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CEO Inside Debt and Risk-Taking in US Banks: Evidence from Three Bank Policies

by

Abhishek Srivastav

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The following chapter of this thesis has been based on work from a jointly-authored publication:

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Chapter 3: Inside debt and Bank Payout Policies	Srivastav, A, Armitage, S, Hagendorff, J. (2014). CEO Inside Debt Holdings and Risk-shifting: Evidence from Bank Payout Policies, *Journal of Banking and Finance*, 47, 41-53.

The candidate confirms that he is the principal author of this publication. The work contained in this article arose directly out of the work for this PhD thesis. The candidate undertook the literature review, data collection and statistical analyses and made a significant contribution to the conceptual framework used.

Declaration Page

This is to certify that that the work contained within has been composed by me and is entirely my own work. No part of this thesis has been submitted for any other degree or professional qualification.

Signed:

Date:

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Dedication

I would like to dedicate this thesis to my parents who supported me with this ambitious endeavor without thinking about the difficulties and sacrifices they may have to make. My every accomplishment is a result of their blessings and unconditional love.

ABSTRACT

Widespread losses during the recent financial crisis have raised concerns that equity-based CEO compensation (stocks and stock options) causes risky bank policies. This has led to the need to understand whether CEO pay can be re-structured such that it dampens risk-taking incentives. Against this background, this thesis analyses if debt-based compensation (also known as inside debt and consisting of pension benefits and deferred compensation) motivates CEOs to pursue risk-reducing bank policies.

Over three decades of research into executive compensation has not explored the impact of inside debt, primarily due to lack of detailed data on inside debt which only became available after 2006 in the United States (US). The paucity of empirical work on inside debt is particularly unfortunate, given that the value of inside debt is often substantial. This dissertation provides one of the first empirical investigations into the impact of inside debt on bank risk-taking by determining whether CEO inside debt leads to less risky behaviour, through three policy decisions that are capable of increasing the overall risk of the bank.

First, this thesis focuses on the payout policies of banks. Bank payouts divert cash to shareholders, while leaving behind riskier and less liquid assets to repay creditors in the future. Payouts, thus, constitute a type of risk-taking that benefits shareholders at the expense of creditors. The results presented in this thesis indicate

that higher inside debt results in more conservative bank payout policies. Specifically, CEOs paid with more inside debt are more likely to cut payouts and to cut payouts by a larger amount. Reductions in payouts occur through a decrease in both dividends and repurchases. The results also hold over a subsample of banks which received government support in the form of the Troubled Asset Relief Program (TARP) where the link between risk-taking and payouts is of particular relevance because it involves wealth transfers from the taxpayer to shareholders.

Second, this thesis tests the impact of inside debt on the risk implications of bank acquisitions. Bank acquisitions are large scale investment decisions that can affect bank risk. To this end, this thesis shows that higher inside debt holdings motivate CEOs to pursue acquisitions that result in lower bank default risk. It also prevents CEOs from using acquisitions to shift risk to the financial safety-net. Since the safety net is underwritten by the taxpayer, the results show that CEO inside debt has a measurable impact on the subsidy which bank shareholders obtain from taxpayers.

Third, the thesis shows that inside debt plays a critical role in influencing bank capital holdings. Higher equity capital provides creditors with a larger loss-absorbing equity buffer to protect the value of their claims on bank cash flows. *Ceteris paribus*, higher equity protects creditors from losses. To this end, this thesis shows that higher inside debt results in motivating banks to hold higher capital, whether defined using regulatory or economic terms. Higher inside debt also results in reducing the estimated value of the taxpayer losses. Furthermore, banks with higher inside debt are at a lower risk of facing capital shortfalls.

Taken together, the study provides insights on how incentives stemming from inside debt impact bank policies in a manner that protects creditor interests. Inside debt can help in addressing excessive risk-taking concerns by aligning the interests of CEOs with those of creditors, regulators, and the taxpayer. This thesis makes a novel contribution to the banking literature by providing evidence on the implications of inside debt in the US banking industry. This work should be interpreted as part of a wider body of research which demonstrates that inside debt matters for bank risk-taking and that this role of inside debt should be recognized more widely in ongoing discussions on compensation incentives in banking.

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CEO	Chief Executive Officer
CFO	Chief Financial Officer
CRSP	Center for Research in Security Prices
DD	Distance to Default
FDIC	Federal Deposit Insurance Corporation
IPP	Insurance Premium per Dollar of Liabilities
M&A	Mergers & Acquisitions
OLS	Ordinary Least Squares
RWA	Risk Weighted Assets
SEC	Securities and Exchange Commission
SERP	Supplemental Executive Retirement Plan
TARP	Troubled Asset Relief Program
UK	United Kingdom
US	United States (of America)

1. INTRODUCTION

1.1. Introduction

Banks play a key role in a well-functioning and efficient economy. They help in pooling funds from units with excess savings and allocate these excess funds to borrowers for productive uses. In doing so, they create liquidity and act as an important source of funding to firms. But what happens if a bank fails? The repercussions can be severe. A case in point is the financial crisis that started in 2007. The crisis caused the failure of hundreds of US banks and resulted in losses over $10 trillion for the US economy (Atkinson et al., 2013). Eventually, the taxpayers had to step in and fund $700 billion of bailouts to prevent a financial meltdown.

The magnitude of losses for creditors and taxpayers has focussed attention on the responsibility of governments and policy makers to ensure the safety and soundness of banks. In principle, the government has a responsibility to act because banks transform short-term deposits into illiquid long-term assets, and bank default can result in forced sale of illiquid assets and lead to acute liquidity shortage. This issue is further exacerbated due to the vulnerability of financial system to contagion, wherein shocks in one bank or financial intermediary can spill-over to others and this can quickly escalate to a systemic crisis. This was visible during the recent financial

crisis which was triggered by the collapse of a key financial intermediary (Lehmann Brothers) but resulted in serious externalities by resulting in a banking crisis.

It is by now widely recognized that bank fragility during the recent financial crisis was caused by the build-up of excessive risk in the financial system, usually a result of risky policies implemented by the banks before the crisis (DeYoung et al., 2013; Brunnermeier, 2009; Hellwig, 2010). For instance, a large number of banks engaged in risky lending practices in the sub-prime mortgage sector, relied excessively on short-term wholesale funding, and increasingly invested in risky assets such as hard-to-value derivative contracts. The ensuing debate has focused on understanding how to mitigate such forms of risk-taking and called for reforming the state of bank governance.

Further, the compensation structure of senior executives such as the Chief Executive Officer (CEO) played a key role in inducing excessive forms of risk-taking and could have contributed to the financial crisis (DeYoung et al., 2013; Bebchuk et al., 2010; Bhagat and Bolton, 2014). In general, the compensation structure of a CEO consists of a large fraction of equity-like instruments like common stocks and stock options. When managers are paid with such equity-like instruments, their wealth is tied to that of shareholders, thereby causing them to engage in excessive risk-taking. Consistent with this, recent banking reform proposals highlight the need to understand better how to structure CEO compensation that can mitigate such risk-taking behaviour (Bebchuk and Spamann, 2010; Federal Reserve, 2010).

CEO pay can also be aligned with the interests of debt holders. A growing literature has shown that compensating CEOs with debt-based pay, commonly referred to as inside debt, can lower the risk-taking preferences of CEOs (Sundaram and Yermack, 2007; Edmans and Liu, 2011; Cassel et al. 2012). In practice, CEO pay consists of such debt-like instruments in the form of pension benefits and deferred compensation. CEOs with inside debt have a claim on bank cash flows because inside debt becomes payable upon retirement. Crucially, these claims are unfunded and unsecured firm obligations, thereby putting the value of inside debt at risk if the firm defaults and exposing CEOs to the same default risk concerns as faced by external creditors (Edmans and Liu, 2011). As a result, when paid with inside debt, the risk preferences of CEOs should converge with those of external creditors, whose promised payoffs are fixed and whose expected payoffs decrease in risk. The issue of inside debt is discussed in further detail in section 1.3 of this chapter.

In practice, the value of total CEO inside debt is often substantial. For instance, the CEO of US Bancorp held nearly $24 million in 2012 and the CEO of PNC Financial Services held $48 million in 2012. As shown in Chapter 2 of this thesis, the average inside debt held by bank CEOs in the top-100 US banks by market capitalisation over the period 2007-2012 is $6.3 million. Despite the prevalence of inside debt as an important component of CEO pay (Sundaram and Yermack, 2007; Edmans and Liu, 2011), there has been only limited focus on inside debt in the literature.

The lack of empirical work on inside debt can be partly attributed to the unavailability of reliable data on the value of CEO inside debt holdings. Only since

2006 have revised Securities and Exchange Commission (SEC) disclosure requirements mandated the publication of CEO inside debt holdings in the US, including pension benefits and total deferred compensation. This dissertation exploits the presence of detailed data on inside debt by being one of the first to analyse the impact of inside debt as a means of aligning executives to their creditors. It looks at US banks due to the availability of detailed data on inside debt for US executives which are not disclosed in other countries.

The core idea of this thesis rests on the foundation that CEOs can also be paid with 'debt'. If using firm equity to compensate CEOs aligns them with shareholders, then using firm debt should align CEOs with creditor interests. With CEOs aligned with creditors, they should be less likely to pursue risky bank policies. This dissertation will analyse the role of inside debt in mitigating risk-taking incentives of bank CEOs by focusing on three specific bank policies: payout policy in the form of dividends and repurchases (shown in Chapter 3), investment policy by focusing on mergers and acquisitions (shown in Chapter 4), and financing policy by focusing on bank capital holdings (shown in Chapter 5).

The remainder of this introductory chapter is organised as follows. The next section provides a brief overview of the bank risk-taking literature and lays the premise for focusing on the banking industry. This is followed by a discussion of why the thesis looks at CEO inside debt holdings. Finally, the main contributions that this thesis makes to the debate about the motivations and implications of CEO compensation structure are presented.

1.2. Agency Theory and Bank Risk-Taking

Risk-taking in the banking industry has become a key concern for bank regulators and bank creditors. Risk-taking results in the favouring of shareholders since they occupy residual claims and the value of these claims is increasing in firm risk; however, the costs of firm default due to increases in risk are borne by creditors. However, the social costs extend well beyond that and affect a large number of stakeholders. For instance, excessive build-up of risk results in destabilizing the financial system, undermining investor confidence, and critically disrupting the economy.

Essentially, risk-taking is an outcome of the capital structure of banks and is thus rooted in agency theory. Going back to Jensen and Meckling (1976), it is well known that the capital contributed by external investors exists in the form of both equity which contributed by shareholders (or equity holders) and debt which is contributed by creditors (or debt holders)[1]. The critical difference between shareholders and creditors lies in their payoff structure with creditors having fixed and primary claims on a firm's assets and shareholders having residual claims. Due to this, shareholders hold convex claims over firm assets which cause their expected payoffs to rise exponentially with bank risk; by contrast, creditor payoffs are concave due to limited upside potential in the value of their claims. For creditors, high risk taking, therefore, implies a higher probability of losses without the same potential for gains that shareholders benefit from.

[1]Critically, this is a simplifying assumption since there are different classes of shareholders (common and preferred shareholders) and creditors (subordinated debtholders, insured depositors, uninsured depositors).

Shareholder incentives to increase firm risk are particularly high in the banking industry. This is caused by the presence of deposit insurance which acts as an explicit government guarantee (Bhattacharya and Thakor, 1993) as well as the prospect of bank bailouts which acts as an implicit government guarantee. The value of this financial safety net acts as a taxpayer-funded put option (Merton, 1977). Bank shareholders may maximize the value of this put by engaging in additional risk-taking at the expense of bank creditors and the deposit insurer. The extant literature has provided ample evidence of moral hazard arising from the safety net as well as from government guarantees more generally (e.g., Dewatripont and Triole, 1994; Hovakimian and Kane, 2000; Freixas and Rochet, 2013; Dam and Koetter, 2012). Second, the option value of the safety net increases in firm leverage (Keeley and Furlong, 1990; John et al., 2010; Bebchuk and Spamann, 2010). Since banks are substantially leveraged and hold less equity than any other major industry, the benefits of risk-taking are magnified for bank shareholders compared with non-financial firms.

Taken together, there are conflicts between shareholders and external firm creditors over the desired level of firm risk. However, given the separation of ownership and control, the providers of capital do not run the firm and they delegate the day-to-day operations to the CEO. Shareholders can distort CEO incentives in their favour by structuring CEO pay such that it rewards CEOs for greater risk-taking. Jensen and Meckling (1976) posit that shareholders may induce CEOs to pursue shareholder-friendly policies by granting them higher equity-based compensation (or inside equity) in the form of stock grants and stock options). These incentives may motivate bank CEOs to pursue riskier policies. Consistent with this

view, DeYoung at al. (2013) show that, as the amount of equity-based pay that bank CEOs receive increases, CEOs respond to increased risk-taking incentives by engaging in more risky activities.

Jensen and Meckling (1976) discuss that paying CEOs with debt may help alleviate excessive risk-taking concerns since the net payoff from increasing firm risk (via more valuable stock and option grants) will be offset by a higher prospect of losing some of the value of a CEO's debt-based compensation components. The following section provides a brief insight into such forms of debt-like compensation and its role in mitigating risk-taking at banks.

1.3. Inside Debt: Turning CEOs into Internal Creditors

Inside debt is a form of executive compensation which broadly consists of deferred compensation and defined pension benefits. Sundaram and Yermack (2007) show that 78% of large S&P firms in their sample had some form of inside debt arrangements, with an average CEO holding $4.2 million in pensions. In the banking industry, Bennett et al. (2012) show that 72% of banks in their sample held some form of inside debt in 2006, with an average CEO holding nearly $3.1 million.

An important characteristic of inside debt is that it accrues over the CEO's tenure and most of it will only be released upon retirement. Thus, inside debt acts as a liability (or debt) for the firm to the CEO. Crucially, the value of any inside debt that a CEO can claim upon retirement is contingent on the firm remaining solvent. This is because inside debt is an unsecured and unfunded firm obligation. If a firm fails, CEOs have equal claims as those of other unsecured creditors and the amount

they can recover depends on the liquidation value of the firm (Sundaram and Yermack, 2007; Cassel et al., 2012). Thus, inside debt results in exposing CEOs to firm default risk as some of their wealth is closely linked to that of external creditors in the firm. As a result, when paid with inside debt, the risk preferences of CEOs should converge with those of external creditors (whose payoffs are fixed and decreasing in risk) and incentives to take on risk should be dampened. Put simply, inside debt should be negatively associated with risk-taking.

The issue of investigating the impact of inside debt on risk-taking is vital for the banking industry. As pointed out by DeYoung et al. (2013), bank CEO incentives are more heavily geared towards the interests of shareholders than in other industries even though, equity makes up only a small proportion of a bank's balance sheet. It is therefore particularly important to understand if aligning managerial interests with the interests of external creditors dampens risk-taking. As a first step in this direction, this thesis aims to establish a direct link between inside debt and bank policies through which debt-like pay limits risk-taking incentives of bank CEOs.

1.4. Impact of Inside Debt: Evidence from Three Bank Policies

Broadly, firms can engage in risk-taking by changing the firm's investment policy, payout policy, or financing policy (Jensen and Meckling, 1976; Galai and Masulis, 1976; Smith and Warner, 1979). If this is the case, then the impact of inside debt in mitigating risk-taking should be visible in the choice of these firm policies. Accordingly, this thesis looks at the following three broad policies for stronger causal interpretation, with each policy explored in a separate thesis chapter:

I. Inside Debt and Bank Payout Policies

Chapter 3 looks at the issue of bank payout policies which consist of cash disbursements to shareholders in the form of dividends and repurchases. When banks declare large payouts, they deplete the quality and quantity of assets available for creditors in the event of default. Thus, large bank payouts constitute a form of additional risk-taking that reduces the amount of equity capital available to absorb losses. Kalay (1982) also posits that firm payouts constitute a form of increasing firm risk, beyond that desirable to the creditors.

This chapter tests whether inside debt results in creating a disincentive to pay out capital to the shareholders. The sample period focuses from the run-up to the financial crisis to the recovery period (2007 to 2011). Arguably, banks should have reduced payouts since it would have made it more likely ex ante that they could withstand the crisis.

II. Inside Debt and Bank Mergers & Acquisitions (M&A)

Chapter 4 explores whether CEOs with higher inside debt are more likely to pursue less risky investment policies. This chapter specifically focuses on the case of bank acquisitions since acquisitions are potentially long-term investment decisions and critical in terms of the allocation of firm resources (Masulis et al., 2007; Datta et al., 2001). Moreover, an acquisition is a discrete strategic decision, in which the CEO can safely be assumed to have a direct, leading role. Because of this, acquisitions provide a relatively clear-cut

means of testing for the existence of a causal link between inside debt and investment decisions through which a CEO affects bank risk.

III. Inside Debt and Bank Capital

Chapter 5 addresses the broader empirical issue of bank capital. Since banks holding higher amount of equity capital have a larger loss-absorbing capacity, ceteris paribus they should have lower default risk. This chapter examines the hypothesis that inside debt is effective in providing incentives for firms to limit their default risk, by holding higher capital buffers. The findings are tested against different definitions of equity capital, whether defined using book-based, market-based measures, or the claims of taxpayers via deposit insurance.

Thus, these three mechanisms act as empirical tests through which this thesis tests whether paying CEOs with inside debt leads to mitigating their risk-taking behaviour. Using a wide array of policies to examine bank behaviour helps in the understanding of the different ways in which inside debt can affect bank risk and offers greater generalizability of the empirical findings. The next section discusses the contribution of this thesis to the current knowledge on bank risk-taking and executive compensation.

1.5. Contributions of the Thesis

The compensation structure of senior executives in the banking industry has become a key concern for the public and for bank regulators, and it is the focus of a flurry of

new research. This thesis contributes to the ongoing research conversation on bank risk-taking by determining whether CEO inside debt leads to less risky behaviour, through three policy decisions (payouts, investment, and bank leverage) that are capable of increasing the overall risk of the bank. Through these empirical tests, this research aims to find out if higher inside debt motivates CEOs to pursue less risky policies.

The broad contribution of this thesis lies in extending the literature investigating the impact of CEO pay on bank risk-taking (e.g. DeYoung et al., 2013; Fahlenbrach and Stulz, 2011; Hagendorff and Vallascas, 2011; Houston and James, 1995). Prior work has primarily focused on the impact of paying executives with equity-based compensation on bank risk. For instance, Chen et al. (2006) show that there is a positive association between the percentage of option-based CEO wealth in total compensation and market-based measures of bank risk (e.g. systematic risk, idiosyncratic risk). More recently, Bai and Elyasiani (2013) also show that higher option incentives result in reduced bank stability and greater default risk. This association is also reflected in the choice of bank policies, with higher option-induced incentives resulting in riskier acquisitions (Hagendorff and Vallascas, 2011) and riskier investment policies (DeYoung et al., 2013; Mehran and Rosenberg, 2007). While informative, these and related previous studies have implicitly assumed that managers do not hold debt-like instruments and hence did not account for its impact on such risk-taking incentives.

Applied work has only recently started to explore the impact of inside debt on bank risk. For instance, Bennett et al. (2012) show a negative association between inside debt and a market-based measure of default risk. Similarly, Bekkum (2014)

also reports a negative relation between CEO and Chief Financial Officer (CFO) inside debt and measures of subsequent market volatility and tail risk. Although research has established that inside debt helps in reducing default risk, it has not yet established how such risk-reductions are realized. This being an important empirical issue warrants further attention to understand if any association between inside debt and bank risk implies causality. As a first step in this direction, this thesis establishes a direct between inside debt and the choice of bank policies through which inside debt limits risk-taking incentives of bank CEOs. Specifically, higher inside debt is associated with conservative payout, investment, and financing policies.

This thesis also contributes to an emerging stream of research that studies the impact of inside debt on firm behaviour which shows that inside debt can lead to conservative decisions (e.g. Sundaram and Yermack, 2007; Cassell et al., 2011; Phan, 2014). The contributions of each chapter to this literature are highlighted below.

1.5.1. Contribution to the Literature on Payout Policy

Chapter 3 studies how incentives stemming from inside debt impact bank payout policy in a manner that protects creditor interests. It shows that CEOs with higher amount of inside debt are more likely to cut payouts to shareholders and to cut payouts by a larger amount. This research finding is critical for the current payout policy literature examining the role of compensation incentives as a determinant of corporate payout choices (e.g. Fenn and Liang, 2001; Aboody and Kasznik, 2008; Cuny et al., 2009). Although prior research has explored the compensation–payout link, it has not accounted for debt-like incentives. This study extends prior research

by taking into account the role of inside debt on payouts and offers a novel perspective by introducing a previously unrecognized and important, component of CEO compensation to this literature.

Additionally, this chapter also contributes to the banking literature by examining payout policies (Hirtle, 2004; Boldin and Legget, 1995). It provides the first comprehensive examination of bank payout behaviour, by taking into account total payouts rather than separately studying one of the components of total payouts (dividends or repurchases). This is important since looking at only dividends or repurchases may not offer a complete picture of how inside debt affects payouts. For instance, it is possible that inside debt results in reducing the level of bank dividends, but part of these funds are still distributed in the form of share repurchases.

1.5.2. Contribution to the Literature on M&A Policy

Chapter 4 studies the impact of inside debt on bank acquisitions. Acquisitions are important investment decisions that frequently increase the default risk of the acquirer (Furfine and Rosen, 2011; Hagendorff and Vallascas, 2011). Since inside debt should align CEO and creditor interests, this Chapter hypothesises higher inside debt to be associated with creditor-friendly policies, that is, policies which reduce bank risk. Put differently, there should be a negative relation between the inside debt ratio of the CEO and the change in risk following an acquisition.

The results provide robust evidence to support this hypothesis. Specifically, higher inside debt results in a larger fall in default risk after acquisitions. Overall, this Chapter makes two key contributions to the literature.

First, it contributes to the literature on bank risk and the value of the safety net (e.g. Benston et al., 1995; Hovakimian et al., 2012; Dam and Koetter, 2012; Carbo-Valverde et al., 2012). Prior work in this area has shown that banks have strong incentives to engage in risk-shifting on to the financial safety net. Carbo-Valverde et al. (2012) show that bank acquisitions exist as an important means to increase the value of deposit insurance. Brewer and Jagtiani (2013) also show that bank acquisitions may be motivated by incentives to become too-big-to-fail and hence reap a higher subsidy from regulators. An important determinant of such incentives could be the compensation structure of the CEO (John et al., 2000). This research is the first to link inside debt and other forms of executive compensation to the loss exposure of taxpayers caused by deposit insurance guarantees. In effect, this chapter estimates how CEO inside debt and other pay components affect the dollar amount which shareholders extract from the financial safety net. This is an important question to address.

Second, this chapter extends prior research investigating the impact of CEO pay on bank risk-taking (DeYoung et al., 2013; Fahlenbrach and Stulz, 2011; Hagendorff and Vallascas, 2011; Houston and James, 1995). To date, this research has focused on the cash- and equity-based components of CEO pay, thus offering limited insight into the role and effectiveness of inside debt. Recent papers by Bennett et al. (2012) and Bekkum (2014) document a negative relation between inside debt and bank risk. The current study adds to this evidence by focusing on a specific policy in the form of acquisitions, which previous research has not examined. An acquisition is a discrete strategic decision, in which the CEO can safely be assumed to have a direct, leading role. Because of this, acquisitions provide a relatively clear-cut means of

testing for the existence of a causal link between inside debt and decisions through which a CEO affects bank risk in way that previous have not done.

Interestingly, Phan (2014) also studies the impact of inside debt on the post-acquisition performance and equity volatility of non-financial firms. This research builds upon Phan's work by studying how inside debt affects post-acquisition risk in the banking industry and the value of the financial safety net to shareholders. Chapter 4 differs from Phan by showing that inside debt affects the changes in bank risk after an acquisition through two different channels, asset risk and leverage risk. Moreover, the public-good character of financial stability means it is important to understand if inside debt can dampen risk-taking incentives in banking, and banks differ in other ways from non-financial firms that warrant a separate analysis of how inside debt affects risk.

1.5.3. Contribution to the Literature on Bank Capital

Chapter 5 studies the role of CEO inside debt holdings in the context of bank capital decisions. This chapter takes a different view of inside debt and proposes that CEO's inside debt holdings turn CEOs into creditor-managers. These creditor-managers monitor and influence bank behaviour in a manner which is consistent with the interests of outside creditors. The discipline resulting from inside dent is referred to as 'internal discipline'. Analogous to external discipline that is exerted by external bank creditors (e.g. sub-ordinated creditors, uninsured depositors, etc.), the results show that higher internal discipline motivates executives to manage banks which hold higher equity capital buffer. It also reduces capital adequacy concerns since

banks with higher internal discipline are less likely to face a capital shortfall in the near future.

This chapter makes several contributions. First, it extends the market discipline literature. It is well recognized that external creditors play a key role in monitoring bank policies. For instance, Flannery and Sorescu (1996) show that bank subordinated debt spreads are sensitive to measures of bank risk, suggesting that unsecured creditors actively monitor banks and price their assessments in the interest rate charged on debt issued. Furfine (2001) shows that interests paid on interbank deposits are also sensitive to the credit risk of borrowing banks. More recently, Dinger and Hagen (2009) also show that banks which held long-term interbank deposits had lower risk exposures. However, majority of this research has assessed the role of external creditors as monitors of bank behaviour.

The focus of this chapter is to take an expansive view of creditor discipline to show that executives who hold inside debt act as internal creditors and they can also impose discipline over bank policies. It contributes to the existing literature by developing a novel measure of internal discipline which is measured as the percentage of uninsured bank debt that is owned by the CEO (or *CEO debt ownership*). This measure directly captures the alignment of interests between the CEO and creditors. It reflects creditor-manager alignment more closely than prior work, which focuses on bank capital structure by inter alia focusing on deposits or fraction of subordinated debt[2], and is strongly correlated with bank policies.

[2] For example, using deposits as a measure of market discipline could also be indicative of regulatory discipline since banks may be responding to regulatory pressure to hold higher equity if banks are

Relatedly, prior work on creditor discipline is circumspect over the ability of external creditors to correctly assess bank risk and elicit prompt firm responses. This is because external creditors may find it costly to monitor banks and may not hold the necessary information to assess the firm's true condition (Bliss and Flannery, 2001). For instance, *ex ante* risky bank policies did not show the build-up of systemic risk on balance sheets before the crisis, it was only visible once the banks started suffering huge losses at the onset of the crisis. Consistent with this, Bliss and Flannery (2001) are able to only document weak evidence in support of creditor discipline influencing bank policies. Furthermore, Nier and Baumann (2006) show that banks which held higher fraction of uninsured deposits held higher capital buffer, however this effect becomes weak if banks have implicit government guarantees. This is particularly worrisome given that market discipline is considered to be a key ingredient for financial stability by the Basel Committee. In this regard, Chapter 5 shows that bank executives who hold some amount of inside debt can also exert internal discipline. Specifically, the results presented in this chapter highlight that internal discipline can motivate banks to hold higher levels of bank capital and also hold capital that is commensurate to their default risk.

Second, by examining how managerial debt ownership in their own bank determines bank capital, this chapter provides evidence on an important, yet unaddressed, issue which brings together capital structure and corporate governance theories. Previous theoretical work on bank capital has focused on theorizing the optimal bank capital structure (e.g. Flannery, 1994; Diamond and Rajan, 2000; Allen

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funded with a larger fraction of depositors. Similarly, the fraction of sub-ordinated debt held by banks can reflect greater level of monitoring by creditors but also result in exacerbating risk-shifting incentives of shareholders due to increased leverage.

et al., 2011). While informative, these and related previous studies have either overlooked the role of agency conflicts or assumed that managers own stock and hence are aligned with the shareholders. This chapter argues that most managers hold some fraction of firm debt, in addition to equity, and future theoretical and empirical work should take this into account. These issues matter for how banking theory evolves to take into account the role of corporate governance in shaping bank capital and whether internal discipline should play a role in bank regulation.

Finally, this research also contributes to the recent stream of research exploring the determinants of bank capital levels (e.g. Gropp and Heider, 2010; Berger et al., 2008; Flannery and Rangan, 2008). This stream has shown that bank capital levels exhibit substantial cross-sectional variation and that regulatory discipline is not a first-order determinant of bank capital. For instance, Flannery and Rangan (2008) show that market discipline can influence the level of equity buffer held by banks. Gropp and Heider (2010) find that standard determinants of non-financial firm's capital structure can also predict bank capital holdings for financially healthy banks. This chapter extends prior work by showing that internal discipline is also a key determinant of bank capital holdings. It shows that agency conflicts play a key role, with banks where executives are subject to higher internal discipline holding higher amounts of discretionary capital.

1.6. Key Takeaways/Implications

This thesis tests the implications of CEO inside debt holdings on bank risk-taking. Currently, the topic of inside debt is still a 'black box' wherein the

mechanisms through which inside debt decreases bank risk remain largely unidentified and warrant further attention. In this respect, this thesis establishes a direct and causal link between inside debt and various bank policies through which inside debt limits risk-shifting incentives of bank CEOs. It shows that banks where CEOs hold higher amount of inside debt pursue less risky bank policies in the form of lower bank payouts to shareholders, less risky bank acquisitions, and a higher equity capital buffer.

The main implication deriving from this thesis is that the incentive effects associated with inside debt holdings by CEOs should find wider recognition both in applied empirical work on compensation, and amongst policymakers. As regards empirical work, most studies to date do not explicitly consider CEO inside debt holdings and focus instead exclusively on the implications of equity-based pay incentives. While earlier work was not able to access data on CEO inside debt holdings, this has changed since 2006 with the advent of wider SEC disclosure requirements on executive pensions and deferred compensation. However, not all recent studies on executive compensation that use post-2006 data include debt-based forms of compensation in their analysis. This study shows that inside debt is economically substantial in banking (debt-based CEO wealth is almost at the same level as equity-based CEO wealth) and that it has measurable implications for bank risk-taking incentives. Therefore, future research on the incentive effects of CEO compensation arrangements should incorporate debt-based compensation arrangements to obtain a holistic view of the various incentives resulting from CEO compensation arrangements.

Further, the role of inside debt in curbing bank risk-taking should find wider recognition amongst policy makers. It is a widely held view that large equity-based risk-taking incentives have caused risky bank policies before the financial crisis and are one of the many factors which have contributed to the severity of the recent crisis. Recent U.S. compensation guidelines for CEOs and other senior executives at large banks by the Board of Governors et al. (2010) acknowledge the role of equity-based compensation arrangements in the crisis and suggest that a larger share of compensation should be deferred.

However, recent U.S. compensation guidelines fall short of explicitly endorsing inside debt as a mechanism to mitigate excessive risk taking in banking. This is in contrast to European policy discussions which are aimed at turning more bank employees into holders of inside debt (see Liikanen Report, 2012). The results of this thesis, by showing that inside debt is effective in mitigating risk-shifting at banks, support a more widespread use of inside debt in managerial compensation contracts. This work should be interpreted as part of a wider body of research which demonstrates that inside debt matters for bank risk-taking and should be recognized as such much more widely in U.S. policy discussions on compensation incentives in banking.

1.7. Structure of the Thesis

This thesis is organized as follows.

- As background to the analysis, Chapter 2 provides a theoretical and institutional overview of inside debt.

- Chapter 3 studies the impact of inside debt on bank payout policies by assessing whether inside debt increases the likelihood and magnitude of a fall in bank payouts.
- Chapter 4 analyses the impact of inside debt on bank M&A policy by assessing the association between changes in risk following acquisitions and inside debt holdings.
- Chapter 5 proposes that executives who hold inside debt act as a source of 'internal' market discipline, and analyses the impact of this internal discipline on bank capital holdings.
- Chapter 6 draws together the conclusions, policy implications and limitations of this thesis. Directions for further research are also discussed in this chapter.

2. BACKGROUND: THE THEORETICAL AND INSTITUTIONAL FOUNDATIONS OF INSIDE DEBT

2.1. Introduction

The compensation structure of bank CEOs has stimulated much debate amongst academics and policymakers. CEO compensation broadly consists of cash compensation, equity-based compensation and debt-based compensation. Equity-based compensation (or inside equity) takes the form of stock options and bank equity, while debt-based compensation (or inside debt) consists of pension benefits and deferred compensation.

Traditionally, executive compensation of bank CEOs was not geared towards use of equity-based compensation, with Smith and Watts (1992) and Houston and James (1995) showing that bank CEOs hold only small amounts of firm stock and options. However, there has been a structural shift with CEOs receiving a large fraction of their pay in the form of stocks and options since the 2000s (Chen et al., 2006; DeYoung et al., 2013). This was in part due to various regulatory changes enacted over the past two decades, such as the Reigle-Neal Act of 1994 and the Gramm-Leach-Biley Act of 1999.

The Reigle-Neal (RN) Act of 1994 resulted in allowing banks to acquire in other states, thereby promoting geographic diversification. This resulted in triggering a large number of acquisitions and giving rise to larger and more profitable banks (Nippani and Green, 2002). However, greater degree of consolidation may result in increasing operating risk since larger banks are difficult to manage (Liang and Rhodes, 1988). Moreover, Chong (1991) shows that interstate banking resulted in an increase in bank risk – both idiosyncratic and systematic. Akhigbe and Whyte (2003) find that banks in states with liberal interstate banking provisions, thereby allowing for geographic expansion, tend to be riskier than banks in states which have more restrictive provisions. By contrast, there also exists evidence to suggest that the RN act resulted in value-creation and reducing idiosyncratic risk. For instance, Brook et al. (1998) highlight that there was a positive increase in bank market values to the announcement of the RN act and the deregulation resulted in creating value worth $85 billion for the banking industry. Hughes et al. (1999) also show that bank consolidation in the post-RN period resulted in diversifying bank risk and improving profitability. Thus, there is mixed evidence on the impact of RN on bank risk.

The second major regulatory change in the US banking industry was the enactment of the Gramm-Leach-Biley (GLB) Act of 1999 which allowed banks to provide other non-traditional banking services such as investment banking and securities brokerage. Consistent with this, DeYoung and Roland (2001) find that banks with a higher proportion of fee-based income were associated with higher volatility and leverage. Allen and Jagtiani (1999) show that expanding operations into securities and insurance activities results in increasing systematic risk, thereby exacerbating concerns of an interconnected financial system. Similarly, Boyd et al.

(1993) also simulate mergers between banking and non-banking financial firms to show that merged firms are riskier when banks merge with firms in securities and real-estate sector. More recently, DeYoung et al. (2013) propose that the emergence of new investment opportunities and competitive environment in the post-GLB period motivated the board members to structure CEO pay in a manner which gives them strong incentives to respond and shift the business model of banks towards riskier policies.

While use of equity-based pay resulted in higher returns for banks, it also exposed them to larger default risk. These risks materialized during the financial crisis of 2007-09, leading to losses worth billions for the stakeholders. Many view the structure of CEO compensation, specifically excessive reliance on equity-based compensation, as a key contributing factor in motivating bank executives to increase bank risk (e.g. DeYoung et al., 2013; Bolton et al., 2010).

The aim of this chapter to is to highlight the downside of CEO pay that is structured too much in favour of shareholders, and subsequently lays the foundation behind use of inside debt to mitigate such risk-taking incentives. This chapter is organized as follows. Section 2.2 discusses the consequences of using equity-based compensation, Section 2.3 sets the theoretical and empirical background for the use of inside debt in CEO pay, Section 2.4 lays the institutional background, and section 2.5 discusses the prevalence of inside debt in the banking industry. Finally, section 2.6 concludes.

2.2. Disadvantages of too much Equity-based Compensation

The theoretical rationale behind paying CEOs with firm equity is based on Jensen and Meckling's (1976) agency theory wherein the authors posit that managers act as agents for the principal or shareholders. When managers are given a fractional stake in the firm through equity, their interests are aligned with shareholders. This induces managers to exert effort and pursue actions that increase shareholder value, while mitigating incentives to extract perquisites. However, the idea of paying managers with instruments which are sensitive to shareholder value instead of firm value has two fundamental shortcomings:

First, it may motivate managers to focus primarily on shareholder value instead of considering the interests of other stakeholders (Jensen and Meckling, 1976; Galai and Masulis, 1976). This issue is critical for banking firms, where a multitude of stakeholders have interests in ensuring a safe and stable bank. For instance, bank creditors account nearly 90% of bank assets due to the highly leveraged structure of banks. Since creditors have fixed-claims on the value of bank assets, they prefer low volatility and are concerned about long-term solvency of the bank; on the other hand, shareholders have convex claims and prefer high volatility and have short-term perspectives. Clearly, managers aligned more with shareholders are more likely to pursue policies which may increase firm risk, to benefit shareholders. Similarly, the government and taxpayers are concerned about the default risk of the bank since they are required to bail-out the insured depositors; and more generally, bank failures pose significant externalities which may affect investor sentiment and lead to financial crisis if a large or interconnected bank fails. This was evident during late-2007 when *ex ante* bank CEOs pursued risky bank policies with the expectation that such

policies will maximize shareholder returns. In retrospect, however, such policies resulted in the build-up of excessive risk on bank balance sheets and led to large-scale losses for the government, taxpayers, and creditors. The default of a bank thus carries immense social and economic costs for its stakeholders.

The second shortcoming is that equity-based pay is sensitive to the occurrence of bankruptcy but not on the liquidation value of assets (Edmans and Liu, 2011). A CEO who holds a large amount of equity-based pay will receive increasing payoffs if the firm performance is good but zero in the event of bankruptcy (when firm performance is poor), irrespective of the bank's liquidation value. This results in an asymmetric payoff structure due to which the CEO may have incentives to gamble for firm resources near default by pursuing a risky firm policy. If the risk pays off, it may help in keeping the bank solvent while shifting the costs of default on the creditors if the bank defaults. This gambling behaviour, while beneficial to shareholders, is to the detriment of creditors and taxpayers who are interested in the liquidation value of a bank.

To alleviate these shortcomings, various researchers have raised the need for compensation incentives of bank managers to be structured in a manner that aligns their interests with the interests of creditors, taxpayers, and depositors (Macey and O'Hara, 2003; Adams and Mehran, 2003). Consistent with this, Dewatripont and Triole (1994) and Bebchuk and Spamann (2010) also suggest that managerial incentives should be correlated with equity value as well as the value of debt. One such mechanism is the use of debt-based compensation which results in tying managerial wealth with the wealth of creditors (Sundaram and Yermack, 2007;

Edmans and Liu, 2011). The next section provides a detailed discussion of this mechanism and how CEO's pay can be restructured using inside debt.

2.3. Theoretical Background on Inside Debt

Inside debt consists of compensating managers with deferred compensation and pension benefits (Sundaram and Yermack, 2007; Edmans and Liu, 2011). These instruments resemble debt in two aspects: first, inside debt acts as a fixed obligation from the firm to make ongoing payments to the manager, generally beginning upon her retirement and continuing throughout her lifetime. Second, inside debt is an unsecured firm obligation, i.e. in the event of bankruptcy, the CEO stands in line with the unsecured creditors to recover some fraction of her inside debt holdings. With the payoffs of CEO's wealth now tied to creditors, managers also act as internal creditors of the firm and shift their focus to long-term solvency of the firm (Edmans and Liu, 2011).

The idea of compensating managers with debt was first assessed by Jensen and Meckling (1976) who proposed that inside debt can help attenuate conflicts of interest between shareholders and creditors that arise when managers hold only firm equity. However, the authors were not able to incorporate this formally in their model and intuitively proposed that firm managers may not transfer wealth from creditors to shareholders if they own equal fractions of firm debt and equity.

The first theoretical framework for inside debt was given by Eaton and Rosen (1983). The authors argued that firms employ inside debt when the impact of managerial effort is not reflected fully in current firm performance. Using inside debt

acts as a form of delayed compensation, allowing investors to wait and infer the impact of CEO effort on future firm performance and accordingly decide on the executive's compensation package. Since the CEO receives part of her compensation in the future, she has incentives to ensure firm solvency and not engage in risk-taking for short-term profits. However, the authors do not establish a clear link between risk-taking and firm policies. This was addressed more recently by Edmans and Liu (2011) who formalize the role of inside debt as an efficient instrument to prevent equity-aligned managers from pursuing policies which increase shareholder wealth at the cost of increasing risk beyond that desirable to creditors. The authors posit that managers who own a larger fraction of firm debt, relative to percentage of firm equity, are more likely to pursue conservative firm policies and reduce firm risk.

Thus, the use of inside debt is rooted in agency theory wherein extant theoretical research has proposed that inside debt acts as a mechanism to align CEO-creditor interests and shifts managerial focus to long-term solvency of the company.

2.3.1. Empirical Evidence on Inside Debt

Although the theoretical foundations of inside debt are well-developed, only a limited amount of applied research has assessed the impact of inside debt on bank policies (Bekkum, 2014; Bennett et al., 2012). This is primarily due to lack of data on inside debt. Prior to 2006, firms were not required to disclose the estimated value of pension benefits and deferred compensation – both of which are components of inside debt. Although there was some information provided by firms as regards the formula used to calculate pension benefits, there was considerable firm discretion over revealing the input variables used to calculate the value of inside debt. For

instance, Kalyta and Magnan (2008) note that a large number of input variables have to be interpreted from company proxy statements or assumed (e.g. mortality rate of executives, period over which pensionable earnings are estimated; the amount of post-retirement salary that executives receive each year). Thus, monetary value of such benefits is ambiguous and an attempt to carry out such calculations might lead to considerable differences in the value of inside debt. This acted as a barrier for researchers to explore the role of inside debt and whether it can affect firm policies or not.

Beginning from 2007, however, the SEC implemented a widespread reform in executive compensation wherein it introduced increased disclosure surrounding executive compensation agreements. According to the new regulations, a firm must disclose the amount of annual pension benefits, years of service, present value of pension benefits and deferred compensation in the firm's SEC filings.

Enhanced disclosure requirements around inside debt have given the field of inside debt much needed research attention. For instance, Bennett et al. (2012) and Bekkum (2014) show that pre-crisis levels of inside debt are negatively associated with bank risk during the crisis. However, since research in this area is still at an embryonic stage, the knowledge of inside debt and its impact is patchy. One such aspect of inside debt that has not received much attention so far is its impact on various policy decisions by bank CEOs. This thesis uses publicly available data on inside debt from 2006 onwards and aims to provide empirical evidence on the role of inside debt in bank risk-taking. Arguably, focusing over the period after 2006 gives more accurate and uniform valuations of inside debt and is thus less circumspect.

2.4. Institutional Background

This section explains the components of inside debt and then discusses the prevalence of inside debt in the banking industry.

2.4.1. Components of Inside Debt: Pension Benefits

Pension benefits exist as fixed post-retirement salaries that executives receive upon retirement. In the US, pension benefits for executives are primarily held in the form of Supplemental Executive Retirement Plans (or SERPs). SERP benefits are generally employed to pay senior executives in the firm and are not used for other employees.

2.4.1.1. Valuation of SERPs

The present value of SERP benefits, which acts as an annuity, can be calculated using the following formula (Sundaram and Yermack, 2007):

$$\sum_{n=1}^{N} \frac{p(n)X}{(1+d)^n} \tag{2.1}$$

where *X* represents the annual pension amount that the CEO is liable to receive each year upon retirement, *n* represents the number of years a CEO is entitled to receive her pension, *p(n)* is the probability that CEO is alive after *n* years, and *d* is the firm's cost of debt.

Firms have discretion over how to set the value of annual pension amount (*X*). This is usually based on some fraction of CEO's salary while she was in office and the number of serviceable years the CEO has served with the company. A simplified formula for calculating *X* is (Sundaram and Yermack, 2007):

$$\sum_{k=1}^{k} \frac{C_{t-k}}{K} \times M \times S \tag{2.2}$$

where *C* represents the cash salary in period *t* and *k* represents the number of past years used to average CEO's cash salary, *M* is a multiplier which is between 1.5% and 2% upon the discretion of the firm, and *S* is the number of years the executive has served in the company.

The first part of the formula ($\sum_{k=1}^{k} \frac{C_{t-k}}{K}$) is usually an average cash salary amount that is calculated for each CEO over a number of past years. The second part of the formula, product of *M* and *S*, represents what fraction of the average salary is to be paid as an annual retirement benefit. Calculating the present value of annual pension benefits is cumbersome and requires a range of assumptions (as noted by Bebchuk and Jackson, 2005; Kalyta and Magnan, 2008) due to which it is not dealt here and for the purposes of this study, the present value of SERP benefits is directly extracted from annual proxy statements filed with the SEC.

2.4.1.2. Why are SERPs used?

SERP arrangements exist because standard pension arrangements which are used by firms for all employees are limited in terms of the maximum retirement income that can be paid to the retiree. In the US, regulations stipulate that the maximum annual compensation is less than $230,000 (Kalyta and Magnan, 2008). For a CEO, this limit is well below her annual cash compensation. Consider the case of a hypothetical CEO with 30 years of pensionable service and a base salary of $1,000,000 in 2012. The CEO was due to retire in 2013. Under the simplifying assumption that the firm uses last year's salary and a multiplier of 2%[3] (this is the equivalent of M in formula (2.2)), the annual SERP benefits for this CEO would be:

$$X = \sum_{k=1}^{k} \frac{C_{t-k}}{K} \times M \times S$$

where k = 1, C_{t-1} = $1,000,000, M = 2%, and S = 30 years

$$X = 1{,}000{,}000 \times 2\% \times 30 = \$600{,}000$$

However, under the traditional pension plans, CEO would only be entitled to receive $230,000 of annual retirement benefits, instead of $600,000. This simple example shows the motivation behind why companies employ SERP arrangements above the standard pension arrangements.

[3] These figures are for illustration purpose and are based for a CEO at a hypothetical bank

2.4.2. Components of Inside Debt: Deferred Compensation

Deferred compensation is the amount of cash compensation (salary and bonus) that the executive voluntarily elects to defer to a future period. Like SERP benefits, CEO is liable to receive the amount of deferred compensation upon her retirement, although in some cases it can be at an earlier date also. Since deferred compensation acts as a form of firm debt which matures upon CEO's retirement, from the executive's viewpoint it acts as another form of debt-based compensation (Eaton and James, 1982). This aspect is well recognized by companies, for instance, the DEF 14A proxy statement of PNC Financial Services clearly mentions that deferred compensation

"…rewards performance immediately and over the long term, based on continued performance and risk management"

(PNC Financial Services, Proxy Statement, 2012, pg 36)

Deferred compensation offers CEOs more flexibility in terms of how much of compensation they want to defer and the return that can be achieved on these plans (Wei and Yermack, 2011). Typically, the executive elects to invest this deferred compensation from a list of investment choices given by the firm, which may include treasury securities, mutual funds, or in some cases company's stock. Any potential gains/losses on these instruments are added back to the amount of deferred compensation in each year's proxy statement. Furthermore, each year the executive is allowed to make additional contributions to her deferred compensation balance.

2.5. Inside Debt in the US Banking Industry

This section gives a preview into the use of inside debt in practice by banks to compensate their CEOs. It helps in understanding if inside debt is used commonly, how much is the average amount of inside debt and whether it is comparable to the CEO's equity-based pay. While prior research on inside debt has shown that it is an important and prevalent component of CEO compensation (e.g. Sundaram and Yermack (2007); Cassell et al. (2012)), majority of this research has focused on non-financial firms. Consequently, another aim of this section is to provide a short premier on inside debt levels in the banking industry.

Figure 2.1 provides a first impression about the prevalence of inside debt amongst the top-100 publicly listed US banks by market capitalization with complete compensation data available in SNL Financial database over the period 2006-2012. The figure shows that over 80% of the largest publicly-listed banks used inside debt to pay CEOs. This shows that the use of inside debt is widespread.

Next, Table 2.1 presents summary statistics on inside debt and various other CEO and firm characteristics. The average amount of pension benefits is $4.2 million and deferred compensation is $2.5 million. An average CEO holds $6.3 million in debt and $38 million in firm equity. This shows that despite its prevalence as a form of compensation, inside debt is far less than the value of equity-based compensation. This is also reflected in the ratio of CEO's debt-based compensation to her equity-based compensation (or *CEO inside debt ratio*) which is 0.54 for an average CEO and 0.13 for a median CEO.

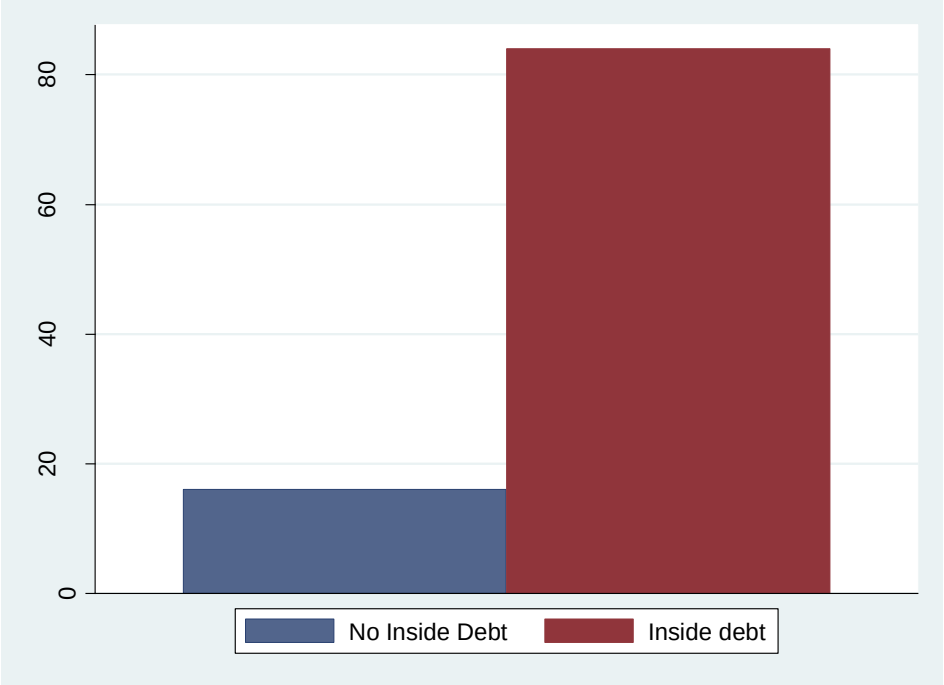

Figure 2.1: Percentage of top-100 US banks by market capitalization which compensate CEOs with inside debt, 2006-2012. Inside debt consists of both present value of pension benefits and deferred compensation.
Sources: SNL Financial, CRSP

In general, the impact of CEO holdings of inside debt and equity-based pay on the choice of firm business policies is moderated by the capital structure of the firm. Jensen and Meckling (1976) argue that a CEO's risk-taking incentives are captured by the fraction of a firm's debt held by a CEO (CEO inside debt/firm debt) relative to the fraction of firm equity held by the CEO (CEO equity-based pay/firm equity). CEOs face reduced risk-taking incentives as this ratio approaches the optimal value of one. This is because increasing firm risk would mean that any marginal increases in the value of CEO equity wealth would be offset by losses on a CEO's debt-based wealth. As shown in Table 2.1, the average *CEO relative inside debt ratio* (*CEO inside debt ratio*/bank debt-to-equity) is 0.07, which is substantially low. The relative figure indicates clearly that personal incentives of bank CEOs are aligned more

towards shareholders than towards creditors. One of the reasons for such low inside debt ratios is the large amount of debt in bank balance sheets, with average debt levels reaching 88% of firm assets.

To assess the relationship between inside debt and other components of CEO compensation (such as equity-based compensation and cash compensation), the Pearson correlations are shown in Table 2.2. The correlations range from 0.01 to 0.31, suggesting that the ratios do not hold a mechanical relationship with other variables.

Table 2.1: Summary statistics on components of CEO compensation for top-100 US banks by market capitalisation, 2006-2012. This table shows the descriptive statistics of CEO pay components. *Cash compensation* is defined as the sum of salary and bonus. *Equity-based compensation* is calculated as the sum of the market value of CEO's common stock holdings and Black-Scholes (1973) value of stock options held. *Inside debt* is the sum of the present value of pension benefits and deferred compensation. *CEO inside debt ratio* is the fraction of CEO's inside debt to CEO's equity-based pay. *CEO relative inside debt ratio* is the fraction of *CEO inside debt ratio* to the firm's debt-to-equity ratio. Values of Salary, Bonus, Cash compensation, Total compensation, Pension benefits, Deferred compensation, Inside Debt, and Equity-based compensation have been expressed in in $ thousands.
Sources: SNL Financial, CRSP, FRY 9C

	Mean	**Median**	**25th percentile**	**75th percentile**	**Standard Dev.**
Salary	801.13	743.27	512.31	504.96	950.00
Bonus	304.92	0.00	0.00	1268.73	15.75
Cash compensation	1073.38	791.67	593.83	1341.83	1000.00
Total compensation	4677.91	2252.71	1255.28	6316.26	4962.36
Value of pension benefits	4158.51	838.01	0.00	7683.98	5362.50
Deferred compensation	2494.61	312.23	0.00	6108.31	1871.73
Inside debt (sum of pension benefits and deferred compensation)	6338.26	1906.53	352.47	11058.58	7349.41
Equity-based compensation	37971.86	10442.15	3830.97	64874.68	35056.24
Measures of inside debt					
CEO inside debt ratio	0.54	0.22	0.02	0.77	0.71
CEO relative inside debt ratio	0.07	0.04	0.00	0.08	0.10

Table 2.2: Correlation matrix for different components of CEO pay. This table shows the Pearson correlation coefficients between measures of inside debt and key elements of CEO compensation. Sample consists of 700 observations.

	Pearson correlations	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Salary	1									
2	Bonus	0.0715	1								
3	Cash compensation	0.4499	0.9287	1							
4	Total compensation	0.4083	0.3876	0.5059	1						
5	Value of pension benefits	0.2441	-0.0763	0.0284	0.4838	1					
6	Deferred compensation	0.1616	0.1329	0.1779	0.4237	0.3092	1				
7	Equity-based compensation	0.1338	0.2328	0.2551	0.3787	0.1143	0.2827	1			
8	Inside debt	0.2643	0.0203	0.1252	0.5678	0.8487	0.7685	0.2169	1		
9	CEO inside debt ratio	-0.0111	-0.0385	-0.0397	0.0275	0.3072	0.1086	-0.2902	0.2803	1	
10	CEO relative inside debt ratio	-0.0593	-0.0072	-0.0331	0.0313	0.2396	0.1796	-0.3003	0.2775	0.872	1

The amount of inside debt held by the CEO is mechanically related to the CEO's age. This trend is shown in Figure 2.2 which illustrates mean and median inside debt holdings for different age groups in the sample. Two interesting facts emerge when observing the variation of CEO inside debt holdings in the figure. First, the rate of change in inside debt values is particularly steep near the retirement age of CEOs, suggesting that increases in the value of inside debt accelerate during the last few years of a CEO's service. Due to this, CEOs may become increasingly conservative in order to protect the value of their inside debt claims. Second, the value of inside debt to CEOs peaks around the retirement age (between 60 and 65) but falls off for subsequent age groups. This is similar to Sundaram and Yermack's (2007) finding. The authors posit that this fall in the value of inside debt may motivate CEOs to retire after passing their retirement age since each additional year after this would amount to sacrificing the annual post-retirement salary that the CEO could have earned. Alternatively, another explanation that can be proposed is that CEOs with more generous inside debt holdings choose to retire at 65 while those with less generous inside debt may decide to work for longer.

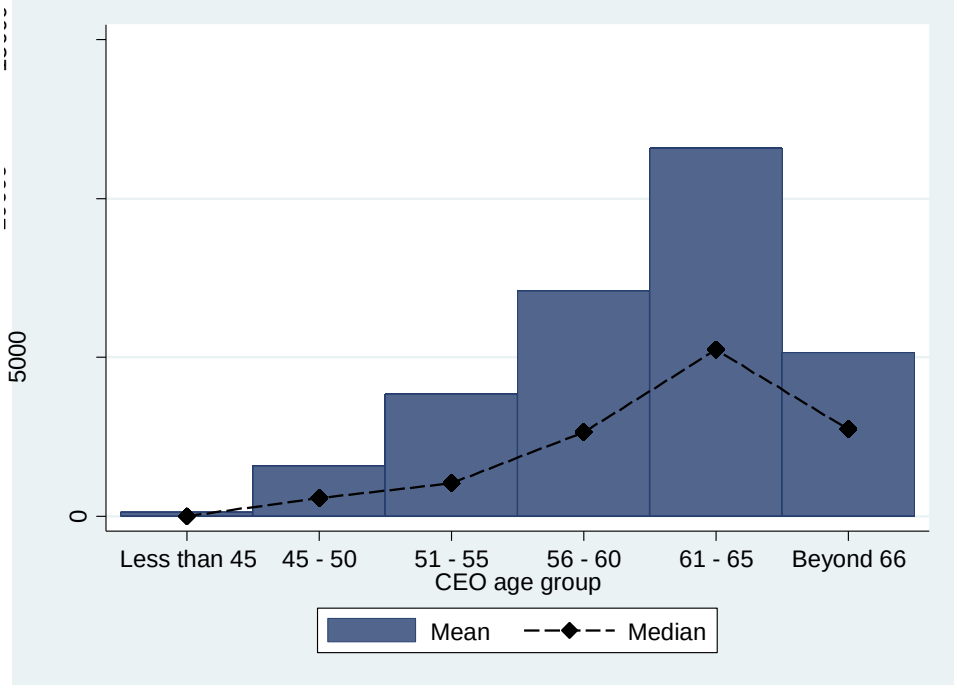

Figure 2.2: Mean and median values of CEO inside debt holdings by age group. Mean and median values of inside debt are shown for a sample of 100 largest US banks by market capitalisation over 2006 to 2012.

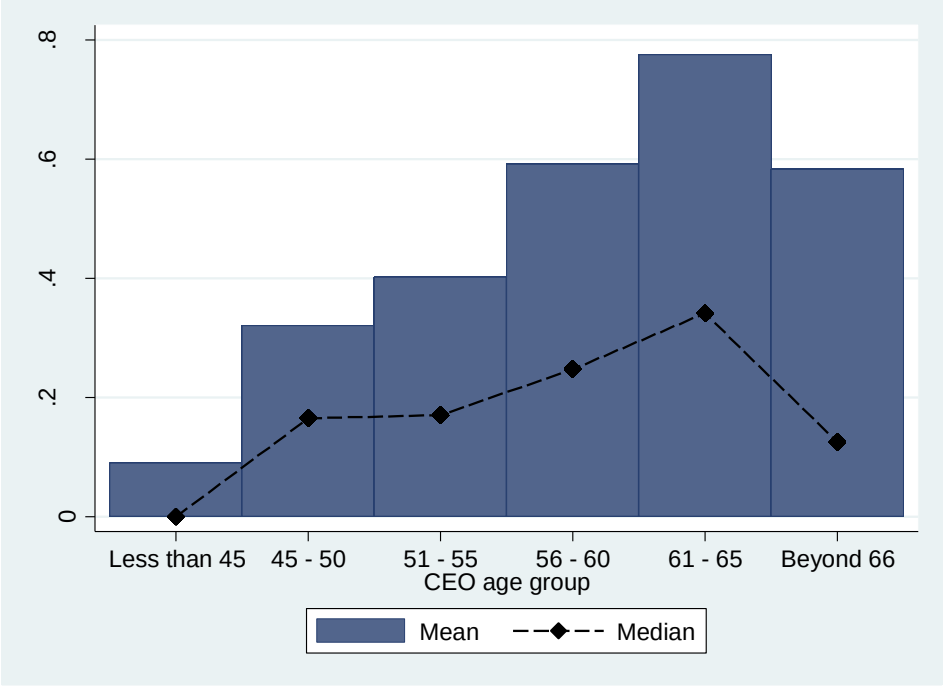

Figure 2.3: Mean and median values of CEO inside debt ratio by age group. Mean and median values of CEO inside debt ratio are shown for a sample of 100 largest US banks by market capitalisation over 2006 to 2012. CEO inside debt ratio is defined as the ratio of CEO's inside debt holdings to her equity-based pay.

While the absolute amount of inside debt increases monotonically with CEO age, it is possible that this increase is offset by a higher increase in CEO's equity-based pay in order to prevent CEOs from pursuing excessively conservative policies. Figure 2.3 explores this intuition by plotting the mean and median *CEO inside debt ratio* to understand whether the increase in inside debt with age is offset by increases in CEO's equity-based pay. Note that inside debt values tend to rise more rapidly than CEO's equity-based pay due to which there is an upward trend. If inside debt represents substantial fractions of CEO's firm-specific wealth, then it can motivate the CEO to manage the bank more in the interests of creditors and pursue policies which reduce bank risk.

Taken together, this section shows the importance of CEO inside debt, especially in comparison to conventional pay components. Inside debt is commonly used as an instrument to pay CEOs; however, it is often much below the amount of equity-based pay.

2.6. Conclusion

Clearly, it is in the interest of bank creditors that their managers are concerned about the impact of their policies on the long-term solvency of the bank. Frequently, however, these concerns are neglected by bank executives in an attempt to boost short-term profit or pursue risky policies which may increase shareholder value. This is primarily due to the fact that the monetary incentive structures of the CEO are geared towards equity-based compensation.

Recent research has shown that inside debt can act as an effective instrument to align interests of the CEO with bank creditors (Sundaram and Yermack, 2007; Edmans and Liu, 2011). This chapter has outlined the theoretical and institutional foundations behind the use of inside debt. Broadly, inside debt consists of deferred compensation and pension plans. It is an unsecured and unfunded firm obligation due to which the recovery value of inside debt in the event of default depends on the liquidation value of the firm (Edmans and Liu, 2011). This results in tying a CEO's personal wealth to the wealth of creditors.

This chapter shows that over 80% of largest US publicly-listed banks (top-100 by market capitalization) use inside debt to compensate CEOs and an average CEO in these banks holds $6.3 million in inside debt. Thus, use of inside debt to compensate CEOs is prevalent and the value is often substantial. As a result, when paid with inside debt, the incentives to take on risk should be dampened and this should be visible in the choice of bank policies. The next chapter attempts to explore this empirical issue by looking at a specific bank policy: capital distributions or payouts in the form of dividends and repurchases.

3. INSIDE DEBT AND BANK PAYOUT POLICIES

3.1. Introduction[4]

This chapter assesses the role of debt-based CEO compensation in affecting risk-taking behavior by examining bank payout policy choices. Bank payouts[5] offer an ideal setting, because payouts result in distributing the bank's most liquid assets to shareholders, while depleting the capital available to creditors by reducing the amount of retained earnings (through dividends) or the amount of equity capital outstanding (through share repurchases). Thus, higher bank payouts result in increasing shareholder wealth, while adversely affecting creditors.

Whether changes in payout policy are influenced by incentives stemming from a CEO's inside debt holdings is an important empirical question and the focus of this chapter. Bank CEOs face a trade-off between increasing current payouts (to the benefit of shareholders) and preserving/reinvesting cash which could be transferred to creditors in the event of default. Since inside debt holdings are an unsecured firm

[4] A version of this chapter has been accepted for publication as Srivastav, A., Armitage, S., Hagendorff, J. CEO Inside Debt Holdings and Risk-shifting: Evidence from Bank Payout Policies, *Journal of Banking and Finance* (October 2014).

[5] For the purposes of this chapter, payouts are defined as consisting of cash disbursements to equity holders in the form of cash dividends and share repurchases. Since payouts are also commonly referred to as capital distributions in the banking industry, both terms are used interchangeably throughout this thesis

obligation, inside debt falls in value as bank default risk increases, possibly as a result of a higher payout to shareholders. Thus, the compensation structure of CEOs geared towards a higher fraction of inside debt creates a disincentive to pay out excess capital to the shareholders. Stated alternatively, CEO inside debt should have a negative effect on total payouts.

The focus of this chapter is to view payouts as a mechanism which results in distributing the bank's most liquid assets (or cash) to shareholders while leaving behind riskier assets for creditors. This is commonly referred as the risk-shifting problem (Kalay, 1982). While prior work on payouts for non-financial firms has often viewed payouts as a mechanism to alleviate agency costs of equity, such as the free cash flow problem (Jensen, 1986), or as a tool to signal financial stability to the market (Miller and Rock, 1985), this chapter focuses on bank payouts during recent financial turmoil of 2007-2011 and argues that payouts during such periods are a form of risk-taking. The sample period for this Chapter (2007-2011) covers the payout behavior by banks from the run-up to the crisis as well as the recovery period. Arguably, banks should have reduced their payouts during the run-up to the crisis as this would have made it more likely *ex ante* that they could withstand the crisis. More importantly, Onali (2014) finds that riskier banks tend to declare larger dividends and thus finds evidence consistent with the risk-taking hypothesis over other payout theories advanced in the literature for non-financial firms. Kanas (2013) also shows that bank dividends during crisis period represent a case of risk-shifting, wherein banks declaring higher dividends register an increase in bank risk. Owing to the uniqueness of the sample period of this chapter and recent empirical evidence,

this study does not focus on different payout theories and argues that bank payouts exist as a form of risk-taking.

For the purposes of this study, bank payouts are defined as the total amount of cash distributed to shareholders in the form of cash dividends and stock repurchases. While this measure offers a holistic view of the total cash disbursed to shareholders, additional analysis presented here also focuses separately on the components of payout, cash dividends and repurchases.

Overall, the results show that bank CEOs with higher inside debt holdings pursue conservative bank payout policies, consistent with the hypothesis that inside debt aligns CEO interests with that of creditors. Bank CEOs with higher inside debt holdings are more likely to cut payouts and cut payouts by a larger magnitude. Next, this chapter focuses on the subsample of banks which received government support in the form of the Troubled Asset Relief Program (TARP) during the recent financial crisis. Recent work has shown that TARP acted as a form of bank bailout which further encouraged TARP banks to engage in additional risk-taking. For instance, TARP banks approved riskier loans (Black and Hazelwood, 2013) and shifted investment portfolios toward riskier securities (Duchin and Sosyura, 2014). This chapter assesses if TARP also affected the link between inside debt and payout policies. The results present evidence that TARP banks where CEOs held a higher amount of inside debt reduced payouts by a larger amount than non-TARP banks. This shows that inside debt can help in addressing risk-taking concerns by aligning the interests of CEOs with those of creditors, regulators, and in the case of TARP banks, the taxpayer.

The rest of this chapter is organized as follows. Section 3.2 develops hypotheses on the impact of inside debt on bank payouts. Section 3.3 describes the sample of banks, measurement of variables, and descriptive statistics. Section 3.4 discusses the empirical results. Section 3.5 then extends the analysis to the subsample of TARP banks. Section 3.6 offers insights on how inside debt affects the different components of bank payouts. Section 3.7 conducts robustness checks. The final section concludes.

3.2. Theoretical Background

This section begins by briefly restating the issue of agency conflicts of interest between shareholders and creditors, which has already been discussed previously (Section 1.2 of Chapter 1).

Agency theory postulates that the existence of debt and outside equity results in conflict between both groups of claim holders (Jensen and Meckling, 1976). The premise of the agency costs which result from this conflict is the asymmetric payoff structure of shareholders and creditors with creditors having fixed and primary claims on a firm's assets and equity holders having residual claims. Firms incur agency costs of debt when managers engage in risk-taking and increase default risk for the benefit of shareholders and at the expense of creditors.

While Jensen and Meckling's arguments are based on non-financial firms, they are exacerbated for the banking industry where shareholder incentives to increase firm risk are particularly high. This is caused by explicit deposit insurance as well as more implicit guarantees in the form of emergency liquidity provision or the prospect

of bailouts to prevent the large social costs associated with bank failures (Bhattacharya and Thakor, 1993). In particular, bailouts of financial institutions act as a put option on a bank's assets (Merton, 1977; Karekan and Wallace, 1978). With the value of the put option increasing in bank risk, shareholders will seek to maximize the value of the put by pursuing bank policies which increase overall risk. Consistent with this view, the extant literature has provided evidence of increased risk taking in the presence of government guarantees (e.g. Hovakimian and Kane, 2000; Dam and Koetter, 2012).

In order to address the conflict between shareholders and creditors and the risk-taking problem which results from it, Jensen and Meckling (1976) propose that managerial wealth should be sensitive to both equity and debt claims on the firm. The following section develops hypotheses on the incentive effects of CEO holdings of inside debt in mitigating risk-taking at banks. It uses the payout policies of banks as a laboratory to examine the relationship between pay incentives and risk-taking.

3.3. Hypotheses Development

Inside debt broadly consists of defined benefit pensions and deferred compensation (Sundaram and Yermack, 2007). Its payoff structure resembles that of firm debt because inside debt is made up of unfunded and unsecured liabilities of the firm. A key feature of inside debt is that the payoff to the CEO depends not only on the incidence of default but also on the liquidation value of the firm (Edmans and Liu, 2011).

Debt-based compensation, therefore, could serve as an effective instrument to mitigate shareholder-creditor conflicts. Executives with large inside debt holdings face a trade-off between incurring losses on their debt-based wealth and maximizing the value of the safety net through risk-shifting (Bolton et al., 2010). As a result, inside debt may help align CEO and creditor interests (Wei and Yermack, 2011; Edmans and Liu, 2011; Cassell et al., 2012).

Sundaram and Yermack (2007) argue that the amount of debt-based compensation held by CEOs affects their choice of firm policies. Specifically, CEOs with large inside debt claims against their firms will choose more conservative firm policies that reduce default risk. Consistent with this, Cassell et al. (2012) show that CEOs with high levels of debt-based compensation decrease total risk by pursuing conservative investment and financing policies.

In the same vein, CEO holdings of inside debt may shape the bank payout policies. Sundaram and Yermack (2007) and Edmans and Liu (2011) argue that higher debt-based compensation may curb excessive cash payouts and other forms of firm policies which increase default risk. Since reducing bank payouts permits banks to increase their capital buffers via retained earnings, doing so is a creditor-friendly policy. By contrast, higher levels of payouts deplete banks of some of the most liquid and safe assets (cash), thus, increasing bank risk and shifting risk on to creditors (Acharya et al., 2013). To this end, this chapter proposes that bank CEOs with sizable inside debt holdings to be more likely to reduce bank payouts. The central hypothesis is that CEOs at banks paid with a higher proportion of inside debt will be more likely to reduce payouts (and reduce payouts by a larger magnitude) than CEOs paid with a lower proportion inside debt.

3.4. Data and Variables

This chapter relies on compensation data which is extracted from Compustat's Execucomp database between 2007 and 2011. The sample starts in 2007, because data on the value of CEO inside debt compensation started to become publicly available only after 2006 (as mandated by the SEC). Compensation data is matched with quarterly FR Y-9C reports filed with the Federal Reserve and the Center for Research in Security Prices (CRSP) to obtain bank accounting data and stock return data, respectively. The initial sample size is 403 bank-year observations. To ensure universal coverage of the 50 largest US banks (by assets), missing compensation data for the 50 largest banks is hand-collected from proxy statements (form DEF-14A) filed with the SEC. By stipulating that firms file FR Y-9C reports, this sample contains commercial banks with unambiguous access to the financial safety net (such as deposit insurance and liquidity support). The final sample contains 442 bank-year observations for a total of 103 unique banks.

3.4.1. Dependent Variables: Cash Distributions to Shareholders

Cash distributions to shareholders can take the form of cash dividends and share repurchases. To account for both forms of payouts, an aggregate measure 'total payouts' is employed which is the sum of cash dividends and repurchases.

While total payouts captures the total cash outflow to shareholders, Boudoukh et al. (2007) suggest the need to offset cash inflows from shareholders in the form of seasoned equity offerings against payouts to arrive at a more holistic measure of the net cash distributions to shareholders. Accordingly, an alternate measure of bank payouts 'net payouts' is used and is defined as the sum of cash dividends and

repurchases minus any cash proceeds from equity issues. This is consistent with Cuny et al.'s (2009) definition of net payouts. Following Gaspar et al. (2012), data on share repurchases is extracted from Compustat, while data on the proceeds of equity issues and cash dividends is retrieved from FR-Y 9C reports.

Payout behavior of banks is examined through two key variables: the likelihood to change payout and the magnitude of a change in payout. The first is a dummy variable '$\Delta Payouts \geq 0$'. This measure takes the value one if the change in payouts (both total payouts and net payouts) was non-negative (i.e. no reduction took place), and zero if the change was negative (i.e. a reduction in payouts took place). The second measure is the magnitude of the change in payouts (both total payouts and net payouts), scaled by the book value of assets in the prior year.

3.4.2. CEO Inside Debt

The argument that inside debt affects the CEO's incentive to take risk is simply that, other things being equal, the value of the bank's debt, including inside debt, is maximised by taking less risk than the risk required to maximise the value of its equity. This is because some high-risk projects create more value per dollar of equity than per dollar of debt and *vice versa* for some low-risk projects.

Jensen and Meckling (1976) and Edmans and Liu (2011) suggest measuring managerial incentives linked to inside debt via the CEO's debt-based relative to equity-based compensation scaled by the firm's debt-to-equity ratio. The rationale behind this *CEO relative inside debt ratio* is that, at a value of one, CEO incentives are perfectly aligned with creditors and shareholders. If the ratio is larger than one, CEO incentives are more aligned with creditors than with shareholders. Following

Cassell et al. (2012) and others, the strength of inside debt incentives is measured as the ratio of CEO debt-based compensation to equity-based compensation divided by bank debt-to-equity ratio[6].

$$\textit{CEO relative inside debt ratio} = \frac{\textit{CEO inside debt/CEO equity-based pay}}{\textit{Bank debt/Bank equity}} \quad (3.1)$$

where *CEO inside debt* is the sum of the present value of accumulated pension benefits and deferred compensation, as estimated by the bank and shown in its annual report; *CEO equity-based pay* is the value of the CEO's holdings of equity and stock, as at the financial year-end of the bank; *Bank debt* is the total of the bank liabilities; and *Bank equity* is the market value of the bank's equity.

Since the decision to declare capital distributions is a flow variable, one-year lagged values of CEO compensation incentives are employed while using contemporaneous control variables (as in Cuny et al. (2009)). This helps establish a causal link between the corporate decision and executive incentives. As put forward in the hypothesis, higher values of the *CEO relative inside debt ratio* (i.e. higher inside debt) should be negatively associated with bank payouts.

[6] To reduce its skewness, a natural logarithm of (1 + *CEO relative inside debt ratio*) is taken but for ease of interpretation it is referred as *CEO relative inside debt ratio* throughout this chapter. The results remain similar if the absolute value of *CEO relative inside debt ratio* is taken instead.

3.4.3. Control Variables

Research on CEO compensation has shown that higher equity-based compensation, in the form of options and stock grants, also shapes CEO incentives to engage in risk-shifting. The asymmetric payoff structure of options encourages CEOs to make risk-increasing corporate decisions (Guay, 1999; Coles et al., 2006), whereas, due to their linear payoff structure, stock grants cause CEOs to become relatively more risk-averse (Smith and Stulz, 1985).

There are two types of incentives created by CEO equity-based compensation: first, 'vega' incentives which measure the sensitivity of CEO's equity-based wealth to changes in bank risk; and second, 'delta' incentives which measure the sensitivity of CEO's equity-based wealth to changes in stock price. Vega acts as a risk incentive since the payoff to CEOs increases with higher firm risk, while Delta acts as performance incentive since it results in exposing CEO wealth to changes in stock price. Following Liu and Mauer (2011), Vega and Delta are scaled by total CEO compensation to capture the relative importance of each component with respect to total compensation. For ease of interpretation, these scaled variables are referred as *CEO Vega* and *CEO Delta* throughout this chapter. More details on Vega and Delta are provided in Appendix A.

The literature on the determinants of payout policy (for both non-financial firms and banks) suggests various other control variables. For instance, the probability of distributing cash to shareholders has been shown to depend on firm size, profitability, and a firm's growth opportunities (Fama and French, 2001; DeAngelo et al., 2006; for banks: Dickens et al., 2003; Boldin and Leggett, 1995). These

controls are captured through *Size* (log of total assets), *Profitability* (return on equity), and *Charter value* (market value of equity/book value of equity), respectively. Further, the amount of cash held by the firm can affect payout policies, although, the direction of such a relationship is ambiguous since higher cash may indicate excess cash or a buffer to fund future projects (DeAngelo et al., 2006). This effect is controlled through *Cash* (total cash/assets). Casey and Dickens (2000) and Dickens et al. (2003) argue that banks with more equity (that is, lower leverage) will be more likely to be permitted by regulators to continue declaring dividends. Hence, *Leverage* (book value of liabilities/market value of equity), as in Jagtiani et al., (2002) and Brewer and Jagtiani (2013), is also included in the regression specifications.

The literature also documents that a key component of payout, dividends, is affected by the level of firm risk (Chay and Suh, 2009; Akhigbe and Whyte, 2012). This is because firms facing higher income uncertainty may reduce payouts to preserve cash for meeting future firm needs (Chay and Suh, 2009). Since payouts result in reducing the quality of bank's asset portfolio, a market-based measure of risk: *Portfolio risk*, calculated as the standard deviation of the market value of the bank's assets, is used. *Portfolio risk* acts as a better measure to capture asset and liability returns, while avoiding a mechanical relationship with the amount of bank capital (Vallascas and Hagendorff, 2013). Other risk measures (e.g. Z-score) are influenced by the level of capitalization due to which they may not be able to capture the fall in quality of bank assets and may simply reflect the impact of payouts on capitalization. In addition to this, book-based measures of risk are often backward looking. The procedure to calculate *Portfolio risk* is outlined in Appendix B.

Next, this analysis also controls for age of the CEO (*CEO age*). Older CEOs have been found to be more risk-averse (Bennett et al., 2012) and may be more likely to cut payouts as a result. Finally, when assessing the determinants of changes in payouts, it is also important to account for the historical trend in payouts (Hirtle, 2004; Brav et al., 2005; Aboody and Kasznik, 2008). This is because changes in bank payouts tend to be sticky in nature and are likely to be affected by past changes in payout levels. Thus, a measure of the lagged change in bank payouts is also used (Δ *Total Payouts* or Δ *Net Payouts*, depending on the measure of payouts used in the analysis)

3.4.4. Descriptive Statistics

To gain some initial insights on the trends in bank payouts, Figure 3.1 shows the cash distributions in the form of dividends and repurchases to shareholders by the banks in this sample, over the period 2007-2011. The graph highlights that banks use both dividends and repurchases as a means to distribute capital to shareholders and that the composition of payouts varies over time. This indicates the importance of taking into account both share repurchases and dividends when considering bank payouts.

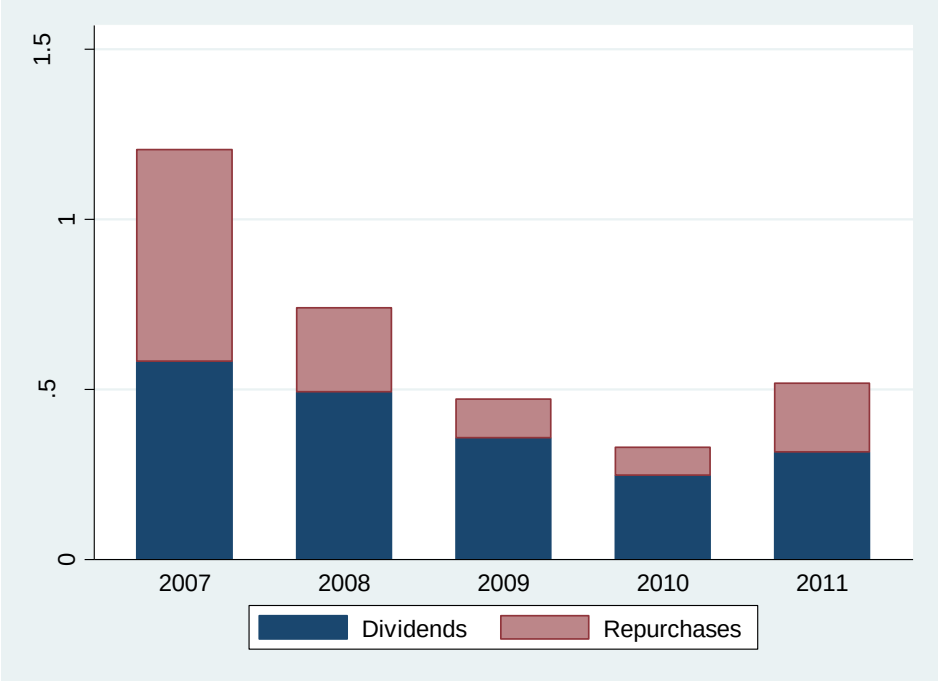

Figure 3.1: Average bank payouts, 2007 – 2011. The figure shows trend of average bank payouts (dividends + repurchases) scaled by bank assets for a sample of 103 unique banks over the period 2007-2011.
Sources: FR Y-9C reports, CRSP, Execucomp, DEF 14A statements, Compustat

The descriptive statistics are shown in Table 3.1. With regard to the primary variable of interest, CEOs hold substantial amount of inside debt relative to their equity-based compensation with the average *CEO inside debt ratio* being 0.567. The average *CEO relative inside debt ratio* is 0.076, indicating that bank CEOs are more equity-incentivised.

Table 3.1: **Descriptive statistics for full sample.** The sample period is 2007-2011. CEO compensation variables are lagged by one year, while other explanatory variables are contemporaneous. Total payouts is the sum of cash dividends and share repurchases. Net payouts is the sum of cash dividends and share repurchases minus proceeds from new equity issues.
Sources: FR Y-9C reports, CRSP, Execucomp, DEF 14A statements, Compustat

Variable		**Mean**	**Median**	**Std Dev.**	**25th percentile**	**75th percentile**
ΔTotal Payouts≥0	1 = Change in total payouts over prior year is non-negative; 0 = otherwise	0.514	1.000	-	-	-
ΔNet Payouts≥0	1 = Change in net payouts over prior year is non-negative; 0 = otherwise	0.500	0.500	-	-	-
Magnitude of Δ Total Payouts	Change in total payouts, by lagged book value of assets (%)	0.019	0	0.965	-0.369	0.165
Magnitude of Δ Net Payouts	Change in net payouts, by lagged book value of assets (%)	-0.058	0	1.424	-0.687	0.539
CEO inside debt ratio (absolute)	CEO inside debt / CEO equity-based compensation	0.567	0.212	0.802	0.026	0.757
CEO inside debt ratio	Natural log of (1 + CEO inside debt / CEO equity-based compensation)	0.354	0.192	0.404	0.025	0.564
CEO relative inside debt ratio (absolute)	CEO inside debt ratio, scaled by the value of a bank's debt-to-equity	0.076	0.040	0.116	0.003	0.101
CEO relative inside debt ratio	Natural log of (1 + CEO inside debt ratio, scaled by the value of a bank's debt-to-equity)	0.068	0.039	0.094	0.003	0.096
CEO vega	Sensitivity of equity wealth to a 1 unit change in stock volatility, scaled by total CEO compensation	0.025	0.015	0.052	0.004	0.032
CEO delta	Sensitivity of equity wealth to a 1 unit change in stock price, scaled by total CEO compensation	0.153	0.049	0.345	0.023	0.128
Size	Natural log of total assets	16.726	16.301	1.623	15.616	17.476
Profitability	Net income over equity	0.024	0.068	0.172	0.016	0.103
Charter value	Market value of equity over book value of equity	1.029	1.011	0.142	0.972	1.052
Cash	Total cash to total Assets	0.053	0.033	0.061	0.021	0.059
Leverage	Natural log of book value of liabilities over market value of equity	2.140	2.016	0.588	1.747	2.419
Portfolio risk	Natural log of standard deviation of market value of assets	-2.881	-2.969	0.577	-3.249	-2.474
CEO age	Age in years	56.652	56.000	6.521	52.000	61.000

3.5. Empirical Results: Inside Debt and Payout Policy

3.5.1. Probability of Reduction in Payout

This section tests the hypothesis that debt-based CEO compensation is associated with an increased likelihood of a cut in payouts. The model specification employed for the analysis is as follows:

$$\Delta Payout{\geq}0 = ß_1 + ß_2\ CEO\ relative\ inside\ debt\ ratio_{it-1} + ß_3\ CEO\ vega_{it-1} + ß_4\ CEO\ delta_{it-1} + ß_5\ Size_{it} + ß_6\ Profitability_{it} + ß_7\ Charter\ Value_{it} + ß_8\ Cash_{it} + ß_9\ Leverage_{it} + ß_{10}\ Portfolio\ risk_{it} + ß_{10}\ CEO\ age_{it} + F_t + \varepsilon_{it}, \quad (3.2)$$

where the dependent variable $\Delta Payout{\geq}0$ takes a value one if the change in payouts was non-negative over the last year, and zero if the change in payouts was negative. Thus, a negative coefficient would indicate that the independent variable is associated with an increased likelihood of a cut in payouts. Columns (1) to (4) test the hypotheses by modeling an increase in total payouts and the results in columns (5) to (8) are estimated using an increase in net payouts. The results are reported in Table 3.2.

Table 3.2: Binary choice analysis of change in payout. The dependent variable takes the value one if the change in bank payouts is non-negative (i.e. the bank did not reduce payouts), and zero if there was a reduction in payouts. A fixed-effects linear regression model is run for all the columns. The sample period is 2007-2011. Variable definitions are given in Table 3.1. The equations are estimated with year dummies. Standard errors (clustered at bank level) are shown in brackets. *, **, *** denote significance at 10%, 5%, and 1% level respectively.

	Total Payouts			**Net Payouts**		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag (CEO relative inside debt ratio)	**-0.690****	**-0.664****	**-0.667***	**-0.770****	**-0.786****	**-0.789****
	(0.337)	**(0.334)**	**(0.337)**	**(0.312)**	**(0.317)**	**(0.321)**
Lag (CEO vega)	-0.666	-0.589	-0.552	-0.560	-0.565	-0.536
	(0.581)	(0.593)	(0.583)	(0.633)	(0.626)	(0.615)
Lag (CEO delta)	0.065	0.052	0.052	0.063	0.063	0.063
	(0.100)	(0.101)	(0.102)	(0.089)	(0.090)	(0.091)
Size	-0.141	-0.120	-0.100	-0.243	-0.225	-0.210
	(0.140)	(0.141)	(0.142)	(0.170)	(0.180)	(0.181)
Profitability	0.313	0.333	0.296	0.939**	0.970**	0.940**
	(0.380)	(0.391)	(0.399)	(0.408)	(0.405)	(0.417)
Charter value	-0.674**	-0.599**	-0.581**	-0.630*	-0.637*	-0.622*
	(0.272)	(0.273)	(0.278)	(0.325)	(0.324)	(0.330)
Cash		1.390*	1.477*		-0.384	-0.315
		(0.800)	(0.811)		(0.933)	(0.948)
Leverage	-0.304***	-0.319***	-0.319***	-0.051	-0.030	-0.030
	(0.081)	(0.084)	(0.082)	(0.095)	(0.096)	(0.097)
Portfolio risk		0.042	0.046		0.060	0.064
		(0.056)	(0.056)		(0.065)	(0.066)
CEO age			-0.007			-0.005
			(0.004)			(0.006)
Lag (ΔTotal Payouts)	-0.392***	-0.386***	-0.387***			
	(0.045)	(0.046)	(0.046)			
Lag (ΔNet Payouts)				-0.341***	-0.337***	-0.337***
				(0.048)	(0.049)	(0.049)
Observations	442	442	442	442	442	442
Adjusted R^2	0.344	0.347	0.348	0.311	0.309	0.309

The key finding is that, after controlling for various bank level variables, the *CEO relative inside debt ratio* is a determinant of a bank's payout policy. Increasing a CEO's debt-based compensation increases the likelihood of a payout cut. The results are also significant in an economic sense. Increasing the *CEO relative inside debt ratio* by one standard deviation, results in increasing the probability of a payout cut by 6.3% (net payouts: 7.5%).

The signs on the control variables are consistent with prior studies that explore the determinants of firm payout policies. Banks with higher profitability and charter values decrease the probability of a payout cut. Banks holding higher cash are less likely to decrease payouts while higher leverage increases the probability of dividend cut. Finally, lagged change in bank payouts is also significant, consistent with prior literature arguing for the need to account for historical changes in payouts.

3.5.2. Magnitude of Change in Payout

In the previous section, it was established that CEO compensation affects the decision whether or not to cut payouts. However, if debt-based compensation were only to cause a small reduction in payouts relative to bank assets, the type of asset substitution and risk-taking that results when banks distribute cash to shareholders would still be present. In this section, the analysis focuses on the magnitude of change in payouts as the dependent variable.

The dependent variable is the dollar change in payouts standardized by the book value of assets in the prior year. It is scaled by assets because the focus of this

investigation is on the asset substitution effects towards riskier assets when banks continue to declare payouts. The model is as follows:

$$\begin{aligned} \textit{Magnitude of } \Delta \textit{Payouts/Assets}_{it-1} = {} & ß_1 + ß_2\ \textit{CEO relative inside debt ratio}_{\ it-1} + ß_3\ \textit{CEO vega}_{it-1} + ß_4\ \textit{CEO delta}_{it-1} + ß_5 \textit{Size}_{it} + ß_6\ \textit{Profitability}_{it} + ß_7\ \textit{Charter value}_{it} + ß_8\ \textit{Cash}_{it} + ß_9\ \textit{Leverage}_{it} + ß_{10}\ \textit{Portfolio risk}_{it} + ß_{11}\ \textit{CEO age}_{it} + ß_{12}\, \Delta \textit{(Payouts)}_{it-1} + F_t + \varepsilon_{it} \end{aligned} \quad (3.3)$$

The regression results are shown in Table 3.3. Broadly, the results are consistent with the results in previous section. *CEO relative inside debt ratio* enters negatively and is statistically significant. Thus, a higher *CEO relative inside debt ratio* is associated with a larger reduction in payouts. The relationship is also significant in an economic sense. A one standard deviation increase in the ratio increases the magnitude of a payout cut by 13 basis points (or $86 million on average) when considering total payouts and by 20 basis points (or $130 million on average[7]) when considering net payouts. Clearly, CEO inside debt plays a significant role in limiting the amount of payouts and protecting creditor losses through an increased capital buffer.

[7]The economic significance is calculated by standardizing the coefficient of inside debt (i.e. multiply the regression coefficient by the standard deviation of inside debt) and multiplying this by the amount of assets held by an average bank in the sample.

Table 3.3: Magnitude of change in total payouts and net payouts. The dependent variable for models 1-3 is the difference between the total payouts (dividends + repurchases) over the prior year, deflated by the lagged book value of assets. For models 4-6, the dependent variable is the difference between net payouts (dividends + repurchases - equity issues) over prior year, deflated by the lagged book value of assets. The sample period is 2007-2011. Variable definitions are given in Table 3.1. The equations are estimated with bank-specific fixed effects as well as year dummies. Standard errors (clustered at firm level) are shown in brackets. *, **, *** denote significance at 10%, 5%, and 1% level respectively

	Total Payouts			**Net Payouts**		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag (CEO relative inside debt ratio)	**-1.473***	**-1.386***	**-1.386***	**-1.969****	**-2.106****	**-2.106****
	(0.750)	**(0.709)**	**(0.711)**	**(0.834)**	**(0.853)**	**(0.854)**
Lag (CEO vega)	-1.836	-1.749	-1.741	-0.592	-0.837	-0.832
	(1.513)	(1.565)	(1.563)	(1.590)	(1.640)	(1.639)
Lag (CEO delta)	0.003	-0.007	-0.007	0.089	0.125	0.124
	(0.199)	(0.206)	(0.206)	(0.254)	(0.273)	(0.274)
Size	-0.574*	-0.612*	-0.608*	-0.556	-0.566	-0.563
	(0.309)	(0.319)	(0.317)	(0.643)	(0.656)	(0.662)
Profitability	-0.096	-0.126	-0.131	1.575*	1.558**	1.554*
	(0.328)	(0.328)	(0.328)	(0.837)	(0.781)	(0.791)
Charter value	-4.123***	-4.051***	-4.049***	-4.461*	-4.671**	-4.669**
	(1.235)	(1.173)	(1.173)	(2.251)	(2.179)	(2.178)
Cash		2.249	2.268		-5.111	-5.097
		(2.167)	(2.198)		(3.230)	(3.267)
Leverage	-0.729***	-0.807***	-0.807***	0.035	0.137	0.136
	(0.202)	(0.231)	(0.232)	(0.418)	(0.462)	(0.463)
Portfolio risk		-0.148	-0.147		0.050	0.051
		(0.137)	(0.137)		(0.226)	(0.222)
CEO age			-0.001			-0.001
			(0.010)			(0.019)
Lag (Magnitude of change in Total Payout)	-0.614***	-0.618***	-0.618***			
	(0.096)	(0.092)	(0.092)			
Lag (Magnitude of change in Net Payout)				-0.531***	-0.538***	-0.538***
				(0.078)	(0.083)	(0.083)
Observations	442	442	442	442	442	442
Adjusted R^2	0.363	0.365	0.363	0.315	0.320	0.318

Overall, the results show that higher CEO debt-based compensation mitigates risk-taking concerns. The coefficients on *CEO Vega* and *Delta* incentives do not enter significantly, while charter value is associated with a reduction and profitability is associated with an increase in bank payouts. Finally, leverage is associated with a decrease in the magnitude of bank payouts.

3.6. Inside Debt and Payout Policy: Evidence from TARP Banks

The evidence in the previous section indicates that inside debt holdings are associated with more conservative bank payout policies. This section tests the central hypothesis over the sub-sample of banks which were bailed out during the recent financial crisis.

The financial crisis which started in 2007 resulted in widespread bailouts of the banking industry. In one of its largest efforts to stabilize the financial sector, the US government initiated TARP, a taxpayer-funded capital assistance program for crisis-affected financial firms. It is a frequently raised concern that TARP, by extending the financial safety net, has encouraged additional bank risk-taking (Flannery, 2010). Consistent with this view, recent evidence suggests that TARP banks have indeed approved riskier loans (Black and Hazelwood, 2013) and shifted investment portfolios toward riskier securities (Duchin and Sosyura, 2014). Similarly it can also be argued that payouts by TARP banks also represent a type of risk-taking. Any cash distributed by banks after the receipt of TARP funds to shareholders represents a subordination of creditor and taxpayer interests. Thus, the payout policies of TARP banks exists as a natural experiment to assess the effectiveness of inside debt to constrain additional risk-taking by TARP banks after they received state support.

However, in contrast to the risk-taking argument, it can be argued that payouts by some TARP banks were justified on the grounds that these banks were financially healthy. For instance, payouts by TARP banks may act as a signal to shareholders about the financial status of the institution. Furthermore, TARP banks may declare payouts to reduce the costs of raising capital in the future or to improve their valuation. Did TARP moderate the effect of inside debt on bank payouts? This issue is addressed next.

The allocation of TARP funds is not a random and exogenous process. For instance, Bayatizova and Shivdasani (2012) show that TARP recipients were financially healthy banks relative to non-TARP banks. This could lead to a spurious relationship between TARP and bank payouts since healthy banks facing short-term liquidity during the crisis may declare lower payouts. Thus, it is not TARP but short-term illiquidity that may have resulted in a change in payout behavior. Therefore, the results from using a simple interaction terms analysis to estimate how the receipts of TARP funds moderates the effect of inside debt may be misleading. To potentially control for the endogeneity surrounding the receipt of TARP funds, an instrumental variable analysis is used to isolate the causal impact of TARP on bank payouts.

The choice of instrumental variables that affect the decision to receive TARP but do not materially impact bank payouts is motivated from prior literature (Duchin and Sosyura (2014); Li (2013); Berger and Roman (2013)). These are based on banks' geographic location and political connectedness. As in Duchin and Sosyura (2014), the first instrument *%FIRE contributions* is defined as the bank's campaign contributions to members of the Financial Institutions and Capital Markets sub-committees of the House Financial Services Committee for the 2008 congressional

election, standardized by bank assets. Next, the second instrument *Political connections*[8] captures how many representatives who sat on either of the two sub-committees represented the congressional district where the bank was headquartered. Lastly, Bayatizova and Shivdasani (2012) show that the geographic location of banks may affect the receipt of TARP funds, with banks in more severely affected regions having a higher likelihood to receive TARP. This forms the basis of the third instrument *State macro index growth* which is defined as the change in the Philadelphia Federal Reserve's state coincident index from December 2007 to October 2008, weighted according to a bank' share of deposits in a given state. The results of this first-stage estimation procedure are provided in Table 3.4.

[8] Both sub-committees played a key role in the drafting and allocation process of TARP funds. Higher contributions and more political connections will allow banks to exert a stronger influence on sub-committee members. Data for campaign contributions and district representation are from the Center for Responsive Politics and the Congress online database, respectively.

Table 3.4: Determinants of TARP funds distribution. This table presents the first-stage results of instrumental variable approach. It presents probit estimates of the bank's TARP decisions. The dependent variable is the TARP dummy which is equal to one if the bank received TARP funds. This measure is re-adjusted to announcements of new banks' which enter TARP or banks which exit TARP by repaying TARP funds. The sample period covers 2009-2011, starting from the year when TARP funds were distributed. As regards the instruments, following Duchin and Sosyura (2014), Li (2013), and Berger and Roman (2013), three instruments are used based on the banks' geography and political connectedness: the campaign contributions during the election cycle for the 2008 to the members of the Financial Institutions and Capital Markets Subcommittees of the House Financial Services Committee (*%FIRE contributions*); the number of representatives who sat on either of the two sub-committees who represented the same congressional district where the bank was headquartered (*Political connections*); and change in state coincident index, weighted according to the level of bank deposits (*State macro index growth*). Data on campaign contributions from the Financial Services, Insurance, and Real Estate (FIRE) sector is collected from the Center for Responsive Politics and standardized by bank assets. Data on coincident index is retrieved from the Federal Reserve Bank of Philadelphia website. Following Bayatizova and Shivdasani (2012) and Li (2013), control variables include the bank's capital adequacy (*Tier-1 Ratio* and its squared term), *Asset quality* (Loans past 90 days as a fraction of bank capital), *Profitability* (Return on equity), *Cash* (fraction of cash to bank assets), *Sensitivity to market risk* (expressed as the fraction of loans to deposits), and *Bank size* (natural logarithm of bank assets). The sample consists of lagged control variables.

First-stage Probit Estimates	(1)	(2)	(3)	(4)
%FIRE contributions		**1.022***	**1.778****	**1.864****
		(0.567)	**(0.869)**	**(0.895)**
Political connections			**-0.178**	**-0.203**
			(0.183)	**(0.183)**
State macro index growth				**-0.938****
				(0.398)
(Tier-1 Ratio)^2	-158.5***	-160.6***	-160.600***	-160.000***
	(42.70)	(42.62)	(42.74)	(42.23)
Tier-1 Ratio	38.50***	38.85***	39.070***	39.060***
	(11.06)	(11.03)	(11.07)	(10.98)
Asset quality	-1.773	-1.796	-1.860	-2.684*
	(1.455)	(1.448)	(1.449)	(1.603)
Profitability	0.303	0.686	0.471	0.252
	(3.125)	(3.125)	(3.113)	(3.297)
Cash	-2.670	-2.539	-2.659	-2.297
	(1.705)	(1.708)	(1.721)	(1.789)
Sensitivity to market risk	-0.031	-0.017	-0.007	0.004
	(0.050)	(0.051)	(0.051)	(0.054)
Bank size	-7.539***	-7.773***	-7.913***	-8.233***
	(0.855)	(0.791)	(0.814)	(1.266)
State and Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,054	1,054	1,054	997
Pseudo R^2	0.141	0.145	0.146	0.148

The first-stage of the 2SLS approach focuses on identifying the determinants of TARP approval by using a binary-choice model where the dependent variable is whether the bank was under TARP (i.e. received TARP funds) or not. These results are shown in Table 3.4. Broadly, the instruments are statistically significant and carry the expected signs. The predicted likelihood of receiving TARP funds from the first-stage enters the second-stage regression (where the dependent variable is bank payouts). The results of two-stage estimation framework are shown in Table 3.5 which control for endogeneity around the TARP approval process.

The results in Table 3.5 show that inside debt resulted in decreasing bank payouts. However, the coefficient on TARP is not significant which means that, after controlling for the factors that cause banks to receive TARP funds, TARP banks do not declare fewer payouts. Further, the coefficient on the interaction term between *TARP* × *CEO-bank debt-to-equity ratio* is significant when the dependent variable is the level of total payouts by banks. Taken together, there is some evidence that TARP strengthened the link between payouts and inside debt. Inside debt was more effective in limiting payouts for TARP banks compared to non-TARP banks. However, this finding holds for total payouts and not for net payouts.

Table 3.5: Impact of TARP on bank payouts. This table reports regression estimates from a treatment effects model which estimates the impact of TARP on payouts. The dependent variable for models 1-2 and 5-6 is a dummy variable which takes the value one if the change in payouts is non-negative (i.e. no reduction in payouts), and zero if the change in payouts is negative (i.e. reduction in payouts). For the remaining models, the dependent variable is change in payouts, deflated by the lagged book value of assets. For models 3-4 and 7-8, dependent variable is the change in total (net) payouts over prior year, scaled by the lagged book value of assets. TARP is a dummy variable equal to one if the bank was provided TARP for years 2009-2011. The value of TARP dummy is re-adjusted after each year to take into account banks which repaid TARP. TARP is instrumented as the predicted likelihood that a bank remains under TARP, as obtained from Table 3.4. The sample period is 2007-2011. Variable definitions are given in Table 3.1. The equations are estimated with bank fixed effects as well as year dummies. Standard errors (clustered at firm level) are shown in brackets. *, **, *** denote significance at 10%, 5%, and 1% level respectively

	Total Payouts				**Net Payouts**			
	Likelihood		Magnitude		Likelihood		Magnitude	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TARP	**-0.236**	**-0.061**	**-0.428**	**-0.130**	**-0.016**	**0.085**	**-0.167**	**-0.018**
	(0.250)	**(0.265)**	**(0.313)**	**(0.307)**	**(0.235)**	**(0.240)**	**(0.810)**	**(0.835)**
TARP × Lag(CEO relative inside debt ratio)		**-2.835*** **		**-4.802*** **		**-1.625**		**-2.395**
		(0.942)		**(1.269)**		**(1.148)**		**(2.573)**
Lag (CEO relative inside debt ratio)	**-0.674***	**-0.306**	**-1.613****	**-0.985***	**-0.850*** **	**-0.641***	**-2.170****	**-1.860***
	(0.340)	**(0.318)**	**(0.719)**	**(0.564)**	**(0.313)**	**(0.367)**	**(0.865)**	**(0.962)**
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	418	418	418	418	418	418	418	418
Adjusted R^2	0.364	0.380	0.370	0.379	0.323	0.326	0.307	0.307

3.7. Inside Debt and Bank Capital Distributions: Dividends, Repurchases, and Equity Issues

The primary empirical analyses presented in this chapter show a negative association between bank payouts and CEO inside debt holdings. However, this approach does not take into consideration the potential impact of inside debt on the different components of bank payouts, i.e. dividends and repurchases. It is important to look at this issue. The literature has shown some evidence of a substitution effect between dividends and repurchases (e.g. Fenn and Liang, 2001; Kahle, 2002).

It is possible that inside debt results in reducing the level of bank dividends, but part of these funds are still distributed in the form of share repurchases. While the results show a negative relationship, inside debt would not be entirely effective in reducing the level of total bank payouts since it is not able to mitigate capital distributions in the form of share repurchases. To disentangle this effect, inside debt is regressed on the two components of payouts separately. Additionally, the impact of inside debt on the proceeds from new equity issues is also analyzed since it is a component of the net payouts variable. This analysis helps determine if previous findings are driven by a single component or is consistent across the components of bank payouts.

The following regression specification is employed:

$$\Delta Payout\ variables = ß_1 + ß_2\ CEO\ relative\ inside\ debt\ ratio_{it-1} + ß_3\ Vega_{it-1} + ß_4\ Delta_{it-1} + ß_5 Size_{it} + ß_6\ Profitability_{it} + ß_7\ Charter\ Value_{it} + ß_8\ Cash_{it} + ß_9\ Leverage_{it} + ß_{10}\ Risk_{it} + ß_{11}\ CEO\ Age_{it} + ß_{12}\ \Delta(Payouts)_{it-1} + F_t + \varepsilon_{it} \quad (3.4)$$

The dependent variable for models 1-3 in Table 3.6 is equal to one if the change in the component of payouts was non-negative, and zero otherwise. For models 4-6, the dependent variable is magnitude of change in the payout component.

The coefficients on *CEO relative inside debt ratio* have the predicted sign and are statistically significant for each of the two components of payout. This indicates that inside debt affects both bank dividends and repurchases and confirms that a reduction in dividends is not being channeled towards repurchases. Equity issues are positively associated with inside debt. Higher equity financing reduces the default risk for creditors and lowers distress costs (Mehran and Thakor, 2011), thereby acting as a creditor-friendly policy. Thus, CEOs paid with higher inside debt are more likely to opt for equity financing, and less likely to disburse cash in the form of stock repurchases and dividends. These results provide further evidence that inside debt is negatively associated with capital distributions to shareholders.

Table 3.6: Component of payouts. For models 1-3, the dependent variable takes the value zero if a bank reduced the payout component of interest in the next year, and one otherwise. Dependent variable in the remaining models is the change in the payout component (dividends, repurchases, or equity issues), deflated by the lagged book value of assets. Sample period is 2007-2011. Variable definitions are given in Table 3.1. Equation is estimated with bank-specific fixed effects as well as year dummies. Standard errors (clustered at firm level) are shown in brackets. *, **, *** denote significance at 10%, 5%, and 1% level respectively

	Likelihood of Increase in Payouts			**Magnitude of Change in Payouts**		
	Dividends	Repurchases	Equity Issuances	Dividends	Repurchases	Equity Issuances
	(1)	(2)	(3)	(4)	(5)	(6)
Lag (CEO relative inside debt ratio)	**-0.741****	**-0.074**	**-0.540**	**-0.127****	**-1.190***	**1.090***
	(0.310)	**(0.413)**	**(0.350)**	**(0.058)**	**(0.676)**	**(0.648)**
Lag (CEO vega, scaled)	-0.043	-1.479*	-1.946***	0.331*	-2.877*	-0.863
	(0.795)	(0.767)	(0.729)	(0.179)	(1.652)	(1.118)
Lag (CEO delta, scaled)	-0.049	0.077	0.040	-0.013	0.152	-0.161
	(0.102)	(0.097)	(0.115)	(0.027)	(0.206)	(0.183)
Size	-0.196	-0.203	0.119	0.009	-0.585**	0.027
	(0.156)	(0.200)	(0.196)	(0.027)	(0.273)	(0.485)
Profitability	0.452*	0.092	-0.396	0.098**	-0.285	-1.637***
	(0.247)	(0.171)	(0.266)	(0.044)	(0.262)	(0.618)
Charter value	0.949*	-1.045***	0.519*	0.174**	-4.840***	-0.110
	(0.507)	(0.240)	(0.281)	(0.085)	(0.981)	(0.982)
Cash	2.064**	1.426*	0.252	0.420***	0.144	8.157***
	(0.871)	(0.852)	(0.792)	(0.157)	(1.482)	(1.826)
Leverage	-0.093	-0.151	-0.054	-0.037*	-0.738***	-1.032***
	(0.105)	(0.091)	(0.099)	(0.020)	(0.186)	(0.290)
Portfolio risk	0.008	0.088	-0.020	-0.032**	-0.034	-0.126
	(0.066)	(0.067)	(0.065)	(0.012)	(0.123)	(0.160)
CEO age	-0.015***	-0.008	-0.000	-0.001	0.000	-0.003
	(0.005)	(0.006)	(0.007)	(0.001)	(0.010)	(0.015)
Lag (Δ Payouts)	-0.116***	-0.363***	-0.279***	-0.112***	-0.703***	-0.651***
	(0.044)	(0.053)	(0.059)	(0.041)	(0.049)	(0.058)
Observations	442	442	442	442	442	442
Adjusted R^2	0.334	0.330	0.144	0.448	0.424	0.419

3.8. Robustness Tests

This section presents the results of additional tests to evaluate the robustness of results. The results of these robustness tests are displayed in Panels A to C of Table 3.7. First, an alternate measure of inside debt incentives is employed. This measure (*CEO inside debt ratio*) measures the relative incentives created by equity-based compensation and inside debt. The variable has been defined in Table 3.1.

Next, alternate measures of repurchases are employed by following Cuny et al.'s (2009) measure which adjusts the consolidated repurchase measure on Compustat to decreases in the redemption value of preferred stock, and Hirtle's (2004) definition of repurchases which includes gross treasury stock purchases and is as reported in the FRY-9C bank regulatory reports. These results are shown in Panels B and C, respectively.

The results of these robustness tests present evidence in support of analyses conducted in previous sections. The finding that inside debt is negatively associated with bank payouts is not sensitive to a different specification of inside debt or to the alternative measurements of repurchases.

Table 3.7: Robustness checks. Panel A uses an alternative measure of inside debt (*CEO inside debt ratio*), Panel B follows Cuny et al.'s (2009) payout measure where repurchases are adjusted to changes in redemption value of preferred stock and Panel C uses Hirtle's measure of bank repurchases, as stated in bank regulatory reports. Variable definitions are given in Table 3.1. For brevity, coefficients of only CEO compensation incentives are shown. Equation is estimated with bank-specific fixed effects as well as year dummies. Standard errors (clustered at firm level) are shown in brackets. *, **, *** denote significance at 10%, 5%, and 1% level respectively

	Total Payouts		**Net Payouts**	
	(1): Likelihood	(2): Magnitude	(3): Likelihood	(4): Magnitude
Panel A: Alternative Measure of Inside Debt				
Lag (CEO inside debt ratio)	**-0.317*** **	**-0.572*** **	**-0.310*** **	**-0.907*** **
	(0.095)	**(0.204)**	**(0.095)**	**(0.288)**
Lag (CEO Vega, scaled)	-0.638	-1.878	-0.556	-1.067
	(0.574)	(1.610)	(0.627)	(1.757)
Lag (CEO Delta, scaled)	0.048	-0.028	0.057	0.090
	(0.101)	(0.199)	(0.091)	(0.278)
Observations	442	442	442	442
Adjusted R^2	0.361	0.371	0.309	0.328
Panel B: Alternative Measure of Payouts, following Cuny et al. (2009)				
Lag (CEO relative inside debt ratio)	**-0.818** **	**-0.559***	**-0.642** **	**-1.142***
	(0.317)	**(0.307)**	**(0.306)**	**(0.616)**
Lag (CEO Vega, scaled)	-0.971	-0.782	-0.052	-0.338
	(0.591)	(0.859)	(0.659)	(1.387)
Lag (CEO Delta, scaled)	0.103	0.091	0.088	0.258
	(0.106)	(0.159)	(0.104)	(0.231)
Observations	442	442	442	442
Adjusted R^2	0.359	0.373	0.357	0.387
Panel C: Alternative Measure of Payouts, following Hirtle's repurchase measure (2004)				
Lag (CEO relative inside debt ratio)	**-0.539***	**-0.379***	**-0.531***	**-1.404** **
	(0.313)	**(0.215)**	**(0.320)**	**(0.637)**
Lag (CEO Vega, scaled)	0.165	0.499	-0.029	1.448
	(0.872)	(0.498)	(0.847)	(1.455)
Lag (CEO Delta, scaled)	0.118	0.031	0.192	0.142
	(0.152)	(0.084)	(0.143)	(0.275)
Observations	442	442	442	442
Adjusted R^2	0.363	0.461	0.353	0.414

3.9. Conclusions

This chapter analyzes the link between CEO inside debt and risk-taking by exploring the case of bank payout policy. Payouts act as important channels to risk-taking (Kalay, 1982; Acharya et al., 2009; etc.). If banks distribute large payouts to shareholders, they draw down their liquid assets and retained earnings, leaving behind riskier and less liquid assets. Payouts, therefore, reduce the quantity and quality of capital available to repay bank creditors. If higher payouts result in decreasing the bank's equity capital base, such payouts may result in increasing bank risk. Since shareholders hold convex claims over firm assets, shareholder payoffs increase with risk which causes shareholders to prefer higher payouts. This chapter examines whether CEO pay incentives can mitigate these risk-taking incentives. Specifically, the objective is to investigate the extent to which paying CEOs with 'debt' helps to align a bank's payout choices with creditor preferences.

The results reveal that debt-based compensation can help address risk-taking concerns by aligning the interests of CEOs with those of creditors, regulators, and ultimately taxpayers who may have to fund bank bailouts. CEOs with higher inside debt relative to equity-based compensation are associated with more conservative bank payout policies. Specifically, higher CEO inside debt is associated with a reduction in payouts. Further, the results continue to hold for the subsample of TARP banks. CEOs at TARP banks with larger holdings of inside debt are less likely to distribute capital to shareholders. Next, inside debt affects both components of payouts, i.e. inside debt reduces both the amount of dividends and share repurchases.

Finally, CEOs with higher inside debt holding raise more funds raised through new equity issues.

Having established the impact of inside debt on bank payouts, the focus of Chapter 4 is on testing the impact of inside debt in the context of investment policies. It focuses on a sample of US bank acquisitions and tests whether inside debt reduces CEO incentives to pursue acquisitions which may increase bank risk. Furthermore, this chapter assesses if inside debt mitigates CEO incentives to pursue acquisitions which shift risk to the financial safety-net and, by extension, to taxpayers who underwrite bank bailout guarantees.

4. INSIDE DEBT AND BANK M&A

4.1. Introduction

Chapter 3 demonstrated that inside debt moderates the choice of bank payout policies, with higher inside debt motivating bank managers to act conservatively by reducing payouts. This chapter shifts the focus towards a specific bank investment policy: M&A[9]. M&A provide an ideal setting to test the impact of inside debt on bank risk-taking, because M&A are publicly observable, potentially long term, and critical in terms of the allocation of firm resources (Masulis et al., 2007; Datta et al., 2001). Further, Benston et al. (1995) and Carbo-Valverde et al. (2012) show that bank shareholders may use acquisitions as a device to engage in excessive risk-taking to capitalize on the value of government guarantees of some bank liabilities.

Prior work has shown that bank risk increases after an acquisition if the structure of CEO pay is geared more towards equity-based compensation (Furfine and Rosen, 2011; Hagendorff and Vallascas, 2011; etc.). By contrast little is known empirically of the impact of inside debt on acquisition-related increases in bank risk. The premise of this chapter rests on the argument that bank policy choices present CEOs with a trade-off in terms of the effects that these policies have on both their debt-based wealth and their equity-based wealth. If CEOs were to engage in risky

[9] For ease of interpretation, the terms acquisitions and M&A are used synonymously throughout this thesis.

acquisitions, this would decrease the value of their inside debt while increasing the value of their equity-based pay. Therefore, a higher fraction of debt-based to equity-based compensation should result in causing the CEO to focus on reducing default risk by pursuing risk-decreasing acquisitions.

To assess this prediction, this chapter focuses on acquisitions announced by public US banks between 2007 and 2012. Default risk is measured using a market-based distance-to-default measure, as employed in Sundaram and Yermack (2007). The results show that bank risk after an acquisition is negatively related to two measures of inside debt (*CEO relative inside debt ratio* and *CEO inside debt ratio*). The results are economically significant. For example, a one-standard-deviation increase in one of the measures of inside debt implies an increase in the bank's industry-adjusted distance-to-default, i.e. a reduction in bank risk, of 31% compared with the pre-acquisition risk value. The analysis controls for possible selection bias in the sample by adopting a Heckman two-stage method. The negative relation between CEO inside debt and the change in bank risk in fact becomes more significant using the Heckman method. The first stage, which explains the decision to acquire, reveals that a higher inside debt ratio is also associated with a reduced likelihood of making an acquisition. This is consistent with the evidence mentioned above that some banks use acquisitions as a means of increasing risk.

Prior work on acquisitions argues that bank risk is affected through two potential channels, namely changes in leverage and in asset risk. Does inside debt affect both channels? This empirical question is addressed next. The results show that the link between CEO inside debt and the change in risk after an acquisition arises because of changes in both leverage and asset risk.

In a final step, this chapter examines whether inside debt mitigates CEO incentives to shift risk to the financial safety-net and, by extension, to taxpayers who underwrite bank bailout guarantees. This issue is of particular relevance to taxpayers and the government. Following prior work (Merton, 1977; Ronn and Verma, 1986; Duan et al., 1992), this study assesses the value of the government's financial safety net to shareholders as the value of a put option that is funded by taxpayers. Thus, the option-value of this financial safety-net, which is increasing in bank risk, measures the expected value of losses that taxpayers may have to bear in the event of bank default. This chapter reports a negative relation between CEO inside debt and the change in the estimated value of the safety net due to an acquisition. This suggests that CEO inside debt reduces the propensity of bank CEOs to engage in shifting risk to the safety net.

The results reported here are robust to a battery of checks. The analysis uses different measures of bank risk, including equity risk. Moreover, the analysis is re-run after excluding acquisitions of failing targets by stronger banks. Finally, the results are replicated using an alternate measure of CEO inside debt (following Wei and Yermack (2011)). The results remain similar after imposing all of these conditions.

The rest of the chapter is organized as follows: Section 4.2 develops the main prediction; Sections 4.3 and 4.4 describe the sample and the data. The results on the impact of inside debt on changes in default risk are shown in Section 4.5 and on changes in the value of safety-net benefits in Section 4.6. Section 4.7 addresses potential endogeneity concerns associated with CEO compensation and risk-taking,

before providing various other robustness tests in Section 4.8. Finally, Section 4.9 concludes.

4.2. Background and Testable Predictions

M&A are complex firm strategies which can lead to reorganization of bank assets and change the scope of operations. It can also have important implications for the firm creditors and regulators by influencing the level of risk. For instance, M&A can result in diversifying firm assets and income sources (Hughes et al., 1998; Berger, 2000), thereby stabilizing income and decreasing firm risk (Amihud and Lev, 1981). In contrast to this risk-reduction effect, recent research has shown that acquisitions may not be effective in decreasing the level of firm risk. For instance, consolidation in the banking industry can lead to an increase in the systemic risk since the combined firms become similar and interdependent, hence are more vulnerable to shocks (De Nicolo and Kwast, 2002). There may also be an increase in firm risk due to diversification into unrelated and inherently riskier activities (Boyd et al., 1993), and differences in regulatory regime (Choi et al., 2010; Amihud et al., 2002).

Acquisitions are thus important investment decisions that frequently increase the default risk of the acquirer (Furfine and Rosen, 2011; Hagendorff and Vallascas, 2011). But, the choice of pursuing a risky acquisition over a risk-decreasing acquisition is likely the result of CEO's compensation structure. If CEOs hold higher inside debt, then such acquisitions should be associated with a reduction in default risk following an acquisition. This prediction is based on the argument that inside debt helps align CEO and creditor interests (Jensen and Meckling, 1976; Edmans and Liu, 2011). Since risk-decreasing acquisitions reduce the likelihood of creditor

losses, pursuing a risk-reducing deal is a creditor-friendly policy and, by extension, it is taxpayer-friendly also. In contrast, the gains from a risk-increasing acquisition are mainly captured by the shareholders, with creditors not sharing most of the upside while bearing the costs from any increase in default risk after the acquisition. Thus, this chapter tests if higher inside debt is negatively related to changes in bank risk due to an acquisition.

4.3. Sample Construction

The acquisition sample is obtained from the Thomson Financial Mergers and Acquisitions (SDC Platinum) database. The sample is subject to the following criteria:

I. Both acquirers and targets are listed in the US. Acquirers should be publicly listed banks.

II. Bank acquisitions are announced and completed between 01.01.2007 and 31.12.2012.

III. Self-tenders, leveraged buyouts and recapitalizations are excluded from the analysis, following prior work (e.g. Hagendorff and Vallascas (2011)).

IV. Deal value should be at least $10 million.

These screening criteria result in an initial sample of 170 deals over the period 2007 – 2012. However, on deeper inspection, it is revealed that some banks make multiple acquisitions within a year. For these banks, multiple deals occurring during the same year are consolidated into a single value-weighted deal (following Furfine

and Rosen (2011)), weighted by the value of each transaction. In these cases, the announcement date of value-weighted deal is the date when the first acquisition was announced, and the completion date is the date when last acquisition was completed. This results in reducing the sample by 14 deals.

As regards the source of data for calculating the variables used in the analysis, financial data for the acquiring bank is extracted from the quarterly FR Y9-C reports, market data from CRSP, CEO compensation data from Compustat's Execucomp, which is supplemented with hand collected data from proxy statements filed with the SEC where missing, and finally corporate governance data from the Riskmetrics database. The resulting sample is further reduced by 56 deals which do not have the required data.

The final acquirer sample consists of 100 acquisitions by 62 banks over the period 2007-2012. This dataset is described in Table 4.1. The average market capitalization of the acquiring banks at the time of the announcement is $17.2 billion, and the average amount paid for the acquired banks is $814.4 million.

Table 4.1: Overview of M&A sample. The table provides an overview of the acquisitions in this sample. Panel A describes the deals, according to year. Average Deal Value is represented in $ millions, and the total deal value and average market value of acquirer are in $ billions. Panel B presents the frequency of acquisitions according to each sample firm.
Source: SDC Platinum

Panel A: Distribution of M&A by year	**Number of Acquisitions**	**Average Deal Value**	**Total Deal Value**	**Average Market Value of Acquirer**
2007	40	561.063	22.443	27.275
2008	19	3236.949	61.502	27.779
2009	7	472.813	3.310	23.971
2010	13	328.702	4.273	22.654
2011	8	169.611	1.357	7.996
2012	13	117.489	1.527	3.500
Total	**100**	**814.438**	**94.412**	**18.863**

Panel B: Number of deals by acquirers	**Frequency**	**%**
1	62	62%
2	26	26%
3	9	9%
4	3	3%
Total	**100**	

4.4. Data

4.4.1. Dependent Variable: Acquisition-Related Changes in Default Risk

A firm defaults when it is unable to meet the debt obligations or, put differently, when the market value of its assets falls short of the face value of its liabilities. To incorporate this definition into a default risk indicator, this study adopts the Merton distance-to-default (DD) measure. This is the same measure as employed in Sundaram and Yermack (2007) who relate CEO inside debt to firm default risk. Gropp et al. (2006) demonstrate that DD can be suitably applied to banking firms and that DD scores outperform pure market measures of risk in terms of predicting bank default over most examination periods.

The starting point of the DD framework is that shareholders hold convex claims over firm assets which are akin to a call option. Since shareholders would exercise the call only if firm value is greater than the liabilities, strike price of this call option is equal to the face value of bank liabilities and exercise price equals the market value of firm assets. Default occurs when the call option is out-of-money.

Under the DD model, the default risk of a firm is calculated as the number of standard deviations that the market value of assets needs to fall in order to reach the default point. Therefore, higher DD means a safer bank. Following Gropp et al. (2006), DD is expressed as:

$$\textit{Distance-to-default (DD)} = [\ln (V_{A,t} / L_t) + (r - 0.5\ \sigma^2_{A,t})T] / \sigma_{A,t}T \qquad (4.1)$$

where $V_{A,t}$ is the market value of assets, L is the book value of bank liabilities, $\sigma_{A,t}$ is a measure of asset volatility calculated using the standard deviation of asset values, and T is set equal to one to determine the acquirer's default risk in the next year. More details on the calculation of the market value of assets and asset volatility are provided in Appendix B.

To measure the change in risk due to an acquisition, the average pre-acquisition and post-acquisition *DD* value of each acquirer is calculated. Pre-acquisition DD is defined as the average daily *DD* value of each acquirer over the period of 180 to 11 trading days before the deal is first announced. Post-acquisition DD is defined as the average daily *DD* value of each acquirer over the period of 180 to 11 trading days after completion is announced. This gives an absolute change in DD due to the acquisition. However, there is a need to control for general industry trends in default risk. This is critical. Consider the case where many acquisitions occur towards the end of distressed periods for the banking industry, with high default risk, it may be wrongly attributed that an acquisition resulted in a reduction in bank risk instead of the return of market conditions back to normal levels of default risk. General industry trends in default risk are calculated by means of a value-weighted average *DD* score, over the same pre- and post-acquisition windows for each deal, across all banks on CRSP which did not engage in an acquisition. A change in the industry-adjusted distance-to-default ($\Delta IADD$) between announcement and completion of the acquisition can then be calculated:

$\Delta IADD_i$ = Change in *DD* for bank *i* – Change in *DD* of non-acquiring banks

(4.2)

where a positive value of $\Delta IADD$ implies a *reduction* in default risk.

4.4.2. CEO Inside Debt

This chapter uses two variables to measure the incentive effect of CEO inside debt. The first measure of inside debt is *CEO relative inside debt ratio*. Please refer to Section 3.3.2 in Chapter 3 for a detailed explanation of this measure. To briefly reiterate, the variable *CEO relative inside debt ratio* is CEO's inside debt to her equity-based compensation, scaled by the debt-to-equity ratio of the bank. The motivation behind this ratio stems from the work of Jensen and Meckling (1976) and Edmans and Liu (2011). Theory suggests that CEOs face stronger incentives to decrease firm risk as the CEOs fractional ownership of debt (CEO inside debt/firm debt) approaches the fractional ownership of equity (CEO equity-based compensation/firm equity). This is because the increases in equity wealth due to higher risk are compensated with decreases in debt-based compensation due to a higher risk of failure. In addition to the above measure, this chapter also presents results using simple *CEO inside debt ratio* which is measured as the ratio of CEO inside debt to equity-based compensation.

4.4.3. Control Variables

This section describes the control variables used and the measures to capture these variables.

CEO equity-based incentives: Prior work on CEO compensation has argued that a separate incentive to take risk, one that is not measured by an inside debt ratio, arises as a result of the CEO's holding stock options (Guay, 1999; Coles et al., 2006; etc.). To control for this second incentive, this research calculates *CEO vega*/*delta* for the CEO's portfolio of stocks and options, following a standard methodology as set out in Grant et al. (2009) and Cassell et al. (2012). Vega is the rate of change of the value of the portfolio of stocks and options with respect to the volatility of the shares. If there are no options, vega is zero. Delta is the rate of change of the value of the portfolio with respect to the price of the shares. Delta is equal to one for the equity component, and it is a number between zero and one for the stock options. Scaling vega by delta results in a measure of the incentive to take risk that is peculiar to the options, per unit of incentive to maximise value arising from the portfolio of equity and options[10].

Firm-specific variables: This study controls for bank-specific attributes by including measures of bank size, *Bank size* (natural logarithm of the book value of assets), and profitability, *Profitability* (net income scaled by the book value of equity). Keeley (1990) posits that banks with high charter value are less likely to engage in risk-taking since they have more to lose if the bank defaults. The value of bank charter is measured through the variable *Charter value*, defined as the market value of equity divided by the book value as at the financial year-end. This is a measure of the present value of future benefits that the bank can extract through the

[10] The results remain unchanged if vega and delta enter the regressions separately, however, they have been consolidated into one measure since both are highly correlated (0.66) with each other. This study uses a parsimonious measure (vega/delta) which results in reducing multicollinearity concerns and preserves the degrees of freedom.

presence of a bank charter. Next, a measure of leverage, *Leverage*, is also included since the benefits to shareholders from risk-taking are increasing in bank leverage (John and John, 1993). It is measured as the natural logarithm of the ratio of the market value of equity (number of shares outstanding multiplied by the stock price) to the market value of assets. Finally, Furfine and Rosen (2011) report that the change in risk after a takeover is positively related to the level of pre-takeover risk. This is controlled by including a dummy variable (*High risk*) which is one if the bank was in the top quartile of risk as measured by industry-adjusted distance to default days 180 to 11 before the acquisition is announced, and zero otherwise.

Corporate governance. A stronger board of directors might avoid excessive risk-taking. The impact of strength of the board is controlled by means of a dummy variable which equals one if the CEO also serves as the chairman (*CEO is chair*), and by including the percentage of independent directors (*Board independence*), and the number of directors on the board (*Board size*). CEO characteristics such as the age of the CEO (*CEO age*), and tenure (*CEO tenure*) are also included since it is possible that older and longer-serving CEOs are more likely to be conservative with respect to risk.[11]

Deal characteristics. This study also accounts for the following deal characteristics: deal size (*Relative size*, measured as the amount paid for the target bank divided by the acquirer's market capitalization at the time of the announcement) since larger deals may lead to increases in risk owing to increased

[11] Younger CEOs benefit most from increases in post-acquisition compensation (Yim, 2013). Longer-serving, entrenched CEOs are more likely to avoid risk-increasing acquisitions, to avoid an acute threat to their position if the acquisition is problematic (Hermalin and Weisbach, 1998).

complexity when integrating the target bank into the operations of the acquirer; diversifying deal (*Diversifying takeover*, which is equal to one if the target and acquirer have different SIC sub-industry classifications); type of target (*Private target*, which is a dummy variable taking the value one if target firm is not publicly listed) since a private (unlisted) target bank is likely to have a higher degree of opacity (Officer et al., 2009); and the method of deal financing (*Method of financing*, measured as an ordinal variable which equals one if the deal is financed by cash, two if the deal is financed by stock, and zero otherwise (i.e. mixed financing)) since a primarily cash-financed deal could increase default risk by depleting the bank's most liquid assets (Choi et al., 2010).

Macroeconomic conditions. Since CEOs face fewer restrictions on their choice of bank policies during periods of economic growth, they may be more likely to pursue risky policies during periods of economic growth (DeYoung et al., 2013). Accordingly, this study controls for macroeconomic conditions through *Macro conditions*, measured through the Federal Reserve Bank of Philadelphia's state-coincident index which summarizes the macroeconomic conditions in the state where the acquirer has its headquarters. The value of state-coincident index is averaged over twelve months preceding the bank's financial year-end in the state where the bank is head-quartered.

4.4.4. Descriptive Statistics

Table 4.2 presents descriptive statistics for the above variables. The mean (median) *CEO relative inside debt ratio* is 0.07 (0.05) and *CEO inside debt ratio* is 0.45 (0.28). These ratios are similar for each of the six years in the sample period. The

relative figure indicates clearly that the personal incentives of bank CEOs are aligned more towards shareholders than towards creditors. In addition, the mean *CEO vega/delta ratio* is 0.37 (0.28), indicating that the risk-increasing incentive arising from stock options is substantial in relation to the incentive to increase shareholder value arising from the CEO's holdings of equity and options. Acquirers are large banks with average assets exceeding $188 billion, and they have high charter value; market value of equity is higher than book value, on average. Twenty-three per cent of the acquisitions in the sample involve private target banks.

Table 4.2: Descriptive statistics. The sample is 100 acquisitions over the period 2007 to 2012. ΔIADD is average daily distance-to-default (DD) value of acquirer over 11 to 180 trading days after completion is announced less the average over 180 to 11 days before the deal is announced, after subtracting the value-weighted average DD score across non-acquiring banks. *CEO relative inside debt ratio* is the ratio of the CEO's inside debt to equity holdings, scaled by the bank's debt-to-equity ratio. *CEO inside debt ratio* is the ratio of CEO's inside debt to equity holdings. *CEO vega/delta*, is the ratio of *vega*, measured as the sensitivity of the CEO's equity portfolio with respect to stock volatility, and *Delta*, measured as the sensitivity of the portfolio with respect to share price. *Bank size* is the natural logarithm of the book value of bank assets, and *Profitability* is the bank's net income scaled by bank equity. *Charter value* is the ratio of market value of equity to book value. *Leverage* is the natural logarithm of the market value of equity divided by the market value of the assets. *High risk* is a dummy variable which equals one if the bank is in the top quartile of pre-acquisition risk measured by IADD over 180 to 11 days pre-announcement. *CEO is chair* is a dummy variable which equals one if the CEO is also chair. *Board independence* is the percentage of board seats held by independent directors. *Relative size* is the amount paid for the target bank divided by the acquirer's market capitalisation at the time of the announcement. *Diversifying takeover* is a dummy variable which equals one if the target and acquirer belong to different SIC sub-industry groups. *Private target* is a dummy variable which equals one if the target bank is not publicly listed. *Method of financing* is an ordinal variable which equals one if the deal is financed by cash, two if the deal is financed by stock, and zero otherwise. *CEO age* and *CEO tenure* are the natural logarithm of CEO's age and tenure in years. *Macro conditions* is the average over twelve months preceding the bank's financial year-end of the Federal Reserve Bank of Philadelphia's monthly state-coincident index in the state where the acquirer has its headquarters.
Sources: FR Y-9C reports, CRSP, Execucomp, DEF 14A statements, Riskmetrics, SDC Platinum.

	Mean	**25th percentile**	**Median**	**75th percentile**	**Standard deviation**
ΔIADD	0.420	-0.231	0.345	0.643	1.210
CEO relative inside debt ratio	0.070	0.002	0.045	0.093	0.088
CEO inside debt ratio	0.422	0.015	0.261	0.572	0.563
CEO vega/delta	0.378	0.102	0.293	0.597	0.331
Bank size	16.448	14.921	15.793	18.291	2.247
Profitability	0.980	0.804	1.027	1.214	0.443
Charter value	1.568	1.148	1.500	2.010	0.569
Leverage	-1.743	-1.874	-1.749	-1.593	0.220
High risk	0.210	0.000	0.000	0.000	0.409
CEO is chair	0.500	0.000	0.500	1.000	-
Board independence	0.814	0.769	0.830	0.889	0.093
Board size	13.010	11.000	13.000	16.000	3.205
CEO age	4.019	3.942	4.025	4.111	0.109
CEO tenure	1.799	0.698	1.392	2.220	1.665
Relative size	0.135	0.034	0.096	0.198	0.119
Diversifying takeover	0.690	0.000	1.000	1.000	-
Private target	0.230	0.000	0.000	0.000	-
Method of financing	0.900	0.000	1.000	2.000	-

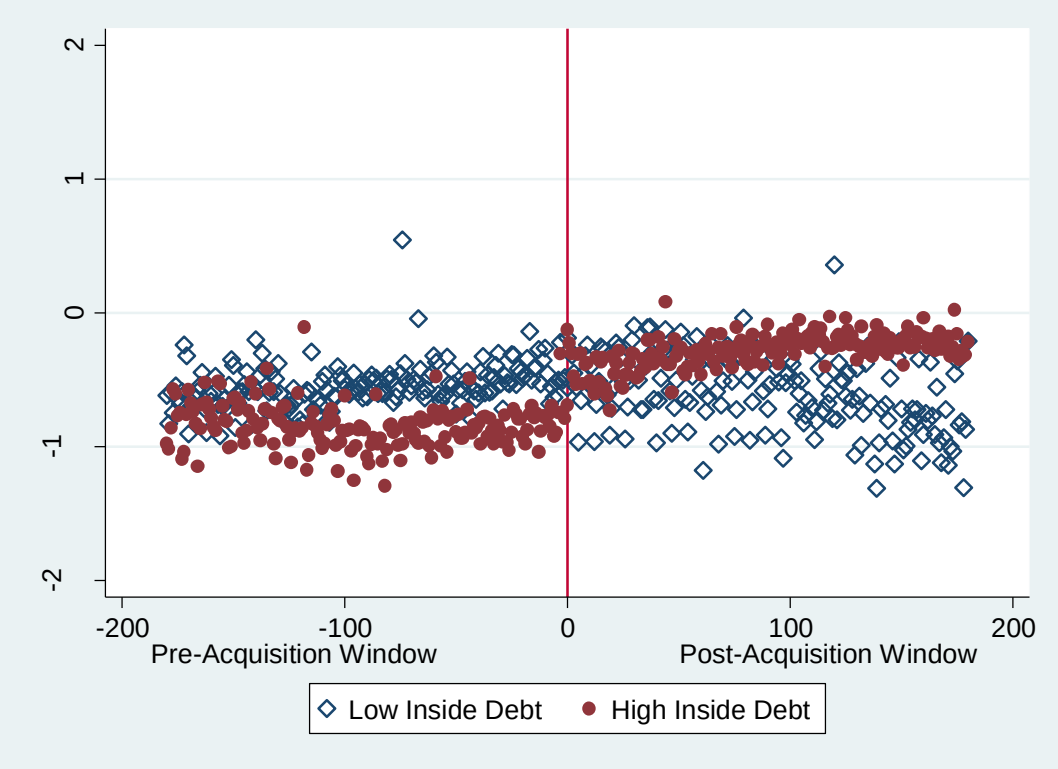

Figure 4.1: Acquisition risk and CEO inside debt holdings for deals announced between 2007 and 2012. The figure shows a scatter plot of the impact of acquisitions pursued by CEOs holding High and Low inside debt on the bank risk. Acquisition risk (on Y axis) is measured by industry-adjusted distance-to-default (IADD) which captures the number of standard deviations the acquirer is above default point, after adjusting for industry-specific trends. CEOs are classified into high and low inside debt groups on the basis of the top and bottom quartile according to their CEO relative inside debt ratios.
Sources: FR Y-9C reports, CRSP, Execucomp, DEF 14A statements, SDC Platinum.

Figure 4.1 provides a first impression about whether inside debt affects ΔIADD. The figure shows the average IADD for each day in the 180-day event windows before announcement and after completion, for the top and bottom quartile of banks by *CEO relative inside debt ratio*. An upward shift indicates an increase in the average distance-to-default (a reduction in default risk). There is a substantial difference across the two samples in the impact of the acquisition on bank risk. Average IADD for the low-inside-debt sample of acquirers shows no obvious change

after the acquisition, whereas average IADD increases (risk declines) noticeably for the high-inside-debt sample.

4.5. Results: Inside Debt and Changes in Default Risk

4.5.1. Results via Ordinary Least Squares (OLS) Regression

The following regression model is used to test the central hypothesis:

$$\Delta IADD_{i,t} = \beta_0 + \beta_1(CEO\ inside\ debt_{i,t-1}) + \beta 2(Control\ variables_{i,t-1}) + \beta_3(F_t) + \varepsilon_{i,t} \quad (4.3)$$

where the *t* subscript denotes calendar year *t*, *CEO inside debt* is measured by two variables *CEO relative inside debt ratio* and *CEO inside debt ratio* for different model specifications, Control variables have been described in Section 4.4.3 of this chapter, and F_t is a dummy variable equal to one for year *t*. Table 4.3, columns 1 and 2, summarize the regression results. Δ*IADD* is positively related to both measures of CEO inside debt at the 5% level or better, which supports the hypothesis that the CEO's remuneration package affects the riskiness of the bank's acquisitions. A one standard deviation increase in *CEO relative inside debt ratio*, for example, increases Δ*IADD* by 0.22 units (for model 1). To put this into perspective, the mean level of bank risk before the merger is -0.70 units. Thus, on average, if relative inside debt is one standard deviation higher, the increase in distance to default (Δ*IADD*/mean pre-takeover *IADD*) is 30.9 percentage points. This is a substantial negative impact on the acquirer's default risk.

Table 4.3: Change in default risk following acquisition, and CEO inside debt. The dependent variable is Δ*IADD*. Columns 1 and 2 present the results of OLS regressions, and columns 3 and 4 present OLS results controlling for selection bias by including the inverse Mills ratio from a first-stage probit regression shown in Table 4.4. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	OLS		**OLS controlling for selection bias**	
	(1)	(2)	(3)	(4)
CEO relative inside debt ratio	**2.466*** **		**5.592*** **	
	(0.812)		**(1.557)**	
CEO inside debt ratio		**0.329** **		**0.858*** **
		(0.140)		**(0.264)**
CEO vega/delta	0.016	0.002	-0.986**	-1.155**
	(0.340)	(0.337)	(0.493)	(0.502)
Bank size	0.026	0.028	0.098	0.100
	(0.081)	(0.082)	(0.083)	(0.085)
Profitability	-0.145	-0.128	-0.438	-0.443
	(0.246)	(0.251)	(0.270)	(0.277)
Charter value	0.379	0.423*	0.575**	0.705**
	(0.227)	(0.238)	(0.255)	(0.286)
Leverage	-0.287	-0.178	0.761	1.148
	(0.599)	(0.591)	(0.722)	(0.760)
High risk	1.581***	1.582***	1.482***	1.480***
	(0.313)	(0.317)	(0.309)	(0.313)
CEO is chair	0.207	0.203	0.122	0.086
	(0.281)	(0.280)	(0.279)	(0.278)
Board independence	-1.752	-1.692	-2.614	-2.673
	(1.554)	(1.569)	(1.761)	(1.812)
Board size	0.024	0.024	-0.009	-0.018
	(0.043)	(0.043)	(0.045)	(0.047)
CEO age	-0.641	-0.570	-1.942	-2.010
	(1.133)	(1.136)	(1.220)	(1.246)
CEO tenure	0.007	0.006	0.020	0.022
	(0.020)	(0.020)	(0.025)	(0.025)
Relative size	1.161	1.260	1.362	1.530
	(1.053)	(1.055)	(1.047)	(1.036)
Diversifying takeover	-0.075	-0.103	0.043	0.016
	(0.234)	(0.236)	(0.230)	(0.233)
Private target	-0.171	-0.161	-0.231	-0.221
	(0.325)	(0.328)	(0.333)	(0.334)
Method of financing	-0.091	-0.082	-0.059	-0.044
	(0.129)	(0.130)	(0.133)	(0.133)
Macro conditions	0.001	-0.001	-0.002	-0.004
	(0.007)	(0.007)	(0.006)	(0.006)
Inverse Mills ratio			-1.447**	-1.687**
			(0.613)	(0.667)
Constant	1.818	1.741	10.33*	11.84**
	(4.274)	(4.330)	(5.169)	(5.485)
Observations	100	100	98	98
Adjusted R^2	0.397	0.390	0.420	0.413

Of the control variables, only *Charter value* and *High risk* are significant, at the 10% and 1% levels, respectively. Both have the expected sign: a higher charter value is associated with a less risky acquisition, and the existing risk of the acquiring bank is negatively related to the change in risk from the acquisition. The result for charter value is consistent with Keeley's (1990) prediction that a higher charter reduces the incentive to take risk. The results do not show that CEO age and tenure are significant predictors of risk-taking incentives of bank managers. This is also consistent with prior work on inside debt and bank risk-taking where Bennett et al. (2013) do not find CEO age and tenure to be related to bank risk, after accounting for the role of inside debt incentives. This lack of statistical power could be attributed to the fact that age and tenure are strong predictors of inside debt, however, any direct effect of these variables on firm behaviour is likely because of inside debt. For instance, older and more entrenched CEOs may have larger inside debt pay and relatively less equity pay. This may in turn motivate CEOs to pursue less risky policies, in an attempt to protect the value of their inside debt.

4.5.2. Results after Controlling for Self-selection

Banks that choose to make an acquisition are not a random sample from the population of all banks, as will be seen in Table 4.4. As the sample is not random, some of the beta coefficients estimated by standard OLS might not be estimated consistently. In addition, the coefficients might be biased. A possible source of bias is as follows. The impact of an acquisition on bank risk is a key characteristic which matters to bank CEOs in their choice of acquisition target. Given this, it is possible that some CEOs choose not to make an acquisition because the potential acquisition opportunities available to them do not have enough impact on risk, or do not have an

impact in the direction the CEO is looking for. For example, a CEO might be looking to reduce her bank's risk, but be unable to find a feasible acquisition which would have this effect. This implies that the acquisitions observed in the sample are the ones which have a sufficient impact on risk, in the direction desired by the CEO. So the *ex ante* prediction from this particular line of argument is: there should be a stronger relation between CEO inside debt and the riskiness of acquisitions on the basis of the sample of acquisitions that are observed, than on the basis of a hypothetical larger sample which allows for acquisitions which might have happened but which are not observed.

To control for self-selection of banks in the sample, this study employs a Heckman two-stage model. The first stage is a probit regression which estimates coefficients on variables intended to explain why a bank makes an acquisition. The inverse Mills ratio λ_{iA} can then calculated for each bank *i* that is in the main sample of 100 bank acquisitions[12]. The second stage re-estimates the OLS regressions that explain acquisition-related changes in bank risk, with the additional term λ_{iA} included. The coefficient on λ_{iA} estimates the correlation between the error term of the relevant regression before adding λ_{iA}, and the expected value of the error term of the first-stage regression. Thus, the two-stage procedure controls for the possible impact on bank risk of the decision to make an acquisition.

[12]This is the expected value of the error term for *i*, under the probit assumption that the relation between the decision to acquire and the explanatory variables $\boldsymbol{x_i}$ is given by $Acq_{i,t} = \Phi(\boldsymbol{\beta x_{i,t}} + e_{i,t})$, where $Acq_{i,t}$ takes the value of one for an acquiring bank, and $\Phi(.)$ is the probability between 0 and 1 in the cumulative normal distribution corresponding to the number in the brackets.

To conduct the first-stage regression, this study uses a sample of all publicly listed banks which have the required compensation data available on Execucomp and financial data on FR-Y9C, for the sample period 2007-12. The average number of banks in this larger sample per year is 98. The data is analysed by running a probit model in which the dependent variable, $Acq_{i,t}$, which is equal to one if bank *i* announces an acquisition in year *t*, and zero otherwise:

$$Acq_{i,t} = \beta_0 + \beta_1(CEO\ inside\ debt_{i,t-1}) + \beta_2(Control\ variables) + \beta_3(Instruments) + \beta_4(F_t) + \varepsilon_{i,t} \quad (4.4)$$

The explanatory variables in the probit regression are similar to those used in the OLS regression model (equation (4.3)). The analysis excludes deal-specific variables and *High risk*, since the probit sample is now composed of both acquiring and non-acquiring banks. The impact of risk profile of banks on acquisition propensity is controlled via *Credit risk* (Loan-loss provisions/Assets), and distance-to-default (*DD*) as described earlier. Further, to control for selection bias in the follow-on analysis, it is important to add instruments in the form of some new variables in equation (4.4) which are expected to affect a bank's propensity to acquire, but not to affect its risk after the acquisition. The first such variable is excess stock returns (*Excess returns*), calculated as the difference between the cumulative daily returns on bank *i* and the value-weighted returns on the market portfolio over the past year, since banks are more likely to pursue an acquisition when their shares are overpriced. The second variable is the total value of M&A transactions in the banking industry for each year (*M&A value*) since bank mergers occur in waves. The third variable is

the level of bank liquidity defined as the total amount of cash and core deposits held by the bank over its assets (*Liquidity*) since the likelihood of an acquisition is related to the bank's cash resources (Rosen, 2004). Finally, high asset growth (*Asset growth*) signals that the management may be following an aggressive growth strategy and seeking to expand via acquisitions (Bliss and Rosen, 2001; Rosen, 2004). *Asset growth* is measured as the percentage change in bank assets over the prior year.

Table 4.4 reports the first-stage probit results. The results show that the coefficients for both measures of CEO inside debt are negative and statistically significant at the 5% level. This indicates that inside debt is associated with a reduced likelihood to engage in acquisitions, perhaps because many acquisitions are seen by executives as inherently risky. The coefficient on *CEO vega*/*delta* is positive and significant at the 1% level, suggesting that a greater option-based incentive to take risk leads to a greater propensity to acquire. Three of the control variables are significant at the five per cent level; they suggest that acquiring banks are more profitable, have a lower charter value and are more levered than are non-acquirers. Three of the four new variables are also significant at the five per cent level or better. They are *Excess returns*, *Liquidity*, and *M&A value*. A bank's propensity to acquire is greater when the bank's shares have been performing well, when it is relatively liquid, and when the value of acquisitions by banks in general is high.

Table 4.4: Explaining bank propensity to acquire. The table presents first-stage probit regressions in the Heckman two-stage method. The dependent variable is equal to one if a bank makes an acquisition in the relevant financial year, and zero otherwise. *Credit risk* is loan-loss provisions to assets at book value. Excess returns is the difference between the cumulative daily returns on the bank's shares and value-weighted returns on the market portfolio, as given in CRSP database, over the year to financial year-end. *M&A value* is the total value of M&A deals in the banking industry for the calendar year in which the deal was announced. *Liquidity* is cash and core deposits as defined by the bank, over assets. *Asset growth* is the % change in bank assets over prior year. The remaining variables are defined in Table 1. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	(1)	(2)
CEO relative inside debt ratio	**-2.199****	
	(1.057)	
CEO inside debt ratio		**-0.334****
		(0.132)
CEO vega/delta	0.708***	0.726***
	(0.208)	(0.203)
Bank size	0.003	0.003
	(0.081)	(0.078)
Profitability	0.152**	0.158**
	(0.064)	(0.0644)
Charter value	-0.320**	-0.352**
	(0.152)	(0.155)
Leverage	-0.823**	-0.924**
	(0.382)	(0.385)
DD	0.012	0.007
	(0.025)	(0.025)
Credit risk	-0.229	-0.196
	(0.192)	(0.192)
CEO is chair	0.270	0.252
	(0.214)	(0.213)
Board independence	0.512	0.610
	(0.945)	(0.937)
Board size	0.018	0.022
	(0.038)	(0.038)
CEO age	0.743	0.795
	(0.924)	(0.911)
CEO tenure	-0.001	-0.002
	(0.014)	(0.014)
Macro conditions	0.002	0.002
	(0.006)	(0.006)
Excess returns	0.575**	0.518**
	(0.240)	(0.247)
Liquidity	1.661**	1.547**
	(0.660)	(0.650)
M&A value	0.023***	0.022***
	(0.006)	(0.006)
Asset growth	0.622	0.646
	(0.618)	(0.618)
Constant	-7.751*	-8.145**
	(4.181)	(4.148)
Observations	551	551
Pseudo R^2	0.176	0.184

The second-stage OLS results, which include the inverse Mills ratio λ_{iA} from the first stage, are shown in Table 4.3, columns 3 and 4. The coefficient on λ_{iA} turns out to be negative and significant at the 5% level: the expected value of the first-stage error term is negatively related to $\Delta IADD$. That is, the more unexpected is an acquisition, given the values of the bank-specific and other explanatory variables in regression (4.4), the larger is the subsequent increase in bank risk. This result suggests that acquisitions act as a mechanism to engage in risk-taking, or at least that greater risk is an acceptable consequence. The results indicate that, controlling for this effect, the relation between $\Delta IADD$ and both measures of CEO inside debt is more significant; the coefficients are now significant at the 1% level. In addition, the negative coefficient on *CEO vega/delta* becomes significant at the 5% level. Both results suggest that, controlling for the impact on bank risk of the decision of a bank to make an acquisition, the relation between bank risk and the CEO's pay-related incentives to take risk is more pronounced.

To summarize, the results support theoretical predictions of Edmans and Liu (2011) that inside debt helps in mitigating CEO risk-taking tendencies. Acquisitions pursued by CEOs with higher inside debt are risk-decreasing and, hence, creditor-friendly.

4.5.3. How Do Banks Change Their Risk via Acquisitions?

This section explores some of the channels through which bank CEOs are able to achieve risk changes when engaging in acquisitions. Prior research has shown that bank acquisitions often result in affecting the level of leverage and asset risk. For

instance, acquisitions may result in increasing leverage if acquiring firms support riskier activities with lower levels of equity following acquisitions (Demsetz and Strahan, 1997). Alternatively, acquisitions may diversify asset risks by shifting the asset portfolio towards less risky activities (Akhavein et al., 1997; Benston et al., 1995).

To investigate these conjectures, this section examines whether inside debt is associated with a decrease in leverage and asset risk after an acquisition. Two commonly used measures of leverage are employed: the total risk-based capital ratio, which is defined as total equity capital expressed as a fraction of risk-weighted assets, and the fraction of subordinated debt to risk-weighted assets. Asset risk is measured by the standard deviation of the market value of assets, and by the fraction of risk-weighted assets to total assets. All these measures are adjusted by industry averages for non-acquiring banks. The new dependent variables are the measures of leverage and asset risk one quarter after completion of the takeover less the relevant measure one quarter before the announcement. The explanatory variables remain identical to those used in the previous regressions (Table 4.3, columns 3 and 4).

Table 4.5 presents the results. The two measures of CEO inside debt are significant at the 10% level or better in all cases. The results suggest that the CEO's incentive to take risk affects bank acquisition-related risk via both leverage and asset risk. Another noteworthy result is that the inverse Mills ratio is significant only for the change in asset risk defined in terms of market volatility (columns 5 and 6). This suggests that an unexpected decision to acquire is associated with an increase in risk in terms of the quality of the loan book.

Table 4.5: Changes in aspects of risk, and CEO inside debt. The dependent variable in models 1 to 4 is leverage risk, measured as the industry-adjusted change in total shareholders' funds to risk-weighted assets (models 1 and 2), and in subordinated debt expressed as a fraction of risk-weighted assets (models 3 and 4). The dependent variable in models 5 to 8 is asset risk, measured as the change in the industry-adjusted standard deviation of the market value of assets (models 5 and 6), calculated in the Appendix, and the change in risk-weighted assets to total assets (models 7 and 8). The source for risk-weighted assets is FR Y-9C reports. The inverse Mills ratio is calculated from the results in Table 3. *High risk* is a dummy variable which equals one if the pre-acquisition value of the relevant risk measure is in the top quartile of risk, and zero otherwise. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	Leverage risk				**Asset risk**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO relative inside debt ratio	**5.606****		**-1.218****		**-6.705***		**-14.27*****	
	(2.691)		**(0.565)**		**(3.812)**		**(4.978)**	
CEO inside debt ratio		**0.751***		**-0.147***		**-1.047***		**-1.559****
		(0.422)		**(0.079)**		**(0.593)**		**(0.712)**
CEO vega/delta	-0.518	-0.578	0.007	0.002	1.677**	1.829**	1.355	1.245
	(0.798)	(0.824)	(0.245)	(0.255)	(0.782)	(0.832)	(1.856)	(1.949)
Bank size	0.134	0.137	0.026	0.027	-0.134	-0.132	-0.212	-0.172
	(0.117)	(0.114)	(0.030)	(0.030)	(0.099)	(0.100)	(0.193)	(0.201)
Profitability	-1.678**	-1.671**	0.224	0.203	1.215*	1.167	3.510**	3.175**
	(0.651)	(0.676)	(0.171)	(0.177)	(0.718)	(0.706)	(1.466)	(1.448)
Charter value	1.330***	1.441***	-0.170	-0.183	-0.342	-0.475	-1.305	-1.397
	(0.437)	(0.468)	(0.118)	(0.120)	(0.405)	(0.428)	(0.917)	(0.964)
Leverage	-0.339	-0.095	0.376	0.328	-1.682*	-2.062*	-1.293	-1.916
	(0.862)	(0.948)	(0.295)	(0.317)	(1.001)	(1.064)	(2.342)	(2.562)
High risk	0.511	0.472	-0.059	-0.050	-0.630	-0.685	-1.208	-1.151
	(0.349)	(0.350)	(0.144)	(0.145)	(0.658)	(0.640)	(0.847)	(0.879)
CEO is chair	-0.267	-0.310	0.171	0.177	-0.390	-0.356	2.056**	2.113**
	(0.451)	(0.472)	(0.104)	(0.109)	(0.327)	(0.338)	(0.890)	(0.906)
Board independence	-2.672	-2.472	-0.066	-0.125	1.879	1.968	7.633*	6.781
	(1.789)	(1.833)	(0.449)	(0.446)	(2.188)	(2.226)	(4.444)	(4.560)
Board size	0.039	0.038	-0.001	-0.002	0.123**	0.134**	0.078	0.066
	(0.052)	(0.053)	(0.017)	(0.017)	(0.056)	(0.059)	(0.145)	(0.157)
CEO age	-1.197	-1.040	0.147	0.065	0.638	0.752	6.739*	5.421
	(1.795)	(1.839)	(0.477)	(0.476)	(1.821)	(1.847)	(3.633)	(3.791)
CEO tenure	-0.042	-0.044	0.003	0.003	-0.019	-0.021	-0.005	0.010
	(0.031)	(0.031)	(0.008)	(0.008)	(0.036)	(0.037)	(0.082)	(0.083)

Relative size	2.813	3.084	-0.040	-0.088	-0.539	-0.664	-1.311	-1.781
	(2.053)	(2.095)	(0.394)	(0.412)	(1.712)	(1.732)	(3.779)	(3.911)
Diversifying takeover	-0.601	-0.662	0.068	0.082	-0.176	-0.156	-1.311	-1.181
	(0.467)	(0.487)	(0.081)	(0.085)	(0.382)	(0.390)	(0.951)	(0.966)
Private target	0.610	0.635	-0.105	-0.112	-0.196	-0.196	0.307	0.201
	(0.459)	(0.465)	(0.117)	(0.117)	(0.511)	(0.518)	(1.000)	(1.040)
Method of financing	0.107	0.130	-0.013	-0.016	-0.065	-0.084	0.689	0.663
	(0.213)	(0.223)	(0.056)	(0.058)	(0.230)	(0.227)	(0.481)	(0.489)
Macro conditions	0.001	-0.002	-0.001	-0.001	0.004	0.006	-0.015	-0.009
	(0.011)	(0.012)	(0.003)	(0.003)	(0.012)	(0.012)	(0.025)	(0.026)
Inverse Mills ratio	0.425	0.366	0.129	0.120	2.447**	2.661**	2.972	2.792
	(0.943)	(1.023)	(0.241)	(0.254)	(0.945)	(1.019)	(2.160)	(2.277)
Constant	3.533	3.499	-0.423	-0.203	-10.680	-12.380	-37.660**	-34.080*
	(9.259)	(9.777)	(2.595)	(2.700)	(9.504)	(10.18)	(18.07)	(18.79)
Observations	98	98	98	98	98	98	98	98
Adjusted R^2	0.470	0.452	0.102	0.082	0.256	0.254	0.171	0.139

4.6. Inside Debt, M&A and Risk-Shifting to the Safety-Net

Thus far, the analysis has linked compensation to a measure of default risk and found that inside debt lowers the propensity of CEOs to increase bank default risk and shift bank risk to creditors. The banking industry offers a unique setting to observe a different and highly relevant type of risk shifting. Since banks have access the financial safety-net (in the form of explicit and implicit bail out guarantees of their liabilities), shareholders may profitably shift risk to the financial safety-net (Ronn and Verma, 1986). Benston et al. (1995) and Carbo-Valverde et al. (2012) show that acquisitions may serve as a means by which banks engage in risk-shifting. More recently, Brewer and Jagtiani (2013) show that bank mergers occurring over the period 1991-2004 were motivated by attempts to become too-big-to-fail (TBTF) and thus obtain implicit government guarantees (e.g. a bailout during crisis). The authors show that banks were willing to pay a higher premium for deals (between $15 and $23 billion extra) which would allow them to exceed the threshold asset size of $100 billion. Such deals result in increasing the potential losses to taxpayers in the event of default, while any gains from risky bank policies are largely captured by shareholders. This section tests whether CEO inside debt holdings can prevent banks from shifting risk to the financial safety-net. Specifically, the focus is on analysing whether or not inside debt decreases the value of safety-net subsidies afforded to bank shareholders following an acquisition.

4.6.1. Measuring the Value of the Safety-Net

Merton (1977) was the first to model safety-net access as a put option. The put allows bank shareholders to sell a bank's assets to the financial safety-net at an

exercise price which equals the face value of bank liabilities. Higher asset risk, therefore, increases the value of the safety-net to bank shareholders and exposes taxpayers—who guarantee the safety-net and thus write the put option—to potentially greater losses. Therefore, if debt-based compensation prevents CEOs from shifting risk, higher debt-based compensation should linked to a lower propensity of banks to extract subsidies from the financial safety-net.

The value of safety-net benefits to bank shareholders is estimated following a methodology pioneered by Merton (1977). By guaranteeing bank debt, the safety-net guarantors (by extension, taxpayers) write a put option whose value can be expressed as a percentage of a bank's debt (IPP) as:

$$IPP = N(y + \sigma_A\sqrt{T}) - ((1 - \delta)^n (V_A/B)N(y) \quad (4.5)$$

$$y = (\ln[B/V_A(1 - \delta)^n] - \sigma_A^2 T/2)/ \sigma_A\sqrt{T}), \quad (4.6)$$

where B is the book value of liabilities, V_A is the market value of assets, σ_A a measure of portfolio risk (or asset volatility) calculated using the standard deviation of asset values, δ is the fraction of dividend to assets, n is the number of dividend payments per period, $N(\cdot)$ is the cumulative standard normal distribution, and T is set equal to one based on the assumption that bank deposits mature in the next year when a bank examination or audit occurs. Please refer to Appendix B for a detailed explanation on the calculation of $V_{A,t}$ and $\sigma_{A,t}$. IPP variable is transformed by taking a natural logarithm since it is highly skewed towards the right, but for ease of interpretation it

is referred as *IPP*. The dependent variable, which is the change in the value of the safety net or Δ*IPP*, is given by the difference between the average *IPP* during days 180 to 11 before the announcement, and days 11 to 180 after completion, less the changes in *IPP* due to general industry trends. General industry trends in *IPP* are calculated by means of a value-weighted average *IPP*, over the same windows for each deal, across all banks on CRSP which did not engage in an acquisition.

4.6.2. Results: Inside debt and Financial Safety-net

The results in Table 4.6 show that there is a negative relation between Δ*IPP* and both measures of inside debt. The results for the control variables are similar to those in Table 4.3. Of the control variables, *Profitability* and *Leverage* are significant, which means that more profitable banks and banks with lower leverage pursue acquisitions which increase *IPP*. The negative relation between Δ*IPP* and CEO inside debt implies that greater CEO conservativism with respect to risk due to higher inside debt results in a lower value extracted from the financial safety net. This finding is noteworthy because it suggests that the incentives resulting from the CEO's remuneration not only affect the bank's overall risk, as measured by distance-to-default and other measures, but also affect the expected value of the exposure to loss of taxpayers. Such exposure is a consequence of bank risk-taking that is of particular concern to regulators and governments, given a system in which the state protects retail depositors.

Table 4.6: Change in value of deposit insurance, and CEO inside debt. The dependent variable is Δ*IPP*, given by the average *IPP* during days days 11 to 180 after completion less the average during days 180 to 11 before the announcement, less the value-weighted average *IPP*, over the same windows for each deal, across all non-acquiring banks on CRSP. This study uses natural logarithm of *IPP* to reduce its skewness. *High pretakeover IPP* is a dummy variable which equals one if the bank was in the top quartile of the pre-takeover value of deposit insurance as measured by *IPP*. *Asset volatility* is the standard deviation of the market value of bank assets, as calculated in Appendix B. The inverse Mills ratio is calculated from the results in Table 3. The remaining variables are defined in Table 1. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	OLS		**OLS controlling for selection bias**	
	(1)	(2)	(3)	(4)
CEO relative inside debt ratio	**-9.648****		**-11.49****	
	(3.857)		**(5.140)**	
CEO inside debt ratio		**-1.274****		**-1.471***
		(0.580)		**(0.879)**
CEO vega/delta	0.632	0.676	1.298	1.451
	(1.200)	(1.200)	(1.867)	(1.976)
Bank size	0.387	0.378	0.300	0.304
	(0.295)	(0.301)	(0.303)	(0.310)
Profitability	2.550***	2.474***	2.799***	2.716***
	(0.781)	(0.784)	(0.817)	(0.821)
Charter value	-1.115	-1.293	-1.207	-1.418
	(1.138)	(1.158)	(1.178)	(1.230)
Leverage	6.785***	6.365***	6.132**	5.432**
	(1.776)	(1.786)	(2.477)	(2.698)
High pretakeover IPP	-0.273	-0.322	-0.198	-0.250
	(0.955)	(0.951)	(1.025)	(1.028)
CEO is chair	-0.452	-0.429	-0.690	-0.613
	(0.842)	(0.838)	(0.802)	(0.795)
Board independence	3.515	3.223	4.658	4.214
	(3.218)	(3.245)	(3.188)	(3.346)
Board size	-0.162	-0.164	-0.158	-0.159
	(0.137)	(0.141)	(0.136)	(0.143)
Ln(CEO age)	-1.350	-1.659	-0.826	-1.315
	(3.915)	(3.982)	(4.207)	(4.446)
CEO tenure	0.165	0.168	0.175	0.179
	(0.530)	(0.560)	(0.602)	(0.655)
Relative size	-0.609	-0.961	-0.006	-0.529

	(3.429)	(3.381)	(3.258)	(3.273)
Diversifying takeover	-0.878	-0.766	-0.948	-0.817
	(0.760)	(0.757)	(0.777)	(0.766)
Private target	0.652	0.599	0.905	0.823
	(0.707)	(0.739)	(0.757)	(0.791)
Method of financing	-0.052	-0.087	-0.071	-0.104
	(0.397)	(0.413)	(0.399)	(0.421)
Macro conditions	-0.012	-0.009	-0.008	-0.003
	(0.021)	(0.022)	(0.020)	(0.021)
Inverse Mills ratio			0.455	0.677
			(1.996)	(2.185)
Asset volatility ($X10^{-3}$)	-1.504***	-1.514***	-1.599***	-1.585***
	(0.330)	(0.335)	(0.317)	(0.327)
Constant	26.51*	27.01*	23.00	23.14
	(14.02)	(14.55)	(18.06)	(20.06)
Observations	100	100	98	98
Adjusted R^2	0.777	0.772	0.786	0.779

4.7. Endogenous CEO Pay?

An additional challenge that this Chapter must address is that CEO pay may be endogenous. CEOs may have negotiated their compensation arrangements in anticipation of pursuing an acquisition in the future. For instance, in anticipation of a risk-decreasing acquisition, CEOs may have negotiated a higher fraction of salary to be paid in the form of inside debt (and less in the form of equity). In this scenario, it is not inside debt that causes a CEO to undertake a risk-reducing acquisition. Rather, the level of CEO inside debt may be the result of a CEO's intention to pursue an acquisition or unobservable bank characteristics which are associated with CEO inside debt. In order to establish a causal relationship between CEO pay variables and the default risk outcomes of acquisitions, this study uses a two-stage least squares (2SLS) framework.

4.7.1. Instrumental Variables

The instruments for both inside debt and equity incentives (vega/delta) are based on peer level compensation and bank variables that can explain the CEO compensation structure but not changes in bank default risk following an acquisition.

The first instrument is average CEO inside debt at a peer group of publicly listed U.S. banks which are in the same size quartile as the acquiring bank, *Peer CEO relative inside debt ratio* or *Peer CEO inside debt ratio*. The nature of remuneration at a peer group of similar companies is an important determinant of a given CEO's remuneration, as documented by Bizjak et al. (2008) and Faulkender and Yang (2010). Peer-based remuneration has recently been used as an instrument for CEO

remuneration by several other authors, for example, Kini and Williams (2012), Chava and Purnanandam (2007), Cassell et al. (2012). The second instrument for CEO inside debt is *Liquidity*. Cash-constrained firms are more likely to grant equity-based incentives than inside debt, since inside debt would require firms to pay out cash (equity-based compensation does not require the use of cash, see Sundaram and Yermack, 2007). Cash holdings prior to a deal should not affect the risk changes caused by an acquisition.

Additionally, this study also identifies instruments for the measure of option-based incentives, *vega*/*delta*. To the extent that CEO pay is benchmarked to a peer group, it can be argued that the option-based incentives are also benchmarked to a peer group. Accordingly, the first instrument is the peer-average CEO vega/delta ratio defined as the average vega/delta ratio at a peer-group of banks which are in the same size quartile as the acquiring bank, *Peer vega*/*delta*. Following prior literature, the second instrument is the weighted average moneyness of the CEO's option holdings, *Option moneyness*, where moneyness is defined as the ratio of strike price to market price (see for example Kale et al., 2011; Kini and Williams, 2012). The weights are assigned according to the number of options held by the CEO in each tranche of her option portfolio. *Ceteris paribus*, more moneyness implies a higher CEO vega/delta ratio. Moneyness is unlikely to be correlated with unobserved factors that may drive the change in firm risk and equity-based incentives of the CEO.

4.7.2. Results after Controlling for Endogeneity

The first-stage of 2SLS approach identifies the determinants of inside debt and equity-based compensation. These variables are then used to predict the expected value of CEO relative debt-to-equity ratio and CEO vega/delta. In the second stage, the predicted values are regressed on Δ*IADD* and Δ*IPP*.

The results of the first-stage are shown in Table 4.7. *Peer CEO inside debt ratio* is statistically significant at 5% level and shows that peer-CEO pay is an important determinant of CEO compensation for the banks included in this sample. The second-stage results shown in Panel A are largely consistent with the prior analysis on Δ*IADD* and Δ*IPP*. There are two key results in this panel. First, the results hold after controlling for potential endogeneity concerns. For instance, the coefficients of inside debt in columns 1 to 3 are significant at 5% level or better. However, the coefficient of inside debt in column 4 is not significant at conventional levels. Second, there is no evidence of endogeneity and hence OLS results present efficient and unbiased estimates, as opposed to the 2SLS estimator which may be inefficient and less precise.

Table 4.7: Change in bank risk and CEO inside debt controlling for potential endogeneity of CEO remuneration. This table shows results from a two-stage regression framework. Panel A presents the second-stage (main) results using the predicted values of CEO inside debt and *vega*/*delta* from the first stage. The dependent variable is Δ*IADD* or Δ*IPP*. Panel B presents the first-stage results where the dependent variable is *CEO relative inside debt* or *CEO inside debt*. *Peer CEO relative inside debt ratio* is the average CEO relative inside debt ratio at a peer group of publicly listed U.S. banks which are in the same size quartile as the acquiring bank, and similarly for *Peer CEO inside debt ratio.* The first-stage results where the dependent variable is *CEO vega*/*delta* are not shown and are available upon request. For brevity, only the coefficients on the bank-specific variables are shown. Robust standard errors clustered by bank are reported in parentheses. All models include year fixed effects. *Significant at 10%. **Significant at 5%. ***Significant at 1%.

	Δ*IADD*		Δ*IPP*	
Panel A: Second stage	(1)	(2)	(3)	(4)
Instrumented CEO relative inside debt ratio	**11.48*** **		**-24.89** **	
	(3.596)		**(11.33)**	
Instrumented CEO inside debt ratio		**1.168*** **		**-1.810**
		(0.431)		**(1.758)**
Bank size	0.140	0.097	0.177	0.298
	(0.0872)	(0.082)	(0.334)	(0.338)
Profitability	-0.592**	-0.468*	3.005***	2.687***
	(0.288)	(0.254)	(0.720)	(0.752)
Charter value	0.711***	0.785***	-1.659	-1.421
	(0.267)	(0.289)	(1.206)	(1.307)
Leverage	0.598	0.828	5.081**	4.741*
	(0.861)	(0.893)	(2.500)	(2.581)
High pretakeover risk	1.365***	1.395***		
	(0.294)	(0.276)		
High pretakeover IPP			-0.741	-0.541
			(0.830)	(0.859)
Asset volatility ($X10^{-3}$)			-1.491***	-1.578***
			(0.262)	(0.267)
Other controls	Yes	Yes	Yes	Yes
Observations	96	96	96	96
Adjusted R^2	0.379	0.394	0.778	0.785
Hausman Endogeneity Test (p-value)	0.16	0.33	0.34	0.27

	CEO relative inside debt ratio		*CEO inside debt ratio*	
Panel B: First stage	(1)	(2)	(3)	(4)
Peer CEO relative inside debt ratio	0.721***		0.787***	
	(0.230)		(0.221)	
Peer CEO inside debt ratio		0.476**		0.578***
		(0.201)		(0.215)
Liquidity	0.031***	0.260**	0.029**	0.216**
	(0.012)	(0.121)	(0.011)	(0.106)
Other controls	Yes	Yes	Yes	Yes
Observations	96	96	96	96
Centered R^2	0.655	0.639	0.665	0.659

4.8. Robustness Tests

This section conducts additional robustness tests to understand if prior results may be driven by other possible explanations. First, it uses an alternate measure of inside debt. Second, it excludes acquisitions of failing targets. Third, it uses various alternate measures to assess acquisition-related change in bank risk.

4.8.1. Alternate Measure of Inside Debt

The results shown in previous sections have focused on using a 'levels' measure of inside debt where the levels of inside debt and equity-based pay are used. However, Cassell et al. (2012) argue that CEOs may be more concerned about how a specific bank policy affects the sensitivity of their wealth rather than the levels of equity-based and debt-based wealth in their portfolio. To account for this, an alternate measure of inside debt is employed following Wei and Yermack (2011). This uses an estimate of the change in *CEO equity* and *Bank equity* per dollar change in the bank's stock price, instead of *CEO equity* and *Bank equity*.

The results are shown in Table 4.8. Columns 1-3 assess the impact of *CEO relative incentive ratio* on $\Delta IADD$ and ΔIPP. Model specifications remain as shown in previous sections. The results show that previous findings remain qualitatively identical after using this alternate measure of inside debt. The *CEO relative incentive ratio* is still significant and negatively related to both measures of bank risk.

Table 4.8: Change in bank risk following acquisition and alternate measure CEO inside debt. This table uses Wei and Yermack's (2011) measure of inside debt. The dependent variable is Δ*IADD* for columns 1 and 2 and Δ*IPP* for columns 3 and 4. Columns 1 and 3 present the results of OLS regressions, and columns 2 and 4 present OLS results controlling for selection bias by including the inverse Mills ratio from a first-stage probit regression shown in Table 4.4. High risk is a dummy variable which equals one if the pre-acquisition value of the relevant risk measure is in the top quartile of IADD for models 1 and 2 and pre-merger IPP for models 3 and 4, and zero otherwise. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	ΔIADD		**ΔIPP**	
	(1)	(2)	(3)	(4)
CEO relative incentive ratio	**2.706*** (0.892)**	**5.997*** (1.459)**	**-10.120** (4.188)**	**-12.730** (5.239)**
CEO vega/delta	-0.0474	-1.132**	0.851	1.796
	(0.338)	(0.496)	(1.223)	(1.891)
Bank size	0.028	0.104	0.381	0.277
	(0.080)	(0.0808)	(0.293)	(0.303)
Profitability	-0.134	-0.451*	2.466***	2.762***
	(0.243)	(0.263)	(0.775)	(0.802)
Charter value	0.381*	0.611**	-1.126	-1.290
	(0.228)	(0.259)	(1.137)	(1.189)
Leverage	-0.347	0.696	6.761***	5.839**
	(0.618)	(0.734)	(1.798)	(2.444)
High risk	1.536***	1.397***	-0.112	-0.073
	(0.312)	(0.305)	(0.944)	(1.000)
CEO is chair	0.197	0.106	-0.455	-0.659
	(0.280)	(0.273)	(0.852)	(0.803)
Board independence	-1.749	-2.698	3.595	4.909
	(1.520)	(1.726)	(3.196)	(3.177)
Board size	0.028	-0.002	-0.179	-0.171
	(0.042)	(0.044)	(0.134)	(0.131)
CEO age	-0.803	-2.270*	-0.887	0.0270
	(1.142)	(1.204)	(4.025)	(4.387)
CEO tenure	0.010	0.026	0.159	0.161
	(0.020)	(0.024)	(0.543)	(0.629)
Relative size	1.146	1.330	-0.706	-0.149
	(1.056)	(1.061)	(3.506)	(3.358)
Diversifying takeover	-0.086	0.045	-0.827	-0.921
	(0.232)	(0.226)	(0.773)	(0.786)
Private target	-0.144	-0.204	0.566	0.807
	(0.328)	(0.337)	(0.708)	(0.749)
Method of financing	-0.082	-0.046	-0.077	-0.110
	(0.128)	(0.131)	(0.406)	(0.410)
Macro conditions	-0.001	-0.005	-0.008	-0.001
	(0.007)	(0.006)	(0.020)	(0.019)
Inverse Mills ratio		-1.552**		0.865
		(0.614)		(1.985)
Asset volatility ($X10^{-3}$)			-1.414***	-1.497***
			(0.317)	(0.302)
Constant	2.497	11.85**	24.01	18.07
	(4.331)	(5.142)	(14.61)	(18.83)
Observations	100	98	100	98
Adjusted R^2	0.399	0.432	0.777	0.787

4.8.2. Acquisitions of Failing Targets

The banking literature on M&A has argued financial distress as a motive for bank mergers that are caused by the weak and distressed financial position of the target (Koetter et al., 2007). These mergers can often be an outcome of regulatory encouragement to take over weaker targets to prevent the large social costs associated with a bank failure. The CEO's discretion over bank policy and the role of inside debt in motivating bank policy would be severely limited in these cases. To exclude these deals, various restrictions on the sample are employed for this Chapter's analysis:

First, target banks which received funds under the capital assistance program (TARP) during the financial crisis are removed. Second, all deals where target banks are listed as failed in the FDIC database or where the takeover premium (measured as the ratio of target price to target market value one week before the announcement) is negative, and therefore suggestive of a distressed target, are excluded. Third, deals completed during the financial crisis (2008-09) are removed.

The results of these robustness tests, shown in Table 4.9, indicate that inside debt remains statistically and economically significant throughout different models in the subsample. Overall, the results suggest that financially distressed banks are not a driver of the results report here.

Table 4.9: Change in bank risk following acquisition and CEO inside debt, accounting for financial distress as a motive for acquisitions. This table presents regression results for testing the impact of inside debt on ΔIADD when the sample is subject to different sets of inclusion restrictions: for models 1 and 4, all target banks which were involved in TARP are excluded; for models 2 and 5, all deals where the premium paid was below zero or reported as failed by the FDIC are excluded; and for models 3 and 6, all deals which were announced during the crisis period (2008-09) are omitted. The dependent variable is Δ*IADD* for columns 1 and 2 and Δ*IPP* for columns 3 and 4. Columns 1 and 3 present the results of OLS regressions, and columns 2 and 4 present OLS results controlling for selection bias by including the inverse Mills ratio from a first-stage probit regression shown in Table 4.4. Panel A shows the results using *CEO relative inside debt ratio* and Panel B shows the results using *CEO inside debt ratio* as the measure of incentives arising from CEO inside debt holdings. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	ΔIADD			ΔIPP		
Panel A: Using CEO relative inside debt ratio	(1)	(2)	(3)	(4)	(5)	(6)
CEO relative inside debt ratio	**5.403*** **	**4.770*** **	**4.405*** **	**-10.73** **	**-9.633***	**-15.41*** **
	(1.752)	**(1.375)**	**(1.590)**	**(5.076)**	**(5.139)**	**(4.159)**
CEO vega/delta	-0.989*	-0.578	-0.310	1.520	-0.119	0.997
	(0.497)	(0.457)	(0.528)	(1.746)	(2.075)	(1.586)
Bank size	0.054	0.069	0.051	0.232	0.375	0.109
	(0.081)	(0.086)	(0.092)	(0.281)	(0.309)	(0.321)
Profitability	-0.338	-0.566**	-0.774**	2.739***	2.904***	3.297***
	(0.306)	(0.259)	(0.385)	(0.827)	(0.883)	(1.162)
Charter value	0.624**	0.433*	0.338	-1.667	-1.084	-0.769
	(0.295)	(0.251)	(0.289)	(1.333)	(1.159)	(1.274)
Leverage	0.252	0.388	0.518	6.336**	6.616**	4.006
	(0.539)	(0.751)	(0.879)	(2.649)	(2.678)	(2.410)
High risk	1.351***	1.233***	1.238***	-0.097	-0.185	.551
	(0.312)	(0.297)	(.311)	(0.972)	(1.049)	(1.217)
Other controls	Yes	Yes	Yes	Yes		Yes
Observations	89	90	78	89	90	78
Adjusted R^2	0.439	0.386	0.443	0.806	0.792	0.799
Panel B: Using CEO inside debt ratio						
CEO inside debt ratio	**0.814*** **	**0.724*** **	**0.729*** **	**-1.308**	**-1.143**	**-2.373*** **
	(0.289)	**(0.225)**	**(0.256)**	**(0.847)**	**(0.877)**	**(0.758)**
CEO vega/delta	-1.153**	-0.698	-0.436	1.703	-0.035	1.405
	(0.508)	(0.451)	(0.529)	(1.831)	(2.186)	(1.714)

Bank size	0.052	0.074	0.044	0.245	0.371	0.148
	(0.081)	(0.089)	(0.091)	(0.286)	(0.318)	(0.322)
Profitability	-0.330	-0.567**	-0.731*	2.632***	2.828***	3.143***
	(0.313)	(0.264)	(0.383)	(0.819)	(0.884)	(1.156)
Charter value	0.740**	0.529*	0.399	-1.792	-1.217	-0.918
	(0.330)	(0.274)	(0.305)	(1.389)	(1.198)	(1.303)
Leverage	0.601	0.690	0.754	5.624**	6.063**	3.229
	(0.560)	(0.776)	(0.927)	(2.763)	(2.899)	(2.514)
High risk	1.344***	1.232***	1.235***	-0.132	-0.255	0 .685
	(0.315)	(0.303)	(0 .313)	(0.984)	(1.041)	(1.187)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	89	90	78	89	90	78
Adjusted R^2	0.432	0.373	0.438	0.800	0.784	0.792

4.8.3. Alternative Measures of Bank Risk

The dependent variable Δ*IADD* is measured using the changes in default risk due to acquisitions. To ensure that the results are not sensitive to how risk is measured, three alternative measures of risk are employed. First, a relative risk measure is constructed, Δ *Relative DD*, which is the difference between the ratio of post-acquisition acquirer *DD* to benchmark *DD* and pre-acquisition acquirer *DD* to benchmark *DD*. This is similar to the measure used by Amihud et al. (2002) and Hagendorff and Vallascas (2011). Second, Δ*DD* is computed which is the difference in the distance-to-default (*DD*) due to an acquisition without adjustment for the industry-wide changes in default risk. Third, risk is measured by industry-adjusted stock volatility, Δ *Stock volatility*. This is the difference between the standard deviation of daily stock returns for the period 11 days to 70 days after deal completion, and the period 120 days to 60 days before the deal announcement, less the difference between the average stock volatility across all banks on CRSP which did not engage in an acquisition over the same calendar periods.[13]

The results, displayed in Table 4.10, confirm the main finding that higher inside debt holdings induces acquisition-related decrease in bank risk, irrespective of the methodology adopted to compute bank risk.

[13]This study also explored the possibility of using Credit Default Swap (CDS) spreads as an additional measure of bank default risk. However, only ten of the sample banks have CDS data for senior bonds available on Bloomberg. Therefore the findings shown here could not be replicated using CDS data.

Table 4.10: Change in bank risk following acquisition and CEO inside debt, using alternate measures of bank risk. This table uses alternate measures of bank risk, measured as: Δ *Relative DD* for models 1 and 2, Δ *DD* for models 3 and 4, Δ *Stock volatility* for models 5 and 6. The dependent variable is Δ*IADD* for columns 1 and 2 and Δ*IPP* for columns 3 and 4. Columns 1 and 3 present the results of OLS regressions, and columns 2 and 4 present OLS results controlling for selection bias by including the inverse Mills ratio from a first-stage probit regression shown in Table 4.4. *High risk* is a dummy variable which equals one if the pre-acquisition value of the relevant risk measure is in the top quartile of risk, and zero otherwise. Year fixed effects are included. Robust standard errors clustered by bank are reported in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

	Δ *Relative DD*		Δ *DD*		Δ *Stock volatility*	
	(1)	(2)	(3)	(4)	(5)	(6)
CEO relative inside debt ratio	**3.217*** **		**4.697*** **		**-1.376** **	
	(0.988)		**(1.321)**		**(0.585)**	
CEO inside debt ratio		**0.495*** **		**0.691*** **		**-0.199** **
		(0.180)		**(0.202)**		**(0.091)**
CEO vega/delta	-0.061	-0.144	-0.600	-0.721	-0.229	-0.212
	(0.388)	(0.403)	(0.595)	(0.605)	(0.256)	(0.264)
Bank size	0.030	0.032	-0.039	-0.040	-0.020	-0.022
	(0.071)	(0.074)	(0.104)	(0.104)	(0.029)	(0.030)
Profitability	-0.143	-0.137	-0.735**	-0.732**	-0.118	-0.126
	(0.172)	(0.172)	(0.366)	(0.364)	(0.105)	(0.107)
Charter value	0.279	0.351*	1.031***	1.131***	-0.176*	-0.201*
	(0.183)	(0.192)	(0.279)	(0.295)	(0.094)	(0.102)
Leverage	0.479	0.675	-0.177	0.145	0.143	0.094
	(0.404)	(0.425)	(0.744)	(0.767)	(0.273)	(0.298)
High risk	0.291*	0.299*	0.829***	0.817***	-0.451***	-0.467***
	(0.157)	(0.155)	(0.303)	(0.302)	(0.099)	(0.102)
CEO is chair	0.216	0.195	0.155	0.131	-0.037	-0.023
	(0.161)	(0.162)	(0.331)	(0.329)	(0.080)	(0.084)
Board independence	-2.041*	-2.052*	-3.014**	-3.032**	0.499	0.461
	(1.064)	(1.075)	(1.170)	(1.197)	(0.608)	(0.610)
Board size	-0.058**	-0.063**	0.022	0.016	-0.010	-0.009
	(0.028)	(0.029)	(0.045)	(0.045)	(0.015)	(0.015)
CEO age	-1.142	-1.181	-2.198*	-2.187*	0.904**	0.904**
	(0.804)	(0.828)	(1.251)	(1.242)	(0.357)	(0.371)
CEO tenure	0.018	0.019	-0.011	-0.011	-0.005	-0.005
	(0.015)	(0.015)	(0.028)	(0.028)	(0.007)	(0.007)
Relative size	-1.716	-1.609	-0.645	-0.513	0.0286	-0.037

	(1.199)	(1.208)	(1.149)	(1.146)	(0.560)	(0.567)
Diversifying takeover	-0.043	-0.063	-0.160	-0.182	0.088	0.104
	(0.134)	(0.139)	(0.214)	(0.214)	(0.093)	(0.096)
Private target	-0.059	-0.052	0.032	0.044	-0.109	-0.114
	(0.186)	(0.185)	(0.295)	(0.295)	(0.153)	(0.154)
Method of financing	-0.049	-0.039	-0.059	-0.049	0.008	0.001
	(0.088)	(0.089)	(0.161)	(0.164)	(0.057)	(0.057)
Macro conditions	-0.002	-0.003	0.010	0.008	0.001	0.001
	(0.004)	(0.004)	(0.006)	(0.006)	(0.002)	(0.003)
Inverse Mills ratio	-0.612	-0.725*	-1.371**	-1.546**	-0.155	-0.138
	(0.378)	(0.430)	(0.568)	(0.596)	(0.265)	(0.284)
Constant	7.402**	8.135**	7.729*	8.719*	-2.625	-2.721
	(3.226)	(3.415)	(4.616)	(4.781)	(1.755)	(1.935)
Observations	98	98	98	98	98	98
Adjusted R^2	0.105	0.097	0.656	0.653	0.372	0.362

4.9. Conclusion

This chapter uses acquisitions by banks to test the link between CEO inside debt and bank policy regarding risk. The identification strategy focuses on employing acquisitions to test the link between inside debt and risky bank policies since acquisitions often increase the level of firm risk (Furfine and Rosen, 2011; Vallascas and Hagendorff, 2011).

The results show that there is a negative relation between the proportion of inside debt in the CEO's remuneration package, and the change in bank risk following an acquisition. The incentives generated by higher inside debt holdings motivate CEOs to pursue conservative bank policies in the form of risk-reducing acquisitions. The results remain robust to using different measures of bank risk, whether measured using Merton's distance-to-default, asset risk, leverage risk, and equity risk. Moreover, higher inside debt is also associated with a reduced likelihood that the bank pursues an acquisition. From a methodological standpoint, this chapter also tests for potential selection bias in the sample since acquisitions are not a random decision on part of the firm. It controls for this bias by adopting Heckman's two-step estimator.

Next, this chapter investigates some of the channels through which such risk reductions materialize. Previous research highlights that changes in default risk around mergers can occur through two channels: leverage risk and asset risk (Demsetz and Strahan, 1997; Penas and Unal, 2004; Cornett et al., 2006). This chapter tests these conjectures and presents evidence that higher CEO inside debt holdings reduce both asset risk and leverage risk following M&A.

Finally, CEOs with high inside debt extract a smaller benefit from the safety net than CEOs with low inside debt. Since the safety net is underwritten by the taxpayer, the results show that CEO inside debt has a measurable impact on the subsidy which bank shareholders obtain from taxpayers. Overall, the results support the idea that CEO inside debt affects CEO behaviour with regard to risk-taking.

The results are robust to using to controlling for endogeneity of CEO pay through two-stage least squares regression. Moreover, the results hold if the analysis uses an alternate measure of CEO inside debt or after excluding forced acquisitions or failing targets by stronger banks.

Taken together, this chapter presents robust evidence in support of the role of inside debt in mitigating risk-taking through acquisitions in the banking industry. This is the first study to provide empirical evidence that acquisitions are an important channel through which the incentives in the CEO's remuneration package have an impact on bank risk. The next empirical chapter assesses whether inside debt holdings can also affect bank capital holdings. Specifically, it explores whether banks where CEOs hold higher inside debt hold higher amount of equity capital and whether such systematic differences in inside debt holdings can also influence capital adequacy of banks.

5. INSIDE DEBT AND BANK CAPITAL

5.1. Introduction

The amount of capital banks hold matters for economic and financial stability. When banks do not hold sufficient capital, they become more vulnerable to negative shocks that may affect the financial markets. This results in causing the bank to default and affects all the financial intermediaries connected to it. Academic studies and prior experience show that bank defaults often result in a downward spiral resulting in banking crises which affects financial stability and is often followed by a period of economic slowdown associated with sharp growth contraction (Kroszner et al., 2007; Chava and Purnanandanam, 2011; etc.).

Most recently, concerns over the adequacy of bank capital holdings caused widespread instability in bank funding markets and eventually led to the largest bailout in US history. Commentators have long argued that existing regulations designed to ensure banks hold capital in line with the risk of their portfolios are fundamentally flawed (Acharya et al., 2014; Le Leslie and Avramova, 2012; Hanson et al., 2011; Bank for International Settlements, 2010; Federal Reserve, 2012) and allow banks to leverage up too much. Not surprisingly, there are a number of national and multilateral initiatives aimed at increasing the quantity and quality of capital, for instance in the form of Basel III and issuing guidelines for banks to hold a

higher amount of equity capital (Bank for International Settlements, 2010; Bank of England, 2013; European Banking Federation, 2010). Though the details of capital rules seem arcane and technical, ensuring that banks hold sufficient capital is one of the defining conflicts of our time.

One of the determinants of bank capital is monitoring by creditors (e.g. Calomiris and Kahn 1991; Calomiris and Wilson, 2004; Allen et al., 2011). In theory, creditors value equity capital in the bank's capital structure since any losses are first absorbed by the equity buffer before reducing the expected value of their claims on bank cash flows. Consequently, creditors monitor the actions of bank management and seek to influence their actions if banks do not hold sufficient capital. This process is known as market discipline.

The existing empirical literature has focused on evaluating the efficacy of market discipline by focusing on the role of uninsured external creditors, such as depositors, subordinated debtholders, and interbank borrowers (Flannery and Sorescu, 1996; Furfine, 2001; Peria and Schmukler, 2001; Calomiris and Kahn, 1991; Billett et al., 1998; etc.). The view underlying these studies is that only outsiders hold debt-like claims. However, market discipline can also manifest itself internally. This chapter provides a new perspective on this issue by recognizing that many executives own some amount of firm debt and that holders of such instruments may exercise 'internal discipline'.

Formally, internal discipline is defined as the mechanism wherein compensating managers with inside debt disciplines banks since inside debt causes managers to monitor and influence bank behaviour consistent with creditor interests. This is

because executives who hold inside debt face the same default risk concerns as external creditors (Sundaram and Yermack, 2007; Edmans and Liu, 2011). Surprisingly, internal discipline in banking has not received any academic attention. The intuition behind this chapter is rather straightforward: banks may choose to hold insufficient capital in order to extract benefits from the safety net and cause negative externalities by raising the risk that they become insolvent (Kim and Santomero, 1988; Bhattacharya et al., 1988; Berger et al., 1995). However, higher amounts of inside debt internalize these externalities as it passes part of the costs of risky policies back to the CEOs, and therefore impose incentives on bank managers to continually monitor and control the level of bank risk. Nevertheless, the ability of creditor-managers to monitor and control their risk-exposure has not been documented till date.

In essence, this chapter investigates whether CEOs who act as internal creditors to their banks will hold more capital. Therefore, it provides the first empirical examination of internal discipline on bank behaviour by raising the critical question: does internal discipline affect bank capital and, by extension, bank stability?

This chapter begins by proposing a novel measure of internal discipline *CEO debt ownership*. This measure is computed as the fraction of uninsured bank debt that is owned by the CEO (i.e., inside debt/uninsured bank debt). Both CEOs as inside debt holders and the holders of other insured bank debt (such as subordinated debt or uninsured deposits) hold claims that are junior to those of insured depositors and risk making losses on their claims if banks become insolvent. Analogous to external discipline, *CEO debt ownership* captures the discipline exerted by holders of inside debt. The second measure of internal discipline is motivated by the work of Jensen

and Meckling (1976) and Edmans and Liu (2011) who posit that firm policies are moderated by the manager's fractional ownership of debt to her fractional ownership of equity. This is captured through the variable *CEO debt/equity ownership*[14], measured as the fraction of CEO's debt ownership to her equity ownership. It reflects the comparative power of creditors vis-à-vis shareholders in influencing CEOs.

The sample consists of 425 unique publicly listed US banks over the period 2007-2013. In terms of research design, the researcher evaluated comparative advantages of adopting a cross-sectional approach over a fixed-effects panel estimator. The central focus of this chapter is to explore the cross-sectional relationship between the levels of internal discipline (measured using *CEO debt ownership* or *CEO debt/equity ownership*) and bank capital. Typically, cross-sectional variation in ownership levels can be substantial; however within-firm ownership levels change slowly over time (e.g. Zhou (2001)). In such a scenario, using a Fixed-Effects (FE) estimator may not serve the purpose of understanding whether significant cross-sectional variation in ownership levels can predict bank capital levels. This is because a FE estimator forces all the variables to have zero mean in the cross-section and thus estimates how CEO pay affects within-firm variation of bank capital and not cross-sectional variation (Roberts and Whited, 2003). Further, Li and Prabhala (2005) also note that FE estimators are inefficient in estimating the effect of variables which vary little over time, such as ownership levels in the context of this thesis. From an economic standpoint, Zhou (2001) argues that rational managers are expected to pursue policies which are in their long-term interest, and thus are relatively less concerned about year-over-year changes in

[14] It is similar to the measure *CEO relative inside debt ratio* used in Chapters 3 and 4 of this thesis.

their ownership levels. Thus, consistent with the research question of this chapter, a pooled cross-sectional approach was adopted.

It tests this hypothesis through three different tests. First, the analysis examines the impact of internal discipline on the quantity of bank capital, measured using regulatory definitions of bank capital (measured through Total risk-based capital and Tier-1 risk-based capital) and economic definition of bank capital (measured through the fraction of common equity per unit of bank assets held using book-value and market-value).

The results present evidence of a strong association between both measures of internal discipline and bank capital. This finding is consistent with the hypothesis that banks with higher internal discipline are more likely to hold bank capital in a manner consistent with creditor interests. Holding all other variables constant, the coefficient estimates predict that one standard deviation increase in one of the measures of internal discipline (*CEO debt ownership*) results in increasing regulatory bank capital in the magnitude of 25 basis points ($ 60 million) to 28 basis points ($ 68 million), and economic bank capital in the magnitude of 31 basis points ($ 119 million) and 50 basis points ($ 192 million).

Second, the chapter assesses whether higher internal discipline can motivate banks to reduce the expected value of potential taxpayer losses. To the extent that taxpayers also act as unsecured creditors of the bank (Berger et al., 1995), it is proposed that internal discipline should reduce the value of taxpayer claims. As previously in Chapter 4, this chapter also assesses the value of taxpayer losses over bank assets as a put option which increases with bank leverage and asset risk. The

results show that higher internal discipline results in dampening the propensity of banks to increase the expected value of taxpayer losses. In terms of economic significance, one standard deviation increase in one of the measures of internal discipline reducing taxpayer losses of the magnitude of $500 million if 1% of bank assets are wiped out in any given year.

Finally, the chapter deals with the issue of capital adequacy. Various authors (Allen et al., 2011; Berger and Bouwman, 2013; Flannery, 2014) posit that the level of capital held by banks is not adequate given the bank's risk-exposure. This study assesses whether internal discipline can mitigate such incentives. For the purposes of this study, capital adequacy is measured by assessing the magnitude of capital shortfall that the bank is currently facing in order to comply with the Basel-recommended solvency probability of 99.9%[15], wherein the benchmark for solvency probability is motivated by policy work (e.g. Basel committee (2005); Federal Reserve (2006)). Therefore, capital shortfall is the difference between the capital corresponding to Basel-recommended solvency probability and the current level of bank capital. Higher capital shortfall would suggest that banks do not hold adequate bank capital. This chapter shows that higher internal discipline is negatively associated with the amount of capital shortfall. In terms of economic significance, one standard deviation increase in one of the measures of internal discipline (*CEO debt ownership*) results in reducing the magnitude of capital shortfall by 25 to 33 basis points (or decreasing the amount of capital shortfall for an average bank by $100 million to $124 million).

[15]For the purposes of this study, implied capital ratio is the amount of capital that banks should hold in order to lend 99.9% confidence on the ability of the bank to fully repay its debt (including insured deposits)

The results reported here are robust to a battery of tests. The results hold after accounting for potentially endogenous CEO incentives, an alternate measure of internal discipline following Wei and Yermack (2011), excluding all banks which are not well-capitalized, and including bank fixed-effects.

This chapter proceeds as follows. Section 5.2 gives a brief background on creditor discipline and proceeds to develop the empirical hypotheses. Section 5.3 introduces the data and variables. Section 5.4 discusses the main results based on the impact of internal discipline on bank capital. Section 5.5 tests the impact of internal discipline on taxpayer loss exposure and Section 5.6 tests the impact on capital adequacy. Section 5.7 contains additional analysis and shows the results of robustness tests. Section 5.8 concludes.

5.2. Background

The amount of capital that banks hold has been a pervasive issue that has concerned bank creditors and regulators. Fundamentally, capital decisions are a result of the privately optimal choice of executives in response to conflicts of interest between shareholders and creditors (Jensen and Meckling, 1976). Shareholders perceive equity as more expensive than insured debt, such as deposits, which banks are able to raise cheaply under the presence of underpriced deposit insurance subsidy (Ronn and Verma, 1986; Keeley, 1990). Moreover, the residual claim of shareholders acts as a call option on the value of bank assets (Merton, 1977). Lower equity, and hence higher leverage risk, allows shareholders to maximize the value of that call option. In sharp contrast, creditors desire higher level of capital to protect the value of their

claims against bank default. Creditors hold fixed claims the upside of which is contractually limited. These conflicts of interests over risk are particularly strong in banks where shareholders hold a small fraction of the balance sheet, which means that their residual claims represent a highly leveraged bet, and the presence of government guarantees which acts as a put option for the shareholders on the value of bank assets increases in bank leverage (Merton, 1977).

Therefore, creditors have strong incentives to monitor and control bank policies to ensure that banks hold capital that is commensurate with a bank's risk-exposure. There is, however, limited and largely inconclusive evidence on whether external creditors can influence the amount of bank capital held. For instance, Bliss and Flannery (2001) do not find conclusive evidence to show that higher external creditor discipline resulted in higher bank capital and lower dividends. Similarly, Nier and Baumann (2006) find that higher creditor discipline results in larger capital buffer, however this influence is reduced under the presence of financial safety-net.

A common thread among the previously discussed studies is that external creditors monitor managers and the resulting market pressures force managers to meet creditor interests. Put differently, these mechanisms are imposed on managers through external monitoring. This chapter takes an expansionary view of market discipline to argue that internal creditors of a firm also exist and they can monitor and discipline bank behaviour.

A starting point for the investigation is the emerging focus on ownership of debt by insiders in the form of inside debt. Crucially, inside debt is an unsecured and unfunded firm obligation whose value to the CEO is contingent on the firm

remaining solvent. If a firm fails, CEOs have equal claims as those of other unsecured creditors (Sundaram and Yermack, 2007; Edmans and Liu, 2011). Because both external and internal creditors face similar incentives, and both hold claims that are junior to those of insured depositors, one might expect the discipline exercised by the holders of inside debt to be consistent with the objectives of ensuring safety and soundness of their banks. Thus, inside debt disciplines managers and dampens their incentives to pursue risky bank policies, similar to the discipline exerted by external creditors.

Recent evidence shows that inside debt is associated with lower bank default risk and more conservative bank policies (Bennett et al., 2013; Bekkum, 2014; Bolton et al., 2010). In the same vein, inside debt may also motivate the CEO to impose internal discipline and this can affect the amount of capital held by a bank. Since internal discipline helps in aligning executive interests with those of creditors, it results in incentivizing the managers to accurately measure and monitor the financial condition of their bank and hold a larger equity capital buffer. Arguably, bank executives have all the necessary information to gauge whether capital is sufficient to ensure bank stability, given the risk-exposure and maturity structure of their liabilities. Building on these arguments and previous empirical evidence, this chapter posits that banks where executives are subject to higher internal discipline will hold higher bank capital.

5.3. Data and Variables

Data on inside debt holdings were provided by SNL Financial[16] for the period 2007 to 2013. The sample period begins in 2007 since data on inside debt became publicly available only since the SEC issued mandatory compensation disclosure requirements for the financial year ending 2006. The new dataset results in a unique and comprehensive sample that covers inside debt holdings of 426 unique US publicly-listed banks, resulting in 2,164 bank-year observations over the sample period. This is larger than other studies on inside debt which are restricted to S&P 1500 firms or primarily use one-year cross-sectional data due to data collection costs (e.g. Bennett et al. (2012); Bekkum (2014)).

Data on inside debt is matched with quarterly FR Y-9C reports filed with the Federal Reserve and CRSP to obtain bank accounting data and stock return data, respectively. Furthermore, data on executive equity ownership in the form of options is provided by SNL Financial and data on stock ownership is hand-collected from annual DEF 14A proxy statements filed with the SEC.

5.3.1. Dependent Variables: Bank Capital

This study employs various measures of bank capital. First, it includes two commonly used measures of regulatory bank capital. These are *Total capital ratio* which is the ratio to total (Tier-1 and Tier-2) risk-based bank capital scaled by risk-weighted assets (RWA) and *Tier-1 capital ratio* which is defined as the ratio of Tier-1 risk-based capital to RWA. Tier-1 and Tier-2 capital are defined in accordance with the Basel capital standards and are directly available from call reports.

[16]The researcher would like to thank Rabia Arif from SNL Financial for providing the data.

Second, it includes two measures of economic bank capital that capture the perspectives of market investors. The first measure, *Book equity capital* (or book leverage), is measured as the ratio of book value of common-equity to the book value of assets. It represents the amount of capital buffer available for creditors and depositors, before they start experiencing losses. Nier and Baumann (2006) suggest using book-based measure since it is under direct control of the bank managers. The second measure is *Market equity capital* (or market leverage), which is measured as the ratio of the market value of equity (financial year-end stock price multiplied by shares outstanding) divided by the market value of assets. *Market equity capital* incorporates future expectations of the market as regards the bank's liquidation value. This measure has been utilized by various empirical studies (e.g. Flannery and Rangan (2008); Gropp and Heider (2010); Keeley (1990)) and has been advocated by policymakers (e.g. Haldane's (2011) speech). For the purposes of this study, market value of assets is the implied value of assets derived from Merton's (1977) model which represents equity as a call option on the value of bank assets. The methodology is explained in Appendix B.

5.3.2. Dependent Variables: Taxpayer Loss Exposure

The presence of financial safety net, in the form of explicit and implicit guarantees, implies that taxpayers also act as unsecured creditors. This is because taxpayers are required to cover the costs of financial distress imposed on the insured depositors and stand in line with the unsecured creditors (Berger et al., 1995; Flannery, 2014). Thus, the value of taxpayers claim on bank assets also constitutes a measure of bank leverage, which is measured as the ratio of actuarially fair value of the deposit

insurance to the market value of assets. This is referred as *Taxpayer loss exposure* throughout this chapter. It measures the potential losses for taxpayers per unit of bank assets[17]. Higher taxpayer loss exposure should be negatively associated with internal discipline.

Please refer to Section 4.6.1 of Chapter 4 for a detailed explanation of the method for calculating the value of taxpayer losses. To reiterate, the value of taxpayer claims is valued by employing the methodology used by Merton (1977) and Ronn and Verma (1986). It is expressed as:

$$\textit{Taxpayer loss exposure} = N(y + \sigma_{A,t}\sqrt{T}) - ((1-\delta)^n (V_A/B_t)\, N(y)) * B_t \quad (5.1)$$

$$y = (\ln[B/V_{A,t}(1-\delta)^n] - \sigma_{A,t}^2\, T/2)/\sigma_{A,t}\sqrt{T}), \quad (5.2)$$

where B_t is the book value of liabilities, δ is the fraction of dividend to assets, n is the number of dividend payments per year, $N(\cdot)$ is the cumulative standard normal distribution, T is set equal to one based on the assumption that bank deposits mature in the next year when a bank examination or audit occurs. The calculation of $V_{A,t}$ and $\sigma_{A,t}$ is explained in Appendix B.

5.3.3. Dependent Variables: Capital Adequacy

This chapter assesses whether banks hold adequate capital or not through its *capital shortfall* measure. *Capital shortfall* is defined as the difference between the capital required to make default unlikely (or the minimum 'safe' capital) and the bank's current equity capital (measured using *Book equity capital* or *Market equity capital*).

[17]Alternatively, this study also measures taxpayer loss exposure as the actuarial value of deposit insurance scaled by market value of firm equity. The results remain very similar.

To ensure a relevant benchmark for the amount of safe capital, this study computes the equity capital (Equity/Assets) that corresponds to ensuring banks have a default probability of less than 0.1% over a one year horizon, as recommended under the Basel accords (Gordy and Howells, 2006; Basel committee, 2005; Federal Reserve, 2006). Bank default probability is assessed by adopting the methodology of Hillegeist et al. (2001) and Vassalou and Xing (2004). Please refer to Section 4.4.2 of Chapter 4 for a detailed explanation of how to calculate default probability, wherein default probability is the standard cumulative normal function of the distance-to-default computed.

5.3.4. Measure of Internal Discipline

To test the hypotheses that internal discipline affects bank capital, two measures of internal discipline are computed. The first measure is *CEO debt ownership*, defined as the fraction of uninsured bank debt that is owned by the CEO (i.e. inside debt/uninsured bank debt). This measure would indicate the extent to which banks are monitored and disciplined by the CEO. It is analogous to managerial stock ownership variable which shows the degree of alignment with shareholders.

CEO debt ownership = (CEO inside debt / uninsured bank debt) (5.3)

CEO inside debt is calculated as the sum of the present value of accumulated pension benefits and deferred compensation. *Uninsured bank debt* is the total value of the bank's debt, less the estimated amount of retail deposits insured by the FDIC[18]. In the case of insured deposits, it can be argued that FDIC insured creditors

[18]Insured deposits are defined as all domestic noninterest-bearing deposits, interest-bearing demand deposits, money market deposits, and time deposits of value less than $100,000 held by the bank.

are in a better position to protect themselves from losses than uninsured bank creditors. So, for the purpose of the scaling in equation (5.3), this study excludes the amount of insured deposits from Bank external debt.

The second measure of internal discipline –*CEO debt/equity ownership*– is the fraction of CEO's debt ownership (as shown in equation (5.3)) scaled by the fraction of CEO's equity ownership. This is similar to the *CEO relative inside debt ratio* measure used in previous two empirical chapters of this thesis.

CEO debt/equity ownership = (*CEO debt ownership*/*CEO equity ownership*), (5.4)

where *CEO equity ownership* = (*CEO inside equity* / *Bank equity*) (5.5)

CEO inside equity (or equity-based compensation) is the dollar value of the CEO's holdings of firm equity and options, as at the financial year-end of the bank; and *Bank equity* is the market value of the bank's equity. Value of CEO stock options is calculated following Black and Scholes's (1973) option-pricing methodology.

5.3.5. Measure of External Discipline

The measurement of external discipline is motivated from prior work which argues that external creditors act as active monitors of bank policies. For instance, Flannery and Sorescu (1996) show that sub-ordinated creditors actively reflect changes in bank risk in their pricing of subordinated debt. Bliss (2001) shows that peer-banks charge higher interest rates in interbank funds market from riskier banks. Flannery (1994) argues that short-term creditors are an effective source of market discipline since they can refuse to roll-over their loans if a bank is particularly risky.

This study measures external discipline through two variables: *Uninsured liabilities* which reflects the amount of uninsured liabilities (in the form of sub-ordinated debt, interbank deposits, and wholesale funds) scaled by bank debt and *Core deposits* which reflects the fraction of insured core-deposits to total deposits. A higher fraction of uninsured liabilities suggests greater scrutiny of bank policies by external bank creditors. By contrast, insured depositors are weak monitors since they are widely dispersed and protected from losing their deposits due to the presence of deposit insurance. Thus, higher amount of insured deposits should be associated lower bank capital.

5.3.6. Other Control Variables

CEO equity ownership: While the major purpose of this chapter is to examine the relationship between incentives arising from CEO's inside debt holdings and bank capital holdings. CEO compensation also consists of inside equity in the form of common stock and options which align CEO with shareholders, causing them to pursue shareholder-friendly policies (Jensen and Meckling, 1976). To control for such incentives, this analysis adopts *CEO equity ownership* to reflect incentives arising from CEO's ownership of firm equity. This variable has been defined in the previous section (equation (5.5))[19].

[19] It can also be argued that CEO incentives to increase risk are primarily a result of her option holdings. The results of this chapter remain very similar if the analysis controls for such incentives, in addition to *CEO equity ownership*, through the variable *CEO vega/delta* (Grant et al., 2009; Cassell et al., 2012). Please refer to Section 4.4.3 of Chapter 4 for a detailed explanation of how to calculate this measure.

Firm-specific variables: An array of controls for bank-specific attributes are included: *Profitability* (Net income to book value of equity) and *Bank size* (natural logarithm of the book value of assets) since larger and more profitable banks hold higher capital (Flannery and Rangan, 2008; Gropp and Heider, 2010). The presence of valuable bank charters allows banks to enjoy economic rents due to which banks are more likely to protect their charter by lowering leverage (Keeley, 1990). Accordingly, *Charter value* (market value of assets to book value of assets) is included to capture the present value of future benefits that the bank extracts through its charter.

Bank capital may increase due to passive retention of earnings if higher bank earnings are not accompanied with an increase in bank payouts, or due to active growth strategies in the form of larger loans and increases in size through acquisitions (Berger et al., 2008; Flannery and Rangan, 2008). These motivations are captured through Δ *Retained earnings* (change in retained earnings over prior year divided by assets) to proxy for passive increases in bank capital and *Asset growth* (% change in bank assets over prior year) for active increases in bank capital.

Previous research argues that bank risk may be positively associated with capital since banks may hold higher capital buffer against future losses (Shrieves and Dahl, 1992; Calomiris and Wilson, 2004). This study adopts two measures for this. The first measure is *Portfolio risk* which is the implied variance of firm's market value of assets and the procedure is illustrated in Appendix B. The second measure is a measure of *Credit risk* (Loan Loss Provisions/Loans) since banks with higher credit

risk may see further decline in their bank capital in the future. Thus, the analysis accounts for both *ex ante* and *ex post* measures of bank risk.

It is widely argued that bank capital is procyclical in nature, i.e. banks hold higher capital during expansionary macroeconomic environment (Laeven and Majnoni, 2005). To account for this, this study controls for macroeconomic conditions (*Macro conditions*) using the Federal Reserve Bank of Philadelphia's state-coincident index which summarizes the macroeconomic conditions in the state where the bank has its headquarters. The final control variable that is used is a dummy variable *TARP bank* which equals one if the bank received capital infusion in the form of TARP during the sample period, adjusted for repayment. Controlling for TARP helps in delineating the fact that banks which received TARP had weak capital positions.

5.3.7. Descriptive Statistics

Before turning to the empirical results, Table 5.1 reviews some summary statistics of the variables used in this analysis. Banks are generally profitable and have high charter value. In terms of the strength of internal discipline, the average (median) *CEO debt ownership* is 0.31% (0.06%) while *CEO equity ownership* is 1.97% (0.84%). The difference between debt and equity ownership levels indicates that bank CEOs are aligned more towards shareholders than creditors.

The sample exhibits considerable cross-sectional variation in terms of bank capital ratios. For instance, the average *Total capital ratio* is 14.3% and *Tier-1 capital ratio* is 12.7%. This is considerably higher than the minimum capital requirements imposed under Basel-2 rules, which state that well-capitalized banks

should hold 10% Total risk-based capital ratio and 8% Tier-1 capital risk-based ratio. In terms of economic bank capital measures, *book equity capital* is 9.7% with a standard deviation of 2.8%. Similarly, *market equity capital* is also heterogeneous throughout the sample. This supports the argument that banks hold significant amount of discretionary capital buffer, suggesting banks' voluntary decisions to increase the amount of discretionary capital they hold (Berger et al. (2008); Flannery and Rangan (2008); etc).

Table 5.1: Descriptive statistics. The sample is 2164 observations (composed of 425 individual banks) over the period 2007 to 2013. *Total capital ratio* is the ratio of Total risk-based capital to RWA. *Tier-1 capital ratio* is the fraction of Tier-1 risk-based capital to RWA. Definitions of Total risk-based capital and Tier-1 risk-based capital are in accordance with Basel capital standards. *Book equity capital* is the fraction of book value of equity to book value to assets. *Market equity capital* is the ratio of market value of equity to market value of assets, wherein market value of equity is number of shares outstanding times year-end stock price and market value of assets is the implied value of assets derived from Merton's (1978) model which represents equity as a call option of the value of bank assets. The calculation of market value of assets is explained in Appendix B. *Taxpayer loss exposure* is the value of the bank's safety net to market value of assets, wherein value of safety net is calculated as the actuarially fair value of deposit insurance as done in Ronn and Verma (1986). *Capital shortfall (book)* is measured as the difference between Basel-recommended implied equity-to-assets ratio and the bank's current book equity capital. *Capital shortfall (market)* is measured as the difference between Basel-recommended implied equity-to-assets ratio and the bank's current market equity capital. *CEO debt ownership* is the fraction of CEO inside debt to unsecured bank debt. *CEO debt/equity ownership* is the fraction of CEO debt ownership to CEO equity ownership, where *CEO equity ownership* is defined as CEO inside equity to market value of equity. It is similar to the measure *CEO relative inside debt ratio* used in Chapters 3 and 4 of this thesis. CEO inside equity is the sum of Black-Scholes option value of CEO's option holdings and the current market value of her stock holdings. *Uninsured liabilities* is the sum of bank's subordinated debt, interbank deposits and short-term funding, standardized by bank liabilities. *Core deposits* is the sum of non-interest and interest bearing deposits, money market deposits, and time deposits and brokered deposits of less than $100,000, scaled by total deposits. *Profitability* is the ratio of net income to book value of bank equity. *Bank size* is the natural logarithm of the book value of bank assets. *Charter value* is the ratio of market value of equity divided by the book value. Δ *Retained earnings* is measured as the percentage change in retained earnings over prior year, standardized by book value of assets. *Asset growth* is defined as the percentage change in bank assets over prior year. *Portfolio risk* is a measure of the standard deviation of the market value of bank, calculated from Merton's (1978) model. This methodology is explained in Appendix B. *Credit risk* is the fraction of loan loss provisions to bank loans, expressed in percentage. *Macro conditions* is the average over twelve months preceding the bank's financial year-end of the Federal Reserve Bank of Philadelphia's monthly state-coincident index of macro conditions in the state where the bank has its headquarters. *TARP bank* is an indicator variable which equals one if the bank was under TARP program, and zero otherwise
Sources: FR Y-9C reports, CRSP, SNL Financial, DEF 14A statements.

Table 5.1 continued

	Mean	Median	25th percentile	75th percentile	Standard Dev.
Total capital ratio	0.143	0.140	0.123	0.161	0.028
Tier-1 capital ratio	0.127	0.124	0.106	0.145	0.030
Book equity capital	0.097	0.095	0.078	0.116	0.028
Market equity capital	0.100	0.100	0.061	0.133	0.049
Taxpayer loss exposure	0.080	0.011	0.000	0.138	0.113
Capital shortfall (using book capital)	0.011	0.002	-0.033	0.053	0.055
Capital shortfall (using market capital)	0.007	0.004	-0.040	0.058	0.061
Creditor discipline variables					
CEO debt ownership	0.31%	0.06%	0.00%	0.38%	0.51%
CEO debt/equity ownership	0.346	0.096	0.000	0.513	0.485
Uninsured liabilities	0.237	0.227	0.172	0.294	0.087
Core deposits	0.590	0.604	0.523	0.681	0.120
Control variables					
CEO equity ownership	1.97%	0.84%	0.32%	2.05%	2.86%
Profitability	0.038	0.071	0.022	0.107	0.122
Bank size	14.754	14.526	13.801	15.608	1.136
Charter value	1.014	1.007	0.976	1.045	0.050
Δ Retained earnings	0.128	0.299	-0.142	0.596	0.646
Asset growth	0.062	0.043	-0.007	0.108	0.104
Portfolio risk	0.047	0.037	0.025	0.056	0.056
Credit risk	1.023	0.579	0.239	1.448	1.092
Macro conditions	1.465	1.438	1.386	1.514	0.141
TARP bank	0.296	0.000	0.000	1.000	-

5.4. Results: Inside Debt and Bank Capital

The following regression model is used to test the impact of internal discipline on bank capital:

$$Bank\ Capital_{i,t} = \beta_0 + \beta_1\ (Internal\ discipline_{i,t-1}) + \beta_2\ (External\ discipline_{i,t-1}) + \beta_3\ (Control\ variables_{i,t-1}) + \beta_4\ (F_t) + \varepsilon_{i,t} \quad (5.6)$$

where all variables are defined in Table 5.1, the *t* subscript denotes calendar year *t*, the *i* subscript refers to the bank, and F_t is a dummy variable equal to one for year *t*. The dependent variable includes different measures of bank capital, namely *Total capital*, *Tier-1 capital*, *Book equity capital*, and *Market equity capital*. The results are shown in Table 5.2.

Both measures of internal discipline enter positively and significantly at 5% level or better, indicating that banks hold more capital when they are subject to higher internal discipline. The results are also economically significant. Specifically, one standard deviation increase in *CEO debt ownership* results in increasing regulatory capital by 25 basis points ($ 60 million) to 28 basis points ($ 68 million) and increasing economic capital by 31 basis points ($ 119 million) and 50 basis points ($ 192 million).

Table 5.2: Bank capital and internal discipline. The dependent variable in models 1 and 5 is *Total risk-based capital*, measured as the ratio of Total capital (Tier-1 capital + Tier-2 capital) to risk-weighted assets. The dependent variable in models 2 and 5 is *Tier-1 risk-based capital*, measured as the ratio of Tier-1 capital to risk-weighted assets. For models 3 and 6, dependent variable is the *book equity capital*, measured as the ratio of book value of equity to book value of assets. For the remaining columns, the dependent variable is *market equity capital*, measured as the ratio of market value of equity to market value of assets. Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	Total Capital	Tier-1 Capital	Equity capital (book)	Equity capital (market)	Total Capital	Tier-1 Capital	Equity capital (book)	Equity capital (market)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO debt ownership	**0.502*** **	**0.560*** **	**0.606*** **	**0.994*** **				
	(0.188)	**(0.190)**	**(0.206)**	**(0.229)**				
CEO debt/equity ownership					**0.004** **	**0.004** **	**0.009*** **	**0.007*** **
					(0.002)	**(0.002)**	**(0.002)**	**(0.002)**
CEO equity ownership	0.044	0.041	-0.024	-0.031				
	(0.031)	(0.036)	(0.017)	(0.048)				
Uninsured liabilities	0.001	0.001	-0.006	-0.007	0.001	-0.001	-0.006	-0.008*
	(0.003)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)	(0.005)
Profitability	0.045***	0.049***	0.015	0.142***	0.047***	0.052***	0.016	0.146***
	(0.012)	(0.014)	(0.013)	(0.023)	(0.012)	(0.014)	(0.013)	(0.023)
Bank size	-0.000	0.001	0.007***	0.016***	-0.001	0.001	0.006***	0.015***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Bank size^2	-0.000	-0.010***	-0.007*	-0.018***	-0.001	-0.011***	-0.006	-0.017***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Charter value	0.010	0.011	-0.023	0.094*	0.011	0.013	-0.021	0.096*
	(0.010)	(0.010)	(0.025)	(0.052)	(0.009)	(0.009)	(0.024)	(0.053)
Core deposits	-0.024**	-0.030**	0.009	0.026	-0.025**	-0.031**	0.006	0.026
	(0.011)	(0.012)	(0.014)	(0.022)	(0.011)	(0.013)	(0.014)	(0.022)
Δ Retained earnings	0.002**	0.002**	0.005***	-0.001	0.002**	0.002**	0.005***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Asset growth	-0.007	-0.008	-0.002	0.002	-0.007	-0.008	-0.001	0.002
	(0.005)	(0.005)	(0.003)	(0.003)	(0.005)	(0.005)	(0.003)	(0.003)
Portfolio risk	0.055	0.062*	0.094*	0.125*	0.052	0.058	0.091*	0.123*
	(0.035)	(0.037)	(0.052)	(0.066)	(0.036)	(0.037)	(0.055)	(0.069)
Credit risk	0.001	-0.001	-0.002	-0.004**	0.001	-0.001	-0.002	-0.004**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)

Macro conditions	0.004	0.004	0.009	0.023**	0.004	0.004	0.010	0.024**
	(0.007)	(0.008)	(0.008)	(0.009)	(0.007)	(0.008)	(0.008)	(0.010)
TARP bank	0.004**	0.004*	-0.009***	-0.015***	0.004**	0.003	-0.009***	-0.016***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Constant	0.122***	0.111***	-0.008	-0.276***	0.130***	0.119***	-0.000	-0.268***
	(0.023)	(0.024)	(0.033)	(0.051)	(0.023)	(0.024)	(0.032)	(0.053)
Observations	2,159	2,159	2,159	2,159	2,153	2,153	2,153	2,153
Adjusted R^2	0.268	0.282	0.274	0.590	0.260	0.275	0.281	0.584

With regard to the measures of external discipline, *Uninsured liabilities*, there is only weak evidence to suggest that external creditors can influence bank capital. This is consistent with Bliss and Flannery (2001) who are not able to find any *prima facie* support that banks respond to higher levels of external discipline. More importantly, *Core deposits* enters the regression models negatively which shows that banks hold less capital if they hold a larger fraction of insured deposits.

Of the control variables, larger and more profitable banks hold higher capital. Δ *Retained earnings* is also an important determinant of bank capital. This indicates that intertemporal increases in bank capital can also be attributed in part to passive effects, arising from increases in higher profitability yet constant (sticky) payout policies.

Interestingly, *Portfolio risk* does not affect regulatory capital holdings but it does affect economic capital holdings. To the extent that Basel regulatory capital ratios are risk-based, they should be increasing in portfolio risk. However, this study does not find evidence in support of this, thereby suggesting that Basel regulatory capital is not fit for assessing if banks hold capital commensurate to risk-exposure. This is consistent with Vallascas and Hagendorff's (2013) finding that regulatory capital requirements are not sensitive to the portfolio risk of banks.

5.5. Results: Inside Debt and Taxpayer Loss Exposure

This section examines whether internal discipline controls managerial incentives to increase the expected value of taxpayer losses. This is because managers feel great pressure arising from their inside debt holdings to hold extra capital. Higher capital

in turn would give creditors and, by extension, taxpayers a higher equity capital buffer before the expected value of their claims starts decreasing. Therefore, higher internal discipline should be negatively associated with potential taxpayer loss exposure. This link is examined by estimating the following regression model:

$$\textit{Taxpayer Loss Exposure}_{i,t} = \beta_0 + \beta_1\,(\textit{Internal discipline}_{i,t-1}) + \beta_2\,(\textit{External discipline}_{i,t-1}) + \beta_3\,(\textit{Control variables}_{i,t-1}) + \beta_4\,(F_t) + \varepsilon_{i,t} \quad (5.7)$$

where all variables are defined in Table 5.1, the *t* subscript denotes calendar year *t*, the *i* subscript refers to the bank, and F_t is a dummy variable equal to one for year *t*. The dependent variable *Taxpayer loss exposure* is the actuarial value of deposit insurance scaled by the market value of bank assets. The results are shown in Table 5.3.

The results show that coefficients for both measures of internal discipline are negative and statistically significant. This indicates that higher internal discipline helps in limiting the amount of taxpayer loss exposure. A one standard deviation increase in internal discipline is associated with a decrease in taxpayer loss exposure by 37 basis points in column 1 and 34 basis points in column 2. This translates into reducing the average taxpayer losses by roughly $142 million to $168 million per bank (or reducing taxpayer losses by the magnitude of $ 500 million if 1% of bank assets are wiped out in a specific year). This result is noteworthy because internal

discipline not only increases bank capital holdings but also reduces the expected value of the exposure to loss of taxpayers. Other control variables have signs that are consistent with expectations.

Table 5.3: Taxpayer loss exposure and internal discipline. The dependent variable is taxpayer loss exposure, measured as the ratio of the value of deposit insurance to market value of assets. The dependent variable has been expressed in basis points. Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	(1)	(2)
CEO debt ownership	**-0.735****	
	(0.361)	
CEO debt/equity ownership		**-0.007****
		(0.003)
CEO equity ownership	-0.007	
	(0.027)	
Uninsured liabilities	0.008	0.008
	(0.006)	(0.006)
Profitability	-0.001	0.001
	(0.005)	(0.003)
Bank size	-0.002	-0.001
	(0.003)	(0.003)
Bank size^2	-0.005	-0.004
	(0.006)	(0.006)
Charter value	-0.057***	-0.046***
	(0.010)	(0.009)
Core deposits	0.029	0.021
	(0.022)	(0.022)
Δ Retained earnings	-0.022***	-0.011***
	(0.004)	(0.002)
Asset growth	0.001	0.003
	(0.005)	(0.005)
Portfolio risk	0.480***	0.488***
	(0.092)	(0.089)
Credit risk	0.017***	0.016***
	(0.003)	(0.002)
Macro conditions	0.020	0.016
	(0.013)	(0.013)
TARP bank	0.001	0.003
	(0.004)	(0.004)
Constant	0.246***	0.239***
	(0.040)	(0.039)
Observations	2,159	2,153
Adjusted R^2	0.608	0.612

5.6. Results: Inside Debt and Capital Adequacy

The issue of capital adequacy is of particular relevance to regulators and the government. Capital adequacy is central from a macro-prudential perspective, because it concerns assessing whether the current level of bank capital is enough to ensure that the bank remains solvent even during adverse circumstances. For instance, before the onset of the crisis, a large fraction of banks held significant equity capital but performed poorly during the crisis. This is because banks held lower capital relative to their portfolio risk and the maturity of liabilities (e.g. excessive reliance on wholesale funding), among other reasons. In this respect, Allen et al. (2008) suggest that banks may be under-capitalized even if they hold a large capital buffer. This can lead to capital shortfall and subsequent capital infusion from the government and taxpayers.

As a next step, this section explores the relation between internal discipline and capital shortfall through the following regression model:

$$Capital\ shortfall_{i,t} = \beta_0 + \beta_1\ (Internal\ discipline_{i,t-1}) + \beta_2\ (External\ discipline_{i,t-1}) + \beta_3\ (Control\ variables_{i,t-1}) + \beta_4\ (F_t) + \varepsilon_{i,t} \quad (5.8)$$

where all variables are defined in Table 5.1, the *t* subscript denotes calendar year *t*, the *i* subscript refers to the bank, and F_t is a dummy variable equal to one for year *t*. *Capital shortfall* is defined as the difference between the capital required to ensure a default probability of less than 0.1%, wherein the benchmark of 0.1% default

probability is recommended under the Basel accords, and the bank's current equity capital (whether measured using *Book equity capital* or *Market equity capital*).

Table 5.4: Capital shortfall and internal discipline. The dependent variable is capital shortfall, measured as the difference between Basel-recommended implied equity-to-assets ratio and the bank's current book equity capital (in model 1 and 3), and the difference between *implied* equity-to-assets ratio as set under Basel standards and the bank's current market equity capital (in models 2 and 4). Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	(1)	(2)	(3)	(4)
CEO debt ownership	**-0.483*** **		**-0.654*** **	
	(0.177)		**(0.216)**	
CEO debt/equity ownership		**-0.005** **		**-0.005** **
		(0.002)		**(0.002)**
CEO equity ownership	0.066**		0.036	
	(0.028)		(0.034)	
Uninsured liabilities	0.010**	0.011**	0.010***	0.010***
	(0.004)	(0.004)	(0.004)	(0.004)
Profitability	-0.001	0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Bank size	-0.003*	-0.000	-0.008***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Bank size^2	-0.001	-0.004	0.003	0.002
	(0.005)	(0.004)	(0.005)	(0.005)
Charter value	0.379***	0.040	-0.066***	-0.068***
	(0.030)	(0.052)	(0.013)	(0.014)
Core deposits	0.025	0.038**	0.020	0.020
	(0.016)	(0.016)	(0.013)	(0.013)
Δ Retained earnings	-0.006***	-0.007***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Asset growth	-0.008	-0.001	-0.038***	-0.039***
	(0.009)	(0.010)	(0.009)	(0.009)
Portfolio risk	0.285***	0.573***	0.257***	0.250***
	(0.046)	(0.071)	(0.048)	(0.049)
Credit risk	0.010***	0.007***	0.013***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)
Macro conditions	-0.005	-0.006	-0.006	-0.006
	(0.007)	(0.009)	(0.007)	(0.007)
TARP bank	0.004*	-0.001	0.006**	0.006**
	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-0.276***	-0.071	0.253***	0.153***
	(0.036)	(0.051)	(0.026)	(0.026)
Observations	2,152	2,146	2,152	2,146
Adjusted R^2	0.600	0.549	0.627	0.625

Higher capital shortfall suggests that the current level of bank capital is inadequate to meet the Basel-recommended solvency ratio of 99.9%. The results for capital shortfall (shown in Table 5.4) broadly resemble the bank capital results discussed previously. In all columns, as the level of internal discipline increases, banks are less likely to face a capital shortfall. As far as economic magnitudes are concerned, a one standard deviation increase in *CEO debt ownership* reduces the amount of capital shortfall by 25 to 33 basis points.

Most of the control variables generally have the expected signs. Higher charter value (*Charter value*) reduces the chances of a capital shortfall, banks which pursue passive growth (Δ *Retained earnings*) or active growth (*Asset growth*) are also less likely to face capital shortfall. *Portfolio risk* is positively associated with capital shortfall because higher bank risk would result in increasing the put-option value of deposit insurance and hence higher expected losses for taxpayers.

Broadly, the findings of this chapter are consistent with the interpretation that higher internal discipline results in ensuring that banks hold an adequate level of equity capital. Internal discipline results in reducing the possibility that the bank faces a capital shortfall and motivates banks to hold higher discretionary capital buffer over the implied capital required for mitigating default risk concerns.

5.7. Additional Tests and Robustness Checks

5.7.1. Endogeneity

An important aspect of establishing a robust relation between internal discipline and bank capital is to deal with endogeneity issues surrounding CEO debt ownership and

equity ownership. Such endogeneity concerns can arise due to reverse causality, that is bank CEOs in highly capitalised banks may request for a larger proportion of their pay to be paid in inside debt and CEOs of highly leveraged banks may ask a larger fraction of their pay to consist of equity-based compensation.

To address these issues, this chapter uses four instrumental variables as sources of exogenous variation in CEO debt and equity ownership. The first instrument is the *Personal tax rate* which is the sum of maximum state and federal marginal personal income tax rates in the state where a bank is headquartered. If CEOs reside in a state which levies a higher income tax on personal income, CEOs may opt to receive a larger amount of inside debt and lower amount of inside equity (Anantharaman et al., 2013; Kim and Yu, 2011).

The second instrument is *Liquidity*, measured as the natural logarithm of cash holdings to book value of bank assets. Cash-constrained firms (or firms with low *Liquidity*) prefer to use inside equity to compensate CEOs since inside equity does not require firms to pay cash whereas inside debt would require firms to pay cash (Core and Guay, 1999; Sundaram and Yermack, 2007). Armstrong and Vashishtha (2012) also argue that short-term availability of cash is a valid instrument for incentives originating from CEO equity-based compensation. Following prior literature, this study also includes *CEO age* (natural logarithm of CEO's age in years) and *CEO tenure* (CEO's service in the current bank in years) as instruments since older and longer-serving CEOs are more likely to have higher amount of inside debt owing to the mechanical relationship between present value of pension benefits and CEO's age and tenure (Sundaram and Yermack, 2007; Cassell et al., 2012;

Bekkum, 2014). Therefore, this study employs four instruments for endogenous CEO debt and equity ownership variables[20].

The analysis begins by first identifying the determinants of CEO debt ownership and equity ownership, which forms the first-stage regression. It is used to generate the predicted values of CEO debt and equity ownership that take into account only exogenous information, partially coming from the instruments highlighted above. These predicted values are then used in the second stage regression on the various measures of bank capital. The results of first-stage regression are shown in Table 5.5. Broadly, the coefficients on instruments for *CEO debt ownership* have the expected sign and are significant. The second-stage results, shown in Table 5.6 are consistent with prior analysis. Instrumented measures of *CEO debt ownership* are related with higher levels of bank capital and reduced capital shortfall during the sample period. In fact, the results are stronger when using predicted *CEO debt ownership*.

[20]This study also considered using two-year or three-year lags of *CEO debt ownership* and *CEO equity ownership* as instruments for CEO's debt ownership and equity ownership. Results remain very similar with these instruments.

Table 5.5: Determinants of CEO debt ownership, first-stage of 2SLS. This table shows the first-stage results from a two-stage regression framework where the dependent variable is *CEO debt ownership*. The coefficient of *CEO debt ownership* is expressed in percentage for ease of interpretation. *Personal tax rate* is the sum of maximum state and federal personal tax rate in the state where the bank is headquartered, *Liquidity* as the natural logarithm of cash divided by assets, *CEO age* is the natural logarithm of CEO age in years, and *CEO tenure* is CEO's tenure in years. The first-stage results where the dependent variable is *CEO equity ownership* are not shown and are available upon request. Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	(1)	(2)	(3)	(4)
Personal tax rate	0.061*	0.067**	0.089***	0.088***
	(0.033)	(0.032)	(0.030)	(0.030)
Liquidity		0.357*	0.376*	0.360**
		(0.186)	(0.193)	(0.183)
CEO age			4.083**	2.342***
			(1.855)	(0.729)
CEO Tenure				0.066
				(0.047)
Uninsured liabilities	-0.309*	-0.234	-0.270*	-0.358**
	(0.177)	(0.168)	(0.144)	(0.146)
Profitability	0.075	0.195	0.158	-0.262
	(0.708)	(0.662)	(0.688)	(0.894)
Bank size	-0.332	-0.287	-0.283	-0.405
	(0.226)	(0.204)	(0.203)	(0.279)
Bank size^2	0.216	0.095	0.064	0.350
	(0.323)	(0.267)	(0.258)	(0.438)
Charter value	0.330	-0.036	0.163	0.114
	(0.819)	(0.674)	(0.697)	(0.674)
Δ Retained earnings	0.341	0.349	0.399	0.411
	(0.404)	(0.406)	(0.425)	(0.420)
Asset growth	-0.105	-0.086	-0.039	0.003
	(0.145)	(0.141)	(0.112)	(0.095)
Core deposits	1.728	1.661	1.531	1.627
	(1.469)	(1.423)	(1.347)	(1.420)
Portfolio risk	1.248	1.078	1.372	1.618
	(1.150)	(1.012)	(1.045)	(1.177)
Credit risk	0.056*	0.034	0.053	0.054
	(0.033)	(0.026)	(0.035)	(0.038)
TARP bank	-0.363	-0.353	-0.341	-0.294
	(0.221)	(0.216)	(0.208)	(0.179)
Macro conditions	-0.016	-0.031	-0.043	-0.219
	(0.286)	(0.287)	(0.309)	(0.319)
Constant	0.535	1.765	-15.468***	-7.866***
	(2.156)	(2.609)	(5.727)	(2.440)
Observations	2,159	2,159	2,120	2,081
Adjusted R^2	0.027	0.033	0.056	0.077

Table 5.6: Bank capital and internal discipline, controlling for endogeneity of CEO debt ownership and equity ownership (second-stage of 2SLS). This table presents the second-stage (main) results after instrumenting for potentially endogenous CEO debt ownership and CEO equity ownership. The first-stage results where the dependent variable is *CEO debt ownership* are shown in Table 5.5.The dependent variable in columns 1-4 is bank capital, measured as Total risk-based capital (Total risk-based capital/risk-weighted assets) in column 1, Tier-1 capital ratio (Tier-1 capital/risk-weighted assets) in column 2, book equity capital (book value of equity to assets) in column 3, and market equity capital (market value of equity to assets) in column 4. The dependent variable for column 5 is taxpayer loss exposure, measured as the ratio of the value of deposit insurance to market value of assets. For columns 6 and 7, dependent variable is capital shortfall, measured as the difference between Basel-recommended implied equity-to-assets ratio and the bank's current book equity capital (column 6), and the difference between *implied* equity-to-assets ratio as set under Basel standards and the bank's current market equity capital (column 7). Adjusted R^2 values for some regression models have not been shown since they are negative. Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	Total Capital Ratio	Tier-1 Capital Ratio	Equity capital (book)	Equity capital (market)	Taxpayer loss exposure	Capital Shortfall (book)	Capital shortfall (market)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
***Instrumented* CEO debt ownership**	**0.788****	**0.862****	**0.659****	**0.710***	**-4.446****	**-0.795****	**-2.277****
	(0.375)	**(0.407)**	**(0.333)**	**(0.372)**	**(1.839)**	**(0.395)**	**(1.102)**
Instrumented CEO equity ownership	-0.243	-0.268	-0.392	-0.382	0.102	0.303	0.123
	(0.252)	(0.276)	(0.240)	(0.257)	(0.299)	(0.261)	(0.184)
Uninsured liabilities	0.003	0.003	-0.002	-0.006	0.029***	0.020***	0.029***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.009)	(0.006)	(0.007)
Profitability	0.058***	0.064***	-0.001	-0.001	-0.154***	-0.001	-0.038*
	(0.015)	(0.016)	(0.001)	(0.001)	(0.043)	(0.001)	(0.021)
Bank size	0.002	0.004*	0.010***	0.014***	-0.008*	-0.007**	-0.011***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)
Bank size^2	-0.007	-0.017***	-0.014**	-0.020***	0.007	0.006	0.009
	(0.005)	(0.006)	(0.005)	(0.006)	(0.010)	(0.009)	(0.008)
Charter value	0.009	0.010	-0.124***	0.410***	-0.084	0.392***	-0.169***
	(0.013)	(0.013)	(0.035)	(0.038)	(0.062)	(0.033)	(0.041)
Core deposits	-0.045***	-0.052***	0.001	0.001	0.005	0.019	0.022
	(0.016)	(0.018)	(0.018)	(0.019)	(0.032)	(0.025)	(0.026)
Δ Retained earnings	-0.001	0.001	0.009***	0.016***	-0.035***	-0.022***	-0.028***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.008)	(0.003)	(0.004)
Asset growth	-0.006	-0.006	-0.001	0.002	0.012	0.000	-0.009
	(0.004)	(0.004)	(0.002)	(0.003)	(0.010)	(0.005)	(0.007)
Portfolio risk	0.037	0.041	0.076*	0.048	1.662***	0.704***	1.003***

	(0.029)	(0.030)	(0.042)	(0.046)	(0.105)	(0.059)	(0.065)
Credit risk	0.000	-0.001	-0.002***	-0.003***	-0.009**	0.004**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.002)	(0.002)
Macro conditions	0.008***	0.007***	-0.007***	-0.008***	-0.031***	-0.008***	-0.012***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.006)	(0.003)	(0.003)
TARP bank	0.001	-0.001	0.002	0.008	0.091***	0.024***	0.033***
	(0.008)	(0.009)	(0.008)	(0.009)	(0.017)	(0.007)	(0.009)
Constant	0.153***	0.146***	0.104***	-0.484***	0.144*	-0.341***	0.274***
	(0.029)	(0.031)	(0.039)	(0.041)	(0.076)	(0.045)	(0.054)
Observations	2,081	2,081	2,081	2,081	2,081	2,074	2,074
Adjusted R^2	-	-	-	0.445	0.240	0.197	0.306

5.7.2. Alternate Measure of Internal Discipline

It can be argued that the results discussed in previous sections may be specific to the measure of internal discipline proposed (*CEO debt ownership*). As in Chapter 4, this chapter also follows Wei and Yermack's (2011) methodology and constructs a measure of internal discipline which captures the marginal changes in *CEO debt ownership* to *CEO equity ownership*. This measure is referred as *CEO debt/equity ownership (sensitivity)*. *Ceteris paribus*, a CEO whose inside debt holdings are more sensitive than inside equity holdings, will be more conservative and aligned more with creditors. *CEO debt/equity ownership (sensitivity)* is similar to the measure *CEO relative incentive ratio* that has been used in Section 4.8.1 of Chapter 4 of this thesis.

Table 5.7 shows that the central findings remain qualitatively identical after using this new measure of internal discipline. The coefficient of *CEO debt/equity ownership (sensitivity)* is still significant and robust to different model specifications. It increases the amount of bank capital, decreases the taxpayer loss exposure, and reduces the risk of capital shortfall for the bank. This is consistent with the prediction that inside debt motivates CEOs to actively monitor and influence bank policies that are consistent with creditor interests.

Table 5.7: Bank capital and internal discipline, Wei and Yermack's (2011) measure of inside debt. The dependent variable in columns 1-4 is bank capital, measured as *Total risk-based capital* (Total Capital/risk-weighted assets) in column 1, *Tier-1 risk-based capital* (Tier-1 risk-based capital/risk-weighted assets) in column 2, *book equity capital* (book value of equity to assets) in column 3, and *market equity capital* (market value of equity to assets) in column 4. The dependent variable for column 5 is *Taxpayer loss exposure*, measured as the ratio of the value of deposit insurance to market value of assets. For columns 6 and 7, dependent variable is *Capital shortfall*, measured as the difference between Basel-recommended implied equity-to-assets ratio and the bank's current book equity capital (column 6), and the difference between *implied* equity-to-assets ratio as set under Basel standards and the bank's current market equity capital (column 7). Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	Bank capital				**Taxpayer loss exposure**	**Capital Shortfall**	
	Total Capital Ratio (1)	Tier-1 Capital Ratio (2)	Equity capital (book) (3)	Equity capital (market) (4)	(5)	(book) (6)	(market) (7)
CEO debt/equity ownership (sensitivity)	**0.004****	**0.006*****	**0.008*****	**0.008*****	**-0.006****	**-0.004****	**-0.005*****
	(0.002)	**(0.002)**	**(0.002)**	**(0.002)**	**(0.003)**	**(0.002)**	**(0.002)**
Uninsured liabilities	0.001	-0.004	-0.003	-0.008*	0.009	0.009**	0.011***
	(0.003)	(0.005)	(0.003)	(0.005)	(0.006)	(0.004)	(0.004)
Profitability	0.047***	-0.018	0.014	0.146***	-0.159***	-0.001	-0.001
	(0.012)	(0.026)	(0.010)	(0.023)	(0.044)	(0.001)	(0.001)
Bank size	-0.001	-0.002	0.006***	0.015***	-0.002	-0.002	-0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Bank size^2	-0.001	-0.011**	-0.006*	-0.017***	-0.000	-0.002	0.003
	(0.004)	(0.005)	(0.003)	(0.005)	(0.006)	(0.004)	(0.005)
Charter value	0.012	0.277***	-0.018	0.097*	-0.042***	0.457***	-0.111***
	(0.009)	(0.053)	(0.017)	(0.054)	(0.011)	(0.026)	(0.028)
Core deposits	-0.026**	-0.067***	0.009	0.024	0.031	0.029*	0.040***
	(0.011)	(0.022)	(0.012)	(0.022)	(0.021)	(0.017)	(0.014)
Δ Retained earnings	0.002**	0.010***	0.003***	-0.001	-0.004	-0.012***	-0.014***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)
Asset growth	-0.007	-0.010	-0.001	0.002	0.001	-0.011	-0.034***
	(0.005)	(0.006)	(0.003)	(0.003)	(0.005)	(0.009)	(0.009)
Portfolio risk	0.051	0.064	0.074	0.121*	0.549***	0.007	0.042
	(0.036)	(0.062)	(0.046)	(0.069)	(0.092)	(0.029)	(0.028)
Credit risk	0.001	-0.001	-0.002	-0.004**	0.009***	0.010***	0.010***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
Macro conditions	0.004	-0.003	0.007	0.024**	0.010	0.001	-0.001

	(0.007)	(0.011)	(0.007)	(0.010)	(0.012)	(0.008)	(0.008)
TARP bank	0.004**	0.009***	-0.008***	-0.016***	0.002	0.003	0.004
	(0.002)	(0.003)	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)
Constant	0.130***	-0.091*	0.006	-0.267***	0.245***	-0.435***	0.181***
	(0.023)	(0.055)	(0.026)	(0.053)	(0.037)	(0.032)	(0.035)
Observations	2,153	2,153	2,153	2,153	2,153	2,146	2,146
Adjusted R^2	0.262	0.504	0.286	0.588	0.618	0.589	0.622

5.7.3. Other Robustness Tests

Finally, this study conducts two additional robustness tests. First, it excludes all banks which hold low levels of bank capital. This is because supervisors can explicitly ask such banks to raise their capital standards to at least the regulatory minimum (Flannery and Rangan, 2008). For these banks, conventional determinants may not play a significant role in determining bank capital levels since higher capital ratios are in part due to supervisory efforts. To identify whether banks are well-capitalized, this study follows the Federal Reserve's definition of well-capitalized banks as those which have their Total risk-based capital ratio above 10%, Tier-1 risk-based capital ratio above 6%, and leverage ratio above 5%. All banks that fail any of these conditions are removed from the sample. The results are shown in Panel A of Tables 5.8 and 5.9.

Second, this chapter controls for bank fixed-effects since it is possible that some unobserved time-invariant bank-specific factors may govern bank capital holdings, such as the risk-culture of banks. These results are shown in Panel B of Tables 5.8 and 5.9.

The results shown here broadly confirm the main finding that higher internal discipline results in higher bank capital, lower taxpayer losses, and lower magnitude of capital shortfall.

Table 5.8: Bank capital and internal discipline, additional analyses. The dependent variable in columns 1 and 5 is Total risk-based capital ratio, measured as the ratio of Total capital (Tier-1 capital + Tier-2 capital) to risk-weighted assets. The dependent variable in columns 2 and 5 is Tier-1 risk-based capital ratio, measured as the ratio of Tier-1 capital to risk-weighted assets. For columns 3 and 6, dependent variable is the book equity capital, measured as the ratio of book value of equity to book value of assets. For the remaining columns, the dependent variable is market equity capital, measured as the ratio of market value of equity to market value of assets. Panel A presents the results after excluding banks which were not well-capitalized; and Panel B presents the results after controlling for bank-fixed effects. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	Total Capital Ratio	Tier-1 Capital Ratio	Equity capital (book)	Equity capital (market)	Tier-1 Capital Ratio	Total Capital Ratio	Equity capital (book)	Equity capital (market)
Panel A: Excluding banks with low capital	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CEO debt ownership	0.412**	0.439**	0.549***	0.885***				
	(0.199)	(0.200)	(0.207)	(0.234)				
CEO debt/equity ownership					0.003*	0.003*	0.009***	0.007***
					(0.002)	(0.002)	(0.002)	(0.002)
CEO equity ownership	0.044	0.051	-0.025	-0.004				
	(0.033)	(0.037)	(0.020)	(0.049)				
Observations	1,860	1,860	1,860	1,860	1,856	1,856	1,856	1,856
Adjusted R^2	0.257	0.278	0.276	0.603	0.271	0.250	0.290	0.600
Panel B: Bank-fixed effects								
CEO debt ownership	0.119***	0.108***	0.050***	0.067				
	(0.036)	(0.035)	(0.019)	(0.048)				
CEO debt/equity ownership					0.003*	0.003*	0.003**	-0.003
					(0.001)	(0.001)	(0.002)	(0.003)
CEO equity ownership	0.249**	0.224**	0.063	0.005				
	(0.102)	(0.094)	(0.057)	(0.020)				
Observations	2,159	2,159	2,159	2,159	2,153	2,153	2,153	2,153
Adjusted R^2	0.258	0.269	0.380	0.663	0.328	0.328	0.350	0.665

Table 5.9: Taxpayer loss exposure, capital shortfall, and internal discipline, additional analyses. The dependent variable in columns 1 and 2 is taxpayer loss exposure, measured as the ratio of the value of deposit insurance to market value of assets. For the remaining columns, the dependent variable is capital shortfall, measured as the difference between Basel-recommended implied equity-to-assets ratio and the bank's current book capital (in columns 3 and 4), and the difference between *implied* equity-to-assets ratio as set under Basel standards and the bank's current market capital (in columns 5 and 6). Panel A presents the results after excluding banks which were not well-capitalized; and Panel B presents the results after controlling for bank-fixed effects. For brevity, first-stage results are not shown and are available upon request. Year fixed effects are included. Robust standard errors clustered by bank are reported in parenthesis. * Significant at 10%. ** Significant at %. *** Significant at 1%.

	Taxpayer loss exposure		**Capital shortfall (book)**		**Capital shortfall (market)**	
Panel A: Excluding banks with low capital	(1)	(2)	(3)	(4)	(5)	(6)
CEO debt ownership	-0.827***		-0.534***		-0.687***	
	(0.319)		(0.179)		(0.224)	
CEO debt/equity ownership		-0.008**		-0.006***		-0.005***
		(0.003)		(0.002)		(0.002)
CEO equity ownership	-0.024		0.057*		0.019	
	(0.020)		(0.031)		(0.038)	
Observations						
Adjusted R^2	1,860	1,856	1,853	1,849	1,853	1,849
	0.619	0.619	0.606	0.560	0.622	0.621
Panel B: Bank-fixed effects						
CEO debt ownership	-0.731*		-1.146*		-1.011**	
	(0.424)		(0.605)		(0.514)	
CEO debt/equity ownership		-0.024*		-0.009***		-0.005*
		(0.013)		(0.003)		(0.003)
CEO equity ownership	0.196		0.151		0.098	
	(0.249)		(0.142)		(0.132)	
Observations	2,159	2,153	2,152	2,146	2,152	2,146
Adjusted R^2	0.190	0.189	0.551	0.551	0.606	0.605

5.8. Conclusion

Creditor discipline to help banks maintain sufficient capital and reduce the potential loss exposure of taxpayers in the event of default has emerged as a key policy concern. This chapter seeks to contribute to this literature and current policy debates by looking at the role of internal creditors (e.g. Bank for International Settlements (2009); Stephanou (2010)). Formally, internal discipline is defined as a debt-based discipline scheme in which bank managers are compensated with debt-like instruments in order in order to monitor and influence bank behaviour consistent with creditor interests.

This study provides the first analysis of the effect of internal discipline on bank capital. It shows that internal discipline is strongly associated with higher bank capital. This result is robust to using regulatory measures of capital to reflect the supervisors' assessments and economic measures of capital which reflect the market's assessments. This chapter also shows that higher internal discipline dampens incentives to engage in shifting risk to taxpayers. This results in reducing expected taxpayer loss exposure per unit of bank assets.

Moreover, the implications of internal discipline also extend to ensuring capital adequacy. Specifically, banks subject to higher internal discipline hold higher capital than required by Basel standards to ensure 99.9% solvency. This suggests that they are better prepared to handle a sudden fall in their equity values and are less likely to face capital shortfall.

These findings are robust to accounting for endogeneity concerns, using an alternate measure of internal discipline, excluding banks with low capitalization and accounting for bank-specific effects. The next chapter concludes this thesis and lays down the directions for future research.

6. CONCLUSION

6.1. Background to the Thesis

The recent financial crisis that started in 2007 has raised fundamental issues around ensuring the safety and soundness of banks. It is widely argued that hundreds of U.S. banks and subsequent government bailouts for the financial sector were the result of risky bank policies. Not surprisingly, the ensuing research has focused on understanding how to prevent banks from engaging in excessive risk-taking (e.g. Bolton et al. (2010); DeYoung et al. (2013)).

The issue of risk-taking arises from conflicts of interest between bank shareholders and creditors. Shareholders hold convex claims over firm assets. This causes the expected payoffs linked to equity to rise exponentially with overall risk. However, in the banking industry, incentives for risk-taking are further intensified by the presence of government guarantees. Government guarantees, typically in the form of explicit deposit insurance (Bhattacharya and Thakor, 1993) and implicit government support in the form of capital and liquidity support for troubled banks, provide a backstop against bank failure. Therefore, when banks pursue risky investments, shareholders capture the upside gains from risky policies, while government guarantees protect them from downside risk.

The CEO is the principal decision maker in a bank. Shareholders can distort CEO incentives in their favour by structuring CEO pay such that it rewards CEOs for greater risk-taking (Freixas and Rochet, 2013). Jensen and Meckling (1976) posit that shareholders can induce CEOs to pursue shareholder-friendly policies by granting them higher equity-based compensation, in the form of stock grants and stock options. Consistent with this, prior literature has extensively focused on assessing the impact of equity-based compensation on bank risk-taking (Chen et al., 2006; Hagendorff and Vallascas, 2011; etc.).

However, emerging research has shown that CEO pay also consists of debt-based compensation or 'inside debt', in the form of pension benefits and deferred compensation (Sundaram and Yermack, 2007; Edmans and Liu, 2011). Because inside debt is an unsecured and unfunded form of firm debt, it effectively turns CEOs into creditors to their firm (Edmans and Liu, 2011). Thus, CEOs, just like external creditors, are also exposed to firm default risk and this causes CEOs to pursue less risky bank policies.

However, three decades of research into CEO compensation has not explored the impact of inside debt on specific bank policy choices. This is mainly due to lack of data on the value of inside debt which only became available after 2006 and resulted in a flurry of new research to test the implications of inside debt. This thesis is the first such study to document empirical evidence on the impact of inside debt on bank risk-taking.

The central hypothesis that is proposed throughout the thesis is that higher inside debt should be associated with creditor-friendly policies, that is, policies which

reduce bank risk. In order to test for a causal link, this research has examined the impact of CEO inside debt holdings by studying the following questions: Does inside debt act as a disincentive to declare larger payouts in the form of dividends and repurchases? Does inside debt motivate CEOs to pursue a less risky investment strategy? Does inside debt influence financial policy by motivating banks to hold higher bank capital? It is with these issues that this thesis has engaged and, in doing so, it is suggested that the study has deepened the understanding of inside debt in the context of banking industry.

The next section draws upon the overall findings of this thesis before separately summarizing the findings of three empirical chapters. This is followed by a discussion of potential implications for policy research. There is then a consideration of limitations of this thesis. Finally, this thesis concludes with identifying the avenues for future research.

6.2. Summary of Findings

This section discusses the findings of this thesis and the next section (Section 6.3) discusses the potential implications of these findings. Broadly, this thesis shows that inside debt is an effective instrument to curb CEO's risk-seeking behaviour. The empirical evidence documented in this dissertation is consistent with the theoretical prediction advanced in Jensen and Meckling (1976) and Edmans and Liu (2011) that, as the ratio of CEOs debt-based to equity-based compensation increases, managerial incentives to expropriate creditors' wealth are dampened. Taken together, this thesis is able to give a clear and robust assessment of the different ways through which inside debt operates and influences CEO incentives by looking at an array of

different bank policies. The results indicate that inside debt can help in addressing risk-taking concerns by aligning the interests of CEOs with those of creditors, regulators, and ultimately the taxpayer.

To offer the above broad results, this thesis has focused on examining the impact of CEO inside debt holdings on three different bank policies – payout policy (Chapter 3), specific investment policy (Chapter 4), and financing policy in the form of bank capital holdings (Chapter 5). The findings are discussed separately as below:

6.2.1. Inside Debt and Bank Payout Policies

Chapter 3 examines the impact of CEO inside debt holdings on bank payout policies[21]. It hypothesizes that banks where CEOs hold higher fraction of inside debt are associated with more conservative bank payout policies. The findings of this chapter are as follows.

First, the chapter shows that the compensation structure of CEOs which is geared towards a higher fraction of inside debt creates a disincentive to pay out excess capital to shareholders. Specifically, bank CEOs with higher inside debt holdings are more likely to cut payouts and cut payouts by a larger magnitude. The results are economically significant. A one-standard-deviation increase in the measure of inside debt results in a cut in total payouts by 13 basis points (the equivalent of $86 million for the average bank in the sample). The results hold if an alternate measure to capture the value of CEO inside debt holdings or alternative measures for bank payouts are employed.

[21]Payouts are defined as cash distributions in the form of both dividends and repurchases

Next, this chapter focuses on the subsample of banks which received government support in the form of the TARP during the recent financial crisis. Under TARP, any cash distributed to shareholders by banks after the receipt of TARP funds represents subordination of not just creditor but also taxpayer interests. TARP bank payouts are thus a direct transfer of wealth from taxpayers to bank shareholders. To the extent that TARP resulted in exacerbating the risk-taking incentives of bank shareholders (e.g. Duchin and Sosyura (2014); Flannery, 2010), it is hypothesized that inside debt should be more effective in limiting additional risk-taking by TARP banks in comparison to non-TARP banks. The results present evidence in support of the hypothesis that TARP banks where CEOs held a higher amount of inside debt reduced payouts by a larger amount than non-TARP banks.

Finally, this chapter tests if the negative association between bank payouts and inside debt is driven by either one of the components of bank payouts, namely dividends or repurchases. Additional analyses conducted in this chapter confirm that the reported negative relation between inside debt and payouts is driven by both dividends and repurchases. Moreover, there is a positive association between inside debt and the cash raised from share issues. Thus, incentives stemming from CEO inside debt holdings reduce all forms of cash outflows to shareholders and increase cash inflows from shareholders.

6.2.2. Inside Debt and Bank M&A

Chapter 4 assesses the impact of CEO inside debt holdings on a specific bank investment policy: acquisitions. Acquisitions exist as critical resource allocation decisions that can increase firm risk (Furfine and Rosen, 2011; Vallascas and

Hagendorff, 2011). But, this chapter hypothesizes that any changes in risk due to an acquisition should be negatively associated with inside debt.

The analysis begins by measuring acquisition-related change in risk through Merton's (1978) distance-to-default (DD) model. DD captures the number of standard deviations by which the market value of its assets needs to fall in order to reach the default point. The results show that change in bank risk after an acquisition is negatively related to CEO inside debt holdings. The impact of inside debt is economically significant with one standard deviation increase in one of the measures of inside debt resulting in a fall in bank risk by 31% compared with the pre-acquisition risk value. Moreover, this chapter also investigates two potential channels through which an acquisition could affect the bank's risk, namely changes in leverage and in asset risk. The results show that the link between CEO inside debt and the change in risk after an acquisition arises because of changes in both leverage and asset risk.

The results on the relation between CEO inside debt and risk measured by the value of deposit insurance are of particular relevance to regulators and the government. Following Merton (1977) and Ronn and Verma (1986), the financial safety-net to shareholders is valued as a put option underwritten by taxpayers. The value of the put (and the potential losses to taxpayers) increases with asset risk. The results present evidence that acquisitions pursued by CEOs with higher inside debt relative to equity-based compensation are associated with a reduction in the value of the safety-net to bank shareholders (and therefore potential losses to taxpayers).

The chapter conducts several robustness checks. It employs Heckman two-stage method to control for potential sample selection bias arising due to the fact that the sample is not random, because CEOs choose to pursue an acquisition. The chapter also controls for potential endogeneity of CEO pay with respect to acquisition-related risk by means of the two-stage instrumental-variables method. Moreover, the chapter assesses whether the results hold if alternate measures of inside debt and bank risk are used. Finally, the sample excludes forced acquisitions of failing targets by stronger banks since these acquisitions may be the result of regulatory encouragement. Overall, the results remain qualitatively unchanged after running these additional tests.

6.2.3. Inside Debt and Bank Capital

Chapter 5 focuses on assessing the impact of inside debt on bank capital. Higher bank capital acts as a creditor-friendly strategy because it provides a larger equity buffer to protect the value of creditors' claims on bank cash flows. The central hypothesis proposed here is that higher inside debt should motivate banks to hold a larger capital buffer.

To the extent that inside debt turns CEOs into internal creditors of the bank, this chapter proposes that internal creditors, just like external creditors, also monitor and influence bank behaviour and hence constitute a form of market discipline. The discipline resulting from inside debt is referred to as *internal discipline*. This chapter begins by proposing a novel measure of internal discipline 'CEO debt ownership'. This measure is computed as the fraction of uninsured bank liabilities that are owned

by the CEO (inside debt/uninsured bank debt). Analogous to external discipline, this measure captures the discipline exerted by holders of inside debt.

The results of this chapter are as follows. First, it shows a positive relationship between internal discipline and bank capital. Specifically, banks subject to higher internal discipline hold higher regulatory capital, calculated according to Basel rules, measured as *Total capital ratio* (Total (Tier-1 + Tier-2) bank capital/RWA) and *Tier-1 capital ratio* (Tier-1 bank capital/RWA); and higher economic capital, measured as *Book equity capital*, (book-value of common equity to book-value of assets) and *Market equity capital* (market-value of equity to market-value of assets). These findings are consistent with the hypothesis that banks with higher internal discipline were more likely to hold bank capital in a manner consistent with creditor interests. The results are also economically significant with a one standard deviation increase one of the measures of internal discipline (CEO debt ownership) means banks hold higher regulatory bank capital in the magnitude of 51 to 57 basis points ($60 million to $68 million) and higher economic bank capital in the magnitude of 61 to 101 basis points ($119 million to $192 million).

Next, this chapter assesses whether higher internal discipline can prevent banks from increasing the expected value of potential taxpayer losses. The exposure of taxpayers to bank losses has remained a key policy concern, with the recent financial crisis of 2007-08 resulting in taxpayer losses worth $700 billion to bailout US banks. Since taxpayers, via provision of (implicit) guarantees, are exposed to substantial losses in the event of bankruptcy, they act as unsecured creditors of the bank. The results show that there is a negative relationship between internal discipline and the estimated value of the taxpayer losses, with one standard deviation increase in one of

the measures of internal discipline (*CEO debt ownership*) reducing taxpayer losses of the magnitude of $500 million if 1% of bank assets are wiped out in any given year.

Finally, this chapter assesses the impact of internal discipline on capital shortfall. Capital shortfall is the difference between current bank capital and the capital required to comply with the Basel-recommended solvency probability of 99.9%, wherein the benchmark for solvency probability is motivated by policy work (e.g. Basel committee (2005); Federal Reserve (2006)). A higher capital shortfall indicates that current level of capital is not adequate given the bank's risk-exposure. The results show that higher internal discipline is negatively associated with the amount of capital shortfall. This result is also economically significant. One standard deviation increase in CEO debt ownership reduces the magnitude of capital shortfall by 25 to 33 basis points (or decreasing the amount of capital shortfall for an average bank by $100 million to $124 million).

The results are subject to additional robustness checks. First, the chapter controls for the possibility of endogenous CEO debt ownership to account for the explanation that managers may first choose the bank's capital structure and then decide on the fraction of firm debt and equity they desire to hold. Second, an alternative measure of internal discipline is used which captures the sensitivity of CEO's debt and equity ownership to changes in firm value, following Wei and Yermack (2011). Third, all banks that are not well capitalized are excluded since Flannery and Rangan (2008) argue that such banks may be facing higher levels of supervisory discipline and control. Finally, the empirical analysis accounts for bank fixed-effects since at least part of the results may be attributed to potential unobserved bank-specific time-

invariant factors that may explain bank capital decisions. The results hold up in all of these tests.

6.3. Implications for Policy Research

The results of this thesis have important implications for bank investors and regulatory policy. They support the view that it is beneficial for bank creditors, and for taxpayers, for the CEO's personal incentives to be aligned with those of creditors. CEOs with high inside debt have more subdued incentives to engage in increasing bank risk, and this does make a different to how the bank is managed.

Extant policy debates, however, have not explicitly endorsed the use of inside debt. These discussions have primarily focused on regulating bank CEO pay owing to the public good character of banks. For instance, Thanassoulis (2012) proposes a regulatory cap on the amount of executive bonuses since the unregulated labour market competition for bank CEOs creates a negative externality which increases bank risk[22]. Bebchuk and Spamann (2009) argue that regulators should monitor and regulate CEO pay since banks are highly leveraged and the benefits of risk-taking are particularly high for CEOs while they do not share the entire costs of bank default. Recent U.S. compensation guidelines for CEOs and other senior executives at large banks also come close to dictating that no bonuses be paid in equity-based

[22] This externality results from the well-known 'winners curse', wherein competing banks bid-up the CEO's bonus in order to attract the CEO, but the costs of high bonus payments are finally borne by the institution which employs the CEO. If the hiring bank performs poorly and its equity declines, then a large fraction of bonuses may further reduce its equity and result in increasing bank default risk.

instruments, that such payment be deferred, and that vesting be contingent on performance (Federal Reserve et al., 2010, p. 33).

Such attempts at regulating CEO pay have been criticized on the grounds that there may be excessive regulatory intervention and such interference may drive away talent (Bebchuk and Spamann, 2010). In this regard, the findings in Chapter 3 and Chapter 4 demonstrate that inside debt is effective in dampening CEO incentives to pursue risky bank policies, as shown in the choice of conservative bank payout policies and less risky acquisitions. Inside debt therefore may complement current regulatory efforts aimed at reforming CEO pay, thereby justifying a more widespread use of inside debt in managerial remuneration contracts.

Relatedly, Chapter 5 shows that inside debt turns CEOs into internal creditors of the bank and this causes CEOs to impose 'internal discipline' on bank behaviour. This chapter contributes to recent regulatory efforts which focus on reforming market discipline (Basel committee, 2009; Liikanen report, 2011). Extant policy discussions over improving the effectiveness of market discipline have narrowly focused on improving transparency and disclosure around bank's financial condition, e.g. requiring banks to publish detailed reports on their capital holdings and explaining how key regulatory ratios are calculated (Basel Committee, 2009). Greater transparency will release accurate and timely information which will lead to greater scrutiny and discipline from external investors.

However, it is widely argued that the presence of explicit and implicit guarantees weaken incentives of external creditors to collect this information and monitor banks (Flannery and Sorescu, 1996; Peria and Schmukler, 2001). Chapter 5 contributes to

this debate by showing that inside debt exists as another potential policy tool to turn insiders into effective monitors. It can motivate bank executives to impose internal discipline on banks since their inside debt holdings are an unsecured firm obligation and CEOs share some fraction of the costs of bank default. This is consistent with Stephanou's (2010) proposal to take into account the incentives of insiders in setting an effective system of market discipline. Inside debt or internal creditors can be a building block in strengthening market discipline architecture, one which lays the foundation of a safe and sound banking system.

Moreover, external market discipline has been argued to be particularly harsh as seen in the withdrawal of funding during the crisis which led to acute liquidity crisis. For instance, short-term bank debt was not rolled over by unsecured creditors during the financial crisis which resulted in further attenuating the liquidity crisis for banks and failure of some large banks such as Northern Rock (Hanson et al., 2011). Due to this, discipline exerted by external creditors was widely argued to be myopic since creditors did not intervene and discipline banks *ex ante* but were amongst the first to withdraw funding when banks became risky. Moreover, Bennett et al. (2014) show that market discipline was not effective in monitoring bank behaviour, especially over the past few years. The authors show that interest rate spreads on unsecured bank debt were weakly associated with the level of bank risk, suggesting the inability of creditors to correctly price bank risk.

In this regard, internal discipline can be envisaged as more effective in controlling managerial incentives for pursuing risky policies while preventing large-scale bankruptcy. Recent work by Bennett et al. (2012) shows that banks where CEOs who hold higher inside debt had lower risk and performed better than banks

with low inside debt during the financial crisis (2007 and 2008). Similarly Bekkum (2014) shows that CEOs with higher inside debt pursued less risky bank policies, such as better quality assets and departing from fee-based income activities, and lower risk-exposures during the financial crisis. This shows that inside debt can serve as a strong disciplinary mechanism to discipline bank behaviour during recent periods of economic stress. However, due to the lack of data on inside debt, there is limited research which evaluates the impact of inside debt on bank risk-taking incentives before 2006.

Finally, ongoing debates over enhancing regulatory discipline are focused on implementing regulations which better protect interests of the society, e.g. issuing mandatory capital regulations under Basel-III and conducting more frequent bank stress-tests (e.g. Basel Committee (2009); Federal Reserve et al. (2010)). While such macro-prudential initiatives are focused on ensuring safety of the financial system, Hellwig (2010) and Kashyap et al. (2010) argue that the real problem lies in the incentive structure of bank managers. Macroprudential regulation and enhanced market discipline cannot work without a system which promotes alignment managerial interests with that of taxpayers and the society. In this regard, this thesis shows that reforming pay practices of CEOs can complement ongoing regulatory efforts to build a safe and stable financial system.

6.3.1. Recommendations for Future Policies

This research also carries important policy recommendations on the broader issue of CEO pay in the banking industry. Current regulatory efforts have largely called for reforming pay practices of bank CEOs in a manner which aligns CEO interests

with that of ensuring long-term safety of the bank. However, the potential mechanisms through which this can be issued has not been explored in detail by policymakers. This thesis proposes that CEOs should hold some fraction of their total compensation in the form of inside debt. The theoretical foundation behind this proposal is based on the work of Edmans and Liu (2011). The authors show that risk-taking considerations are mitigated if firm managers hold some amount of their firm-specific wealth in the form of inside debt.

Broadly, this thesis proposes that the amount of inside debt (as a fraction of bank debt) should be increasing in the intensity of risk-taking problem affecting a firm. For instance, riskier banks should be required by regulators to modify their pay practices and receive a greater fraction in the form of inside debt. This will incentivise them to reduce firm risk and pursue less risky policies. It should however be noted that there is no optimum value for the fraction of inside debt and equity-based pay that CEOs should hold. The optimum value will be heterogeneous and it will depend on the degree of agency costs of debt and agency costs of equity that are present in the firm (Edmans and Liu, 2011).

6.4. Limitations of this Thesis

Based on the analyses conducted in three empirical chapters, a number of shortcomings of this thesis can be identified.

First, the conclusions of this thesis have been set in the context of US banks due to which it can be argued that the findings are country specific. There is still limited knowledge on the characteristics of inside debt in other countries, such as the United

Kingdom (UK) and Europe. If the value of pension benefits is treated senior to that of creditors in other countries, then CEOs may not consider themselves at risk of default. This may limit the effectiveness of inside debt in mitigating risk-taking since CEOs may receive the value of inside debt even if the bank defaults. Wei and Yermack (2011) also posit that some firms put the deferred compensation arrangements in a separate 'rabbi trust' which prevents creditors from claiming executive's inside debt arrangements in the event of bankruptcy. However, the authors note that such arrangements are occasional.

Second, many of the variables used in Chapter 4 to depict board characteristics could be interpreted as crude. For example, CEO age and tenure are used as a proxy for CEO's experience; and board size and the percentage of board seats occupied by independent directors are used to measure board governance. While these variables are commonly used in the corporate governance literature (e.g. Hermalin and Weisbach (2003); Palia (2001)), they tend to oversimplify the degree of complexity with which the CEO experience and board decisions affect bank policies. Specifically, the ability of young CEOs is not known when her tenure begins with the company (Murphy, 1999) and hence CEO age which linearly increases may reflect her experience, but the incremental impact of each additional year of tenure may be high once the CEO approaches retirement. More sophisticated and reliable measures of experience and board governance can greatly enhance the analysis.

Moreover, the primary risk measure used in Chapter 4 to assess the impact of acquisitions on bank default risk relies on Merton's (1977) distance-to-default (DD) model. Since measuring default risk of banks is inherently noisy (Gropp et al., 2006; Chan-Lau and Sy, 2006), it can be argued that the results discussed in this chapter

may be relying excessively on using DD model to compute bank risk. While an honest attempt has been made to show the robustness of results using other risk measures, such as book-based measures of risk (leverage risk and asset risk), equity risk, and systemic risk, more accurate default risk measures can be used to further lend credibility to the research findings.

Further, Chapter 5 assesses the impact of CEO's debt ownership in their own bank on bank capital adequacy. Majority of prior work on capital structure has excluded banks since it is commonly argued that the capital structure of banks is determined by regulators. While recent empirical work presents contradictory evidence, by showing that banks hold significant amount of discretionary capital (Gropp and Heider, 2010; Flannery and Rangan, 2010; Berger et al., 2008), it can still be argued that capital holdings of weakly capitalised banks are under greater regulatory scrutiny. This chapter partially attempts to control for such motivations by eliminating all banks which went below the regulatory minimum during the sample period. However, there is still some possibility that regulatory interference may have a second-order effect on capital holdings.

Finally, the results of this dissertation focus on the impact of CEO inside debt holdings since CEO is the principal decision maker in the firm. An emerging stream of research also studies the impact of Chief Financial Officer (CFO) incentives on non-financial firm policy choices since CFOs can also be expected to exert some influence (Chava and Purnanandam, 2010; Kim et al., 2011; etc.). For instance, CFOs may play a more discrete role when it comes to determining earnings management and debt maturity choices since these policies require financial expertise (Chava and Purnanandam, 2010; Jiang, Petroni, and Wang, 2010).

Similarly, it can be argued that CEO and CFO compensation could help researchers better understand the differential impact of inside debt on bank policies. This study could not account for incentives of the CFO due to data collection costs. Moreover, it can also be argued the CFO acts as an agent for the CEO (Graham and Harvey, 2001) and the incentives of CEOs are much larger and hence more influential than CFOs (McAnally, Weaver, Srivastava, 2008) due to which CFOs may play a relatively low-key role in influencing bank behaviour.

6.5. Future Research

The study of inside debt will remain a fruitful area for future researchers since data on inside debt has only recently become available and the state of knowledge is still limited. Perhaps, future research can address the limitations highlighted in the previous section to further develop this area. Some of the future research avenues are highlighted below.

Future research can look into the presence of inside debt or similar debt-like instruments in the UK and Europe. There is some preliminary evidence that CEOs in the UK are also paid with pensions and deferred compensation (Sundaram and Yermack, 2007), however, empirical evidence is still lacking on the implications of inside debt in the UK. This offers the opportunity to conduct a cross-country study and understand the differences between characteristics of inside debt in the two countries. It would be interesting to see if such differences, if any, can explain the differential impact of inside debt on firm policies in the US and the UK.

Also, following the discussion in Section 6.4 that this dissertation solely focuses on CEO incentives, future research needs to be directed at assessing the impact of inside debt holdings on other members of a bank's top management team. This will allow researchers to understand the impact of inside debt on different executives. An emerging stream of research has shown that differences in pay between the CEO and other senior executives can highlight the inner workings of the top management (Bebchuk et al., 2011; etc.). Exploring this idea by looking at differences between inside debt and equity-based compensation between the top management can help explain the relative importance of inside debt for different executives and assess if systematic differences between compensation structures of senior executives can have an impact of bank value and risk.

In addition to this, future research can also look into other bank policies to assess the implications of inside debt on risk-taking. This thesis has presented empirical evidence by focusing on three bank policies for assessing bank risk-taking behaviour. However, agency conflicts between creditors and shareholders, and the risk-taking problem which arises from it, can affect a range of bank policies, e.g. earnings management, focussing excessively on risky derivatives, and relying on non-traditional fee-based bank activities. Future research can offer a more textured understanding by looking at these alternative channels of risk-taking. Moreover, the impact of inside debt likely extends beyond affecting risk-taking incentives and can be broadly linked to firm value (Jensen and Meckling, 1976). Consequently, future research can also explore the impact of inside debt on bank value, such as the impact of CEO inside debt holdings on shareholder value and creditor value after an acquisition has been announced. It is possible that CEOs with large inside debt

engage in acquisitions which transfer wealth from shareholders to bond holders and other bank creditors.

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Appendix A: CEO Vega and Delta calculations

Vega or option-based risk incentive is the rate of change of the value of the portfolio of inside equity and options with respect to the volatility of the shares (Guay, 1999). If there are no options, vega is zero. Delta or pay-for-performance measure is the rate of change of the value of the portfolio with respect to the price of the shares (Jensen and Murphy, 1990). Delta is equal to one for the equity component, and it is a number between 0 and 1 for the stock options.

The sensitivity of CEO wealth to stock volatility (*Vega*) and to stock price (*Delta*) is calculated as follows:

$$\text{CEO Vega} = \partial(\text{portfolio value})/\partial\sigma \times 0.01 = e^{-dT} \times N'(Z) \times S\sqrt{T} \times 0.01 \qquad (A.1)$$

$$\text{CEO Delta} = \partial(\text{portfolio value})/\partial S \times S/100 = e^{-dT} \times N(Z) \times S/100 \qquad (A.2)$$

where $Z = (\ln(S/X) + (r_f - d + \sigma^2/2)T)/(\sigma\sqrt{T})$ and $N'(x)$ is the normal density function:

$$N'(x) = 1/\sqrt{2\pi} * e^{-sq(x)/2} \qquad (A.3)$$

Portfolio value is the sum of market value of inside equity (number of shares held multiplied by year-end stock price) and the Black-Scholes option value of CEO's options with the input variables (such as option exercise price and maturity) extracted from SEC filings and Execucomp. S is the price of underlying stock at fiscal year-end; X represents the exercise price of the option, σ is the annualized

stock return volatility estimated over the past 60 months; r_f is the natural log of 1 + risk-free rate with the interest rate adjusted according to the remaining life of the option; T is the remaining time to maturity (in years); and d is the natural log of 1 + expected dividend rate where dividend rate is calculated by using the 3 year average dividend yield.

Appendix B: Calculation of variables required for Distance-to-default (DD) and Insurance Premium (IPP)

Vassalou and Xing (2004) and Hillegeist et al. (2004) show that, under the assumption that market value of assets follows a geometric Brownian motion, the market value of equity can be derived from the Black and Scholes (1973) option pricing formula for call options as:

$$V_{E,t} = V_{A,t}N(d_{1,t}) - Be^{-rT}N(d_{2,t}) \quad \text{(B.1)}$$

where

$$d_{1,t} = (\ln(V_{A,t}/B) + (r + (\sigma^2_{A,t}/2))T)/\sigma_{A,t}T \quad \text{(B.2)}$$

$$d_{2,t} = d_{1,t} - \sigma_A T^{0.5} \quad \text{(B.3)}$$

where $V_{E,t}$ is the market value of equity with t corresponding to measurement frequency which can be calendar year (for chapter 3 and 5) or day (for chapter 4), $V_{A,t}$ is the market value of assets, B is the book value of liabilities updated quarter by quarter, r is the risk-free rate on one-year T-bills as at the bank's financial year-end, T is the horizon over which distance-to-default of the bank is predicted and is set to

one year following Ronn and Verma (1986), $\sigma_{A,t}$ is the standard deviation of the market value of assets, and N(.) represents the cumulative density function of the standard normal distribution. To solve for two unknowns, $V_{A,t}$ and $\sigma_{A,t}$, this study uses an iterative procedure as outlined in Hilleigeist et al. (2004) which involves simultaneously solving equation B.1 and the following optimal hedge equation:

$$\sigma_{E,t} = V_{A,t} N(d_1) \sigma_{A,t} / V_{E,t} \quad \text{(B.4)}$$

where $\sigma_{E,t}$ is the standard deviation of the daily stock return which is measured over the rolling period *t*-90 to day *t* when computing DD for Chapter 4 and over the calendar year for Chapters 3 and 5. The above estimates of $V_{A,t}$ and $\sigma_{A,t}$ are used in the calculation of distance-to-default *DD* and elsewhere in the thesis.

For the insurance premium IPP, the procedure for calculating VA,t and σA,t is similar to the above. The only difference is that the book value of liabilities B is now multiplied by an additional parameter, ρ, which takes into account regulatory forbearance wherein the regulator (FDIC) might not liquidate the bank immediately. ρ is set at 0.97, which means that the regulator is assumed to proceed with liquidation if the market value of assets falls below 97% of the bank's liabilities. The regression estimates are not sensitive to the chosen value for ρ.