Essays in Bank Capital Structure

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ABSTRACT

This thesis provides an in-depth discussion on banks' capital structure which has drawn very little attention from the literature. It consists of three major empirical essays. The first essay (Chapter III) reviews the major conclusions drawn from the traditional corporate finance literature that has at length examined the capital structures of non-financial firms, while compares their findings with the limited work on the leverage decisions of banking firms. It aims to provide an insight into the factors that actually govern banks' capital choices, cast doubt on whether capital requirements are binding and primarily decide the bank leverage, and introduce the core assumption of this thesis – information asymmetry as an important determinant of capital structure decisions. The second essay (Chapter IV) empirically investigates the effects of information asymmetry on capital structure adjustments of US bank holding companies (BHCs) during 1986 to 2015. By identifying BHCs with bankrupt subsidiaries and arguing that their managers possess better knowledge than market investors concerning the failure of their subsidiaries, this chapter disentangles the real effect of private information on the capital structures of holding banks. The results show that subsidiary failure significantly affects financial policies of the parent companies. Specifically, BHCs increase leverage as early as one year prior to the failure of their subsidiaries, and substantially lower leverage after subsidiary failure. Further tests document that the parent BHCs increase not only debt borrowing but also liquidity assets, and curtail lending in advance to avoid further liquidity and financial constraint problems after their subsidiary failure. Examinations on the dynamic patterns of these BHCs' performance around the subsidiary failure time confirm a smoother performance transition. The third essay (Chapter V) adds to the evidence in Chapter IV and discusses the information asymmetry effect by identifying a different treatment group - BHCs with subsidiaries engaging in M&A activities. The findings lend further support to the

core assumption in this thesis. The chapter also finds the indication that financial constraints of BHCs are on average mitigated following their subsidiaries receiving capital infusion following the M&A deals. Overall, this thesis has important implications for the public to understand various incentives that banks may have in making their capital structure decisions.

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Acknowledgments

During the past three and a half years, I have been working at the ever-shifting boundary between the known and the unknown as a PhD student. Looking back, it is hard to believe that this journey is drawing to an end. Accomplishing a doctorate is never an easy path. It requires a substantial amount of efforts as well as external help. While being proud of the achievement, I also feel there are many people to thank. Without their generous and selfless support, I would not have been able to accomplish this milestone.

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Senyu Wang

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Authors' declaration

I declare that, except where explicit reference is made to the contribution of others, that this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

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Chapter I: Introduction

The goal of this thesis is to look into various motives banks may have to change their capital structure. Specifically, the thesis explores capital choices among bank holding companies in the United States around the time when their subsidiaries have material status changes (e.g., bankruptcy, consolidations). By identifying that whether bank holding companies intentionally exploit information advantage to adjust their financing decisions during this period, the study aims to offer a new insight into the role asymmetry information plays in affecting firms' capital structure decisions. This thesis therefore contributes to three broad areas in the corporate finance and banking literature that explore information asymmetry and banks' capital choices, bank failure and M&A, and risk-shifting. This introductory chapter sets the overall context of the thesis by laying out the motivation of the research, an overview of each following chapter, and the structure of the thesis.

1.1. Motivation

The seminal work by Modigliani and Miller (1958) proposes the famous capital structure irrelevance principle where they argue that the value of a firm is independent of its financing choices in a perfect capital market. Following their pioneering work, many financial researchers have systematically investigated the capital structure decisions of non-financial firms. However, banking firms are largely excluded from the traditional corporate finance literature. Part of the reasons might be that regulation constitutes the overriding departure from what have been found for those non-financial firms (Gropp and Heider, 2009). As pointed out by Myres (2001) financial firms cannot adjust their financial policies at relatively low costs and thus have very limited financing objectives.

While these views appear sensible, they actually contradict the evidence of the distribution of bank capital over the past decades. The Figure 3 in Gropp and Heider (2010) drawing the distribution of banks' regulatory Tier 1 capital ratio for those largest public traded banks in the US and EU from 1991 to 2004 shows that there is large cross-sectional variation in the capital ratio of banks under the Basel regulatory regime. Banks also do not appear to hold the minimum amount of equity capital as required by the regulatory authorities. In contrast, researchers find that there has been a significant rise in bank regulatory capital ratio since 1990. BHC book equity to asset ratio, on average, rose from 6% in the late 1980s to over 8% in the 1990s, and then surprisingly 9% until the 2007-2008 financial crisis (Gropp and Heider, 2010). In market value terms, this phenomenon is even more noticeable. The market value of equity to market value of assets rose from 6% in 1990 to more than 15% after 2000. The rightward shift trend in bank capital demonstrates that it is worthy of further investigation for bank capital structure. Understanding what factors actually drive the bank capital decision over the past decades can provide essential insights for regulations, industry, and various reform proposals.

While it is well documented that banks generally have very high leverage compared with most firms from non-banking industry, this does not mean similar determinants do not take effect when both banks and non-banking firms decide the form of their capital structure. Indeed, Gropp and Heider (2010) document that the determinants of capital structure for banks and non-financial firms are very similar. They even report that the sign and significance of most variables when examining their effects on bank leverage are similar to those in studies of non-financial firms in the US and other G7 countries. Their findings provide the strong theoretical foundation for this thesis to examine the various incentives of BHCs adjusting their capital choices while at the same time accounting for other important factors that may affect bank leverage decisions. The study is also motivated by the fact that a bank holding company (henceforth referred to as "BHC") will suffer from internal capital scarceness when one or some of its subsidiaries have major structural changes. This chapter focuses on the changes in subsidiaries including them filing for bankruptcy or announcing M&A deals. Prior literature shows that BHCs operate internal capital markets where they allocate capital and liquidity to and between subsidiary banks (Houston, James, and Marcus, 1997; Houston and James, 1998). Therefore, this provides an effective mechanism through which subsidiary banks affect the cash flow, capital position, and liquidity of parent holding companies. Substantial costs involved in changes in subsidiaries could have a significant impact on the capital allocations and operational activities for the whole organization. BHCs facing such scarce internal capital problems have incentives to take actions to avoid the further financial constraints. One of the most popular actions BHCs can take in the capital market is to change their financing decisions. To demonstrate these arguments, suppose that one or some of a BHC's subsidiaries declare bankruptcy in a specific year. Investors holding the debt or equity of these subsidiaries are likely to lose part or all of their investment. As is often the case that subsidiary banks are funded by their parent, subsidiary failure means a costly process because the loss incurred will be majorly covered by the parent and the internal capital market established by the BHC will be hurt to some extent. BHCs facing limited internal funds may be forced to seek external financing to sponsor their various financial activities. Additionally, information asymmetry is severe prior to subsidiary failure. BHC insiders have information advantage over outside investors regarding the status of their subsidiaries. The advantage may be utilized by managers to adjust BHCs' financing decisions accordingly. Furthermore, following the subsidiary bankruptcy, managers may instead take actions to mitigate the asymmetric information in order to lower the future financing cost. All of these provide motivations for parent banks to heavily adjust their capital structures around the periods when their subsidiaries go bankrupt.

This thesis is closely related to the studies of information asymmetry and financing decisions. While the previous literature widely accepts the importance of private information in exploring firms' capital structure, banks are generally excluded from empirical investigations of financing decisions. This is due to the fact that banking industry is generally heavily regulated, which may bring the overriding departure from what researchers have concluded in those non-financial firms. This thesis, however, specializes the information asymmetry arisen prior to the subsequent subsidiary bank status changes and investigates if the information asymmetry will be exploited by bank managers to adjust their financing decisions accordingly. To the best of the knowledge, this is the first paper to use material structural changes of subsidiary banks as a cut-off to discern the real effect of private information. Additionally, it also adds the contribution to the limited literature which can reflect banks' financing decisions under asymmetric information. Lucas and McDonald (1992) point out that financing decisions of banks can be distorted due to information asymmetry because they are better informed of their assets quality than are outsiders. Jagtiani and Lemieux (2001) examine the pricing behavior of bonds issued by the parent BHCs of failed subsidiaries. Their findings show that bond spreads begin rising as early as six quarters prior to the failure, as the issuing BHC's financial condition and credit rating deteriorate. They also report that the spreads for troubled BHCs are many times those of healthy ones. Billett and Garfinkel (2004) explore banks' funding choices from segmented markets. They argue that with the existence of asymmetry information banks' securities could be priced remarkably differently by segmented markets, and banks will increase their reliance on the relatively cheaper external market. The degree of the reliance depends on the costs of raising funds from different markets. Accordingly, banks try to take most advantage of the pricing discrepancies and target the market with the lowest access costs. Holod and Peek (2007) investigate the access of banks to information-based external financial market by comparing the behaviors of banks (including bank holding companies) with different transparency in response to the exogenous shock and find information asymmetry does affect their financing decisions. Morgan (2002) suggests that banking is more opaque than any other sorts of industries. They find that ratings from major agencies often disagree more over the bank bond issues than over issues by other types of firms, and this disagreement provides a good proxy for the bank uncertainty associated with asymmetric information. The veil between banks and outsiders makes market investors unable to accurately quantify the risk of banking firms as well as their securities. While supplementing these previous studies, this thesis attempts to propose some new sights of judging the private information and examine its effectiveness in changing BHCs' capital structure. Therefore, the core premise within our topic is that banks have information advantage over market investors. Whether or not this kind of information asymmetry underlying in the banking system may be exploited by bank managers is an open question with important implications for understanding various motivations that banks may have in making capital choices.

1.2. An overview of chapters

This dissertation studies three major empirical research topics in the area of bank capital structure. The first chapter (Chapter II) combines with the existing literature and discusses the theories of bank capital structure. It majorly discusses capital structure decisions by firms in general. This helps us understand bank capital in a more intuitive way as banks, in the first instance, are firms. Some classic models are covered in this chapter, such as trade-off theory and pecking-order theory. It also discusses several famous surveys by financial researchers to exam the determinants that affect firms' capital structure choices.

Chapter III extends the discussion to banking firms. By comparing the similarities and differences between banks and non-financial firms, it discusses whether the findings concluded in the traditional corporate finance literature can be applied to banks for their capital structure decisions. It also discusses the trend in the recent decades that banks substantially increase their capital ratios well above the regulatory minimum. More importantly, this chapter draws out the core issue uncovered in this thesis that whether information asymmetry plays an important role in changing banks' capital choices during this period. This chapter further discusses some regulatory questions, such as bank illiquid assets and liquid liabilities, bank capital, deposits, and monitoring, etc. This chapter finishes with some preliminary tests on the determinants that could reliably affect bank capital decisions and sets out a clear view on the choices of control variables in the following chapters.

Chapter IV formally investigates the effects of information asymmetry on capital structure adjustments of US bank holding companies (BHCs) during 1986 to 2015. By identifying BHCs with bankrupt subsidiaries and arguing that their managers possess better knowledge than market investors concerning the failure of their subsidiaries, this chapter disentangles the real effect of private information on the capital structures of holding banks. Due to costly subsidiary failures, BHCs facing limited internal funds have incentives to find external financing before their financial conditions deteriorate. It is plausible that, prior to the subsidiary bankruptcy, the BHC may want to raise more debt at relatively lower costs. Once the subsidiary bankruptcy is realized, BHCs come under great pressures from regulators and market participants to control their default risk (Ashcraft, 2008). Thus, they may wish to lower the leverage and have more equity capital to secure the capital requirement. To examine these conjectures, this chapter employs a standard event-study difference-in-differences (DID) approach. This estimation strategy has been previously used by Schoar (2002), Autor (2003), and Almond, Hoynes, and Schanzenbach (2011), among others, to study firm performance around different events. In the event-study difference-in-differences (DID) framework, this chapter first estimates the leverage changes among BHCs with subsidiary failure ("troubled" BHCs) around the time of their subsidiary failure *relative to* the changes during the same period among those BHCs without subsidiary failure ("healthy" BHCs). The results show that subsidiary failure significantly affects financial policies of the parent companies. Specifically, BHCs increase leverage as early as one year prior to the failure of their subsidiaries, and substantially lower leverage after subsidiary failure. Further tests document that the parent BHCs increase not only debt borrowing but also liquidity assets, and curtail lending in advance to avoid further liquidity and financial constraint problems after their subsidiary failure. Examinations on the dynamic patterns of these BHCs' performance around the subsidiary failure time confirm a more smooth performance transition. The evidence suggests that the "troubled" BHCs foresee tightened credit market access and increased borrowing costs once the bankruptcy of subsidiary banks is realized. Thus, "troubled" BHCs increase debt financing in advance to take advantage of the presently cheaper debt financing and enjoy benefits. The findings are consistent with the argument of Billett and Garfinkel (2004) that, with the existence of asymmetric information, bank securities could be priced remarkably differently in segmented markets, and that banks take most advantage of the pricing discrepancies and target the segment, which has the lowest access costs. More importantly, the results provide strong support to the view that information asymmetry is an important determinant of capital structure decisions.[1]

Chapter V adds to the evidence in Chapter IV and discusses the information asymmetry effect by looking into BHCs with subsidiaries engaging in M&A activities (treated BHCs) and the impact on BHCs' capital structure decisions, performance, and risk. The results show a marked pre-M&A increase in treated BHCs' relative long-term debt as well as their subordinate debt issuance. The findings lend further support to the core assumption in this thesis. Further tests on cross-sectional variation in BHC specific characteristics using difference-in-difference-in-differences (DDD) regression models show that the impact of

[1] Fama and French (2005), when revisiting the classic pecking order theory, acknowledge that information asymmetry is an important or perhaps the only determinant of firms' capital structure.

information asymmetry on bank capital structure decisions is more pronounced for small and better capitalized BHCs. These tests shed further light on the mechanisms underlying the main results. This chapter also analyzes the dynamic pattern of BHCs' liquidity and lending around the subsidiary M&A time. The idea is to test whether the parent BHCs of subsidiaries experiencing M&A deals facing limited internal funds are forced to hoard more cash or liquidity assets, and curtail loans to ease the financial constraints before M&A deals taking place. The results validate this conjecture with the effect being stronger for smaller and less well capitalized BHCs, which suggests they are more vulnerable to internal capital fluctuation and thus have more adjustments in both asset and liability parts on their balance sheet. Further check on the performance of treated BHCs which increase long-term debt one year before subsidiaries engaging in M&A activities *relative to* those which do not around M&A deals shows that the treated BHCs have a more smooth transition in performance and suffer less in operating and market performance than those control BHCs which do not make such adjustments in advance. This chapter also documents several other mechanisms through which subsidiary banks' engagement in M&A activities affects parent BHCs' capital structure decisions including the following two findings: 1. Information asymmetry induced by subsidiary M&A activities affects BHCs' capital structure decisions by increasing the adjustment speed to the target leverage ratio; 2. Around the time of subsidiary banks engaging in M&A activities, the more quickly the BHCs close the gap between the last year's leverage and this year's target, the less risk they contribute to the whole system. Overall, this article, for the first time in the literature, systematically examines the dynamic aspects of various BHC capital structure decisions around the time of subsidiary bank M&A deals and their effects on BHC performance, liquidity, lending, and risk. The study can be seen as supplementary testimony in terms of the role of asymmetry information in affecting bank capital choices.

It is worth noting that Chapter III uses subsidiary bank status change (e.g., insolvency or acquisition) as a cut-off to discern the real effect of private information on the financial policies of holding banks. This constitutes the most important setting in my thesis. The following empirical chapters IV and V follow this setting and discuss the effect in the scenario of subsidiary failure and M&A, respectively. One may argue that why subsidiary failure and MA should be examined separately. The reasons are majorly twofold. First, the responses to these two different subsidiary bank events from parent BHCs have different motivations. Particularly, a subsidiary failure may be due to the financial deterioration of its own circumstance or the deterioration of the holding bank's circumstance. In anticipation of the bankruptcy of its subsidiary bank, the parent BHC may choose to conceal the disadvantageous information as argued in Chapter IV. Thus, the financial market does not have the failure information beforehand and hence, may over-evaluate the BHC's credit quality and the BHC can accordingly exploit the "window of opportunity" to conduct financing at relatively cheaper costs. BHC managers are tempted to do so because they want to grasp currently greater and cheaper credit market access, which will be highly likely to vanish once the bankruptcy news becomes widely known. These BHCs may also have low liquidity positions, thus must find external financing before their troubled affiliates fail. The empirical results of Chapter IV confirm that BHCs are incentivized to increase cheap debt borrowing before their subsidiaries going bust.

Whereas in the scenario of subsidiary M&A, the capital structure adjustment of BHCs has disparate motives. Subsidiary acquisitions may be a means for BHCs to penetrate new markets, realize potential economies, and acquire financial power and prestige associated with larger size.[2] Prior literature shows that those BHCs operate internal capital markets where they allocate capital and liquidity to and between subsidiary banks (Houston, James, and Marcus, 1997; Houston and James, 1998). Therefore, they provide an effective mechanism through which subsidiary banks affect the cash flow, capital position, and liquidity of parent holding companies. As many costs are involved in acquisition activities such as underwriter fees, consultancy fees, and distribution costs, these costs could have a significant impact on the capital allocations and operational activities for the whole organization. BHCs facing such scarce internal capital problems have incentives to seek external financing to avoid the further financial constraints. While these actions also take advantage of the information asymmetry to attract investors before takeover transactions as argued in Chapter V, BHCs concern more about their internal capital allocation problem rather than the deterioration of their financial circumstances when in a scenario of subsidiary failure.

Second, subsidiary failure and MA may pose different influence on the parent BHCs' capital structure decisions. While for either situation BHCs are prone to increase leverage beforehand, their capital decisions are quite divisive afterwards. The subsidiary failure lowers the credit quality of the BHC, which tightens the BHC's access to the credit market and raises its costs of debt financing (Kwan and Eisenbeis, 1997). Hence, continuing going for debt financing is not a sensible choice once the subsidiary failure is realized. BHCs also come under great pressures from regulators and market participants to control their default risks (Ashcraft, 2008). Creditors conjecture that subsidiary failure weakens the guarantees made by the BHCs and thus demand a higher risk premium for the BHCs' obligations. Thus, the BHCs' managers need to adjust their equity capital more closely in order to contain asset risk exposures in preference to paying large risk premium (Furlong and Keeley, 1989). Therefore,

[2] The terms M&A and acquisitions are used synonymously hereafter as in Chapter V I only study the scenario when subsidiary banks being the acquirer.

following subsidiary failure BHCs tend to lower the debt ratios and increase the capital reserve. The main results in Chapter IV validate this conjecture.

Contrarily, what parent BHCs do following subsidiary M&A could be different. Although subsidiary banks make the decisions of merges often for the consideration of efficiency gains and these gains may benefit them in turn, they are not necessarily improving the welfare to the parent BHCs. Some holding companies may be adversely affected by these changes and experience reduced capital available to allocate among the internal capital market. The limited capital and liquidity may prompt the parent BHCs to continue to improve their access to cheap financing sources (Desai, Foley, and Hines, 2004). In this vein, subsidiary acquisition activities could lead to higher financial leverage ratios and worse capitalization for the holding banks for more years to come. The main results in Chapter V also corroborate this conjecture.

Overall, Chapter IV and V provide two different mechanisms through which information asymmetry affects capital structure decisions of parent BHCs. Due to the aforementioned reasons, subsidiary failure and MA indeed need to be examined separately and thoroughly.

1.3. Structure of the thesis

The rest of the thesis proceeds as follows. Chapter II combines with the existing literature and discusses the theories of bank capital structure. Chapter III draws out the core assumption in this thesis and conducts several preliminary tests. Chapter IV investigates the information advantage BHC managers have prior to the declaration of a subsidiary failure, and analyzes the impact it may have on BHCs' capital structure. Chapter V examines the impact of information asymmetry induced by subsidiary M&A activities on BHCs' capital structure decisions. Chapter VI concludes.

Chapter II: Capital structure theories in banking

As Gropp and Heider (2010) note, "subsequent to the departures from Modigliani and Miller (1958)'s irrelevance proposition, there is a long tradition in corporate finance to investigate the capital structure decisions of non-financial firms. But what determines banks' capital structures? ...bank capital structure deserves further investigation." Unlike general firms, banks may be special in many aspects. However, in the first instance, banks are firms. Therefore, a good starting point to understand bank capital structure is to evaluate the current knowledge about capital structure decisions by firms in general. First, it is necessary to clarify some terminology terms used differently by regulators and researchers. Regulators tend to use "leverage ratio" to refer to the ratio of a bank's tier 1 capital to total assets, which, however, in this thesis, I will use "tier 1 capital ratio" to refer to. The leverage ratio is generally referred to the proportion of a firm's debt in terms of its total assets by finance researchers, and will continuously be used this way throughout this thesis.

2.1. Capital structure theories

Since Modigliani and Miller (1958) show that the value of a firm is unaffected by its capital structure choices under certain conditions, many financial economists have subsequently investigated the effects of relaxing these conditions. Several famous theories have been proposed, such as pecking order theory (Myers, 1984; Myers and Majluf, 1984), trade-off theory (Kraus and Litzenberger, 1973), market timing hypothesis (Baker and Wurgler, 2002), etc. Pecking order model states that firms prefer to fund investments by first using internal funds, then debt, and equity financing only as a last resort. According to this view, the leverage ratio of a firm increases when its retained earnings drop and decreases when internal funds build up. Trade-off theory states that a firm makes its capital structure decisions by trading off the benefits of the tax shield from debt against the costs of financial distress and agency costs. It is often seen as a competitor theory to the pecking order theory. Market timing hypothesis states that firms prefer equity financing when the cost of equity is low, and prefer debt otherwise. In other words, firms do not generally care whether they finance with debt or equity, but choose the form of financing which, at that point in time, appears to be more valued by financial markets. Baker and Wurgler (2002) claim that market timing is the first order determinant of a corporate capital structure. While controversy exists among researchers, the currently more accepted consensus is the second model as large empirical evidence shows that most of firms generally set a target leverage ratio and actively adjust towards this ratio, which is consistent with the prediction of dynamic trade-off model. In the classic survey article by Graham and Harvey (2001), CEOs or CFOs from over 70 percent of the firms report that their firms have a target leverage ratio.[3] Despite all this, researchers still have large estimation discrepancy regarding how fast firms adjust towards their target leverage. For example, Fama and French (2002) report a 7 to 10 percent adjustment speed rate for firms each year. In contrast, Flannery and Rangan (2006) report a surprisingly 34 percentage points speed of adjustment per year. Overall, financial economists are far from reaching consensus, nor are they certain that whether the target leverage is fixed or varied over time.

Nevertheless, one thing we can be certain of is that the Modigliani–Miller theorem provides the base to examine real world reasons why a company's value is relevant to the capital structure it chooses. These reasons include bankruptcy costs, agency costs, taxes, and information asymmetry. Particularly, Bharath, Pasquariello, and Wu (2009) empirically certify that information asymmetry is an important determinant of firms' capital structure, which constitutes the building block of the assumptions in this thesis.

In fact, a number of approaches to explaining capital structure have become possible since the introduction of information asymmetry. In one way, capital structure decisions are made to

[3] Graham and Leary (2011) also make an excellent review of all the existing capital structure theories.

mitigate inefficiencies in the firm's investment decisions that are caused by the information asymmetry (Harris and Raviv, 1991). This strand of research began with the work of Myers and Majluf (1984) and Myers (1984). In another, firms' capital structure can signal inside information to outside investors. This branch of the literature starts with Ross (1977) and Brealey, Leland, and Pyle (1977).

Many have also discussed various characteristics that could affect capital structure and financing decisions, e.g., size and market-to-book ratio. Size has been used to proxy firms' expected bankruptcy cost and is expected to be positively correlated with firms' debt issuance (Graham, Lemmon, and Schallheim, 1998; Hovakimian, Opler, and Titman, 2001; Diamond, 1991). The market-to-book ratio has been used as a measure of growth opportunities and is expected to be positively correlated with firms' external financing (Baker and Wurgler, 2002).

Profitability and asset tangibility are also shown to be related to firms' capital structure choices. However, their effects are relatively opaque. Profitability can either be used as a proxy for internal cash available for investment funding or taxable income to be shielded (Donaldson, 2000; Myers, 1984; Leary, 2009). Similarly, the effect of asset tangibility is unclear as it can either proxy for the severity of the information asymmetry, collateral available for firms' external financing, or demand for future investments (Titman and Wessels, 1988; Rajan and Zingales, 1995).

The recent literature has also found firm fixed effects help explain more in the variation of firms' leverage (Lemmon, Roberts, and Zender, 2008). This finding suggests that firms' choice of capital structure is largely driven by unobserved time-invariant firm-specific characteristics. Since Modigliani and Miller (1958) show that the value of a firm is unaffected by its capital structure choices under certain conditions, many financial economists have subsequently investigated the effects of relaxing these conditions. Several famous theories have been proposed, such as pecking order theory (Myers, 1984; Myers and Majluf, 1984), trade-off theory (Kraus and Litzenberger, 1973), market timing hypothesis (Baker and Wurgler, 2002), etc. Pecking order model states that firms prefer to fund investments by first using internal funds, then debt, and equity financing only as a last resort. According to this view, the leverage ratio of a firm increases when its retained earnings drop and decreases when internal funds build up. Trade-off theory states that a firm makes its capital structure decisions by trading off the benefits of the tax shield from debt against the costs of financial distress and agency costs. It is often seen as a competitor theory to the pecking order theory. Market timing hypothesis states that firms prefer equity financing when the cost of equity is low, and prefer debt otherwise. In other words, firms do not generally care whether they finance with debt or equity, but choose the form of financing which, at that point in time, appears to be more valued by financial markets. Baker and Wurgler (2002) claim that market timing is the first order determinant of a corporate capital structure. While controversy exists among researchers, the currently more accepted consensus is the second model as large empirical evidence shows that most of firms generally set a target leverage ratio and actively adjust towards this ratio, which is consistent with the prediction of dynamic trade-off model. In the classic survey article by Graham and Harvey (2001), CEOs or CFOs from over 70 percent of the firms report that their firms have a target leverage ratio.[4] Despite all this, researchers still have large estimation discrepancy regarding how fast firms adjust towards their target leverage. For example, Fama and French (2002) report a 7 to 10 percent adjustment speed rate for firms each year. In contrast, Flannery and Rangan (2006) report a surprisingly 34 percentage points speed of adjustment per year. Overall, financial economists are far from reaching consensus, nor are they certain that whether the target leverage is fixed or varied over time. Nevertheless, one thing we can be certain of is that the Modigliani–Miller theorem provides the base to examine real world reasons why a company's value is relevant to

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the capital structure it chooses. These reasons include bankruptcy costs, agency costs, taxes, and information asymmetry. Particularly, Bharath, Pasquariello, and Wu (2009) empirically certify that information asymmetry is an important determinant of firms' capital structure, which constitutes the building block of the assumptions in this thesis.

The extant literature documents several approaches to explaining capital structure with the introduction of information asymmetry. In one way, capital structure decisions are made to mitigate inefficiencies in the firm's investment decisions that are caused by the information asymmetry (Harris and Raviv, 1991). This strand of research began with the work of Myers and Majluf (1984) and Myers (1984). In another, firms' capital structure can signal inside information to outside investors. This branch of the literature starts with Ross (1977) and Brealey, Leland, and Pyle (1977).

A large stand of literature also provides evidence that several firm characteristics could significantly affect capital structure and financing decisions, e.g., size and market-to-book ratio. Size has been used to proxy firms' expected bankruptcy cost and is expected to be positively correlated with firms' debt issuance (Graham, Lemmon, and Schallheim, 1998; Hovakimian, Opler, and Titman, 2001; Diamond, 1991). The market-to-book ratio has been used as a measure of growth opportunities and is expected to be positively correlated with firms' external financing (Baker and Wurgler, 2002). Profitability and asset tangibility are also shown to be related to firms' capital structure choices. However, their effects are relatively opaque. Profitability can either be used as a proxy for internal cash available for investment funding or taxable income to be shielded (Donaldson, 2000; Myers, 1984; Leary, 2009). Similarly, the effect of asset tangibility is unclear as it can either proxy for the severity of the information asymmetry, collateral available for firms' external financing, or demand for future investments (Titman and Wessels, 1988; Rajan and Zingales, 1995). The recent literature has also found firm fixed effects help explain more in the variation of firms' leverage (Lemmon, Roberts, and Zender, 2008). This finding suggests that firms' choice of capital structure is largely driven by unobserved time-invariant firm-specific characteristics.

As discussed above, the current prevalent opinion in academia regarding firm capital structure decisions is that firm managers choose a target leverage ratio to which they actively adjust over time. This argument corresponds to the universally accepted dynamic trade-off model, where firms have to trade off the benefits of interest tax shield against the costs of financial distress and agency costs when increasing their leverage ratio. There is an optimal point where the value of the firm reaches to the maximum and which firm managers target to. Whether banks have similar working mechanisms is largely in doubt. The relevant literature is also very limited. Some financial researchers have argued from the market perspective and reported that banks work through a similar trade-off model to the one used by the non-financial firms determined by the various market factors. Such work includes, but is not limited to Berger, DeYoung, Flannery, Lee, and Öztekin (2008), Flannery and Rangan (2008), and Gropp and Heider (2010) which can be regarded as preliminary explorations of banks' target leverage. Others argue that the regulation indeed determines the banks' capital choices. Banks hold the minimum required equity capital plus some cushion to avoid the high costs of issuing equity or reducing assets at a short notice by the regulation. While no consensus is reached, the results in this thesis are more supportive to the market view. As the following chapters will do, this thesis examines the validity of the setting of the market view on banks' leverage decisions and presents some mechanisms through which information asymmetry operates.

While the empirical evidence has not concluded that whether banks have preference to only hold the minimum regulatory capital plus some capital buffer, or just pursue the optimal capital structure decisions driven by market pressures, the literature does reach some agreement regarding the characteristics and utilization of bank capital. These consensus could potentially form the important components of the complete bank capital structure theory in the future. In detail, they include the following several aspects.

Bank assets are risky and relatively illiquid compared with liquid liabilities. As already known, banks are highly levered and most of their liabilities come from deposits. These deposits can be used as instant money and become a primary output of banks. At the same time, the assets of banks are more risky. They consist of loans and other portfolios. Banks have to monitor the borrower to ensure the return can be adequate enough to repay depositors and other investors. Bank capital, as required by the regulation, serves as the buffer protect the banks from the default of any assets or portfolios. However, this also creates a paradox where the more capital a bank has, that is, the less levered and better capitalized the bank is, the weaker the depositors' monitoring imposed on the bank.

Second, although bank capital could help prevent from a bank run, it also has high holing costs. Therefore, how much a bank needs to hold for its capital is a trade-off. Meanwhile, it is commonsense that the revenues of a firm will first meet the claim by debt holders, and then they could be paid to shareholders. Accordingly, the gain of stockholders will only increase if the firm revenues significantly increase. Banks are no exception. When the major equity holders invest more in banks, the more incentives they have to monitor the banks as they could potentially earn more in the event of successful loan payback.

Third, more deposits also force bankers to monitor the borrowers. The more deposits invested by depositors, and thus the higher the bank's leverage. In this case, as banks own large amount of deposit contracts, fear of depositors withdrawing money with a short notice, bankers have strong incentives to monitor the loan borrowers to ensure the loans will be paid back without delay. They can then use the loan revenues to make the promised payments to depositors, debt holders, and then shareholders. Thus, a more levered bank with more deposits in stock comes with a more rigorous monitoring mechanism.

2.2. Asymmetric information and bank capital structure

So far, I have discussed that many financial researchers have systematically investigated the capital structure decisions of non-financial firms. However, banking firms are largely excluded from the traditional corporate finance literature. Part of the reasons might be that regulation constitutes the overriding departure from what have been found for those non-financial firms (Gropp and Heider, 2009). As pointed out by Myres (2001) financial firms cannot adjust their financial policies at relatively low costs and thus have very limited financing objectives.

While these views appear sensible, they actually contradict the evidence of the distribution of bank capital over the past decades. The Figure 3 in Gropp and Heider (2010) drawing the distribution of banks' regulatory Tier 1 capital ratio for those largest public traded banks in the US and EU from 1991 to 2004 shows that there is large cross-sectional variation in the capital ratio of banks under the Basel regulatory regime. Banks also do not appear to hold the minimum amount of equity capital as required by the regulatory authorities. In contrast, researchers find that there has been a significant rise in bank regulatory capital ratio since 1990. BHC book equity to asset ratio, on average, rose from 6% in the late 1980s to over 8% in the 1990s, and then surprisingly 9% until the 2007-2008 financial crisis. In market value terms, this phenomenon is even more noticeable. The market value of equity to market value of assets rose from 6% in 1990 to more than 15% after 2000. The rightward shift trend in bank capital demonstrates that it is worthy of further investigation for bank capital structure. Understanding what factors actually drive the bank capital decision over the past decades can provide essential insights for regulations, industry, and various reform proposals.

While it is well documented that banks generally have very high leverage compared with most firms from non-banking industry, this does not mean similar determinants do not take effect when both banks and non-banking firms decide the form of their capital structure. Indeed, Gropp and Heider (2010) document that the determinants of capital structure for banks and non-financial firms are very similar. They even report that the sign and significance of most variables when examining their effects on bank leverage are similar to those in studies of non-financial firms in the US and other G7 countries. Their findings provide the strong theoretical foundation for this thesis to examine the various incentives of BHCs adjusting their capital choices while at the same time accounting for other important factors that may affect bank leverage decisions. The study is also motivated by the fact that a bank holding company (henceforth referred to as "BHC") will suffer from internal capital scarceness when one or some of its subsidiaries have major structural changes. This chapter focuses on the changes in subsidiaries including them filing for bankruptcy or announcing M&A deals. Prior literature shows that BHCs operate internal capital markets where they allocate capital and liquidity to and between subsidiary banks (Houston, James, and Marcus, 1997; Houston and James, 1998). Therefore, this provides an effective mechanism through which subsidiary banks affect the cash flow, capital position, and liquidity of parent holding companies. Substantial costs involved in changes in subsidiaries could have a significant impact on the capital allocations and operational activities for the whole organization. BHCs facing such scarce internal capital problems have incentives to take actions to avoid the further financial constraints. One of the most popular actions BHCs can take in the capital market is to change their financing decisions. To demonstrate these arguments, suppose that one or some of a BHC's subsidiaries declare bankruptcy in a specific year. Investors holding the debt or equity of these subsidiaries are likely to lose part or all of their investment. As is often the case that subsidiary banks are funded by their parent, subsidiary failure means a costly process because the loss incurred will be majorly covered by the parent and the internal capital market established by the BHC will be hurt to some extent. BHCs facing limited internal funds may be forced to seek external financing to sponsor their various financial activities. On the other hand, information asymmetry is severe prior to subsidiary failure. BHC insiders have information advantage over outside investors regarding the status of their subsidiaries. The advantage may be utilized by managers to adjust BHCs' financing decisions accordingly. Furthermore, following the subsidiary bankruptcy, managers may instead take actions to mitigate the asymmetric information in order to lower the future financing cost. All of these provide motivations for parent banks to heavily adjust their capital structures around the periods when their subsidiaries go bankrupt.

This thesis is closely related to the studies of information asymmetry and financing decisions. While the previous literature widely accepts the importance of private information in exploring firms' capital structure, banks are generally excluded from empirical investigations of financing decisions. This is due to the fact that banking industry is generally heavily regulated, which may bring the overriding departure from what researchers have concluded in those non-financial firms. This thesis, however, specializes the information asymmetry arisen prior to the subsequent subsidiary bank status changes and investigates if the information asymmetry will be exploited by bank managers to adjust their financing decisions accordingly. To the best of the knowledge, this is the first paper to use material structural changes of subsidiary banks as a cut-off to discern the real effect of private information. Additionally, it also adds the contribution to the limited literature which can reflect banks' financing decisions under asymmetric information. Lucas and McDonald (1992) point out that financing decisions of banks can be distorted due to information asymmetry because they are better informed of their assets quality than are outsiders. Jagtiani and Lemieux (2001) examine the pricing behavior of bonds issued by the parent BHCs of failed subsidiaries. Their findings show that bond spreads begin rising as early as six quarters prior to the failure, as the issuing BHC’s financial condition and credit rating deteriorate. They also report that the spreads for troubled BHCs are many times those of healthy ones. Billett and Garfinkel (2004) explore banks’ funding choices from segmented markets. They argue that with the existence of asymmetry information banks’ securities could be priced remarkably differently by segmented markets, and banks will increase their reliance on the relatively cheaper external market. The degree of the reliance depends on the costs of raising funds from different markets. Accordingly, banks try to take most advantage of the pricing discrepancies and target the market with the lowest access costs. Holod and Peek (2007) investigate the access of banks to information-based external financial market by comparing the behaviors of banks (including bank holding companies) with different transparency in response to the exogenous shock and find information asymmetry does affect their financing decisions. Morgan (2002) suggests that banking is more opaque than any other sorts of industries. They find that ratings from major agencies often disagree more over the bank bond issues than over issues by other types of firms, and this disagreement provides a good proxy for the bank uncertainty associated with asymmetric information. The veil between banks and outsiders makes market investors unable to accurately quantify the risk of banking firms as well as their securities. While supplementing these previous studies, this thesis attempts to propose some new sights of judging the private information and examine its effectiveness in changing BHCs’ capital structure. Therefore, the core premise within our topic is that banks have information advantage over market investors. Whether or not this kind of information asymmetry underlying in the banking system may be exploited by bank managers is an open question with important implications for understanding various motivations that banks may have in making capital choices.

In 2001, George Akerlof, Michael Spence, and Joseph Stiglitz jointly received the Nobel Prize in economics for their analyses of markets with asymmetric information and adverse selection. In this chapter, I discuss the implications of their theory for firm capital structure. This theory, however, has much broader applications. As described on the Nobel Prize Web site (www.nobelprize.org): Many markets are characterized by asymmetric information: Actors on one side of the market have much better information than those on the other. Borrowers know more than lenders about their repayment prospects, managers and boards know more than shareholders about the firm's profitability, and prospective clients know more than insurance companies about their accident risk. During the 1970s, this year's Laureates laid the foundation for a general theory of markets with asymmetric information. Applications have been abundant, ranging from traditional agricultural markets to modern financial markets. The Laureates' contributions form the core of modern information economics.[5]

In this vein, to systematically review the bank capital structure given the asymmetric information, the following main empirical chapters focus on the setting of bank holding companies (BHCs) and their subsidiaries. A BHC is a financial holding group that controls one or more commercial banks as well as other non-financial affiliates. The setting is based on the parent BHC's changes in capital structure choices in response to the momentous status changes of their subsidiaries such as bankruptcy or M&A. There's evidence that subsidiary failure or M&A can affect the parent as well as the whole holding company system on several grounds. As argued by Wall and Peterson (1987), a BHC as the owner needs to provide its financial assistance to its troubled subsidiary, which means the balance sheet of the parent is influenced by the status of its subsidiaries. Second, Ashcraft (2008) notes that holding company subsidiaries often work together to process the common data and provide financial products to customers. The failure of one subsidiary will bring down the whole chain of

[5] "The Prize in Economic Sciences 2001 - Press Release." Nobelprize.org.

products, finally impairing the whole holding company. Third, the traditional theory suggests that the negative effects of highly risky subsidiaries can be insulated by the "firewalls" built around other subsidiaries. However, Boyd et al. (1993) cast doubt on this stating 'firewalls' may not provide the desired result. They report that banking-subsidiary resources will be employed to aid financially distressed subsidiaries if the activities of banking and nonbanking subsidiaries are not fully separated by law. Fourth, Wall (1987) points out the failure of one subsidiary may cause the public to suspect the management quality of the affiliates within the holding company and a bank run in a worse situation. In sum, the dilemma described above provides BHCs incentives to raise more external funds to alleviate the deterioration of the financial conditions incurred by the failure of one or more of their subsidiaries.

There're two federal laws enacted in the early 1990s which are connected with the above concern. One is the Federal Deposit Insurance Corporation Improvement Act (FDICIA), and the other is the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA). The FDICIA passed by the US Congress in 1991 allows a BHC to use the resources of its subsidiaries to support a troubled subsidiary bank including the capital transfer to that bank to prevent bankruptcy. That is to say while the ultimate failure of a banking subsidiary may potentially harm the internal capital market established by the holding company, the parent can actually act as a "source-of-strength" to this troubled child ex ante. The FDICIA clarifies this "source-of-strength" doctrine and grants the Federal Reserve the authority to take enforcement actions for the BHCs that fail to do so when resources were available. The other federal law the FIRREA passed in 1989 authorizes the Federal Deposit Insurance Corporation (FDIC) to shift the expected losses of a failed subsidiary onto the capital of non-failing affiliates. These banking reforms have been documented by the previous literature (Ashcraft, 2005, 2008). However, these papers mainly focus on the bailouts of sick affiliations and associated allocations of the internal capital. In fact, these policies have been challenged by the banking industry through litigation reflecting the fact that the BHCs are not willing to do what the regulators are forcing them to do. There might be an incentive contradiction between the BHCs and the regulators regarding troubled bank subsidiaries. The following chapters contrarily look at the BHCs' actions in the outside security market and study whether they have incentives to find external financing in the wake of the subsidiary structural changes. Whether the funds raised by issuing debt or equity from the outside market is for subsidiary affiliations or their own interests is worthy of further investigation.

Additionally, information problems and other capital market frictions make external financing costly, while banks play a fundamental role in mitigating many such problems. However, this might cause an additional layer of information problems for banks themselves as a great variety of bank activities may be difficult for outsiders to attain (Houston, James, and Marcus, 1997). Particularly, the unfavorable private information of a bank, being only available to bank insiders, may create morale hazard problem resulting from its engaging in undesirable activities from the outsider's point of view. Moreover, managers (insiders) are reluctant to release firm relevant information to the market that would compromise their strategic programs as pointed out by Kisgen (2006). Therefore, we have reasons to believe that banks may exploit such information asymmetry and adjust their financing decisions accordingly. BHC managers are able to foresee the subsidiaries' financial conditions in the near future with greater precision than investors, based on their better knowledge of the inside information. As reported by Myres (2001), firm managers have large information advantage over outsiders. Whether or not this kind of information asymmetry underlying in the banking system may be exploited by bank managers is an open question with important implications for understanding various motivations that banks may have in issuing securities. Intuitively, BHCs may have incentives to pursue more external financing when they ex ante learn one of the subsidiaries is going to fail or engage in M&A activities. Managers are tempted to do so because they want to grasp current greater and cheaper credit market access which will be highly likely to vanish once the bankruptcy or M&A news becomes known to all. These BHCs also tend to be negatively associated with liquidity, thus must find external financing before their troubled affiliates fail. Tang (2009) makes a similar allegation for this situation that "credit market imperfections such as information asymmetry significantly affect firms' financing and investment decisions".

Figure 2.1 shows the distribution of BHCs' book equity ratio (ratio of total equity capital to assets) for the 10889 BHC-year observations in the sample for the US BHCs from FR Y-9C reports over the period from 1986 to 2015 (the data is described in more detail in Chapter IV). As can be seen, there is large heterogeneity in BHCs' book equity ratios with capital ratios of most of banks being around nine percent, which is well above the capital requirement set by the Basel accord. However, this figure suggests that bank capital structure is worthy of further investigation.

It is worth noting that prior literature shows that BHCs operate internal capital markets where they allocate capital and liquidity to and between subsidiary banks (Houston, James, and Marcus, 1997; Houston and James, 1998). Therefore, internal capital markets provide an effective mechanism through which subsidiary banks affect the cash flow, capital position, and liquidity of parent holding companies. As a BHC owns a significant share of its subsidiaries' equity capital and often has counterparty business relations with subsidiaries, the material structural changes of a subsidiary bank may render the debt and equity of the subsidiary worthless and hence, brings substantial losses to its BHC and jeopardizes the BHC's financial conditions, accordingly incentivizing BHCs to adjust capital decisions to avoid further financial constraints.

This thesis considers the information advantage BHC managers have in shaping BHCs' capital structure and postulates that, based on the better knowledge of a subsidiary's up-to-date financial condition, managers in the parent bank are able to foresee the material structural changes of a subsidiary in the near future with greater precision than outside investors. The following empirical chapters will examine whether bank holding companies exploit such an information advantage and adjust financing activities in their own interests. The evidence suggests that the "troubled" BHCs foresee a tightened credit market access and the increased borrowing costs once the bankruptcy or takeover deal of subsidiary banks is realized. Thus, "treated" BHCs increase debt financing in advance to take advantage of the presently cheaper debt financing and enjoy benefits. The findings are consistent with the argument of Billett and Garfinkel (2004) that, with the existence of asymmetric information, bank securities could be priced remarkably differently in segmented markets, and that banks take most advantage of the pricing discrepancies and target the segment that has the lowest access costs.

This thesis majorly makes the following contributions. First, this paper adds to the extant literature that documents bank-specific information asymmetry. Houston, James, and Marcus (1997) report that a great variety of bank activities may be difficult for outsiders to attain. Dell'Ariccia and Marquez (2004) argue that unfavorable private information of a bank, which is available only to insiders, may create morale hazard problems and result in a bank's engagement in undesirable activities. Holod and Peek (2007) investigate the access of banks to information-based external financial markets by comparing the behaviors of banks, including bank holding companies, with different transparency levels in response to exogenous shocks, and find that information asymmetry does affect bank financing behaviors. Morgan (2002) argues that the banking industry is more opaque than other industries, and finds that ratings from major agencies often disagree more over banks' bond issues than issues by other types of firms. Blau, Brough, and Griffith (2017) report that bank opacity is associated with less information efficiency in financial markets.

This thesis emphasizes the information asymmetry arisen prior to the subsidiary bank failure, and investigates whether bank managers exploit such information asymmetry to adjust their capital structure decisions accordingly. The core premise of our question is that banks have information advantage over market investors (i.e., the parent bank knows that one or some of its subsidiaries may go bankrupt or engage in takeover deals, but investors do not have this information). To the best of our knowledge, this thesis is the first to use subsidiary bank status changes as a cut-off to discern the association between private information and financial policies of holding banks. The findings of the paper imply that the veil between banks and outsiders makes investors unable to accurately quantify the risk of banking firms as well as their securities.

Second, this thesis is related to the market timing theory, which states that firms prefer equity financing when the cost of equity is low, and prefer debt otherwise. Baker and Wurgler (2002) claim that firms do not generally care whether they finance with debt or equity, but choose the form of financing which, at that point in time, appears to be more valued by financial markets. Bolton, Chen, and Wang (2013) show that firms appear to optimally time financial markets and hold precautionary cash buffers in anticipation of adverse financing shocks. Our work takes the perspective of banks and attempts to discern the potential timing behavior of BHC insiders in anticipation of future subsidiary failure.

Third, this thesis also extends prior limited work that focuses on bank capital structure. Some recent work includes Gropp and Heider (2010), Mehran and Thakor (2011), and Allen, Carletti, and Marquez (2015). Gropp and Heider (2010) document that the determinants of capital structure for banks and non-financial firms are very similar. Mehran and Thakor (2011) show that total bank value, as well as its various components, is positively associated with bank capital. Allen, Carletti, and Marquez (2015) study optimal bank capital structure and its implications for the pricing of equity, deposits, and loans. None of these studies is designed to consider the role of information asymmetry in shaping bank capital structure that is the focus of this paper.

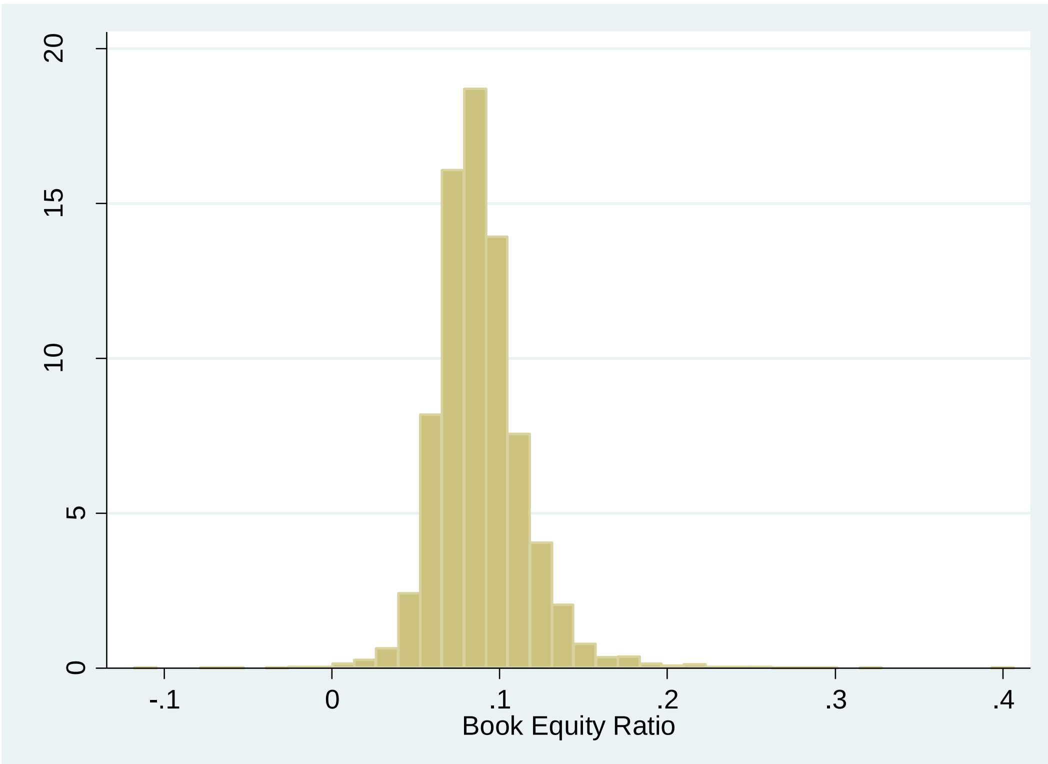
Fourth, this thesis also adds to the literature that examines bank mergers and acquisitions. For example, DeYoung et al. (2009) document the fundamental change of banks as the roles of financial intermediaries through the consolidations over the past decades, and evaluate the economic consequences of this ongoing trend, Karolyi and Taboada (2015) study cross-border acquisitions and argue that they provide a mechanism through which banks can change their regulatory environment from a stronger supervision environment to a much weaker one, and Chen and Vashishtha (2017) explore the effects of bank takeovers on corporate information disclosure and find that corporate borrowers significantly increase information disclosure after their lending banks engage in takeovers. The main focus of this study is trying to build the link between subsidiary bank mergers and the parent BHC's capital structure decisions.

Last but not least, this study contributes to the large strand of literature that focuses largely on the real effects of private information, such as financing arrangements (Sufi, 2007), equity issues (Dierkens, 1991), asset prices (Chan, Menkveld, and Yang, 2008), and competition, adverse selection, and information dispersion in the banking industry (Marquez, 2002). One implication of this chapter is that some results in the following ones could be associated with the role information asymmetry plays in banks' capital structure decisions.

Overall, this article, for the first time in the literature, systematically examines the dynamic aspects of various BHC capital structure decisions around the time of its subsidiary bank material structural changes and their effects on BHC performance, liquidity, lending, and risk. This study thus broadly contributes to the literature examining the determinants of firm and bank performance (Rajan and Zingales, 1995; Lemmon, Roberts, and Zender, 2008; Gropp and Heider, 2010; Marcus, 1983).

Figure 2. 1: Distribution of BHC book equity ratio

This figure shows the distribution of BHCs' book equity ratio (ratio of total equity capital (BHCK3210) to assets (BHCK2170)) for the 10889 BHC-year observations in the sample for the US BHCs from FR Y-9C reports over the period from 1986 to 2015.



Chapter III: Asymmetry information and banks' capital structure adjustments

3.1. Introduction

In 2001, George Akerlof, Michael Spence, and Joseph Stiglitz jointly received the Nobel Prize in economics for their analyses of markets with asymmetric information and adverse selection. In this chapter, I discuss how asymmetry information may motivate bank managers to alter a bank's capital structure. This theory, however, has much broader applications. As described on the Nobel Prize Web site (www.nobelprize.org): *Many markets are characterized by asymmetric information: Actors on one side of the market have much better information than those on the other. Borrowers know more than lenders about their repayment prospects, managers and boards know more than shareholders about the firm's profitability, and prospective clients know more than insurance companies about their accident risk. During the 1970s, this year's Laureates laid the foundation for a general theory of markets with asymmetric information. Applications have been abundant, ranging from traditional agricultural markets to modern financial markets. The Laureates' contributions form the core of modern information economics*.

The recent banking literature has barely covered the capital structure issue. Part of the reasons might be regulation constitutes the overriding departure from what have been found for those non-financial firms (Gropp and Heider, 2009). As pointed out by Myres (2001) financial firms cannot adjust their financial policies at relatively low costs and thus have very limited financing objectives.

In fact, banks may have various motives to change their capital structure. I specifically explore financing actions among bank holding companies in the United States when information asymmetry is most severe (e.g., internal structure or financial circumstance changes). The study therefore aims to disentangle the role of information asymmetry in shaping banks' financial policy.

It is widely accepted that banks play an important role in mitigating information problems and other capital market frictions that make external financing costly. However, this role suggests that a great variety of bank activities may be difficult for outsiders to attain, which, in turn, can create an additional layer of information problems for banks themselves (Houston, James, and Marcus, 1997). Particularly, the unfavorable private information of a bank, being only available to bank insiders, may create morale hazard problem resulting from its engaging in undesirable activities from the outsider's point of view. Moreover, managers (insiders) are reluctant to release firm relevant information to the market that would compromise their strategic programs as pointed out by Kisgen (2006). Therefore, we have reasons to believe that banks may exploit such information asymmetry and adjust their financing decisions accordingly.

BHC managers are able to foresee their internal financial circumstances in the near future with greater precision than investors, based on their better knowledge of the insider information. As reported by Myres (2001), firm managers have large information advantage over outsiders. Whether or not this kind of information asymmetry underlying in the banking system may be exploited by bank managers is an open question with important implications for understanding various motivations that banks may have in issuing securities. Intuitively, BHCs may have incentive to pursue more external financing when they ex ante forecast the negative future cash flows. Managers are tempted to do so because they want to grasp current greater and cheaper credit market access which will be highly likely to vanish once the negative news becomes known to all. These BHCs also tend to be negatively associated with liquidity at that moment, thus must find external financing before any rating downgrading. Tang (2009) makes a similar allegation for this situation that "credit market imperfections such as information asymmetry significantly affect firms' financing and investment decisions"

This conjecture may contradict the traditional trade-off theory which explains that firms choose an optimal capital structure to maximize value to current shareholders and debtholders. However, as discussed in Chapter 2, capital structure decisions, like investment decisions, are made by managers who have their own incentives. Proponents of the management entrenchment theory of capital structure believe that managers choose a capital structure primarily to avoid the discipline of debt and maintain their own entrenchment. Thus, managers seek to minimize leverage to prevent the job loss that would accompany financial distress. Managers are constrained from using too little debt, however, to keep shareholders happy. If managers sacrifice too much firm value, disgruntled shareholders may try to replace them or sell the firm to an acquirer. Under this hypothesis, firms will have to find a balance between debt and equity financing resort in response to a takeover threat or the threat of shareholder activism.

This chapter introduces a new model which I term as *information gap* model and uses it to investigate the role of information asymmetry in shaping banks' capital structure decisions. As an intro empirical chapter, I use subsidiary bank status change (bankruptcy or M&A) as a cut-off to discern the real effect of private information on the financial policies of holding banks. This constitutes the most important setting in my thesis. The following empirical chapters will follow this setting and discuss the effect in the scenario of subsidiary failure and M&A, respectively. Existing studies show that material subsidiary status change such as bankruptcy or having a takeover deal can affect the parent as well as the whole holding company system on several grounds. As argued by Wall and Peterson (1987), a BHC as the owner needs to provide its financial assistance to its subsidiary, which means the balance sheet of the parent is influenced by the status of its subsidiaries. Second, Ashcraft (2008) notes that holding company subsidiaries often work together to process the common data and provide financial products to customers. The failure of one subsidiary will bring down the whole chain of products, finally impairing the whole holding company. Third, the traditional theory suggests that the negative effects of highly risky subsidiaries can be insulated by the "firewalls" built around other subsidiaries. However, Boyd et al. (1993) cast doubt on this stating 'firewalls' may not provide the desired result. They report that banking-subsidiary resources will be employed to aid financially distressed subsidiaries if the activities of banking and nonbanking subsidiaries are not fully separated by law. Fourth, Wall (1987) points out the failure of one subsidiary may cause the public to suspect the management quality of the affiliates within the holding company and a bank run in a worse situation. In sum, the dilemma described above provides BHCs incentives to raise more external funds to alleviate the deterioration of the financial conditions incurred by the failure of one or more of their subsidiaries.

To capture the value of information asymmetry, I construct a measure of the information gap between BHCs and outside investors concerning the prediction of subsidiary bankruptcy or engaging in acquisition activities in the next year. I present a model in which outsiders predict this based on the parent's actions and all other publicly available information. The framework therefore explicitly accommodates the ability of outsiders to infer bank internal conditions by observing the parents' actions on capital structure changes. The information gap is thus defined as the difference between the actual and the forecasted status of subsidiaries. We then model the relation between the BHCs' financing adjustments prior to their subsidiary failure or acquisition and our measure of the information gap, controlling for a set of conventional variables.

The empirical analyses suggest that information asymmetry significantly influences BHCs' choices to fund investment. More specifically, BHCs on average increase their long-term debt financing by 1.41% one year prior to their subsidiary status change. Further results show that BHCs continue to raise their long-term debt in the same year. We however find that ex post, long-term debt issuance is lessened immediately and ceteris paribus, BHCs turn to rely more on equity financing and on average increase it by 0.91%. These findings can be explained in the following way. First of all, the "troubled" BHC enjoys potential benefits from the presently better credit market access because investors can't easily discern between them and other normal BHCs in the presence of information asymmetry. However, the credit market access of the "troubled" BHCs will be shortly tightened after their subsidiary banks go into liquidation or try to acquire other banks. In anticipation of this managers in the parent banks will take advantage and rely more on the cheaper debt financing knowing their future borrowing costs will rise sharply. Secondly, overly optimistic expectations about the future performance, cause the market to temporarily misprice the debt and equity of these "troubled" BHCs in advance of their subsidiary status changes. Informed of this, inside managers will try to exploit the mispricing. Similarly, as claimed by Flannery (1986) firm insiders, who are better informed than outside investors, choose to issue certain types of securities that the market appears to overvalue the most. Myers (2001), among others, describes such kind of "financing tactics" or "financing strategies" due to information asymmetry. Thirdly, BHCs may prefer to get the benefits of leverage before (Hung et al., 2014). Berger et al. (2005) also suggest that firms with unfavorable private information are willing to pay the costs on long-term debt. Contrarily, raising equity will have limited benefits, but immediate costs with significant drops in the share price on the announcement (Asquith and Mullins, 1986). Consequently, the "troubled" BHC is more likely to choose to enjoy the relatively cheaper cost of debt borrowing when balancing the benefits and costs of debt or equity financing choice.

This paper is closely related to the studies of information asymmetry and financing decisions. While the previous literature widely accepts the importance of private information in exploring firms' capital structure, banks are generally excluded from empirical investigations of financing decisions. This is due to the fact that banking industry is generally heavily regulated, which may bring the overriding departure from what researchers have concluded in those non-financial firms. This paper, however, specializes the information asymmetry arisen prior to the subsequent subsidiary bank failure and investigates if the information asymmetry will be exploited by bank managers to adjust their financing decisions accordingly. To the best of my knowledge, this is the first paper to use subsidiary bank bankruptcy or acquisition as a cut-off to discern the real effect of private information. Additionally, it also adds the contribution to the limited literature which can reflect banks' financing decisions under asymmetric information. Lucas and McDonald (1992) point out that financing decisions of banks can be distorted due to information asymmetry because they are better informed of their assets quality than are outsiders. Jagtiani and Lemieux (2001) examine the pricing behavior of bonds issued by the parent BHCs of failed subsidiaries. Their findings show that bond spreads begin rising as early as six quarters prior to the failure, as the issuing BHC's financial condition and credit rating deteriorate. They also report that the spreads for troubled BHCs are many times those of healthy ones. Billett and Garfinkel (2004) explore banks' funding choices from segmented markets. They argue that with the existence of asymmetry information banks' securities could be priced remarkably differently by segmented markets, and banks will increase their reliance on the relatively cheaper external market. The degree of the reliance depends on the costs of raising funds from different markets. Accordingly, banks try to take most advantage of the pricing discrepancies and target the market with the lowest access costs. Holod and Peek (2007) investigate the access of banks to information-based external financial market by comparing the behaviors of banks (including bank holding companies) with different transparency in response to the exogenous shock and find information asymmetry does affect their financing decisions. Morgan (2002) suggests that banking is more opaque than any other sorts of industries. They find that ratings from major agencies often disagree more over the bank bond issues than over issues by other types of firms, and this disagreement provides a good proxy for the bank uncertainty associated with asymmetric information. The veil between banks and outsiders makes market investors unable to accurately quantify the risk of banking firms as well as their securities. While supplementing these previous studies, this chapter attempts to propose some new sights of judging the private information and examine its effectiveness in changing BHCs' capital structure.

The paper is also related to the market timing (or windows of opportunity) theory, which states that firms prefer equity financing when the cost of equity is low, and prefer debt otherwise. In other words, firms do not generally care whether they finance with debt or equity, they just choose the form of financing which, at that point in time, seems to be more valued by financial markets. Baker and Wurgler (2002) claim that market timing is the first order determinant of a corporation's capital structure use of debt and equity.

The remainder of this chapter is organized as follows. Section 3.2 describes the model on information asymmetry. Section 3.3 gives the description of the data. Section 3.4 contains general empirical tests and additional tests are presented in Section 3.5. Section 3.6 concludes.

3.2. A model on information asymmetry

3.2.1. Information gap model – theoretical background

In this section, I introduce a new model which I term as *information gap* model. As Myers (2001) argues, firm managers' information advantage over outsider investors is large. I postulate that BHCs' private information only available to bank managers allows them to accurately anticipate the subsidiaries' status in the near future.

Let $\mathcal{I}_{i,t}^{SF}$ be the indicator of the event of the subsidiary material status change and take a value of 1 when a subsidiary of the BHC *i* fails or acquires other firms in year *t*, and zero when no subsidiary does. As we discuss above, market participants have access to only publicly available information at time *t* - 1. Define $X_{i,t-1}$ as the information set that is publicly available about BHC *i* including any publicly observable action taken by the BHC at time *t* - 1 that might lead to its subsequent subsidiary status change. After observing the action, the investors can infer their expectation of event $\mathcal{I}_{i,t}^{SF}$. However, private information which is only available to bank insiders, or has not been publicly revealed, may also cause the failure or acquisition of a BHC's subsidiary. We accordingly define $Z_{i,t-1}$ as the private information set.

Let $I^{SF}\left(X_{i,t-1}, Z_{i,t-1}\right)$ be the indicator function that indicates the subsidiary status of BHC *i* at time *t* based on the information sets $X_{i,t-1}$ and $Z_{i,t-1}$. It follows that the following equation holds:

$$\mathcal{I}_{i,t}^{SF} = I^{SF}\left(X_{i,t-1}, Z_{i,t-1}\right) \tag{3.1}$$

where $\mathcal{I}_{i,t}^{SF}$ refers to the observed event of a subsidiary for BHC *i* at time *t*. The investors have to predict the event without full knowledge of the BHC's inside information $Z_{i,t-1}$. Thus, for an outside investor without the knowledge of $Z_{i,t-1}$, his / her expectation at time *t* - 1 of the BHC's subsidiary at *t* is:

$$\begin{aligned} E\left[\mathcal{I}_{i,t}^{SF} \middle| X_{i,t-1}\right] &= E\left[I^{SF}\left(X_{i,t-1}, Z_{i,t-1}\right) \middle| X_{i,t-1}\right] \\ &= \hat{I}^{SF}(X_{i,t-1}) \end{aligned} \tag{3.2}$$

However, for the manager of BHC *i* who has the knowledge of both $X_{i,t-1}$ and $Z_{i,t-1}$, the expectation of its subsidiary is:

$$\begin{aligned} E\left[\mathcal{I}_{i,t}^{SF} \middle| X_{i,t-1}, Z_{i,t-1}\right] &= E\left[I^{SF}\left(X_{i,t-1}, Z_{i,t-1}\right) \middle| X_{i,t-1}, Z_{i,t-1}\right] \\ &= I^{SF}\left(X_{i,t-1}, Z_{i,t-1}\right) \\ &= \hat{I}^{SF}(X_{i,t-1}) + \hat{I}^{SF}(Z_{i,t-1}) \end{aligned} \tag{3.3}$$

As a result, the *information gap* between the BHC manager and the outside investors is:

$$E\left[\mathcal{I}_{i,t}^{SF}\middle|X_{i,t-1},Z_{i,t-1}\right]-E\left[\mathcal{I}_{i,t}^{SF}\middle|X_{i,t-1}\right]=I^{SF}\left(X_{i,t-1},Z_{i,t-1}\right)-\hat{I}^{SF}(X_{i,t-1}) \\ =\hat{I}^{SF}(Z_{i,t-1}) \quad (3.4)$$

Define $G^{SF}(Z_{i,t-1})=\hat{I}^{SF}(Z_{i,t-1})$ as the function depicting the information gap. Here, it's a function of the unobserved variables $Z_{i,t-1}$ for outsiders.

Now we can discuss how the information gap will be exploited by bank insiders to adjust their financing activities and arrive at our initial hypothesis.

Consider a BHC of which one or several of its subsidiaries face liquidity shortage in the next year. The current external market may over evaluate its credit quality and thus grant opportunities for the BHC to hold back the unfavorable information from the outsiders, and allow a time window for the BHC to conduct financing at relatively cheaper costs.

Formally, define the market value of the BHC *i* at time *t* - 1 as:

$$A_{i,t-1}=E_{i,t-1}+D_{i,t-1} \quad (3.5)$$

where $E_{i,t-1}$ and $D_{i,t-1}$ are the market values of equity and debt for BHC *i* at time *t* – 1, respectively. A subsidiary material status change at time *t* will lead to a reduction of the BHC value which will lower the market value of the BHC to $A_{i,t}^{SF}$. Therefore, we have:

$$A_{i,t}^{SF}=A_{i,t-1}^{SF}+\Delta A_{i,t}^{SF}\ ,\ \Delta A_{i,t}^{SF}<0 \quad (3.6)$$

Hence, the expected market value of the BHC *i* by the managers is:

$$E\left[A_{i,t}^{SF}\middle|X_{i,t-1},Z_{i,t-1}\right]=A_{i,t-1}^{SF}+I^{SF}\left(X_{i,t-1},Z_{i,t-1}\right)\Delta A_{i,t}^{SF} \quad (3.7)$$

The expected market value of the BHC *i* by the uninformed public investor is:

$$E\left[A_{i,t}^{SF}\middle|X_{i,t-1}\right]=A_{i,t-1}^{SF}+\hat{I}^{SF}(X_{i,t-1})\Delta A_{i,t}^{SF} \quad (3.8)$$

Thus, the difference in the expected market value of the BHC *i* from the information gap between the BHC and the public is:

$$E\left[A_{i,t}^{SF} \middle| X_{i,t-1}, Z_{i,t-1}\right] - E\left[A_{i,t}^{SF} \middle| X_{i,t-1}\right] = \left[I^{SF}\left(X_{i,t-1}, Z_{i,t-1}\right) - \hat{I}^{SF}\left(X_{i,t-1}\right)\right]\Delta A_{i,t}^{SF} < 0$$

$$\Rightarrow E\left[A_{i,t}^{SF} \middle| X_{i,t-1}\right] > E\left[A_{i,t}^{SF} \middle| X_{i,t-1}, Z_{i,t-1}\right] \qquad (3.9)$$

It's clear therefore that there is overpricing in the current market value of the BHC because of the increased likelihood of a debt default. In other words, before its subsidiary material status change a BHC enjoys potential discrete benefit in its value from the presently higher credit market access.

Effectively, the BHC is in a position to explore mis-pricing by increasing debt or equity at time *t* - 1. When a BHC faces the subsidiary financial distress, its decision is whether to raise equity or debt in order to exploit overpricing. These actions, however, have costs, and therefore, BHCs must balance the associated costs and benefits of debt and equity to decide the optimal financing choice. I argue that BHCs will prefer debt to equity since increasing equity will have limited benefits, but immediate costs. The choice of increasing equity at time *t* - 1 may cause significant drops in the stock price on the announcement of an equity issuance (Asquith and Mullins, 1986). This is because investors are aware of the problem of information asymmetry, and believe that the BHC's stock is overvalued when the BHC undertakes seasoned equity offerings (Fama and French, 2005).

By using debt financing before, BHCs can take advantage of the relatively better credit market access and cheaper financing cost. The cost of debt capital reflects the perceived creditworthiness of the BHC, and these BHCs may prefer to get the benefits of leverage beforehand. Berger, Espinosa-Vega, Frame and Miller (2005) also suggest that BHCs with unfavorable private information are willing to pay the costs on long-term debt. From the above analysis we arrive at our hypothesis: BHC managers who perceive superior inside information will have a preference to fund investment using debt when information asymmetry arises.

3.2.2. Information gap model – An empirical model

Suppose subsidiary failure or acquisition takes place in year $t+1$. Let $SubChange_{i,t+1}$ be the indicator of the event of the subsidiary status change and take a value of 1 when at least one of the BHC *i*'s subsidiaries fails or acquires other firms in year $t+1$, and zero when no subsidiary does. One year prior to the event year, there's various information regarding the whole BHC that could be used to speculate if the BHC will have a subsidiary which is going to change the status in the coming year. As I discuss above, market participants only have access to publicly available information at time *t*. Define $X_{i,t}$ as the information set that is publicly available about BHC *i* including any publicly observable action taken by the BHC at time *t* that might lead to its subsequent subsidiary status change. After observing these actions, the investors can infer their expectations of BHCs' health status. More formally, based on the public available information the outsiders' expectation in year *t* regarding whether BHC *i* has any subsidiary which will change the status at $t+1$ can be achieved by:

$$Pred_{i,t}^{Outsiders} = E\left[SubChange_{i,t+1} \middle| X_{i,t}\right] \in [0,1] \qquad (3.10)$$

However, managers sitting in the parent, when making the inference, will also benefit from the private information that is only available to bank insiders and not publicly revealed. Similarly, in a more formal way, we define $Z_{i,t}$ as the private information set which has actually been defined in the previous section. For bank insiders, as they master the superior private information $Z_{i,t}$ in addition to the public information $X_{i,t}$, we can well believe that their predictions for the status of their own subsidiaries in the following year are judicious. It therefore follows that:

$$Pred_{i,t}^{Insiders} = E\left[SubChange_{i,t+1} \middle| X_{i,t}, Z_{i,t} \right] = \begin{cases} 1, & if \quad SubChange_{i,t+1} = 1 \\ 0, & if \quad SubChange_{i,t+1} = 0 \end{cases} \tag{3.11}$$

This presumption states one essential point underlying in our story: BHC managers have good knowledge of their subsidiaries and can foresee their status changes in the near future.

As discussed, managers in the BHC are able to forecast the circumstances of their subsidiaries in the near future since they can always communicate with the managers of their subsidiaries and they are well aware of the whole holding company's financial conditions. It naturally follows that there exists a large information asymmetry between inside managers and market investors. I term this as *Information Gap*. I am now ready to specify the empirical model that is used to capture the information gap between bank managers and outsiders when anticipating the circumstances of subsidiaries.

In order to obtain the expectation of outsiders at time t for whether BHC i has one subsidiary that will change at $t+1$, I first use a logit model to calculate the likelihood of a subsidiary failure or acquisition in the next year based on the information available to investors in the current period. I regress the subsidiary status variable $SubChange_{i,t+1}$ on a group of BHC characteristics including: ΔLeverage, size, market-to-book ratio, profitability, diversification, liquidity, and marginal expected shortfall. All these variables are publicly observable. Therefore, the model reflects predictive abilities of public investors without full knowledge of BHCs' inside information. It is worth mentioning that this logit model is different from the above one used for addressing the reverse causality issue. I employ the model at the consolidated parent BHC level. That is, I only focus on the outsiders' predictions for whether a parent BHC has one or more subsidiaries that will have circumstance change in the following year rather than their forecasts regarding the circumstance of a specific subsidiary bank.

The log likelihood function that I use to obtain actual parameter estimates is:

$$L\left(\hat{\boldsymbol{\beta}}\right)=\sum_{i=1}^{n}\sum_{t=1}^{T}\left\{SubChange_{i,t+1}\ln F\left(\mathbf{X}_{i,t}\right)+\left(1-SubChange_{i,t+1}\right)\ln\left[1-F\left(\mathbf{X}_{i,t}\right)\right]\right\} \qquad (3.12)$$

Having estimated the parameters, I obtain the forecasted probability of the subsidiary status for the parent BHC *i* in year $t+1$ by the public investors as given below:

$$\Pr\left(SubChange_{i,t+1}=1\middle|X_{i,t}\right)=E\left[SubChange_{i,t+1}\middle|X_{i,t}\right]=\frac{\exp\left(\mathbf{X}'_{i,t}\hat{\boldsymbol{\beta}}\right)}{1+\exp\left(\mathbf{X}'_{i,t}\hat{\boldsymbol{\beta}}\right)} \qquad (3.13)$$

In fact, combining equation (3.10) with equation (3.13) can exactly arrive:

$$Pred_{i,t}^{Outsiders}=\Pr\left(SubChange_{i,t+1}=1\middle|X_{i,t}\right) \qquad (3.14)$$

As a result, the information gap between bank insiders and outside investors is:

$$IG_{i,t}=Pred_{i,t}^{Insiders}-Pred_{i,t}^{Outsiders} \qquad (3.15)$$

which in practice states the difference between the realized subsidiary circumstance in year $t+1$ and outsiders' expectation based on the public information available in year *t* and is a function of the unobserved variables $Z_{i,t}$ (private information).

3.3. Data

3.3.1. Data source

My data come from three sources. I collect BHC data from Compustat bank data from 1983-2016, using annual observations. Compustat is a database of financial, statistical and market information on active and inactive global companies throughout the world. The service began in 1962 and is provided by Standard & Poor's, a division of The McGraw-Hill Companies who supplies financial information and a variety of databases and software products for institutional investors, financial and corporate clients. The database covers 99,000 global securities, covering 99% of the world's total market capitalization with annual company data history available on income statement, balance Sheet, flow of funds and supplemental data items back to 1950 and quarterly data available back to 1962 (depending when that company was added to the database). With Compustat, I can customize the data output for virtually any financial application. Several Compustat files are available in both annual and quarterly formats. The industrial annual formats offer both historical and restated data. The industrial quarterly formats offer restated data, which is standardized. The restated data allows analysts to compare current and prior years' results on a comparable basis and determine financial trends and growth rates. Compustat is available on WRDS including North America daily, global daily, bank daily, historical segments daily, snapshot monthly updates, and Execucomp monthly updates. The Compustat bank fundamentals used by this chapter includes financial, statistical, and market information on the largest and most important banks in the United States, including a wide range of fundamental and technical data. Compustat is widely used by many corporate finance and capital market researchers. Some of the most famous are Myers and Majluf (1984), Asquith and Mullins (1986), and Fama and French (2005).[6]

Stock prices data are obtained from the Center for Research in Security Prices (CRSP). The Center for Research in Security Prices (CRSP) is a provider of historical stock market data. The Center is a part of the Booth School of Business at the University of Chicago. CRSP maintains some of the largest and most comprehensive proprietary historical databases in stock market research. Academic researchers and investment professionals rely on CRSP for accurate, survivor bias-free information which provides a foundation for their research and analyses. CRSP is available on WRDS and a powerful tool used by many academic

[6] For more information on Compustat, see the official website http://www.compustat.com.

researchers and practitioners who would like the market stock and bond data. Some of the most famous researchers who ever used this database are Baker and Wurgler (2002), Donaldson (2000), Myers (1984), and Leary (2009).[7]

Lastly, subsidiary bank data come from the Federal Reserve Report of Condition and Income (Call Reports). Call Report data can be accessed through WRDS. Every national bank, state member bank, insured state nonmember bank, and savings association ("institution") is required to file Consolidated Reports of Condition and Income (a "Call Report") as of the close of business on the last day of each calendar quarter, i.e., the report date. The specific reporting requirements depend upon the size of the institution, the nature of its activities, and whether it has any foreign offices. Institutions submit Call Report data to the bank regulatory agencies each quarter for the agencies' use in monitoring the condition, performance, and risk profile of individual institutions and the industry as a whole. Call Report data serve a regulatory and public policy purpose by assisting the agencies in fulfilling their missions of ensuring the safety and soundness of financial institutions and the financial system and the protection of consumer financial rights, as well as agency-specific missions affecting national and state-chartered institutions, e.g., monetary policy, financial stability, and deposit insurance. Call Reports are the source of the most current statistical data available for identifying areas of focus for on-site examinations and off-site monitoring. The agencies use Call Report data to evaluate the corporate applications of institutions, and to calculate the deposit insurance assessments of institutions and the semiannual assessment fees of national banks and federal savings associations. Call Report data are also used by the public, state banking authorities, researchers, bank rating agencies, and the academic community. Some of

[7] For more information on CRSP database, see http://www.crsp.com/.

the most famous researchers who ever used this database include Loutskina (2011), Gilje, Loutskina, and Strahan (2016).[8]

To examine BHCs' capital structure decisions, this chapter looks at four different measures of debt and equity financing including changes in long-term debt, short-term debt, total debt, and common equity, all scaled by the previous year's total assets. In the final sample, there're 694 BHCs that didn't have any subsidiary status change during 1983-2016 and 219 BHCs that ever had one or more subsidiaries which went bankrupt or acquired other firms in some specific years during the same period. 11883 BHC-year observations constitute the final data sample.

3.3.2. Estimations of the information gap model

To reiterate, the framework developed so far works on the premise that the managers have superior information over public investors. The inside managers know with certainty about the near-term status of their subsidiaries, and hence do not need to estimate the logit model (3.12) as the outsiders do. Panel A of Table 3.1 presents the logit model that I use to obtain the values for the variable $Pred_{i,t}^{Outsiders}$. Panel B of Table 3.1 presents the summary statistics for the variable $IG_{i,t}$ and shows that, for those BHCs whose subsidiaries are static in the next year (i.e., $Pred_{i,t}^{Insiders} = 0$), outsiders, on average, infer that the chance that these BHCs will have

[8] For more information on "Call Reports", see https://www.fdic.gov/regulations/resources/call/index.html.

Table 3. 1: Information gap estimation

This table provides estimates of the information gap variable *IG*. The outsiders' prediction $Pred^{Outsiders}$ is obtained from estimating the logit model in Panel A. Panel B lists the descriptive statistics of the information gap variable *IG*. The dependent variable *SubChange* is a dummy variable indicating if a BHC has one or more subsidiaries that have material status change in the current calendar year. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are at the consolidated BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

Panel A: Outsiders' predictions using the logit model (3.12)

	SubChange
ΔLeverage	0.250
	(1.51)
Size	0.234**
	(2.17)
Market to book ratio	0.228*
	(1.80)
Profitability	-4.820**
	(-2.08)
Diversification	0.101
	(0.40)
Liquidity	-0.074
	(-0.26)
MES	-0.875***
	(-3.02)
Constant	1.302***
	(3.70)
Year Fixed Effects	Yes
N	7483
Pseudo R^2	0.176

Panel B: Descriptive statistics of the information gap estimate

	N	Mean	Std. Dev.	Min	Max
			$Pred^{Insiders} = 1$		
$Pred^{Outsiders}$	136	0.112	0.086	0.002	0.720
IG	136	0.888	0.086	0.281	0.998
			$Pred^{Insiders} = 0$		
$Pred^{Outsiders}$	7347	0.012	0.027	0.000	0.169
IG	7347	-0.012	0.027	-0.169	0.000

subsidiary status changes is only 1.19%, which reflects the fact that the information gap is not large for these "healthy" BHCs. In contrast, when BHC managers precisely foresee the incoming failure or acquisition of subsidiary banks (i.e., $Pred_{i,t}^{Insiders} = 1$), investors, on average, only have 11.21% probabilities of correct predictions, while they have nearly 89% chances of failing to forecast the occurrence of the subsidiary bankruptcy or acquisition. These results suggest a potentially large information gap for those "troubled" BHCs. Ex facto, the content of managers' superior information is captured as well as instrumented by the information gap defined above. In the next empirical section, I examine whether the information gap can be exploited by bank managers to change BHCs' financing decisions and ultimately their leverage.

3.4. Empirical results

3.4.1. The effect of information gap on BHCs' capital structure decisions

As discussed, managers in the BHC are able to forecast the circumstances of their subsidiaries in the near future since they can always communicate with the managers of their subsidiaries and they are well aware of the whole holding company's financial conditions. It naturally follows that there exists a large information asymmetry between inside managers and market investors. We term this as *Information Gap*. In this section, we examine whether parent BHCs indeed exploit the information gap to adjust their capital structure.

To control for BHCs' characteristics that could affect their financing decisions, this paper considers BHCs' size, market-to-book ratio, asset tangibility, and profitability. These are reliable variables demonstrated to be related to the capital structure. Size has been used to reveal firms' expected bankruptcy cost and is expected to be one of the crucial determinants of the capital structure (Graham, Lemmon, and Schallheim, 1998; Hovakimian, Opler, and Titman, 2001; Diamond, 1991). The market-to-book ratio has been used as a proxy for growth opportunities and is expected to be positively correlated with firms' external financing (Baker and Wurgler, 2002). The effect of profitability on leverage, however, is less clear because it can either be used as a proxy for internal cash available for investment funding or taxable income to be shielded (Donaldson, 1961; Myers, 1984; Leary, 2006). Similarly, the effect of asset tangibility is unclear as it can either stand for the severity of the information asymmetry, collateral available for firms' external financing, or demand for future investments (Titman and Wessels, 1988; Rajan and Zingales, 1995).

One may argue that the above variables are extensively borrowed from the empirical corporate finance literature that has at length examined the capital structure of non-financial firms while financial firms are mostly excluded from analyses. In fact, Gropp and Heider (2010) document that the determinants of the capital structure between banks and non-financial firms are very similar. They even report that the sign and significance of the effect of most variables on bank leverage are identical when compared to the results found in the classical literature covering for firms such as in the US or more widely, in the G7 countries. Besides, the reason I do not include dividends which is examined in Gropp and Heider (2010) is that it is not significant in any scenario in the following regression analysis. It is thus dropped from the analysis.

Specifically, I estimate the following model:

$$\Delta Y_{i,t} = \beta_0 + \beta_1 IG_{i,t} + \boldsymbol{\beta_v} \mathbf{X_{i,t-1}} + \gamma_i + \lambda_t + \varepsilon_{i,t} \qquad (3.16)$$

Table 3.2 reports the regression results. As shown in the table, the information gap significantly dominates the financing decisions of the parent BHCs. The positive and significant coefficients on *IG* in column (1) and (2) show that the larger information gap is associated with higher BHC leverage and more long-term debt raised in the year prior to subsidiary circumstance change.

The coefficient estimates indicate that the economic impact of information asymmetry on bank capital decisions is also economically large. For instance, the point estimate for *IG* on Δ*Leverage* implies that leverage changes for BHCs with 1% more information gap is 3.6% higher, which indicates a 169.81% increase relative to the sample average Δ*Leverage* of 2.12%. Similarly, for the other two leverage measures, 1% increase in information gap is associated with a 123.66% increase in long term debt changes (relative to the sample average Δ*Long-term debt* of 1.86%) and an 81.40% decrease in short term debt changes (relative to the sample average Δ*Short-term debt* of 0.86%).

As discussed earlier, the information asymmetry between outsiders and insiders is significantly large before their subsidiaries go bankrupt or acquire other firms. Bank insiders benefit from the presently larger information gap and take this advantage to quickly finance the BHCs. These evidence suggests that parent BHCs are keen to find external funds in advance. These raised funds can act as a cushion against the deterioration of the holding company's financial conditions and further lower the liquidity risk. These findings also suggest that when information asymmetry arises, parent banks prefer to raise more of their long-term debt. The previous literature documents that long-term debt acts as a cheaper financing resort and serves as a preferred choice for external financing (Flannery, 1986; Berger et al., 2005). BHCs would like to avoid costly equity financing and exploit the temporarily better creditworthiness to obtain funds through long-term debt at low cost knowing they will have to undertake the forthcoming capital outflow (Calomiris and Wilson 1998).

Table 3. 2: The effect of information gap on BHCs' capital structure changes

Effects of information gap on BHCs' leverage changes. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are at the consolidated BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)	(3)
	ΔLeverage$_t$	ΔLong-term debt$_t$	ΔShort-term debt$_t$
IG$_t$	0.036***	0.023***	-0.007**
	(3.28)	(4.22)	(-2.31)
Size$_{t-1}$	-0.019***	-0.028***	-0.037**
	(-8.55)	(-8.55)	(-9.38)
Market to book ratio$_{t-1}$	0.064***	-0.097***	-0.178***
	(7.48)	(-7.48)	(-12.12)
Profitability$_{t-1}$	0.082***	0.077***	0.093***
	(11.06)	(9.70)	(10.13)
Diversification$_{t-1}$	-0.075	-0.019*	0.022**
	(-1.50)	(-1.95)	(1.67)
Liquidity$_{t-1}$	-0.099**	-0.007	-0.018
	(-2.48)	(-0.85)	(-1.60)
MES$_{t-1}$	0.003	-0.000	0.002
	(0.39)	(-0.12)	(0.71)
Constant	0.124***	0.093**	0.050
	(12.73)	(1.98)	(0.98)
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	6779	6779	6071
Adj. R^2	0.344	0.596	0.125

3.4.2. A reexamination on BHCs with publicly traded bonds outstanding

The above test elaborates the way outside investors predict a BHC's internal circumstances in the next year based on its publicly available characteristics in the current year. However, the utilization of the general BHC information in the prediction may have limitations, which neglect some specific factors that may help reveal BHCs' internal financial conditions. Berger and Davies (1998) find that bank examinations generate bank condition information that has not been uncovered by the market, and that part of the valuable private information may be transmitted to market participants and incorporated into capital market prices to some extent.[9]

I therefore incorporate BHC bond spreads into the information gap model as additional publicly observable information that can be used by outside investors. Specifically, for each BHC in each year, from its various outstanding bonds I choose the one that has the longest maturity as the longer bond yield is more affected by both liquidity and credit risk of the issuing firm (Helwege, Huang, and Wang, 2014). I then define the BHC bond spread variable *YieldSpread* as the yield difference between this BHC bond and a treasury bond with a comparable maturity as determined from Datastream. BHCs with no outstanding bonds in that year are dropped. Additionally, I exclude any non-straight bonds such as convertibles, callable bonds, etc. The sample size is heavily reduced because of either the above screening or the availability of bond price data.

I repeat the logistic regression in Panel A of Table 3.1 after including *YieldSpread* as an additional regressor. Panel A of Table 3.3 reports the results. To save space I only report the coefficient on *YieldSpread*. The positive and significant coefficient on *YieldSpread* shows that it is a good predictor and indicates that, the larger the difference between a BHC bond

[9] The CAMELS rating system is generally used by US supervisory authorities to examine the soundness of a bank's condition. The evaluation results are not publicly disclosed but only provided to top bank managers.

yield and the yield of a comparable maturity treasury bond, the more likely is the issuing parent to have subsidiaries go bankrupt or engaging in M&A activities in the following year. Panel B of Table 3.3 presents summary statistics of the information gap variable *IG*. Compared with Panel B of Table 3.1, the lower absolute mean values of *IG* indicate that the information asymmetry between market participants and bank insiders is narrowed. My model hereby reflects the improved predictive abilities of outside investors based on publicly observable information when including spreads on BHC bonds.

Although outsiders' predictions are improved, the information gap for those "troubled" BHCs is still very large as shown in the table. Thus, my next step is to retest whether the large information asymmetry is exploited by parent BHC managers to adjust capital structure specifically on these BHCs with outstanding bonds. The empirical specification is the same as Equation (3.16). Panel C of Table 3.3 presents the results. The positive and significant coefficients on *IG* in columns (1) and (2) show that the larger information gap is associated with more increase in long-term debt and BHC leverage. Overall, the results support my argument that bank mangers benefit from their information advantage and adjust the BHCs' capital structure accordingly.

Table 3. 3: Information gap for BHCs with publicly traded bonds outstanding

This table shows the additional estimation of the information gap variable *IG* and its effect on BHCs with outstanding publicly traded bonds. The outsiders' prediction $Pred^{Outsiders}$ is obtained from estimating the logit model in Panel A. The dependent variable *SubChange* is a dummy variable indicating if a BHC has one or more subsidiaries that have material status change in the current calendar year. $YieldSpread_{BHC}$ is the yield difference between the BHC bond and a treasury bond with a comparable maturity as determined from Datastream. We also include the same variables as we use in Panel A of Table 4.15 in the regression, but do not report their coefficients to save the space. Panel B lists the descriptive statistics of the information gap variable *IG*. Panel C reports the effect of information gap on BHCs' leverage changes one year before subsidiary failure. We only report the coefficient on the information gap variable *IG* in order to save the space. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; and Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets. All variables are at the consolidated BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

Panel A: Outsiders' predictions of BHCs having bankrupt subsidiaries

	SubChange
YieldSpread	2.306***
	(5.29)
Constant	0.842***
	(12.38)
Year Fixed Effects	Yes
BHC Controls	Yes
N	1129
Pseudo R^2	0.269

Panel B: Descriptive statistics of the information gap estimate

	N	Mean	Std. Dev.	Min	Max
			$Pred^{Insiders} = 1$		
$Pred^{Outsiders}$	26	0.183	0.155	0.004	0.868
IG	26	0.817	0.155	0.132	0.996
			$Pred^{Insiders} = 0$		
$Pred^{Outsiders}$	1103	0.009	0.060	0.000	0.349
IG	1103	-0.009	0.060	-0.349	0.000

Panel C: Effects of information gap on BHCs' leverage changes

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt
IG	0.030***	0.028***	-0.006
	(3.31)	(3.68)	(-0.92)
BHC Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
BHC Controls	Yes	Yes	Yes
N	867	867	867
Adj. R^2	0.223	0.179	0.120

3.5. Additional test

In this section, I try to differentiate several channels that lead to BHCs' capital structure changes in the same year and following the arisen of information asymmetry. Specifically, I employ the following specification:

$$\Delta FinancingDecision_{i,t+\Delta t} = \beta_0 + \beta_1 SubChange_{i,t+1} + \mathbf{\beta_v X}_{i,t+\Delta t-1} + \gamma_i + \lambda_t + \varepsilon_{i,t} \qquad (3.17)$$

where *FinancingDecision* are BHCs' financing decisions and measured using several measures of debt and equity financing including changes in long-term debt, short-term debt, and common equity, all scaled by the previous year's total assets, and $SubChange_{i,t+1}$ is a dummy variable indicating whether there is status change (failure or acquisition) among subsidiaries of BHC *i* in year $t+1$, γ_i and λ_t capture BHC and year fixed effects, respectively, to eliminate time-invariant BHC heterogeneity and year variation. I would like to examine subsidiary failure's influence on the parent's capital structure changes in the same year (in year $t+1$), and one year after (in year $t+2$). Therefore, we have $\Delta t \in \{1,2\}$, where $\Delta t = 1$ for the same year of the subsidiary bankruptcy and $\Delta t = 2$ for one year after the subsidiary bankruptcy.

I continue to use the controls that we used in the above tests, in addition to adding a new control variable, *Asset tangibility*. To reiterate, these controls are reliable covariates demonstrated to be related to the corporate financing adjustment. Size has been used to reveal firms' expected bankruptcy cost and is expected to be one of the crucial determinants of the capital structure changes (Graham, Lemmon, and Schallheim, 1998; Hovakimian, Opler, and Titman, 2001; Diamond, 1991). The market-to-book ratio has been used as a proxy for growth opportunities and is expected to be positively correlated with firms' external financing (Baker and Wurgler, 2002). The effect of profitability on leverage, however, is less clear because it can either be used as a proxy for internal cash available for investment funding or taxable income to be shielded (Donaldson, 2000; Myers, 1984; Leary, 2009). Similarly, the effect of asset tangibility is unclear as it can either stand for the severity of the information asymmetry, collateral available for firms' external financing, or demand for future investments (Titman and Wessels, 1988; Rajan and Zingales, 1995).

One may argue that the above variables are extensively borrowed from the empirical corporate finance literature that has at length examined the capital structure of non-financial firms while financial firms are mostly excluded from analyses. In fact, Gropp and Heider (2010) document that the determinants of the capital structure between banks and non-financial firms are very similar. They even report that the sign and significance of the effect of most variables on bank leverage are identical when compared to the results found in the classical literature covering for firms such as in the US or more widely, in the G7 countries.

For the same year, the empirical results are reflected in Table 3.4. I can still find highly significant impact on long-term debt issuance although there seems not to be the case for short-term debt. The slightly higher coefficient suggests that BHCs with most severe information asymmetry problem hurry to increase their long-term debt on that year. The mixed influence on both long-term and short-term debt yields a significant increase in these BHCs' total debt financing (on average 1.82% more than those whose subsidiaries are all safe). In addition, these BHCs continue to curtail their equity borrowing aiming to cut the cost of capital.

Table 3. 4: BHCs' capital structure changes in the same year of subsidiary status change

This table presents the regression estimates for the relation between subsidiary status change and BHCs' capital structure changes in the same year. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are yearly results and at the consolidated BHC level. Standard errors are robust and clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; and * = significant at 10%.

	(1)	(2)	(3)	(4)
	ΔLeverage$_{BHC}$	ΔLong-term debt$_{BHC}$	ΔShort-term debt$_{BHC}$	ΔEquity$_{BHC}$
SubChange	0.025***	0.019**	-0.004	-0.009***
	(3.13)	(2.38)	(-0.36)	(-4.50)
Size	-0.017***	-0.016***	-0.001	-0.174***
	(-5.03)	(-5.75)	(-1.15)	(-12.66)
Market to book ratio	0.060**	0.066***	0.008***	0.241***
	(2.22)	(2.97)	(2.69)	(3.77)
Profitability	0.113	0.022	0.012	1.917***
	(1.14)	(0.30)	(1.24)	(6.99)
Diversification	0.008	-0.009	-0.002	0.009
	(0.41)	(-0.85)	(-1.30)	(0.23)
Liquidity	-0.012	-0.007	-0.002	-0.047
	(-0.86)	(-0.59)	(-0.91)	(-1.10)
MES	-0.000	0.003	0.000	-0.005
	(-0.12)	(1.37)	(1.21)	(-0.80)
Constant	0.169***	0.154***	0.006	2.221***
	(2.99)	(3.75)	(0.48)	(11.41)
BHC fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	338	338	338	338
Adj. R^2	0.120	0.059	0.285	0.218

I further analyze the effects subsidiary status changes may bring on parent banks' subsequent financing decisions. A summary of the effects one year after is given by Table 3.5. In sharp contrast to the above case, BHCs with subsidiaries going bankrupt or engaging acquisition activities significantly lower their leverage in the following year. The effects on their financing decisions provide a more robust evidence for this change. The treated BHCs on average reduce more subsequent long-term debt by roughly 0.8% of lagged total assets than those without affiliates. The former turn to raise more equity. I, however, again find an insignificant effect on BHCs' short-term debt changes, which reveals the BHCs' preference of funding choices when information gap is most severe.

The shift of financing from debt to equity *after* information asymmetry has arisen can be explained for several reasons. Firstly, BHCs try to reduce the information asymmetry at this moment in order to lower the cost of any forthcoming issuance. This means BHCs are keen to convey the favorable information to the market that their credit quality is improving in terms of the whole company. Equity financing can serve as a more transparent communication tool in the market than debt financing. Secondly, parent stock offerings carry advantageous information about subsidiary value and increase subsidiary wealth subsequently (Slovin and Sushka, 1997). By doing so, the parent bank can rebuild the market confidence across its subsidiaries, thus benefiting the whole parent-subsidiary governance structure. Thirdly, the parent raises equity to further secure its compliance to the capital requirement. Maintaining certain equity capital ratios acts as material protection for depositors, shareholders, and the government safety net.

Table 3. 5: BHCs' capital structure changes in the year following subsidiary status change

This table presents the regression estimates for the relation between subsidiary status change and BHCs' capital structure changes in the *following* year. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are yearly results and at the consolidated BHC level. Standard errors are robust and clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; and * = significant at 10%.

	(1) $\Delta Leverage_{BHC}$	(2) $\Delta Long\text{-}term\ debt_{BHC}$	(3) $\Delta Short\text{-}term\ debt_{BHC}$	(4) $\Delta Equity_{BHC}$
SubChange	-0.044***	-0.027***	0.005	0.011***
	(-2.69)	(-4.97)	(0.98)	(2.75)
$Size_{BHC,t-1}$	-0.220***	-0.016***	-0.015***	-0.001
	(-12.27)	(-5.50)	(-5.71)	(-1.40)
Market-to-book $ratio_{BHC,t-1}$	0.256***	0.060**	0.065***	0.005**
	(4.61)	(2.34)	(3.14)	(2.24)
$Profitability_{BHC,t-1}$	2.697***	0.128	0.034	0.014
	(5.50)	(1.32)	(0.50)	(1.47)
$Diversification_{BHC,t-1}$	-0.045	0.003	-0.005	-0.003**
	(-0.94)	(0.14)	(-0.49)	(-2.04)
$Liquidity_{BHC,t-1}$	-0.080*	-0.015	-0.012	-0.002
	(-1.81)	(-1.16)	(-0.98)	(-1.37)
$MES_{BHC,t-1}$	0.002	-0.000	0.003*	0.000*
	(0.31)	(-0.03)	(1.75)	(1.73)
Constant	2.839***	0.157***	0.136***	0.008
	(11.17)	(3.15)	(3.48)	(0.90)
BHC Fixed Effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	9719	8185	8185	8185
Adj. R^2	0.236	0.083	0.053	0.281

3.6. Conclusion

This chapter discusses the relation between information asymmetry and bank capital structure decisions by introducing a new model which I term as *information gap* model. Relative to public investors, bank insiders possess better knowledge and precise predictions on BHCs' next-period status. By specifically focusing on the information gap between these two parts, this study explores whether the superior information of bank managers may motivate them to alter their bank's capital structure.

I construct the information gap measure between BHCs and outside investors concerning the prediction of subsidiary circumstance change in the next year and present a model in which outsiders make the prediction based on the parent's actions and all other publicly available information. The framework therefore explicitly accommodates the ability of outsiders to infer the conditions of subsidiaries by observing the parents' actions on capital structure changes. The information gap is thus defined as the difference between the actual and the forecasted status of BHC subsidiaries. I then model the relation between the BHCs' financing adjustments and the measure of the information gap, controlling for a set of conventional variables.

The results show that the information gap significantly distorts BHCs' external financing decisions. BHC managers who perceive superior inside information will have a preference to fund investment using debt when information asymmetry is most severe. The short-term debt issuance also exhibits drastic differences between normal and "troubled" BHCs. The findings thus have initial implications for the public to understand various incentives that banks may have in issuing securities.

This chapter also serves as an introductive empirical chapter where I use subsidiary bank status change (bankruptcy or M&A) as a cut-off to discern the real effect of private information on the financial policies of holding banks. This constitutes the most important setting in my thesis. The following empirical chapters will follow this setting and discuss the effect in the scenario of subsidiary failure and M&A, respectively.

Chapter IV: Capital structure adjustments of bank holding companies and subsidiary failure

4.1. Introduction

A bank holding company (BHC, hereafter) owns a significant share of its subsidiaries' equity capital and often has counterparty business relations with subsidiaries. Thus, the bankruptcy of a subsidiary bank, which we term 'subsidiary failure', may render the debt or equity of the subsidiary worthless and hence, brings substantial losses to its BHC and jeopardizes the BHC's financial conditions.

In this chapter, we consider the information advantage BHC managers have prior to the declaration of a subsidiary failure, and analyze the impact it may have on BHCs' capital structure. We posit that, based on the better knowledge of a subsidiary's up-to-date financial condition, managers in the parent bank are able to foresee the bankruptcy of a subsidiary in the near future with greater precision than outside investors. We examine whether bank holding companies exploit such an information advantage and adjust financing activities in their own interests surrounding the time when the subsidiaries go bankrupt.

Due to costly subsidiary failures, BHCs facing limited internal funds have incentives to find external financing before their financial conditions deteriorate. It is plausible that, prior to the subsidiary bankruptcy, the BHC may want to raise more debt at relatively lower costs. Once the subsidiary bankruptcy is realized, BHCs come under great pressures from regulators and market participants to control their default risk (Ashcraft, 2008). Thus, they may wish to lower the leverage and have more equity capital to secure the capital requirement.

In an event-study difference-in-differences (DID) framework, we first estimate the leverage changes among BHCs with subsidiary failure ("troubled" BHCs) around the time of their subsidiary failure *relative to* the changes during the same period among those BHCs without subsidiary failure ("healthy" BHCs). Using a large sample of U.S. banks from 1986 to 2015, we find that the subsidiary failure induces a 5.45 percentage point increase in leverage among "troubled" BHCs during the year prior to their subsidiary failure. In contrast, we find a significant decrease in the leverage of those "troubled" BHCs in the year following subsidiary bankruptcy. We further separate the deposit and several non-deposit debt items from the leverage of BHCs, and find that the long-term debt financing of "troubled" BHCs exhibits a substantial increase before subsidiary failure and significant decrease afterwards.

Our evidence suggests that the "troubled" BHCs foresee tightened credit market access and increased borrowing costs once the bankruptcy of subsidiary banks is realized. Thus, "troubled" BHCs increase debt financing in advance to take advantage of the presently cheaper debt financing and enjoy benefits. Our findings are consistent with the argument of Billett and Garfinkel (2004) that, with the existence of asymmetric information, bank securities could be priced remarkably differently in segmented markets, and that banks take most advantage of the pricing discrepancies and target the segment, which has the lowest access costs.

For robustness checks, we further construct a measure of an information gap between BHCs and outside investors concerning the prediction of a subsidiary bankruptcy in the next year. We present a model in which outsiders predict whether a BHC will have a subsidiary failure based on the parent's actions and all other publicly available information. Our framework explicitly accommodates the ability of outsiders to infer the financial conditions of subsidiaries by observing the parents' actions on capital structure changes. The information gap is defined as the difference in the predicted probability of a subsidiary failure between the BHC insiders and outside investors. We then model the relation between the BHCs' financing adjustments prior to their subsidiary failure and our measure of the information gap, controlling for a set of conventional variables. The results further confirm our hypothesis.

Our paper emphasizes the information asymmetry arisen prior to the subsidiary bank failure, and investigates whether bank managers exploit such information asymmetry to adjust their capital structure decisions accordingly. The core premise of our question is that banks have information advantage over market investors (i.e., the parent bank knows that one or some of its subsidiaries may go bankrupt, but investors do not have this information). To the best of our knowledge, we are the first to use subsidiary bank failure as a cut-off to discern the real effect of such private information on the financing actions of holding banks.

We make the following contributions. First, prior research points out bank-specific information asymmetry. This paper contributes to the literature on the impact of information asymmetry on banks' financial policies. Houston, James, and Marcus (1997) document that a great variety of bank activities may be difficult for outsiders to attain. Dell'Ariccia and Marquez (2004) argue that unfavorable private information of a bank, which is available only to insiders, may create morale hazard problems and result in a bank's engagement in undesirable activities. Holod and Peek (2007) investigate the access of banks to information-based external financial markets by comparing the behaviors of banks, including bank holding companies, with different transparency levels in response to exogenous shocks, and find that information asymmetry does affect their financing decisions. Morgan (2002) argues that the banking industry is more opaque than other industries, and finds that ratings from major agencies often disagree more over banks' bond issues than issues by other types of firms. The veil between banks and outsiders makes investors unable to accurately quantify the risk of banking firms as well as their securities.

Second, this paper is related to the market timing (or windows of opportunity) theory, which states that firms prefer equity financing when the cost of equity is low, and prefer debt otherwise. In other words, firms do not generally care whether they finance with debt or equity, but choose the form of financing which, at that point in time, appears to be more valued by financial markets. Baker and Wurgler (2002) claim that market timing is the first order determinant of a corporate capital structure. Third, this paper is also related to the large strand of literature on risk-shifting.

The remainder of this chapter is organized as follows. Section 4.2 develops the hypotheses. Section 4.3 presents the methodology. Section 4.4 describes the data. Section 4.5 contains empirical tests. Section 4.6 concludes.

4.2. Hypotheses development

In this section, we first review the basics of bank insolvency, describe the process and timeline during bank failures, and summarize legal issues that commonly arise in a bank failure. We then describe how we reach our hypotheses. Whether changes in capital take the form of increases in debt (non-deposit) or equity depends not only on BHC managers' incentives, but also on the cost of borrowing given the information asymmetry.

4.2.1. The effects and regulation background of bank subsidiary failure

A subsidiary failure can affect the financial standing of the holding company for several reasons. First, as argued by Wall and Peterson (1987), a BHC as the owner needs to provide financial assistance to its troubled subsidiary, which affects the balance sheet of the parent company. Second, Ashcraft (2008) notes that subsidiaries of a holding company often work together to process the data commonly available within the parent umbrella and provide financial products to customers. Thus, the failure of one subsidiary can bring down the whole product chain, hence impairing the holding company. Third, the traditional theory suggests that the negative effects of highly risky subsidiaries can be insulated by the "firewalls" built around other subsidiaries (Wall, 1987). However, Boyd, Graham, and Hewitt (1993) cast doubt on this argument and state that ‘firewalls’ may not provide the desired result. They report that banking-subsidiary resources will be employed to aid financially distressed subsidiaries if the activities of banking and nonbanking subsidiaries are not fully separated by laws. Fourth, Wall (1987) points out that the failure of one subsidiary may cause the public to suspect the management quality of the affiliates within the holding company, leading to a bank run in a worsened situation.

Two federal laws enacted in the early 1990s are related to these concerns: one is the Federal Deposit Insurance Corporation Improvement Act (FDICIA), and the other is the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA). The FDICIA passed by the US Congress in 1991 states that the BHC regulator has the authority to force a parent company to guarantee the performance of a troubled banking affiliate as part of a capital restoration plan, while it limits the liability of the parent to 5% of the problem bank’s assets (Ashcraft, 2008). As the ultimate failure of a subsidiary bank may harm the internal capital market of the holding company, the holding company acts as a “source-of-strength” to this troubled subsidiary. The FDICIA clarifies this “source-of-strength” principle, and grants the Federal Reserve the authority to take enforcement actions for the BHCs that fail to do so when resources are available. The other federal law, the FIRREA passed in 1989, authorizes the Federal Deposit Insurance Corporation (FDIC) to shift the expected losses of a failed subsidiary onto the capital of non-failing affiliates. Ashcraft (2005, 2008), among others, document the bailouts of distressed affiliations and the associated allocations of the internal capital in relation to these banking reforms.

4.2.2. Subsidiary failure and BHCs’ financing actions

In this paper, we study whether and how the BHCs use external financing in the wake of the foreseeable subsidiary failure. Our focuses are that managers are able to anticipate the future subsidiary failure, and that managers have concerns about the BHCs' financing circumstances. We posit that banks may exploit information asymmetry concerning a subsidiary failure and adjust their financing accordingly.

Consider the situation where one or several of a BHC's subsidiaries face severe financial deterioration and are anticipated to go bankrupt in the year to come. The financial market does not have this information and hence, may over-evaluate the BHC's credit quality. Before a subsidiary goes bankrupt, the parent BHC may conceal the disadvantageous information and exploit the "window of opportunity" to conduct financing at relatively cheaper costs.

A subsidiary bankruptcy will veritably reduce the market value of its BHC.[10] With the existence of information asymmetry the financial market misprices the debt and equity of these "troubled" BHCs in advance of a subsidiary failure. Therefore, the BHC's assets are overvalued if the BHC's subsidiary is going to be bankrupt in the near future, while such information remains unrevealed to the market. Meanwhile, the BHC enjoys potential discrete benefits (see Kisgen, 2006) in its value from the presently better credit market access. Thus, when a BHC faces its subsidiary bankruptcy managers are in a position to decide whether to raise debt or equity at current time to exploit overvaluation.

Managers are tempted to do so because they want to grasp currently greater and cheaper credit market access, which will be highly likely to vanish once the bankruptcy news becomes widely known. These BHCs may also have low liquidity positions, thus must find external financing before their troubled affiliates fail. Tang (2009) makes a similar assertion for this situation that "credit market imperfections such as information asymmetry significantly affect firms' financing and investment decisions".

[10] Hung et al. (2017) provide a formal proof.

These BHCs, while taking actions, must determine the optimal financing vehicle through balancing the costs and benefits for either debt or equity issuances. We argue that BHC managers will prefer debt to equity. The current stock market price is overvalued relative to managers' private information about the value of assets. The announcement of raising equity at current time is inferred by rational investors, who are aware of management's decision rules, as that the BHC's stock is overpriced, hence causing the stock price to drop significantly (Myers and Majluf, 1984; Asquith and Mullins, 1986; Fama and French, 2005). Furthermore, the stock price will fall even further once the news of subsidiary insolvency goes public. As a result, there will be limited benefits, but immediate costs for raising equity.

On the contrary, by funding with debt before the news of subsidiary bankruptcy is publicly known, those "troubled" BHCs can obtain relatively cheaper financing and get leverage benefits beforehand. Informed managers thus try to exploit the mispricing. Flannery (1986) claims that firm insiders choose to issue certain types of securities that the market appears to overvalue the most. Myers (2001) describes such kind of "financing tactics" due to information asymmetry. Additionally, Berger, Espinosa-Vega, Frame, and Miller (2005) summarize the implications of Flannery's (1986) and Diamond's (1991) theoretical models, and suggest that firms with unfavorable private information may prefer long-term debt because short-term debt has greater liquidity risk and may be difficult to roll over. Consequently, the "troubled" BHC is more likely to choose to enjoy the relatively cheaper cost of debt borrowing when balancing the benefits and costs of debt or equity financing choice before its subsidiaries fail. Thus, we arrive at the first hypothesis:

Hypothesis 1: *BHCs tend to increase leverage before their subsidiaries going bankrupt.*

The subsidiary failure lowers the credit quality of the BHC, which tightens the BHC's access to the credit market and raises its costs of debt financing (Kwan and Eisenbeis, 1997). Hence, going for debt financing is not a sensible choice once the subsidiary failure is realized.

Second, BHCs come under great pressures from regulators and market participants to control their default risks (Ashcraft, 2008). Creditors conjecture that subsidiary failure weakens the guarantees made by the BHCs and thus demand a higher risk premium for the BHCs' obligations. Thus, the BHCs' managers need to adjust their equity capital more closely in order to contain asset risk exposures in preference to paying large risk premium (Furlong and Keeley, 1989). Finally, funding with equity absorbs losses from the decrease in asset values and reduces the probability of financial distress. Moreover, raising more equity further secures the BHC's capital requirement. Taking all together, we arrive at the second hypothesis:

Hypothesis 2: *BHCs tend to lower leverage after their subsidiaries going bankrupt.*

4.3. Methodology

We build our sample based on the group of BHCs that had subsidiary failures during specific years (treatment group) and the BHCs that did not have subsidiary failures around those years (control group). We identify the year in which a BHC declares a subsidiary failure as year T_i. To test our hypotheses, we estimate the following event-study difference-in-differences regression:

$$\Delta Y_{i,t} = \beta_0 + \sum_{\tau=-2,\tau\neq 0}^{3} \beta_\tau D_{i,t=T_i+\tau} + \boldsymbol{\beta}_{\mathbf{v}} \mathbf{X}_{i,t\text{-}1} + \gamma_i + \lambda_t + \varepsilon_{i,t} \qquad (4.1)$$

where $\Delta Y_{i,t}$ is the changes in bank total liability from year *t* - 1 to year *t*, scaled by the total book assets at year *t* – 1, $D_{i,t}$ is a group of DID estimators that identify the years prior to and following the subsidiary failure in year T_i for a treated BHC *i*, $\mathbf{X}_{i,t-1}$ is a set of control variables containing bank characteristics that may affect bank financial policy, and γ_i , λ_t specify BHC and year fixed effects that control for unobserved time-invariant differences across BHCs and overall time trends, respectively.[11] Standard errors are clustered at the BHC level to resolve heteroscedasticity and serial correlation of error terms (Petersen, 2009). Our tests focus on the capital structure of "troubled" BHCs in the year immediately prior to and following subsidiary failure (i.e., $T_i - 1$ and $T_i + 1$), while also include $T_i - 2$ and up to $T_i + 3$ to allow for analyzing the effects over a wider range of years. Our base year is the year of subsidiary failure (year T_i) that has been omitted in this specification. The coefficients of interest are β_τ, which capture the dynamic pattern of the impact of subsidiary failure on various dependent variables.

The above specification has been used previously by Bertrand and Mullianathan (2003) and Chemmanur, He, and Nandy (2009), among others, to study firm performance around different events. As the time of subsidiary failure is spread over time, we control for year fixed effects to account for variations over time related to market circumstances that may lead to bank failure, such as the financial crisis period. The event year dummies $D_{i,t}$ capture residual changes in the dependent variables around subsidiary failure after controlling for the BHC and time fixed effects. More specifically, their coefficients measure the estimated changes in the difference between treated and control BHCs' liability changes during the years prior to or after the subsidiary failure relative to the omitted subsidiary failure year (base year). These coefficients trace out the time path of differences between treated and control BHCs' leverage changes. By choosing the subsidiary failure year as the omitted category, we make it easier to detect differential trends in pre- and after- failure leverage changes.

It is worth noting that the regression framework of the specification (4.1) corresponds to an event-study difference-in-differences estimation strategy which is different from the general

[11] In our tables, we use variable names *Year 1 Before*, *Year 2 Before*, etc., to represent these DID estimators. For example, *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise.

DID technique. In the traditional quasi-natural experimental design, the validity of the general DID requires that in the absence of the treatment, the difference between the treatment and control group is constant over time. In other words, there should be no pre-treatment trends so that the parallel trend assumption is met. However, the event-study DID approach in this thesis is another different estimation model. The model is used to discover the time trends of the changes in outcomes before and after the treatment. In other words, the event-study DID is to investigate whether there exist pre-treatment trends or post-treatment trends, while the general DID technique should only be used after demonstrating that there are no pre-treatment trends.

When examining BHCs' capital structure, we mainly look at changes in bank leverage, which includes both debt and non-debt liabilities such as deposits. Bank capital structure is different from that in non-financial firms as a bank takes deposits, and non-deposit debt has become a more important source of bank funds over time (Gropp and Heider, 2010). Thus, we further decompose BHC leverage into non-deposit debt and deposits. Specifically, we look at changes in long-term debt, short-term debt, subordinate, and deposits, all scaled by the previous year's total bank assets. We then test their relationships with subsidiary failures.

Our choice of control variables follows Gropp and Heider (2010) and includes BHCs' size, market-to-book ratio, and profitability. We also control for marginal expected shortfall (Acharya et al., 2017), diversification, and liquidity to mitigate the omitted variable bias.[12]

4.4. Data

We focus on the BHCs that are publicly listed financial firms in the United States. We only consider BHCs with the highest hierarchy positions, and collect consolidated financial information of BHCs from the FR Y-9C reports over the period from 1986 to 2015. The FR Y-

[12] The Appendix contains definitions of these variables.

9C is the consolidated financial statements for bank holding companies report. The report collects basic financial data from a domestic bank holding company (BHC), a savings and loan holding company (SLHC), a U.S intermediate holding company (IHC) and a securities holding company (SHC) on a consolidated basis in the form of a balance sheet, an income statement, and detailed supporting schedules, including a schedule of off balance-sheet items. The information is used to assess and monitor the financial condition of holding company organizations, which may include parent, bank, and nonbank entities. The FR Y-9C is a primary analytical tool used to monitor financial institutions between on-site inspections. The report is the most widely requested and reviewed at the holding company level and filed quarterly as of the last calendar day of March, June, September, and December. The FR Y-9C reports are widely used by the public, the regulatory authority, and the academic community. They can be accessed through Wharton Research Data Services (WRDS). Some of the top papers using the reports are Afonso, Kovner, and Schoar (2011), Gopalan, Nanda, and Yerramilli (2011), Ellul and Yerramilli (2013), and Goetz, Laeven, and Levine (2013)[13].

We obtain data on BHCs' changes in long-term and short-term debt from COMPUSTAT Bank. Compustat is a database of financial, statistical and market information on active and inactive global companies throughout the world. The service began in 1962 and is provided by Standard & Poor's, a division of The McGraw-Hill Companies who supplies financial information and a variety of databases and software products for institutional investors, financial and corporate clients. The database covers 99,000 global securities, covering 99% of the world's total market capitalization with annual company data history available on income statement, balance Sheet, flow of funds and supplemental data items back to 1950 and quarterly data available back to 1962 (depending when that company was added to the database). With Compustat, I can customize the data output for virtually any financial

[13] See Note 3 for Goetz, Laeven, and Levine (2013).

application. Several Compustat files are available in both annual and quarterly formats. The industrial annual formats offer both historical and restated data. The industrial quarterly formats offer restated data, which is standardized. The restated data allows analysts to compare current and prior years' results on a comparable basis and determine financial trends and growth rates. Compustat is available on WRDS including North America daily, global daily, bank daily, historical segments daily, snapshot monthly updates, and Execucomp monthly updates. The Compustat bank fundamentals used by this chapter includes financial, statistical, and market information on the largest and most important banks in the United States, including a wide range of fundamental and technical data. Compustat is widely used by many corporate finance and capital market researchers. Some of the most famous are Myers and Majluf (1984), Asquith and Mullins (1986), and Fama and French (2005).[14]

BHC stock price data come from the Center for Research in Security Prices (CRSP). The Center for Research in Security Prices (CRSP) is a provider of historical stock market data. The Center is a part of the Booth School of Business at the University of Chicago. CRSP maintains some of the largest and most comprehensive proprietary historical databases in stock market research. Academic researchers and investment professionals rely on CRSP for accurate, survivor bias-free information which provides a foundation for their research and analyses. CRSP is available on WRDS and a powerful tool used by many academic researchers and practitioners who would like the market stock and bond data. Some of the most famous researchers who ever used this database are Baker and Wurgler (2002), Donaldson (2000), Myers (1984), and Leary (2009).[15]

We finally obtain subsidiary bank information from the Federal Reserve Report of Condition and Income (Call Reports), and then merge this data with our BHCs data. Call

[14] For more information on Compustat, see the official website http://www.compustat.com.
[15] For more information on CRSP database, see http://www.crsp.com/.

Report data can be accessed through WRDS. Every national bank, state member bank, insured state nonmember bank, and savings association ("institution") is required to file Consolidated Reports of Condition and Income (a "Call Report") as of the close of business on the last day of each calendar quarter, i.e., the report date. The specific reporting requirements depend upon the size of the institution, the nature of its activities, and whether it has any foreign offices. Institutions submit Call Report data to the bank regulatory agencies each quarter for the agencies' use in monitoring the condition, performance, and risk profile of individual institutions and the industry as a whole. Call Report data serve a regulatory and public policy purpose by assisting the agencies in fulfilling their missions of ensuring the safety and soundness of financial institutions and the financial system and the protection of consumer financial rights, as well as agency-specific missions affecting national and state-chartered institutions, e.g., monetary policy, financial stability, and deposit insurance. Call Reports are the source of the most current statistical data available for identifying areas of focus for on-site examinations and off-site monitoring. The agencies use Call Report data to evaluate the corporate applications of institutions, and to calculate the deposit insurance assessments of institutions and the semiannual assessment fees of national banks and federal savings associations. Call Report data are also used by the public, state banking authorities, researchers, bank rating agencies, and the academic community. Some of the most famous researchers who ever used this database include Goetz, Laeven, and Levine (2013), Loutskina (2011), Gilje, Loutskina, and Strahan (2016).[16]

We focus on the BHCs who have subsidiary failure occurring only once during our sample period to avoid compound effects by more than one subsidiary bankruptcy in consecutive time periods. Our final treatment group sample thus restricts to 136 BHCs that have failed subsidiaries.

[16] For more information on "Call Reports", see https://www.fdic.gov/regulations/resources/call/index.html.

Our analyses further require a control group to compare with the BHCs with subsidiary failure. We use two different procedures to obtain such control samples. The first procedure obtains a control group based on all BHCs that had no subsidiary failures. We use this sample to get the summary statistics and the baseline results. The second approach is based on a propensity score matching (PSM) procedure to match each treated BHC with a control one that is similar across all observable variables. We mainly use this matched sample throughout our regression analyses. The matched sample analysis allows us to more effectively control for differences in relevant dimensions between BHCs with bankrupt subsidiaries and BHCs without.[17]

Table 4.1 presents summary statistics for the whole sample. To reduce the influence of outliers, these variables are winsorized at the first and 99th percentile. The average BHC in the sample has a market-to-book ratio of 0.93, a profitability ratio of 0.007, a diversification ratio of 0.154, and a liquidity ratio of 0.223. The average BHC also has a 10.2% increase of its lagged total assets in leverage, a 1% increase of its lagged total assets in long-term debt, a 0.6% increase of its lagged assets in short-term debt, and an 8.4% increase of its lagged assets in deposits. In terms of other real outcomes, the average BHC experiences relatively no change in subordinated debt, and contributes approximately to 1.4% of the loss during the worst days of the whole banking sector.

[17] Appendix B presents detailed matching procedures.

Table 4. 1: Summary Statistics I

This table presents summary statistics for the variables used in our analysis for the full sample. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are yearly results.

Variable	*N*	Mean	Std. Dev.	Min	Max
BHCs' changes in Capital Structure					
ΔLeverage	9907	0.102	0.177	-0.656	3.989
ΔLong-term debt	7872	0.010	0.043	-0.284	0.693
ΔShort-term debt	7872	0.006	0.044	-0.844	0.719
ΔSubordinate	9907	0.001	0.007	-0.048	0.231
ΔDeposits	7785	0.084	0.148	-0.610	3.280
Determinants of Capital Structure					
Size	10889	14.369	1.554	11.193	21.668
Market-to-book ratio	10889	1.045	0.073	0.890	3.425
Profitability	10889	0.007	0.011	-0.204	0.068
Diversification	10889	0.154	0.147	-1.528	10.967
Liquidity	8427	0.223	0.114	0.000	0.941
MES	8041	1.388	5.070	-6.304	45.263

Table 4.2 presents summary statistics for the variables used in our analysis for “troubled” BHCs and “healthy” BHCs separately in the year prior to subsidiary failure (i.e., $T_i - 1$). From Table 4.2, we find that the BHCs with subsidiary failure in the next year, on average, have higher leverage ratio when compared with BHCs without subsidiary failure in the following year. BHCs with subsidiary failure in the next year tend to increase more long-term debt (5.9% versus 1.0% of lagged total assets), have more subordinate (0.4% versus 0.1% of lagged total assets), but rely less on short-term debt financing (0.1% versus 0.7% of lagged total assets) than those BHCs without subsidiary failure in the following year. In terms of control variables, “troubled” BHCs are less profitable than “healthy” ones in Year $T_i - 1$. The former also have lower market-to-book ratio and liquidity, and contribute more to the aggregate banking sector’s loss prior to subsidiary failure.

Table 4. 2: Summary Statistics II

This table presents summary statistics for the variables used in our analysis separately for "troubled" BHCs and "healthy" BHCs in the year prior to subsidiary failure (i.e., $T_i - 1$). Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	BHCs with Bankrupt Subsidiaries			BHCs without Bankrupt Subsidiaries				
	N	Mean	Median	*N*	Mean	Median	Difference	*t*-statistics
BHCs' changes in Capital Structure								
ΔLeverage	136	0.161	0.104	9771	0.101	0.065	0.060***	3.63
ΔLong-term debt	136	0.059	0.040	7736	0.010	0.000	0.049***	9.59
ΔShort-term debt	136	0.001	-0.002	7736	0.007	0.000	-0.005*	-1.76
ΔSubordinate	136	0.004	0.000	9771	0.001	0.000	0.003***	3.44
ΔDeposits	124	0.101	0.063	7661	0.083	0.052	0.018	1.10
Determinants of Capital Structure								
Size	136	15.172	14.659	9771	14.454	14.159	0.718***	5.26
Market-to-book ratio	136	0.950	0.936	9771	1.046	1.034	-0.096*	-1.71
Profitability	136	0.005	0.005	9771	0.007	0.009	-0.002***	-2.76
Diversification	136	0.150	0.149	9771	0.158	0.136	-0.008***	-2.89
Liquidity	125	0.117	0.109	7743	0.224	0.210	-0.107***	-8.27
MES	125	1.530	1.591	7377	1.406	1.587	0.124**	1.96

We present summary statistics for the year following subsidiary failure (i.e., T_i + 1) in Table 4.3. As shown in the table, following subsidiary failure the "troubled" BHCs on average lower their leverage ratio relative to those "healthy" ones.

When decomposing BHCs' leverage, we find that, in contrast to the financing activities in Year T_i - 1, BHCs with failure subsidiaries in the previous year are more likely to reduce long-term debt financing. The comparison between the two types of BHCs for other control variables in Year T_i + 1 is similar to that in Year T_i – 1.

Table 4. 3: Summary Statistics III

This table presents summary statistics for the variables used in our analysis separately for "troubled" BHCs and "healthy" BHCs in the year following subsidiary failure (i.e., $T_i + 1$). Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	BHCs with Bankrupt Subsidiaries			BHCs without Bankrupt Subsidiaries				
	N	Mean	Median	*N*	Mean	Median	Difference	*t*-statistics
BHCs' changes in Capital Structure								
ΔLeverage	136	0.041	0.032	9771	0.103	0.066	-0.061***	-5.52
ΔLong-term debt	136	-0.024	-0.017	7736	0.011	0.000	-0.035***	-13.55
ΔShort-term debt	136	0.008	0.000	7736	0.006	0.000	0.001	0.33
ΔSubordinate	136	0.002	0.000	9771	0.001	0.000	0.000	0.33
ΔDeposits	128	0.066	0.042	7657	0.084	0.052	-0.018**	-2.02
Determinants of Capital Structure								
Size	136	15.297	14.777	9771	14.453	14.157	0.844***	5.12
Market-to-book ratio	136	0.978	0.967	9771	1.046	1.034	-0.068**	-2.35
Profitability	136	0.004	0.009	9771	0.007	0.009	-0.003**	-2.02
Diversification	136	0.191	0.169	9771	0.158	0.136	0.033***	3.89
Liquidity	129	0.159	0.162	7739	0.224	0.210	-0.065***	-4.49
MES	123	1.471	1.589	7379	1.406	1.587	0.065	1.62

Table 4.4 provides the pair-wise correlations between BHCs' capital structure and various financial characteristics. We use the superscript "*" to denote statistical significance at the 5% level. The results show that most of the correlations are modest and the multi-collinearity problem should be limited.

To provide a more intuitionistic pattern of BHC leverage around the subsidiary failure year, we conduct the univariate analysis for the dynamic changes of various BHC liability items from three years prior to subsidiary failure to three years after that occurring. We report the results in Figures 4.1-4.5. Note that these figures only show various liability items of BHCs that had subsidiary failure. In Figure 4.1, we can apparently see that these "troubled" BHCs had dramatically increased their leverage before the bankruptcy of their subsidiaries, while lowered it after the bankruptcy of their subsidiaries.

Overall, the results support our hypotheses. However, these comparisons are based on simple univariate analyses. In the next section, we employ more rigorous regression analyses to test our hypotheses.

Table 4. 4: Correlation Matrix

This table presents pair-wise correlations among all the key variables used in our analysis. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. We use * to denote statistical significance at the 5% level.

	ΔLeverage	ΔLong-term debt	ΔShort-term debt	ΔSubordinate	ΔDeposits	Size	Market-to-book ratio	Profitability	Diversification	Liquidity	MES
ΔLeverage	1.000										
ΔLong-term debt	0.416*	1.000									
ΔShort-term debt	0.308*	-0.084*	1.000								
ΔSubordinate	0.220*	0.152*	0.051*	1.000							
ΔDeposits	0.945*	0.235*	0.114*	0.201*	1.000						
Size	0.020*	0.006	0.036*	0.087*	-0.010	1.000					
Market-to-book ratio	0.132*	0.166*	0.066*	0.082*	0.111*	0.127*	1.000				
Profitability	0.155*	0.090*	0.082*	0.047*	0.136*	0.052*	0.350*	1.000			
Diversification	-0.024*	-0.033*	0.009	0.013	-0.031*	0.320*	0.128*	0.040*	1.000		
Liquidity	-0.008	0.029*	0.072*	-0.089*	-0.048*	-0.051*	0.073*	0.144*	-0.022*	1.000	
MES	-0.004	-0.005	-0.002	0.007	-0.003	0.065*	0.003	-0.002	0.025*	-0.052*	1.000

Figure 4. 1: Dynamic pattern of Δ*Leverage* around subsidiary failure

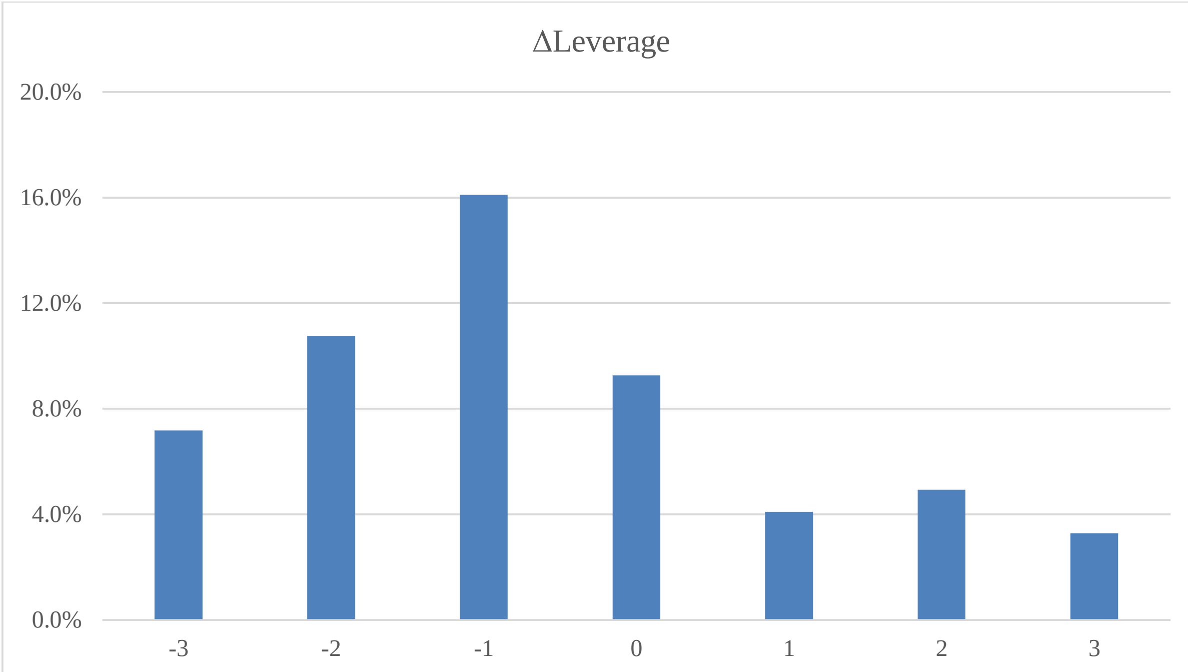


Figure 4. 2: Dynamic pattern of Δ*Long-term debt* around subsidiary failure

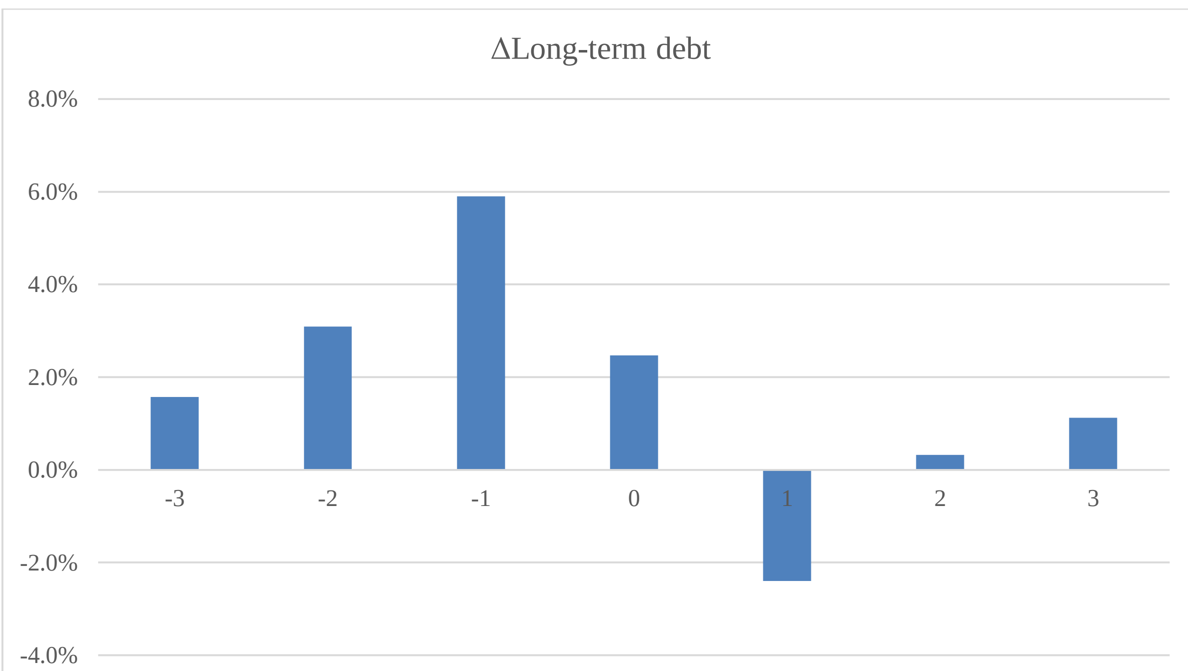


Figure 4. 3: Dynamic pattern of Δ*Short-term debt* around subsidiary failure

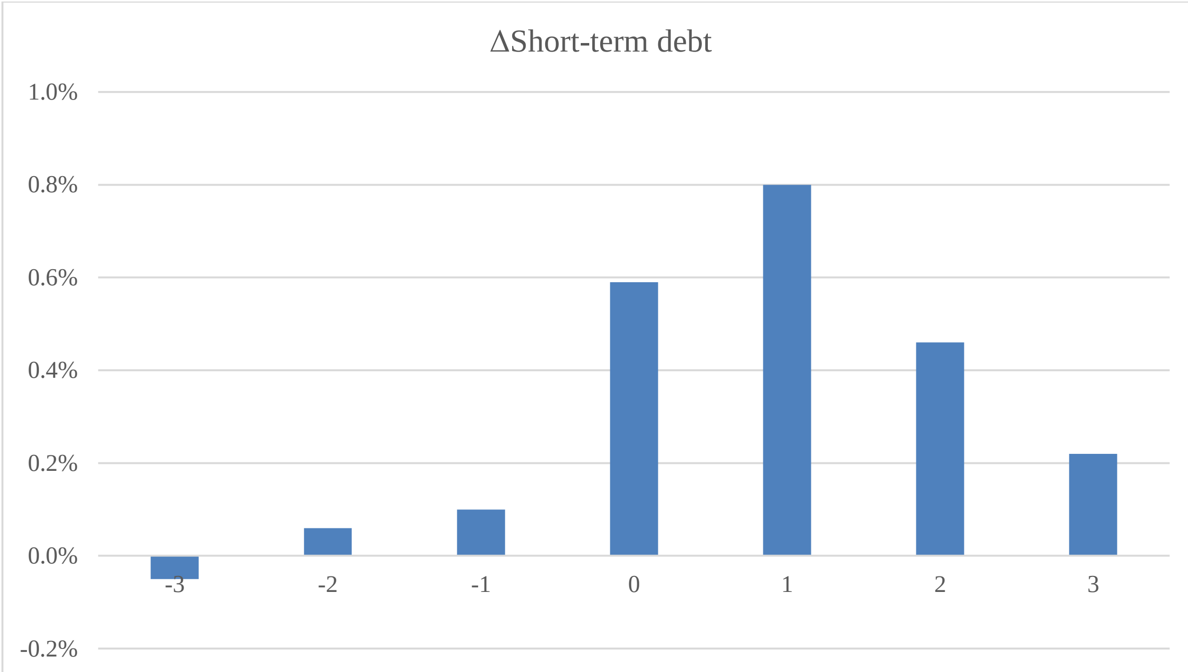


Figure 4. 4: Dynamic pattern of Δ*Subordinate* around subsidiary failure

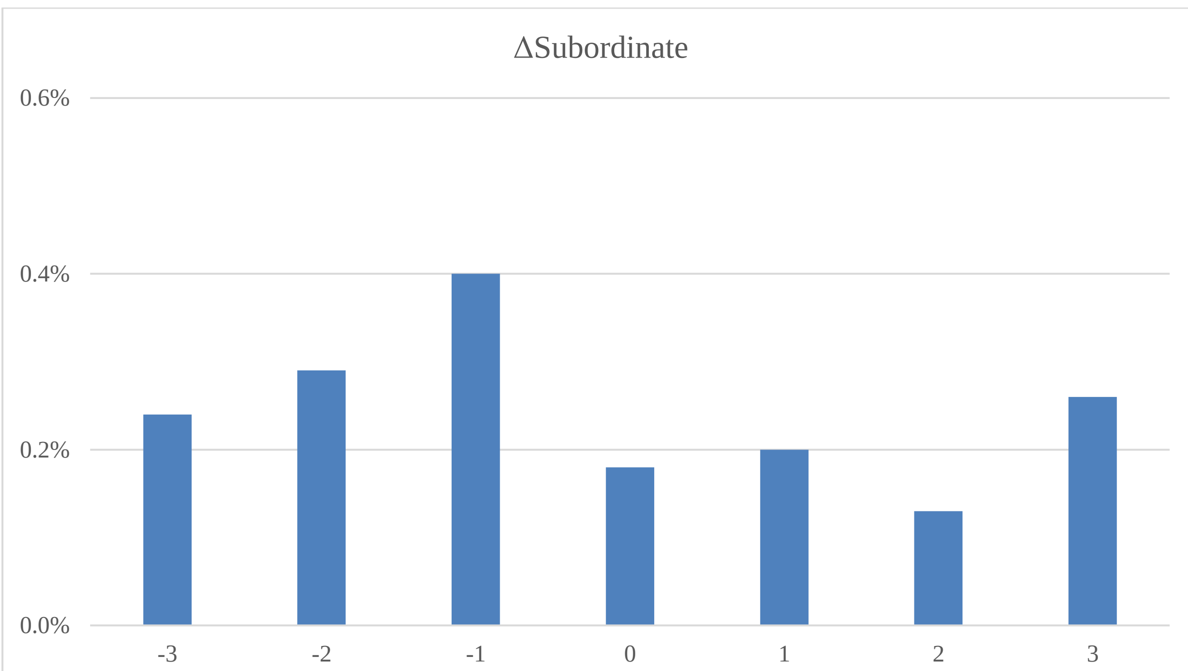
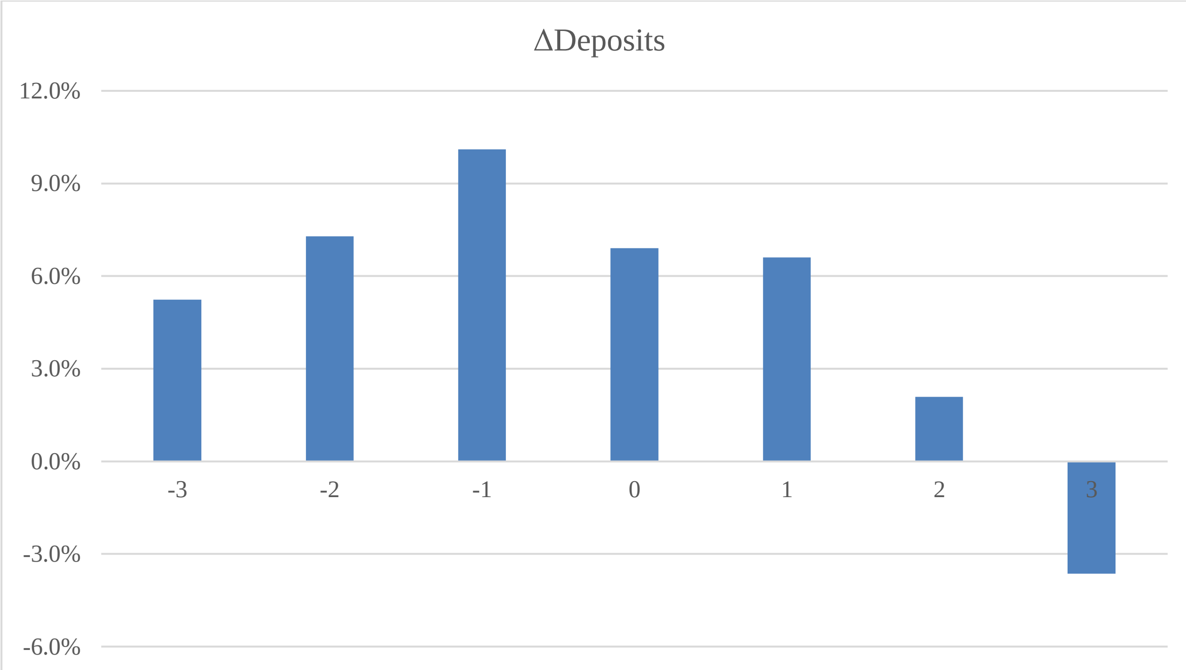


Figure 4. 5: Dynamic pattern of Δ*Deposit* around subsidiary failure



4.5. Empirical results

4.5.1. BHCs' leverage changes around subsidiary failure

Table 4.5 presents the results from estimating Equation (4.1) by using Δ*Leverage* as the outcome variable. We report the coefficient estimates of β_τ for each of the two years before and three years after subsidiary failure. Column (1) reports the results from estimating the model without including control variables using the full sample. Column (2) adds additional controls that may affect BHCs' leverage changes. Columns (3) and (4) give the results using the matched sample. Across all columns in Table 4.5, the coefficients on *Year 1 Before* are all positive and statistically significant. When controlling for BHC characteristics, the estimates based on the full sample imply an absolute increase of 5.45 percentage points in the leverage of BHCs with subsidiary failure, relative to the control group, during the year prior to their subsidiary failure. The coefficients on *Year 1 Before* are also economically significant and large. For instance, the point estimate for *Year 1 Before* on Δ*Leverage* in column (2) implies 257.08% estimated changes in the difference between treated and control BHCs' leverage changes during the year prior to the subsidiary failure relative to the sample average Δ*Leverage* of 2.12%. Contrarily, the consistently negative and significant coefficients on *Year 1 After* in Table 4.5 suggest a significant decrease in the leverage of those "troubled" BHCs in the one year following subsidiary bankruptcy.

In terms of control variables, we find that BHC leverage is positively associated with market-to-book ratio and profitability, and negatively related with size. These findings are generally in line with prior studies on bank capital structure (e.g., Gropp and Heider, 2010), suggesting that our sample is representative.

Overall, these findings support our hypotheses that BHCs are more likely to be more-levered in the year prior to subsidiary failure, and less levered in the year after. Additionally, because the significance of the subsidiary failure effect does not vary widely across all columns, we restrict our attention to the matched sample with a full set of controls in the analyses in later sections.

4.5.2. The reverse causality issue

The main concern in this paper is the reverse causality issue. One may argue that it's the substantial increase in leverage of parent BHCs that leads to the subsequent subsidiary failure, and that the main argument that the parents intentionally increase leverage when foreseeing the defunct among their children, is not true. To address this concern, we employ the following test.

We construct a new binary response variable $Failure_{i,t}$ which indicates if a particular individual bank *i* goes bankrupt at time *t*. It is important to note that these individual banks are

Table 4. 5: Subsidiary Failure and BHC Leverage Changes

This table reports estimates of Equation (1) for US BHCs from 1986 to 2015. Columns (1) and (2) estimate the model using the full sample. Columns (3) and (4) estimate the model using the matched sample. *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
	ΔLeverage	ΔLeverage	ΔLeverage	ΔLeverage
Year 2 Before	-0.005	0.004	-0.003	0.004
	(-0.41)	(0.29)	(-0.24)	(0.27)
Year 1 Before	0.048***	0.055***	0.054***	0.053***
	(3.56)	(3.63)	(3.44)	(3.41)
Year 1 After	-0.052***	-0.040**	-0.056***	-0.027**
	(-4.50)	(-2.52)	(-4.58)	(-2.15)
Year 2 After	-0.008	0.016	-0.010	0.012
	(-0.60)	(1.24)	(-0.66)	(0.81)
Year 3 After	-0.007	0.006	0.001	0.004
	(-0.53)	(0.46)	(0.04)	(0.32)
Size		-0.220***		-0.211***
		(-12.24)		(-13.14)
Market to book ratio		0.255***		0.355***
		(4.61)		(4.61)
Profitability		2.693***		2.100***
		(5.50)		(6.22)
Diversification		-0.048		-0.004
		(-0.99)		(-0.08)
Liquidity		-0.078*		-0.067
		(-1.77)		(-1.33)
MES		0.002		-0.002
		(0.29)		(-0.28)
Constant	0.123***	2.850***	0.134***	2.629***
	(12.43)	(11.15)	(7.56)	(11.30)
BHC fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	9907	6779	338	338
Adj. R^2	0.082	0.243	0.095	0.246

at the subsidiary level. We regress the variable $Failure_{i,t}$ on the leverage changes of the subsidiary itself and its BHC. Apart from this, we also include a group of bank characteristics' variables at the both parent and subsidiary level containing: size, market-to-book ratio, profitability, marginal expected shortfall, diversification and liquidity, all of which are considered related to bank risk. Using BHCs' leverage changes as a key explanatory variable, this test examines whether BHCs' capital structure decisions would affect the survivorship of their subsidiaries in the following year. If the reverse causality concern holds, the increase in leverage of parent BHCs should have a significant impact on their subsidiary failure.

Table 4.6 presents the results of the test. It shows that the subsidiary bank failure is not significantly correlated to prior changes of the parent BHC's capital structure. The evidence suggests that the increase in the leverage of the parent BHC does not increase the chance of its subsidiaries being bankrupt, which is counterfactual to the prediction arisen from the reverse causality concern.

4.5.3. Decomposing BHC leverage

In the above analysis, we calculate BHC leverage by using bank total liabilities divided by total assets and examine its changes around subsidiary failure. In this section we decompose BHC liabilities into deposit and several non-deposit debt items, consisting of long-term, short-term, and subordinated debt, and run regressions against each liability item using equation (4.1) to show which item primarily leads to relative leverage changes of "troubled" BHCs

Table 4. 6: Logit test of the effect of BHCs' leverage changes on subsidiary failure

This table examines the impact of BHCs' leverage changes on each of their subsidiaries based on the individual subsidiary sample. The dependent variable *Failure* is a dummy variable indicating if the individual subsidiary bank goes bankrupt in the current calendar year. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are yearly results and classified as two groups including BHC and subsidiary level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	Failure
$\Delta Leverage_{BHC,t-1}$	2.136
	(0.44)
$Size_{BHC,t-1}$	0.586*
	(1.83)
Market-to-book $ratio_{BHC,t-1}$	-0.849
	(-0.88)
$Profitability_{BHC,t-1}$	-2.701**
	(-2.54)
$Diversification_{BHC,t-1}$	0.262
	(0.80)
$Liquidity_{BHC,t-1}$	-2.106
	(-0.35)
$MES_{BHC,t-1}$	0.070**
	(2.19)
$\Delta Leverage_{Sub,t-1}$	0.091
	(0.85)
$Size_{Sub,t-1}$	-0.231**
	(-2.14)
Market-to-book $ratio_{Sub,t-1}$	-2.656***
	(-4.67)
$Profitability_{Sub,t-1}$	-2.765***
	(-3.44)
$Diversification_{Sub,t-1}$	-0.017*
	(-1.55)
$Liquidity_{Sub,t-1}$	-3.858***
	(-5.78)
Constant	-2.762***
	(-5.33)
Year Fixed Effects	Yes
N	59201
Pseudo R^2	0.657

surrounding their subsidiary failure.[18] Table 4.7 reports the results. In column (1), we observe a substantial pre-failure increase and post-failure decrease in "troubled" BHCs' relative long-term debt. Specifically, the positively significant coefficient on *Year* 1 *Before* in column (1) suggests that long-term debt of BHCs with subsidiary failure increases by 4.97 percentage points during the year prior to their subsidiary failure, on average. The negative and significant coefficient on *Year* 1 *After* indicates that BHCs with subsidiaries going bankrupt in the previous year significantly lower the long-term debt relative to those without subsidiary failure. In columns (2) and (3), we find that "troubled" BHCs also reduce their short-term debt financing and issue more subordinated debt one year before their subsidiary failure. The increase in subordinated debt reflects its relatively lower issuing costs (Sironi, 2003). The coefficients in column (4) indicate that there is no substantial relative deposit change for those "troubled" BHCs around their subsidiary failure. These findings are mutually supportive and show that "troubled" BHCs prefer to adjust their long-term debt financing around their subsidiary failure. Our results are consistent with the findings from prior research that long-term debt acts as a cheaper financing resort and serves as a preferred choice for external financing (Flannery, 1986; Berger et al., 2005). The evidence suggests that BHCs would like to avoid costly equity financing and exploit the temporarily better creditworthiness to obtain funds through long-term debt at a relatively lower cost, knowing that they will have to undertake the forthcoming loss incurred by the subsidiary failure. This process therefore yields a higher leverage for these "troubled" BHCs prior to their subsidiary failure.

[18] Bank non-deposit liabilities can be viewed as debt for firms. They consist of senior long term debt, subordinated debt and other debenture notes.

Table 4. 7: Decomposing BHC Leverage

This table reports estimates of Equation (1) after decomposing BHC leverage into long-term debt, short-term debt, subordinated debt, and deposits based on the matched sample. *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLong-term debt	(2) ΔShort-term debt	(3) ΔSubordinate	(4) ΔDeposits
Year 2 Before	0.009***	0.002	-0.000	-0.008
	(2.87)	(0.56)	(-0.44)	(-0.64)
Year 1 Before	0.050***	-0.010**	0.002***	0.010
	(9.01)	(-2.44)	(2.60)	(0.91)
Year 1 After	-0.030***	0.007	-0.001	-0.004
	(-8.33)	(1.59)	(-1.42)	(-0.40)
Year 2 After	0.001	0.004	-0.000	0.006
	(0.26)	(0.57)	(-0.01)	(0.60)
Year 3 After	-0.004	-0.005	0.000	0.011
	(-1.00)	(-1.31)	(0.08)	(1.00)
Size	-0.017***	-0.016***	-0.001	-0.174***
	(-5.03)	(-5.75)	(-1.15)	(-12.66)
Market to book ratio	0.060**	0.066***	0.008***	0.241***
	(2.22)	(2.97)	(2.69)	(3.77)
Profitability	0.113	0.022	0.012	1.917***
	(1.14)	(0.30)	(1.24)	(6.99)
Diversification	0.008	-0.009	-0.002	0.009
	(0.41)	(-0.85)	(-1.30)	(0.23)
Liquidity	-0.012	-0.007	-0.002	-0.047
	(-0.86)	(-0.59)	(-0.91)	(-1.10)
MES	-0.000	0.003	0.000	-0.005
	(-0.12)	(1.37)	(1.21)	(-0.80)
Constant	0.169***	0.154***	0.006	2.221***
	(2.99)	(3.75)	(0.48)	(11.41)
BHC fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	338	338	338	338
Adj. R^2	0.120	0.059	0.285	0.218

4.5.4. Placebo control approach

The baseline results, however, could also overstate the effect of subsidiary failure on capital structure decisions of parent BHCs if unobservable BHC characteristics are correlated with the failure of subsidiary banks and with the changes of BHC capital. There is evidence that subsidiary performance is related to the background financial characteristics of parent BHCs (Ashcraft, 2008). Financially fragile BHCs may be more prone to suffer subsidiary failure. The financial management and risk preferences of senior managers of parent BHCs could also simultaneously elevate the probability of capital adjustments and a subsidiary failure. All these imply that BHCs having subsidiary failure is endogenous to their underlying characteristics.

To address this bias in tests that seek to discover changes in BHCs' capital structure around subsidiary failure time, we exploit the variation in the failure time of subsidiary banks among BHCs with subsidiary failure. We treat BHCs with later subsidiary failure as a control group for BHCs with earlier subsidiary failure. Specifically, we match the BHCs who have subsidiary failure in year T_i (treatment group) with the BHCs that suffer subsidiary failure in the future year $T_i + n$ (placebo control group). Both groups of BHCs have subsidiary failure and hence would potentially share certain common characteristics. However, because the BHCs in the control group did not have subsidiary failure in year T_i, their capital structure changes from $T_i - 2$ to $T_i + 3$ serve as a comparison with the treatment group. This approach allows us to control for potential common characteristics when we test the capital structure changes of BHCs around the year of subsidiary failure.

To this end, for each BHC in the control group, we create a placebo subsidiary failure date equal to the actual failure date of their subsidiary banks minus *n* years. We then compare the capital structure changes of the treatment and the control groups from $T_i - 2$ to $T_i + 3$. We want to ensure that, during this period (i.e., from $T_i - 2$ to $T_i + 3$), while BHCs in the treatment group experience subsidiary bankruptcy, BHCs in the control group do not. This requires certain restrictions on our original sample data: the treatment group is comprised of all BHCs that had subsidiary failure during 1988 – 1999, and the control group consists of BHCs whose subsidiary failure occurred during 2005 – 2016. The five-year gap in between is to minimize the correlation between post-placebo subsidiary failure window and actual subsidiary failure event for each control BHC. Finally, there are 112 BHCs included into the treatment and control group, and we include all their yearly data from 1986 – 2016, which finally form the subsample for the use of this approach. In this subsample, both the treatment and control groups experience subsidiary failure, however, only the treatment group experiences a subsidiary failure in the estimation window.

Applying this placebo control strategy, we estimate the following specification:

$$\begin{aligned}\Delta Y_{i,t} &= \beta_0 + \sum_{\tau=-2,\tau\neq 0}^{3} \beta_\tau D_{i,t=T_i+\tau} + \sum_{\tau=-2,\tau\neq 0}^{3} \mu_\tau \cdot Treat_i \cdot D_{i,t=T_i+\tau} \\ &+ \delta \cdot Treat_i + \boldsymbol{\beta}_{\mathbf{v}} \mathbf{X}_{i,t-1} + \gamma_i + \lambda_t + \varepsilon_{i,t}\end{aligned} \tag{4.2}$$

where $Treat_i$ is a dummy variable that equals one if BHC i belongs to the treatment group defined in this section. The coefficients of interest are η_t, which are difference-in-differences estimators, measuring the difference between treatment and placebo control BHCs with respect to the changes in capital structure from two years prior to subsidiary failure to three years after the failure.

Based on this identification strategy, if a BHC's capital structure changes prior to or following its subsidiary failure, that change will be captured by the coefficients μ_τ estimated before or after the failure. These coefficients indicate whether the capital structure of the BHCs in the treatment group (who experience a subsidiary failure at time T_i) deviates from that of their counterparts in the placebo control group (who experience a subsidiary failure at a future time $T_i + n$) during the years prior to or following T_i.

Table 4.8 reports estimates from specification (4.2). The dummy variable Treat is dropped from the regression because of the inclusion of BHC fixed effects. We observe similar pre-failure and post-failure trends of capital structure changes compared with those reported in Table 4.5 and Table 4.7. For instance, the positive (negative) and significant coefficient on Year 1 Before × Treat (Year 1 After × Treat) in column (1) indicates that, relative to the placebo control group, the leverage of the BHCs in the treatment group increases (decreases) during the year prior to (following) the subsidiary failure. All the other columns are largely consistent with the event-study specification (4.1). The results confirm that "troubled" BHCs increase leverage ratio as early as one year prior to the failure of their subsidiaries, and that leverage increase is significantly reversed following the subsidiary failure.

4.5.5. Subsidiary failure effect by BHC size and capital ratio

The results in Table 4.7 show a marked pre-failure increase in "troubled" BHCs' relative long-term debt as well as their subordinate debt issuance. This could reflect strategic behavior, or it could reflect an increased financing demand by BHCs who were already in financial distress. We address this concern by identifying subsets of BHCs with different sizes. Large banks may have greater flexibility to withstand a short-term liquidity shortage (Vazquez and Federico, 2015). If BHCs' financial distress is the key driver of the leverage changes around subsidiary failure, we would expect that this change is more significant for small banks compared to large banks. In addition, the impact of subsidiary failure on bank capital structure could also be shaped by the regulatory frameworks. Banks may hold discretionary capital, above the regulatory minimum in order to avoid the costs of having to issue fresh equity at short notice (Peura and Keppo, 2006). Thus, we examine the differential effects of subsidiary bankruptcy on financing decisions across the BHCs that might be subject to different regulatory requirements for capital adequacy. To evaluate these conjectures, we implement several tests as follows.

First, we separate BHCs into two groups based on the BHC's tier 1 capital ratio. Since the minimum tier 1 capital ratio specified in the Basel III is 6%, we classify the BHCs with tier 1 ratio greater than 6% as well capitalized and those with tier 1 less than 6% as lowly capitalized. Table 4.9 reports the sub-sample results. We find that in the year prior to subsidiary failure, well capitalized BHCs significantly increase long-term debt and leverage, and reduce short-term debt while lowly capitalized BHCs only significantly raise their long-term debt financing. One year after subsidiary bankruptcy, both well and lowly capitalized BHCs significantly lower their long-term debt financing and leverage ratio.

Second, we define a dummy variable *Small* as one if the total assets of a BHC in that year are below \$10 billion, and zero otherwise. The \$10 billion size cutoff is important since the BHCs which are above this asset threshold are subject to stress testing and large-bank deposit pricing rules (Bennett, Güntay, and Unal, 2015). Ellul and Yerramilli (2013) among others, use the same cut-off value to separate large BHCs from small ones. We then interact it with the DID estimators in equation (4.1) to examine the size effect. Table 4.10 presents the results from our main specification. The positive and significant coefficient on *Year 1 Before* × *Small* in column (1) shows that small BHCs have relatively more leverage increase than large BHCs do in the year prior to subsidiary failure. We also find that small BHCs have more long-term and subordinated debt increases, and more short-term debt decrease as indicated by the significant coefficients on the interaction term *Year 1 Before* × *Small* in columns (2) through (4).

Table 4. 8: Subsidiary Failure and BHC Capital Structure Changes Using Placebo Control Approach

This table reports estimates of Equation (4.2). *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Appendix A provides all other variable definitions. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	0.067	0.006	0.071	-0.001	0.029**
	(1.15)	(0.67)	(1.39)	(-0.45)	(2.09)
Year 1 Before	0.106*	0.014*	0.025	0.001	0.005
	(1.90)	(1.81)	(1.15)	(0.42)	(0.43)
Year 1 After	-0.039*	0.008	-0.069***	-0.008	0.051***
	(-1.91)	(0.94)	(-2.78)	(-1.17)	(6.23)
Year 2 After	-0.018	0.145	-0.209	0.001	0.024
	(-0.94)	(1.51)	(-1.52)	(0.89)	(0.41)
Year 3 After	-0.107	-0.072	-0.066**	-0.000	0.036***
	(-1.23)	(-1.26)	(-1.98)	(-0.16)	(3.90)
Year 2 Before × Treat	-0.012	0.009	-0.071	0.001	-0.031
	(-1.53)	(0.73)	(-1.37)	(0.26)	(-1.20)
Year 1 Before × Treat	0.037***	0.035**	-0.031	0.002	0.052
	(3.62)	(2.56)	(-1.34)	(0.87)	(1.02)
Year 1 After × Treat	-0.020**	-0.030***	0.081***	0.007	-0.078***
	(-2.23)	(-2.90)	(3.18)	(1.02)	(-3.65)
Year 2 After × Treat	0.025	-0.147	0.203	-0.002	-0.028
	(0.89)	(-1.53)	(1.47)	(-1.07)	(-0.44)
Year 3 After × Treat	0.120	0.072	0.064*	0.001	-0.022
	(1.32)	(1.25)	(1.90)	(0.29)	(-0.89)
Constant	2.636***	0.176***	0.154***	0.006	2.221***
	(11.30)	(3.09)	(3.74)	(0.50)	(11.42)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	2738	2738	2738	2738	2738
Adj. R^2	0.243	0.097	0.068	0.284	0.217

Table 4. 9: Subsidiary Failure Effect Stratified by BHC Capital Ratio

This table reports estimates of Equation (4.1) for US BHCs from 1986 to 2015, but stratifies the matched sample by BHC capital ratio. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔLeverage	ΔLeverage	ΔLong-term debt	ΔLong-term debt	ΔShort-term debt	ΔShort-term debt
	Well capitalized (Tier 1 ≥ 6%)	Low capitalized (Tier 1 < 6%)	Well capitalized (Tier 1 ≥ 6%)	Low capitalized (Tier 1 < 6%)	Well capitalized (Tier 1 ≥ 6%)	Low capitalized (Tier 1 < 6%)
Year 2 Before	-0.002	0.025	0.008***	0.011	0.003	-0.010
	(-0.16)	(0.93)	(2.87)	(0.41)	(0.92)	(-0.49)
Year 1 Before	0.070***	0.011	0.048***	0.090**	-0.008**	-0.025
	(3.37)	(0.51)	(9.28)	(2.35)	(-1.97)	(-1.44)
Year 1 After	-0.024*	-0.094**	-0.029***	-0.063**	0.006	0.029
	(-1.75)	(-2.07)	(-8.10)	(-2.10)	(1.21)	(0.97)
Year 2 After	0.012	0.057	-0.001	0.021	0.009	-0.039
	(0.77)	(1.36)	(-0.27)	(0.42)	(1.52)	(-0.75)
Year 3 After	0.009	-0.005	-0.002	-0.067*	-0.003	0.013
	(0.66)	(-0.13)	(-0.60)	(-1.79)	(-0.83)	(0.70)
Size	-0.216***	-0.223***	-0.014***	-0.054**	-0.016***	-0.030
	(-12.89)	(-3.22)	(-4.34)	(-2.20)	(-6.14)	(-1.39)
Market to book ratio	0.328***	1.179***	0.073**	0.096	0.046**	0.455***
	(4.15)	(4.38)	(2.57)	(1.03)	(2.02)	(3.11)
Profitability	2.115***	0.510	0.246**	-0.441	-0.001	0.203
	(5.22)	(0.86)	(2.24)	(-1.32)	(-0.01)	(0.72)
Diversification	-0.053	0.354***	-0.012	0.065	-0.002	0.061
	(-0.82)	(3.78)	(-0.52)	(1.50)	(-0.16)	(1.22)
Liquidity	-0.086	0.001	-0.025*	0.014	0.004	-0.075
	(-1.62)	(0.01)	(-1.81)	(0.20)	(0.36)	(-1.03)
MES	-0.004	0.006	-0.000	-0.005	0.001	0.022
	(-0.47)	(0.19)	(-0.02)	(-0.31)	(0.46)	(1.34)
Constant	2.733***	1.996**	0.125**	0.629*	0.167***	-0.010
	(11.42)	(2.09)	(2.23)	(1.73)	(4.12)	(-0.03)
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	514	224	514	224	514	224
Adj. R^2	0.231	0.358	0.121	0.231	0.061	0.136

We, however, find that the leverage of small BHCs decreases significantly more than that of large BHCs in the year immediately following subsidiary bankruptcy. Moreover, the negative and significant coefficient on *Year 1 After* × *Small* in column (2) shows that the long-term debt of small BHCs also significantly decreases more during this period. This suggests an even higher debt financing cost for small BHCs as their financial conditions deteriorate more severely due to the assets constraint.[19]

Third, we define a dummy variable *Well Capitalization* as one if the BHC's tier 1 capital ratio is greater than 6%, and zero otherwise.[20] We then interact it with the DID estimators in equation (4.1) to examine the regulatory effect. Table 4.11 reports the results. We find that in the year prior to subsidiary failure, well capitalized BHCs have significantly more increase in leverage. Specifically, they increase more in long-term and subordinated debt, and reduce more in short-term debt financing compared to lowly capitalized BHCs. One year after subsidiary bankruptcy, well capitalized BHCs have significantly more decrease in their long-term debt financing and leverage ratio.

Overall, these results support our hypotheses that subsidiary failure induces substantial leverage changes of their parent BHCs surrounding the failure time. We find significant evidence of differential effects of subsidiary bankruptcy on financial policy for different

[19] I obtain qualitatively similar results when using $50 billion and $100 billion as two alternative cut-off points. Table A.2 and A.3 in the appendix report their respective results.
[20] The minimum tier 1 capital ratio specified in the Basel III is 6%.

Table 4. 10: Subsidiary Failure Effect by BHC Size

This table estimates the difference-in-difference-in-differences (DDD) effect of subsidiary failure by BHC size for US BHCs from 1986 to 2015. *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)	(3)	(4)	(5)
	ΔLeverage	ΔLong-term debt	ΔShort-term debt	ΔSubordinate	ΔDeposits
Year 2 Before	-0.000	0.008**	-0.001	0.000	-0.00901
	(-0.00)	(2.03)	(-0.17)	(0.14)	(-0.61)
Year 1 Before	0.059**	0.050***	-0.017***	0.001	0.0244
	(2.21)	(7.48)	(-3.56)	(1.41)	(1.09)
Year 1 After	-0.039***	-0.030***	0.007	-0.000	-0.0164
	(-2.75)	(-7.13)	(1.20)	(-0.32)	(-1.38)
Year 2 After	0.001	0.001	0.003	-0.000	-0.00469
	(0.09)	(0.20)	(0.94)	(-0.02)	(-0.38)
Year 3 After	-0.018	-0.003	-0.008	0.000	-0.00903
	(-1.43)	(-0.53)	(-1.62)	(0.42)	(-0.76)
Year 2 Before × Small	0.001	0.011**	0.007	-0.001	-0.009
	(0.08)	(2.49)	(1.18)	(-1.35)	(-0.69)
Year 1 Before × Small	0.062**	0.049***	-0.009*	0.003**	0.027
	(2.14)	(4.97)	(-1.71)	(2.21)	(1.05)
Year 1 After × Small	-0.054*	-0.027***	0.005	0.001	0.035
	(-1.82)	(-3.30)	(0.85)	(1.02)	(1.56)
Year 2 After × Small	-0.048	0.002	-0.002	0.000	0.033
	(-1.52)	(0.18)	(-0.16)	(0.08)	(1.25)
Year 3 After × Small	-0.050*	-0.011	0.000	0.000	0.065***
	(-1.74)	(-1.20)	(0.01)	(0.42)	(2.98)
Small	0.008	0.016***	0.000	-0.000	-0.005
	(0.38)	(3.75)	(0.06)	(-0.70)	(-0.53)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	338	338	338	338	338
Adj. R^2	0.295	0.183	0.120	0.286	0.220

Table 4. 11: Subsidiary Failure Effect by BHC Capital Ratio

This table estimates the difference-in-difference-in-differences (DDD) effect of subsidiary failure by BHC capital ratio for US BHCs from 1986 to 2015. *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	0.064**	0.018	-0.013	0.002	0.051***
	(2.46)	(0.85)	(-0.91)	(0.54)	(2.77)
Year 1 Before	0.051	0.072**	-0.032**	-0.002	0.008
	(1.38)	(1.98)	(-2.44)	(-1.35)	(0.37)
Year 1 After	-0.074*	-0.057**	0.026	-0.003	-0.045
	(-1.76)	(-2.40)	(1.35)	(-1.17)	(-1.46)
Year 2 After	-0.007	0.018	-0.048	-0.001	0.022
	(-0.38)	(0.56)	(-1.15)	(-0.52)	(0.82)
Year 3 After	-0.076	-0.047	-0.022	0.001	0.008
	(-1.46)	(-1.41)	(-1.51)	(1.04)	(0.21)
Year 2 Before × Well Capitalization	-0.002	0.025	0.003	-0.000	-0.012
	(-0.16)	(0.93)	(0.72)	(-0.73)	(-0.99)
Year 1 Before × Well Capitalization	0.070***	0.048***	-0.008*	0.002***	0.009
	(3.37)	(9.15)	(-1.95)	(2.77)	(0.76)
Year 1 After × Well Capitalization	-0.024*	-0.029***	0.006	-0.001	-0.002
	(-1.75)	(-8.48)	(1.26)	(-1.18)	(-0.20)
Year 2 After × Well Capitalization	0.012	-0.001	0.009	-0.000	0.004
	(0.77)	(-0.30)	(1.44)	(-0.01)	(0.35)
Year 3 After × Well Capitalization	0.009	-0.002	-0.004	-0.000	0.011
	(0.66)	(-0.58)	(-1.05)	(-0.03)	(0.94)
Well Capitalization	-0.022**	-0.006	-0.009***	-0.001	-0.008
	(-1.97)	(-1.62)	(-2.77)	(-1.48)	(-0.79)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	338	338	338	338	338
Adj. R^2	0.246	0.115	0.058	0.285	0.219

groups of BHCs, which is consistent with our previous argument that BHCs' leverage changes are mainly due to the internal financial deterioration. We also find a shift from debt to equity financing for BHCs *after* subsidiary bankruptcy due to their significant leverage drop. It is mainly because that the parent BHC raises equity to further secure its compliance to the capital requirement as subsidiary bankruptcy may tighten the regulatory watch. Maintaining certain equity capital ratios acts as material protection for depositors, shareholders, and the government safety net.

4.5.6. The effect of subsidiary failure on BHCs' liquidity and lending

We next analyze the dynamic pattern of BHCs' liquidity and lending around the subsidiary failure time. The above results show that BHCs' external borrowing has significantly increased prior to the subsidiary failure time. We have argued that this action is incentivized by the managers' anticipation of failure. If the subsidiary bank failure leads to the parent BHC not having surplus capital to distribute among its various other affiliates, and if the capital requirement limits the BHC's ability to use insured deposits, then it follows that these "troubled" BHCs expecting limited internal funds may be forced to hoard more cash or liquidity assets, and curtail loans to ease the financial difficulties. Therefore, we expect more increase in cash and liquidity assets, and more decrease in lending of "troubled" BHCs relative to the "healthy" ones, prior to the time of subsidiary failure.

To test this conjecture, we estimate the same specification as Equation (4.1) by substituting the following three dependent variables: Δ*Cash*/*assets*, Δ*Liquidity*/*assets*, and Δ*Total loans*/*assets*. Table 4.12 reports the results. As shown in columns (1) and (2), the coefficients on *Year 1 Before* are significant and positive for dependent variables Δ*Cash*/*assets* and Δ*Liquidity*/*assets*, which implies that cash and liquidity assets of "troubled" BHCs significantly climb one year before subsidiary failure. The significant and negative coefficient on *Year 1 Before* for the dependent variable Δ*Total loans/assets* suggests that loans of "troubled" BHCs on average decline prior to the subsidiary failure time.

We further exploit the difference-in-difference-in-differences (DDD) regression model to explore which type of "troubled" BHCs are more affected by the bankruptcy of subsidiary banks. Similar as we do in Table 4.10, we interact the size dummy variable *Small* with the DID estimators in equation (4.1) to capture the size effect. Columns (4) and (5) in Table 4.12 show that "troubled" BHCs with smaller size tend to hoard more cash and liquidity assets prior to the time of subsidiary failure, as shown by the positive and significant coefficients on the interaction term *Year 1 Before* × *Small*. Similarly, column (6) shows that smaller BHCs with subsidiary failure in the following year have more cut in lending. These results are reasonable as small BHCs are more vulnerable to capital shortage and thus have more adjustments in both their asset and liability parts.

We next define a dummy variable *Low Capitalization* as one if the BHC's tier 1 capital ratio is less than 6%, and zero otherwise. We then interact it with the DID estimators in equation (1) to capture the regulatory effect. Columns (7) to (9) in Table 4.12 show that in the year prior to the subsidiary failure, the increase in cash and liquidity assets and decrease in total loans for "troubled" BHCs are even more intensified for those lowly capitalized ones, as shown by the significant coefficients on the interaction term *Year 1 Before* × *Low Capitalization*. The findings suggest that lowly capitalized BHCs face more severe financial deteriorations prior to their subsidiary failure.

Overall, the results show that the parent BHCs will conduct a selection of activities in advance to avoid further liquidity and financial constraint problems after their subsidiary failure. They are not just to increase debt borrowing, but also to increase liquidity and curtail lending.

Table 4. 12: Subsidiary Failure Effect on BHCs' Liquidity and Lending

This table reports the dynamic effects of subsidiary failure on BHCs' liquidity and lending based on the matched sample. Δ*Cash/Assets* is calculated as ratio of the current year's total cash minus the previous year's total cash to the previous year's total assets; Δ*Liquidity* is calculated as ratio of the current year's total liquidity assets minus the previous year's total liquidity assets to the previous year's total assets; Δ*Total Loans/Assets* is calculated as ratio of the current year's total loans minus the previous year's total loans to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔCash/Assets	(2) ΔLiquidity	(3) ΔTotal Loans/Assets	(4) ΔCash/Assets	(5) ΔLiquidity	(6) ΔTotal Loans/Assets	(7) ΔCash/Assets	(8) ΔLiquidity	(9) ΔTotal Loans/Assets
Year 2 Before	0.003	-0.045	-0.003	-0.002	-0.036	-0.003	0.000	0.049	-0.020
	(0.96)	(-1.37)	(-0.33)	(-0.55)	(-0.85)	(-0.26)	(0.04)	(0.68)	(-0.70)
Year 1 Before	0.005**	0.043*	-0.062***	0.014**	0.072*	-0.076**	0.006*	0.060**	-0.049**
	(1.98)	(1.69)	(-3.63)	(2.13)	(1.68)	(-2.44)	(1.86)	(2.07)	(-2.52)
Year 1 After	-0.001	0.0124	0.009	-0.012***	0.077	0.009	-0.004	-0.033	-0.034
	(-0.46)	(0.56)	(0.88)	(-2.66)	(1.48)	(0.49)	(-0.31)	(-0.55)	(-1.11)
Year 2 After	-0.002	0.0287	0.009	-0.003	0.036	0.015	0.029	-0.094	-0.006
	(-0.58)	(1.26)	(0.97)	(-0.98)	(1.00)	(1.02)	(1.48)	(-0.98)	(-0.27)
Year 3 After	0.001	0.038	0.012	0.007	0.013	0.049***	0.026*	0.124	-0.027
	(0.39)	(1.53)	(1.27)	(1.52)	(0.23)	(2.66)	(1.87)	(1.32)	(-1.06)
Year 2 Before × Small				0.006	-0.011	0.004			
				(1.12)	(-0.19)	(0.27)			
Year 1 Before × Small				0.018***	0.087*	-0.052**			
				(2.62)	(1.76)	(-2.49)			
Year 1 After × Small				-0.009*	-0.078	-0.027			
				(-1.74)	(-1.38)	(-1.24)			
Year 2 After × Small				0.002	-0.010	-0.010			
				(0.40)	(-0.23)	(-0.55)			
Year 3 After × Small				-0.008	-0.057	-0.022			
				(-1.53)	(-1.02)	(-0.60)			
Year 2 Before × Low Capitalization							0.003	0.041	-0.035
							(0.79)	(1.28)	(-0.74)
Year 1 Before × Low Capitalization							0.008**	0.055*	-0.061***
							(1.97)	(1.81)	(-3.22)
Year 1 After × Low Capitalization							-0.001	0.048	0.026
							(-0.07)	(0.80)	(0.80)
Year 2 After × Low Capitalization							-0.033*	-0.029	0.017
							(-1.73)	(-1.03)	(0.71)
Year 3 After × Low Capitalization							-0.027*	-0.026	0.042
							(-1.89)	(-0.88)	(1.54)
Small				0.002	-0.004	-0.061***			
				(0.78)	(-0.56)	(-4.22)			
Low Capitalization							-0.004**	-0.022	0.008
							(-2.36)	(-1.42)	(0.96)
BHC Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	395	395	395	395	395	395	395	395	395
Adj. R^2	0.065	0.347	0.247	0.069	0.354	0.253	0.070	0.352	0.248

4.5.7. BHC performance transition around subsidiary failure

In this section, we check the performance of "troubled" BHCs which increase long-term debt one year before subsidiary failure relative to those which do not around the failure time. As we have shown in the above section that "troubled" BHCs tend to increase borrowing and liquidity, and cut lending beforehand to smooth out the negative impact, we expect that following the subsidiary failure, these BHCs should have a more smooth transition in performance and suffer less in operating and market performance than those "troubled" BHCs which do not make such adjustments in advance. To test this hypothesis, we further analyze the dynamic patterns of BHC performance (*ROA* and Tobin's Q) and risk (*MES*) around the year of subsidiary failure.

Table 4.13 first re-estimates the main specification, but changes the dependent variables to *ROA*, *Market-to-book ratio* (Tobin's Q), and *MES*. Across all three columns, we observe no apparent effect of subsidiary failure on the relative operating and market performance, and risk of "troubled" BHCs around the failure year.

In Table 4.14, we define a dummy variable *Debt increase 1 year before* as one if Δ*Long-term debt* for the "troubled" BHC is greater than zero one year before subsidiary failure, and zero otherwise. We then employ the difference-in-difference-in-differences (DDD) estimation strategy by interacting the event DID estimators in the main specification with *Debt increase 1 year before* dummy to capture the dynamics of the performance of "troubled" BHCs who increase long-term debt borrowing in the year prior to subsidiary failure. It is worth noting that the dummy variable *Debt increase 1 year before* is dropped from the regression because of the

Table 4. 13: The Dynamic Patterns of BHC Performance around Subsidiary Failure

This table reports the dynamic effects of subsidiary failure on BHCs' performance and risk based on the matched sample. The dependent variables are *Profitability*, *Market-to-book ratio* (Tobin's Q), and *MES* (Marginal Expected Shortfall). *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) Profitability_t	(2) $\text{Market to book ratio}_t$	(3) MES_t
Year 2 Before	0.001*	-0.001	0.002
	(1.82)	(-0.34)	(0.09)
Year 1 Before	0.001*	-0.004	-0.011
	(1.92)	(-1.05)	(-0.50)
Year 1 After	-0.001	-0.000	-0.000
	(-0.68)	(-0.20)	(-0.00)
Year 2 After	0.000	0.006**	0.040*
	(0.19)	(2.16)	(1.92)
Year 3 After	0.000	0.001	-0.014
	(0.34)	(0.22)	(-0.55)
Size_{t-1}	-0.002***	-0.008***	0.088***
	(-3.79)	(-2.98)	(4.39)
$\text{Market to book ratio}_{t-1}$	0.024***	0.503***	0.346***
	(3.54)	(7.85)	(3.69)
$\text{Profitability}_{t-1}$	0.301***	0.118	-0.070
	(6.47)	(1.27)	(-0.18)
$\text{Diversification}_{t-1}$	0.005*	0.001	-0.088
	(1.72)	(0.09)	(-0.92)
Liquidity_{t-1}	0.003	0.004	-0.126*
	(1.58)	(0.43)	(-1.67)
MES_{t-1}	-0.001**	0.001	0.106***
	(-2.43)	(0.46)	(5.20)
Constant	0.013	0.625***	-0.470
	(1.32)	(7.92)	(-1.57)
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	395	395	395
Adj. R^2	0.344	0.596	0.125

inclusion of BHC fixed effects. As shown in columns (1) and (2), the positive and significant coefficients on *Year 1 After × Debt increase 1 year before* indicate that the operating and market performance of "troubled" BHCs who increase long-term borrowing one year before increases more compared to those who do not in the one year following the subsidiaries filing for bankruptcy. The negative and significant coefficient on *Year 1 After × Debt increase 1 year before* in column (3) indicates that the "troubled" BHCs who increase long-term borrowing one year before contribute less to the systemic risk following the subsidiary failure.

Overall, these findings are consistent with the hypothesis and further imply that the activities taken by the parent BHCs including changes in liquidity, capital structure, and lending all aim to alleviate the concerns on financial constraints, stabilize the performance, and lower the risks.

Table 4. 14: The DDD Estimation of the Dynamic Patterns of BHC Performance around Subsidiary Failure

This table reports the dynamic effects of subsidiary failure on BHCs' performance and risk based on the matched sample using the difference-in-difference-in-differences (DDD) estimation strategy. The dependent variables are *Profitability*, *Market-to-book ratio* (Tobin's Q), and *MES* (Marginal Expected Shortfall). *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)	(3)
	Profitability_t	$\text{Market to book ratio}_t$	MES_t
Year 2 Before	0.002	-0.006	0.020
	(0.48)	(-1.02)	(0.46)
Year 1 Before	-0.004**	0.007	0.019
	(-2.33)	(1.51)	(0.48)
Year 1 After	0.001	-0.009	0.028
	(0.79)	(-1.41)	(0.70)
Year 2 After	0.000	0.001	0.013
	(0.17)	(0.13)	(0.23)
Year 3 After	0.000	0.007	0.082*
	(0.03)	(0.98)	(1.82)
Year 2 Before × Debt increase 1 year before	-0.001	0.006	-0.020
	(-0.22)	(0.85)	(-0.40)
Year 1 Before × Debt increase 1 year before	-0.002	-0.011*	-0.033
	(-1.08)	(-1.92)	(-0.71)
Year 1 After × Debt increase 1 year before	0.005***	0.018**	-0.102*
	(2.83)	(2.37)	(-1.92)
Year 2 After × Debt increase 1 year before	0.004*	0.006	0.028
	(1.65)	(0.70)	(0.47)
Year 3 After × Debt increase 1 year before	0.004	-0.007	-0.031
	(1.39)	(-0.88)	(-0.64)
Size_{t-1}	-0.002***	-0.008***	0.088***
	(-3.80)	(-2.99)	(4.39)
$\text{Market to book ratio}_{t-1}$	0.024***	0.503***	0.346***
	(3.54)	(7.84)	(3.70)
$\text{Profitability}_{t-1}$	0.301***	0.119	-0.069
	(6.46)	(1.27)	(-0.18)
$\text{Diversification}_{t-1}$	0.005*	0.002	-0.088
	(1.74)	(0.10)	(-0.91)
Liquidity_{t-1}	0.004	0.004	-0.126*
	(1.60)	(0.42)	(-1.66)
MES_{t-1}	-0.001**	0.001	0.106***
	(-2.43)	(0.47)	(5.20)
Constant	0.013	0.626***	-0.471
	(1.32)	(7.92)	(-1.58)
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	395	395	395
Adj. R^2	0.344	0.596	0.126

4.6. Conclusion

In this chapter, we explore capital structure adjustments of BHCs that have subsidiary bankruptcy. Relative to public investors, bank insiders possess better knowledge and precise predictions on BHCs' next-period status. By specifically focusing on the information asymmetry between these two parts, we examine whether and how bank managers adjust the financial policy before and after their subsidiaries going bankrupt.

We find that BHCs tend to exploit better capital market access and cheaper borrowing costs to increase leverage before subsidiaries fail. Subsequent to subsidiary failures, however, these BHCs significantly lower the leverage. We additionally construct a measure of the information gap between BHCs and outside investors concerning the prediction of subsidiary bankruptcy in the next year to check the robustness of our conclusions. We present a model in which outsiders predict the failure of a BHC's subsidiary based on the parent's publicly available information. Our framework therefore explicitly accommodates the ability of outsiders to infer the conditions of subsidiaries. The information gap is thus defined as the difference between the actual and the forecasted status of subsidiaries. We then model the relation between the BHCs' capital structure adjustments prior to their subsidiary failure and our measure of the information gap, controlling for a set of conventional variables. The results further validate our hypothesis.

The adjustment in capital structure can be ascribed to several factors. The study documents these factors including BHCs' internal capital risk and most importantly, the information asymmetry/gap between BHCs and the outside market. Our findings have important implications for the public to understand various incentives that banks may have in adjusting their capital structure.

Chapter V: Capital structure adjustments of bank holding companies and subsidiary M&A

5.1. Introduction

How do the costs associated with subsidiary banks engaging in acquisition activities affect capital structure decisions of their parent bank holding companies (BHCs)? Prior literature shows that those BHCs operate internal capital markets where they allocate capital and liquidity to and between subsidiary banks (Houston, James, and Marcus, 1997; Houston and James, 1998). Therefore, they provide an effective mechanism through which subsidiary banks affect the cash flow, capital position, and liquidity of parent holding companies. As many costs are involved in acquisition activities such as underwriter fees, consultancy fees, and distribution costs, these costs could have a significant impact on the capital allocations and operational activities for the whole organization. BHCs facing such scarce internal capital problems have incentives to take actions to avoid the further financial constraints. One of the most popular actions BHCs can take in the capital market is to change their financing decisions.

During the past decades, we have witnessed substantial bank consolidations through acquisitions in the US banking industry. This leads to the significant drop in the numbers of banks and the emergence of some whopping banks. Researchers have argued that bank consolidations fundamentally alter the traditional role for banks as financial intermediaries, by affecting both how banks find sources other than deposits to fund their expanded businesses and how banks lend to firms, diversify the services, and securitize the products (e.g., Amel, Barnes, Panetta, and Salleo, 2004; DeYoung, Evanoff, and Molyneux, 2009; Chen and Vashishtha, 2017). If these consolidations through acquisitions occur to subsidiary banks that form part of their respective BHCs, then the activities would ultimately impact the parents' financing and lending decisions, and change the products and services that the BHCs could offer. In this chapter, we focus on the financing decisions (i.e., capital structure decisions) of the parent BHCs that could be shaped by the consolidations happening at the subsidiary level.

From a theoretical perspective, the impact of subsidiary bank consolidations on the parents' capital structure decisions is twofold. For one thing, banks make the decisions of merges often for the consideration of efficiency gains. While these gains may benefit the merging subsidiaries, they are not necessarily improving the welfare to the parent BHCs. Some holding companies may be adversely affected by these changes and experience reduced capital available to allocate among the internal capital market. The reduced capital and liquidity may prompt the parent BHCs to take advantage of the information advantage beforehand to improve their access to alternative financing sources (Desai, Foley, and Hines, 2004). In this vein, subsidiary acquisition activities could lead to higher financial leverage ratios and worse capitalization for the holding banks.

For another, firm acquisitions are often perceived by the market as having some synergies which can enhance cash flows and the firm value. However, empirical findings do not seem to show support for this view for the bank setting. Some researchers even report the negative short-term market reactions to the share price for the merged banks around deal announcements (Houston, James, and Ryngaert, 2001). Further, bank mergers at the subsidiary level could tremendously strength the market power of the whole holding company, lessen the pressure of competition from other banks, and achieve greater merger gains (Penas and Unal, 2004). In anticipation of the reduced risk of being financially distressed, the parent BHCs could lower the debt ratios and increase the capital reserve.

A key factor affecting this trade-off, at lease from the perspective of parent banks, is the extent to which subsidiary banks' engagement in acquisition activities affects the internal capital flows within the established internal capital market by the BHCs. This is an open empirical question as subsidiary acquisition activities can lead to the additional costs for the parent BHCs as subsidiary failure does as discussed in the last chapter. BHCs with huge capital evaporation during acquisition deals of subsidiary banks, for instance, face higher costs of accessing cheap external financing in the future. Additionally, moral considerations may further reduce the ability of parent BHCs to default on their existing obligations to relieve the financial burden and maintain the liquidity.

To disentangle the real effects on parent BHCs' financing decisions, in this chapter we focus on the BHCs that are publicly listed financial firms in the United States and have subsidiary acquisitions over the period from 1986 to 2015. We analyze the dynamic patterns of various capital structure variables of BHCs that have subsidiary acquisitions using the BHCs that do not have any subsidiary acquisitions through our sample period as a benchmark. Specifically, we employ a standard event-study difference-in-differences (DID) approach to study the dynamics of BHC capital structure and various financing decisions from two year prior to subsidiary acquisitions to three years after the acquisitions. This estimation strategy has been previously used by Schoar (2002), Autor (2003), and Almond, Hoynes, and Schanzenbach (2011), among others, to study firm performance around different events. In this event-study DID framework, we again estimate the leverage changes among BHCs with subsidiary acquisitions (treated BHCs) around the time of their subsidiary banks engaging in acquisition activities *relative to* the changes during the same period among those BHCs without subsidiary acquisitions (control/benchmark BHCs). Using a large sample of U.S. banks from 1986 to 2015, we find that a subsidiary acquisition induces an average 8.5 percentage point increase in leverage among treated BHCs during the year prior to their subsidiary acquisitions. In contrast, we find a significant decrease in the leverage of those treated BHCs in the year following subsidiary acquisitions. We further separate the deposit and several non-deposit debt items from the leverage of BHCs, and find that the long-term debt financing of treated BHCs exhibits a substantial increase before subsidiary acquisitions and significant decrease afterwards.

The baseline results could reflect strategic behavior, or they could reflect a protective financing demand by BHCs who are uncertain about the future internal capital sufficiency. The study addresses this concern by identifying subsets of BHCs with different sizes and different capital adequacy. The results reveal significant differential effects of subsidiary acquisitions on financial policies of different groups of BHCs. Specifically, small or well capitalized BHCs have relatively more leverage increases than large or lowly capitalized BHCs do in the year prior to subsidiary acquisitions, respectively. The former also have more long-term and subordinated debt increases. Noticeably, one year after deal announcements of subsidiary acquisition activities, small or well capitalized BHCs substantially retire more subordinated debt from the outside market relative to large or lowly capitalized counterparts. These findings are consistent with the hypothesis that higher leverage ratios take place in anticipation of subsidiary acquisitions and BHCs' leverage changes are mainly due to the deterioration of internal capital markets where scarce capital is allocated.

This chapter also analyzes the dynamic pattern of BHCs' liquidity and lending around the subsidiary acquisition time. The idea is to test whether the parent BHCs of subsidiaries experiencing acquisition deals facing limited internal funds are forced to hoard more cash or liquidity assets, and curtail loans to ease the financial constraints before acquisition deals taking place. The results validate this conjecture with the effect being stronger for smaller and less well capitalized BHCs, which suggests they are more vulnerable to internal capital fluctuation and thus have more adjustments in both asset and liability parts on their balance sheet.

Further check on the performance of treated BHCs which increase long-term debt one year before subsidiaries engaging in acquisition activities *relative to* those which do not around acquisition deals shows that the treated BHCs have a more smooth transition in performance and suffer less in operating and market performance than those control BHCs which do not make such adjustments in advance. This chapter also documents several mechanisms through which subsidiary banks' engagement in acquisition activities affects parent BHCs' capital structure decisions including the following two findings: 1. Information asymmetry induced by subsidiary acquisition activities affects BHCs' capital structure decisions by increasing the adjustment speed to the target leverage ratio; 2. Around the time of subsidiary banks engaging in acquisition activities, the more quickly the BHCs close the gap between the last year's leverage and this year's target, the less risk they contribute to the whole system.

Overall, this article, for the first time in the literature, systematically examines the dynamic aspects of various BHC capital structure decisions around the time of subsidiary bank acquisition deals and their effects on BHC performance, liquidity, lending, and risk. This study thus broadly contributes to the literature examining the determinants of firm and bank capital structure decisions (Rajan and Zingales, 1995; Lemmon, Roberts, and Zender, 2008; Gropp and Heider, 2010; Marcus, 1983).

This chapter also adds to the literature that examines bank mergers and acquisitions. For example, DeYoung et al. (2009) document the fundamental change of banks as the roles of financial intermediaries through the consolidations over the past decades, and evaluate the economic consequences of this ongoing trend, Karolyi and Taboada (2015) study cross-border acquisitions and argue that they provide a mechanism through which banks can change their regulatory environment from a stronger supervision environment to a much weaker one, and Chen and Vashishtha (2017) explore the effects of bank acquisitions on corporate information disclosure and find that corporate borrowers significantly increase information disclosure after their lending banks engage in acquisitions. The main focus of this study is trying to build the link between subsidiary bank mergers and the parent BHC's capital structure decisions.

This study also extends prior work that focuses largely on the real effects of information asymmetry, such as financing arrangements (Sufi, 2007), equity issues (Dierkens, 1991), asset prices (Chan, Menkveld, and Yang, 2008), and competition, adverse selection, and information dispersion in the banking industry (Marquez, 2002). One implication of this chapter is that some results in these papers could be associated with the role information asymmetry plays in banks' capital structure decisions.

The remainder of this chapter proceeds as follows. Section 5.2 discusses the institutional background of subsidiary bank acquisition activities and their effects on parent BHCs. Section 5.3 and 5.4 describe the empirical methodology and data. Section 5.5 reports the results. Section 5.6 conducts additional tests. Section 5.7 concludes.

5.2. Institutional background and hypotheses

In this section, we fist describe the background on the subsidiary merger and acquisition (acquisition) of US bank holding companies (BHCs) and the related regulatory environment. We then develop the hypotheses about the effect of subsidiary acquisition on the parent BHC's capital choices.

5.2.1. The effect and regulation background of bank M&A

The banking industry has experienced a fast consolidation in the past decades. During the process of the integration, the lines between traditional banking activities have become hazier. Technology innovations and steady-going deregulations from the government induce banks to engage in many unconventional financial activities such as asset management, investment banking, insurance, etc.[21] Meanwhile, banks also strive to expand their sizes in the face of mounting pressure of competition from other peers. This is mostly done by engaging in M&A transactions with competitors. For the two parties involved in the M&A activity, the literature has argued whether it is value-enhancing (e.g., Berger, 1998; Pilloff and Santomero, 1998; Berger, Demsetz, and Strahan, 1999; Focarelli, Panetta, and Salleo, 2002). The evidence is mixed. There are still no conclusive results on the benefits or costs of bank mergers and acquisition. We broadly review some findings below.

Focarelli, Panetta, and Salleo (2002) explore the M&A among the Italian banks over the period of 1985-2006 and find that mergers and acquisitions have different motivations (selling more services for mergers and better credit management for acquisitions). They argue that these different motivations lead to separated consequences, most remarkably, with an increase in return on equity following mergers and a long-run decrease in bad loans for acquired banks. Zollo and Singh (2004) study the relationship between the post-acquisition performance and management levels of US banks. They point out that the acquiring bank can either implicitly gather acquisition experience or explicitly put it in manuals (called *codification* in their paper), to learn to increase the management during the post-acquisition integration process. Particularly, they argue that the integration capability, which is developed by the acquiring firm to manage the takeover process, is at least, as important as to identify a potential target. The results show that codification significantly influences the post-acquisition performance of

[21] One of the most notable events in banking deregulation and financial liberalization is the passage of the Gramm–Leach–Bliley Act (GLBA) by the US Congress in 1999, which repealed part of the Glass–Steagall Act that prohibited commercial banks from operating in other investment or insurance-related services.

acquiring banks. More importantly, they interact the degree of codification and the level of integration to investigate the mechanisms behind the co-evolution of integration decisions and capability building processes, and find that the interaction positively impacts the acquisition performance, which demonstrates that the advantages of knowledge-learning processes from the codification outweigh the costs of time and money spent on engaging these activities.

Molyneux, Schaeck, and Zhou (2014) argue that banks can grow substantially via M&As and become ‘too-systemically-important-to-fail’ (TSITF), and that the M&As between banks or other financial institutions may pose systemic risk to the whole financial industry, and affect the stability of the financial system. To support this argument, they point out several reasons. First, the banking structure is flattened to be more monotonic during the consolidation, and banks become more interdependent as a result of sharing similar business models and investment products, and exposing to common risks. Such interdependence increases systemic risk dramatically with the failure of one bank resulting in contagious consequences among other peers. Second, more complexity for banks after M&As reduces their transparency and tempts them to exploit the regulatory loophole. Third, coordination problems between regulators of different countries further complicate the issues involved in the cross-border M&As, which may exacerbate the TSITF effects. Overall, by exploring the motivations of bank M&As to obtain safety net subsidies and their implications for systemic risk, they find strong evidence that gaining government subsidies via M&As significantly increases the rescue probability in the crisis and the increased interdependence between TSITF banks during the post-merger period increases the instability of the whole financial system.

Karolyi and Taboada (2015) study how different regulations in different countries drive banks to engage in cross-border M&A activities and find that acquirers are more from countries with stricter regulatory environments and cumulative abnormal returns (CAR) around deal announcements for targets are more positive for the targets of these acquirers. They refer to these cross-border activities as banks engaging in "regulatory arbitrage" and point out that regulatory arbitrage may have both positive and negative effects. One the one hand, acquirers from rigorously regulated countries can have more freedom to pursue higher profitable investment opportunities if their targets are from countries with relatively slack regulations. Targets can further benefit from this "bonding connections" when they are bonded with acquirer banks from countries with stronger supervision while adopting the governance system of these countries (Rossi and Volpin, 2004; Bris and Cabolis, 2008).

On the other hand, acquirers may engage in more risk-taking activities in countries of their targets that have loose regulatory environment. This harmful form of regulatory arbitrage could weaken the bank performance and damage the shareholder value, which ultimately brings adverse consequences for the whole financial system and drives up systemic risk.

This paper is also related to two streams of previous literature. One branch is to investigate the new capital and liquidity requirements of Basel III and their impact on banks as well as the whole financial system. The other is about correlations among bank capital, liquidity and systemic risk.

It's widely observed that there are many limitations in both Basel I and II such as excessive procyclicality and lack of liquidity regulation (Gordy and Howells, 2006; Schmaltz, Pokutta, Heidorn, and Andrae, 2014). The latter exactly lead to the drying up of liquidity during the latest financial crisis which brought many financial institutions down (Brunnermeier, 2009). Therefore, the recent crisis has provided an explicit rationale that banks need more regulations on their liquidity assets. As a result of this, the new Basel III improves in many aspects and especially imposes liquidity requirements which are huge gaps in the previous Basel framework. As pointed out by Schmaltz et al. (2014), the introduction of Basel III will fill many regulation loopholes having been existent heretofore and ultimately facilitate the stability of the whole financial system. It should be evident that the sounder is the financial environment, the lower is systemic risk.

Freixas, Parigi, and Rochet (2000) analyze the framework of systemic risk in their theoretical paper. They point out interbank networks expose the banking system to the danger of coordination failure and the insolvency of one bank will have contagious effects on the system leading to the inefficient liquidation of the rest solvent banks. In the similar work, Allen and Gale (2000) discuss liquidity shocks deteriorate the stability of financial system and emphasize chain reactions resulting from linkages among financial intermediaries.

Tarashev and Zhu (2008) regard the banking sector as a portfolio of banks and study the relationship between the bank capital and systemic risk. They conclude that an increase in capital ratios, with liquidity being settled, decreases the probability of banking crisis. Barrell et al. (2009) show that raising capital adequacy and introducing liquidity requirements can have beneficial effects on reducing the likelihood of a bank crisis. However, they also mention the average influence of liquidity on crisis still needs checking. Cornett et al. (2011) argue that 07-08 global financial crisis was more like a liquidity crisis and banks with more illiquid assets on their balance sheets made more efforts to overcome the liquidity shortage thus tightening the credit supply.

Shin (2008) focuses on the liquidity of the financial system as a whole and theoretically proposes that the shortage of aggregate liquidity can generate series of failures in the banking system. Diamond and Rajan (2011) stress that capital holdings determine the probability of potential bank asset fire sales in times of trouble. The latter plays an essential part in systemic risk in financial system.

Perotti and Suarez (2011) theoretically demonstrate the proposition that a binding net stable funding requirement (NSFR) will reduce the aggregate systemic risk.

Although all the above paper have surveyed systemic risk and its several contributors, the specific issue about the impact of liquidity on banking system has drawn little attention. Especially in the most recent financial crisis, we witnessed the extensive liquidity crisis with the collapse of financial institutions and several huge government bailouts. Additionally, in response to the deficiency in regulation, the newest Basel III has further strengthened capital requirements and more importantly, introduced two essential liquidity ratios: Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR) which we will use later in this paper. This means banks are now required to have more stable and high quality funding to withstand liquidity shocks. Therefore, the lesson learnt from the 07-08 financial crisis has made regulators realize the importance of bank liquidity assets (Klomp and De Haan, 2012). However, if banks react relatively slow when their liquidity fall under the target ratio imposed by Basel III, will this also drive up systemic risk and even at last lead to the full-scale crisis in banking system?

To the best of my knowledge, this idea has not been formally investigated to date. This paper aims to fill this gap and bring some novel empirical results about subsidiary banks engaging in M&A activities and its impact on their parent banks' capital structure, performance, and risk.

5.2.2. Subsidiary M&A and BHCs' changes in capital structure

Why would subsidiary banks engaging in M&A activities affect their parent BHCs' capital structure decisions? As discussed above, most of the subsidiary banks that make M&A

decisions are involved in cross-state or cross-border deals. Such deals represent one of the most important motives banks have in making various investment decisions – regulatory arbitrage, where banks can pursue excessive risk-taking activities and escape from costly regulation areas. The reason is that the profit of banks that undertake major business in rigorous supervision systems will be cut due to the less tolerance of the excess risk-taking activities. These banks are more likely to pursue the higher-profit business by acquiring or being merged with those banks headquartered in those more forbearance regimes (Acharya, 2003; Dell' Ariccia and Marquez, 2006; Morrison and White, 2009; Agarwal et al., 2012). Karolyi and Taboada (2015) call this as value-destroying regulatory arbitrage and argue that bank M&A of this form may receive negative market reaction and have adverse consequences for bank performance and shareholder value. Bank M&A of this form could be more harmful if it increases the fragility of the internal capital market established by the BHC and the involved subsidiary bank extracts subsidies from the holding company, or other subsidiaries for losses from its high exposure to unmonitored risks.

The influence is not limited to above. As Houston, James, and Marcus (1997) point out that bank holding companies manage their capital and liquidity on a consolidated basis and transfer excess capital within subsidiaries to the parents as dividends, substantial cash flow changes of subsidiary M&A activities would impede the parents' abilities to manage capital within the organization in an efficient way. What is more, as discussed in Chapter IV, the Federal Reserve Regulation Act Y12 CFR (Section 225.4(a)(1)) states that: "A bank holding company shall serve as a source of financial and managerial strength to its subsidiaries...". Based on this regulation, BHCs have the obligation to infuse capital to those subsidiaries with significant losses and may not have additional funds to inject into the projects of other subsidiaries with the high net present values (NPVs), which impedes the investment efficiency of the whole organization. Last but not least, Sections 23A and 23B of the Federal Reserve Act place the limitations on inter-subsidiary transactions and asset sales, these restrictions further impede the holding company's ability to allocate capital to the most profitable projects. Arguably, one important factor to influence banks' efficient investment is liquidity. Since subsidiary banks' engagement in M&A activities bring much uncertainty and potential value-destroying outcomes to the internal capital market, and the regulation limits the BHCs' ability to allocate surplus capital, it follows that these BHCs may take actions to make capital structure changes to find external financing source beforehand to strengthen their liquidity.

In addition, if it is of a high price for parent BHCs to have subsidiary banks engaging M&A activities, BHCs are less likely to adjust their investment activities in response to prevailing economic conditions, as doing so will contract their profitable opportunities. This result has been documented in several previous empirical works. For instance, Bucă and Vermeulen (2017) analyze the credit tightening indexes of the banks from Germany, France, Italy, Spain, Belgium and Portugal, and find that banks in these countries are less likely to tighten their credit in periods when their subsidiary banks are making M&A deals. Allen, Carletti, and Marquez (2015), in their theoretical paper, adds support to this argument and show that banks could intentionally reduce their investment in risky assets, however, they will invest more capital to lend to firms and leave the deposits untouched as they are insured. Therefore, the only resort left for BHCs is to find efficient external funding channel. Especially, the low cost in nature for debt financing might ease BHCs' likelihood of being financially distressed and thereby increase their optimal leverage ratio according to the classic trade-off theory.

5.3. Methodology

Much similar to what we did in Chapter IV, in this chapter we build our sample based on the group of BHCs that had subsidiaries engaging in M&A activities during specific years (treatment group) and the BHCs that did not have subsidiaries engaging in M&A around those years (control group). We again identify the year in which one or several subsidiaries of a BHC *i* announce a M&A deal as year T_i. To test our hypotheses, we implement a standard event-study difference-in-differences (DID) specification as in Autor (2003) and Almond, Hoynes, and Schanzenbach (2011):

$$\Delta Y_{i,t} = \beta_0 + \sum_{\tau=-2,\tau\neq 0}^{3} \beta_\tau D_{i,t=T_i+\tau} + \boldsymbol{\beta}_{\mathbf{v}}\mathbf{X}_{i,t\text{-}1} + \gamma_i + \lambda_t + \varepsilon_{i,t} \qquad (5.1)$$

where $\Delta Y_{i,t}$ is the changes in bank total liability from year *t* - 1 to year *t*, scaled by the total book assets at year *t* – 1, $D_{i,t}$ is a group of DID estimators that identify the years prior to and following the subsidiary M&A in year T_i for a treated BHC *i*, $\mathbf{X}_{i,t-1}$ is a set of control variables containing bank characteristics that may affect bank financial policy, and γ_i, λ_t specify BHC and year fixed effects that control for unobserved time-invariant differences across BHCs and overall time trends, respectively.[22] Standard errors are clustered at the BHC level to resolve heteroscedasticity and serial correlation of error terms (Petersen, 2009). Our tests focus on the capital structure of treated BHCs in the year immediately prior to and following subsidiary M&As (i.e., T_i – 1 and T_i + 1), while also include T_i – 2 and up to T_i + 3 to allow for analyzing the effects over a wider range of years. We do not focus on year T_i itself because how soon after the deal announcement the BHC board of directors and managers make responses to adjust the capital after subsidiary M&A is unclear.

[22] In the empirical tables of this chapter, we still use variable names *Year 1 Before*, *Year 2 Before*, etc., to represent these DID estimators. For example, *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary M&A in two years and zero otherwise.

The coefficients of interest are β_τ, which measure the estimated changes in the difference between treated and control BHCs' liability changes during the years prior to or after the subsidiary M&A relative to the omitted subsidiary M&A year. These coefficients trace out the time path of differences between treated and control BHCs' leverage changes. By choosing the subsidiary M&A year as the omitted category, we make it easier to detect differential trends in pre- and after- M&A leverage changes.

When examining BHCs' capital structure, we mainly look at changes in bank leverage, which includes both debt and non-debt liabilities such as deposits. Bank capital structure is different from that in non-financial firms as a bank takes deposits, and non-deposit debt has become a more important source of bank funds over time (Gropp and Heider, 2010). Thus, we further decompose BHC leverage into non-deposit debt and deposits. Specifically, we look at changes in long-term debt, short-term debt, subordinate, and deposits, all scaled by the previous year's total bank assets. We then test their relationships with subsidiary M&As.

Our choice of control variables follows Gropp and Heider (2010) and includes BHCs' size, market-to-book ratio, and profitability. We also control for marginal expected shortfall (see Acharya et al., 2017), diversification, and liquidity to mitigate the omitted variable bias.

5.4. Data

We again focus on the BHCs that are publicly listed financial firms in the United States. We only consider BHCs with the highest hierarchy positions, and collect consolidated financial information of BHCs from FR Y-9C reports over the period from 1986 to 2015. We also obtain data on BHCs' changes in long-term and short-term debt from COMPUSTAT

Bank. BHC stock price data come from the Center for Research in Security Prices (CRSP). We obtain information on BHCs' subsidiary M&A deals from FDIC Failed Bank List, and then merge this data with BHCs data. We focus on the BHCs who have subsidiary M&A occurring only once during our sample period to avoid compound effects by more than one subsidiary M&A in consecutive time periods. Our final treatment group sample thus restricts to 363 BHCs that have failed subsidiaries.

Our analyses further require a control group to compare with the BHCs with subsidiary M&As. We use two different procedures to obtain such control samples. The first procedure obtains a control group based on all BHCs that had no subsidiary M&As. We use this sample to get the summary statistics and all the main results. The second approach is based on a propensity score matching (PSM) procedure to match each treated BHC with a control one that is similar across all observable variables. In other words, this procedure provides a control sample that has similar bank characteristics to the BHCs with subsidiaries engaging in M&A activities, but different levels of subsidiary status, and hence internal financial circumstances. We mainly use this matched sample throughout our regression analyses. The matched sample analysis allows us to more effectively control for differences in relevant dimensions between BHCs with M&A subsidiaries and BHCs without.[23]

Table 5.1 presents summary statistics for the whole sample. To reduce the influence of outliers, these variables are winsorized at the first and 99th percentile. The average BHC in the sample has a market-to-book ratio of 0.93, a profitability ratio of 0.007, a diversification ratio of 0.154, and a liquidity ratio of 0.223. The average BHC also has a 10.2% increase of its lagged total assets in leverage, a 1% increase of its lagged total assets in long-term debt, a 0.6% increase of its lagged assets in short-term debt, and an 8.4% increase of its lagged assets in

[23] We use exactly the same matching procedure as we use in Chapter IV except that in the first step, the dependent variable is replaced by *M&A* to acquire the propensity scores. Appendix B presents detailed matching procedures.

deposits. In terms of other real outcomes, the average BHC experiences relatively no change in subordinated debt, and contributes approximately to 1.4% of the loss during the worst days of the whole banking sector.

Table 5.2 presents summary statistics for the variables used in our analysis for treated BHCs and control groups separately in the year prior to subsidiary M&As (i.e., T_i – 1). From Table 5.2, we find that the BHCs with subsidiary M&A in the next year, on average, have higher leverage ratio when compared with BHCs without subsidiary M&A in the following year. BHCs with subsidiary M&A in the next year tend to increase more long-term debt (5.7% versus 1.0% of lagged total assets), have more subordinate (0.3% versus 0.1% of lagged total assets), but rely less on short-term debt financing (0.4% versus 0.6% of lagged total assets) than those BHCs without subsidiary M&A in the following year. In terms of control variables, BHCs with M&A subsidiaries are larger, and more diversified than those without in Year T_i – 1. The former also have higher market-to-book ratio and less liquidity, and contribute more to the aggregate banking sector's loss prior to subsidiary failure, although the differences are lack of statistical significance.

Table 5. 1: Summary Statistics I

This table presents summary statistics for the variables used in our analysis for the full sample. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are yearly results.

Variable	*N*	Mean	Std. Dev.	Min	Max
BHCs' changes in Capital Structure					
ΔLeverage	9907	0.102	0.177	-0.656	3.989
ΔLong-term debt	7872	0.010	0.043	-0.284	0.693
ΔShort-term debt	7872	0.006	0.044	-0.844	0.719
ΔSubordinate	9907	0.001	0.007	-0.048	0.231
ΔDeposits	7785	0.084	0.148	-0.610	3.280
Determinants of Capital Structure					
Size	10889	14.369	1.554	11.193	21.668
Market-to-book ratio	10889	1.045	0.073	0.890	3.425
Profitabilitiy	10889	0.007	0.011	-0.204	0.068
Diversification	10889	0.154	0.147	-1.528	10.967
Liquidity	8427	0.223	0.114	0.000	0.941
MES	8041	1.388	5.070	-6.304	45.263

Table 5. 2: Summary Statistics II

This table presents summary statistics for the variables used in our analysis separately for treated BHCs and control BHCs in the year prior to subsidiary M&As (i.e., $T_i - 1$). Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	BHCs with M&A Subsidiaries			BHCs without M&A Subsidiaries				
	N	Mean	Median	*N*	Mean	Median	Difference	*t*-statistics
BHCs' changes in Capital Structure								
ΔLeverage	363	0.184	0.110	9544	0.102	0.065	0.082**	2.07
ΔLong-term debt	363	0.057	0.042	7509	0.010	0.000	0.046***	4.89
ΔShort-term debt	363	0.004	-0.002	7509	0.006	0.000	-0.002	-0.27
ΔSubordinate	363	0.003	0.000	9544	0.001	0.000	0.002*	1.86
ΔDeposits	308	0.136	0.075	7477	0.084	0.052	0.053	1.31
Determinants of Capital Structure								
Size	363	15.496	14.651	10526	14.366	14.065	1.131***	2.87
Market-to-book ratio	363	1.051	1.054	10526	1.045	1.033	0.006	0.51
Profitabilitiy	363	0.008	0.009	10526	0.007	0.009	0.001	0.96
Diversification	363	0.197	0.176	10526	0.154	0.132	0.043*	1.78
Liquidity	330	0.192	0.168	8097	0.223	0.209	-0.032	-1.46
MES	330	1.395	1.588	7711	1.388	1.587	0.007	0.09

We present summary statistics for the year following subsidiary M&As (i.e., T_i + 1) in Table 5.3. As shown in the table, following subsidiary M&As the treated BHCs on average lower their leverage ratio relative to those control ones.

When decomposing BHCs' leverage, we find that, in contrast to the financing activities in Year T_i - 1, BHCs with subsidiaries engaging in M&A activities in the previous year are more likely to reduce long-term debt financing. The comparison between the two types of BHCs for other control variables in Year T_i + 1 is similar to that in Year T_i – 1.

The correlations between the key variables used in the analysis have been reported in Table 4.4 in Chapter IV. This chapter will thus not repeat this procedure again.

Table 5. 3: Summary Statistics III

This table presents summary statistics for the variables used in our analysis separately for treated BHCs and control BHCs in the year following subsidiary M&As (i.e., T_i + 1). Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	BHCs with M&A Subsidiaries			BHCs without M&A Subsidiaries				
	N	Mean	Median	*N*	Mean	Median	Difference	*t*-statistics
BHCs' changes in Capital Structure								
ΔLeverage	363	0.015	0.032	9544	0.102	0.066	-0.087***	-5.94
ΔLong-term debt	363	-0.023	-0.013	7509	0.011	0.000	-0.034***	-7.34
ΔShort-term debt	363	0.002	0.000	7509	0.006	0.000	-0.005	-1.30
ΔSubordinate	363	0.000	0.000	9544	0.001	0.000	-0.001	-1.12
ΔDeposits	330	0.031	0.033	7455	0.084	0.052	-0.054***	-3.74
Determinants of Capital Structure								
Size	363	15.565	14.741	10526	14.365	14.065	1.200***	3.08
Market-to-book ratio	363	1.040	1.031	10526	1.045	1.033	-0.005	-0.35
Profitabilitiy	363	0.003	0.009	10526	0.007	0.009	-0.004	-0.95
Diversification	363	0.199	0.183	10526	0.154	0.132	0.045*	1.91
Liquidity	363	0.197	0.196	8064	0.223	0.210	-0.026	-1.48
MES	319	1.402	1.579	7722	1.388	1.587	0.015	0.16

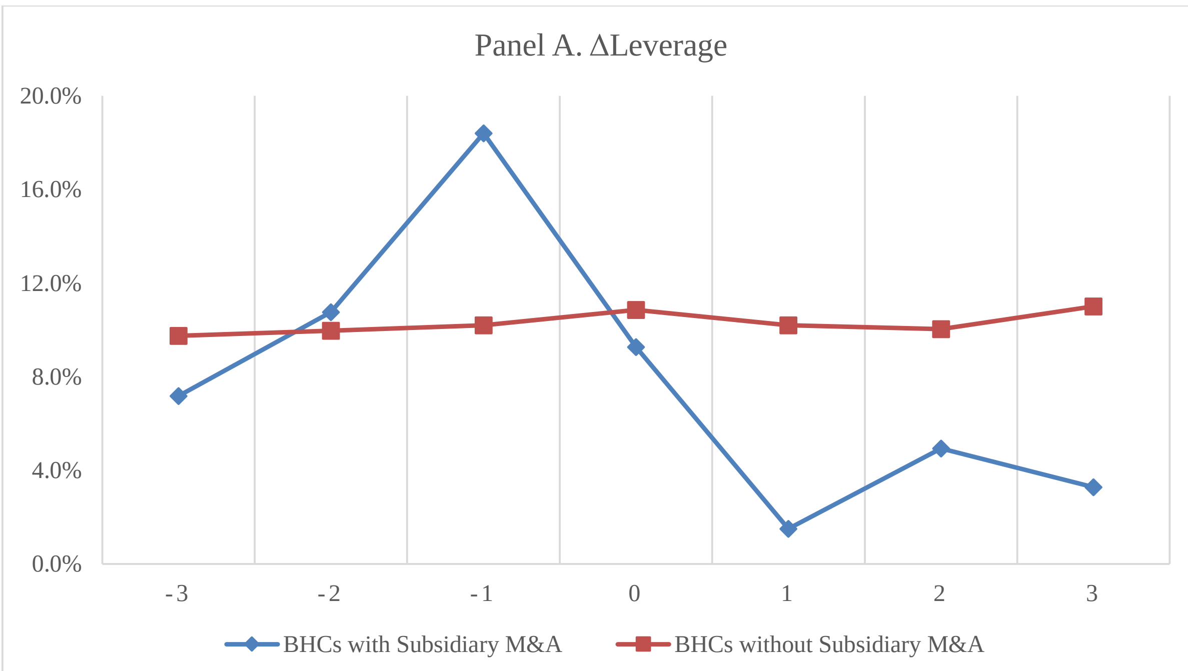
To provide a more intuitionistic pattern of BHC capital structure decisions around the subsidiary M&A year, we conduct the univariate analysis for the dynamic changes of various BHC liability items from three years prior to subsidiary M&A to three years after that occurring. We report the results in Figure 5.1. Note that the figures compare the changes of various liability items between BHCs that had subsidiaries engaging in M&A activities and those that did not have subsidiaries engaging in M&A activities.

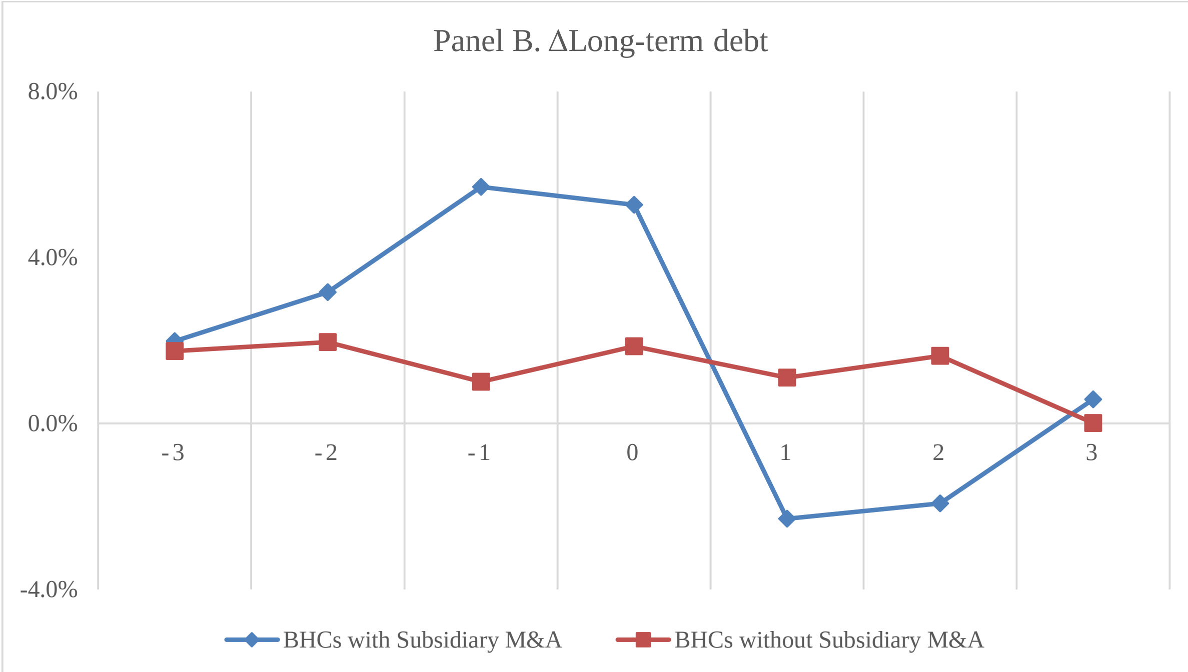
Figs. 5.1 plot BHCs' cumulative capital structure decisions in the three years prior to and following subsidiary M&As. Much similar to the trend as reported in the summary statistics, in the years prior to M&A period BHCs that had subsidiaries engaging in M&A activities on average have higher levels of leverage and long-term debt changes than control BHCs. After that, however, the former on average lower the leverage and reduce the long-term debt, by approximately 8.7% and 3.4% of BHCs' lagged assets, respectively, than the latter. The short-term debt changes do not exhibit drastic differences among BHCs with M&A subsidiaries and BHCs without in both pre- and post-M&A years. Lastly, BHCs with subsidiaries engaging in M&A activities have similar changes in deposits as those without in the years prior to M&A period. After the M&A years, the former on average hold less deposits on their balance sheets.

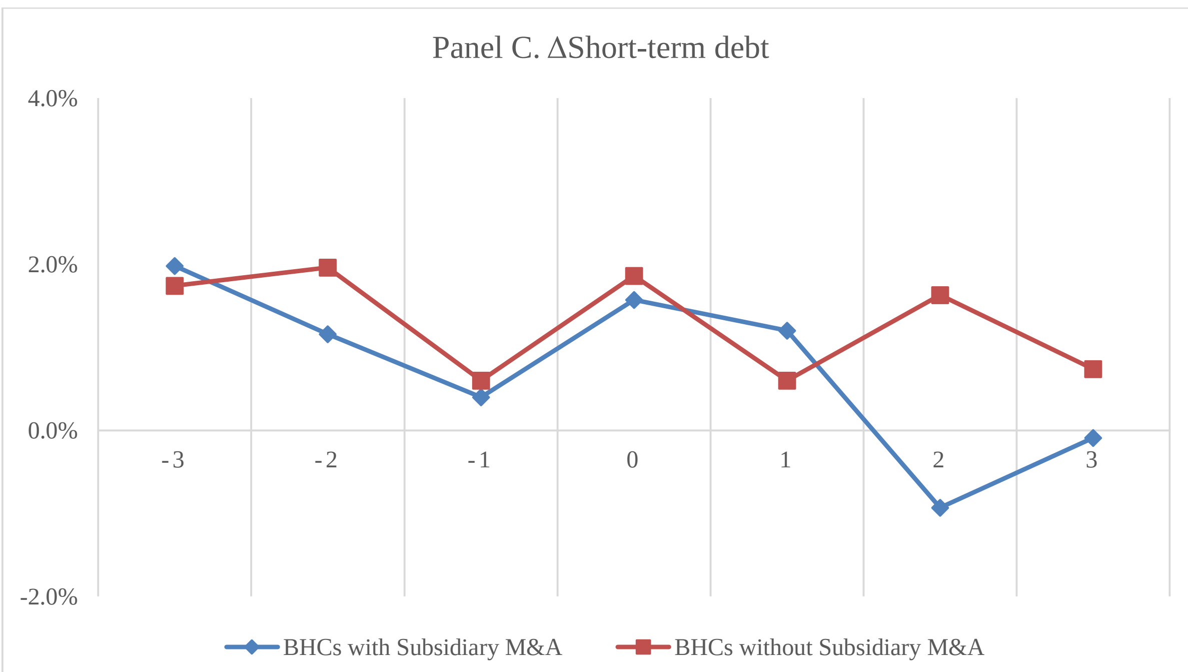
Overall, the results support our hypotheses. However, these comparisons are based on simple univariate analyses. In the next section, we employ more rigorous regression analyses to test our hypotheses.

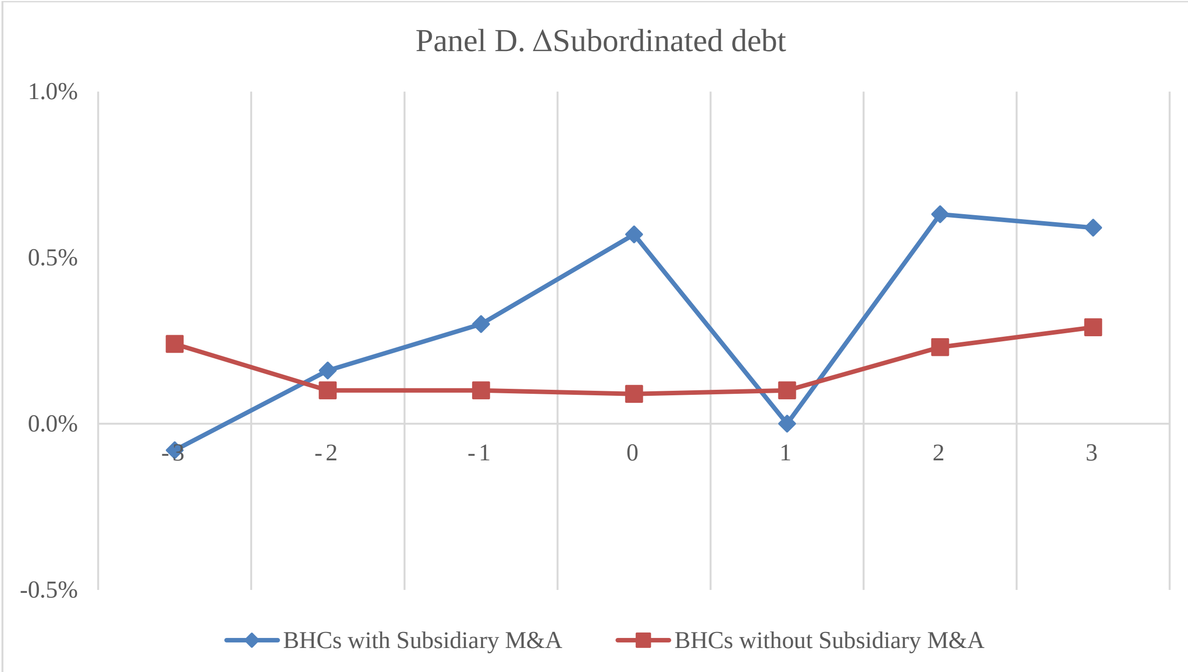
Figure 5. 1

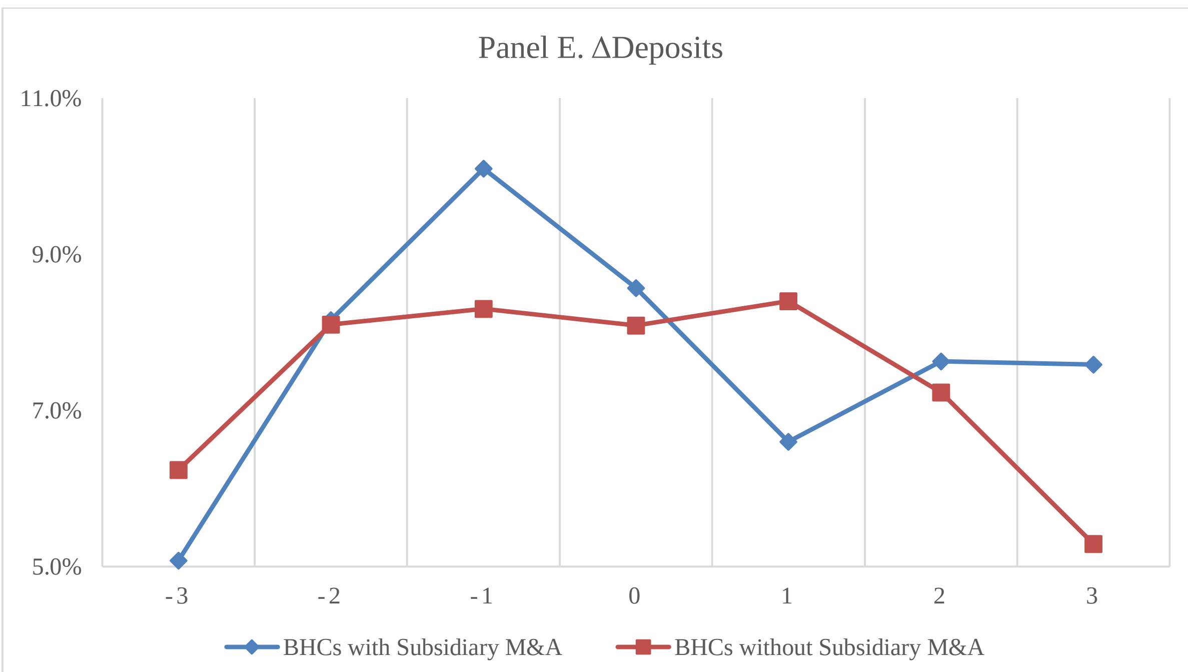
The graphs show BHCs' average capital structure changes during each of the three years prior to and following the announcement of subsidiary M&As (denoted as year ''0'' in the figures). All graphs are re-centered at year 0. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinated debt* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets.




Panel B. ΔLong-term debt
8.0%
4.0%
0.0%
-4.0%
-3
-2
-1
0
1
2
3
BHCs with Subsidiary M&A
BHCs without Subsidiary M&A


Panel C. ΔShort-term debt
4.0%
2.0%
0.0%
-2.0%
-3
-2
-1
0
1
2
3
BHCs with Subsidiary M&A
BHCs without Subsidiary M&A





5.5. Empirical results

5.5.1. BHCs' leverage changes around subsidiary M&A

Table 5.4 presents the results from estimating Equation (5.1) by using $\Delta Leverage$ as the outcome variable. We report the coefficient estimates of β_τ for each of the two years before and three years after subsidiary M&A. Column (1) reports the results from estimating the model without including control variables using the full sample. Column (2) adds additional controls that may affect BHCs' leverage changes. Column (3) and (4) give the results using the matched sample. Across all columns in Table 5.4, the coefficients on *Year* 1 *Before* are all positive and statistically significant when adding control variables. When controlling for BHC characteristics, the estimates based on the full sample imply an absolute increase of 8.5 percentage points in the leverage of BHCs with subsidiaries engaging in M&A activities, relative to the control group, during the year prior to the time when their subsidiaries make M&A deals. Contrarily, the consistently negative and significant coefficients on *Year* 1 *After* in Table 5.4 suggest a significant decrease in the leverage of those treated BHCs in the one year following subsidiary M&As.

In terms of control variables, we find that BHC leverage is positively associated with market-to-book ratio and profitability, and negatively related with size. These findings are generally in line with prior studies on bank capital structure (e.g., Gropp and Heider, 2010), suggesting that our sample is representative.

Overall, these findings support our hypotheses that BHCs are more likely to be more-levered in the year prior to subsidiary M&As, and less levered in the year after. Additionally, because the significance of the subsidiary failure effect does not vary widely across all

Table 5. 4: Subsidiary M&As and BHC Leverage Changes

This table reports estimates of Equation (5.1) for US BHCs from 1986 to 2015. Columns (1) and (2) estimate the model using the full sample. Columns (3) and (4) estimate the model using the matched sample. *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	Full sample		Matched sample	
	(1)	(2)	(3)	(4)
	ΔLeverage	ΔLeverage	ΔLeverage	ΔLeverage
Year 2 Before	0.010	0.013	0.007	0.013
	(0.47)	(0.59)	(0.33)	(0.53)
Year 1 Before	0.062	0.085*	0.062	0.090*
	(1.41)	(1.79)	(1.24)	(1.68)
Year 1 After	0.080***	0.040*	0.088***	0.044**
	(4.71)	(1.95)	(4.46)	(2.00)
Year 2 After	0.042**	0.020	0.043*	-0.025
	(2.05)	(1.20)	(1.71)	(-1.37)
Year 3 After	-0.019	-0.012	-0.013	-0.014
	(-0.66)	(-0.49)	(-0.35)	(-0.45)
Size		-0.220***		-0.239***
		(-12.28)		(-11.79)
Market to book ratio		0.255***		0.243***
		(4.58)		(4.11)
Profitability		2.681***		2.821***
		(5.46)		(5.39)
Diversification		-0.047		-0.054
		(-0.97)		(-0.84)
Liquidity		-0.078*		-0.087*
		(-1.78)		(-1.73)
MES		0.002		0.004
		(0.37)		(0.52)
Constant	0.123***	2.847***	0.139***	3.121***
	(12.44)	(11.18)	(13.49)	(10.75)
BHC fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	9907	6779	819	819
Adj. R^2	0.074	0.237	0.078	0.243

columns, we restrict our attention to the matched sample with a full set of controls in the analyses in later sections.[24]

5.5.2. The Reverse causality issue

The main concern in this paper is the reverse causality issue. One may argue that it's the substantial increase in leverage of parent BHCs that leads to the subsequent subsidiary engaging in M&A activities, and that the main argument that the parents intentionally increase leverage when foreseeing the substantial capital outflows during the takeover deals, is not true. To address this concern, we employ the following test.

We construct a new binary response variable $M\&A_{i,t}$ which indicates if a particular individual bank *i* makes a merger or acquisition deal at time *t*. It is important to note that these individual banks are at the subsidiary level. We regress the variable $M\&A_{i,t}$ on the leverage changes of the subsidiary itself and its BHC. Apart from this, we also include a group of bank characteristics' variables at the both parent and subsidiary level containing: size, market-to-book ratio, profitability, marginal expected shortfall, diversification and liquidity, all of which are considered related to bank risk. Using BHCs' leverage changes as a key explanatory variable, this test examines whether BHCs' capital structure decisions would affect the extent of their subsidiaries participating in merger or acquisition transactions in the following year. If the reverse causality concern holds, the increase in leverage of parent BHCs should have a significant impact on their subsidiary M&A activities.

Table 5.5 presents the results of the test. It shows that the subsidiary bank M&As is not significantly correlated to prior changes of the parent BHC's capital structure. The evidence

[24] This chapter uses the same method as used in the last chapter to build the matched sample. The detailed matching procedure is provided in the Appendix.

suggests that the increase in the leverage of the parent BHC does not increase the chance of its subsidiaries being acquired or acquiring other banks, which is counterfactual to the prediction arisen from the reverse causality concern.

5.5.3. Decomposing BHC leverage

Bank capital structure is fundamentally different from that of non-financial firms as banks take deposits. Deposits constitute an important financing source for commercial banks and are generally not available to firms. Apart from this, non-deposit liabilities are growing substantially over the past decades on banks' balance sheet. According to Figure 2 in Gropp and Heider (2010), the proportion of non-deposit liabilities as a percentage of the book value of banks for the 200 largest publicly traded banks in the US and the EU has increased from rough 20% in the early 90s to 29% in 2004. By contrast, the proportion of deposits has declined from 73% in the early 90s to 64% in 2004. They argue that banks seem to rely more and more on non-deposit liabilities to finance their growth. Therefore, it is essential to differentiate specific liability changes from leverage changes.

In the above analysis, we calculate BHC leverage by using bank total liabilities divided by total assets and examine its changes around subsidiary M&A period. In this section we decompose BHC liabilities into deposit and several non-deposit debt items, consisting of long-term, short-term, and subordinated debt, and run regressions against each liability item using equation (5.1) to show which item primarily leads to relative leverage changes of treated

Table 5. 5: Logit Test of the Effect of BHCs' Leverage Changes on Subsidiary M&As

This table examines the impact of BHCs' leverage changes on each of their subsidiaries based on the individual subsidiary sample. The dependent variable *M&A* is a dummy variable indicating if the individual subsidiary bank makes an M&A announcement in the current calendar year. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are yearly results and classified as two groups including BHC and subsidiary level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	$M\&A_t$
$\Delta Leverage_{BHC,t-1}$	-2.479
	(-1.38)
$Size_{BHC,t-1}$	0.318**
	(2.48)
Market-to-book $ratio_{BHC,t-1}$	-1.322
	(-0.41)
$Profitability_{BHC,t-1}$	19.399
	(0.70)
$Diversification_{BHC,t-1}$	-0.125
	(-0.06)
$Liquidity_{BHC,t-1}$	-2.517
	(-1.24)
$MES_{BHC,t-1}$	-0.591
	(-1.04)
$\Delta Leverage_{Sub,t-1}$	2.260
	(1.27)
$Size_{Sub,t-1}$	0.332***
	(2.59)
Market-to-book $ratio_{Sub,t-1}$	-1.861
	(-0.50)
$Profitability_{Sub,t-1}$	35.045
	(1.00)
$Diversification_{Sub,t-1}$	-0.023
	(-0.01)
$Liquidity_{Sub,t-1}$	-1.699
	(-0.84)
Constant	-7.382*
	(-1.88)
Year Fixed Effects	Yes
N	62410
Pseudo R^2	0.539

BHCs surrounding their subsidiary M&As.[25]

We report the results in Table 5.6 after controlling for BHC and year fixed effects. In column (1), we observe very similar pre-M&A increase and post-M&A decrease in treated BHCs' relative long-term debt changes. Specifically, the positively significant coefficient on *Year* 1 *Before* in column (1) suggests that long-term debt of BHCs with subsidiary M&As increases by 4.5 percentage points during the year prior to their subsidiary announcing a M&A deal, on average. The negative and significant coefficient on *Year* 1 *After* indicates that BHCs with subsidiaries engaging in M&A activities in the previous year have significantly lower long-term debt relative to the control group. It is worth noting that the coefficients on *Year 1 Before* and *Year 1 After* in column (3) both become significant after controlling for fixed effects, which implies that BHCs have incentives to issue more subordinated debt before their subsidiaries make M&A deals and may be forced to retire the outstanding subordinates in the market once the M&A deals have been announced. Also, the increase in subordinated debt prior to subsidiary M&A transactions reflects its relatively lower issuing costs (Sironi, 2003). The coefficients in column (4) indicate that there is no substantial relative deposit change for those treated BHCs around their subsidiary M&As.

These findings are mutually supportive and show that BHCs with subsidiary M&As prefer to adjust their long-term debt financing including the adjustment of the subordinated debt around the announcements of their subsidiary M&A transactions, which mainly drives the changes of BHC leverage during these periods. Our results are consistent with the traditional findings from prior corporate finance literature that long-term debt acts as a cheaper financing resort and serves as a preferred choice for external financing (Flannery, 1986; Berger et al., 2005). The evidence suggests that BHCs would like to avoid other costly financing resorts

[25] Bank non-deposit liabilities can be viewed as debt for firms. They consist of senior long-term debt, subordinated debt and other debenture notes.

such as the equity financing and exploit the temporarily better creditworthiness to obtain funds through long-term debt at a relatively lower cost, knowing that they will experience substantial capital flows once the subsidiary M&A transaction is confirmed. This process therefore yields a higher leverage for these treated BHCs prior to their subsidiaries making such deals.

5.5.4. Placebo-matched approach

The above results could suffer the same endogeneity issue that appears in Chapter 4, i.e., BHCs having subsidiary acquisition is endogenous to their underlying characteristics. To address this issue, we again exploit the variation in the acquisition time of subsidiary banks among BHCs with subsidiary M&A. We treat BHCs with later subsidiary takeover as a placebo control group for BHCs with earlier subsidiary takeover. Specifically, we match the BHCs who have subsidiary acquisition in year T_i (treatment group) with the BHCs that have subsidiary acquisition in the future year $T_i + n$ (placebo control group). Both groups of BHCs have subsidiary M&A and hence would potentially share certain common characteristics. However, because the BHCs in the control group did not have subsidiary acquisition in year T_i, their capital structure changes from $T_i - 2$ to $T_i + 3$ serve as a comparison with the treatment group. This approach allows us to control for potential common characteristics when we test the capital structure changes of BHCs around the year of subsidiary M&A.

The sample construction under this approach is similar to that in Section 4.5.4. To reiterate, in the subsample, both the treatment and control groups experience subsidiary acquisition, however, only the treatment group experiences a subsidiary acquisition in the estimation window.

Applying this placebo control strategy, we estimate the following specification:

$$\Delta Y_{i,t} = \beta_0 + \sum_{\tau=-2,\tau\neq 0}^{3} \beta_\tau D_{i,t=T_i+\tau} + \sum_{\tau=-2,\tau\neq 0}^{3} \mu_\tau \cdot Treat_i \cdot D_{i,t=T_i+\tau}$$
$$+\delta \cdot Treat_i + \boldsymbol{\beta}_{\mathbf{v}} \mathbf{X}_{i,t-1} + \gamma_i + \lambda_t + \varepsilon_{i,t} \qquad (5.2)$$

where $Treat_i$ is a dummy variable that equals one if BHC i belongs to the treatment group defined in this section. The coefficients of interest are η, which are difference-in-differences estimators, measuring the difference between treatment and placebo control BHCs with respect to the changes in capital structure from two years prior to subsidiary M&A to three years after the M&A.

Based on this identification strategy, if a BHC's capital structure changes prior to or following its subsidiary acquisition, that change will be captured by the coefficients μ_τ. These coefficients indicate whether the capital structure of the BHCs in the treatment group (who experience a subsidiary acquisition at time T_i) deviates from that of their counterparts in the placebo control group (who experience a subsidiary acquisition at a future time $T_i + n$) during the years prior to or following T_i.

Table 5.7 reports estimates from specification (5.2). The results are largely consistent with those from the standard event-study DID approach (5.1). We observe similar pre-M&A and post-M&A trends of capital structure changes compared with those reported in Table 5.4 and Table 5.6. This suggests that the baseline results do not suffer too much from the endogenous subsidiary acquisition issue.

5.5.5. Subsidiary M&A effect by BHC size and capital ratio

In this section, we again look at the subsample results. The results in Table 5.6 show a marked pre-M&A increase in treated BHCs' relative long-term debt as well as their subordinate debt issuance. This could reflect strategic behavior, or it could reflect a protective financing demand by BHCs who are uncertain about the future directions of capital flows (Bruno and Shin, 2015). We address this concern by identifying subsets of BHCs with different sizes. Large banks may have greater flexibility to withstand a short-term liquidity shortage (Vazquez and Federico, 2015). If the uncertainty of BHCs' internal capital flows is the key driver of the leverage changes around subsidiary M&A deals, we would expect that

Table 5. 6: Decomposing BHC Leverage

This table reports estimates of Equation (5.1) after decomposing BHC leverage into long-term debt, short-term debt, subordinated debt, and deposits and controlling for BHC and time fixed effects based on the matched sample. *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets; *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLong-term debt	(2) ΔShort-term debt	(3) ΔSubordinate	(4) ΔDeposits
Year 2 Before	0.011*	0.000	-0.000	0.002
	(1.67)	(0.05)	(-0.66)	(0.10)
Year 1 Before	0.045***	-0.009	0.002*	0.055
	(4.35)	(-1.02)	(1.94)	(1.20)
Year 1 After	0.022***	0.002	0.002*	-0.020
	(3.88)	(0.32)	(1.91)	(-0.91)
Year 2 After	0.008	-0.025	-0.001	0.000
	(0.69)	(-1.51)	(-1.16)	(0.02)
Year 3 After	-0.010	-0.009	-0.000	0.011
	(-1.13)	(-1.51)	(-0.00)	(0.47)
Size	-0.016***	-0.015***	-0.001	-0.189***
	(-5.60)	(-5.69)	(-1.41)	(-11.51)
Market to book ratio	0.060**	0.063***	0.005**	0.165***
	(2.33)	(3.09)	(2.23)	(3.67)
Profitability	0.121	0.035	0.014	2.347***
	(1.25)	(0.51)	(1.42)	(5.50)
Diversification	0.002	-0.005	-0.003**	-0.006
	(0.09)	(-0.48)	(-2.06)	(-0.14)
Liquidity	-0.014	-0.012	-0.002	-0.032
	(-1.10)	(-0.96)	(-1.34)	(-0.83)
MES	0.000	0.003*	0.000*	-0.004
	(0.10)	(1.75)	(1.77)	(-0.69)
Constant	0.162***	0.137***	0.008	2.484***
	(3.22)	(3.49)	(0.91)	(11.03)
BHC fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
N	819	819	819	819
Adj. R^2	0.088	0.054	0.282	0.229

Table 5. 7: Subsidiary M&A and BHC Capital Structure Changes Using Placebo Control Approach

This table reports estimates of Equation (5.2). *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. Appendix A provides all other variable definitions. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	-0.027	0.080	-0.033	0.001	0.102***
	(-0.22)	(1.26)	(-0.60)	(1.30)	(2.61)
Year 1 Before	0.111	0.127*	-0.049***	0.003**	0.028
	(0.97)	(1.87)	(-5.79)	(2.18)	(0.99)
Year 1 After	-0.030	-0.009	0.007	0.001	-0.034
	(-0.28)	(-0.49)	(1.21)	(1.10)	(-0.37)
Year 2 After	0.045	0.078	-0.135	0.001	0.070
	(1.00)	(0.99)	(-1.21)	(1.10)	(1.42)
Year 3 After	-0.047	-0.088	-0.052	0.001	0.085***
	(-0.45)	(-1.09)	(-1.43)	(1.19)	(3.67)
Year 2 Before × Treat	0.039	-0.073	0.035	0.001	-0.107**
	(0.37)	(-1.15)	(0.63)	(0.72)	(-2.46)
Year 1 Before × Treat	0.154***	0.042***	-0.100*	0.004***	0.029
	(2.86)	(3.12)	(-1.85)	(3.04)	(0.54)
Year 1 After × Treat	-0.150***	-0.024*	-0.006	-0.003**	0.016
	(-2.60)	(-1.73)	(-0.74)	(-2.20)	(0.18)
Year 2 After × Treat	-0.076*	-0.079	0.125	-0.003*	-0.082
	(-1.65)	(-1.01)	(1.12)	(-1.74)	(-1.63)
Year 3 After × Treat	-0.010	0.100*	0.046	-0.001	-0.081***
	(-0.09)	(1.85)	(1.28)	(-0.72)	(-2.65)
Constant	2.859***	0.163***	0.142***	0.009	2.491***
	(11.28)	(3.25)	(3.61)	(0.98)	(11.13)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	2106	2106	2106	2106	2106
Adj. R^2	0.238	0.094	0.060	0.282	0.230

this change is more significant for small banks compared to large banks as small banks are more vulnerable to the shock of the changes of internal capital flows resulting from the takeover transactions.

In addition, the impact of subsidiary M&As on bank capital structure decisions could also be shaped by the regulatory frameworks. This may be especially crucial for the scenario of BHCs having subsidiaries engaging in M&A activities compared to the scenario of BHCs having failure subsidiaries. The reason is that the former involves in more uncertainty of bank capital flows as many subsidiaries in our sample make cross-border M&A transactions and the changes in capital flows are affected by a broader international context such as the fluctuations of currencies. The holding company has to take more precautionary measures to protect from the capital shortfall in case of sudden decrease in bank capital flows or substantial capital outflows during the acquisition process. Bruno and Shin (2015) summarize that the adjustment of bank capital structure acts as the linchpin through different risk-taking channels and cross-border bank capital flows could be influenced by the inter-bank market as well as the spillover effect of different monetary policies. Moreover, as previously argued, banks may hold discretionary capital, above the regulatory minimum in order to avoid the costs of having to issue fresh equity at short notice (Peura and Keppo, 2006). Thus, we examine the differential effects of subsidiary M&As on capital structure decisions across the BHCs that might be subject to different regulatory requirements for capital adequacy. To evaluate these conjectures, we implement several tests as follows.

First, we stratify the sample into two size groups. We define BHCs as of large size in a given year if their total assets are above $10 billion in that year. Otherwise, the BHCs are defined as of small size. Table 5.8 reruns Equation (5.1) for each group of BHCs and presents the results for the split sample without controlling for the BHC and year fixed effects. Table 5.9 reports the results after controlling for the fixed effects to account for unobserved time-invariant BHC-specific factors and time-specific effects which are common to all BHCs and can change over time. The comparison between these two tables shows that there is not too much discrepancy in the results before and after controlling for BHC and year fixed effects. We hereby mainly report the results shown in Table 5.9. In the year prior to subsidiary M&A, we find that small BHCs have significantly more leverage increases than large BHCs. Small BHCs also have significantly more increases in long-term debt than large BHCs. There is no significant change for both large and small BHCs' short-term debt. We again find that small BHCs have a significant decrease in both leverage and long-term debt in the year immediately following subsidiary bankruptcy. The coefficients also show that large BHCs lower their leverage and long-term debt during the year immediately following subsidiary bankruptcy. However, the results are lack of statistical significance. Nevertheless, these findings are consistent with the expectations and demonstrate that the more vulnerability to capital flows leads to small BHCs' more heavy changes in capital structure around the periods when their subsidiaries make M&A transactions. This also suggests a more important utilization of debt financing as a component of capital structure for small BHCs especially in the periods when their financial conditions significantly change.

Table 5. 8: Subsidiary M&A Effect Stratified by BHC Size I

This table reports estimates of Equation (5.1) for US BHCs from 1986 to 2015 on the stratified matched sample by BHC size and without controlling for fixed effects. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔLeverage	ΔLeverage	ΔLong-term debt	ΔLong-term debt	ΔShort-term debt	ΔShort-term debt
	Large BHCs (above $10 bn)	Small BHCs (below $10 bn)	Large BHCs (above $10 bn)	Small BHCs (below $10 bn)	Large BHCs (above $10 bn)	Small BHCs (below $10 bn)
Year 2 Before	0.002	0.008	0.008	0.012	0.031*	-0.004
	(0.04)	(0.22)	(0.50)	(1.23)	(1.74)	(-0.52)
Year 1 Before	0.053	0.084**	0.019	0.044***	0.010	-0.013
	(0.86)	(2.32)	(1.03)	(4.34)	(0.60)	(-1.40)
Year 1 After	-0.074	-0.070*	-0.033**	-0.026***	0.002	-0.003
	(-1.22)	(-1.84)	(-2.09)	(-2.58)	(0.13)	(-0.34)
Year 2 After	-0.064	-0.036	0.019	-0.003	-0.049***	-0.008
	(-1.00)	(-0.93)	(1.06)	(-0.27)	(-2.60)	(-0.77)
Year 3 After	-0.008	-0.031	-0.012	-0.010	-0.007	-0.002
	(-0.12)	(-0.72)	(-0.62)	(-0.85)	(-0.34)	(-0.15)
Size	0.004	-0.030***	0.003*	-0.004***	0.003*	-0.002**
	(0.68)	(-10.66)	(1.76)	(-5.34)	(1.79)	(-2.38)
Market to book ratio	0.226***	0.475***	0.149***	0.074***	0.051**	0.067***
	(3.98)	(12.52)	(7.10)	(6.85)	(2.29)	(7.03)
Profitability	2.922***	2.103***	0.354	0.320***	0.664**	0.074
	(3.43)	(8.68)	(1.27)	(4.29)	(2.23)	(1.12)
Diversification	-0.194***	-0.025	-0.064***	-0.025***	-0.044***	0.012*
	(-3.77)	(-0.92)	(-4.53)	(-3.38)	(-2.94)	(1.85)
Liquidity	0.151**	-0.097***	-0.010	-0.004	0.031*	0.013***
	(2.47)	(-4.91)	(-0.57)	(-0.67)	(1.74)	(2.63)
MES	0.778*	0.018***	0.056	0.001	0.197	0.002
	(1.71)	(2.78)	(0.46)	(0.79)	(1.52)	(1.38)
Constant	-1.458**	0.011	-0.272	-0.007	-0.419**	-0.050***
	(-1.97)	(0.22)	(-1.38)	(-0.51)	(-1.99)	(-4.01)
N	220	599	220	599	220	599
Adj. R^2	0.078	0.084	0.115	0.036	0.049	0.019

Table 5. 9: Subsidiary M&A Effect Stratified by BHC Size II

This table reports estimates of Equation (5.1) for US BHCs from 1986 to 2015, but stratifies the matched sample by BHC size and controls for BHC and year fixed effects. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLeverage	(3) ΔLong-term debt	(4) ΔLong-term debt	(5) ΔShort-term debt	(6) ΔShort-term debt
	Large BHCs (above $10 bn)	Small BHCs (below $10 bn)	Large BHCs (above $10 bn)	Small BHCs (below $10 bn)	Large BHCs (above $10 bn)	Small BHCs (below $10 bn)
Year 2 Before	0.051	-0.000	0.016*	0.010	0.036	-0.007
	(1.45)	(-0.01)	(1.89)	(1.12)	(1.44)	(-1.11)
Year 1 Before	0.055	0.072**	0.010	0.040***	0.013	-0.016
	(1.56)	(2.14)	(1.57)	(2.77)	(0.68)	(-1.56)
Year 1 After	-0.035	-0.061**	-0.012	-0.023***	0.011	0.001
	(-0.86)	(-2.47)	(-1.40)	(-3.32)	(1.48)	(0.16)
Year 2 After	0.010	-0.032	0.029	-0.001	-0.044	-0.008
	(0.40)	(-1.55)	(0.88)	(-0.34)	(-1.22)	(-1.09)
Year 3 After	0.051	-0.035	-0.011	-0.009*	-0.003	-0.003
	(1.04)	(-1.59)	(-0.44)	(-1.93)	(-0.38)	(-0.66)
Size	-0.286***	-0.240***	-0.025***	-0.017***	-0.038***	-0.011***
	(-6.12)	(-10.65)	(-3.72)	(-4.76)	(-3.62)	(-3.93)
Market to book ratio	0.218***	0.322***	0.056	0.052**	0.086**	0.055**
	(3.58)	(3.82)	(0.98)	(2.28)	(2.34)	(2.50)
Profitability	2.797***	2.525***	0.190	0.105	0.458	0.007
	(3.26)	(4.79)	(0.72)	(1.07)	(1.18)	(0.11)
Diversification	-0.052	-0.058	-0.000	-0.000	-0.015	-0.002
	(-0.44)	(-1.04)	(-0.01)	(-0.02)	(-0.49)	(-0.22)
Liquidity	0.133	-0.126***	0.041*	-0.026*	-0.005	-0.016
	(0.87)	(-2.85)	(1.72)	(-1.80)	(-0.10)	(-1.43)
MES	0.582*	0.008	-0.032	0.001	0.135	0.002
	(1.84)	(1.23)	(-0.37)	(0.53)	(1.58)	(0.84)
Constant	3.690***	2.942***	0.400**	0.177***	0.341*	0.091**
	(4.47)	(9.59)	(2.45)	(3.19)	(1.71)	(2.23)
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	220	599	220	599	220	599
Adj. R^2	0.284	0.247	0.145	0.085	0.125	0.049

Second, well capitalized banks face less regulatory pressure and thus have more flexibility to make discretionary adjustments in capital structure. Therefore, we expect that there will be more leverage changes around the time of subsidiaries engaging in M&A activities for well capitalized BHCs. To evaluate this conjecture, we separate BHCs into two groups based on the BHC's tier 1 capital ratio. Since the minimum tier 1 capital ratio specified in the Basel III is 6%, we classify the BHCs with tier 1 ratio greater than 6% as well capitalized and those with Tier 1 less than 6% as lowly capitalized. Table 5.10 reports the sub-sample results. We find that in the year prior to subsidiary M&A, well capitalized BHCs significantly increase more long-term debt and leverage compared to those lowly capitalized ones. One year after subsidiary M&A, we, however, see more decreases in long-term debt and leverage for well-capitalized BHCs relative to lowly capitalized counterparts.

Third, to further confirm the above two types of results, we define a dummy variable *Small* as one if the total assets of a BHC in that year are below $10 billion, and zero otherwise. We then interact it with the DID estimators in equation (5.1) to examine the size effect using a difference-in-difference-in-differences (DDD) estimation strategy. Table 5.11 presents the results from our main specification. The positive and significant coefficient on *Year 1 Before* × *Small* in column (1) shows that small BHCs have relatively more leverage increase than large BHCs do in the year prior to subsidiary M&A. We also find that small BHCs have more long-term and subordinated debt increases as indicated by the significant coefficients on the interaction term *Year 1 Before* × *Small* in columns (2) and (4). We, however, find that the leverage of small BHCs decreases significantly more than that of large BHCs in the year immediately following subsidiary M&A. Moreover, the negative and significant coefficient on *Year 1 After* × *Small* in column (5) shows that the deposits of small BHCs also significantly decrease more during this period. This reflects a weakening ability to attract deposits for small

Table 5. 10: Subsidiary M&A Effect Stratified by BHC Capital Ratio

This table reports estimates of Equation (5.1) for US BHCs from 1986 to 2015 on the stratified matched sample by BHC capital ratio and controlling for BHC and year fixed effects. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)	(3)	(4)	(5)	(6)
	ΔLeverage	ΔLeverage	ΔLong-term debt	ΔLong-term debt	ΔShort-term debt	ΔShort-term debt
	Well capitalized (Tier 1 ≥ 6%)	Low capitalized (Tier 1 < 6%)	Well capitalized (Tier 1 ≥ 6%)	Low capitalized (Tier 1 < 6%)	Well capitalized (Tier 1 ≥ 6%)	Low capitalized (Tier 1 < 6%)
Year 2 Before	0.000	0.129***	0.007*	0.074	0.001	-0.024
	(0.01)	(2.93)	(1.66)	(1.52)	(0.22)	(-0.45)
Year 1 Before	0.090*	0.136	0.039***	0.069	-0.008	-0.024
	(1.69)	(1.36)	(4.72)	(1.23)	(-0.85)	(-1.28)
Year 1 After	-0.046**	0.025	-0.022***	-0.006	-0.001	-0.013
	(-2.38)	(0.32)	(-3.63)	(-0.12)	(-0.18)	(-0.16)
Year 2 After	-0.036**	0.115*	-0.002	0.062	-0.009	-0.095
	(-2.17)	(1.66)	(-0.68)	(0.70)	(-1.60)	(-0.92)
Year 3 After	-0.012	0.041	-0.001	-0.122**	-0.005	0.027
	(-0.46)	(0.89)	(-0.18)	(-2.52)	(-0.88)	(1.05)
Size	-0.221***	-0.233***	-0.013***	-0.054**	-0.014***	-0.027
	(-12.30)	(-3.39)	(-4.84)	(-2.26)	(-5.88)	(-1.30)
Market to book ratio	0.236***	0.870***	0.071***	0.106	0.046**	0.427***
	(4.09)	(3.67)	(2.64)	(1.04)	(2.20)	(2.94)
Profitability	2.902***	1.671***	0.246**	-0.292	0.018	0.025
	(3.81)	(2.91)	(2.27)	(-0.80)	(0.23)	(0.07)
Diversification	-0.087	0.230***	-0.018	0.072	0.003	0.029
	(-1.51)	(2.66)	(-0.84)	(1.63)	(0.22)	(0.56)
Liquidity	-0.104**	-0.187	-0.026**	0.027	0.000	-0.100
	(-2.25)	(-0.98)	(-2.05)	(0.34)	(0.03)	(-1.49)
MES	-0.002	0.038	0.000	-0.000	0.001	0.019
	(-0.23)	(1.38)	(0.00)	(-0.01)	(0.74)	(1.29)
Constant	2.891***	2.457**	0.120**	0.614*	0.145***	-0.012
	(11.20)	(2.46)	(2.43)	(1.69)	(3.70)	(-0.04)
BHC fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
N	657	162	657	162	657	162
Adj. R^2	0.215	0.379	0.087	0.214	0.055	0.124

BHCs following M&A deals compared to those large counterparts and suggests the intrinsic vulnerability for these small banks when exposing to short-term massive capital flows. The results also suggest an even higher debt financing cost for small BHCs as their financial conditions deteriorate more severely due to the assets constraint.

Fourth, we define a dummy variable *Well Capitalization* as one if the BHC's tier 1 capital ratio is greater than 6%, and zero otherwise.[26] We then interact it with the DID estimators in equation (5.1) to examine the regulatory effect using the same DDD strategy as used above. Table 5.12 reports the results. We find that in the year prior to subsidiary M&A, well capitalized BHCs have significantly more increase in leverage. Specifically, they increase more in long-term, short-term, and subordinated debt financing compared to lowly capitalized BHCs. Noticeably, one year after the deal announcement of subsidiary M&A activity, well capitalized BHCs substantially retire more subordinated debt from the outside market relative to the lowly capitalized counterparts.

[26] The minimum tier 1 capital ratio specified in the Basel III is 6%.

Table 5. 11: Subsidiary M&A Effect by BHC Size

This table estimates the difference-in-difference-in-differences (DDD) effect of subsidiary M&A activities by BHC size for US BHCs from 1986 to 2015. *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	0.042	0.014*	0.021	-0.002**	0.015
	(1.42)	(1.83)	(1.14)	(-2.09)	(0.60)
Year 1 Before	0.177*	0.055***	0.004	0.005**	0.124
	(1.65)	(4.83)	(0.27)	(2.14)	(1.15)
Year 1 After	0.003	-0.019**	-0.001	-0.002	0.020
	(0.12)	(-1.97)	(-0.06)	(-1.52)	(0.94)
Year 2 After	0.008	0.029	-0.062	0.000	0.041
	(0.38)	(0.82)	(-1.34)	(0.05)	(1.34)
Year 3 After	0.041	-0.011	-0.021	0.001	0.091***
	(0.80)	(-0.44)	(-1.50)	(0.42)	(2.64)
Year 2 Before × Small	0.044	0.005	-0.029	0.003**	-0.024
	(1.06)	(0.39)	(-1.49)	(2.00)	(-0.60)
Year 1 Before × Small	0.174*	0.032**	-0.020	0.005***	-0.110
	(1.88)	(1.98)	(-1.06)	(2.81)	(-0.98)
Year 1 After × Small	-0.063*	-0.004	0.003	0.001	-0.064*
	(-1.95)	(-0.34)	(0.18)	(0.67)	(-1.83)
Year 2 After × Small	-0.039	-0.030	0.054	-0.002	-0.061*
	(-1.34)	(-0.84)	(1.17)	(-0.84)	(-1.66)
Year 3 After × Small	-0.077	0.002	0.018	-0.002	-0.119***
	(-1.37)	(0.09)	(1.21)	(-0.61)	(-2.91)
Small	-0.098***	-0.016***	-0.000	-0.000	-0.078***
	(-4.92)	(-3.95)	(-0.07)	(-0.46)	(-4.27)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	819	819	819	819	819
Adj. R^2	0.245	0.092	0.057	0.283	0.237

Table 5. 12: Subsidiary M&A Effect by BHC Capital Ratio

This table estimates the difference-in-difference-in-differences (DDD) effect of subsidiary M&A activities by BHC capital ratio for US BHCs from 1986 to 2015. *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	-0.027	0.080	-0.033	-0.001**	0.102***
	(-0.22)	(1.26)	(-0.60)	(-2.30)	(2.61)
Year 1 Before	0.111	0.127	-0.049***	-0.002**	0.028
	(0.97)	(1.57)	(-5.79)	(-2.18)	(0.99)
Year 1 After	-0.030	-0.009	0.007	0.001	-0.034
	(-0.28)	(-0.49)	(1.21)	(1.10)	(-0.37)
Year 2 After	0.045	0.078	-0.135	0.001	0.070
	(1.00)	(0.99)	(-1.21)	(1.10)	(1.42)
Year 3 After	-0.047	-0.100*	-0.052	0.001	0.085***
	(-0.45)	(-1.85)	(-1.43)	(1.19)	(3.67)
Year 2 Before × Well Capitalization	-0.150***	0.073	0.035	0.001	-0.107**
	(-2.60)	(1.15)	(0.63)	(0.72)	(-2.46)
Year 1 Before × Well Capitalization	0.154***	0.100*	0.042***	0.004***	0.029
	(2.86)	(1.85)	(3.12)	(3.04)	(0.54)
Year 1 After × Well Capitalization	-0.010	-0.014	-0.006	-0.003**	0.016
	(-0.09)	(-0.73)	(-0.74)	(-2.20)	(0.18)
Year 2 After × Well Capitalization	-0.076*	-0.079	0.125	-0.003*	-0.082
	(-1.65)	(-1.01)	(1.12)	(-1.74)	(-1.63)
Year 3 After × Well Capitalization	0.039	-0.088	0.046	-0.001	-0.081***
	(0.37)	(-1.09)	(1.28)	(-0.72)	(-2.65)
Well Capitalization	-0.017	-0.004	-0.009***	-0.001	-0.006
	(-1.53)	(-1.35)	(-2.85)	(-1.52)	(-0.66)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	819	819	819	819	819
Adj. R^2	0.246	0.115	0.058	0.285	0.219

Overall, these results support our hypotheses that subsidiary M&A induces substantial internal capital flows and leverage changes of their parent BHCs surrounding the time of subsidiary M&A announcement. We find the significant evidence of differential effects of subsidiary M&A on financial policy for different groups of BHCs, which is consistent with our previous argument that BHCs' leverage changes are mainly due to the internal financial deterioration.

5.5.6. The effect of subsidiary M&A on BHCs' liquidity and lending

We nest analyze the dynamic pattern of BHCs' liquidity and lending around the subsidiary M&A time. The above results show that BHCs' external borrowing has significantly increased prior to the subsidiary M&A time. We have attributed this to the incentivized action by the managers' anticipation of M&A deals. If the subsidiary bank engaging in M&A activities leads to the parent BHC not having surplus capital to distribute among its various other affiliates, and if the capital requirement limits the BHC's ability to use insured deposits, then it follows that these parent BHCs of subsidiaries announcing M&A deals expecting limited internal funds may be forced to hoard more cash or liquidity assets, and curtail loans to ease the financial constraints. Therefore, we expect more increase in cash and liquidity assets, and more decrease in lending of treated BHCs relative to the control group, prior to the time of subsidiaries engaging in M&A activities.

To test this conjecture, we estimate the same specification as Equation (5.1) by substituting the following three dependent variables: Δ*Cash*/*assets*, Δ*Liquidity*/*assets*, and Δ*Total loans*/*assets*. Table 5.13 reports the results. As shown in columns (1) and (2), the coefficients on *Year 1 Before* are significant and positive for dependent variables Δ*Cash*/*assets* and

Δ*Liquidity*/*assets*, which implies that cash and liquidity assets of BHCs with subsidiaries engaging in M&A activities significantly climb one year before M&A deals. The significant and negative coefficient on *Year 1 Before* for the dependent variable Δ*Total loans*/*assets* in column (3) suggests that loans of BHCs with subsidiaries engaging in M&A activities on average decline prior to the time of subsidiary M&A deals.

We further exploit the difference-in-difference-in-differences (DDD) regression model to explore which type of treated BHCs are more affected by the M&A activities of subsidiary banks. Similar as we do in Table 5.11, we interact the size dummy variable *Small* with the DID estimators in equation (5.1) to capture the size effect. Columns (1) and (2) in Table 5.14 show that treated BHCs with smaller size tend to hoard more cash and liquidity assets prior to the time of subsidiary M&A deals, as shown by the positive and significant coefficients on the interaction term *Year 1 Before* × *Small*. Similarly, column (3) shows that smaller BHCs with subsidiaries engaging in M&A activities in the following year have more cut in lending to firms. These results are reasonable as small BHCs are more vulnerable to capital flows and thus have more adjustments in both asset and liability parts on their balance sheet.

Table 5. 13: Subsidiary M&A Effect on BHCs' Liquidity and Lending

This table reports the dynamic effects of subsidiary M&A activities on BHCs' liquidity and lending. Δ*Cash/Assets* is calculated as ratio of the current year's total cash minus the previous year's total cash to the previous year's total assets; Δ*Liquidity* is calculated as ratio of the current year's total liquidity assets minus the previous year's total liquidity assets to the previous year's total assets; Δ*Total Loans/Assets* is calculated as ratio of the current year's total loans minus the previous year's total loans to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔCash/Assets	(2) ΔLiquidity	(3) ΔTotal Loans/Assets
Year 2 Before	-0.002	0.013	0.018
	(-0.59)	(0.48)	(1.11)
Year 1 Before	0.014**	0.086**	-0.069***
	(2.24)	(2.34)	(-4.20)
Year 1 After	-0.009*	-0.003	0.047
	(-1.92)	(-0.19)	(1.48)
Year 2 After	0.003	0.011	-0.015
	(0.73)	(0.43)	(-1.28)
Year 3 After	0.001	-0.026*	0.002
	(0.17)	(-1.71)	(0.11)
Size	-0.010***	-0.235***	-0.154***
	(-8.20)	(-7.85)	(-10.51)
Market to book ratio	0.005	0.286***	0.180***
	(0.63)	(3.49)	(4.21)
Profitability	0.033	-1.398	2.475***
	(0.43)	(-1.10)	(5.75)
Diversification	0.003	-0.033	-0.002
	(0.21)	(-0.26)	(-0.05)
Liquidity	0.014**	-0.642***	0.112***
	(2.35)	(-7.28)	(3.45)
MES	0.001	0.014*	-0.001
	(1.04)	(1.66)	(-0.20)
Constant	0.140***	3.170***	1.945***
	(7.34)	(7.19)	(9.64)
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	819	819	819
Adj. R^2	0.065	0.341	0.244

Table 5. 14: The Effect of Size Variation on BHCs' Liquidity and Lending

This table reports the dynamic effects of subsidiary M&A activities on BHCs' liquidity and lending. Δ*Cash*/*Assets* is calculated as ratio of the current year's total cash minus the previous year's total cash to the previous year's total assets; Δ*Liquidity* is calculated as ratio of the current year's total liquidity assets minus the previous year's total liquidity assets to the previous year's total assets; Δ*Total Loans*/*Assets* is calculated as ratio of the current year's total loans minus the previous year's total loans to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔCash/Assets	(2) ΔLiquidity	(3) ΔTotal Loans/Assets
Year 2 Before	0.003	-0.069***	0.026**
	(0.49)	(-9.89)	(2.12)
Year 1 Before	0.025*	0.035**	0.098
	(1.96)	(2.50)	(1.37)
Year 1 After	-0.022**	-0.003	0.030
	(-2.32)	(-0.37)	(1.43)
Year 2 After	0.001	-0.063***	0.018
	(0.09)	(-6.49)	(1.12)
Year 3 After	0.013*	-0.022	0.057
	(1.76)	(-1.33)	(1.56)
Year 2 Before × Small	-0.007	-0.023	-0.015
	(-1.01)	(-0.59)	(-0.57)
Year 1 Before × Small	0.019*	0.142***	-0.079***
	(1.78)	(3.44)	(-2.96)
Year 1 After × Small	-0.029**	-0.005	-0.081
	(-2.13)	(-0.24)	(-1.08)
Year 2 After × Small	0.003	0.087***	-0.046**
	(0.37)	(2.99)	(-2.21)
Year 3 After × Small	-0.017*	0.001	-0.080*
	(-1.92)	(0.01)	(-1.96)
Small	-0.007***	-0.074***	-0.064***
	(-3.85)	(-3.53)	(-4.40)
BHC controls	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	819	819	819
Adj. R^2	0.069	0.347	0.250

We next define a dummy variable *Low Capitalization* as one if the BHC's tier 1 capital ratio is less than 6%, and zero otherwise. We then interact it with the DID estimators in equation (5.1) to capture the regulatory effect. Columns (1) to (3) in Table 5.15 show that in the year prior to the announcement of subsidiary M&A deals, the increase trend in cash and liquidity assets and decrease trend in total loans for "troubled" BHCs are even more intensified for those lowly capitalized ones, as shown by the positive and significant coefficients on the interaction term *Year 1 Before* × *Low Capitalization* for dependent variables Δ*Cash*/*assets* and Δ*Liquidity*/*assets*, and the negative and significant coefficient on the interaction term *Year 1 Before* × *Low Capitalization* for the dependent variable Δ*Total loans*/*assets*. The findings suggest that lowly capitalized BHCs face more severe financial deteriorations prior to their subsidiary M&A time.

Table 5. 15: The Effect of Capitalization Variation on BHCs' Liquidity and Lending

This table reports the dynamic effects of subsidiary M&A activities on BHCs' liquidity and lending. Δ*Cash*/*Assets* is calculated as ratio of the current year's total cash minus the previous year's total cash to the previous year's total assets; Δ*Liquidity* is calculated as ratio of the current year's total liquidity assets minus the previous year's total liquidity assets to the previous year's total assets; Δ*Total Loans*/*Assets* is calculated as ratio of the current year's total loans minus the previous year's total loans to the previous year's total assets; *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔCash/Assets	(2) ΔLiquidity	(3) ΔTotal Loans/Assets
Year 2 Before	-0.001	-0.005	0.013
	(-0.43)	(-0.24)	(0.79)
Year 1 Before	0.008	0.022	0.049
	(1.39)	(0.75)	(1.47)
Year 1 After	-0.012**	-0.018*	-0.019
	(-2.58)	(-1.67)	(-1.26)
Year 2 After	-0.002	-0.003	-0.044
	(-0.50)	(-0.14)	(-1.22)
Year 3 After	-0.002	-0.036***	-0.001
	(-0.58)	(-2.75)	(-0.04)
Year 2 Before × Low Capitalization	0.000	0.054	0.073*
	(0.08)	(0.73)	(1.66)
Year 1 Before × Low Capitalization	0.040***	0.151*	-0.020*
	(2.91)	(1.74)	(-1.83)
Year 1 After × Low Capitalization	0.028	0.002	-0.035
	(1.25)	(0.06)	(-0.50)
Year 2 After × Low Capitalization	0.033**	0.002	0.033
	(2.41)	(0.05)	(0.73)
Year 3 After × Low Capitalization	-0.014**	0.001	0.032
	(-2.09)	(0.00)	(0.64)
Low Capitalization	0.004***	0.021	-0.009
	(2.61)	(1.40)	(-1.18)
BHC controls	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	819	819	819
Adj. R^2	0.068	0.344	0.244

5.5.7. BHC performance transition around subsidiary M&A

In this section, we check the performance of treated BHCs which increase long-term debt one year before subsidiaries engaging in M&A activities relative to those which do not around the M&A deal. As we have shown in the above section that BHCs with subsidiaries engaging in M&A activities tend to increase borrowing and liquidity, and cut lending beforehand to raise the cash reserve and ease the financial constraint problem, we expect that following the subsidiary M&A activities, these BHCs should have a more smooth transition in performance and suffer less in operating and market performance than those control BHCs which do not make such adjustments in advance. To test this hypothesis, we further analyze the dynamic patterns of BHC performance (*ROA* and Tobin's Q) and risk (*MES*) around the years of subsidiaries engaging in M&A activities.

Table 5.16 first re-estimates the main specification – equation (5.1), but changes the dependent variables to *ROA*, *Market-to-book ratio* (Tobin's Q), and *MES*. All these three variables are solid and reliable variables documented in various prior literature to reflect firm performance. *ROA* could be used to reflect the BHC's operating performance. Tobin's Q could reflect the BHC's market performance with a higher value indicating that the market has a higher expectation on the firm's value. *MES* is a valid systemic risk measure introduced by Acharya, Pedersen, Philippon, and Richardson (2017). Across all three columns, we observe no apparent effect of subsidiary M&A on the relative operating and market performance, and risk of their BHCs around the year of the M&A deal.

Table 5. 16: The Dynamic Patterns of BHC Performance around Subsidiary M&A

This table reports the dynamic effects of subsidiary M&A on BHCs' performance and risk. The dependent variables are *Profitability*, *Market-to-book ratio* (Tobin's Q), and *MES* (Marginal Expected Shortfall). *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) $Profitability_t$	(2) Market to book $ratio_t$	(3) MES_t
Year 2 Before	0.002^{***}	-0.006	-0.084
	(3.78)	(-1.01)	(-1.63)
Year 1 Before	0.002	-0.010	-0.056
	(1.45)	(-0.95)	(-1.31)
Year 1 After	-0.001	-0.001	-0.031
	(-0.20)	(-0.12)	(-0.71)
Year 2 After	-0.001	-0.004	0.032
	(-0.42)	(-0.55)	(0.65)
Year 3 After	0.002^{*}	0.003	-0.077
	(1.96)	(0.42)	(-1.25)
$Size_{t-1}$	-0.002^{***}	-0.008^{***}	0.088^{***}
	(-3.82)	(-2.96)	(4.42)
Market to book $ratio_{t-1}$	0.024^{***}	0.503^{***}	0.345^{***}
	(3.55)	(7.84)	(3.67)
$Profitability_{t-1}$	0.301^{***}	0.116	-0.093
	(6.45)	(1.24)	(-0.24)
$Diversification_{t-1}$	0.005^{*}	0.002	-0.086
	(1.71)	(0.10)	(-0.89)
$Liquidity_{t-1}$	0.003	0.005	-0.126^{*}
	(1.58)	(0.43)	(-1.67)
MES_{t-1}	-0.001^{**}	0.001	0.106^{***}
	(-2.38)	(0.45)	(5.22)
Constant	0.013	0.624^{***}	-0.477
	(1.32)	(7.90)	(-1.59)
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	819	819	819
Adj. R^2	0.344	0.596	0.126

In Table 5.17, we, similarly as we do in the last chapter, define a dummy variable *Debt increase 1 year before* as one if Δ*Long-term debt* for the BHC with one or more subsidiaries announcing M&A deals is greater than zero one year before the M&A time, and zero otherwise. We then employ the difference-in-difference-in-differences (DDD) estimation strategy by interacting the event DID estimators in the main specification with *Debt increase 1 year before* dummy to capture the dynamics of the performance of treated BHCs who increase long-term debt borrowing in the year prior to subsidiary M&A. It is worth noting that the dummy variable *Debt increase 1 year before* is dropped from the regression because of the inclusion of BHC fixed effects. As shown in columns (1) and (2), the positive and significant coefficients on *Year 1 After* × *Debt increase 1 year before* indicate that the operating and market performance of treated BHCs who increase long-term borrowing one year before the time of M&A increases more compared to those who do not in the one year following the subsidiaries announcing M&A deals. The negative and significant coefficient on *Year 1 After* × *Debt increase 1 year before* in column (3) indicates that the treated BHCs who increase long-term borrowing one year before the M&A contribute less to the systemic risk in the year following the subsidiaries' M&A deals.

Overall, these findings are consistent with the hypothesis and further imply that the activities taken by the parent BHCs including changes in liquidity, capital structure, and lending all aim to alleviate the concerns on financial constraints, stabilize the performance, and lower the risks.

Table 5. 17: The DDD Estimation of the Dynamic Patterns of BHC Performance around Subsidiary M&A

This table reports the dynamic effects of subsidiary M&A on BHCs' performance and risk using the difference-in-difference-in-differences (DDD) estimation strategy. The dependent variables are *Profitability*, *Market-to-book ratio* (Tobin's Q), and *MES* (Marginal Expected Shortfall). *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. *Debt increase 1 year before* is a dummy variable defined as one if Δ*Long-term debt* for the treated BHC one year before the time of subsidiary M&A is greater than zero, and zero otherwise. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) Profitability$_t$	(2) Market to book ratio$_t$	(3) MES$_t$
Year 2 Before	0.003	-0.017	0.025
	(1.38)	(-1.02)	(0.23)
Year 1 Before	-0.001	-0.007	-0.050
	(-0.90)	(-0.90)	(-1.12)
Year 1 After	0.005***	-0.036***	0.049
	(3.06)	(-3.87)	(0.61)
Year 2 After	-0.002***	-0.016***	0.054
	(-3.79)	(-3.18)	(0.52)
Year 3 After	0.005	0.009	0.052
	(0.98)	(0.89)	(0.59)
Year 2 Before × Debt increase 1 year before	-0.001	0.012	-0.120
	(-0.57)	(0.66)	(-0.99)
Year 1 Before × Debt increase 1 year before	-0.003	-0.003	-0.007
	(-1.47)	(-0.24)	(-0.11)
Year 1 After × Debt increase 1 year before	0.004**	0.038***	-0.107*
	(2.25)	(3.51)	(-1.92)
Year 2 After × Debt increase 1 year before	0.002	0.014	-0.024
	(1.00)	(1.63)	(-0.20)
Year 3 After × Debt increase 1 year before	-0.004	-0.007	-0.142
	(-0.66)	(-0.56)	(-1.28)
Size$_{t-1}$	-0.002***	-0.008***	0.088***
	(-3.82)	(-2.95)	(4.41)
Market to book ratio$_{t-1}$	0.024***	0.502***	0.347***
	(3.55)	(7.83)	(3.70)
Profitability$_{t-1}$	0.301***	0.116	-0.086
	(6.45)	(1.25)	(-0.23)
Diversification$_{t-1}$	0.005*	0.002	-0.086
	(1.71)	(0.10)	(-0.90)
Liquidity$_{t-1}$	0.003	0.005	-0.126*
	(1.58)	(0.44)	(-1.66)
MES$_{t-1}$	-0.001**	0.001	0.106***
	(-2.37)	(0.45)	(5.22)
Constant	0.013	0.624***	-0.478
	(1.32)	(7.91)	(-1.60)
BHC fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	819	819	819
Adj. R^2	0.344	0.596	0.126

5.6. Additional tests

5.6.1. BHCs' target leverage and adjustment speed around subsidiary M&A

As discussed in Chapter II, the current prevalent opinion in academia regarding firm capital structure decisions is that firm managers choose a target leverage ratio to which they actively adjust over time. This argument corresponds to the universally accepted dynamic trade-off model, where firms have to trade off the benefits of interest tax shield against the costs of financial distress and agency costs when increasing their leverage ratio. There is an optimal point where the value of the firm reaches to the maximum and which firm managers target to. Whether banks have similar working mechanisms is largely in doubt. The relevant literature is also very limited. Some financial researchers have argued from the market perspective and reported that banks work through a similar trade-off model to the one used by the non-financial firms determined by the various market factors. Such work includes, but is not limited to Berger, DeYoung, Flannery, Lee, and Öztekin (2008), Flannery and Rangan (2008), and Gropp and Heider (2010) which can be regarded as preliminary explorations of banks' target leverage. Others argue that the regulation indeed determines the banks' capital choices. Banks hold the minimum required equity capital plus some cushion to avoid the high costs of issuing equity or reducing assets at a short notice by the regulation. While no consensus is reached, the results in this chapter are more supportive to the market view. Nevertheless, in this section, we examine the validity of the setting of the market view on banks' leverage decisions and presents some mechanisms through which information asymmetry operates.

We first test whether information asymmetry induced by subsidiary M&A activities affects BHCs' capital structure decisions by increasing the adjustment speed to the target leverage ratio. The results above have shown that the affected BHCs heavily adjust their borrowing and lending prior to the time when their subsidiaries engage in M&A activities. On the other side, these BHC's activities are conducted when the public are not aware of the ongoing changes of one or more of their subsidiaries. We expect that the information advantage also incentivizes the senior BHC managers to increase the speed of adjustment in their capital structure decisions to quickly reach the target leverage knowing that the market discipline will take effect once their information advantage vanishes after the announcement of M&A deals by their subsidiaries. To test this conjecture, we first rebuild our treatment group and control group. For BHCs with subsidiaries engaging in M&A activities, we only include their BHC-year observations from 3 years prior to the M&A deals to three years after the M&A deals, and these observations constitute the treatment group. We then identify all the BHCs without any subsidiary announcing a M&A deal within the sample period of the treatment group, and use them to build our control group. The sample is therefore larger compared to the matched sample used in the above empirical results section, and provides a greater testing power.

We follow Flannery and Rangan (2006), Lemmon, Roberts, and Zender (2008), and Gropp and Heider (2010) to employ a standard partial adjustment model on the treatment and control sample separately to check whether subsidiary M&A activities bring significant differences in the speed of adjustment to reach the target leverage for the two different groups of BHCs.

In case one is not familiar with this model, we briefly review the standard partial adjustment model from the theoretical perspective. The standard partial adjustment model comprises two parts, a static part to describe how the desired amount (target) is determined and a dynamic part which includes the partial adjustment process:

$$\begin{aligned} y_t^* &= \alpha_0 + \alpha_1 x_{t-1} + u_t \\ y_t - y_{t-1} &= \lambda(y_t^* - y_{t-1}) \end{aligned} \qquad (5.3)$$

where y^* is the desired level of y, and the λ is the adjustment parameter measuring the speed of adjustment and lies between 0 and 1. The closer it is to 1 the faster the speed of adjustment.

By substituting the expression for y^* into the other equation we obtain the following estimating equation:

$$y_t = \alpha_0 \lambda + (1-\lambda) y_{t-1} + \lambda \alpha_1 x_{t-1} + \lambda u_t \qquad (5.4)$$

This equation actually belongs to the family of general autoregressive distributed lag (ARDL) models which are standard least squares regressions that include lags of both the dependent variable and explanatory variables as regressors (Greene, 2012). The general format of equation (5.4) is shown as follows:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_t + \beta_3 x_{t-1} + \varepsilon_t \qquad (5.5)$$

The following restriction condition would be imposed if the partial adjustment process occurs:

$$\beta_2 = 0 \qquad (5.6)$$

From the estimation of equation (5.5) we could get all the estimates of the parameters in the original equation (5.3) including the adjustment parameter λ:

$$\begin{aligned} &\beta_1 = (1-\lambda) \\ &\Rightarrow \lambda = (1-\beta_1) \end{aligned} \qquad (5.7)$$

In our BHC setting, equation (5.5) changes into the following specification:

$$\Delta Leverage_{i,t} = \beta_0 + \beta_1 \Delta Leverage_{i,t-1} + \boldsymbol{\beta}_{\mathbf{v}} \mathbf{X}_{i,t\text{-}1} + \varepsilon_{i,t} \qquad (5.8)$$

where $\Delta Leverage_{i,t}$ is the changes in bank total liability from year t - 1 to year t, scaled by the total book assets at year t – 1, and $\mathbf{X}_{i,t\text{-}1}$ is a set of control variables containing bank characteristics that may affect bank capital choices.

Table 5.18 presents the estimation results of equation (5.8) for the treatment sample. Columns (1) and (2) report the pooled OLS estimates without controlling for fixed effects. The adjustment parameter λ does not show significance in both columns. Flannery and Rangan (2006) argue that the pooled OLS method may give underestimated adjustment speed as the model assumes that there does not exist unobserved time-invariant heterogeneity across firms that may affect their target leverage ratio. Lemmon, Roberts, and Zender (2008) add that firm fixed effects rather than the observed time-variant corporate finance variables play the most important role in explaining the target capital structures of firms. Gropp and Heider (2010) confirm that these findings apply to banks and find that adding bank fixed effects increases the speed of adjustment by 34.4 percentage points (i.e., from 12.4% to 46.8%, see Gropp and Heider, 2010, Table X). Therefore, columns (3) and (4) repeat the regression in columns (1) and (2) after including BHC fixed effects. The adjustment parameter λ shows strong statistical and economic significance. Specifically, the value of λ in column (4) indicates that BHCs with subsidiaries engaging in M&A activities have a very fast speed of adjustment towards their target leverage ratio around the time of the M&A deals.

Table 5.19 reports the estimation results of equation (5.8) for the control sample. The value of λ is generally not significant expect in column (3) where standard determinants of capital structure are not included. The finding shows that BHCs that do not have any subsidiaries engaging in M&A activities react very slowly to adjust their leverage towards the target ratio during the same period as their treated counterparts.

Table 5. 18: Partial Adjustment Estimations for Treated BHCs

This table reports the partial adjustment estimation for the treated BHCs' speed of adjustment to target leverage ratios. The dependent variable is $\Delta Leverage_t$ which is the change in BHC leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets. λ is the adjustment parameter measuring the speed of adjustment. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) $\Delta \text{Leverage}_t$	(2) $\Delta \text{Leverage}_t$	(3) $\Delta \text{Leverage}_t$	(4) $\Delta \text{Leverage}_t$
λ	0.443	0.310	0.575***	0.639***
	(1.63)	(0.30)	(4.63)	(6.18)
Size_{t-1}		0.005		-0.167***
		(0.79)		(-6.69)
$\text{Market to book ratio}_{t-1}$		0.242***		0.263***
		(4.28)		(3.90)
$\text{Profitability}_{t-1}$		2.741***		0.893
		(3.25)		(1.56)
$\text{Diversification}_{t-1}$		-0.181***		0.177**
		(-3.51)		(2.06)
Liquidity_{t-1}		0.148**		0.248*
		(2.43)		(1.90)
MES_{t-1}		0.747*		0.627*
		(1.66)		(1.83)
Constant	0.096***	-1.442**	0.109***	1.610***
	(16.16)	(-1.97)	(34.49)	(2.86)
BHC fixed effects	No	No	Yes	Yes
N	901	901	901	901
Adj. R^2	0.002	0.071	0.006	0.226

Table 5. 19: Partial Adjustment Estimations for Control BHCs

This table reports the partial adjustment estimation for the control BHCs' speed of adjustment to target leverage ratios. The dependent variable is $\Delta Leverage_t$ which is the change in BHC leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets. λ is the adjustment parameter measuring the speed of adjustment. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) $\Delta Leverage_t$	(2) $\Delta Leverage_t$	(3) $\Delta Leverage_t$	(4) $\Delta Leverage_t$
λ	0.049	0.041	0.057***	0.008
	(1.49)	(1.00)	(3.62)	(0.35)
$Size_{t-1}$		-0.009***		-0.126***
		(-5.13)		(-14.96)
Market to book $ratio_{t-1}$		0.316***		0.288***
		(10.61)		(5.97)
$Profitability_{t-1}$		2.356***		2.187***
		(10.40)		(4.69)
$Diversification_{t-1}$		-0.039*		0.107***
		(-1.70)		(2.95)
$Liquidity_{t-1}$		-0.060***		-0.130***
		(-3.27)		(-3.08)
MES_{t-1}		0.003		0.012
		(0.45)		(1.59)
Constant	0.076***	-0.126***	0.090***	1.589***
	(36.92)	(-3.57)	(52.60)	(11.38)
BHC fixed effects	No	No	Yes	Yes
N	6326	6326	6326	6326
Adj. R^2	0.041	0.106	0.004	0.191

Overall, we conclude that the information asymmetry induced by the subsidiary status changes significantly impacts the parent BHCs' capital structure decisions by substantially increasing their adjustment speed towards the target leverage.

5.6.2. BHCs' capital structure adjustment and risk

In this section, we discuss the impact of BHCs' adjustment in capital structure on their risk. Specifically, we test how the adjustment speed towards the target leverage for BHCs with subsidiaries engaging in M&A activities influences on systemic risk surrounding the time of M&A deals.

Systemic risk has been a hot topic since the financial crisis of 2007-2008. Those banks who create too many systemic risks tend to have lower capital ratios, less stable funding, and more exposure to potentially risky market-based activities (Laeven, Ratnovski, and Tong, 2014; Laeven, Ratnovski, and Tong, 2016). Whether the unusual adjustment in capital structure around the M&A deals announced by subsidiary banks makes parent BHCs pose too much risk to the whole financial system is unclear. As changes in the status of subsidiary banks cause various degrees of financial constraint problems for the parent BHCs and we have documented above that BHCs conduct selections of activities to ease the deteriorations of their assets, we expect that around the time of subsidiary banks engaging in M&A activities, the more quickly the BHCs close the gap between the last year's leverage and this year's target, the less risk they contribute to the whole system.

To test the conjecture, this section uses two systemic risk measures *MES* and *CoVaR* (e.g., see Acharya, Pedersen, Philippon, and Richardson, 2017; Adrian and Brunnermeier, 2016). The reaction speed of BHCs towards the target leverage is measured by the adjustment speed of Δ*Leverage*, which is derived using the partial adjustment model in the last section. We again use the standard event-study difference-in-differences (DID) specification (10) while using the MES as the dependent variable and interacting the adjustment speed λ with those DID estimators to capture the effect of different BHCs' speed of adjustment to the target leverage ratio on the systemic risk. A set of BHC characteristic variables are also included in the right hand side of our regression model to control for their effects on systemic risk.

Table 5.20 reports the estimation results. We find that the coefficients on *Year 1 After* $\times$ λ are significant and negative whether we use the *MES* or Δ*CoVaR* to quantify the systemic risk. This testifies our hypothesis in the sense that when BHCs promptly adjust their leverage ratios in order to smooth out the negative impact of subsidiary M&As, systemic risk underlying the whole financial system will be significantly undermined.

Table 5. 20: BHC Capital Structure Adjustment and Systemic Risk around Subsidiary M&A

This table reports the dynamic effects of BHC Capital Structure Adjustment on BHCs' systemic risk using the difference-in-difference-in-differences (DDD) estimation strategy. The dependent variables are *MES* (Marginal Expected Shortfall) and Δ*CoVaR*. *Year 2 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have a subsidiary engaging in M&A activity in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had a subsidiary engaging in M&A activity three years ago and zero otherwise. *λ* is the adjustment parameter measuring the speed of adjustment. The control variables include the following: *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1)	(2)
	MES_t	$\Delta CoVaR_t$
Year 2 Before	-0.018	0.023
	(-1.02)	(0.20)
Year 1 Before	0.003	-0.052
	(0.87)	(-1.11)
Year 1 After	0.040***	0.053
	(4.03)	(0.62)
Year 2 After	0.016*	0.057
	(1.77)	(0.52)
Year 3 After	0.007	0.055
	(0.77)	(0.59)
Year 2 Before × λ	0.013	-0.121
	(0.68)	(-0.94)
Year 1 Before × λ	-0.016	-0.007
	(-1.30)	(-0.11)
Year 1 After × λ	-0.037***	-0.092***
	(-4.76)	(-2.95)
Year 2 After × λ	-0.019***	-0.079**
	(-4.00)	(-2.16)
Year 3 After × λ	-0.000	-0.151***
	(-0.01)	(-4.16)
λ	-0.036***	-0.106***
	(-3.72)	(-5.56)
$Size_{t-1}$	-0.011	0.091**
	(-0.88)	(2.42)
Market to book $ratio_{t-1}$	0.479	0.373
	(0.68)	(0.94)
$Profitability_{t-1}$	0.090	-0.346
	(0.92)	(-0.84)
$Diversification_{t-1}$	0.002	-0.157*
	(0.09)	(-1.77)
$Liquidity_{t-1}$	0.007	-0.164**
	(0.60)	(-2.07)
MES_{t-1}	0.001	0.100***
	(0.43)	(4.89)
Constant	0.691***	-0.512*
	(8.69)	(-1.66)
BHC fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
N	7227	7227
Adj. R^2	0.584	0.125

As an extension of our research, we also broadly review the effects of all the control variables on the bank systemic risk. As can be seen, bank diversification and local market power both have significant influences and their effects remain consistent for both measures of systemic risk employed in our analysis. These results uphold the former empirical claims such as Allen, Gu, and Kowalewski (2012). The other variables such as size, market-to-book ratio, and profitability do not appear to have uniform impacts or consistent significance in both regressions. This is implying that these individual BHC characteristics do not augment additional apparent effects on systemic risk. The previous literature has supported these findings. Zhu (2010) develops a theoretical model and shows that bank size is not necessarily a good proxy of systemic risk. He emphasizes that the financial system is not sensibly threatened by the crisis of a large bank, but rather the diversified activities of those "too big to fail" institutions might exert their influences on the whole banking system. Apart from this, the weaker evidence that either size or leverage contributes to systemic risk is also reported by Lopez-Espinosa, Moreno, Rubia, and Valderrama (2012), which further asserts what we have found in this paper.

As a matter of fact, it's not difficult to understand that BHCs' increased speed of adjustment in the leverage in response to their subsidiary banks' M&A deals plays an essential part in relieving systemic risk. We have, at least, two closely connected reasons to interpret this phenomenon. As we have discussed in the introduction part, banks' overreliance on short-term wholesale funding is a key trigger of the recent global financial crisis. This type of funding relates to interbank lending market tightly, making banks easier be exposed to liquidity risk, thus leading to the exacerbation of systemic risk. The new Basel III regulatory framework, being an overhaul of bank regulation, responds to this fatal deficiency by introducing brand new liquidity requirements including both NSFR and LCR, which exactly addresses this issue. The more stable and high quality funding required promotes structural changes on bank balance sheet, helping reduce asset-liability maturity mismatches and finally mitigate systemic risk ignited by individual liquidity risk.

Secondly, the higher pressure imposed by Basel III in liquidity regulation forces banks to increase liquidity adjustment speed to maintain a certain probability of complying with the regulatory requirements, very much like the action banks will take for the adjustment speed of their capital ratios as argued by Memmel and Raupach (2010). The higher adjustment speed shortens bank's reaction time in the case of falling below the required liquidity ratio, thus reducing the likelihood of liquidity risk. The long term benefit of combined actions leads to a more stabilized financial system and lower systemic risk.

5.7. Conclusion

This chapter explores capital structure decisions of BHCs surrounding the time when their subsidiary banks engage in M&A activities. Similar to the setting in Chapter II, bank insiders possess better knowledge and precise predictions on BHCs' next-period status, relative to public investors. By specifically focusing on the information asymmetry between these two parts, this study examines whether and how bank managers adjust the financial policy before and after their subsidiaries engaging in M&A activities.

The study finds that BHCs are more likely to be more-levered in the year prior to subsidiary M&As, and less levered in the year after. Further results show a substantial pre-M&A increase and a post-M&A decrease in treated BHCs' relative long-term debt changes. BHCs also tend to issue more subordinated debt before their subsidiaries make M&A deals. The study finds the significant evidence of differential effects of subsidiary M&A on financial policies for different groups of BHCs, which implies that BHCs' leverage changes are mainly due to the internal financial deterioration. BHCs with subsidiaries engaging in M&A activities tend to increase borrowing and liquidity, and cut lending beforehand to raise the cash reserve and ease the financial constraint problem. Following the subsidiary M&A activities, these BHCs have a more smooth transition in performance and suffer less in operating and market performance than those treated BHCs which do not make such adjustments in advance.

These findings are consistent with the hypothesis and further imply that the activities taken by the parent BHCs including changes in liquidity, capital structure, and lending all aim to alleviate the concerns on financial constraints, stabilize the performance, and lower the risks.

This chapter adds evidence to the core assumption of this thesis that information asymmetry is an important determinant of capital structure decisions. The relationship is more pronounced in banking industry. In line with the view by Houston, James, and Marcus (1997) and others, the study provides a further indication that a large portion of bank internal activities is difficult for outside investors to value, which, in turn, creates information problems for banks themselves when they have to raise external capital. Lastly, the findings in this chapter can be regarded as a supplement to the classic argument by Diamond (1984) that contracts and institutions need to ‘monitor the monitor’.

Chapter VI: Conclusion

This thesis bundles three theoretical and empirical chapters in the area of capital structure in banking. These studies investigate the bank capital decisions and their influence with a special focus on the BHC-subsidiary relationship. The results of this thesis highlights how asymmetry information affects bank capital structure decisions in the real world with capital market friction in place. This chapter begins with the summary of the key findings and contributions, and then finishes with the remarks and suggestions for the future work.

6.1. Key findings and contributions

Chapter II majorly covers the following several aspects. First, this chapter starts by discussing capital structure decisions by firms in general. This helps us understand bank capital in a more intuitive way as banks, in the first instance, are firms. Some classic models are covered in this chapter, such as trade-off theory and pecking-order theory. It also discusses several famous surveys by financial researchers to exam the determinants that affect firms' capital structure choices. Second, the chapter extends the discussion to banking firms. By comparing the similarities and differences between banks and non-financial firms, it discusses whether the findings concluded in the traditional corporate finance literature can be applied to banks for their capital structure decisions. It also discusses the trend in the recent decades that banks substantially increase their capital ratios well above the regulatory minimum. It draws out the core issue uncovered in this thesis that whether information asymmetry plays an important role in changing banks' capital choices during this period. Third, this chapter further discusses some regulatory questions, such as bank illiquid assets and liquid liabilities, bank capital, deposits, and monitoring, etc. Fourth, this chapter conducts several preliminary tests to identify the determinants that govern banks' capital choices and sets out a clear view on the choices of control variables in the following chapters.

Chapter III formally investigates the effects of information asymmetry on capital structure adjustments of US bank holding companies (BHCs) during 1986 to 2015. By identifying BHCs with bankrupt subsidiaries and arguing that their managers possess better knowledge than market investors concerning the failure of their subsidiaries, this chapter disentangles the real effect of private information on the capital structures of holding banks. Due to costly subsidiary failures, BHCs facing limited internal funds have incentives to find external financing before their financial conditions deteriorate. It is plausible that, prior to the subsidiary bankruptcy, the BHC may want to raise more debt at relatively lower costs. Once the subsidiary bankruptcy is realized, BHCs come under great pressures from regulators and market participants to control their default risk (Ashcraft, 2008). Thus, they may wish to lower the leverage and have more equity capital to secure the capital requirement. To examine these conjectures, this chapter employs a standard event-study difference-in-differences (DID) approach. This estimation strategy has been previously used by Schoar (2002), Autor (2003), and Almond, Hoynes, and Schanzenbach (2011), among others, to study firm performance around different events. In the event-study difference-in-differences (DID) framework, this chapter first estimates the leverage changes among BHCs with subsidiary failure ("troubled" BHCs) around the time of their subsidiary failure *relative to* the changes during the same period among those BHCs without subsidiary failure ("healthy" BHCs). The results show that subsidiary failure significantly affects financial policies of the parent companies. Specifically, BHCs increase leverage as early as one year prior to the failure of their subsidiaries, and substantially lower leverage after subsidiary failure. Further tests document that the parent BHCs increase not only debt borrowing but also liquidity assets, and curtail lending in advance to avoid further liquidity and financial constraint problems after their subsidiary failure. Examinations on the dynamic patterns of these BHCs' performance around the subsidiary failure time confirm a more smooth performance transition. The evidence suggests that the "troubled" BHCs foresee tightened credit market access and increased borrowing costs once the bankruptcy of subsidiary banks is realized. Thus, "troubled" BHCs increase debt financing in advance to take advantage of the presently cheaper debt financing and enjoy benefits. The findings are consistent with the argument of Billett and Garfinkel (2004) that, with the existence of asymmetric information, bank securities could be priced remarkably differently in segmented markets, and that banks take most advantage of the pricing discrepancies and target the segment, which has the lowest access costs. More importantly, the results provide strong support to the view that information asymmetry is an important determinant of capital structure decisions.

Chapter IV makes the following contributions. First, prior research points out bank-specific information asymmetry. This paper contributes to the literature on the impact of information asymmetry on banks' financial policies. Houston, James, and Marcus (1997) document that a great variety of bank activities may be difficult for outsiders to attain. Dell'Ariccia and Marquez (2004) argue that unfavorable private information of a bank, which is available only to insiders, may create morale hazard problems and result in a bank's engagement in undesirable activities. Holod and Peek (2007) investigate the access of banks to information-based external financial markets by comparing the behaviors of banks, including bank holding companies, with different transparency levels in response to exogenous shocks, and find that information asymmetry does affect their financing decisions. Morgan (2002) argues that the banking industry is more opaque than other industries, and finds that ratings from major agencies often disagree more over banks' bond issues than issues by other types of firms. The veil between banks and outsiders makes investors unable to accurately quantify the risk of banking firms as well as their securities. Second, this paper is related to the market timing (or windows of opportunity) theory, which states that firms prefer equity financing when the cost of equity is low, and prefer debt otherwise. In other words, firms do not generally care whether they finance with debt or equity, but choose the form of financing which, at that point in time, appears to be more valued by financial markets. Baker and Wurgler (2002) claim that market timing is the first order determinant of a corporate capital structure. Third, this paper is also related to the large strand of literature on risk-shifting.

Chapter V, for the first time in the literature, systematically examines the dynamic aspects of various BHC capital structure decisions around the time of subsidiary bank M&A deals and their effects on BHC performance, liquidity, lending, and risk. It adds to the evidence in Chapter IV and discusses the information asymmetry effect by looking into BHCs with subsidiaries engaging in M&A activities (treated BHCs) and the impact on BHCs' capital structure decisions, performance, and risk. The results show a marked pre-M&A increase in treated BHCs' relative long-term debt as well as their subordinate debt issuance. The findings lend further support to the core assumption in this thesis. Further tests on cross-sectional variation in BHC specific characteristics using difference-in-difference-in-differences (DDD) regression models show that the impact of information asymmetry on bank capital structure decisions is more pronounced for small and better capitalized BHCs. These tests shed further light on the mechanisms underlying the main results. This chapter also analyzes the dynamic pattern of BHCs' liquidity and lending around the subsidiary M&A time. The idea is to test whether the parent BHCs of subsidiaries experiencing M&A deals facing limited internal funds are forced to hoard more cash or liquidity assets, and curtail loans to ease the financial constraints before M&A deals taking place. The results validate this conjecture with the effect being stronger for smaller and less well capitalized BHCs, which suggests they are more vulnerable to internal capital fluctuation and thus have more adjustments in both asset and liability parts on their balance sheet. Further check on the performance of treated BHCs which increase long-term debt one year before subsidiaries engaging in M&A activities *relative to* those which do not around M&A deals shows that the treated BHCs have a more smooth transition in performance and suffer less in operating and market performance than those control BHCs which do not make such adjustments in advance. This chapter also documents several other mechanisms through which subsidiary banks' engagement in M&A activities affects parent BHCs' capital structure decisions including the following two findings: 1. Information asymmetry induced by subsidiary M&A activities affects BHCs' capital structure decisions by increasing the adjustment speed to the target leverage ratio; 2. Around the time of subsidiary banks engaging in M&A activities, the more quickly the BHCs close the gap between the last year's leverage and this year's target, the less risk they contribute to the whole system. Overall, this article, for the first time in the literature, systematically examines the dynamic aspects of various BHC capital structure decisions around the time of subsidiary bank M&A deals and their effects on BHC performance, liquidity, lending, and risk. The study can be seen as supplementary testimony in terms of the role of asymmetry information in affecting bank capital choices.

Chapter V broadly contributes to the literature examining the determinants of firm and bank capital structure decisions (Rajan and Zingales, 1995; Lemmon, Roberts, and Zender, 2008; Gropp and Heider, 2010; Marcus, 1983). This chapter also adds to the literature that examines bank mergers and acquisitions. For example, DeYoung et al. (2009) document the fundamental change of banks as the roles of financial intermediaries through the consolidations over the past decades, and evaluate the economic consequences of this ongoing trend, Karolyi and Taboada (2015) study cross-border acquisitions and argue that they provide a mechanism through which banks can change their regulatory environment from a stronger supervision environment to a much weaker one, and Chen and Vashishtha (2017) explore the effects of bank M&As on corporate information disclosure and find that corporate borrowers significantly increase information disclosure after their lending banks engage in M&As. The main focus of this study is trying to build the link between subsidiary bank mergers and the parent BHC's capital structure decisions. This study also extends prior work that focuses largely on the real effects of information asymmetry, such as financing arrangements (Sufi, 2007), equity issues (Dierkens, 1991), asset prices (Chan, Menkveld, and Yang, 2008), and competition, adverse selection, and information dispersion in the banking industry (Marquez, 2002).

6.2. Concluding remarks and suggestions for the future work

Many newspaper columnists and standard textbooks suggest that banking industry is generally heavily regulated, which brings the overriding departure in capital structure from what researchers have concluded for those non-financial firms. A financial economics textbook (Mishkin, 2013) reports that "Because of the high costs of holding capital for the reasons just described, bank managers often want to hold less bank capital relative to assets than is required by the regulatory authorities. In this case, the amount of bank capital is determined by the bank capital requirements." While these views appear sensible, they actually contradict the evidence of bank capital build-up over the past decades. This thesis, based on the prior finding from Gropp and Heider (2010), tries to borrow the conclusions from those empirical literature on non-financial firms to explain the motives that actually govern bank capital decisions. The results in this thesis can only be regarded as preliminary, and researchers are still far from reaching the consensus on several issues including whether banks actively adjust toward a target leverage ratio and whether the usual laws of corporate finance apply to banks. In addition, as discussed in Chapter II, in the models of most researchers, much of the variation in bank leverage is explained by fixed effects that are indeed there, but unknown, which reflects our limited knowledge of capital structure in banking. Nevertheless, it is better to have an explanation than no one at all, and it is more an invitation to further research than a pile of common arguments.

The current literature on whether information asymmetry plays an important role in shaping capital structure decisions is very limited. While this thesis is trying to establish a link between these two through the setting of the BHC-subsidiary relationship, it does not directly answer the question of whether information asymmetry is an important determinant of bank capital structure decisions. Several other disputes also exist in the literature to provide alternative explanations such as regulatory buffer view, or market pressure view. Overall, the high bank capital levels over the past decades imply that bank capital structure is much more than that straightforward explanation in the standard textbook. Further studies should explore unified laws that can reconcile all the existing controversies in the context of the contemporary banking theory.

Appendix

A. Main variable definitions

Variable	Description
BHC Capital Structure	
ΔLeverage	Change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets
ΔLong-term debt	Change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets
ΔShort-term debt	Change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets
ΔSubordinate	Change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets
ΔDeposits	Change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets
BHC Characteristics	
Size	Natural logarithm of the book value of total assets
Market-to-book ratio	Ratio of the market value of total assets to the book value of total assets
Profitability	Ratio of income before extraordinary items to the book value of total assets
Diversification	Ratio of noninterest income to the sum of interest income and noninterest income
Liquidity	Ratio of the sum of cash and available for sale securities to the book value of total asset
MES	Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year
CoVaR	Conditional value-at-risk, which is the banking system's expected return during the 5% worst days among the time when BHC *i* is at its 5% worst return in that given year

B. Propensity score matched sample

We build our matched sample through a propensity score matching approach (PSM). The PSM test allows us to control for differences in relevant dimensions between BHCs with bankrupt subsidiaries and BHCs without failed subsidiaries. Following the spirit of the econometric method developed by Rosenbaum and Rubin (1983), we first need to control for differences in the characteristics of these two types of BHCs. A propensity score is computed for each BHC-year based on the logit model, where the dependent variable is D_{i,T_i} as defined above and other independent variables include size, market-to-book ratio, profitability, marginal expected shortfall, diversification, and liquidity. These explanatory variables explicitly reflect BHC-specific characteristics that have economically significant impacts on the subsidiaries. Apart from that, they are observable for both the treatment group (BHCs with subsidiary failure) and the control group (BHCs without subsidiary failure). Having obtained the estimation results of the first model (reported in Panel A, Table B1), we then match the samples based on the Nearest Neighbor, which is the most commonly used matching method. Lastly, the treatment effect is determined by averaging the difference in capital structure changes between two pairs of groups.

In essence, our job is to find two types of BHCs whose characteristics are sufficiently close. By utilizing bank characteristics the matching methods provide the optimal approach to building a control group. Panel B, Table B1 compares the means of capital structure changes between the two groups. We see the significant differences between the two types of BHCs and the results are consistent with our previous findings. BHCs with bankrupt subsidiaries raise more long-term debt than those "healthy" ones in the year prior to subsidiary failure, leading to a higher leverage. In the year following the bankruptcy, the former, however, turn to issue more equity. These evidence suggests that subsidiary failure brings a non-negligible impact on the BHC's funding choices.

Table A. 1: Propensity score matching procedure

This table provides the propensity score matching procedure which we use to obtain the matched sample. Panel A presents the pooled estimations of the propensity scores using the logit model for the year prior to subsidiary failure (i.e., $T_i - 1$). The procedure of estimating the propensity score is repeated for Year $T_i + 1$ and not reported for brevity. Panel B compares the average capital structure changes based on the matched samples for the treatment and control groups. The matching method used here is the Nearest Neighbor. *Size* is the natural logarithm of the book value of total assets; *Market-to-book ratio* is the ratio of the market value of total assets to the book value of total assets; *Profitability* is the ratio of income before extraordinary items to the book value of total assets; *Diversification* is the ratio of noninterest income to the sum of interest income and noninterest income; *Liquidity* is the ratio of the sum of cash and available for sale securities to the book value of total asset; and *MES* is the Marginal Expected Shortfall, which is a bank's expected equity loss during the 5% worst days for the overall return of the banking sector in that given year. All variables are at the consolidated BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

Panel A: Estimations of Propensity Scores

	SubFail
Size	0.336***
	(2.72)
Market to book ratio	-0.596
	(-0.21)
Profitability	6.711
	(0.29)
Diversification	-0.162
	(-0.08)
Liquidity	-2.255
	(-1.15)
MES	-0.614
	(-1.10)
Constant	-8.575***
	(-2.65)
N	6779
Pseudo R^2	0.359

Panel B: Matching Results

	In the year prior to subsidiary failure (i.e., $T_i - 1$)				In the year following subsidiary failure (i.e., $T_i + 1$)			
	N	BHCs with bankrupt subsidiaries	BHCs without bankrupt subsidiaries	Difference	*N*	BHCs with bankrupt subsidiaries	BHCs without bankrupt subsidiaries	Difference
Nearest Neighbor Matching								
ΔLeverage	116	0.178	0.112	0.066***	87	0.072	0.110	-0.038**
ΔLong-term debt	89	0.060	0.009	0.051***	60	-0.039	0.008	-0.047***
ΔShort-term debt	89	-0.001	0.005	-0.006**	60	0.003	0.002	0.001
ΔSubordinate	89	0.005	0.000	0.005**	60	0.001	0.001	0.000
ΔDeposits	89	0.102	0.089	0.013*	60	0.095	0.096	-0.001

Table A. 2: Subsidiary failure effect by BHC size using $50 billion cut-off point

This table estimates the difference-in-difference-in-differences (DDD) effect of subsidiary failure by BHC size for US BHCs from 1986 to 2015. *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	0.032	0.007	-0.001	-0.001	0.013
	(1.32)	(0.09)	(-0.04)	(-0.70)	(0.51)
Year 1 Before	0.077	-0.014	0.003	0.004	0.001
	(1.52)	(-0.74)	(0.21)	(1.36)	(0.03)
Year 1 After	-0.015	0.009	-0.003	-0.004**	0.015
	(-0.47)	(0.74)	(-0.26)	(-2.40)	(0.47)
Year 2 After	-0.000	-0.012	-0.017	-0.002	0.025
	(-0.01)	(-1.31)	(-1.19)	(-0.51)	(0.55)
Year 3 After	0.080	0.013	-0.015	0.002	0.091**
	(1.42)	(1.55)	(-1.17)	(0.51)	(2.34)
Year 2 Before × Small	-0.024	-0.018*	0.001	0.000	-0.015
	(-0.68)	(-1.88)	(0.07)	(0.31)	(-0.41)
Year 1 Before × Small	0.026***	0.056***	-0.015	0.002*	0.064
	(4.59)	(3.80)	(-0.90)	(1.82)	(0.91)
Year 1 After × Small	-0.120*	-0.029***	0.005	0.003	-0.043
	(-1.95)	(-2.95)	(0.43)	(1.60)	(-1.04)
Year 2 After × Small	-0.026	0.025	-0.009	0.000	-0.031
	(-0.64)	(1.44)	(-0.38)	(0.12)	(-0.62)
Year 3 After × Small	-0.031	-0.030**	0.008	-0.003	-0.107**
	(-0.77)	(-2.29)	(0.56)	(-0.63)	(-2.36)
Small	-0.058*	-0.002	-0.004	-0.002	-0.068***
	(-1.84)	(-0.36)	(-0.61)	(-0.72)	(-3.32)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	338	338	338	338	338
Adj. R^2	0.238	0.089	0.055	0.283	0.231

Table A. 3: Subsidiary failure effect by BHC size using $100 billion cut-off point

This table estimates the difference-in-difference-in-differences (DDD) effect of subsidiary failure by BHC size for US BHCs from 1986 to 2015. *Year 2 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in two years and zero otherwise. *Year 1 Before* is an indicator variable equal to one if a BHC will have subsidiary failure in one year and zero otherwise. *Year 1 After* is an indicator variable equal to one if a BHC had subsidiary failure one year ago and zero otherwise. *Year 2 After* is an indicator variable equal to one if a BHC had subsidiary failure two years ago and zero otherwise. *Year 3 After* is an indicator variable equal to one if a BHC had subsidiary failure three years ago and zero otherwise. Δ*Leverage* is the change in leverage calculated as ratio of the current year's total liabilities minus the previous year's total liabilities to the previous year's total assets; Δ*Long-term debt* is the change in long-term debt calculated as ratio of the current year's long-term debt minus the previous year's long-term debt to the previous year's total assets; Δ*Short-term debt* is the change in short-term debt calculated as ratio of the current year's short-term debt minus the previous year's short-term debt to the previous year's total assets; Δ*Subordinate* is the change in subordinate debt calculated as ratio of the current year's subordinate debt minus the previous year's subordinate debt to the previous year's total assets; and Δ*Deposits* is the change in deposits calculated as ratio of the current year's total deposits minus the previous year's total deposits to the previous year's total assets. All control variables are at the consolidated BHC level. Standard errors are clustered at the BHC level. *t*-statistics are in parentheses. *** = significant at 1%; ** = significant at 5%; * = significant at 10%.

	(1) ΔLeverage	(2) ΔLong-term debt	(3) ΔShort-term debt	(4) ΔSubordinate	(5) ΔDeposits
Year 2 Before	0.034	0.019***	-0.032*	-0.001	0.074***
	(0.90)	(6.55)	(-1.83)	(-0.41)	(5.06)
Year 1 Before	0.239***	-0.024	0.016	0.001	0.123***
	(7.34)	(-0.80)	(0.48)	(0.53)	(3.62)
Year 1 After	0.026	-0.012	-0.026	-0.005***	0.072***
	(1.21)	(-1.20)	(-0.91)	(-4.42)	(3.17)
Year 2 After	0.070***	-0.013	-0.023	-0.010	0.126***
	(4.91)	(-0.72)	(-0.95)	(-0.89)	(6.29)
Year 3 After	0.014	0.002	-0.039**	-0.006***	0.085***
	(0.49)	(0.22)	(-2.20)	(-5.68)	(6.45)
Year 2 Before × Small	-0.023	-0.008	0.035*	0.001	-0.078***
	(-0.51)	(-1.05)	(1.85)	(0.27)	(-2.93)
Year 1 Before × Small	0.164***	0.067**	-0.027**	0.004***	-0.073
	(2.74)	(2.44)	(-2.01)	(2.76)	(-1.21)
Year 1 After × Small	-0.068**	-0.009**	0.031**	0.001	-0.098***
	(-2.31)	(-2.31)	(2.11)	(0.35)	(-3.06)
Year 2 After × Small	-0.095***	0.023	-0.002	0.008**	-0.135***
	(-4.38)	(1.06)	(-0.06)	(2.07)	(-5.07)
Year 3 After × Small	-0.026	-0.013	0.033*	0.006***	-0.080***
	(-0.67)	(-0.91)	(1.77)	(4.51)	(-2.98)
Small	-0.120**	-0.017*	0.001	-0.001	-0.121***
	(-2.38)	(-1.89)	(0.09)	(-0.82)	(-3.38)
BHC Controls	Yes	Yes	Yes	Yes	Yes
BHC fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
N	338	338	338	338	338
Adj. R^2	0.240	0.089	0.055	0.283	0.234

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