***	0.028**
	(13.05)	(14.14)	(6.34)	(8.42)	(12.60)	(10.21)
ROAe i,t-1	-0.010***	-0.016***	-0.017**	-0.041**	-0.007***	-0.019
	(-3.20)	(-3.48)	(-2.51)	(-4.64)	(-0.73)	(-1.61)
Constant	0.12***	-0.013	0.043**	-0.052**	-0.060**	-0.136***
	(6.77)	(-0.61)	(9.48)	(-2.14)	(-6.16)	(-4.22)
Variance due to FE			34.72%	41.53%		
Number of IVs					314	314
AR(1)					0.000	0.000
AR(2)					0.561	0.766
Hansen test p-value					0.000	0.004
Difference in Hansen test					0.007	0.072
Wald test p-value					0.000	0.000
R2	74.33%	75.44%	74.31%	73.60%		
Observation	57,389	57,389	57,389	57,389	57,389	57,389

This table presents the regression results of model (5.2). The sample includes the full sample. Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) are not included. Firms are required to have at least five years to perform the regression analysis. The data of macroeconomic characteristics are collected via Datastream. All variables are defined and explained in Appendix 1 and Appendix 2. This table uses OLS, FE and SYS-GMM as the three alternative methods to estimate model (5.2). Coefficients and t-values (z-stats for SYS-GMM) are reported. The number of observations is reported. This table reports the number of instrumental variables, and p-values of the AR test and the Hansen test. This table uses the Wald test to check the overall significance. *** indicates significant difference at 1% level; ** indicates significant difference at 5% level; * indicates significant difference at 10% level.

5.7 Discussion, Conclusion and Limitations

Chapter 5 empirically examines the influence of supply-side factors on firm leverage decisions. It uses several macroeconomic variables to capture the supply-side factors and tests whether these factors influence firms' financing choices and the capital structure. This chapter broadly categorizes these factors into those related to the cost of equity financing and those related to the cost of debt financing. The first category includes equity risk premium, aggregate stock return, stock market capitalization and investor sentiment. The second category includes real interest rate, default spread, term spread, GDP growth rate, financial development and government borrowings. This chapter also discusses whether these factors wipe out leverage target adjustments to examine whether firm capital structure is mechanically determined.

The *pecking order theory* suggests that firms prefer debt financing to equity financing, which is tested by a regression of net debt issuance on the financing deficit in Shyam-Sunder and Myers (1999). Section 5.3 extends this work by using proxies for the supply-side factors to interact with the pecking order coefficient. The results suggest that firms are more likely to use debt financing when the supply-side effects reduce the cost of debt financing or increase the cost of equity financing. On the contrary, firms are more likely to use equity financing when the supply-side effects increase the cost of debt financing or reduce the cost of equity financing. Among the supply-side factors influencing the cost of equity financing, investor sentiment seems to be the most important and shows high robustness. Among the supply-side factors influencing the cost of debt financing, interest rate seems to be the most important and show high robustness. These results suggest that debt financing is not always used before equity financing. The results in section 5.3 suggest that firms consider the costs of financing sources when making financing choices, rather than following a stable pecking order.

Recent studies (such as Baker, 2009 and Graham and Leary, 2011) point out that supply-side effects are largely ignored in capital structure studies. Besides using classical firm-level characteristics to control demand-side effects (following Faulkender and Peterson, 2006; Baker, 2009; and Leary, 2009), this chapter also includes a list of macroeconomic variables to proxy for the supply-side factors. Although a common practice in empirical capital structure studies is to control year-fixed effects, this method does not help to predict future financing decisions. Using a partial adjustment framework (Flannery and Rangan, 2006), section 5.4 finds that supply-side factors are important determinants of firm capital structure. In particular, capital supply proxies, investor sentiment proxies and business cycle proxies are positively associated with firm leverage ratio, while stock return proxies and risk proxies are negatively associated with firm leverage ratio. The empirical results in section 5.4 highlight that supply-side effects are unneglectable determinants of firm capital structure.

Previous studies debate whether the leverage ratio is pro-cyclical or counter-cyclical. For instance, among recent studies, Mclean and Zhao (2014) find that leverage is pro-cyclical, while Halling et al. (2016) find that leverage is counter-cyclical. Covas and Den Haan (2011) investigate the cyclicality of debt financing and equity financing separately and find that both debt issuances and equity issuances are pro-cyclical. A common feature of these studies is that economic expansions and recessions are labelled according to the NBER classification. Moreover, there is no distinction between the economic cycle and the financial cycle. This chapter demonstrates that business cycle is one of the determinants of firm capital structure, using macroeconomic variables (i.e., *aggregate stock return*, *real interest rate* and *real GDP growth rate*). The results show that firm leverage ratio is pro-cyclical to the economic cycle but counter-cyclical to the financial cycle. Firms have a higher reliance on debt financing in economic expansions than in economic recessions.[52] The pro-cyclical behaviour of leverage to the economic cycle indicates that debt issuance is more sensitive to the economic condition than is equity issuance. At the same time, firms also follow the financial cycle. Firms tend to increase the reliance on debt financing when the interest rate is high and when the stock market return is low.

The *market timing hypothesis* (Baker and Wurgler, 2002) suggests that firms time the security market when making financing decisions. The empirical evidence in Baker and Wurgler (2002) is that historical financing cost is correlated with current leverage ratio. This chapter provides further evidence, by investigating a list of supply-side factors related to the cost of equity financing or the cost of debt financing. The results show that firm leverage ratio is significantly correlated with the proxies for the costs of financing sources. The relationship is robust to pooling the variables related

[52] This study is different from the literature, since most of previous empirical studies use dummy variables to label economic expansions and economic recessions. This chapter, using continuous variables rather than dummy variables to capture the economic environment, gives more precise estimates.

to the cost of financing sources, the alternative estimation methods, a few alternative definitions of variables, and to the full sample. This result is consistent with Mclean and Zhao's (2014) recommendation to consider the cost of debt financing in addition to the cost of equity financing, in examining external financing decisions. The supply-side effects are stronger for small firms than for large firms, which reflects the impact of the financing constraint. Overall, this chapter provides further supports to the *market timing hypothesis* of capital structure.

This chapter also erases the question on whether firm leverage ratio is mechanically determined by cyclical supply-side factors. The *trade-off theory* suggests that firms target an optimal leverage ratio at which firm value is maximized. Fama and French (2002) provide empirical evidence by documenting the mean reversion in leverage ratio. However, several studies, such as Covas and Den Haan (2011) and Mclean and Zhao (2014), find that firms make pro-cyclical financing decisions. If financing decisions have cyclical patterns, it is worthy asking whether the reversion in leverage is mechanically determined, because cyclical patterns could generate a mechanical mean reversion. This chapter investigates this issue by comparing the estimated adjustment speeds with and without controlling supply-side effects. The results show that the leverage target adjustment is robust to controlling the supply-side effects. Particularly, controlling the supply-side effects does not result in a reduction in the estimated SOA, but often results in a slight increase. It may suggest that firms consider supply-side factors as important determinants of the optimal capital structure. The active target adjustment is actively-determined rather than being driven by making cyclical financing decisions.

Overall, the results in this chapter are in line with three branches of the literature. First, the results are consistent with Graham et al. (2014) and Antzoulatos et al. (2016) that both economy-wide factors and firm specific characteristics determine firm capital structure. This chapter examines the effects of several macroeconomic factors on firm capital structure. This enriches the literature on how macroeconomic conditions influence the real economy by showing how the macroeconomic conditions influence firms' financing choices and capital structure. Second, the results are consistent with the suggestion in the literature (e.g., Faulkender and Petersen, 2006; Baker, 2009; Leary, 2009; Lemmon and Roberts, 2010; Graham and Leary, 2011, and Antzoulatos et al., 2016) that supply-side factors should be an important determinant of firm leverage policy. This chapter discusses how supply-side factors could influence firm leverage decisions by influencing the costs of financing sources and tests the role of these supply-side factors using the two regression approaches. Third, the results support the *trade-off theory* that firms actively target an optimal leverage ratio. Although the supply-side factors are important determinants of firm capital structure, the results in this chapter show that controlling for the supply-side factors do not wipe out leverage target adjustment. This helps mitigating the concern that the estimated leverage target adjustment may be mechanically determined by firms' timing cyclical security market conditions.

This thesis uses the data collected from CRSP/Compustat merged database which only contains firms in the US. Hence, this chapter is unable to capture the variation in either leverage or in the supply-side factors at country level. Cross-country differences are important to the variation in macroeconomic variables. Therefore, further studies are encouraged to investigate international data and to explore the situation outside of the US.

Another limitation is that this chapter does not completely eliminate the problem of IV prolification. This chapter uses collapsed Instrumental Variables (IVs) to reduce the number of IVs, following the suggestion in Wintoki et al. (2012). Using this method generates an exogenous set of IVs, but even using collapsed IVs does not completely eliminate the problem of IV prolification, according to the results of Hansen test. Therefore, this chapter uses OLS and FE to test the robustness of the results. Although this chapter uses system GMM to reduce endogeneity, a careful selection and justification on other decent IVs are always recommended.

Chapter 6 Conclusions, Limitations and Directions for Future Research

6.1 Contributions

This thesis investigates the dynamics and interactions of firm financial behaviours, with a particular focus on the role of leverage decisions. A recent issue in corporate finance studies is that firms cannot achieve all of the financial tasks (i.e., dividend target, leverage target, investment, equity market timing) at the same time. As a result, leverage decisions can be determined by other financial behaviours. The *trade-off theory*, as one of the theories explaining firm financing behaviours, suggests that firms target an optimal leverage ratio. There are, however, some issues with this theory. Debt decisions being driven by the other financial motives or by the cyclical supply-side factors may generate a mechanical mean reversion in the leverage ratio. The mechanical mean reversion can be misinterpreted as active target adjustments. Therefore, it is crucial to differentiate the mechanical reversion from an active leverage target adjustment in order to evaluate whether the trade-off theory is valid. The thesis focuses on this issue and uses data collected from CRSP/Compustat to empirically test the role of leverage decisions. The thesis is composed of three empirical chapters, after a review of the literature in Chapter 2.

Chapter 3 of this thesis uses a five-variable SVAR framework to investigate the dynamics and interactions behind firm investment, dividend, leverage, equity issuance behaviours and profitability. This chapter shows rich empirical evidence on how firm financial behaviours are interdependent. The results show that none of the aforementioned financial behaviours is completely independent, as predicted by theories under perfect market assumptions. Instead, firm financial behaviours are determined by their previous realizations and the previous realizations of other financial characteristics. The results are robust to firms with a continuous record from 1960s onward or from 1980s onward. These results are also robust to high-growth firms and low-growth firms.

By decomposing the forecast error variances, Chapter 3 compares the relative exogeneity of the simultaneously determined financial behaviour. The results suggest an order of priority. Specifically, firms give the highest priority to equity issuance decisions. This is followed by the dividend target, then investment and lastly the leverage target. It appears that firms use debt and investment to absorb shocks to operating profits and to smooth out the distributions to shareholders. Dividend is also smoother than leverage, suggesting that dividend target has a higher priority than the leverage target. The empirical evidence in this thesis supports Lambrecht and Myers (2012) who state that firms issue debt to smooth dividend, although it appears that debt is not a pure shock-absorber. All of the other financial behaviours respond reversely to absorb leverage shocks. The order of priority reveals the relative cost of deviating from the desired levels of these financial characteristics. The results suggest that adjusting equity issuance decisions to absorb shocks to other financial behaviours is the most costly. Deviating from the target leverage ratio is the least costly.

To further examine the interactions of firm financial behaviours, Chapter 3 uses orthogonal IRFs to visualize how an exogenous shock to one of the financial characteristics leads to responses in the system. The results show that all of the firm financial characteristics deviate from their desired levels to accommodate shocks to other financial characteristics and revert to their desired levels at varying speeds. These results suggest that firms may jointly minimize over the costs of deviating from the desired levels of several financial characteristics. There is neither a completely sticky financial behaviour nor a residual financial behaviour.

A few recent studies question whether firm leverage target adjustment is mechanically determined (such as Shyam-Sunder and Myers, 1999; Chang and Dasgupta, 2009) and whether the partial adjustment model (Flannery and Rangan, 2006) provides valid estimation of the true adjustment speed (Hovakimian and Li, 2011, 2012). Chapter 4 of this thesis extends the partial adjustment model by using interaction terms to capture the mechanical effects of other financial behaviours. It provides an explanation for the mean reversion in leverage by investigating the extent to which other financing behaviours mechanically drive leverage target adjustments and whether there is a non-mechanical fraction of the estimated speed of adjustment.

The results in Chapter 4 suggest that other financial behaviours have a mechanical impact on leverage target adjustments. Specifically, firm investment, equity issuance and variations in ROA are associated with the SOA of over-levered firms; whereas investment and variations in ROA are associated with the SOA of under-levered firms. These effects are more pronounced in financially-constrained firms. The results are robust to an alternative specification by using the financing deficit variable to test the mechanical effects. The thesis finds that the mechanical effects constitute around 50% of the mean reversion in leverage.

There is also a substantial fraction of the SOA that cannot be explained by the mechanical effects. Although controlling the mechanical effects reduces the estimated SOA by around 50%, it does not wipe out leverage target adjustment behaviours. This indicates that leverage target adjustment is not completely driven by other financial behaviours and that nearly a half of the leverage target adjustment is actively determined. The existence of active target adjustments is robust to the partitions according to firm size and dividend payment, and is robust to a few of other definitions of variables. The evidence points to a unified theory of capital structure in which firms consider both targeting an optimal leverage ratio and balancing the budget constraint when making financing decisions.

The results in Chapter 4 show that under-levered firms adjust the leverage ratio faster than do over-levered firms, which supports the leverage ratchet effects explanation (Admati et al, 2018). The results are robust to both the traditional partial adjustment model and the extended partial adjustment model. Among the partitioned subgroups, constrained and over-levered firms show the lowest adjustment speed, showing the unwillingness to reduce leverage.

Chapter 5 contributes to capital structure literature by discussing how the supply-side factors influence firm leverage policy by influencing the costs of financing sources. This chapter empirically examines a list of supply-side factors related to the costs of financing sources. These factors include aggregate stock market return, investor sentiment, interest rate, default risk, economic growth, financial development and government borrowings.

The results in chapter 5 show that firms consider the cost of financing sources when making financing choices. This chapter extends the model testing the *pecking order theory* in Shyam-Sunder and Myers (1999), by using proxies for the supply-side factors to interact with the pecking order coefficient. The results show that firms tend to use equity financing when the cost of equity financing is low or when the cost of debt financing is high, and vice versa. Moreover, using a partial adjustment framework, this chapter finds that the supply-side factors are important determinants of firm capital structure, even when the demand-side effects are controlled.

Although supply-side factors influence firm capital structure and the choice between debt financing and equity financing, the results in Chapter 5 show that these factors captured by macroeconomic characteristics do not wipe out the observed leverage target adjustment. Although firm capital structure is pro-cyclical to the economic cycle and counter-cyclical to the financial cycle, the estimated SOA is not reduced. This indicates that although firms time the security market and consider the supply of capital, the leverage target remains an important consideration to managers.

6.2 Limitations of the Thesis

The studies has a few limitations, due to the constraint of the methodology, the assumptions and the availability of data.

First, the SVAR model used in Chapter 3 is a newly-developed method (Abrigo and Love, 2015). It is not yet able to accommodate explicit specifications of each equation. In the real world, many factors, such as tax rate, stock prices and other events influence more than one financial behaviours at the same time; but the SVAR methodology is unable to model these effects and specific control variables for each equation. Instead, the method relies on the orthogonal shocks that are extracted technically (Sims, 1980). Future studies could work on this point when the technology is available.

Second, since time series methods require a long time period, this chapter is unable to take into account the firms that went bankrupt in the sample period. Those firms have a negative profitability and accumulate debt until a level that is unable to be repaid. Therefore, their leverages are unable to revert to the natural status. So, it can be anticipated that these firms give a low priority to debt decisions but can hardly use other financial behaviours to absorb leverage shocks.

Third, both Chapter 3 and Chapter 4 assume that the variables are homogeneous. Chapter 3 uses the VAR methodology (Sims, 1980) to extract orthogonal shocks to achieve the identification, but orthogonal and homogeneous shocks are very rare in practice. Chapter 4 takes the variation in firm financial behaviours as homogeneous. For example, it does not account for any potentially different effects of M&A and R&D activities from the investment in capital expenditures. Debt is assumed homogenous, without differentiating its maturity structure and seniority structure. DeMarzo and He (2016) find that both the target leverage ratio and the leverage adjustment speed are a function of debt maturity structure. This thesis does not account for potential impact of debt maturity structure, although the long-term debt ratio is used as one way of robustness checks. Also, equity decisions in Chapter 3 include the issuances and repurchases on the secondary market but do not account for IPO. Alti (2006) finds that firm leverage ratio fully revert after IPO within 3 years. This is substantially faster than the results that are based on exogenous shocks on the secondary market.

Fourth, this thesis uses the data collected from CRSP/Compustat merged database where international data are not available. Therefore, this thesis is unable to capture the variation in either leverage or the supply-side factors at country level. Future studies are also encouraged to explore the situation outside of the US, especially for Chapter 5 in which supply-side factors vary widely across countries.

Fifth, the regression analysis in Chapter 5 does not completely eliminate the problem of IV prolification. Chapter 5 uses collapsed Instrumental Variables (IVs) to reduce the number of IVs, following the suggestion in Wintoki et al. (2012). Using this method help generate an exogenous set of IVs, but even using this method does not completely eliminate the problem of IV prolification, according to the results of Hansen test. The uses and justifications of other IVs beyond using lagged variables are always recommended.

6.3 Directions for Future Studies

Based on the empirical results in this thesis, I have three important suggestions for future research. First, since firm financial behaviours are jointly-determined, this thesis recommends that the analysis of any financial behaviours should take into account of other simultaneously-determined financial behaviours to avoid the mis-interpretation caused by omitted variables. For example, the *signalling theory* suggests that dividend payout ratio signals future earnings, and hence, a decrease in dividend payment predicts a decrease in future earnings or financial distress. Is this definitely true? Based on the results in this thesis, I would give an answer of “not always”. Consider the situation when firms have an unexpected investment opportunity, firms may need to temporarily reduce dividend payment to fund the investment project. In this situation, future earnings may increase rather than decrease. The analysis without considering other financial behaviours may lead to an inaccurate prediction.

Second, this thesis find that the adjustment speed from above or from below the leverage target is not symmetric; and more specifically, the adjustment is faster from below than from above. Hence, future studies are recommended to examine firm capital structure for over-levered firms and under-levered firms separately. Moreover, traditional leverage determinants may have different roles for over-levered firms and under-levered firms. For example, an under-levered firm with an increase in profitability may issue more debt to shield the tax, which is consistent with the prediction of the *trade-off theory*. However, an over-levered with an increase in profitability firm may choose to reduce the debt burden, which is consistent with the prediction of the *pecking order theory*. An analysis without considering whether the firm is over-levered or under-levered may lead to a misinterpretation.

Third, since the thesis finds that firms consider both supply-side factors and the optimal leverage ratio when making financing decisions, I recommend future studies on firm capital structure consider both demand-side effects and supply-side effects. Moreover, the supply-side effects may differ according to market condition, institutional environment and firm characteristics (such as the firm size in this study), further studies are recommended to explore heterogeneous features of the supply-side effects. Further studies are also recommended to explore other supply-side factors to enrich this branch of literature.

Appendix 1 Firm Characteristics Variables

Briefs	Variables	Definitions	Sources and Reasons for inclusion
Lev	Leverage	Total debt / Total assets (book value)	To measure firm total leverage level (Graham et al., 2014), where Total debt is measured by the sum of long-term debt and short-term debt.
Mkt Lev	Market Leverage Ratio	Total debt / (Total assets - Book value of Equity + Market Value of Equity)	As an alternative to measure firm leverage ratio, following Flannery and Rangan (2006)
Levl	Long-term Debt Ratio	(Total liabilities - current liabilities)/(Total liabilities - current liabilities + Net worth)	As an alternative to measure firm leverage ratio following the definition in Booth et al. (2001), because investment (capx) is mainly long-term
	Debt Issuance (repurchase) ratio	(Total debt_t - Total debt_{t-1})/ Total Assets_t	To measure annual debt net issuance (or repurchase if < 0), used in Fama and French (2002) and Graham et al. (2014).
Tan	Tangibility	Tangible Assets / Total Assets	To measure firm tangibility, as Rajan and Zingales (1995) use property, plant and equipment, devided by total assets to measure tangibility.
MB	Market to Book ratio	Market Value of Total Assets / Book Value of Total Assets	To measure firm growth rate, as Rajan and Zingales (1995) use Market to Book Ratio to capture potential investment opportunities.
ROA	Return on Assets	Net income / Total assets	To measure firm profitability (Fan et al., 2012).
ROAe		EBIT/Total Assets	As an alternative to measure firm profitability (Rajan and Zingales, 1995)
Etr	Effective Tax Rate	Tax/Earnings Before Tax	To capture the effective tax rate (Dyreng et al., 2017)
Dpr	Depretiation Rate	Depreciation and Amortization)/Total Assets	To capture the non-debt tax shield (Antoniou et al., 2008)
Inv	Investment to assets	Capital Expenditure / Total Assets	To measure firm investment, following Gatchev et al. (2014)
Div	Dividend to assets ratio	Cash Dividend / Total assets	To measure firm dividend payment, as Fama and French (2002) scale dividend with total asset rather than net income in case of observation problem
Cash	Cash flow to assets ratio	(Cash t - Cash t-1)/Total Assets	To measure the change in cash balance (Gatchev et al., 2014).
Equ	equity issuance (repurchase) ratio	(ΔShareholders' Equity_t – Δ Retained Earnings t)/ Total assets	Being consistent with the measurement for debt issuance (Graham et al., 2015), this study uses the increase (decrease) in equity capital scaled by total assets to measure equity issuance (repurchase) speed.
Deficit	Financing Deficit	(ΔTotal Assets - ΔRetained Earnings)/ Total Assets	To capture the demand for external capital (Fama and French, 2005).

Appendix 2 Macroeconomic Characteristics Variables

Briefs	Variables	Definitions	Database
Panel A. Variables Capturing the Cost of Equity Financing			
ERP	Implied Market Equity Risk Premium	This thesis uses the data of ERP provided by the Absolute Strategy Research.	Datastream
ASR	Aggregate Stock Market Return	The increase in the Dow Jones Industrial index at year t scaled by the value of the index at t-1.	Datastream
STG	Stock market value to GDP	The overall stock market value divided by GDP.	Datastream
CSI	Consumer Sentiment Index	University of Michigan's consumer sentiment index, scaled by 100.	Datastream
TRCSI	Thomas Reuters CSI	The Thomas Reuters CSI, scaled by 100.	Datastream
BFA	Bond Funds Asset ratio	The net assets' of mutual funds (all bond and income funds) divided by the sum of net assets of mutual funds (all bond and income funds plus all equity funds).	Datastream
Panel B. Variables Capturing the Cost of Debt Financing			
RIR	Real Interest Rate	Nominal interest rate net of inflation.	Datastream
DSP	Default Spread	The difference between yields of Moody's Baa-rated bonds and Aaa-rated bonds.	Datastream
TSP	Term Spread	The difference between yields on 10- and one-year constant maturity treasures.	Datastream
RGDP	Real GDP growth rate	The increase in GDP at year t scaled by GDP at year t-1.	Datastream
FD	Financial Development index	Word bank financial development index score, measuring the easy access to capital.	Datastream
GBG	Government Borrowings to GDP	The overall value of government bond scaled by GDP.	Datastream

Appendix 3 Firm Characteristics of Full Sample

Variable	N	Mean	Median	Std. Dev	p1	p99	Skewness	Kurtosis	Jarque-Bera
Leverage	91,045	0.231	0.187	0.216	0	0.979	1.248	4.789	214,650.81
Market Leverage	76,424	0.656	0.214	1.383	0	9.632	4.445	25.876	11,508,374
Long-term Leverage	90,424	0.394	0.353	2.511	0	1.309	1.491	6.2999	447,184.30
Debt issuance ratio	86,074	0.018	0	0.103	-0.115	0.421	0.483	7.764	508,457.45
Total assets	92,159	10,637.85	464.763	88,312.73	8.508	25,438	17.047	431.74	4,261,901,904
Tangibility	88,986	0.281	0.207	0.261	0	0.925	0.864	2.894	666,77.655
Market to Book ratio	46,205	1.527	0.873	2.093	0.039	13.395	3.103	14.761	2,042,671.7
ROAe	91,744	0.039	0.072	0.222	-1.257	0.406	-3.397	17.469	5,860,386.5
Return on Assets (ROA)	91,409	-0.007	0.038	0.235	-1.470	0.328	-3.955	21.496	9,247,622.7
Etr	76,424	0.246	0.328	0.323	0	0.540	-1.586	12.067	1,762,950.2
Dpr	76,424	0.042	0.037	0.029	0	0.163	1.569	6.491	420,983.99
Investment / Assets	85,693	0.057	0.038	0.065	0	0.350	2.238	8.953	1,188,407.3
Dividend / Assets	91,457	0.017	0.004	0.034	0	0.237	3.719	19.963	7,843,974.5
Equity issuance ratio	82,090	0.067	0.005	0.207	-0.172	1.257	3.605	17.276	5,249,414.9
Cash change / Assets	76,424	0.011	0.002	0.112	-0.439	0.527	0.616	11.109	1,285,331.4
Deficit	82,125	0.112	0.052	0.254	-0.445	1.319	2.357	10.610	1,645,249.1

This table presents the descriptive statistics of the full sample. The data are collected from CRSP/Compustat database. The sample includes all the unregulated firms with Financials (SIC Codes 6000-6999), utilities (4900-4949), railroads (4000-4100) and telecommunications (4800-4900) excluded. This table reports the number of observations (N), the mean, the median, the standard deviation, the values at the 1st and 99th quantiles, skewness,,kurtosis and Jarque-Bera Statistics. The definitions of variables are summarized in Appendix 1.

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